Dear Governor Brown, Senators Steinberg and Huff, Speaker Perez and Assembly Member Conway:

In 2009, California’s elected leadership approved a package of bills designed to solve statewide issues of water supply reliability and to guarantee a restored Delta ecosystem. Commonly called the “Coequal Goals”, you set new policy for the people of California.

Among many other things, the legislation created the Delta Stewardship Council and directed us to adopt and implement a comprehensive – and enforceable – sustainable management plan to achieve the coequal goals. We are pleased to forward to you the final Delta Plan, adopted unanimously by the Council in May 2013.

The unique nature of the 2009 bill package cannot be overstated. A reliable supply of water and an improved and restored Delta ecosystem are legally equal in importance. State law now requires we “…reduce reliance on the Delta in meeting California’s future water supply needs…”, through statewide improvements in local and regional water supplies and local and regional water efficiency, all encouraged by prudent state investments to help make that possible.

Finally, the new legislative direction included statutory authority for the Council over ‘covered actions’ – plans, programs and/or projects that must be consistent with the Delta Plan. It is no surprise that some would prefer not to be required to help achieve the Coequal Goals. Nevertheless, accountability is the cornerstone for progress on the linked issues of a reliable supply of water and the Delta’s deteriorating ecosystem.

Forged through eights drafts, hundreds of hours of public meetings and thousands of public comments over two years, the Delta Plan is guided by the best available science. Although State law requires state and local agencies to be consistent with the Delta Plan, it is founded on cooperation and coordination, in addition to the regulatory authority spelled out in the Delta Reform Act.

"Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.”

— CA Water Code §85054
The Delta Plan builds on work by the Department of Water Resources, Department of Fish and Wildlife, and the State Water Resources Control Board. Collectively, its required policies and numerous recommendations:

- Reduce reliance on water from the Delta by requiring those who take water from, transfer water through, or use water in the Delta to describe and certify that they are using all feasible options to use water efficiently and to develop additional local and regional water supplies.

- Identify ways to improve statewide water supply reliability throughout California by calling for state investments in improved local and regional supplies and water use efficiency. The Plan also calls for improved Delta conveyance and expansion of groundwater and surface storage.

- Protect, restore and enhance the Delta ecosystem by designating six high priority locations in the Delta and Suisun Marsh to recover endangered species, rebuild salmon runs and enhance habitat for wildlife. The Plan also prioritizes actions to reduce pollution, ensure improved water quality and limit invasive species, while moving to establish a more natural pattern of water flows in the Delta.

- Protect the uniqueness of the California Delta by preserving rural lands for agriculture and habitat use, and requiring that new residential, commercial or industrial development is located in areas currently designated for urban use.

- Reduce risks to people, property, and state interests in the Delta by prohibiting encroachment on floodways and floodplains, requiring a minimum level of flood protection for new residential development of five or more parcels, and committing to develop priorities for state investment in Delta flood protection by 2015.

- Integrate governmental actions and the best available science through both regulatory policies and non-binding recommendations.

- Call for swift and successful completion of the Bay Delta Conservation Plan, which seeks to modernize the existing water conveyance system, and improve the health of the estuary. If the BDCP meets the requirements of law it will be incorporated into the Delta Plan.

If much of the Delta Plan sounds familiar, it is because water and environmental leaders and scientists have been recommending such a comprehensive and balanced approach for decades. That said, the history of modern American government is replete with multiple federal, state and local agencies pursuing their own separate legal agendas. Pulling those agencies together and organizing around common elements is extraordinarily difficult, but essential. The Delta Plan provides the framework and starts that process.

Sincerely,

[Signature]
Phil L. Isenberg, Chair
Encl.
The Delta Plan
Ensuring a reliable water supply for California, a healthy Delta ecosystem, and a place of enduring value
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STATE OF CALIFORNIA

Edmund G. Brown, Jr., Governor

THE DELTA STEWARDSHIP COUNCIL

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Executive Summary
(as amended January 2019)
Executive Summary

The Sacramento-San Joaquin River Delta is the grand confluence of California’s waters, the place where the state’s largest rivers merge in a web of channels—and in a maze of controversy. The Delta is a zone where the wants of a modern society come into collision with each other and with the stubborn limitations of a natural system. In 2009, seeking an end to decades of conflict over water, the Legislature established the Delta Stewardship Council with a mandate to resolve long-standing issues. The first step toward that resolution is the document you have before you, the Delta Plan.

Though more than 50 miles inland from the Golden Gate, Delta waters rise and fall with ocean tides. The Delta is in fact the upstream, mostly freshwater portion of the San Francisco Estuary, the largest estuarine system on the West Coast of the Americas, and one of California’s prime natural assets. It is a major stop on the Pacific Flyway and the portal through which important fish species, including anadromous Chinook salmon, pass on their way to and from their spawning grounds in the interior.

The system of waters in which the Delta is so central has changed dramatically since California became a state. Rivers have been dammed and aqueducts built. Natural flows and fluxes have been disrupted to support cities and make the Central Valley the fruit basket and salad bowl of the nation. Approximately half of the water that historically flowed into and through the Delta is now diverted for human use, never reaching the sea. Much of this diversion occurs at points upstream, before the rivers come down to the Delta; but the last and largest draws take place in the Delta itself. On the southeast edge of the region, near Byron, two sets of mighty pumps extract water for shipment as far south as San Diego.

Two-thirds of California’s people and 4.5 million acres of farmland receive some part of their water from the Delta.

The Delta landscape we know is itself the result of a great transformation, from a primeval wetland complex to an archipelago of diked islands, where soils that once grew vast thickets of tules now yield bountiful corn, alfalfa, tomatoes, and many other crops. The Delta is home to about 12,000 people on farms and in small historic communities, and to about half a million in the larger cities that are
pressing into the region from the fringe. More millions come to it for boating, fishing, hunting, bird watching, even windsurfing on its 700 miles of channels. Steeped in history, combining notes of the American heartland and of Holland, the Delta looks and feels like no other place in California. This is a land that people love.

It is not doing so well.

The very shape of the modern Delta is in danger. Farming of peat-rich ground like this always leads to oxidation, the literal vanishing of soil, and thus to subsidence. Many Delta islands now lie 15 feet or more below sea level and depend on aging dikes to prevent the water in adjacent channels from pouring in. Higher river flows in winter or spring, predicted results of climate change, will add to the pressure, and a great earthquake, sooner or later, will shake the region like a paint can on a mixer. Encroaching urbanization, meanwhile, puts more people and property on dangerous ground.

After years of slow decline, the condition of the Delta’s watery ecosystem, as measured especially by the population of wild salmon and other native fishes, has gone critical. The list of causes begins, but does not end, with all those water withdrawals, a kind of tax that leaves the system in a condition of chronic drought. The specific, peculiar manner in which the last large gulps of water are withdrawn adds to the ecological cost. The continual introduction of alien aquatic species from around the world is altering the web of life, often at the expense of native and other valued species. Pollution from the vast and busy watershed does its share of harm.

Today, all those who depend on or value the Delta are, in a word, afraid. Delta residents face the possibility of floods from the east when the rivers flow strongly and of salinity intrusion from the west if they flow too feebly. Fishermen, both commercial and recreational, fret about the future of salmon and other species. Water suppliers that receive water from the Delta find those supplies insecure, subject to interruption by weather vagaries, levee failures, or pumping restrictions imposed in the desperate attempt to stem the decline of fish.

**The Coequal Goals, the Delta Stewardship Council, and the Delta Plan**

Since the middle 1980s, California has been looking for ways to secure the natural and human values of the Delta while maintaining its place in the state’s water plumbing. These efforts have generally started in hope and ended in impasse. In recent years environmentalists turned to the courts, using the blunt tool of the federal Endangered Species Act to force curtailment of water exports at certain times. In reaction, water suppliers south of the Delta have complained of “regulatory drought.”

In 2009 the Legislature made its latest, most determined bid to find solutions, passing the Delta Reform Act and associated bills. First and foremost, it declared that State policy toward the Delta must henceforth serve two “coequal goals”:

- Providing a more reliable water supply for California, and
- Protecting, restoring, and enhancing the Delta ecosystem.
These goals, the Legislature added, must be met in a manner that:

- Protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

By affirming the equal status of ecosystem health and water supply reliability, the Legislature changed the terms of the conversation. It changed them further with the following pronouncement: “The policy of the state of California is to reduce reliance on the Delta in meeting California’s future water supply needs.” Here was recognition that, for the sake of the water system and the Delta both, a partial weaning of the one from the other is required.

The Delta Stewardship Council is the body entrusted with giving practical meaning to these directives. Publication of this Delta Plan completes its first assignment. The product of eight drafts, almost 100 public meetings, and nearly 10,000 comments, the Delta Plan pulls together in one place the steps that need to be taken to meet the coequal goals—measures that, in one way or another, could affect almost everyone in California. The Plan is to be revised every 5 years, or sooner as circumstances change.

The Delta Plan contains 87 provisions, some broad and some narrowly technical, some novel, some commonsensically familiar. What, in essence, does the Plan propose be done differently? At the risk of oversimplification, we can say that it asks California and Californians to do six large things:

- In order to improve and secure our water supply, while taking pressure off the Delta, we must use water more efficiently in cities and on farms, and develop alternative, usually local, sources.

- We must also get much better at capturing and storing the surplus water that nature provides in the wettest years, building reserves that can be drawn on in dry ones.

- To revitalize the Delta ecosystem, we must provide adequate seaward flows in Delta channels, on a schedule more closely mirroring historical rhythms: what the Plan calls natural, functional flows.

- We must also bring back generous wetlands and riparian zones in the Delta for the benefit of fish and birds.

- To preserve the Delta as a place, we must restrict new urban development to those peripheral areas already definitely earmarked for such growth, while supporting farming and recreation in the Delta’s core.

- And we must floodproof the Delta, as far as feasible, mainly by improving levees and by providing more overflow zones where swollen rivers can spread without doing harm.

What about today’s headline issue concerning the Delta—the proposed construction of tunnels to improve the way water destined for export southwards reaches the pump intakes near Byron? This initiative is part of what is called the Bay Delta Conservation Plan (BDCP). The BDCP is a different and more narrowly focused undertaking than the Delta Plan, into which, if certain conditions are met, it will be fused (see section, A Better System: Delta Conveyance).

The Delta Plan is California’s plan for the Delta, prepared in consultation with, and to be carried out by, all agencies in the field: the State Water Resources Control Board, ultimate arbiter of water rights and water quality; the California Department of Water Resources, the state’s water planner and also operator of the great State Water Project; the California Department of Fish and Wildlife, responsible for the welfare of the living system of the Delta; the Delta Protection Commission, which oversees land use and development on low-lying Delta islands; and many more agencies, State and local. Add to the list federal players like the Bureau of Reclamation, which runs the Central Valley Project; the U.S. Fish and Wildlife Service; the National Marine Fisheries Service; and the U.S. Army Corps of Engineers. Their cooperation has been promised, and it is vital.
The working parts of the Plan are 73 Recommendations and 14 Policies. Recommendations call attention to tasks being done or to be done by others. Policies are legal requirements that anyone undertaking a significant project in the Delta must meet. See the sidebar, From Plan to Reality, for more on the mechanics of realizing the Plan and pages ES-15 to ES-35 for a survey of all 87 provisions.

Where Is the Money?

The Legislature sees “adequate and secure funding” as a need “inherent in the coequal goals.” In order to know what this entails, we need to form a clearer picture of the costs of the work now proposed for the Delta or on its behalf and how those costs might be met. This first edition of the Delta Plan proposes research toward that clarity.

FROM PLAN TO REALITY

The Legislature instructed the Delta Stewardship Council to “direct efforts across state agencies.” This “direction” has three distinct aspects.

First of all, the Council is to coordinate. It will chair a high-powered committee dedicated to implementing the Plan. The heads of key State and local agencies will be at that table, together with federal representatives. This body will meet for the first time in fall 2013. Agency staffs will work with that of the Council daily.

Second, the Council is to keep track of progress. Using specific performance metrics contained in the Plan, and guided by the Delta Science Program (see sidebar, Science at the Center), it will monitor what is actually being done toward Plan goals, and what changes of course may be indicated. The results will be widely publicized.

Third, in certain key areas, the Council can be called upon to block damaging actions. The Plan provisions that can trigger this authority are called Policies. To avoid premature encroachment on the work of other agencies, the Legislature devised an indirect path leading to Council intervention.

Actions subject to these Policies are called “covered actions,” but the Council itself cannot declare an action to be covered. It is the proposing agency that makes this determination. Legal standards apply, however, and if an action is questionably deemed not to be covered, the Council or any other party can take the agency to court.

Once an action is determined to be covered, the proposing agency must make sure it is in line with the Policies of the Delta Plan, filing a Certification of Consistency with contents specified in Delta Plan Governance Policy 1. If the agency says the action is consistent but another party or citizen thinks it is not, the opponent can then appeal to the Delta Stewardship Council. A Council member or the Council’s Executive Officer may initiate the appeal.

SCIENCE AT THE CENTER

The Delta Reform Act mandates that the Delta Plan be based on the best available scientific knowledge of our day. It must, moreover, be open to change as knowledge changes—and as paper proposals meet the test of reality. The results of every action are to be closely tracked, so that corrections can be made in a timely way—a process, much discussed but not sufficiently practiced, known as adaptive management.

To be more than a buzzword, adaptive management must bring two things to bear: new information, and a readiness to let new information disrupt old plans. Both, in the past, have been in scant supply.

Though Delta knowledge has expanded hugely in recent years, it is often a challenge to pull that data together and draw conclusions from it. Studies are done by different agencies for specific purposes and in narrow contexts; findings can be hard to integrate. The Delta Science Program, a function of the Council, will seek to overcome these gaps, linking the whole community of scientists at work. Guided by a top-flight Delta Independent Science Board, it will prepare, by December 31, 2013, a companion to the Delta Plan called the Delta Science Plan (Governance Recommendation 1).

The Delta Science Plan will propose a collaborative structure for doing science in the Delta. It will suggest ways of improving communication, resolving conflicting results, and accommodating uncertainty. It will offer priorities: how to apportion attention between immediate practical questions, on the one hand, and research aimed at increasing long-term understanding, on the other. It will sketch a more integrated approach to monitoring, so that results from different settings can be compared, and consider how computer modeling of the intricate Delta system might be improved.

Once a year, the Council will bring scientists together to assess what has been learned and what changes in ongoing plans and projects the new knowledge may suggest. Another conference? Yes, but with a difference: These findings will feed directly into ongoing refinement of the Delta Plan.
First step is an inventory: How much is now actually being spent, by all the agencies involved, that can be chalked up to furthering the coequal goals? Second comes an assessment of costs: How much will it take to carry out the projects and programs described in the Delta Plan, and what might the sources of support be for each one? The third step must be a comparison of resources and needs, and a reckoning of gaps: What key elements lack probable funding, and what might be done to fill these holes? (Funding Principles Recommendations 1 through 3)

Providing a More Reliable Water Supply for California...

The Delta’s contribution to the overall statewide water supply is smaller than many people think. The proportion drawn directly from the Delta, mostly through the pumps near Byron, is only about 8 percent of the total. The bulk of California’s water comes from more local sources, and always has.

Nevertheless, the Delta supply is important to many regions. Southern California imports about 25 percent of its water via the Byron pumps. The Tulare Lake Basin, the southern end of the Great Central Valley, gets 27 percent of its water by that route. Even the San Francisco Bay Area takes 16 percent of its supply from Delta pumps. On a more local scale, several water suppliers rely entirely on the Delta, and others have become dependent on this one overtaxed source to a risky degree.

In addition to water pulled directly from the Delta, a great deal is drawn from the Delta’s tributary streams before they come down to sea level. San Francisco Bay Area cities reach far inland to tap the Tuolumne and Mokelumne Rivers in the Sierra Nevada, taking 27 percent of their water needs from these sources. Parts of the Central Valley tributary to the Delta get all of their water from that watershed by definition, as do the people and farms of the Delta itself. (See also sidebar, The Problem with Numbers.)

California water planning is full of good intentions. If the laws and policies that are now on the books were consistently carried out, the state’s water system—including that part that is tied to the Delta—would work much better.

The Delta Plan addresses water supply on three scales: California-wide, on the Delta watershed level, and in the areas that receive water from the Delta pumps. (See Figure ES-1, The Delta Watershed and Areas Receiving Delta Water.)

California water planning is full of good intentions. If the laws and policies that are now on the books were consistently carried out, the state’s water system—including that part that is tied to the Delta—would work much better. The Delta Plan calls on all water suppliers to obey the many laws and guidelines that exist, and on the State’s regulatory agencies to insist on compliance (Water Resources Recommendation 1).

The Problem with Numbers

In talking of California water, we put trust in numbers: flows, usages, capacities, trends. But some seemingly solid and much-quoted figures are little more than guesses. By and large, we do not truly know how much water we are using or how much we are saving through conservation efforts. We know less than we should about Delta inflows and outflows. We know little about groundwater except that water tables in too many places are dropping. What information is available is often packaged in inscrutable ways. The Delta Plan asks all the agencies and water suppliers involved to provide or demand better information, and to communicate it better (Water Resources Policy 2, WR Recommendations 16 through 19).
Whatever the outcome of some current debates, California’s next large increment of water supply will not come from major new engineering but from water conservation, recycling, local stormwater capture, and reasonable use of aquifers (see section, A Better System: Storing Floods to Ride Out Droughts). These measures can yield an amount of water larger than the total that is drawn from the Delta today. State agencies in charge of water matters should systematically promote these practices, and all State agencies should model them in their own water usage. (Water Resources Recommendations 6, 8, and 14.)

Zooming in a bit from the statewide picture, the Delta Plan calls for all water users linked to the Delta—whether they take water from it directly, or tap the watershed—to reduce their draws. The State Water Resources Control Board should give special scrutiny to water use applications that could boost demand on the watershed. Urban and agricultural water suppliers are already required to write water management plans; these now should include “water supply reliability elements,” discussing, among other things, how to deal with the cascading effects if Delta pumping were halted for as long as 3 years. (Water Resources Recommendations 3, 4, 5, and 7.)

The Plan speaks most directly to those suppliers that serve water within the Delta or pump water out of the region—including the State Water Project, the Central Valley Project, and by extension the many agricultural and urban water purveyors that are the customers of these giants. Any organization that receives water from the projects must do its share to reduce reliance on the Delta, setting specific reduction targets and actually putting measures in place.

The State Water Project is called on to write the corresponding provisions into contracts with its clients when these agreements are renewed or revised (Water Resources Policies 1 and 2, WR Recommendation 2).

A Better System: Storing Floods to Ride Out Droughts (and Give the Delta a Break)

The measures so far mentioned will take pressure off the Delta while actually increasing California’s developed water supply. The further key to both goals is to harvest and store the water that is available from Central Valley rivers in the
wettest years, at the least environmental cost. The need is heightened by the fact of climate change, which stands to make rainy years all the wetter, and droughts all the more severe.

There are few opportunities left in California to build large new dams (or to raise the height of old dams), and the options that exist are dauntingly expensive. The California Department of Water Resources and the Bureau of Reclamation have been studying the possibilities. The Delta Plan urges the agencies to wrap up these studies, so that the State can decide the fate of these proposals once and for all (Water Resources Recommendations 13 and 14).

Much more water storage space exists right under our feet: in groundwater basins, or aquifers.

California began its history with a vast supply of water stored naturally in underground gravel fields and free for the taking via wells. In parts of the state, including most of the southern Central Valley, this endowment has been squandered, and groundwater levels have dropped, sometimes by hundreds of feet. One of the rationales for sending water south from the Delta has been to recharge aquifers, but not enough recharging has occurred. And the State’s last comprehensive assessment of its groundwater situation was published in 1980—a third of a century ago.

The Delta Plan calls for a rededication to the conservative idea of using aquifers like bank accounts: to be filled up in wet times, in order that they may be drawn from in dry.

There is another tool for making the supply stretch further: the sale or trade of water between suppliers, especially in times of shortage. Existing rules governing such transfers are found cumbersome by some and insufficiently protective of water rights and the environment by others. The State Water Resources Control Board should reformulate the guidelines by mid-2016 (Water Resources Recommendations 14 and 15).

A Better System: Delta Conveyance

As noted, many of the state’s water suppliers take their water from rivers at points upstream of the Delta. The two biggest, however—the State Water Project and the Central Valley Project—are different. Though most of the water they transport has its origin to the north, in the Sacramento River, their withdrawal points are deep in the Delta and well to the south, on the channel called Old River. Unlike most other water withdrawals, these affect the region not only by removing water but also by distorting flows.

The pumps at Byron have so much power that they essentially give the Delta a second mouth. In many channels, water runs backward at times, toward the pump intakes, not toward the sea. This situation is bad for salmon, Delta smelt, and other sensitive and legally protected species. Under the Bay Delta Conservation Plan, the Department of Water Resources and the federal Bureau of Reclamation are planning a kind of arterial bypass, segregating the water meant for the pumps at a new northern intake on the Sacramento River. The water corralled at this point would be sent to the pumps via a pair of tunnels. This arrangement
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is intended to alleviate the backward flows that harm fish; in conjunction with major habitat improvements and other measures, it is supposed to bring endangered species far enough back from the brink to satisfy protective laws. Many Delta residents and environmentalists, though, fear that the new system will simply allow more water to be shipped south, doing, on balance, more harm than good.

The Delta Stewardship Council is not the author of the BDCP. Its role for now is to advise and to urge timely completion (Water Resources Recommendation 12). Later on, though, the Council may have a decisive say. Once the proposal is complete, the Department of Fish and Wildlife must declare that it meets the standards of the Delta Reform Act, and this declaration can in turn be appealed to the Council. If the Council does not concur, certain aspects of the BDCP will lose access to State funding. If all hurdles have been cleared, on the other hand, the BDCP will take its place as a component of the Delta Plan.

...and Protecting, Restoring, and Enhancing the Delta Ecosystem...

The effort to improve the fortunes of the Delta ecosystem has two components that are vital: guaranteeing adequate flows from the rivers feeding into and through Delta channels, and creating new wetlands and other habitats in partial replacement for what has been lost. Three other components are merely very important: combating harmful exotic species, improving the management of salmon hatcheries, and protecting and improving water quality.

Habitat Restoration

In its primeval state, the Delta was no uniform sea of reeds but a vast mesh of habitats including tule marsh threaded with rivers and sloughs, perched lakes filled by floods and very high tides, natural levees with big trees on them, and seasonal overflow basins behind the levees. Most of this mosaic has disappeared, converted to fifty large and many small leveed islands. Evidence of what was remains in agricultural soils of uncommon quality (and fragility).

The old scene will never return, but careful habitat restoration projects can help to reverse the region's
ecological decline. Biologists have spent years locating the likeliest areas for such revival. The Delta Plan incorporates the latest thinking, essentially the Conservation Strategy drafted in 2011 by the Department of Fish and Wildlife (formerly the Department of Fish and Game).

Since the heart of the Delta is now well below sea level, due to subsidence, the suitable restoration sites are mostly found near Delta margins, where the soil surface is still high enough to permit marsh plants and riparian vegetation to take root. The Plan outlines six such zones: the Yolo Bypass, the floodplain west of Sacramento into which the Sacramento River spills in wet years; the Cache Slough Complex, where the Bypass rejoins the body of the Delta; a nexus in the eastern Delta, where the Mokelumne River and the Cosumnes River add their strands to the Delta’s web; a zone in the southern Delta along the San Joaquin River; a collection of small tracts at the western apex of the Delta, where it narrows to meet Suisun Bay; and finally the Suisun Marsh, fringing that bay to the north. This fresh-to-brackish water marsh, the largest wetland in California, is mostly managed by hunting clubs for seasonal waterfowl ponds, but sizeable areas should be restored to full tidal action. The existing plan for Suisun Marsh, written by the San Francisco Bay Conservation and Development Commission, is 36 years old and does not take into account, for example, probable sea level rise.

The Delta Plan calls for the habitat restorations in the Conservation Strategy to be carried out by the Department of Fish and Wildlife and by the Delta Conservancy, a body established for such purposes in 2009; and it calls for a plan update for Suisun Marsh. The Delta Stewardship Council can be appealed to, if necessary, to block development or any other intrusion that might interfere with a restoration site. (Ecosystem Restoration Policies 2 and 3, ER Recommendations 2, 3, and 5.)

Much of the remaining good habitat in the Delta is found in strips along the water side of levees, and the Delta Plan looks to protect and widen these green margins. When levees are rebuilt or altered, the possibility of shifting them farther away from the water should always be explored. The growth of trees along the waterline should be encouraged. However, authority over many levees lies with the U.S. Army Corps of Engineers, and the Corps requires removal of trees and shrubs, on the theory that root systems have a weakening effect. (The matter is debated.) Given the value of tall vegetation for habitat, the Delta Plan asks the Corps to exempt Delta levees from this rule, where appropriate. (Ecosystem Restoration Policy 4 and ER Recommendation 4.)
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Exotic Species

One of the less-visible forces to buffet the Delta ecosystem is the proliferation of nonnative aquatic species—fish, crustaceans, plants, and even the microscopic floating animals of zooplankton. Some were introduced deliberately; others arrived by random routes including the discharge of bilgewater from oceangoing ships and the dumping of goldfish bowls. New arrivals keep appearing. Some of these intruders affect the system little, but other species, notably certain aquatic plants and filter-feeding clams, transform the web of life profoundly. The Delta Plan prohibits actions that could bring in new exotics or improve conditions for exotics that are here, and endorses the measures the Department of Fish and Wildlife is already planning to take against them. (Ecosystem Restoration Policy 5, ER Recommendation 7.)

Among the exotics are game species introduced in the nineteenth century and well-loved by fishermen: striped, largemouth, and smallmouth bass. It has become apparent that these voracious game fish are helping to deplete salmon, Delta smelt, and other species in trouble. The Delta Plan asks the Department of Fish and Wildlife to change angling rules to permit heavier fishing and somewhat suppress the bass population (Ecosystem Restoration Recommendation 6).

Management of Hatchery Fish

When dams on many rivers cut off spawning grounds for salmon and steelhead trout, hatcheries were built to compensate. Now there is worry that hatchery-raised salmon, less genetically diverse than their wild cousins, may mix with and reduce the fitness of the wild strains. Various solutions are proposed, including capturing wild fish to add their eggs to hatchery stock. The Delta Plan asks the Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to put these ideas and recommendations into effect (Ecosystem Restoration Recommendations 8 and 9).

Water Quality

Pollution from the watershed is bad for the Delta ecosystem and for water users. The Delta Plan urges the responsible agencies—the State Water Resources Control Board, the Central Valley Regional Water Quality Control Board, and the San Francisco Bay Regional Water Quality Control Board—to protect “beneficial uses” of water in the Delta and Suisun Bay. Various ongoing projects of planning, rule-making, and construction should be brought to conclusion. All agencies should look at water quality when weighing actions covered under the Delta Plan. Special attention should be paid to pollution that might degrade habitat restoration sites. (Water Quality Recommendations 1 through 12.)

...In a Way that Protects and Enhances the Values of the Delta as an Evolving Place

Because of its role in greater systems—the San Francisco Estuary, the state water plumbing—the Delta is a subject of statewide debate. The conversation can seem to take place over the heads of the people who actually live in the region; and it can seem to overlook the lasting values of the place that is: its thriving agriculture, the beauty of its countryside, its cultural heritage, and its recreational bounty. The Delta Plan strives to redress this balance without promising what is probably impossible: the retention of the landscape exactly as it is today.

Honorific labels do not protect valuable assets, but they can help us recognize them. The Delta Plan asks that the Delta be declared a National Heritage Area by Congress and that Highway 160, its north-south artery, be designated a National Scenic Byway by the U.S. Department of Transportation (Delta-as-Place Recommendations 1 and 2). Many Delta people fear that their concerns will be brushed aside as new water facilities and habitat restorations get under way. While deference cannot be guaranteed,
the Delta Plan calls on the agencies to respect local plans in siting such projects, to minimize conflict when possible, and to buy land from willing sellers when they can (Delta-as-Place Policy 2, DP Recommendation 4).

The distinctive Delta landscape has been much altered by urban encroachment, often entailing higher flood risk. The Delta Protection Commission, created in 1992 and strengthened by the Delta Reform Act of 2009, oversees development in the core area called the Primary Zone: Local decisions affecting this zone can be appealed to the Commission and overturned by it. However, this authority does not extend to the peripheral Secondary Zone, where the development pressure is strongest. The Delta Plan tightens control further, steering new development to the 26,000 acres in the Peripheral Zone that are already earmarked for urbanization in local plans. Small housing developments that may occur outside these limits must meet high flood control standards (Delta-as-Place Policy 1, Risk Reduction Policy 2). (See Figure ES-2, Delta Communities.)

A little more bustle might actually benefit 11 historic small towns or settlements within the Delta, known as the legacy communities. Most are spaced along the Sacramento River: Freeport, Clarksburg, Hood, Courtland, Locke, Walnut Grove, Ryde, Isleton, and Rio Vista. Knightsen and Bethel Island are near the lower channel of the San Joaquin River. Planners at all levels should respect the character, and promote the vitality, of these places (Delta-as-Place Recommendation 3).

The Delta Protection Commission has written an Economic Sustainability Plan containing numerous ideas for the support of the region’s farm economy, parks and recreation, and roads and infrastructure. The Delta Plan adapts many of these as Delta-as-Place Recommendations 5 through 19.

**Flood Risk Reduction**

In its primeval state, most of the Delta was wetland and slightly above sea level. Since levees created the modern islands and cultivation began, soils have subsided deeply. Many Delta tracts are strikingly below the level of the water in adjacent channels; rising sea level will make the differential worse. While the occasional levee break is part of Delta lore, multiple failures could bring disaster to the Delta landscape, economy, and ecosystem.

The Delta Plan urges all agencies in the Delta to plan for emergencies and to join forces in a regional response consortium, as proposed by the Delta Multi-Hazard Coordination Task Force. Every responsible party, public and private, should allocate money for flood prevention and reaction. Utilities should plan to minimize interruptions of service. The Department of Water Resources should expand its stockpiles of stone and earth for the use of all when breaches require rapid plugging. Higher levels of private flood insurance should be required, and the State should gain immunity from lawsuits related to flooding beyond its power to prevent. (Risk Reduction Recommendations 1, 9, and 10.)

*It is estimated that only about half the Delta’s acreage is adequately protected. There is not enough money for all the desirable improvements, nor is there a mechanism for sharing costs among all who benefit.*
Delta Communities

Figure ES-2

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There are more than 1,000 miles of Delta levees. The State is directly responsible for about one-third of the system; nearly 70 local Reclamation Districts are in charge of the rest. It is estimated that only about half the Delta’s acreage is adequately protected. There is not enough money for all the desirable improvements, nor is there a mechanism for sharing costs among all who benefit. The Delta Plan calls on the Legislature to establish a locally based Delta Flood Risk Management Assessment District to raise money for combined defenses. Public and private utilities, too, should invest in defense of their facilities and lines. (Risk Reduction Recommendations 2 and 3.)

The State contributes massively to levee costs throughout the Delta, but on a not very systematic basis. The Legislature directed the Delta Stewardship Council to set priorities for these investments. Risk Reduction Policy 1 offers broad principles. Urban areas come first; special attention must be paid to levees guarding roads and energy facilities. The channels through which water flows toward export pumps require protection, as does the pipeline that brings Sierra water across the Delta for the East Bay Municipal Utility District. Levees on the western islands, whose failure could bring salinity deep into the Delta, are also of high concern. A more detailed study is to follow. Building on work being done by the Department of Water Resources, the Council will assess, island by island, the state of levees, the degree of subsidence, the extent and value of assets to be protected, and the cost of long-term defense. The result, due at the end of 2014, will be a tiered priority list for the expenditure of State levee funds (Risk Reduction Recommendation 4).

To take pressure off the levee system, floodwaters need room to move and to spread without causing harm (and often to the benefit of plants, birds, and fish). Two such safety valves already exist at the Yolo Bypass and the Cosumnes-Mokelumne floodplain; a third such zone is proposed for the lower San Joaquin River at Paradise Cut. The Delta Plan urges expansion of the flood relief system, and requires that present or potential overflow areas be kept free of encroachments. Levee setbacks are also encouraged. (Risk Reduction Policies 3 and 4, RR Recommendations 5 through 8.)

Given time, land subsidence can actually be reversed. Experimental plots show that soils can be deepened by growing tules in shallowly flooded fields, at a rate of a little over an inch a year. The tule plots also fix a lot of atmospheric carbon and thus do their bit toward slowing climate change. The Delta Plan encourages expansion of this work (Delta-as-Place Recommendation 7).

Finding the Way Through

When the first Spanish explorers took their boats into the Sacramento-San Joaquin River Delta, they were feeling their way. They could see the channel they were in, as far as the next bend or junction of sloughs. They had a general idea of where they were going. Between the near and the far, though, were mysteries. Which waterways connected to others, which petered out in the marshes? Where was the real way through?

**Tangible marks of progress may at first be as subtle as shifting shoreline features seen from a Delta boat.**

This first edition of the Delta Plan is a little like such an exploration. A short reach of channel is visible; another stretch can be assessed from local information. After that, the route is a matter of educated guesswork.

The Delta Plan can be fairly specific about steps to be taken in the next 5 years. The Delta Science Plan is already under way. The in-depth study of levees will begin by fall 2013. The Interagency Implementation Committee will meet by
the end of the year. Just around the next bend, the State Water Resources Control Board will adopt its momentous new flow rules; a final decision on Delta conveyance (the Bay Delta Conservation Plan) looms beyond that.

It will not have escaped the reader how many of these measures seem rather abstract, involving studies, rule-making, the gathering of information, the refining of procedures, the testing of powers—not so much doing as planning, and even planning how to plan. This is simply the phase we are in. Tangible marks of progress may at first be as subtle as shifting shoreline features seen from a Delta boat. Here, though, are some markers to look for. We will be doing well if, in a few years’ time:

- Many urban and rural water suppliers that draw on the Delta have taken real steps to reduce that reliance, with measured, reported results.
- Flows in Delta channels, controlled under new State Water Resources Control Board rules, are looking a good deal more like the historical ones.
- Several new habitat restoration projects in the Delta have moved from the planning to the construction stage.
- Subsidence reversal planting has expanded from the small pilot projects seen today.
- Measurably less acreage of Delta waters is dominated by nonnative water plants.
- Stocks of endangered fish are showing a rebound.
- Key levees have been strengthened, especially in the environs of Stockton and Sacramento.
- No further rural farmland has been lost to urbanization.

The next edition of the Delta Plan, due in 2018 or sooner, will be a little longer on specifics and a little shorter on question marks. A few more miles of the channel ahead will have come into view. New uncertainties, no doubt, will have replaced old. The captains will continue to disagree. But, just as it was in the old days, the route through the Delta will be the one way forward.

Beyond all local debates and confusions, the destination is clear. We want a Delta landscape that remains essentially itself while adapting gradually and gracefully to a future marked by climate change and sea level rise. We want a Delta ecosystem that works markedly better than today’s, reflected partly in a resurgence of native fish. And we want an end to the endless wrangling about Delta flows and plumbing—a truce that can only be achieved if the entire California water system undergoes a measure of reform.

In solving the “Delta problem,” we will not only be doing right by a treasured land- and waterscape. We will be putting the entire state of California on a sounder development path.

Driven by cost, environmental concern, and sheer practicality, the water world is already shifting away from reliance on distant dams and aqueducts and toward trust in conservation, local sources, and better use of groundwater storage. This change is reflected in the fact, startling to many, that California’s total water consumption has not climbed in recent years; in fact, despite our increasing population, use has slightly dropped. The Delta Plan gives a push to trends already under way.

In solving the “Delta problem,” we will not only be doing right by a treasured land- and waterscape. We will be putting the entire state of California on a sounder development path.
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Delta Plan Policies and Recommendations

The Delta Plan contains a set of regulatory policies that will be enforced by the Delta Stewardship Council’s appellate authority and oversight. The Delta Plan also contains priority recommendations, which are nonregulatory but call out actions essential to achieving the coequal goals.

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<th>POLICY OR RECOMMENDATION NUMBER</th>
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| G P1 (23 CCR section 5002)      | Detailed Findings to Establish Consistency with the Delta Plan | (a) This policy specifies what must be addressed in a certification of consistency filed by a State or local public agency with regard to a covered action. This policy only applies after a “proposed action” has been determined by a State or local public agency to be a covered action because it is covered by one or more of the regulatory policies contained in Article 3. Inconsistency with this policy may be the basis for an appeal.

(b) Certifications of consistency must include detailed findings that address each of the following requirements:

1. Covered actions, in order to be consistent with the Delta Plan, must be consistent with this regulatory policy and with each of the regulatory policies contained in Article 3 implicated by the covered action. The Delta Stewardship Council acknowledges that in some cases, based upon the nature of the covered action, full consistency with all relevant regulatory policies may not be feasible. In those cases, the agency that files the certification of consistency may nevertheless determine that the covered action is consistent with the Delta Plan because, on whole, that action is consistent with the coequal goals. That determination must include a clear identification of areas where consistency with relevant regulatory policies is not feasible, an explanation of the reasons why it is not feasible, and an explanation of how the covered action nevertheless, on whole, is consistent with the coequal goals. That determination is subject to review by the Delta Stewardship Council on appeal;

2. Covered actions not exempt from CEQA must include all applicable feasible mitigation measures adopted and incorporated into the Delta Plan as amended April 26, 2018 (unless the measure(s) are within the exclusive jurisdiction of an agency other than the agency that files the certification of consistency), or substitute mitigation measures that the agency that files the certification of consistency finds are equally or more effective;

3. As relevant to the purpose and nature of the project, all covered actions must document use of best available science;

4. Ecosystem restoration and water management covered actions must include adequate provisions, appropriate to the scope of the covered action, to assure continued implementation of adaptive management. This requirement shall be satisfied through both of the following:

   (A) An adaptive management plan that describes the approach to be taken consistent with the adaptive management framework in Appendix 1B, and

   (B) Documentation of access to adequate resources and delineated authority by the entity responsible for the implementation of the proposed adaptive management process.

(c) A conservation measure proposed to be implemented pursuant to a natural community conservation plan or a habitat conservation plan that was:

1. Developed by a local government in the Delta; and
2. Approved and permitted by the California Department of Fish and Wildlife prior to May 16, 2013 is deemed to be consistent with sections 5005 through 5009 of this Chapter if the certification of consistency filed with regard to the conservation measure includes a statement confirming the nature of the conservation measure from the California Department of Fish and Wildlife.

G R1 Development of a Delta Science Plan

The Delta Stewardship Council's Delta Science Program should develop a Delta Science Plan by December 31, 2013. The Delta Science Program should work with the Interagency Ecological Program, Bay Delta Conservation Plan, California Department of Fish and Wildlife, and other agencies to develop the Delta Science Plan. To ensure that best science is used to develop the Delta Science Plan, the Delta Independent Science Board should review the draft Delta Science Plan.

The Delta Science Plan should address the following:

- A collaborative institutional and organizational structure for conducting science in the Delta
- Data management, synthesis, scientific exchange, and communication strategies to support adaptive management and improve the accessibility of information
- Strategies for addressing uncertainty and conflicting scientific information
- The prioritization of research and balancing of the short-term immediate science needs with science that enhances comprehensive understanding of the Delta system over the long term
- Identification of existing and future needs for refining and developing numerical and simulation models along with enhancing existing Delta conceptual models (e.g., the Interagency Ecological Program (IEP) Pelagic Organism Decline (POD) and the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) models)
- An integrated approach for monitoring that incorporates existing and future monitoring efforts
- An assessment of financial needs and funding sources to support science

Chapter 3

WR P1 Reduce Reliance on the Delta through Improved Regional Water Self-Reliance

(a) Water shall not be exported from, transferred through, or used in the Delta if all of the following apply:

1. One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c);
2. That failure has significantly caused the need for the export, transfer, or use; and
3. The export, transfer, or use would have a significant adverse environmental impact in the Delta.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to export water from, transfer water through, or use water in the Delta, but does not cover any such action.
unless one or more water suppliers would receive water as a result of the proposed action.

(c) (1) Water suppliers that have done all of the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:

   (A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;

   (B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and

   (C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).

(2) Programs and projects that reduce reliance could include, but are not limited to, improvements in water use efficiency, water recycling, stormwater capture and use, advanced water technologies, conjunctive use projects, local and regional water supply and storage projects, and improved regional coordination of local and regional water supply efforts.

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<tr>
<td>WR R1</td>
<td>Implement Water Efficiency and Water Management Planning Laws</td>
<td>All water suppliers should fully implement applicable water efficiency and water management laws, including urban water management plans (Water Code section 10610 et seq.); the 20 percent reduction in statewide urban per capita water usage by 2020 (Water Code section 10608 et seq.); agricultural water management plans (Water Code section 10608 et seq. and 10800 et seq.); and other applicable water laws, regulations, or rules.</td>
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<tr>
<td>WR R2</td>
<td>Require SWP Contractors to Implement Water Efficiency and Water Management Laws</td>
<td>The California Department of Water Resources should include a provision in all State Water Project contracts, contract amendments, contract renewals, and water transfer agreements that requires the implementation of all State water efficiency and water management laws, goals, and regulations, including compliance with Water Code section 85021.</td>
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<tr>
<td>WR R3</td>
<td>Compliance with Reasonable and Beneficial Use</td>
<td>The State Water Resources Control Board should evaluate all applications and petitions for a new water right or a new or changed point of diversion, place of use, or purpose of use that would result in new or increased long-term average use of water from the Delta watershed for consistency with the constitutional principle of reasonable and beneficial use. The State Water Resources Control Board should conduct its evaluation consistent with Water Code sections 85021, 85023, 85031, and other provisions of California law. An applicant or petitioner should submit to the State Water Resources Control Board sufficient information to support findings of consistency, including, as applicable, its urban water management plan, agricultural water management plan, and environmental documents prepared pursuant to the California Environmental Quality Act.</td>
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<tr>
<td>WR R4</td>
<td>Expanded Water Supply Reliability Element</td>
<td>Water suppliers that receive water from the Delta watershed should include an expanded water supply reliability element, starting in 2015, as part of the update of an urban water management plan, agricultural water management plan, integrated water management plan, or other plan that provides equivalent information about the supplier’s planned investments in water conservation and water supply development. The expanded water supply reliability element should detail how water suppliers are reducing reliance on the Delta and improving regional self-reliance consistent with Water Code section 85201 through investments in local and regional programs and projects, and should document the expected outcome for a measurable reduction in reliance on the Delta and improvement in regional self-reliance. At a minimum, these plans should include a plan for possible interruption of water supplies for up to 36 months due to catastrophic events impacting the Delta, evaluation of the regional water balance, a climate change vulnerability assessment, and an evaluation of the extent to which the supplier’s rate structure promotes and sustains efficient water use.</td>
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<td>WR R5</td>
<td>Develop Water Supply Reliability Element Guidelines</td>
<td>The California Department of Water Resources, in consultation with the Delta Stewardship Council, the State Water Resources Control Board, and others, should develop and approve, by December 31, 2014, guidelines for the preparation of a water supply reliability element so that water suppliers can begin implementation of WR R4 by 2015.</td>
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<td>WR R6</td>
<td>Update Water Efficiency Goals</td>
<td>The California Department of Water Resources and the State Water Resources Control Board should establish an advisory group with other State agencies and stakeholders to identify and implement measures to reduce impediments to achievement of statewide water conservation, recycled water, and stormwater goals by 2014. This group should evaluate and recommend updated goals for additional water efficiency and water resource development by 2018. Issues such as water distribution system leakage should be addressed. Evaluation should include an assessment of how regions are achieving their proportional share of these goals.</td>
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<td>WR R7</td>
<td>Revise State Grant and Loan Priorities</td>
<td>The California Department of Water Resources, the State Water Resources Control Board, the California Department of Public Health, and other agencies, in consultation with the Delta Stewardship Council, should revise State grant and loan ranking criteria by December 31, 2013, to be consistent with Water Code section 85021 and to provide a priority for water suppliers that includes an expanded water supply reliability element in their adopted urban water management plans, agricultural water management plans, and/or integrated regional water management plans.</td>
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<td>WR R8</td>
<td>Demonstrate State Leadership</td>
<td>All State agencies should take a leadership role in designing new and retrofitted State-owned and -leased facilities, including buildings and California Department of Transportation facilities, to increase water efficiency, use recycled water, and incorporate stormwater runoff capture and low-impact development strategies.</td>
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<td>WR R9</td>
<td>Update Bulletin 118, California’s Groundwater Plan</td>
<td>The California Department of Water Resources, in consultation with the Bureau of Reclamation, U.S. Geological Survey, the State Water Resources Control Board, and other agencies and stakeholders should update Bulletin 118 information using field data, California Statewide Groundwater Elevation Monitoring (CASMEM), groundwater agency reports, satellite imagery, and other best available science by December 31, 2014, so that this information can be included in the next California Water Plan Update and be available for inclusion in 2015 urban water management plans and agricultural water management plans. The Bulletin 118 update should include a systematic evaluation of major groundwater basins to determine sustainable yield and overdraft status; a projection of California’s groundwater resources in 20 years if current groundwater management trends remain unchanged; anticipated impacts of climate change on surface water and groundwater resources; and recommendations for State, federal, and local actions to improve groundwater management. In addition, the Bulletin 118 update should identify groundwater basins that are in a critical condition of overdraft.</td>
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<tr>
<td>WR R10</td>
<td>Implement Groundwater Management Plans in Areas that Receive Water from the Delta Watershed</td>
<td>Water suppliers that receive water from the Delta watershed and that obtain a significant percentage of their long-term average water supplies from groundwater sources should develop and implement sustainable groundwater management plans that are consistent with both the required and recommended components of local groundwater management plans identified by the California Department of Water Resources Bulletin 118 (Update 2003) by December 31, 2014.</td>
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<tr>
<td>WR R11</td>
<td>Recover and Manage Critically Overdrafted Groundwater Basins</td>
<td>Local and regional agencies in groundwater basins that have been identified by the California Department of Water Resources as being in a critical condition of overdraft should develop and implement a sustainable groundwater management plan, consistent with both the required and recommended components of local groundwater management plans identified by the California Department of Water Resources Bulletin 118 (Update 2003), by December 31, 2014. If local or regional agencies fail to develop and implement these plans, the State Water Resources Control Board should take action to determine if the continued overuse of a groundwater basin constitutes a violation of the State’s Constitution Article X, Section 2, prohibition on unreasonable use of water and whether a groundwater adjudication is necessary to prevent the destruction of or irreparable injury to the quality of the groundwater, consistent with Water Code sections 2100 and 2101.</td>
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<td>WR R12a</td>
<td>Promote Options for New and Improved Infrastructure Related to Water Conveyance</td>
<td>Subject to completion of environmental review and approval by the lead agency, and applicable regulatory approvals from other public agencies, the following infrastructure options are hereby promoted: (1) The California Department of Water Resources (DWR) the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), and local beneficiary agencies should pursue a dual-conveyance option for the Delta. Dual conveyance is a combination of through-Delta conveyance and isolated conveyance to allow operational flexibility. Dual conveyance alternatives should be evaluated, and a selected plan designed and implemented, consistent with WR R12b, below. Dual conveyance should incorporate existing and new intakes.</td>
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and facility improvements for both isolated, below-ground conveyance and through-Delta conveyance of State Water Project (SWP) and Central Valley Project (CVP) water supplies from the Sacramento River to the south Delta, as follows:

(a) The isolated conveyance should incorporate one or more new screened intakes that protect native fish and that are operated to minimize harmful reverse flow conditions in Old and Middle rivers while maintaining water quality for in-Delta uses. Isolated conveyance should complement existing and improved through-Delta conveyance to promote operational flexibility, protect water quality, and support ecosystem restoration.

(b) To protect the Delta ecosystem, the State Water Resources Control Board should ensure that operational criteria for new and improved conveyance facilities comply with applicable State Water Resources Control Board requirements, including any flow criteria adopted pursuant to Water Code 85086(c)(2).

(c) Dual conveyance requires continued maintenance and further improvement of through-Delta conveyance. Through-Delta conveyance improvements may include channel improvements consistent with the Delta Plan and additional facilities that could provide for improved operations for native fish protection.

(2) DWR in collaboration with local beneficiary agencies should pursue new intake and conveyance facilities for conveying SWP supplies from the Sacramento River to SWP contractors in Solano and Napa Counties. This is both to protect native fish and improve the quality and reliability of water supplies delivered via the North Bay Aqueduct.

(3) Local agencies, in coordination with DWR and Reclamation, should pursue new conveyance facilities or conveyance facility improvements that allow use of multiple Delta intakes associated with the Los Vaqueros Project. This would increase operational flexibility for local, SWP, and CVP municipal and environmental water supplies conveyed from the south Delta.

(4) DWR, Reclamation, and local beneficiary agencies, in coordination with the California Department of Fish and Wildlife, National Marine Fisheries Service and U.S. Fish and Wildlife Service, should evaluate and identify for near-term implementation feasible actions to contribute to reducing fish losses associated with existing pumping operations at the Banks Pumping Plant and Jones Pumping Plant, consistent with the 2009 Biological Opinion and Conference Opinion on the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan; the 2009 Biological Opinion on the Coordinated Operations of the Central Valley Project and State Water Project in California; and the 2014 Recovery Plan for Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. These actions may include, but are not limited to:

(a) Implementing changes to the operations and physical infrastructure of the facilities where such changes can improve fish screening and salvage operations and reduce mortality from entrainment and salvage.

(b) Evaluating and implementing effective predator control actions, such as fishery management or directed removal programs, for minimizing predation.
on juvenile salmon and steelhead in Clifton Court Forebay and in the primary channel at the Tracy Fish Collection Facility.

(c) Evaluating and implementing effective predation reduction actions associated with salvage operations, such as transporting and releasing fish in multiple locations in the Delta.

(d) Installing equipment to monitor for the presence of predators and to monitor flows at the fish collection facilities.

(e) Modifying Delta Cross Channel gate operations and evaluating methods to control access to Georgiana Slough and other migration routes into the interior Delta to reduce diversion of listed juvenile fish from the Sacramento River and the San Joaquin River into the southern or central Delta.

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| WR R12b                         | Evaluate, Design, and Implement New or Improved Conveyance or Diversion Facilities in the Delta | (1) In selecting new and improved Delta infrastructure for conveying SWP, CVP, and market transfer water supplies from the Sacramento River to the south Delta, project proponents should analyze and evaluate a range of alternatives including, but not limited to the following:  
(a) A reasonable range of flow criteria, rates of diversion, and other operational criteria required to satisfy applicable requirements of State and federal fish and wildlife agencies and the State Water Resources Control Board, and other operational requirements and flows necessary for protecting, restoring, and enhancing the Delta ecosystem under a reasonable range of hydrologic conditions (as described under WR R12h, below). This includes identifying water available for export and other beneficial uses, consistent with water quality requirements of the State Water Resources Control Board.  
(b) A reasonable range of dual-conveyance alternatives, including options for the number and location of new intakes, a range of isolated conveyance capacities, through-Delta conveyance improvements, and other facilities that could improve operations for native fish and in-Delta water quality, as applicable.  
(c) The potential effects of climate change on the conveyance alternatives under consideration, including possible precipitation and runoff pattern changes, temperature, and sea level rise estimates consistent with guidance provided by the California Natural Resources Agency, National Research.  
(d) Council, or other appropriate projections. The potential effects on migratory fish and aquatic resources and habitats.  
(e) The potential effects on Sacramento River and San Joaquin River flood management.  
(f) The resilience and recovery of Delta conveyance alternatives to catastrophic failure caused by earthquake, flood or other natural disaster.  
(g) The potential effects of each Delta conveyance alternative on Delta water quality, flows, and water levels, including the effects of these changes on in-Delta water users.  
(h) The operational benefits and/or detriments of providing multiple intake locations.  
(i) The potential short-term and long-term effects of each Delta conveyance alternative on terrestrial species. |
The potential effects of each Delta conveyance alternative on the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

The cost-effectiveness of the alternatives in furthering the coequal goals. Cost-effectiveness means the degree to which a project or action is effective in achieving desired outcomes in relation to its cost.

Project proponents should design and implement new or improved conveyance infrastructure in the Delta consistent with the following parameters:

- Located in areas with seasonally favorable freshwater conditions, and areas that are less vulnerable to degradation during sustained droughts and under anticipated future climate change and sea level rise conditions.
- Located to avoid impacts to and, where possible, improve conditions for habitat restoration opportunities in priority restoration areas identified in the Delta Plan, and other important restoration opportunity areas identified by the California Department of Fish and Wildlife.
- Located, designed, and operated to minimize adverse conditions for native aquatic and terrestrial species, including but not limited to those conditions related to flow direction and water quality.
- Designed to avoid or minimize native fish entrainment and impingement.
- Designed to balance adverse project impacts against the project’s long- and short-term benefits.
- Designed to minimize disruptions to transportation and business activities during routine maintenance activities, with consideration given to scheduling planned maintenance activities in consultation with local governments to minimize impacts to residents and businesses, and establishing communication protocols to notify residents of planned and unplanned maintenance activities.
- Designed to complement the Delta landscape and minimize aesthetic impacts, including visual impacts of spoils material stockpiles.
- Designed to maximize beneficial reuse of spoils materials to the extent practicable and feasible.
- Implemented in accordance with detailed project implementation plans developed in cooperation with affected communities, local governments, the Delta Protection Commission, and stakeholders to minimize and/or mitigate adverse environmental effects consistent with Delta Plan Policy GP 1, and avoid or reduce conflicts with existing or planned land uses consistent with Delta Plan Policy DP P2, and in consideration of Delta Plan recommendations DP R14, DP R16 and DP R17. Project implementation plans should consider and protect the unique character and historical importance of legacy communities, be consistent with the State’s policy regarding the human right to water, and incorporate good neighbor policies to avoid negative impacts on agricultural lands, residents, and business. Items that should be addressed in the plans include, but are not limited to, the following:
  - Construction sequencing or phasing;
  - Temporary and long-term spoils placement;
  - Plans for temporary traffic routing that are consistent with local transportation plans, including consideration of permanent spoils placement.
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| WR R12c                        | Improve or Modify Through-Delta Conveyance      | (1) Project proponents should design, implement, and adaptively manage improved or modified through-Delta conveyance and appurtenant facilities (such as gates, permanent barriers, or fish handling facilities) to:  
  (a) Substantially lessen or avoid impacts and provide net improvements to riparian habitat and channel margin habitat along anadromous fish migratory corridors and, where feasible, enhance conditions for native fish.  
  (b) Substantially lessen or avoid impediments and provide net improvements to anadromous fish migration.  
  (c) Substantially lessen or avoid impacts to public safety and include or contribute to levee improvements along Old and Middle Rivers consistent with Chapter 7 of the Delta Plan.  
  (d) Modify the conveyance capacity or hydraulic characteristics of existing Delta waterways (e.g., improving levees and/or dredging) in a manner that provides multiple benefits, including: taking advantage of periods when water flow and quality conditions are favorable for improving water supply delivery reliability, quality, and flexibility and for protecting, restoring, and enhancing the Delta ecosystem; improving floodplain values and functions; improving habitat conditions during fish migration; and reducing flood risks. |
| WR R12d                        | Promote Options for New or Expanded Water Storage | Subject to completion of environmental review and approval by the lead agency, and applicable regulatory approvals from other public agencies, options for new or expanded water storage are hereby promoted as follows:  
(1) Within the Delta watershed, project proponents should design and operate new or expanded offstream or onstream surface water storage projects consistent with the criteria in WR R12h to:  
  (a) Provide water supply reliability, water quality, operational flexibility to adapt to changing conditions, and ecosystem benefits under variable hydrologic conditions, and, where possible, flood risk management benefits.  
  (b) Improve resilience to the effects of climate change, sea level rise, higher stream temperatures, long-term drought conditions, and emergency supply disruptions. |
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(c) | Allow greater flexibility in storing water supplies during periods when more water is available for carryover into periods when less water is available and/or Delta exports are reduced. |
(d) | Take advantage of periods when the water flow, quality, and environmental requirements of State and federal agencies are being met, for improving water supply delivery reliability and flexibility and protecting, restoring, and enhancing the Delta ecosystem. |
(e) | Contribute to improved conjunctive management of both surface and groundwater resources to maximize efficient water use and contribute to sustainable management of groundwater basins, consistent with the Sustainable Groundwater Management Act. |
(2) | Within the Delta water export area, project proponents should implement new or expanded surface water storage projects that improve resilience to the effects of climate change and drought and are operated to allow storage of exported and local surface water supplied during wetter periods for use during dryer periods when exports from the Delta are reduced. Opportunities to store stormwater and recycled water supplies of suitable quality should also be promoted as a strategy for improved regional water management and reduced reliance on the Delta. This includes projects in the San Francisco Bay Area, San Joaquin Valley, Central Coast region, and Southern California. |
(3) | Within the Delta watershed and Delta water export area, project proponents should implement groundwater storage and extraction projects, including facilities for groundwater withdrawal, recharge, injection, and monitoring that are consistent with the criteria in WR R12f below. |
(4) | The State Water Resources Control Board should review and consider revisions to existing regulations to facilitate the safe use of recycled water, stormwater, and other local water supplies for groundwater replenishment. |

**WR R12e**  
**Design, Construct and Implement New or Expanded Surface Water Storage**  
(1) Project proponents should design, implement, and adaptively manage new or expanded surface storage projects in the Delta, its watershed, and Delta water export areas to:  
(a) Improve resilience of the State’s water supply system through demonstration of benefits under current and anticipated future conditions, including climate change, changing water demands, and regulatory conditions.  
(b) Contribute to regional self-reliance and reduced reliance on the Delta.  
(c) Demonstrate contributions to the goals of the Sustainable Groundwater Management Act by promoting conjunctive use to achieve long-term groundwater basin sustainability.  
(d) Enable participation in water exchanges and transfers that benefit the Delta ecosystem and improve regional water supply reliability.  
(e) Demonstrate cost-effectiveness, where cost-effectiveness means the degree to which a project or action is effective in achieving desired outcomes in relation to its cost.  
(f) Minimize and mitigate the impacts of storage on stream flows and water quality, including impacts during construction.  
(2) Project proponents should design and implement new or expanded surface water storage projects in the Delta and Delta watershed, where feasible, to further achievement of the coequal goals by:
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<td>(a)</td>
<td>Providing for the dedicated storage of water during wet periods for carry over and later use during dry periods, while balancing the benefits of providing more natural, functional flows to the Delta and its tributaries, meeting other ecosystem needs and providing flood risk management benefits.</td>
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<td>(b)</td>
<td>Enhancing water temperature management on Delta tributaries either directly or through coordinated operations with other facilities.</td>
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<td>(c)</td>
<td>Incorporating storage space dedicated to ecosystem benefits, such as flow management, water temperature, other water quality benefits, or providing water supplies to wildlife refuges.</td>
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<td>(d)</td>
<td>Integrating new and/or expanded storage with other existing or planned storage and conveyance systems to increase ecosystem and water supply benefits. This includes developing and/or updating coordinated operations plans, and/or agreements with other storage and conveyance systems.</td>
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<td>(e)</td>
<td>Contributing to the protection of water quality in the Delta and its watershed for all beneficial uses consistent with the State Water Resources Control Board’s Bay-Delta Plan.</td>
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<td>(f)</td>
<td>Contributing to more natural, functional flows that support ecosystem health.</td>
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<td>(3)</td>
<td>Project proponents should design and implement, where feasible, new or expanded surface water storage projects outside the Delta watershed, but within the Delta water export area, such as projects within the San Joaquin Valley, Central Coast, or Southern California regions, to:</td>
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<td>(a)</td>
<td>Contribute to reduced reliance on the Delta and regional self-reliance and, particularly during dry periods, through storage of available water supplies during wet periods for use during dry periods.</td>
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<td>(b)</td>
<td>Promote conjunctive management of surface and groundwater resources, and contribute to achieving groundwater sustainability goals established pursuant to the Sustainable Groundwater Management Act or applicable local plans, as appropriate.</td>
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<td>(c)</td>
<td>Contribute to a comprehensive, integrated water management approach that considers multiple water supply sources including, but not limited to, stream flow, groundwater, imported water, stormwater, and recycled water, as applicable.</td>
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<td>WR R12f</td>
<td>Implement New or Expanded Groundwater Storage</td>
<td>(1) Funding, planning, and technical support provided by State and regional agencies for groundwater projects should:</td>
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<td>(a) Promote multiple benefits, minimize harmful effects to the ecosystem, help achieve Bay-Delta Plan objectives, as applicable, and be consistent with guidance from the State Water Resources Control Board and DWR for implementing the Sustainable Groundwater Management Act.</td>
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<td>(b) Promote increased groundwater recharge using locally available water, such as recharge via stream-aquifer interactions, floodwater or stormwater capture, recharge using recycled water, or others, provided such actions do not result in harmful impacts to functional flows in local streams.</td>
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<td>(c) Promote conjunctive management of surface water and groundwater resources, including in-lieu recharge.</td>
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<td>(d) Promote new or expanded groundwater banking and exchange projects.</td>
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<td>(e)</td>
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<td>Promote the construction of new or improved local conveyance infrastructure to convey water to and from groundwater recharge and recovery facilities.</td>
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<td>Promote the construction of new or improved conveyance infrastructure that interconnects Delta export conveyance facilities with local conveyance facilities.</td>
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<td>(g)</td>
<td>Promote implementation of the Central Valley Salt and Nitrate Management Plan and achievement of management goals and priorities for protection of water quality, where appropriate.</td>
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<td>(h)</td>
<td>(h)</td>
<td>Promote wellhead treatment, access to conjunctively-managed surface supplies, or other means of providing access to safe, clean, and affordable water supplies for communities relying on impaired groundwater.</td>
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<td>(i)</td>
<td>(i)</td>
<td>Demonstrate consistency with applicable Groundwater Sustainability Plans under the Sustainable Groundwater Management Act.</td>
</tr>
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<td>(j)</td>
<td>(j)</td>
<td>Include new infrastructure that is consistent with WR R12f (1)(a)-(c), above.</td>
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<tr>
<td>(k)</td>
<td>(k)</td>
<td>Assess the ecosystem and water supply impacts and benefits to the Delta, including providing mitigation, as appropriate.</td>
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<tr>
<td>(l)</td>
<td>(l)</td>
<td>Promote opportunities for storage of flood waters (e.g., floodplain storage) or stormwater that can be managed for groundwater recharge.</td>
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<td>(2)</td>
<td>(2)</td>
<td>DWR should develop a model ordinance for groundwater recharge that urges cities and counties to incorporate groundwater recharge and storage into land-use planning and zoning, and to protect areas with the highest potential for groundwater recharge from incompatible uses. (Note: A representative map showing the soil suitability index for groundwater banking projects on agricultural lands is shown in Figure 3-11.</td>
</tr>
<tr>
<td>(3)</td>
<td>(3)</td>
<td>DWR or the State Water Resources Control Board should prepare a proposal for an incentive program, in coordination with the Department of Conservation or the U.S. Department of Agriculture’s conservation programs, for landowners to protect lands with high groundwater recharge potential for the purpose of contributing to sustainable groundwater management.</td>
</tr>
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WR R12g

Promote Options for Operations of Storage and Conveyance Facilities

Subject to completion of environmental review and approval by the lead agency, the following options for the operation of conveyance and storage are hereby promoted:

(1) DWR, in coordination with Reclamation, should develop a Drought Water Operations Strategy for the SWP and CVP to meet State Water Resources Control Board-specified flow and water quality criteria during extended drought conditions lasting up to six years, or for the extended timeframe recommended by the Real Time Drought Operations Team (RTDOT) describing opportunities and tools to improve routine operations to adapt to drought conditions. In developing the Strategy, DWR and Reclamation should include criteria for defining appropriate levels or stages of drought affecting the SWP and CVP, in coordination with the RTDOT agencies and the North, Central, and South Delta Water Agencies. The Strategy should consider in-Delta actions and activities, and operations and storage of other facilities or projects that support achievement of the coequal goals. This strategy should be submitted to the Delta Stewardship Council by 2020 and be updated following future declarations of emergency associated with extreme hydrological conditions pursuant to the California Emergency Services Act (Government Code Sections 8550-8668).
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<td>within one year of completing an After-Action Report, or when physical or regulatory changes necessitate an update.</td>
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<td>(2)</td>
<td>DWR and Reclamation should use an adaptive management approach, consistent with the Delta Plan’s adaptive management framework and in alignment with existing collaborative adaptive management efforts, for the coordinated operation of SWP and CVP through-Delta conveyance to promote the coequal goals, including considerations for protecting, enhancing, and restoring the ecosystem and maintaining adequate flows, flow direction, water levels, and water quality for Delta agriculture, recreation, and communities.</td>
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<tr>
<td>(3)</td>
<td>Lead agencies for new or modified conveyance facilities, and new and expanded storage facilities—including those options identified in WR R12a and WR R12d should develop operational plans consistent with WR R12h, below.</td>
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<td>(4)</td>
<td>To improve water management flexibility and to support coordinated operations with new storage facilities, local agencies—in coordination with DWR and Reclamation, as appropriate—should pursue the following new or improved conveyance facilities outside of the Delta, to reduce reliance on the Delta and promote regional self-reliance:</td>
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<td>(a)</td>
<td>Facilities that promote the movement or exchange of SWP, CVP, and local water supplies, such as between the east and west sides of the San Joaquin Valley or between other regions.</td>
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<tr>
<td>(b)</td>
<td>Facilities that improve groundwater recharge and/or conjunctive use in overdrafted aquifers of the San Joaquin Valley, Tulare Lake Basin, and other Delta water export areas.</td>
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<tr>
<td>(c)</td>
<td>Facilities that increase groundwater banking or exchange, or that promote increased use of stormwater, recycled water, desalinated water, or other local water supplies in regions tributary to, or that rely on, Delta water supplies.</td>
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WR R12h Operate Delta Water Management Facilities Using Adaptive Management Principles

(1) Project proponents should develop plans for the operation or reoperation of water conveyance and control facilities in the Delta, or new or modified storage facilities in the Delta and its watershed, that incorporate adaptive management consistent with the Delta Plan’s adaptive management framework and further achievement of the coequal goals by:

(a) Including specific and measurable operating objectives (consistent with State Water Resources Control Board’s Bay-Delta Plan objectives), that address:
   i. Protection for and enhancements to the Delta ecosystem, including improved water temperature management, while reliably delivering water.
   ii. Avoidance or mitigation of adverse effects on in-Delta recreation and in-Delta water quality, including identifying salinity targets for the south Delta that are designed to prevent severe water quality degradation and toxic events in dry and critically dry years.
   iii. Avoidance or mitigation of adverse effects on stream flows and water quality.
   iv. Avoid or mitigate adverse effects on agriculture in the Delta, including identifying salinity targets suitable for the types of crops grown in the Delta.
v. Protection of the quality, reliability, and affordability of water supplies for communities relying on impaired water supplies, including disadvantaged communities, consistent with California Water Code section 106.3.

(b) Enabling diversions during periods when Delta water flow, quality, and environmental requirements are being met for improving water supply delivery reliability and flexibility to changing conditions, and for protecting, restoring, and enhancing the Delta ecosystem.

(c) Incorporating adaptive management plans, consistent with the Delta Plan’s adaptive management framework and developed in coordination with operators and applicable regulatory agency staff, for modifying operations to meet State Water Resources Control Board flow and water quality requirements, and California Department of Fish and Wildlife conservation and recovery goals, under the following:
   i. Extended drought conditions (more than three years in duration).
   ii. Changed climate conditions including sea level rise and changed hydrologic conditions over the anticipated project life.
   iii. Extreme wet years and flood events.

(d) Demonstrating that projects can contribute to a more reliable water supply, and can protect, restore, and enhance the Delta ecosystem under a range of future conditions, including changing climate and sea level rise projections from the California Natural Resources Agency or National Research Council, or other appropriate projections.

(e) Evaluating the applicability of forecast-informed reservoir operations.

(f) Considering coordination and integration of operations with existing and/or planned conveyance and water storage facilities to maximize their potential to contribute to the goals of the Sustainable Groundwater Management Act, and the goals of other applicable programs and plans related to sustainable groundwater, stormwater, and floodwater management.

(g) Reviewing and updating, as needed, the flood space reservation guidelines for upstream reservoirs in coordination with the U.S. Army Corps of Engineers and reservoir owners or operators.

(2) Project proponents should develop operation plans for new water conveyance facilities in the Delta, and new or expanded storage facilities in the Delta watershed, that:
   (a) Ensure that operations are adequately monitored, evaluated, and revised using adaptive management to make progress towards achieving defined performance measures.
   (b) Be based upon accurate, timely, and transparent water accounting and budgeting.
   (c) Ensure that operations provide water levels, water flow, and water quality suitable for in-Delta agricultural and recreational uses.
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| WR R12i                         | Update the Bay-Delta Plan and Consider Drought | (1) In developing and implementing updates to the Bay-Delta Plan, and flow requirements for priority tributaries to the Delta to protect beneficial uses in the Bay-Delta watershed, the State Water Resources Control Board should:  
(a) Consider and contribute to achievement of applicable Delta Plan performance measures.  
(b) Require water diverters in the Delta and its watershed that are responsible for meeting Bay-Delta Plan requirements, including but not limited to DWR and Reclamation, to develop a process and plan for meeting applicable flow and water quality requirements during extended drought conditions (characterized by multiple, successive dry years) to further the coequal goals and minimize reliance on temporary urgency change petitions and related requests. |
| WR R12j                         | Operate New or Improved Conveyance and Diversion Facilities Outside of the Delta | (1) Conveyance facilities outside the Delta should be operated in consideration of effects on Delta water quality, the timing and magnitude of flows in the Delta, water supplies available for export from the Delta, and effects on opportunities to protect, restore, and enhance the Delta ecosystem.  
(2) In allocating funding for new water conveyance and conveyance improvement projects outside the Delta that support regional self-reliance, the State should give preference to projects that:  
(a) Reduce reliance on the Delta for water supply during dry and critically dry years by the specific designation, in operational agreements or plans, of carryover storage for beneficial use during these periods.  
(b) Improve conjunctive management of surface and groundwater resources and contribute to achieving groundwater sustainability goals established pursuant to the Sustainable Groundwater Management Act or local plans, as appropriate.  
(c) Support ecosystem enhancement and/or provide more natural, functional flows in the Delta and its tributaries.  
(d) Improve the ability of regions that rely on the Delta, for all or a portion of their water supplies, to withstand and adapt to changing current and future hydrologic conditions.  
(e) Improve the quality, reliability, and affordability of water supplies for communities relying on impaired water supplies, including disadvantaged communities, consistent with California Water Code section 106.3.  
(f) Contribute to a comprehensive, integrated water management approach that considers multiple water supply sources including, but not limited to, stream flow, groundwater, imported water, stormwater, desalinated water, water saved through increased efficiency, and recycled water, as applicable.  
(g) Improve flexibility to accommodate water market transfer and exchange opportunities that benefit the environment. |
<p>| WR R12k                         | Promote Water Operations Monitoring Data Management, and Data Transparency | In meeting the requirements of the 2016 Open and Transparent Water Data Act, DWR should coordinate with the Council to incorporate information related to Delta Plan performance measures and links to the Council’s online tracking and reporting tools, as appropriate, in an effort to promote transparency and accessibility of data in tracking progress toward achieving the coequal goals. |</p>
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<tr>
<td>WR R13</td>
<td>Complete Surface Water Storage Studies</td>
<td>The California Department of Water Resources should complete surface water storage investigations of proposed off-stream surface storage projects by December 31, 2012, including an evaluation of potential additional benefits of integrating operations of new storage with proposed Delta conveyance improvements, and recommend the critical projects that need to be implemented to expand the state’s surface storage.</td>
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<tr>
<td>WR R14</td>
<td>Identify Near-term Opportunities for Storage, Use, and Water Transfer Projects</td>
<td>The California Department of Water Resources, in coordination with the California Water Commission, Bureau of Reclamation, State Water Resources Control Board, California Department of Public Health, the Delta Stewardship Council, and other agencies and stakeholders, should conduct a survey to identify projects throughout California that could be implemented within the next 5 to 10 years to expand existing surface and groundwater storage facilities, create new storage, improve operation of existing Delta conveyance facilities, and enhance opportunities for conjunctive use programs and water transfers in furtherance of the coequal goals. The California Water Commission should hold hearings and provide recommendations to the California Department of Water Resources on priority projects and funding.</td>
</tr>
<tr>
<td>WR R15</td>
<td>Improve Water Transfer Procedures</td>
<td>The California Department of Water Resources and the State Water Resources Control Board should work with stakeholders to identify and recommend measures to reduce procedural and administrative impediments to water transfers and protect water rights and environmental resources by December 31, 2016. These recommendations should include measures to address potential issues with recurring transfers of up to 1 year in duration and improved public notification for proposed water transfers.</td>
</tr>
<tr>
<td>WR P2 (23 CCR section 5004)</td>
<td>Transparency in Water Contracting</td>
<td>(a) The contracting process for water from the State Water Project and/or the Central Valley Project must be done in a publicly transparent manner consistent with applicable policies of the California Department of Water Resources and the Bureau of Reclamation referenced below.</td>
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<td>(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers the following:</td>
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<td>(1) With regard to water from the State Water Project, a proposed action to enter into or amend a water supply or water transfer contract subject to California Department of Water Resources Guidelines 03-09 and/or 03-10 (each dated July 3, 2003), which are attached as Appendix 2A; and</td>
</tr>
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<td>(2) With regard to water from the Central Valley Project, a proposed action to enter into or amend a water supply or water transfer contract subject to section 226 of P.L. 97-293, as amended or section 3405(a)(2)(B) of the Central Valley Project Improvement Act, Title XXXIV of Public Law 102-575, as amended, which are attached as Appendix 2B, and Rules and Regulations promulgated by the Secretary of the Interior to implement these laws.</td>
</tr>
<tr>
<td>WR R16</td>
<td>Supplemental Water Use Reporting</td>
<td>The State Water Resources Control Board should require water rights holders submitting supplemental statements of water diversion and use or progress reports under their permits or licenses to report on the development and implementation of all water efficiency and water supply projects and on their net (consumptive) use.</td>
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### EXECUTIVE SUMMARY

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<tr>
<td>WR R17</td>
<td>Integrated Statewide System for Water Use Reporting</td>
<td>The California Department of Water Resources, in coordination with the State Water Resources Control Board, California Department of Public Health, California Public Utilities Commission, California Energy Commission, Bureau of Reclamation, California Urban Water Conservation Council, and other stakeholders, should develop a coordinated statewide system for water use reporting. This system should incorporate recommendations for inclusion of data needed to better manage California’s water resources. The system should be designed to simplify reporting; reduce the number of required reports where possible; be made available to the public online; and be integrated with the reporting requirements for the urban water management plans, agricultural water management plans, and integrated regional water management plans. Water suppliers that export water from, transfer water through, or use water in the Delta watershed should be full participants in the data base.</td>
</tr>
<tr>
<td>WR R18</td>
<td>California Water Plan</td>
<td>The California Department of Water Resources, in consultation with the State Water Resources Control Board, and other agencies and stakeholders, should evaluate and include in the next and all future California Water Plan updates information needed to track water supply reliability performance measures identified in the Delta Plan, including an assessment of water efficiency and new water supply development, regional water balances, improvements in regional self-reliance, reduced regional reliance on the Delta, and reliability of Delta exports, and an overall assessment of progress in achieving the coequal goals.</td>
</tr>
<tr>
<td>WR R19</td>
<td>Financial Needs Assessment</td>
<td>As part of the California Water Plan Update, the California Department of Water Resources should prepare an assessment of the state’s water infrastructure. This should include the costs of rehabilitating/replacing existing infrastructure, an assessment of the costs of new infrastructure, and an assessment of needed resources for monitoring and adaptive management for these projects. The California Department of Water Resources should also consider a survey of agencies that may be planning small-scale projects (such as storage or conveyance) that improve water supply reliability.</td>
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### Chapter 4

| ER P1 (23 CCR section 5005)     | Delta Flow Objectives                                                 | (a) The State Water Resources Control Board’s Bay Delta Water Quality Control Plan flow objectives shall be used to determine consistency with the Delta Plan. If and when the flow objectives are revised by the State Water Resources Control Board, the revised flow objectives shall be used to determine consistency with the Delta Plan.                                                                                   |
|                                 |                                                                       | (b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, the policy set forth in subsection (a) covers a proposed action that could significantly affect flow in the Delta.                                                                                                                                  |
| ER R1                           | Update Delta Flow Objectives                                          | Development, implementation, and enforcement of new and updated flow objectives for the Delta and high-priority tributaries are key to the achievement of the coequal goals. The State Water Resources Control Board should update the Bay Delta Water Quality Control Plan objectives as follows:                                                                                                               |
|                                 |                                                                       | (a) By June 2, 2014, adopt and implement updated flow objectives for the Delta that are necessary to achieve the coequal goals.                                                                                                                                                                                                                   |
## EXECUTIVE SUMMARY

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<td>(b) By June 2, 2018, adopt, and as soon as reasonably possible, implement flow objectives for high-priority tributaries in the Delta watershed that are necessary to achieve the coequal goals. ¹</td>
</tr>
<tr>
<td>Flow objectives could be implemented through several mechanisms including negotiation and settlement, Federal Energy Regulatory Commission relicensing, or adjudicative proceeding. ²</td>
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<tr>
<td>Prior to the establishment of revised flow objectives identified above, the existing Bay Delta Water Quality Control Plan objectives shall be used to determine consistency with the Delta Plan. After the flow objectives are revised, the revised objectives shall be used to determine consistency with the Delta Plan.</td>
</tr>
<tr>
<td>(a) Habitat restoration must be carried out consistent with Appendix 3, which is Section II of the Draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (California Department of Fish and Wildlife 2011). The elevation map attached as Appendix 4 should be used as a guide for determining appropriate habitat restoration actions based on an area’s elevation. If a proposed habitat restoration action is not consistent with Appendix 4, the proposal shall provide rationale for the deviation based on best available science.</td>
</tr>
<tr>
<td>(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that includes habitat restoration.</td>
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<tr>
<td>(a) Within the priority habitat restoration areas depicted in Appendix 5, significant adverse impacts to the opportunity to restore habitat as described in section 5006, must be avoided or mitigated.</td>
</tr>
<tr>
<td>(b) Impacts referenced in subsection (a) will be deemed to be avoided or mitigated if the project is designed and implemented so that it will not preclude or otherwise interfere with the ability to restore habitat as described in section 5006.</td>
</tr>
<tr>
<td>(c) Impacts referenced in subsection (a) shall be mitigated to a point where the impacts have no significant effect on the opportunity to restore habitat as described in section 5006. Mitigation shall be determined, in consultation with the California Department of Fish and Wildlife, considering the size of the area impacted by the covered action and the type and value of habitat that could be restored on that area, taking into account existing and proposed restoration plans, landscape attributes, the elevation map shown in Appendix 4, and other relevant information about habitat restoration opportunities of the area.</td>
</tr>
<tr>
<td>(d) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions in the priority habitat restoration areas depicted in Appendix 5. It does not cover proposed actions outside those areas.</td>
</tr>
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¹ SWRCB staff should work with the Council and DFW to determine priority streams. As an illustrative example, priority streams could include the Merced River, Tuolumne River, Stanislaus River, Lower San Joaquin River, Deer Creek (tributary to Sacramento River), Lower Butte Creek, Mill Creek (tributary to Sacramento River), Cosumnes River, and American River. Implementation through hearings is expected to take longer than the deadline shown here.

² Implementation through adjudicative proceedings or FERC relicensing is expected to take longer than the deadline shown here.
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| ER P4 (23 CCR section 5008)    | Expand Floodplains and Riparian Habitats in Levee Projects | (a) Levee projects must evaluate and where feasible incorporate alternatives, including the use of setback levees, to increase floodplains and riparian habitats. Evaluation of setback levees in the Delta shall be required only in the following areas (shown in Appendix 8): (1) The Sacramento River between Freeport and Walnut Grove, the San Joaquin River from the Delta boundary to Mossdale, Paradise Cut, Steamboat Slough, Sutter Slough; and the North and South Forks of the Mokelumne River, and (2) Urban levee improvement projects in the cities of West Sacramento and Sacramento. 
(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to construct new levees or substantially rehabilitate or reconstruct existing levees. |
| ER R2                           | Prioritize and Implement Projects that Restore Delta Habitat | Bay Delta Conservation Plan implementers, California Department of Fish and Wildlife, California Department of Water Resources, and the Delta Conservancy should prioritize and implement habitat restoration projects in the areas shown on Figure 4-8. Habitat restoration projects should ensure connections between areas being restored and existing habitat areas and other elements of the landscape needed for the full life cycle of the species that will benefit from the restoration project. 
Where possible, restoration projects should also emphasize the potential for improving water quality. Restoration project proponents should consult the California Department of Public Health’s Best Management Practices for Mosquito Control in California.  
- **Yolo Bypass.** Enhance the ability of the Yolo Bypass to flood more frequently to provide more opportunities for migrating fish, especially Chinook salmon, to use this system as a migration corridor that is rich in cover and food.  
- **Cache Slough Complex.** Create broad nontidal, freshwater, emergent-plant-dominated wetlands that grade into tidal freshwater wetlands, and shallow subtidal and deep open-water habitats. Also, return a significant portion of the region to uplands with vernal pools and grasslands.  
- **Cosumnes River–Mokelumne River confluence.** Allow these unregulated and minimally regulated rivers to flood over their banks during winter and spring frequently and regularly to create seasonal floodplains and riparian habitats that grade into tidal marsh and shallow subtidal habitats.  
- **Lower San Joaquin River floodplain.** Reconnect the floodplain and restore more natural flows to stimulate food webs that support native species. Integrate habitat restoration with flood management actions, when feasible.  
- **Suisun Marsh.** Restore significant portions of Suisun Marsh to brackish marsh with land-water interactions to support productive, complex food webs to which native species are adapted and to provide space to adapt to rising sea level action. Use information from adaptive management processes during the Suisun Marsh Habitat Management, Preservation, and Restoration Plan’s implementation to guide future habitat restoration projects and to inform future tidal marsh management.  
- **Western Delta/Eastern Contra Costa County.** Restore tidal marsh and channel margin habitat at Dutch Slough and western islands to support food webs and provide habitat for native species. |
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<tr>
<td>ER R3</td>
<td>Complete and Implement Delta Conservancy Strategic Plan</td>
<td>As part of its Strategic Plan and subsequent Implementation Plan or annual work plans, the Delta Conservancy should:</td>
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<td> Develop and adopt criteria for prioritization and integration of large-scale ecosystem restoration in the Delta and Suisun Marsh, with sustainability and use of best available science as foundational principles.</td>
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<td> Develop and adopt processes for ownership and long-term operations and management of land in the Delta and Suisun Marsh acquired for conservation or restoration.</td>
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<td> Develop and adopt a formal mutual agreement with the California Department of Water Resources, California Department of Fish and Wildlife, federal interests, and other State and local agencies on implementation of ecosystem restoration in the Delta and Suisun Marsh.</td>
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<td> Develop, in conjunction with the Wildlife Conservation Board, the California Department of Water Resources, California Department of Fish and Wildlife, Bay Delta Conservation Plan implementers, and other State and local agencies, a plan and protocol for acquiring the land necessary to achieve ecosystem restoration consistent with the coequal goals and the Ecosystem Restoration Program Conservation Strategy.</td>
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<td> Lead an effort, working with State and federal fish agencies, to investigate how to better use habitat credit agreements to provide credit for each of these steps: (1) acquisition for future restoration; (2) preservation, management, and enhancement of existing habitat; (3) restoration of habitat; and (4) monitoring and evaluation of habitat restoration projects.</td>
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<td> Work with the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to develop rules for voluntary safe harbor agreements with property owners in the Delta whose actions contribute to the recovery of listed threatened or endangered species.</td>
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<tr>
<td>ER R4</td>
<td>Exempt Delta Levees from the U.S. Army Corps of Engineers’ Vegetation Policy</td>
<td>Considering the ecosystem value of remaining riparian and shaded riverine aquatic habitat along Delta levees, the U.S. Army Corps of Engineers should agree with the California Department of Fish and Wildlife and the California Department of Water Resources on a variance that exempts Delta levees from the U.S. Army Corps of Engineers’ levee vegetation policy where appropriate.</td>
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<tr>
<td>ER R5</td>
<td>Update the Suisun Marsh Protection Plan</td>
<td>The San Francisco Bay Conservation and Development Commission should update the Suisun Marsh Protection Plan and relevant components of the Suisun Marsh Local Protection Program to adapt to sea level rise and ensure consistency with the Suisun Marsh Preservation Act, the Delta Reform Act, and the Delta Plan.</td>
</tr>
<tr>
<td>ER P5 (23 CCR section 5009)</td>
<td>Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species</td>
<td>(a) The potential for new introductions of or improved habitat conditions for nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem.</td>
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<td>(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that has the reasonable probability of introducing or improving habitat conditions for nonnative invasive species.</td>
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</table>
**Policy or Recommendation Number** | **Short Title** | **Policy/Recommendation Language**
--- | --- | ---
**ER R6** | Regulate Angling for Nonnative Sport Fish to Protect Native Fish | The California Department of Fish and Wildlife should develop, for consideration by the Fish and Game Commission, proposals for new or revised fishing regulations designed to increase populations of listed fish species through reduced predation by introduced sport fish. The proposals should be based on sound science that demonstrates these management actions are likely to achieve their intended outcome and include the development of performance measures and a monitoring plan to support adaptive management.

**ER R7** | Prioritize and Implement Actions to Control Nonnative Invasive Species | The California Department of Fish and Wildlife and other appropriate agencies should prioritize and fully implement the list of “Stage 2 Actions for Nonnative Invasive Species” and accompanying text shown in Appendix J taken from the Conservation Strategy for Restoration of the Sacramento–San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011). Implementation of the Stage 2 actions should include the development of performance measures and monitoring plans to support adaptive management.

**ER R8** | Manage Hatcheries to Reduce Genetic Risk | As required by the National Marine Fisheries Service, all hatcheries providing listed fish for release into the wild should continue to develop and implement scientifically sound Hatchery and Genetic Management Plans (HGMPs) to reduce risks to those species. The California Department of Fish and Wildlife should provide annual updates to the Delta Stewardship Council on the status of HGMPs within its jurisdiction.

**ER R9** | Implement Marking and Tagging Program | By December 2014, the California Department of Fish and Wildlife, in cooperation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, should revise and begin implementing its program for marking and tagging hatchery salmon and steelhead to improve management of hatchery and wild stocks based on recommendations of the California Hatchery Scientific Review Group, which considered mass marking, reducing hatchery programs, and mark selective fisheries in developing its recommendations.

**Chapter 5**

**DP R1** | Designate the Delta as a National Heritage Area | The Delta Protection Commission should complete its application for designation of the Delta and Suisun Marsh as a National Heritage Area, and the federal government should complete the process in a timely manner.

**DP R2** | Designate State Route 160 as a National Scenic Byway | The California Department of Transportation should seek designation of State Route 160 as a National Scenic Byway, and prepare and implement a scenic byway plan for it.

**DP P1** (23 CCR section 5010) | Locate New Urban Development Wisely | (a) New residential, commercial, and industrial development must be limited to the following areas, as shown in Appendix 6 and Appendix 7:

1. Areas that city or county general plans as of May 16, 2013, designate for residential, commercial, and industrial development in cities or their spheres of influence;

2. Areas within Contra Costa County’s 2006 voter-approved urban limit line, except no new residential, commercial, and industrial development may occur on Bethel Island unless it is consistent with the Contra Costa County general plan effective as of May 16, 2013;

3. Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or
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| DP P2 (23 CCR section 5011)     | Respect Local Land Use When Siting Water or Flood Facilities or Restoring Habitats | (a) Water management facilities, ecosystem restoration, and flood management infrastructure must be sited to avoid or reduce conflicts with existing uses or those uses described or depicted in city and county general plans for their jurisdictions or spheres of influence when feasible, considering comments from local agencies and the Delta Protection Commission. Plans for ecosystem restoration must consider sites on existing public lands, when feasible and consistent with a project’s purpose, before privately owned sites are purchased. Measures to mitigate conflicts with adjacent uses may include, but are not limited to, buffers to prevent adverse effects on adjacent farmland.  
(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve the siting of water management facilities, ecosystem restoration, and flood management infrastructure. |
<p>| DP R3                           | Plan for the Vitality and Preservation of Legacy Communities                   | Local governments, in cooperation with the Delta Protection Commission and Delta Conservancy, should prepare plans for each community that emphasize its distinctive character, encourage historic preservation, identify opportunities to encourage tourism, serve surrounding lands, or develop other appropriate uses, and reduce flood risks.                                                                                                                                                                                                                       |
| DP R4                           | Buy Rights of Way from Willing Sellers When Feasible                           | Agencies acquiring land for water management facilities, ecosystem restoration, and flood management infrastructure should purchase from willing sellers, when feasible, including consideration of whether lands suitable for proposed projects are available at fair prices.                                                                                                                                                                                                                                      |
| DP R5                           | Provide Adequate Infrastructure                                               | The California Department of Transportation, local agencies, and utilities should plan infrastructure, such as roads and highways, to meet needs of development consistent with sustainable community strategies, local plans, the Delta Protection Commission’s Land Use and Resource Management Plan for the Primary Zone of the Delta, and the Delta Plan.                                                                                                                      |</p>
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<tr>
<td>DP R6</td>
<td>Plan for State Highways</td>
<td>The Delta Stewardship Council, as part of the prioritization of State levee investments called for in Water Code section 85306, should consult with the California Department of Transportation as provided in Water Code section 85307(c) to consider the effects of flood hazards and sea level rise on State highways in the Delta.</td>
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<tr>
<td>DP R7</td>
<td>Subsidence Reduction and Reversal</td>
<td>The following actions should be considered by the appropriate State agencies to address subsidence reversal:</td>
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<td>- State agencies should not renew or enter into agricultural leases on Delta or Suisun Marsh islands if the actions of the lessee promote or contribute to subsidence on the leased land, unless the lessee participates in subsidence reversal or reduction programs.</td>
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<td>- State agencies currently conducting subsidence reversal projects in the Delta on State-owned lands should investigate options for scaling up these projects if they have been deemed successful. The California Department of Water Resources should develop a plan, including funding needs, for increasing the extent of their subsidence reversal and carbon sequestration projects to 5,000 acres by January 1, 2017.</td>
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<td>- The Delta Stewardship Council, in conjunction with the California Air Resources Board (CARB) and the Delta Conservancy, should investigate the opportunity for the development of a carbon market whereby Delta farmers could receive credit for carbon sequestration by reducing subsidence and growing native marsh and wetland plants. This investigation should include the potential for developing offset protocols applicable to these types of plants for subsequent adoption by the CARB.</td>
</tr>
<tr>
<td>DP R8</td>
<td>Promote Value-added Crop Processing</td>
<td>Local governments and economic development organizations, in cooperation with the Delta Protection Commission and the Delta Conservancy, should encourage value-added processing of Delta crops in appropriate locations.</td>
</tr>
<tr>
<td>DP R9</td>
<td>Encourage Agritourism</td>
<td>Local governments and economic development organizations, in cooperation with the Delta Protection Commission and the Delta Conservancy, should support growth in agritourism, particularly in and around legacy communities. Local plans should support agritourism where appropriate.</td>
</tr>
<tr>
<td>DP R10</td>
<td>Encourage Wildlife-friendly Farming</td>
<td>The California Department of Fish and Wildlife, the Delta Conservancy, and other ecosystem restoration agencies should encourage habitat enhancement and wildlife-friendly farming systems on agricultural lands to benefit both the environment and agriculture.</td>
</tr>
<tr>
<td>DP R11</td>
<td>Provide New and Protect Existing Recreation Opportunities</td>
<td>Water management and ecosystem restoration agencies should provide recreation opportunities, including visitor-serving business opportunities, at new facilities and habitat areas whenever feasible; and existing recreation facilities should be protected, using California State Parks’ Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh and Delta Protection Commission’s Economic Sustainability Plan for the Sacramento-San Joaquin Delta as guides.</td>
</tr>
<tr>
<td>DP R12</td>
<td>Encourage Partnerships to Support Recreation and Tourism</td>
<td>The Delta Protection Commission and Delta Conservancy should encourage partnerships between other State and local agencies, and local landowners and business people to expand recreation, including boating, promote tourism, and minimize adverse impacts to nonrecreational landowners.</td>
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### EXECUTIVE SUMMARY

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<tr>
<td>DP R13</td>
<td>Expand State Recreation Areas</td>
<td>California State Parks should add or improve recreation facilities in the Delta in cooperation with other agencies. As funds become available, it should fully reopen Brannan Island State Recreation Area, complete the park at Delta Meadows-Locke Boarding House, and consider adding new State parks at Barker Slough, Elkhorn Basin, the Wright-Elmwood Tract, and south Delta.</td>
</tr>
<tr>
<td>DP R14</td>
<td>Enhance Nature-based Recreation</td>
<td>The California Department of Fish and Wildlife, in cooperation with other public agencies, should collaborate with nonprofits, private landowners, and business partners to expand wildlife viewing, angling, and hunting opportunities.</td>
</tr>
<tr>
<td>DP R15</td>
<td>Promote Boating Safety</td>
<td>The California Department of Boating and Waterways should coordinate with the U.S. Coast Guard and State and local agencies on an updated marine patrol strategy for the region.</td>
</tr>
<tr>
<td>DP R16</td>
<td>Encourage Recreation on Public Lands</td>
<td>Public agencies owning land should increase opportunities, where feasible, for bank fishing, hunting, levee-top trails, and environmental education.</td>
</tr>
<tr>
<td>DP R17</td>
<td>Enhance Opportunities for Visitor-serving Businesses</td>
<td>Cities, counties, and other local and State agencies should work together to protect and enhance visitor-serving businesses by planning for recreation uses and facilities in the Delta, providing infrastructure to support recreation and tourism, and identifying settings for private visitor-serving development and services.</td>
</tr>
<tr>
<td>DP R18</td>
<td>Support the Ports of Stockton and West Sacramento</td>
<td>The ports of Stockton and West Sacramento should encourage maintenance and carefully designed and sited development of port facilities.</td>
</tr>
<tr>
<td>DP R19</td>
<td>Plan for Delta Energy Facilities</td>
<td>The California Energy Commission and California Public Utilities Commission should cooperate with the Delta Stewardship Council as described in Water Code section 85307(d) to identify actions that should be incorporated in the Delta Plan by 2017 to address the needs of Delta energy development, storage, and distribution.</td>
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### Chapter 6

| WQ R1                          | Protect Beneficial Uses                  | Water quality in the Delta should be maintained at a level that supports, enhances, and protects beneficial uses identified in the applicable State Water Resources Control Board or regional water quality control board water quality control plans. |
| WQ R2                          | Identify Covered Action Impacts           | Covered actions should identify any significant impacts to water quality.                                                                                                                                                                                                                                                                                      |
| WQ R3                          | Special Water Quality Protections for the Delta | The State Water Resources Control Board or regional water quality control board should evaluate and, if appropriate, propose special water quality protections for priority habitat restoration areas identified in recommendation ER R2 or other areas of the Delta where new or increased discharges of pollutants could adversely impact beneficial uses. |
| WQ R4                          | Complete Central Valley Drinking Water Policy | The Central Valley Regional Water Quality Control Board should complete the Central Valley Drinking Water Policy by July 2013.                                                                                                                                                                                                                           |
| WQ R5                          | Complete North Bay Aqueduct Alternative Intake Project | The California Department of Water Resources should complete the North Bay Aqueduct Alternate Intake Project Environmental Impact Report by December 31, 2012, and begin construction as soon as possible thereafter.                                                                                                               |
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<tr>
<td>WQ R6</td>
<td>Protect Groundwater Beneficial Uses</td>
<td>The State Water Resources Control Board should complete development of a Strategic Workplan for protection of groundwater beneficial uses, including groundwater use for drinking water, by December 31, 2012.</td>
</tr>
<tr>
<td>WQ R7</td>
<td>Participation in CV-SALTS</td>
<td>The State Water Resources Control Board and Central Valley Regional Water Quality Control Board should consider requiring participation by all relevant water users that are supplied water from the Delta or the Delta watershed or discharge wastewater to the Delta or the Delta watershed to participate in the Central Valley Salinity Alternatives for Long-Term Sustainability Program.</td>
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</table>
| WQ R8                          | Completion of Regulatory Processes, Research, and Monitoring for Water Quality Improvement | The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards are currently engaged in regulatory processes, research, and monitoring essential to improving water quality in the Delta. In order to achieve the coequal goals, it is essential that these ongoing efforts be completed and, if possible, accelerated, and that the Legislature and Governor devote sufficient funding to make this possible. The Delta Stewardship Council specifically recommends that:

- The State Water Resources Control Board should complete development of the proposed policy for nutrients for inland surface waters of the State of California by January 1, 2014.

- The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards should prepare and begin implementation of a study plan for the development of objectives for nutrients in the Delta and Suisun Marsh by January 1, 2014. Studies needed for development of Delta and Suisun Marsh nutrient objectives should be completed by January 1, 2016. The water boards should adopt and begin implementation of nutrient objectives, either narrative or numeric, where appropriate, for the Delta and Suisun Marsh by January 1, 2018.

- The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should complete the Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for diazinon and chlorpyrifos by January 1, 2013.

- The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should prioritize and accelerate the completion of the Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for pyrethroids by January 1, 2016.

- The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards have completed Total Maximum Load and Basin Plan Amendments for methylmercury, and efforts to support their implementation should be coordinated. Parties identified as responsible for current methylmercury loads or proponents of projects that may increase methylmercury loading in the Delta or Suisun Marsh should participate in control studies or implement site-specific study plans that evaluate practices to minimize methylmercury discharges. The Central Valley Regional Water Quality Control Board should review these control studies by December 31, 2018, and determine control measures for implementation starting in 2020.  |
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<tr>
<td>WQ R9</td>
<td>Implement Delta Regional Monitoring Program</td>
<td>The State Water Resources Control Board and Regional Water Quality Control Boards should work collaboratively with the California Department of Water Resources, California Department of Fish and Wildlife, and other agencies and entities that monitor water quality in the Delta to develop and implement a Delta Regional Monitoring Program that will be responsible for coordinating monitoring efforts so Delta conditions can be efficiently assessed and reported on a regular basis.</td>
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<tr>
<td>WQ R10</td>
<td>Evaluate Wastewater Recycling, Reuse, or Treatment</td>
<td>The Central Valley Regional Water Quality Control Board, consistent with existing water quality control plan policies and water rights law, should require responsible entities that discharge wastewater treatment plant effluent or urban runoff to Delta waters to evaluate whether all or a portion of the discharge can be recycled, otherwise used, or treated in order to reduce contaminant loads to the Delta by January 1, 2014.</td>
</tr>
<tr>
<td>WQ R11</td>
<td>Manage Dissolved Oxygen in Stockton Ship Channel</td>
<td>The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should complete Phase 2 of the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in the Stockton Deep Water Ship Channel by January 1, 2015.</td>
</tr>
<tr>
<td>WQ R12</td>
<td>Manage Dissolved Oxygen in Suisun Marsh</td>
<td>The State Water Resources Control Board and the San Francisco Bay Regional Water Quality Control Board should complete the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in Suisun Marsh wetlands by January 1, 2014.</td>
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Chapter 7

RR R1  Implement Emergency Preparedness and Response

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

- Responsible local, State, and federal agencies with emergency response authority should consider and implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5). Such actions should support the development of a regional response system for the Delta.

- In consultation with local agencies, the California Department of Water Resources should expand its emergency stockpiles to make them regional in nature and usable by a larger number of agencies in accordance with California Department of Water Resources’ plans and procedures. The California Department of Water Resources, as a part of this plan, should evaluate the potential of creating stored material sites by “over-reinforcing” west Delta levees.

- Local levee-maintaining agencies should consider developing their own emergency action plans, and stockpiling rock and flood-fighting materials.

- State and local agencies and regulated utilities that own and/or operate infrastructure in the Delta should prepare coordinated emergency response plans to protect the infrastructure from long-term outages resulting from failures of the Delta levees. The emergency procedures should consider methods that also would protect Delta land use and ecosystem.
### EXECUTIVE SUMMARY

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<tr>
<td>RR R2</td>
<td>Finance Local Flood Management Activities</td>
<td>The Legislature should create a Delta Flood Risk Management Assessment District with fee assessment authority (including over State infrastructure) to provide adequate flood control protection and emergency response for the regional benefit of all beneficiaries, including landowners, infrastructure owners, and other entities that benefit from the maintenance and improvement of Delta levees, such as water users who rely on the levees to protect water quality.</td>
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This district should be authorized to:

- Identify and assess all beneficiaries of Delta flood protection facilities.
- Develop, fund, and implement a regional plan of flood management for both project and nonproject levees of the Delta, including the maintenance and improvement of levees, in cooperation with the existing reclamation districts, cities, counties, and owners of infrastructure and other interests protected by the levees.
- Require local levee-maintaining agencies to conduct annual levee inspections per the California Department of Water Resources subventions program guidelines, and update levee improvement plans every 5 years.
- Participate in the collection of data and information necessary for the prioritization of State investments in Delta levees consistent with RR P1.
- Notify residents and landowners of flood risk, personal safety information, and available systems for obtaining emergency information before and during a disaster on an annual basis.
- Potentially implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5) in conjunction with local, State, and federal agencies, and maintain the resulting regional response system and components and procedures on behalf of SEMS jurisdictions (reclamation district, city, county, and State) that would jointly implement the regional system in response to a disaster event.
- Identify and assess critical water supply corridor levee operations, maintenance, and improvements.
EXECUTIVE SUMMARY

POLICY OR RECOMMENDATION NUMBER | SHORT TITLE | POLICY/RECOMMENDATION LANGUAGE
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RR R3 | Fund Actions to Protect Infrastructure from Flooding and Other Natural Disasters | - The California Public Utilities Commission should immediately commence formal hearings to impose a reasonable fee for flood and disaster prevention on regulated privately owned utilities with facilities located in the Delta. Publicly owned utilities should also be encouraged to develop similar fees. The California Public Utilities Commission, in consultation with the Delta Stewardship Council, the California Department of Water Resources, and the Delta Protection Commission, should allocate these funds among State and local emergency response and flood protection entities in the Delta. If a new regional flood management agency is established by law, a portion of the local share would be allocated to that agency.

- The California Public Utilities Commission should direct all regulated public utilities in their jurisdiction to immediately take steps to protect their facilities in the Delta from the consequences of a catastrophic failure of levees in the Delta, to minimize the impact on the State’s economy.

- The Governor, by Executive Order, should direct State agencies with projects or infrastructure in the Delta to set aside a reasonable amount of funding to pay for flood protection and disaster prevention. The local share of these funds should be allocated as described above.

RR P1 (23 CCR section 5012) | Prioritization of State Investments in Delta Levees and Risk Reduction | A. **Fund levee maintenance.** Funding for maintenance of levees shall continue to be available throughout the Delta where authorized by Water Code section 12980 et. seq.

**B Prioritize levee improvements.** The priorities listed below (see Delta Plan, Chapter 7 map and table of Delta Levees Investment Priorities) shall guide State discretionary investments in the improvement and major rehabilitation of Delta levees. As DWR selects levee improvement projects for funding through its levee funding programs, it should fund projects at the very high priority islands or tracts, subject to its consideration of the benefits, costs, engineering considerations, and other factors, before approving projects at high priority or other priority tracts. If available funds are sufficient to fully fund levee improvements at the very high priority tracts, then funds for improvements or major rehabilitation of levees on high priority islands and tracts may be provided, and after those projects have been fully funded, then projects at other priority islands and tracts may be funded.

The Department of Water Resources shall certify projects’ consistency with this regulatory policy when its funding decisions are made and shall report annually to the Council about its decisions to award State funds for Delta levee improvements, including the location of each funded improvement, the priority of the affected islands or tracts, the improvements funded, including the relevant levee improvement type, habitat mitigation or enhancement features, estimated reduction in levee fragility, expected reduction in annual fatalities and damages, State funds awarded, and local or federal matching funds.

**Delta Levee Investment Strategy (DLIS) Priorities**

When DWR’s contributions towards levee improvements vary from these priorities, it shall identify how the funding is inconsistent with this guidance, describe why variation from the priorities is necessary, and explain how the funding nevertheless protects lives, property, and the State’s interests in water supply reliability and restoration, protection, and enhancement of the Delta ecosystem.
## EXECUTIVE SUMMARY

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<td>RR R4</td>
<td>Actions for the Prioritization of State Investments in Delta Levees</td>
<td>while considering the Delta’s unique agricultural, natural, historic, and cultural values. That determination is subject to review by the Delta Stewardship Council on appeal. (a) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves discretionary State investments in the improvement and major rehabilitation of Delta levees. Nothing in this policy establishes or otherwise changes existing levee standards. The Delta Stewardship Council, in consultation with the California Department of Water Resources, the Central Valley Flood Protection Board, the Delta Protection Commission, local agencies, and the California Water Commission, should develop funding priorities for State investments in Delta levees by January 1, 2015. These priorities shall be consistent with the provisions of the Delta Reform Act in promoting effective, prioritized strategic State investments in levee operations, maintenance, and improvements in the Delta for both levees that are a part of the State Plan of Flood Control and nonproject levees. Upon completion, these priorities shall be considered for incorporation into the Delta Plan. The priorities should identify guiding principles, constraints, recommended cost share allocations, and strategic considerations to guide Delta flood risk reduction investments, supported by, at a minimum, the following actions to be conducted by the California Department of Water Resources, consistent with available funding: - An assessment of existing Delta levee conditions. This should include the development of a Delta levee conditions map based on sound data inputs, including, but not limited to:  - Geometric levee assessment  - Flow and updated stage-frequency analysis - An island-by-island economics-based risk analysis. This analysis should consider, but not be limited to, values related to protecting:  - Island residents/life safety  - Property  - Value of Delta islands’ economic output, including agriculture  - State water supply  - Critical local, State, federal, and private infrastructure, including aqueducts, state highways, electricity transmission lines, gas/petroleum pipelines, gas fields, railroads, and deep water shipping channels  - Delta water quality  - Existing ecosystem values and ecosystem restoration opportunities  - Recreation  - Systemwide integrity - An ongoing assessment of Delta levee conditions. This should include a process for updating Delta levee assessment information on a routine basis. This methodology should provide the basis for the prioritization of State investments in Delta levees. It should include, but not be limited to, the public reporting of the following items:</td>
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| RR P2 (23 CCR section 5013)   | Require Flood Protection for Residential Development in Rural Areas | (a) New residential development of five or more parcels shall be protected through floodproofing to a level 12 inches above the 100-year base flood elevation, plus sufficient additional elevation to protect against a 55-inch rise in sea level at the Golden Gate, unless the development is located within:
1. Areas that city or county general plans, as of May 16, 2013, designate for development in cities or their spheres of influence;
2. Areas within Contra Costa County’s 2006 voter-approved urban limit line, except Bethel Island;
3. Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or
4. The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove, as shown in Appendix 7.
(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves new residential development of five or more parcels that is not located within the areas described in subsection (a). |
| RR P3 (23 CCR section 5014)   | Protect Floodways | (a) No encroachment shall be allowed or constructed in a floodway, unless it can be demonstrated by appropriate analysis that the encroachment will not unduly impede the free flow of water in the floodway or jeopardize public safety.
(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in a floodway that is not either a designated floodway or regulated stream. |
| RR P4 (23 CCR section 5015)   | Floodplain Protection | (a) No encroachment shall be allowed or constructed in any of the following floodplains unless it can be demonstrated by appropriate analysis that the encroachment will not have a significant adverse impact on floodplain values and functions:
1. The Yolo Bypass within the Delta;
2. 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 California Department of Water Resources or the U.S. Army Corps of Engineers (California Department of Water Resources 2010); and
3. 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 California Department of Water Resources by the partnership of the South Delta Water Agency, the River Islands Development Company, Reclamation District 2062, San Joaquin Resource Conservation District, American Rivers, the American Lands Conservancy, and the Natural |
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<td>RR R5</td>
<td>Fund and Implement San Joaquin River Flood Bypass</td>
<td>Resources Defense Council, March 2011. This area may be modified in the future through the completion of this project. (b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in any of the floodplain areas described in subsection (a). (c) This policy is not intended to exempt any activities in any of the areas described in subsection (a) from applicable regulations and requirements of the Central Valley Flood Protection Board.</td>
</tr>
<tr>
<td>RR R6</td>
<td>Continue Delta Dredging Studies</td>
<td>The Legislature should fund the California 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).</td>
</tr>
<tr>
<td>RR R7</td>
<td>Designate Additional Floodways</td>
<td>The Central Valley Flood Protection Board should evaluate whether additional areas both within and upstream of the Delta should be designated as floodways. These efforts should consider the anticipated effects of climate change in its evaluation of these areas.</td>
</tr>
<tr>
<td>RR R8</td>
<td>Develop Setback Levee Criteria</td>
<td>The California Department of Water Resources, in conjunction with the Central Valley Flood Protection Board, the California Department of Fish and Wildlife, and the Delta Conservancy, should develop criteria to define locations for future setback levees in the Delta and Delta watershed.</td>
</tr>
<tr>
<td>RR R9</td>
<td>Require Flood Insurance</td>
<td>The Legislature should require an adequate level of flood insurance for residences, businesses, and industries in floodprone areas.</td>
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<tr>
<td>RR R10</td>
<td>Limit State Liability</td>
<td>The Legislature should consider statutory and/or constitutional changes that would address the State’s potential flood liability, including giving State agencies the same level of immunity with regard to flood liability as federal agencies have under federal law.</td>
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<td>Chapter 8</td>
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<tr>
<td>FP R1</td>
<td>Conduct Current Spending Inventory</td>
<td>An inventory of current State and federal spending on programs and projects that do or may achieve the coequal goals will be conducted. Data sources to be used include the CALFED cross-cut budget, State bond balance reports, and the annual State budget, among others. Consideration will be given to selecting an independent agency (which could include a non-governmental organization) to conduct the inventory.</td>
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<tr>
<td>FP R2</td>
<td>Develop Delta Plan Cost Assessment</td>
<td>Costs will be assigned to the projects and programs proposed in the Delta Plan (Chapters 2 through 7) and sources of funding will be identified.</td>
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<tr>
<td>FP R3</td>
<td>Identify Funding Gaps</td>
<td>Current State and federal funding gaps will be identified that are determined to hinder progress toward meeting the coequal goals.</td>
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CHAPTER 1

Introduction
ABOUT THIS CHAPTER

This chapter offers historical and current contextual information about the uses and conflicts that besiege the Sacramento-San Joaquin Delta (Delta). The reader will come to understand how and why the West Coast’s largest estuary has evolved from a huge tidal marsh to the maze of islands and channels it is today—shaped over more than a century and a half by the effects of hydraulic mining, flood control, agricultural and urban development, and its placement as the “hub” of California’s major water systems.

The chapter then delves into the realities of decades of stand-offs among the key interests in the Delta and resulting years of relative inaction, leading finally to the bipartisan movement that created the Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act or Act) and its mandate to develop a long-term sustainable management plan for the Delta. The chapter concludes with an overarching explanation of how this Delta Plan (or Plan) will bring about a fundamental and positive sustainability and reformation of this immense natural resource.
CHAPTER 1

Introduction

Throughout the past 160 years, the delta formed by California’s two largest rivers, the Sacramento and the San Joaquin, has been a gateway to many of the state’s collective hopes and dreams. Once the pathway to the Gold Country, it is today a critical component of the state’s water supply infrastructure, a source of sustenance for farmers and fishermen, and home to half a million people and a vast array of fish, birds, and wildlife.

The Sacramento-San Joaquin Delta and Suisun Marsh are referred to throughout this Plan collectively as “the Delta,” unless otherwise specified (see Figure 1-1). Once a great marsh, the Delta now is a network of channels and sunken “islands” that cover—together with Suisun Marsh—about 1,300 square miles. Laid over those islands and channels is the infrastructure of a twenty-first century economy: water supply conduits; major arteries of the state’s electrical grid; natural gas fields, storage facilities, and pipelines; highways and railways; and shipping channels, all surrounded by an increasingly urban landscape. Water from the vast Delta watershed, spanning over 45,000 square miles (30 million acres), fuels both local economies and those in export areas hundreds of miles away (see Figure 1-2).

Today the Delta is many things to many people, and is universally regarded in “crisis” because people have not yet been able to find balance in the tradeoffs among competing demands for the Delta’s resources. Tradeoffs and integration define the Delta dilemma: water conveyance facilities that built strong urban and agricultural economies threaten ecosystem health. Water that is beneficial for fish is alive with plankton and organic material, but sources of drinking water are best in as pure a form as possible. The pollutants of upstream urban and agricultural uses cause problems for downstream fish and water diverters alike. The same ocean-going ships that opened the Central Valley to world trade also introduced nonnative species that alter the Delta ecosystem. High water flows that historically improved habitat and a diverse food web come with the threat of lost homes, flooded farmland, and disaster for Delta residents and the California economy.

Conceived decades ago, a series of water projects has engineered the Delta estuary over time to perform as a water conveyance system, moving water stored upstream to users throughout the state who hold State of California (State) or federal water contracts. This system relies on dredged channels, which at times run counter to natural flow directions as the result of export pumping that occurs in the south Delta. For a number of years, and currently at the publishing time of this Plan, State and federal agencies are exploring options to reconfigure the manner in which the Delta is used to convey water in a way that lessens ecosystem impacts and improves water supply reliability. At this time, the Delta Plan does not make recommendations regarding Delta conveyance (see Appendix A).

As a result of imperfect tradeoffs, key species are endangered or threatened, the amount of water that can be exported from the Delta is determined not just by the state’s variable precipitation and storage but also by court order to protect endangered species, and geologists and engineers continue to worry that the Delta itself is one of the greatest flood risks in the West.

1 The Sacramento-San Joaquin Delta is defined in Water Code section 12220, and Suisun Marsh means the area defined in Public Resources Code section 29101 and protected by Division 19 (commencing with section 29000).
The evolution of the Delta has come in fits and starts, driven by individual initiative, governmental incentive, and crisis. John Hart, writing for *Bay-Nature*, puts it this way:

*The History of the modern Delta belies the image of the region as a static landscape. Reclamation was a battle with many setbacks, almost given up for lost in the 1870s. In the 1880s the ‘crisis’ was the clogging of channels by hydraulic mining debris. In the 1920s, salinity was on the march. A brief calm at midcentury gave way to the ever-spiraling tension over water exports and ecosystem decline. The Delta seems always to have been in crisis, under intensive study, and at the intersection of hostile interests.*

Governmental institutions have reacted to each crisis predictably, often treating individual problems rather than taking a systemwide approach. Over the years, dozens of agencies, task forces, and working groups have been created in a series of sometimes overlapping efforts to find the right combination of leadership and collaboration—incentives and regulation—to provide clean, reliable water; protect our environment; and reduce the risk of flooding.

After decades of conflict and unsuccessful efforts to comprehensively address the many problems and challenges of the Delta, the California Legislature (or Legislature), water agencies, and environmental groups throughout the state united in an unprecedented manner in 2009 to pass a series of water-related measures, including the Delta Reform Act.

The Delta Reform Act created the Delta Stewardship Council (Council) with a primary responsibility to develop and implement a legally enforceable, long-term management plan for the Delta. The Legislature required the Delta Plan to advance the coequal goals of protecting and enhancing the Delta ecosystem and providing for a more reliable water supply for California, and to do so in a manner that protects and enhances the Delta as an evolving place.

This Delta Plan is intended to be a foundational document that prioritizes actions and strategies in support of key objectives such as the State’s requirement to reduce reliance on the Delta to meet future water supply needs. It also restricts actions that may cause harm; serves as a guidebook for all plans, projects, and programs that affect the Delta; and calls for further investigation and focused study of specific issues.

Successful implementation of the Delta Plan depends not only on the Council, but also on coordinated actions by other government agencies—federal, State, and local—and by the stakeholders to whom these agencies are responsible. To be effective, decision making in a dynamic context such as the Delta must be flexible and have the capacity to change policies and practices in response to what is learned over time. Through this Delta Plan, the Council details an inter-agency structure for decision making that fosters communication among scientists; local, State, and federal decision makers; and stakeholders. Future Plan iterations will build on successes as well as lessons learned in order to achieve the coequal goals.

### The Delta and California’s Water Supply

The story of California’s annual water supply is one of great variability in amount, timing, and distribution, and of the human desire to impose certainty and order. Rain and snowfall mostly in the northern and eastern portions of the state, but most Californians live along the coast and in the south. Most of the state’s precipitation occurs in only 5 to 15 days, and that rain and snowfall result in an annual supply that is ample in average years, too little in dry ones, and too much in wet years (see Figure 1-3).
The Sacramento-San Joaquin Delta and Suisun Marsh

Figure 1-1
Source: DWR 2011a
The Delta Watershed and Areas Receiving Delta Water

Figure 1-2
To meet water demand, Californians over the past 160 years have built a vast array of reservoirs, canals, pipelines, and tunnels, all in an effort to capture water when it was available, store it for when it was not, and to move it to the people when and where they wanted it.

As residents in both Northern and Southern California feared they would outgrow their local supplies, they turned to the vast Delta watershed for relief. The river systems flowing into the Delta drain about 40 percent of the land in California and carry about half of the state’s total annual runoff.

And so, at the turn of the twentieth century, San Francisco tapped the Tuolumne River, diverting water through an aqueduct that bypasses the San Joaquin River and Delta. Shortly thereafter, Oakland and the eastern San Francisco Bay Area tapped the Mokelumne River, diverting water through a pipeline across the Delta. Later, construction of the federal Central Valley Project (CVP) and the State Water Project (SWP) resulted in additional diversions directly from the Delta for the Bay Area, Central Valley, and Southern California.

California’s Variable Precipitation

Figure 1-3  The unpredictability of the state’s rainfall and its history of multiyear droughts make the management of water to reliably meet environmental and human uses extremely challenging. Yearly precipitation was calculated from the average of 95 stations located across California. Data were collected by Jim Goodridge, former State climatologist.

Source: Western Regional Climate Center 2011
Today, some two-thirds of the state’s population (approximately 27 million people) depend on water from the Delta watershed for some portion of their water supply, as do more than 3 million acres of irrigated farmland that grow crops for in-state, national, and international distribution. That said, water exported through the Delta represents approximately 8 percent of the state’s annual average water supply. Local and regional water resources, including surface diversions, groundwater, local and out-of-state imports, and water reuse, meet the remaining 84 percent.

Who uses all that water, how it is used, how much returns to the rivers and streams for downstream users, and in what quality, is less than certain on a statewide basis. Data for actual water use and water quality suffer from significant gaps, which may affect the ability of California’s water managers to make timely and better-informed decisions. Since 1914, the State Water Resources Control Board (SWRCB) has issued permits to post-1914 appropriative-right water diverters in the Delta, but actual annual diversion amounts are not thoroughly measured or reported. Owners and operators of nearly one-third of irrigated lands in the Delta watershed do not participate in programs to meet water quality standards, and their compliance with State law is unclear.

Although groundwater and surface water are often interconnected, the SWRCB has limited authority to regulate groundwater. Groundwater is sustainably managed in some areas of the state through either adjudication or special districts, but other areas suffer from unsustainable overdraft and require improved management efforts. Attempts to correct this overdraft often put more pressure on water supplies from the Delta, demonstrating once again the interconnectedness of California’s water systems.

**The Delta and Its Ecosystem**

Although much of the debate over the Delta has centered on events in the last 50 years, the roots of its problems run much deeper. A Delta that for millennia had been a land and waterscape of dynamic floodplain and tidal marshland, rich in flora and fauna, was changed forever by passage of the federal Swamp Land Act of 1850 and similar State legislation in 1861, which provided incentives for the “reclamation” of “nuisance” swampland to reduce threats of vector-borne disease and to gain productive land for farming. Within the Delta, seasonally and tidally flooded land impeding agricultural development led to land reclamation and channelization, and subsequent habitat loss. More than a century ago, with little or no engineering analyses and limited construction tools, Delta residents began to build an intricate levee system to channel water and dry out land, which converted hundreds of thousands of acres of seasonally and tidally flooded wetlands into fertile agricultural fields. As a result of continued land use change and urbanization, 95 percent of the historical tidal marsh in the Delta has been lost. Further detail regarding the historical Delta landscape is provided in Chapter 4.

Hydraulic gold mining, which reached its peak in the 1860s, sent tons of mercury-laden debris down toward the Delta, clogging channels and streams, and leading to devastating floods. Corrective actions—dredging and new levee construction—resulted in the loss of 90 percent of the Central Valley’s riparian habitat (Katibah 1984). This massive-scale destruction has had lasting consequences for ecosystem
health and, in turn, declining ecosystem health has had direct consequences for water supply operations.

The Hetch Hetchy and Mokelumne aqueducts diverted water (as they do currently) before it reached the Delta, and water use upstream increased considerably during the mid- and late 1900s. Construction of the CVP and SWP in the 1940s and 1960s, respectively, introduced new pressures on the Delta. Indeed, it is unusual to use an estuary—normally where fresh and salt water mix according to variable tidal and tributary flows—as a conveyance system for large amounts of fresh water to meet seasonal user demands.

The resulting configuration today causes river channels at times to run backward; and some fish, lacking clear migration corridors and/or migration cues, end up in dead-end channels or, worse yet, “salvaged” at the export pumps. Conflict between these competing uses was soon apparent and continues to plague water policy today.

Fish species have changed over time in response to changing habitat and flows, and from introductions both planned and accidental. Among the first introductions, in 1879, were two eastern game fish—striped bass and American shad. Today, striped bass, which are voracious predators, both support a major sport fishery and are blamed by some for the decline of smelt and salmon. Among the accidental tourists who came to stay are Asian clams, voracious eaters who can deplete the water of nutrients for native species. Of the more than 50 species of fish in the Delta today, more than half, including the most successful, are nonnative.

In addition, growing agricultural production in the Central Valley has resulted in increased runoff of pesticides and fertilizer flowing to the Delta. Runoff and wastewater discharges from increasing upstream urbanization have altered Delta water quality and, thus, its ecosystem. Increased commercial and recreational boat traffic in the Delta, as well as other causes, have introduced many nonnative species that have altered the Delta ecosystem.

The Delta as a Unique and Evolving Place

The Delta is a unique place distinguished by geography, legacy communities, a rural and agricultural setting, vibrant natural resources, and a mix of economic activities. Much has changed over the past 160 years; and although some may desire to maintain a static picture of the Delta as it is today, the past, as well as emerging science, predict constant change.

Once a marshland that was the drain of the vast Central Valley watershed, the Delta changed dramatically following the discovery of gold on the American River in 1848. Suddenly, large numbers of prospectors and service providers were beating a pathway through the Delta to the foothills and, at the peak of the rush, more than 300 steamboats plied the waters between San Francisco and Sacramento. Twenty-one years later, completion of the transcontinental railroad in 1869 freed a huge workforce, many of whom found alternative work dredging Delta channels and building levees.

Communities developed to support river traffic to and from the gold country, and later to transport agricultural products from the newly productive farmland reclaimed from the Delta marshes. The advent of the automobile resulted in a flurry of ferry construction and bridge building in the 1920s; by the 1930s, cars and trucks were replacing steamships for transportation and commercial shipping. The Stockton Deepwater Ship Channel was completed in 1933, opening a direct connection from the San Joaquin Valley to the world, and 30 years later, the Sacramento Deepwater Ship Channel did the same for the Sacramento Valley. Not coincidentally, these channels also opened the Delta to a host of exotic invasive species that hitched rides on the bottoms and in the ballast of ocean-going freighters.

Central Valley Chinook salmon have long been a critically important part of California’s fishing industry, passing through the Delta on their way from and to spawning...
grounds in upstream rivers and streams. Between 1900 and 1950, the fall run numbered more than a million fish returning annually to the Sacramento and San Joaquin river systems. Drought and changing Delta and ocean conditions, however, reduced those numbers to only 66,000 in 2008, resulting in a closure of the salmon fisheries off California and restrictions that lingered into 2010, devastating fishing economies (DFG 2009).

Dredging opened many of the Delta channels for sport fishing, recreational boating, and commercial enterprise. Today there are more than 100 marinas and waterside resorts, RV parks, grocery stores, and dockside restaurants; and house boating remains popular. The Delta is dotted with numerous public parks and fishing sites as well.

The Delta now is a major producer of corn, alfalfa, pasture, and tomatoes; and wine grapes are growing in prominence. Residents and visitors alike celebrate the Delta’s agricultural heritage with the Asparagus Festival in Stockton and the Courtland Pear Fair.

Today, although still largely rural, the Delta is crisscrossed by interstate electric transmission lines, natural gas pipelines, and interstate roads and railroads; and it faces increasing pressure—at least on its periphery—for additional housing development. Those elements, combined with the increasing certainty of sea level rise and changing climate patterns, mean continual change for the Delta.

**The Delta Problem**

In California, sustainable management of the Delta is an exceedingly complex topic fraught with longstanding conflicts and challenges. The Delta and Suisun Marsh ecosystem is the largest estuary on the West Coast and a critical stopping point on the Pacific flyway. The estuary extends westward to the Golden Gate and southward to San Jose. Delta water also flushes southern San Francisco Bay. It is also the hub of the state’s major water supply systems. But the Delta today is failing to balance the tradeoffs inherent in these functions, as well as to provide a place to live, work, and play for residents and visitors alike.

Today the Delta is relied upon for many services and, as a result, is not meeting the demands of farmers and urban water users who want assurances of supply and, in some cases, more water. Nor does the Delta adequately serve the needs of fish and wildlife—some threatened or endangered species’ numbers remain perilously low. And the Delta itself remains inherently floodprone.

**Fish Declines.** In late 2004, scientists noted that several fish species in the upper San Francisco estuary (delta smelt, young striped bass, longfin smelt, and threadfin shad) had remained unusually low since 2001. Although the numbers had historically fluctuated, this steep and lasting dropoff signaled an ecological crisis. Scientists acknowledged many causes such as invasive and predatory species, upstream agricultural and urban runoff, and diminished Delta habitat. The export pumps of the SWP and CVP were culpable as well, and restrictions ensued.

**Water Exports Cut.** These regulatory and court-ordered restrictions on State and federal pumping, in combination with the 2007–2009 drought, significantly reduced exported water deliveries to SWP and CVP contractors. As a result, some San Joaquin Valley farmers pumped groundwater from already overtapped aquifers, fellowed fields, and, in some cases, plowed under permanent crops. The national economic recession, combined with reduced water deliveries, hit the San Joaquin Valley hard. Although the plight of farmers captured much media attention, the salmon fishery was shut down in 2008 and was restricted in 2009–2010, causing economic hardship for the commercial and recreational fishing industries. Urban water managers in the Bay Area and Southern California drew down storage and increased conservation efforts until the rains and snows of 2011 saved the day.
DELTA BY THE NUMBERS

- The 45,600-square-mile Delta watershed provides all or a portion of surface water or groundwater supplies to more than 27 million California residents.
- Approximately 8 percent of the state’s water supply is exported from the Delta (DWR 2009).
- The Delta and Suisun Marsh support more than 55 fish species and more than 750 plant and wildlife species. Of these, approximately 100 wildlife species, 140 plant species, and 13 taxonomic units of fish are considered special-status species and are afforded some form of legal or regulatory protection (CNDB 2010, USFWS 2010, CNPS 2010).
- The Delta and Suisun Marsh are home to more than one-half million residents living in dozens of communities, including portions of 12 incorporated cities such as Stockton and Sacramento, and support more than 146,000 jobs (DPC 2010).
- Approximately 57 percent of the Delta and Suisun Marsh—more than 480,000 acres of agricultural land—currently supports a highly productive agricultural industry that is valued at hundreds of millions of dollars annually (DWR 2007a, DWR 2007b, DOC 2008, DPC 2010).
- The Delta and Suisun Marsh levees and lands support interstate and state highways and railroad tracks that support intrastate and interstate traffic, more than 500 miles of major electrical transmission lines, 60 substations, and more than 400 miles of major natural gas pipelines that provide energy throughout Northern California, as well as critical pipelines that carry transportation fuels to airports and other fuel depots throughout the San Francisco Bay Area and Sacramento (DPC 2010, DWR 2009).
- The Delta and Suisun Marsh have more than 1,335 miles of levees that protect more than 800,000 acres of land and play a role in the water supplies conveyed through the Delta.
- The Delta experiences more than 12 million visitor days annually from recreational boaters (DPC 2012). Fishing, hunting, birdwatching, and camping draw even more visitors to the area.


** Lawsuits.** Over the years, improved understanding about water quality needs and environmental protection in the Delta launched an era of complex regulation that today governs SWP and CVP water supply operations. Litigation over a host of issues related to the CVP and SWP has created a recent spate of water management actions guided by courtroom decisions. Incomplete understanding about how water project operations, pollution, invasive species, and other factors affect native Delta fish species has resulted in a regulatory scheme affecting water supplies that is characterized by uncertainty. Changing rules to curtail pumping and increase Delta outflow have compounded water supply uncertainty for agencies that use water conveyed through the Delta, particularly in drier years when ecosystem conflicts are most pronounced. Some of those agencies have contributed to the uncertainty by becoming increasingly reliant on Delta exports that were intended to be supplemental supplies, but in some cases are now relied upon as core water supplies.

**Flood Threats.** Adding to the complexity of these problems is the increasing volatility of Delta water supplies as a consequence of climate change, including more rain and less snow, earlier snowmelt, and higher winter and lower spring-summer runoff patterns. The potential for catastrophic levee failure in the Delta and the risk to residents and infrastructure alike posed by floods, sea level rise, earthquakes, and land subsidence is real, growing, and has outpaced the State’s ability to manage and fund risk-reduction measures.

**Pursuit of Balance.** Finding the right balance of these competing needs and demands on the Delta has bedeviled California policy makers for decades. The media and the political system tend to focus on water supply shortages, droughts, flood risk, and the decline of fisheries. Although notable and consequential, these events are all symptoms of a greater resource problem. Not unlike other policy areas, when it comes to natural resource issues, California has long attempted to manage symptoms rather than treat core problems.
CHAPTER 1 INTRODUCTION

Governance and the Delta Reform Act of 2009

California has a history of addressing each problem with yet another project and/or program, each generally left to find its own way among all others already set in motion or completed. Today, more than 200 federal, State, regional, and local agencies have responsibility for some aspect of the Delta. As each agency focuses on its specific mission, cooperation, collaboration, and cohesiveness have at times been elusive.

Although the seeds were sown in governmental decisions throughout the early twentieth century, California’s water “wars” came to a head during the years 1987 through 1992, when a 6-year drought in California slowed water deliveries, water quality deteriorated, and two fish species unique to the Delta—the delta smelt and winter-run Chinook salmon—were pushed to the brink of extinction. During these 6 drought years, average runoff to the state’s two largest rivers dipped dramatically: 44 percent into the Sacramento River and 53 percent into the San Joaquin.

State and federal officials tried, often in conflict with each other, to deal with issues of water quality, protection of Delta fisheries, and water impacts on the state’s urban and agricultural water users. In the early 1990s, endangered species listings by federal fish agencies imposed export restrictions on water users. SWRCB efforts to address aquatic resource degradation under State water laws ground to a halt after the governor complained about excessive federal interference under both the Endangered Species Act and the Clean Water Act. In 1991, the U.S. Environmental Protection Agency (USEPA) formally disapproved the SWRCB water quality control plan; and in 1992, Congress passed the Central Valley Project Improvement Act (CVPIA), which reallocated a significant portion of federal (CVP) water supplies to environmental purposes. Virtually every action taken by a State or federal agency during this period ended up in court.

Amid this chaos of competing interests and regulations, the cornerstone for future cooperation was laid when three long-time adversarial interests—environmentalists, agriculture, and urban water users—agreed to work together to find common ground. Four federal agencies—the USEPA, Bureau of Reclamation, National Marine Fisheries Service, and U.S. Fish and Wildlife Service—began collaboration on Delta issues and became known as “Club Fed.” After being on the losing side of a 5-year-long State-federal tug of war over water quality standards, the State and federal administrations negotiated updated water quality standards and, in 1995, created the CALFED Bay-Delta Program.

After 5 years of negotiations and planning, the CALFED agencies completed an ambitious 30-year plan and record of decision heavily dependent on goodwill, generous State and federal funding, and Delta conditions remaining generally as they had in the immediate past. Instead, goodwill and funding evaporated in the face of fiscal crisis, scientists learned more about looming effects of climate change and emerging stressors on the Delta, and competing interests turned back to the courts to force one viewpoint or the other.

While CALFED attempted to bring a holistic focus, it was criticized for not having authority to hold individual agencies and projects accountable for interrelationships and progress and—toward the end of its first 7 years (Stage 1, 2000 through 2008)—for not being focused enough on the Delta. And yet the inescapable truth remains: actions that affect the Delta’s ecosystem and its ability to provide a reliable amount of water for export are inextricably linked. The Delta Vision Task Force, created by then-Governor Arnold Schwarzenegger in 2006 to point the path forward from CALFED, reinforced the need for integration and linkage in both its 2008 Vision for the Delta and its Strategic Plan.
IS MORE GOVERNANCE REFORM NEEDED?

Senate Bill X7 1 (SBX7 1), which included the Delta Reform Act, enacted the most significant governance reform related to water and the Delta since the mid-twentieth century. Two new bodies were formed, the Sacramento-San Joaquin Delta Conservancy and the Council; the Delta Protection Commission was reorganized; and a new Delta Watermaster position was created at the SWRCB. However, some argue that governance change should not stop there.

In recent years, two nonpartisan and independent entities have proposed new water and Delta governance models, with the State’s Little Hoover Commission (LHC) releasing reports in 2005 and 2010, and the Public Policy Institute of California (PPIC) releasing reports in 2007 and 2011. Their conclusions are summarized here.

Little Hoover Commission: LHC is an independent state oversight agency established in 1962. It has a mission to identify and spur government reform in various policy areas, and has confronted the topic of water governance multiple times. In August 2010, LHC proposed dramatic restructuring of Delta and water governance in its report Managing for Change: Modernizing California’s Water Governance (www.lhc.ca.gov).

Public Policy Institute of California: Established in 1994, the mission of PPIC is to inform and improve public policy in California through independent, objective, nonpartisan research. In 2011, PPIC released Managing California’s Water: From Conflict to Resolution (Hanak et al. 2011), which focused more on thematic reforms building on current practices such as increasing urban water conservation and streamlining water transfers (www.ppic.org).

Although PPIC and LHC would remake water governance differently, both proposals have considerable thematic overlap:

- California lacks a system to adequately incorporate the needs of public trust resources with water supply management and planning.
- California lacks a centralized leadership structure to set statewide policy goals and manage inevitable conflicts.
- The institutional separation of water rights planning, administration, and enforcement responsibilities from water supply management complicates policy making.
- Insufficient incentives exist to promote regional cooperation and local consistency with State policy directions.
- There is concern that the demands of California Department of Water Resources’ role in managing the SWP conflicts with its overall statewide water planning responsibilities.

This Delta Plan recommends governance reform related to regional Delta participation in flood management activities. As part of its role in coordinating overall efforts in the Delta, the Council will hold hearings and recommend additional governance reform to the Legislature.

The recommendations from the Delta Vision Task Force, along with general understanding and support from a wide variety of competing interest groups, allowed the Legislature, in 2009, to craft a package of bills that would, for the first time, begin to define those linkages in law and require accountability for implementation. In addition to the Delta Reform Act, the package included measures that set ambitious water conservation policy (20 percent reduction in statewide urban per capita water use by 2020), ensure better groundwater monitoring, and provide for increased enforcement to prevent illegal water diversions. It also included a bond measure that would help fund implementation of various parts of the package, and local and regional water supply and ecosystem projects.

The fifth bill in the package was Senate Bill X7 1 (SBX7 1), which included the Delta Reform Act. With its passage, California embarked upon a new era in Delta governance with creation of the Council, and established as overarching State policy coequal goals of a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. Through its hybrid approach—both regulatory and collaborative—the Council now has the task of facilitating coordination across a broad range of entities to achieve the State’s water policy objectives.

The Delta Reform Act includes an important caveat: while past Delta efforts focused almost exclusively on water supply reliability or ecosystem protection, the Delta Reform Act
requires that the coequal goals be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

In addition, the Delta Reform Act recognized the need to change the way the Delta is viewed, asking not what can be taken, but instead what can be given back. Thus, the Legislature established that the policy of the State is to reduce reliance on the Delta in meeting future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. The Delta Reform Act specifies that each region depending on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.

Finally, in a distinct departure from CALFED and the status quo of disparate agencies struggling to tackle complex modern resource problems, the Council was established with the authority and responsibility to develop a legally enforceable Delta Plan, and to coordinate and collaborate across the myriad governmental agencies that have responsibility for some aspect of the Delta. The Council also was charged with ensuring that actions by State and local agencies in the Delta are consistent with the Delta Plan, and adequately incorporate the best available science and adaptive management principles.

The Delta Plan
The foundation of the Delta Reform Act is the adoption of the coequal goals and direction to the Council to develop an enforceable Delta Plan to further those goals. Figure 1-4 shows the primary area covered by the Delta Plan, including features and uses referred to in policies and recommendations. Accordingly, the Council presents a Delta Plan that is practical, foundational, integrated, and adaptive:

- **Practical**: The Delta Plan builds on years of planning efforts and incorporates actions, recommendations, and strategies developed by other entities—governmental and nongovernmental—that have already invested countless hours on Delta issues and have specialized expertise.

- **Foundational**: The Delta Plan addresses intertwined challenges and establishes foundational actions for Delta management throughout this century. It lays the groundwork for near-term actions for improvement and focuses on the immediate avoidance of further harm or increased risk to the Delta. The Delta Plan shines a spotlight on urgently needed Delta habitat projects and the significant potential for local and regional water supply development. Similarly, the Delta Plan seeks to immediately halt practices known to be detrimental to the sustainability of the Delta’s many functions and services.

- **Integrated**: The Delta Plan establishes an open and accountable governance mechanism for coordinating actions across agency jurisdictions and statutory objectives.
The map shows land uses designated by city and county general plans. Within cities’ spheres of influence (SOIs), the map shows land use designations proposed in city general plans, where available. In cases where cities have not proposed land uses within their SOIs, the map shows land uses designated by county general plans.

Adaptable: The Delta Plan sets direction through policies and recommendations and can incorporate other plans and new information as it becomes available. Informed by science and consistent monitoring, portions of the Delta Plan that do not adequately meet or make progress toward stated goals over time will be refined or revised. The Delta Plan will be updated at least every 5 years, and likely sooner, given the major changes facing the Delta under the Bay Delta Conservation Plan (BDCP) and the Council’s commitment to Delta levee prioritization.

It is inevitable that the Delta Plan will generate controversy. This Delta Plan integrates existing State and federal laws and policies and ongoing programs, and is informed by the best available science to chart a course to further the coequal goals. The Council is one of many agencies with an interest in the Delta, and it was not granted unlimited authority over actions related to water supply and the environment. Specific and targeted authority and actions, however, were included by the Delta Reform Act; these form the basis for the Delta Plan’s enforceable policies and nonenforceable recommendations.

The Delta Plan’s policies and recommendations are based on the following imperatives:

- **Act now.** We have been studying the problems of California’s water supply and the declining Delta ecosystem for decades. While all parties agree the status quo is not acceptable, failure to take action only prolongs a worsening status quo. Near-term actions must move forward while the long-term conveyance, storage, and ecosystem solutions are being decided over the next 5, 10, and 15 years. Waiting is NOT an option. We must continue to invest in the Delta ecosystem and in the improvement of California’s water supplies and water use efficiency.

- **Success depends on integrated approaches and awareness of tradeoffs.** Tradeoffs are inherent in managing a supply for multiple benefits. Water exports out of the Delta can harm the ecosystem unless carefully managed. Protecting the Delta as a place means focusing development in urban areas to reduce effects on agricultural land, and risk to people, property, and state interests. Multiple stressors affect the ecosystem in ways that are not yet fully understood and which may be impossible to completely control. The most effective actions will depend upon the coordinated actions of multiple actors.

- **Improve water supply reliability.** Fundamentally, water supply reliability means that California must better match its demands for and use of water to the available supply. Everyone in California must conserve water and must increase their efforts to do so. New surface and groundwater storage is necessary to manage the timing of water for people and for fish. Done right, additional storage can make efficient water management possible and better allow for water use that is wildlife friendly. Improved Delta conveyance, including successful completion of the BDCP, is essential; and it should be done as soon as possible.

- **Commit to Delta ecosystem restoration.** We must preserve land in the Delta for future habitat restoration, and we must immediately begin restoration efforts on long-studied priority areas. In the Delta, the conflict between the way we move water and the health of native species must be resolved. A successfully permitted BDCP is key to that, including water quality objectives updated by the SWRCB for beneficial uses including the Delta’s ecosystem. Without adequate water flow (the right mix of timing and amount), we cannot expect fisheries to recover, no matter how well we deal with the range of other stressors.

- **Preserve Delta as a place.** The Delta serves many demands, but we must preserve and protect a unique sense of place distinguished by geography, legacy communities, a rural and agricultural setting, vibrant natural resources, and a mix of economic and recreational activities.
What the Delta Plan Will Achieve

The Delta Plan seeks to further the coequal goals and their inherent objectives in the face of dramatically changing conditions. The Delta of 2100 likely will be very different from the Delta of today (see Table 1-1 for examples of anticipated changes). Some of the changes will be intentional or predictable, and others will be unintended and surprising. Changes are likely or expected to result from population growth, climate change and sea level rise, land subsidence, and earthquakes—most beyond human ability or willingness to control. Human-made changes in land use and water use are also expected to continue.

All of this will involve tradeoffs between competing—in some cases, mutually exclusive—values, goals, and objectives. The Delta Plan seeks to ensure that these decisions are made in a timely and open manner, and based on best available information and science as a predictor of the future. The law requires that the Delta Plan be updated every 5 years, and each update is intended to build on an evolving base of knowledge, directing near- and mid-term actions, and preserving and protecting longer-term opportunities as yet unknown.

Summary of Anticipated Changes Affecting the Delta by 2050 and 2100

<table>
<thead>
<tr>
<th>Anticipated Change</th>
<th>Change Predicted by 2050</th>
<th>Change Predicted by 2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population of California(^a)</td>
<td>Increase from 37.2 million in 2010 to 51 million</td>
<td>Continued increase in population</td>
</tr>
<tr>
<td>San Francisco Bay/East Bay Area earthquake affecting Delta by 2032(^b)</td>
<td>63% probability of at least one magnitude 6.7 or greater earthquake</td>
<td></td>
</tr>
<tr>
<td>Probability of island flooding from high water, relative to 2005 conditions(^c)</td>
<td>In range of 200% increase (medium risk scenario)</td>
<td>In range of 450% increase (medium risk scenario)</td>
</tr>
<tr>
<td>Increased weather variability, including longer-term droughts(^d)</td>
<td>Models and analyses of tree rings and other evidence back to the year 800 suggest greater variability and long periods of drought, especially for the Colorado River Basin, a current source of some water to California.</td>
<td></td>
</tr>
<tr>
<td>Sea level rise, relative to 2000(^e)</td>
<td>14 inches</td>
<td>55 to 65 inches</td>
</tr>
<tr>
<td>Snow pack, relative to 1956–2000 average of 15 MAF(^f)</td>
<td>Reduction of 25% (4.5 MAF) to 40% (6 MAF)</td>
<td>Continued reduction expected</td>
</tr>
</tbody>
</table>

---

\(^a\) California Department of Finance 2012

\(^b\) 2007 Working Group on California Earthquake Probabilities 2008

\(^c\) DWR 2008


\(^e\) California Ocean Protection Council 2011; other sources include higher projections

\(^f\) DWR 2010

MAF: million acre-feet
The Delta Plan lays out 14 regulatory policies and 73 recommendations that start the process of addressing the current and predicted ecological, flood management, water quality, and water supply reliability challenges. As required by statute, the Delta Plan adopts a science-based adaptive management strategy to manage decision making in the face of uncertainty (Water Code section 85308(f)). All of these changes—some foreseeable, some not—will create a dynamic context in which the Delta Plan must adapt.

Over the life of the Delta Plan, the coequal goals of providing a more reliable water supply for California and restoring the Delta ecosystem are the foundation of all State water management policies. No water rights decisions or water contracts that directly or indirectly impact the Delta are made without consideration of the coequal goals. Over time, balanced application of the Public Trust Doctrine and the California Constitution, Article 10, Section 2 (requirements for beneficial use, reasonable water use, and no waste), have produced optimized water use, including high levels of water use efficiency and protection of public trust resources throughout the state. California has a comprehensive, fully integrated system for tracking and evaluating actual water use and water quality for both surface water and groundwater supplies.

The Delta Plan seeks first to arrest declining water reliability and environmental conditions related to the Delta ecosystem, and ultimately to improve them. It seeks to achieve a more resilient ecosystem that can absorb and adapt to current and future effects of multiple stressors. Additionally, it seeks to reduce flood risk, improve water quality, increase recreation opportunities in the Delta, and protect Delta legacy communities. Generally speaking, these are long-term goals to reduce and reverse increasing long-term environmental impacts caused by inaction. The vision of the Delta in 2100 will be realized through a series of near-term and longer-term actions informed by performance measures and overall adaptive management.

By 2100:

- **California’s water supply** will be considerably more efficient, local and regional projects will be online to increase supplies and meet the demands of a growing population, and storage will have increased to meet the challenge of climate change and the needs of water transfer systems. Regions reliant on receiving some portion of their water from the Delta watershed will have reduced their reliance and improved regional self-reliance through increased conservation and diversification of their local and regional sources of supply. Delta conveyance will be managed in an adaptive manner that successfully balances ecosystem restoration and protection with more reliable water deliveries. Water quality in the Delta will support a healthy ecosystem and the multiple beneficial uses of water, including municipal supply and recreational uses such as fishing and swimming.

- **The Delta and Suisun Marsh ecosystem** will have the capacity to provide the environmental and societal benefits the public demands (viable populations of desired species, wild habitats for recreation and solace, land for agriculture, and the conveyance of reliable and high-quality fresh water). Large areas of the Delta will be restored in support of a healthy estuary. A diverse mosaic of interconnected habitats will be re-established in the Delta and its watershed. Migratory corridors for fish, birds, and terrestrial wildlife will be largely protected and restored. Actions have been taken to ensure that sufficient freshwater flows following a more natural, functional hydrograph are now dedicated to support a healthy ecosystem. Actions have reduced the impacts caused by stressors such as invasive species, poor water quality, loss of habitat, and urban development, resulting in improved conditions for native species of fish, birds, and wildlife that depend on the Delta and its watershed.
The Delta itself will be a safe, nationally recognized and vibrant place, with well-defined cities and towns, a strong agricultural sector, and a well-deserved reputation as a recreational destination. Despite an increase in sea levels and altered runoff patterns, risks will be reduced, and residents and agencies will be prepared to respond when floods threaten. In 2100, the Delta will retain its rural heritage and be a place where agricultural, recreational, and environmental uses are uniquely integrated and continue to contribute in important ways to the regional economy.

Timeline for Implementing Priority Actions of the Delta Plan

Figure 1-5 contains a timeline for implementing the priority actions contained in the Delta Plan. The timeline emphasizes near-term and intermediate-term actions. In some instances, precedent or complementary actions need to be undertaken by other agencies or entities to ensure success of the Delta Plan.

<table>
<thead>
<tr>
<th>ACTION (REFERENCE #)</th>
<th>LEAD AGENCY(IES)</th>
<th>NEAR TERM 2012–2017</th>
<th>INTERMEDIATE TERM 2017–2025</th>
<th>ACTION DEPENDS ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce reliance on the Delta through improved regional water self-reliance (WR P1)</td>
<td>Council, DWR, SWRCB</td>
<td></td>
<td></td>
<td>State, local water agency cooperation and compliance</td>
</tr>
<tr>
<td>Delta flow objectives (ER P1)</td>
<td>SWRCB</td>
<td></td>
<td></td>
<td>SWRCB completes on time</td>
</tr>
<tr>
<td>Prioritization of State investments in Delta levees and risk reduction (RR P1)</td>
<td>Council, DWR</td>
<td></td>
<td></td>
<td>Council completion; legislative adoption and implementation</td>
</tr>
<tr>
<td>Update Delta flow objectives (ER R1)</td>
<td>SWRCB</td>
<td></td>
<td></td>
<td>SWRCB completes on time</td>
</tr>
<tr>
<td>Prioritize and implement projects that restore Delta habitat (ER R2)</td>
<td>DFW, DWR, Delta Conservancy</td>
<td></td>
<td></td>
<td>Funding, multiagency cooperation</td>
</tr>
<tr>
<td>Designate the Delta as a National Heritage Area (DP R1)</td>
<td>DPC</td>
<td></td>
<td></td>
<td>Federal action, Congress</td>
</tr>
<tr>
<td>Finance local flood management activities (RR R2)</td>
<td>DPC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actions for the prioritization of State investments in Delta levees (RR R4)</td>
<td>Council, DWR</td>
<td></td>
<td></td>
<td>Council completion; legislative adoption and implementation</td>
</tr>
<tr>
<td>Complete Bay Delta Conservation Plan (WR R12)</td>
<td>DWR, Council incorporates</td>
<td></td>
<td></td>
<td>State, federal agency action</td>
</tr>
<tr>
<td>Complete surface water storage studies (WR R13)</td>
<td>DWR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completion of regulatory processes, research, and monitoring for water quality improvements (WG R8)</td>
<td>SWRCB, RWQCBs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of a Delta Science Plan (G R1)</td>
<td>Council</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete Delta Finance Plan</td>
<td>Council</td>
<td></td>
<td></td>
<td>Ongoing funding</td>
</tr>
<tr>
<td>Initiate Delta Plan Interagency Implementation Committee</td>
<td>Council</td>
<td></td>
<td></td>
<td>Agency cooperation</td>
</tr>
<tr>
<td>Evaluate and update Delta Plan</td>
<td>Council</td>
<td></td>
<td></td>
<td>Ongoing funding</td>
</tr>
</tbody>
</table>

Agency Key:  
Council: Delta Stewardship Council  
Delta Conservancy: Sacramento-San Joaquin Delta Conservancy  
DFW: California Department of Fish and Wildlife  
DWR: California Department of Water Resources  
RWQCB: Regional Water Quality Control Board  
SWRCB: State Water Resources Control Board

Figure 1-5
CHAPTER 1 INTRODUCTION

Organization of the Delta Plan

The Delta Plan is organized around the coequal goals and specific subgoals, strategies, actions, and measures set forth in the Delta Reform Act. The following chapters describe in detail the problems, expected outcomes, and performance measures associated with the various policies and recommendations:

- Chapter 2, The Delta Plan
- Chapter 3, A More Reliable Water Supply for California
- Chapter 4, Protect, Restore, and Enhance the Delta Ecosystem
- Chapter 5, Protect and Enhance the Unique Cultural, Recreational, Natural Resource, and Agricultural Values of the California Delta as an Evolving Place
- Chapter 6, Improve Water Quality to Protect Human Health and the Environment
- Chapter 7, Reduce Risk to People, Property, and State Interests in the Delta

In addition, Chapter 8, Funding Principles to Support the Coequal Goals, provides history and background for water project and program financing by discussing various funding schemes and by providing some current data on water-related expenditures in California. It also outlines guiding principles for developing stable financing for Delta Plan implementation and describes urgently needed near-term funding requirements for certain critical activities.

References


City of Benicia. 2003. General Plan land use designations within Suisun Marsh. Digitized into GIS format by AECOM from City of Benicia Land Use map in 2012.

City of Fairfield. 2008. General Plan land use designations within Suisun Marsh. Received from the City of Fairfield in 2012.


City of Manteca. 2012. General Plan land use designations in GIS format. Received by Eryn Pimentel, AECOM, from Jeffrey Davis, City of Manteca, on September 4.


City of Suisun City. 2011. General Plan land use designations within Suisun Marsh. Digitized into GIS format by AECOM from Land Use map in 2012.

City of Tracy. 2011. City of Tracy sphere of influence and General Plan land use designations provided in GIS format. Delivered via file transfer protocol from Victoria Lombardo, Senior Planner, City of Tracy, to Jessica Law, Urban and Environmental Planner, AECOM, on March 10.


DWR (California Department of Water Resources). 2007b. Land use survey agricultural crop data for the Legal Delta and Suisun Marsh area. Developed for the Delta Vision program. Received by AECOM from DWR.


DWR (California Department of Water Resources). 2011c. Locations and attributes of levees in California as maintained by the DWR California Levee Database.


Yolo County. 2010b. Yolo County General Plan 2030 layer provided in GIS format. Delivered via file transfer protocol from Marcus Neuvert, GIS Specialist, Yolo County DITT, to Dillon Cowan, Staff Engineer, CH2M HILL, Inc., on July 1.

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Chapter Divider (clockwise from top left): Delta Conservancy, Delta Conservancy, Chris Austin, Bill Wells

Page 8: California Department of Water Resources

Page 14: Delta Conservancy
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CHAPTER 2

The Delta Plan (as amended January 2019)
ABOUT THIS CHAPTER

This chapter discusses the purpose and role of the Delta Stewardship Council (Council) in the context of Sacramento-San Joaquin Delta (Delta) governance. It also describes the Council’s approach to developing, implementing, and updating the Delta Plan, all within the framework of adaptive management. It describes why best available science and adaptive management are particularly important tools in the Delta, and proposes the development of a new Delta Science Plan to aid in the coordination and focus of science efforts across agencies. For State of California (State) or local agencies that propose a plan, program, or project occurring in whole or in part in the Delta, this chapter contains a description of the regulatory application of the Delta Plan. For instance:

- What is a covered action?
- Certifications of consistency
- Covered action consistency appeals

The chapter includes one policy and one recommendation.
CHAPTER 2 THE DELTA PLAN

RELEVANT LEGISLATION

The Sacramento-San Joaquin Delta Reform Act of 2009 established the Delta Stewardship Council to achieve more effective governance while providing for the sustainable management of the Delta ecosystem and a more reliable water supply, using an adaptive management framework, as reflected in the Water Code sections below.

85001 (c) By enacting this division, it is the intent of the Legislature to provide for the sustainable management of the Sacramento-San Joaquin Delta ecosystem, to provide for a more reliable water supply for the state, to protect and enhance the quality of water supply from the Delta, and to establish a governance structure that will direct efforts across state agencies to develop a legally enforceable Delta Plan.

85020 (h) Establish a new governance structure with the authority, responsibility, accountability, scientific support, and adequate and secure funding to achieve these objectives.

85022 (a) It is the intent of the Legislature that state and local land use actions identified as "covered actions" pursuant to Section 85057.5 be consistent with the Delta Plan. This section’s findings, policies, and goals apply to Delta land use planning and development.

85052 “Adaptive management” means a framework and flexible decision making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives.

85204 The council shall establish and oversee a committee of agencies responsible for implementing the Delta Plan. Each agency shall coordinate its actions pursuant to the Delta Plan with the council and the other relevant agencies.

85211 The Delta Plan shall include performance measurements that will enable the council to track progress in meeting the objectives of the Delta Plan. The performance measurements shall include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends in all of the following:

(a) The health of the Delta’s estuary and wetland ecosystem for supporting viable populations of aquatic and terrestrial species, habitats, and processes, including viable populations of Delta fisheries and other aquatic organisms.

(b) The reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.

85225.5 To assist state and local public agencies in preparing the required certification, the council shall develop procedures for early consultation with the council on the proposed covered action.

85225.10 (a) Any person who claims that a proposed covered action is inconsistent with the Delta Plan and, as a result of that inconsistency, the action will have a significant adverse impact on the achievement of one or both of the coequal goals or implementation of government-sponsored flood control programs to reduce risks to people and property in the Delta, may file an appeal with regard to a certification of consistency submitted to the council.

(b) The appeal shall clearly and specifically set forth the basis for the claim, including specific factual allegations, that the covered action is inconsistent with the Delta Plan. The council may request from the appellant additional information necessary to clarify, amplify, correct, or otherwise supplement the information submitted with the appeal, within a reasonable period.

(c) The council, or by delegation the executive officer, may dismiss the appeal for failure of the appellant to provide information requested by the council within the period provided, if the information requested is in the possession or under the control of the appellant.

85300(c) The council shall review the Delta Plan at least once every five years and may revise it as the council deems appropriate. The council may request any state agency with responsibilities in the Delta to
.make recommendations with respect to revision of the Delta Plan.

(d) (1) The council shall develop the Delta Plan consistent with all of the following:

(A) The federal Coastal Zone Management Act of 1972 (16 U.S.C. Sec. 1451 et seq.), or an equivalent compliance mechanism.

(B) Section 8 of the federal Reclamation Act of 1902.

(C) The federal Clean Water Act (33 U.S.C. Sec. 1251 et seq.).

(2) If the council adopts a Delta Plan pursuant to the federal Coastal Zone Management Act of 1972 (16 U.S.C. Sec. 1451 et seq.), the council shall submit the Delta Plan for approval to the United States Secretary of Commerce pursuant to that act, or to any other federal official assigned responsibility for the Delta pursuant to a federal statute enacted after January 1, 2010.

85300(a) The Delta Plan shall include subgoals and strategies to assist in guiding state and local agency actions related to the Delta.

85302(e) The following subgoals and strategies for restoring a healthy ecosystem shall be included in the Delta Plan:

(1) Restore large areas of interconnected habitats within the Delta and its watershed by 2100.

(2) Establish migratory corridors for fish, birds, and other animals along selected Delta river channels.

(3) Promote self-sustaining, diverse populations of native and valued species by reducing the risk of take and harm from invasive species.

(4) Restore Delta flows and channels to support a healthy estuary and other ecosystems.

(5) Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.

(6) Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.

85300(a) The Delta Plan may also identify specific actions that state or local agencies may take to implement the subgoals and strategies.

85302(a) Implementation of the Delta Plan shall further the restoration of the Delta ecosystem and a reliable water supply.

85302(b) The Delta Plan may include recommended ecosystem projects outside the Delta that will contribute to achievement of the coequal goals.

85302(c) The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem:

(1) Viable populations of native resident and migratory species.

(2) Functional corridors for migratory species.

(3) Diverse and biologically appropriate habitats and ecosystem processes.

(4) Reduced threats and stresses on the Delta ecosystem.

(5) Conditions conducive to meeting or exceeding the goals in existing species recovery plans and state and federal goals with respect to doubling salmon populations.

85302(d) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:

(1) Meeting the needs for reasonable and beneficial uses of water.

(2) Sustaining the economic vitality of the state.

(3) Improving water quality to protect human health and the environment.

85302(h) The Delta Plan shall include recommendations regarding state agency management of lands in the Delta.

85303 The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.

85304 The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.

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.
85305(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 nonproject 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.

85307(b) The Delta Plan may include local plans of flood protection.

85307(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.

85307(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 distribution.

85308 The Delta Plan shall meet all of the following requirements:

(a) Be based on the best available scientific information and the independent science advice provided by the Delta Independent Science Board.

(b) Include quantified or otherwise measurable targets associated with achieving the objectives of the Delta Plan.

(c) Where appropriate, utilize monitoring, data collection, and analysis of actions sufficient to determine progress toward meeting the quantified targets.

(d) Describe the methods by which the council shall measure progress toward achieving the coequal goals.

(e) Where appropriate, recommend integration of scientific and monitoring results into ongoing Delta water management.

(f) Include a science-based, transparent, and formal adaptive management strategy for ongoing ecosystem restoration and water management decisions.
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CHAPTER 2

The Delta Plan

No single entity in California has the sole responsibility or authority for managing water supply and the Delta ecosystem. Instead, authority, expertise, and resources are spread out among a cadre of federal, State, and local agencies, with no single government agency empowered to provide leadership or a long-term vision. This is why governance reform enacted by the Delta Reform Act is fundamentally different from past approaches to managing the Delta. The milestone legislation created the Council, and gave it the direction and authority to serve two primary governance roles: (1) set a comprehensive, legally enforceable direction for how the State manages important water and environmental resources in the Delta through the adoption of a Delta Plan, and (2) ensure coherent and integrated implementation of that direction through coordination and oversight of State and local agencies proposing to fund, carry out, and approve Delta-related activities.

Recommended in significant part by the Delta Vision Task Force effort in 2008, this new approach is different from governance attempts over the past several decades that have tried, but largely failed, to provide effective and stable leadership. The Delta Vision Strategic Plan referred to some 200 agencies that play some role in managing the Delta’s varied resources (Delta Vision 2008). One of the major goals articulated in that strategic plan was the establishment of a new governance structure with sufficient authority, responsibility, accountability, science support, and secure funding to achieve the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The creation of the independent Council was a significant step toward implementing this goal. The Council is made up of seven members who provide a broad, statewide perspective and diverse expertise, and is advised by a 10-member board of nationally and internationally renowned scientists, the Delta Independent Science Board (ISB). The Delta Reform Act instructs the Council to “direct efforts across state agencies,” but considerable challenges lie ahead in coordinating and supporting the multitude of agencies to achieve the goals of the Delta Plan.

The first major task for the newly created Council is the development of this Delta Plan. The Delta Reform Act requires the Council to develop and adopt a legally enforceable, long-term management plan for the Delta that uses best available science and is built upon the principles of adaptive management. The Delta Reform Act also established the Delta Science Program within the Council to provide the best possible unbiased scientific information to inform water and environmental decision making in the Delta. Because California’s Delta is linked to so many statewide issues, described in Chapter 1, the Delta Plan’s scope and purview encompasses statewide water use, flood management, and the Delta watershed, but with a specific
focus on the legal Delta and Suisun Marsh. The Delta Plan contains a set of regulatory policies that will be enforced by the Council’s appellate authority and oversight, described in this chapter. These regulatory policies and supporting documents are contained in Appendix B. The Delta Plan also contains priority recommendations, which are nonregulatory but call out actions essential to achieving the coequal goals. The Council has chosen to apply its regulatory authority in a targeted manner, and does so in an effort to ensure that all significant activities occurring in whole or in part in the Delta become better aligned over time with State policy priorities, including—and especially—the achievement of the coequal goals. The process for demonstrating compliance with Delta Plan policies is described in detail in this chapter.

In developing the first Delta Plan, the Council sought extensive public, stakeholder, and government agency input and, based on that input, developed the foundational set of policies and recommendations detailed in the following chapters to guide actions over the first few years of Plan implementation. Every stage of implementing the Delta Plan will necessitate leadership by the Council and ongoing coordination across a broad range of agencies, nongovernmental entities, and stakeholders.

The Delta Stewardship Council

As described in Chapter 1, the Delta of today is the result of centuries of natural and human-made actions and reactions. Government historically has worked to treat individual problems rather than adopt a systemwide approach. Dozens of agencies, task forces, and working groups have struggled to find the right combination of policy, science, and structure to address what are now California’s fundamental goals for managing the Delta, the coequal goals.

The mission of the Council is to further the achievement of the coequal goals. To do so, the Council was charged with the development of a legally enforceable, long-term management plan for the Delta. To accomplish this, the Council will apply a common-sense approach based on a strong scientific foundation in an adaptive management framework to protect and restore the Delta ecosystem; improve the quality and reliability of California’s water supplies; reduce risk to people, property, and State interests; and protect and enhance the Delta as an evolving place.

The Council’s most important and challenging role is the facilitation, coordination, and integration of a range of actions and policies in support of the coequal goals. Implementation will occur through the Council’s leadership of a formal Interagency Implementation Committee, ongoing informal staff-to-staff agency coordination, development of science to support the Delta Plan, and use of the Council’s various authorities to ensure progress and accountability in how the Delta is managed. See Table 2-1 for a reference list of agencies with responsibilities in the Delta or related to the management of the Delta.

In addition to its role in setting State policy for the Delta in the Delta Plan, and in facilitating and coordinating agencies to achieve policy objectives, the Council was granted specific regulatory and appellate authority over certain actions that take place in whole or in part in the Delta. To do this, the Delta Plan contains a set of regulatory policies with which State and local agencies are required to comply. The Delta Reform Act specifically established a certification process for compliance with the Delta Plan. This means that State and local agencies that propose to carry out, approve, or fund a qualifying action in whole or in part in the Delta, called a “covered action,” must certify that this covered action is consistent with the Delta Plan and must file a certificate of consistency with the Council that includes detailed findings. This process is described in the section “Covered Actions and Delta Plan Consistency” later in this chapter.
# Agencies with Responsibilities in the Delta

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta Stewardship Council</td>
<td>Established in 2009 by the Delta Reform Act to further the achievement of the coequal goals through the development and implementation of a legally enforceable Delta Plan.</td>
</tr>
<tr>
<td>California Department of Fish and Wildlife</td>
<td>Provides fish and wildlife protection and management, including management of wildlife areas and ecological reserves, public access, conservation planning, permitting, and implementation of the Ecosystem Restoration Program.</td>
</tr>
<tr>
<td>California Department of Water Resources</td>
<td>Owns and operates the State Water Project (which stores water upstream and conveys water through the Delta), has emergency response and flood planning responsibilities, holds water quality/supply contracts with Delta water agencies, and coordinates overall statewide water planning.</td>
</tr>
<tr>
<td>Delta Protection Commission</td>
<td>Prepares a comprehensive long-term resource management plan for land uses within the approximate 500,000-acre Primary Zone. Local government plans must be consistent.</td>
</tr>
<tr>
<td>Sacramento-San Joaquin Delta Conservancy</td>
<td>A primary State agency to implement ecosystem restoration in the Delta and also to assist/protect the region’s agricultural, cultural, economic, and historical value.</td>
</tr>
<tr>
<td>State Water Resources Control Board</td>
<td>Required to develop in 2010 nonregulatory flow criteria for the Delta ecosystem necessary to protect public trust uses to inform planning proceedings for the Delta Plan and Bay Delta Conservation Plan (BDCP). Responsible for developing and implementing the Bay-Delta Water Quality Control Plan to establish water quality objectives, including flow objectives, to ensure reasonable protection of beneficial uses in the Bay-Delta. Responsible for establishing, implementing, and enforcing water right requirements to ensure the proper allocation and efficient use of water in and out of the Delta, including the role of the Delta Watermaster and implementation of the Bay-Delta Water Quality Control Plan. With regional boards, responsible for developing and implementing other water quality standards and control plans consistent with State and federal laws to reasonably protect aquatic beneficial uses.</td>
</tr>
<tr>
<td>California Emergency Management Agency</td>
<td>Plans, prepares emergency response, and coordinates the activities of all State agencies in connection to an emergency in the Delta; provides resources if local agencies are overwhelmed.</td>
</tr>
<tr>
<td>Central Valley Flood Protection Board</td>
<td>Plans flood control along the Sacramento and San Joaquin rivers and their tributaries in cooperation with the U.S. Army Corps of Engineers.</td>
</tr>
<tr>
<td>Office of the Delta Watermaster</td>
<td>Created in 2009 to oversee day-to-day administration of water rights, enforcement activities, and reports on water right activities regarding diversions in the Delta.</td>
</tr>
<tr>
<td>California Natural Resources Agency</td>
<td>Coordinates with a group of local water agencies, environmental and conservation organizations, State and federal agencies, and other interest groups developing the BDCP, a conservation strategy to be compliant with the Endangered Species Act (ESA) and Natural Community Conservation Planning Act, to be implemented over the next 50 years.</td>
</tr>
<tr>
<td>Other State agencies</td>
<td>Have various roles or responsibilities in the Delta relevant to the agency’s concern (for example, California Department of Food and Agriculture, California Department of Transportation, California State Parks, California Department of Boating and Waterways, State Lands Commission, California Environmental Management Agency, and others).</td>
</tr>
</tbody>
</table>
Agencies with Responsibilities in the Delta

<table>
<thead>
<tr>
<th>Federal</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bureau of Reclamation</strong></td>
<td>Owns and operates the Central Valley Project, which, among other activities, pumps water through and out of the Delta.</td>
</tr>
<tr>
<td><strong>U.S. Fish and Wildlife Service</strong></td>
<td>Develops plans for the conservation and recovery of fish and wildlife resources, and addresses the variable needs of fish and wildlife pursuant to the ESA.</td>
</tr>
<tr>
<td><strong>U.S. Army Corps of Engineers</strong></td>
<td>Involved with both federal and nonfederal partners in assessing channel navigation, ecosystem, and flood risk management projects in the Delta. Works cooperatively with its nonfederal partners regarding the regulation, maintenance, and improvement of project levees in the Delta.</td>
</tr>
<tr>
<td><strong>National Marine Fisheries Service</strong></td>
<td>Develops plans for the conservation and recovery of salmonids in the Delta pursuant to the ESA.</td>
</tr>
<tr>
<td><strong>U.S. Environmental Protection Agency</strong></td>
<td>Responsible for protection and restoration of water quality in the Delta, pursuant to the Clean Water Act, which regulates the discharge of pollutants into waterways and sets standards for water quality. Oversees implementation of Clean Water Act programs and policies delegated to the State.</td>
</tr>
<tr>
<td><strong>Other federal agencies</strong></td>
<td>Various roles or responsibilities in the Delta relevant to the agency’s concern (for example, U.S. Department of Agriculture, Natural Resources Conservation Service, and others).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Local</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hundreds of local reclamation districts, resource conservation districts, water districts, city and county governments, and other special districts.</td>
<td></td>
</tr>
</tbody>
</table>

To be effective, governance to support science and implement adaptive management for a changing Delta must be flexible and have the capacity to change policies and practices in response to what is learned over time. An adaptive management approach as detailed in this chapter will ensure that the Delta Plan is updated as often as necessary to incorporate new information or modify policies and recommendations to ensure achievement of the coequal goals. The following section discusses the particular importance of science and adaptive management as they relate to the Delta.

Science and Adaptive Management in the Delta

The Delta Reform Act requires that the Delta Plan be based on and implemented using the best available science, and requires the use of science-based, transparent, and formal adaptive management strategies for ongoing ecosystem restoration and water management decisions. This section describes the importance of science, especially as it relates to the Delta, describes how the Delta Plan itself uses an adaptive management plan, and proposes the development of a Delta Science Plan as a companion to the Delta Plan.

“The State of Bay-Delta Science report concluded that most of the decision making in the Delta was occurring on the basis of a false understanding that the Delta was a static system, and that “the Delta of the future would be much the same as the Delta of today” (Healey et al. 2008). Science indicates that significant changes are expected in the Delta over the coming decades, including climate change and the potential for earthquakes and flooding, as described in Chapter 1. In addition, current planning processes for habitat restoration, changes to water conveyance in the Delta, urban expansion, and other human drivers could reshape the Delta as we know it today.
The State of Bay-Delta Science urged a new perspective for decision making in the Delta (Healey et al. 2008). Decision making should be based on best available science, should account for risk and uncertainty, should acknowledge the dynamic nature of ecosystems, and should be responsive and adaptive to future change. The Delta Reform Act, enacted 1 year after that report, requires a strong science foundation for Council decisions. This includes the ongoing provision of scientific expertise to support the Council and other agencies through the Delta Science Program and Delta ISB. The Delta Science Program’s mission is to provide the best possible scientific information for water and environmental decisions in the Bay-Delta system. The Delta ISB provides oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta to ensure that the application of the best science is used in Delta programs. The Delta ISB reviewed early drafts of this Delta Plan to ensure that the best science was used in the Delta Plan.

Why is it important that the Delta Plan emphasize science? First, science provides the basis of nearly all current understanding of the Delta’s status (Healey et al. 2008, Lund et al. 2010). Second, new perspectives on science and policy in the Delta instill urgency for addressing the health of Delta ecosystems and the need for a more reliable water supply. Third, the interaction of multiple stressors to the ecosystem must be understood if they are to inform effective policy decisions.

Science and adaptive management are not simply academic exercises; they are tools that provide managers and decision makers an approach for using public funds more effectively, and increase the likelihood of success for a given project. Science by itself does not make or prioritize management decisions; it only informs actions and proposals. “Using the best science is only part of what is needed to resolve the competing interests…” that clamor over the Delta (NRC 2012).

The next sections describe what the Council means when it comes to best available science and adaptive management in the context of the coequal goals.

**Best Available Science**

Not all science is created equal nor deserves equal weight in decision making. Best available science provides the knowledge base for making sound decisions and is foundational for adaptive management. Best available science provides understanding for defining problems, developing conceptual models, identifying potential management actions, monitoring ecological and physical responses, and analyzing responses relative to the actions taken. Adaptive management both uses best available science and contributes to the creation of the best available science.

Best available science is specific to the decision being made and the time frame available for making that decision. There is no expectation of delaying decisions to wait for improved scientific understanding. Action may be taken on the basis of incomplete science if the information used is the best available at the time.

Best available science is developed through a process that meets the criteria of (1) relevance, (2) inclusiveness, (3) objectivity, (4) transparency and openness, (5) timeliness, and (6) peer review (NRC 2004). Best available science is consistent with the scientific process (Sullivan et al. 2006). Ultimately, best available science requires scientists using the best information and data to assist management and policy decisions. The processes and information used should be clearly documented and effectively communicated to foster improved understanding and decision making.

Under the Delta Plan, covered actions are required to demonstrate the use of best available science in their decision making (see policy G P1 in this chapter). Guidelines and criteria for identifying or developing best available science are provided in Appendix C.
SCIENCE IN THE DELTA – ADVANCES IN UNDERSTANDING

The following is a partial list of scientific advances that have changed understanding of the Delta and California’s water supply over the last decade.

Effects of Climate Change on People and the Environment

- Increased frequency of (1) extreme water heights that cause floods, (2) water temperatures lethal to salmon and delta smelt, and (3) flooding in the Yolo Bypass, which will be much more common by the latter half of this century (Cloern et al. 2011).
- Trends in snowfall versus rainfall precipitation in the western United States show that temperatures have warmed during winter and early spring storms; and, consequently, the fraction of precipitation that falls as snow has declined while the fraction that falls as rain has increased. This shift from snowfall to rainfall will reduce natural water storage and is likely to increase risks of winter and spring flooding (Knowles et al. 2006).
- By mid-century, the Colorado River Reservoir System will not be able to meet all of the demands placed on it, including water supply for Southern California and the inland southwest, because reservoir levels will be reduced by over one-third and releases reduced by as much as 17 percent. Reductions in precipitation for the Colorado River Basin will threaten the ability to meet mandated water allocations (Barnett et al. 2004).

Water Supply Reliability

- The rate of groundwater depletion in the Central Valley was quantified using satellite imaging; approximately 2.5 million acre-feet per year of groundwater was lost during the period from October 2003 to March 2010 (Famiglietti et al. 2011).
- Precipitation and streamflow are proportionally more variable from year to year in California than in any other part of the United States (Dettinger et al. 2011).

Ecosystem Restoration

- Several open-water (pelagic) fish species have undergone steep declines known as the Pelagic Organism Decline (POD) (Sommer et al. 2007). The Interagency Ecological Program investigation of these declines led to new insights about the effects of multiple stressors on these species and the Delta ecosystem (summarized in Baxter et al. 2010). Improved knowledge about the POD also led to regulatory changes for water exports and pollutant discharges.
- In 86 percent of approximately 3,000 assessed streams across the United States, streamflow magnitudes (especially flow maxima and minima) were altered. In comparison to other evaluated stressors, streamflow alterations were found to have the greatest significance for explaining ecological impairment (Carlisle et al. 2011).
- Altered flow regimes by human activities influence the ecological impact of drought anomalies and increase the susceptibility of ecosystems to biological invasion. Extreme climatic events act together with environmental disturbances to enable the establishment of invasive species (Winder et al. 2011).
- Ratios of nutrients in Delta waters have been hypothesized to be a primary driver in the composition of aquatic food webs in the Bay-Delta (Glibert et al. 2011).

Water Quality

- Ammonium concentrations may be having a significant impact on phytoplankton composition and open-water food webs because of suppression of diatom blooms in the Bay-Delta (Dugdale et al. 2007).
- Pyrethroid pesticides largely derived from urban and suburban runoff are regularly found at levels that are toxic to aquatic invertebrates (Weston et al. 2005, Weston and Lydy 2010).

Risk Reduction

- With permanently flooded conditions and managed water depths, short-term sediment accretion rates as high as 7 to 9 centimeters per year can be obtained to help reverse subsidence on Delta islands (Miller et al. 2008).
- Atmospheric rivers (narrow corridors of concentrated moisture in the atmosphere) contribute 33 to 50 percent of the total average amount of rainfall for California and have been the source of many floods along the West Coast of the United States. California’s water resources and floods come from the same storms to an extent, which makes integrated flood and water resources management all the more important (Dettinger et al. 2011).
Adaptive Management

Adaptive management is defined in the Delta Reform Act as:

*a framework and flexible decision making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives (Water Code section 85052).*

Adaptive management is useful in that it provides flexibility and feedback to manage natural resources in the face of often considerable uncertainty. This approach requires careful science-based planning followed by measurement to determine whether a given action actually achieves intended goals.

If goals are not achieved, informed adjustments can be made. This is especially important in the context of the Delta because, in some instances, competing and uncertain explanations arise, and decision making cannot be delayed until causes are better understood (Healey et al. 2008). The Council has adopted a three-phase adaptive management framework for the purposes of developing, implementing, and updating the Delta Plan, described later in this chapter, and also for use by ecosystem restoration and water management covered actions, as set forth in G P1 with additional detail in Appendix C.

A Delta Science Plan

Multiple frameworks for science in the Delta have been proposed, but a comprehensive science plan that specifies how scientific research, monitoring, analysis, and data management will be coordinated among entities has yet to be developed. Currently, science efforts in the Delta are performed by multiple entities with varying missions and mandates, and without an overarching plan. The National Research Council (NRC) found that “only a synthetic, integrated, analytical approach to understanding the effects of suites of environmental factors (stressors) on the ecosystem and its components is likely to provide important insights that can lead to enhancement of the Delta and its species” (NRC 2012). Therefore, a comprehensive science plan for the Delta is needed to organize and integrate ongoing scientific research, monitoring, and learning about the Delta as it changes over time.

A Delta Science Plan will guide efficient use of resources for balancing investments in addressing short-term science needs and those that build understanding over the long run. This plan will address effective governance for science in the Delta, strategies for addressing uncertainty and conflicting scientific information, the prioritization of research, near-term science needs, financial needs to support science, and more. Such a plan is essential to support the adaptive management of ecosystem restoration and water management decisions in the Delta.

Additional detail regarding the proposed Delta Science Plan is provided in recommendation G R1 in this chapter.

The Delta Plan

The Delta Reform Act established the Council and directed it to develop an overarching, long-term management plan for the Delta. Figure 2-1 shows the roles assigned to the Council under the Act. The Act specifically requires that this plan for the Delta include a science-based, formal adaptive management strategy for ongoing ecosystem restoration and water management decisions.

This section presents a three-phase adaptive management framework (Plan, Do, and Evaluate and Respond), describes specific considerations that went into the development of the Delta Plan, and provides the overarching framework for how the Council (in collaboration with others) will implement and continuously amend the Delta Plan to achieve the coequal goals.
Council Roles and the Delta Plan

Several existing frameworks for adaptive management provide the basis for the Delta Plan’s own adaptive management approach. Although there are differences among various frameworks, they generally consist of three broad phases: Plan, Do, and Evaluate and Respond.

Throughout all three phases of the adaptive management process, decisions are made by managers, policy makers, and/or technical experts. In developing an adaptive management plan, the best available science should be used to inform all phases of the adaptive management process.

In addition to requiring adaptive management for certain proposed covered actions, the Council, in coordination with others, will use adaptive management to develop, implement, and update the Delta Plan. The Council will rely in large part on the Delta Science Program to determine the relevance, value, and reliability of the best available science and to organize that information for its use in the Council’s decisions. The Council has the final responsibility for determining the best available science used in support of its actions, including when a choice among competing interpretations of available science must be made.

The three phases of the Council’s adaptive management framework (Plan, Do, and Evaluate and Respond) are shown on Figure 2-2, and are further broken down into nine steps, which are described in detail in Appendix C.

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Plan: Development of the Delta Plan

The first phase of adaptive management is “Plan.” The Plan phase requires clear definition of the problem, establishment of objectives, how to achieve those objectives, and actions for implementation. Performance measures are included to evaluate whether the actions are successfully meeting their intended objectives. As described in Chapter 1, the Council was established in response to an ongoing crisis in the Delta. Water supply reliability and the health of the Delta ecosystem are both at risk, and the status quo—including the patchwork governance of State, local, and federal agencies—is not making acceptable progress toward reversing disturbing trends in a balanced and sustainable manner.

The Delta Plan is intended to be foundational and adaptive. It is foundational in that the Council has built on previous efforts, including CALFED, the Delta Vision, the California Water Plan, planning efforts of the State Water Resources Control Board (SWRCB), the Delta Protection Commission (DPC), and others. The framework established in this Delta Plan is intended to advance the coequal goals of water supply reliability and ecosystem health, and to employ adaptive management to improve the Plan over time.

This Delta Plan officially supersedes and replaces the Interim Delta Plan adopted by the Council on August 27, 2010.

Structure of the Delta Plan

The Delta Plan contains five core policy chapters (Chapters 3 through 7) and a chapter on Funding Principles to Support the Coequal Goals (Chapter 8). The narrative sections of each policy chapter provide subject matter context and rationale for the selection and implementation of core strategies. These core strategies are then broken down into actions: the policies and recommendations. The policies in the Delta Plan are regulatory in nature, and compliance is required for those who propose covered actions. In each policy chapter, the Policies and Recommendations section is followed by a section identifying both science needs and key issues for future evaluation by the Council.

Finally, each policy chapter concludes with a set of performance measures. The Delta Reform Act requires that the Delta Plan include performance measures to evaluate whether it is achieving its objectives over time. Information learned from performance measures will be an important part of how the Council determines when and how to update the Delta Plan as part of the Evaluate and Respond phase of the adaptive management process. See the sidebar, Performance Measures in the Delta Plan, later in this chapter.

Considerations in the Development of the Delta Plan

The Delta Reform Act set forth certain requirements and guidance for the development of the Delta Plan. The Act required the development of several State agency plans to inform the Delta Plan planning process and set forth statutory guidelines for the consideration or inclusion of certain plans, some of which were not yet completed at the date of Delta Plan publication and will be considered in future plan updates.

- Delta Reform Act objectives. The Act lists numerous objectives and, in some sections, provides detailed guidance for what the Delta Plan shall include (see Table 2-2).
- State agency proposals. Specific agencies are named in the Delta Reform Act as being responsible for submitting reports or recommendations to the Council for consideration or inclusion in the Delta Plan. The DPC, California State Parks, and the California Department of Food and Agriculture (CDFA) all submitted proposals that were considered in the development of this Delta Plan.
- Consistency with federal law. The Delta Reform Act requires that the Delta Plan be developed consistent with the federal Clean Water Act, Section 8 of the federal Reclamation Act of 1902, and the federal Coastal Zone Management Act of 1972 (CZMA), or an equivalent compliance mechanism. See sidebar, Federal Participation in Implementing the Delta Plan, for more information.
# Delta Plan Requirements by Water Code Section

<table>
<thead>
<tr>
<th>Water Code Section</th>
<th>Requirement</th>
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<tbody>
<tr>
<td>85211</td>
<td>The Delta Plan shall include performance measurements that will enable the council to track progress in meeting the objectives of the Delta Plan. The performance measurements shall include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends in all of the following:</td>
</tr>
<tr>
<td>85211(a)</td>
<td>– The health of the Delta’s estuary and wetland ecosystem for supporting viable populations of aquatic and terrestrial species, habitats, and processes, including viable populations of Delta fisheries and other aquatic organisms.</td>
</tr>
<tr>
<td>85211(b)</td>
<td>– The reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.</td>
</tr>
<tr>
<td>85300(a)</td>
<td>The Delta Plan shall include subgoals and strategies to assist in guiding state and local agency actions related to the Delta.</td>
</tr>
<tr>
<td>85302(e)</td>
<td>The following subgoals and strategies for restoring a healthy ecosystem shall be included in the Delta Plan:</td>
</tr>
<tr>
<td>85302(e)(1)</td>
<td>– Restore large areas of interconnected habitats within the Delta and its watershed by 2100.</td>
</tr>
<tr>
<td>85302(e)(2)</td>
<td>– Establish migratory corridors for fish, birds, and other animals along selected Delta river channels.</td>
</tr>
<tr>
<td>85302(e)(3)</td>
<td>– Promote self-sustaining, diverse populations of native and valued species by reducing the risk of take and harm from invasive species.</td>
</tr>
<tr>
<td>85302(e)(4)</td>
<td>– Restore Delta flows and channels to support a healthy estuary and other ecosystems.</td>
</tr>
<tr>
<td>85302(e)(5)</td>
<td>– Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.</td>
</tr>
<tr>
<td>85302(e)(6)</td>
<td>– Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.</td>
</tr>
<tr>
<td>85300(a)</td>
<td>The Delta Plan may also identify specific actions that state or local agencies may take to implement the subgoals and strategies.</td>
</tr>
<tr>
<td>85302(a)</td>
<td>Implementation of the Delta Plan shall further the restoration of the Delta ecosystem and a reliable water supply.</td>
</tr>
<tr>
<td>85302(b)</td>
<td>The Delta Plan may include recommended ecosystem projects outside the Delta that will contribute to achievement of the coequal goals.</td>
</tr>
<tr>
<td>85302(c)</td>
<td>The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem:</td>
</tr>
<tr>
<td>85302(c)(1)</td>
<td>– Viable populations of native resident and migratory species.</td>
</tr>
<tr>
<td>85302(c)(2)</td>
<td>– Functional corridors for migratory species.</td>
</tr>
<tr>
<td>85302(c)(3)</td>
<td>– Diverse and biologically appropriate habitats and ecosystem processes.</td>
</tr>
<tr>
<td>85302(c)(4)</td>
<td>– Reduced threats and stresses on the Delta ecosystem.</td>
</tr>
<tr>
<td>85302(c)(5)</td>
<td>– Conditions conducive to meeting or exceeding the goals in existing species recovery plans and state and federal goals with respect to doubling salmon populations.</td>
</tr>
<tr>
<td>85302(d)</td>
<td>The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:</td>
</tr>
<tr>
<td>85302(d)(1)</td>
<td>– Meeting the needs for reasonable and beneficial uses of water.</td>
</tr>
<tr>
<td>85302(d)(2)</td>
<td>– Sustaining the economic vitality of the state.</td>
</tr>
<tr>
<td>85302(d)(3)</td>
<td>– Improving water quality to protect human health and the environment.</td>
</tr>
<tr>
<td>85302(h)</td>
<td>The Delta Plan shall include recommendations regarding state agency management of lands in the Delta.</td>
</tr>
</tbody>
</table>
**Delta Plan Requirements by Water Code Section**

<table>
<thead>
<tr>
<th>Water Code Section</th>
<th>Requirement</th>
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<tbody>
<tr>
<td>85303</td>
<td>The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.</td>
</tr>
<tr>
<td>85304</td>
<td>The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.</td>
</tr>
<tr>
<td>85305(a)</td>
<td>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.</td>
</tr>
<tr>
<td>85305(b)</td>
<td>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.</td>
</tr>
<tr>
<td>85306</td>
<td>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 nonproject levees.</td>
</tr>
<tr>
<td>85307(a)</td>
<td>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.</td>
</tr>
<tr>
<td>85307(b)</td>
<td>The Delta Plan may include local plans of flood protection.</td>
</tr>
<tr>
<td>85307(c)</td>
<td>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.</td>
</tr>
<tr>
<td>85307(d)</td>
<td>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 distribution.</td>
</tr>
<tr>
<td>85308</td>
<td>The Delta Plan shall meet all of the following requirements:</td>
</tr>
<tr>
<td>85308(a)</td>
<td>Be based on the best available scientific information and the independent science advice provided by the Delta Independent Science Board.</td>
</tr>
<tr>
<td>85308(b)</td>
<td>Include quantified or otherwise measurable targets associated with achieving the objectives of the Delta Plan.</td>
</tr>
<tr>
<td>85308(c)</td>
<td>Where appropriate, utilize monitoring, data collection, and analysis of actions sufficient to determine progress toward meeting the quantified targets.</td>
</tr>
<tr>
<td>85308(d)</td>
<td>Describe the methods by which the council shall measure progress toward achieving the coequal goals.</td>
</tr>
<tr>
<td>85308(e)</td>
<td>Where appropriate, recommend integration of scientific and monitoring results into ongoing Delta water management.</td>
</tr>
<tr>
<td>85308(f)</td>
<td>Include a science-based, transparent, and formal adaptive management strategy for ongoing ecosystem restoration and water management decisions.</td>
</tr>
</tbody>
</table>

**Incorporation of the Bay Delta Conservation Plan into the Delta Plan.** The Bay Delta Conservation Plan (BDCP) is a major project considering large-scale improvements in water conveyance and large-scale ecosystem restoration in the Delta. When completed, it must be incorporated into the Delta Plan if it meets certain statutory requirements. Completion of the BDCP process and the number of projects now under consideration in that process would have large impacts on the Delta and would affect the coequal goals. (More detailed discussions of the BDCP are provided in Chapters 3 and 4.) The Delta Reform Act describes a separate, explicit process for incorporating the BDCP into the Delta Plan (Water Code section 85320), and the
Council has adopted administrative procedures governing appeals to the Council related to BDCP incorporation (see Appendix D). If the BDCP is incorporated into the Delta Plan, it becomes part of the Delta Plan and, therefore, part of the basis for future consistency determinations.

**Incorporation of other plans into the Delta Plan.**

The Council may incorporate other plans or programs in whole or in part into the Delta Plan to the extent that they promote the coequal goals.

**Do: Implementation and Oversight of the Delta Plan**

The second phase of adaptive management is “Do.” The “doing,” or implementation, of the Delta Plan will occur over time (through 2100) through the coordinated efforts of many State, local, and federal agencies, in cooperation with nongovernmental organizations and private parties, and Council oversight and exercise of appellate authorities.

Federal participation in implementing the Delta Plan and the coequal goals is described in detail in the sidebar, Federal Participation in Implementing the Delta Plan.

The Council is responsible for overseeing the Delta Plan’s implementation. Given the numerous government agencies that frequently have conflicting or overlapping jurisdictional and programmatic interest in Delta matters (see Table 2-1), there is a compelling need for the Council to fulfill the role as integrator of Delta policy and coordinator of actions. This integration and coordination will occur through convening a formal Interagency Implementation Committee, providing ongoing informal staff-to-staff agency coordination, providing comments and advice from the Council to other agencies on proposed or ongoing plans and programs, holding public hearings, developing science to support the Delta Plan, and using the Council’s appellate authority over consistency of significant actions in the Delta with the Delta Plan.

**Delta Plan Interagency Implementation Committee**

Perhaps the most significant tool the Council will have for implementing the Delta Plan and ensuring accountability is a formal method for active agency coordination. The Delta Reform Act directs the Council to establish and oversee a committee of agencies responsible for implementing the Delta Plan. Notably, the law states that “each agency shall coordinate its actions pursuant to the Delta Plan with the Council and other relevant agencies” (Water Code section 85204). Governance challenges have long plagued management of the Delta and California’s ability to achieve stated objectives for water supply and the Delta ecosystem. Ambiguous and sometimes conflicting authorities and responsibilities among agencies thwart real progress (NRC 2012).

The Council, therefore, will coordinate implementation of the Delta Plan through the establishment and leadership of an Interagency Implementation Committee to do the following:

- Monitor progress of priority actions and agency activities to implement the Delta Plan;
- Report regularly on implementation plans and actions;
- Identify opportunities for integration and leveraging of funding;
- Identify funding needs and support development of a finance plan to implement the Delta Plan;
- Assist in the ongoing development and tracking of Delta Plan performance measures;
- Coordinate regulatory actions on significant projects to implement the Delta Plan, as appropriate; and
- Discuss common issues and resolve interagency conflicts.

The Interagency Implementation Committee, which shall convene at least twice each year and more often as needed, will be overseen by the Council and will be organized around the implementation of the Delta Plan. The Interagency Implementation Committee will include federal, local, and State agency representatives as dictated by the specific matter...
FEDERAL PARTICIPATION IN IMPLEMENTING THE DELTA PLAN

The Delta Reform Act recognizes the federal government’s critical role in achieving the coequal goals through the Delta Plan’s comprehensive, Delta-wide planning and implementation effort. This effort goes beyond federal participation in the more narrowly focused BDCP. This recognition builds upon the history of federal-State cooperative governance efforts in the Delta made necessary by the multitude of federal and State agencies working on interconnected, cross-jurisdictional issues in and related to the Delta, including water project operations, water quality regulation, levee maintenance, habitat restoration, and endangered species regulation.

Federal Law Now Incorporates the Coequal Goals

The federal Energy and Water Development Appropriations Act of 2012 (Title II of the Consolidated Appropriations Act of 2012 (PL 112-074)) contains, in pertinent part, the following:

The Federal policy for addressing California’s water supply and environmental issues related to the Bay-Delta shall be consistent with State law, including the coequal goals of providing a more reliable water supply for the State of California and protecting, restoring, and enhancing the Delta ecosystem... Nothing herein modifies existing requirements of Federal law. (Section 205)

The Council’s staff will work with federal agency representatives to explore opportunities for federal participation in Delta Plan implementation efforts to help those agencies comply with this new Congressional policy directive.

The current regulatory provisions of the Delta Plan, including the consistency review and appeals process, apply to only covered actions of State and local agencies. However, once the Delta Plan is adopted, the Delta Reform Act requires the Council to pursue a compliance mechanism that requires consistency of federal actions. The Delta Reform Act identifies the CZMA, or “an equivalent compliance mechanism,” as the preferred means to accomplish this objective. Under the CZMA, states are authorized to review certain activities of federal agencies, including activities directly conducted by federal agencies and activities permitted or licensed by these agencies, for consistency with a state’s federally approved coastal management program. This review authority applies to any activity that affects any land or water use or natural resource of the state coastal zone.

In this regard, the Council staff has met, and will continue to meet, with federal agency representatives to identify the appropriate process to submit the Delta Plan to the Secretary of Commerce for approval under the CZMA (and with representatives of the California Coastal Commission and the San Francisco Bay Conservation and Development Commission, which administer California’s coastal management program).
Protection Act outlines a process for the DPC to review and provide comments and recommendations to the Council on any significant project or proposed project within the scope of the Delta Plan that may affect the unique values of the Delta (Public Resources Code section 29773(a)). The Council’s adopted procedures include a process whereby the Council will notify the DPC of covered action appeals.

Other Delta Plan Implementation Actions
In addition to convening the Interagency Implementation Committee and carrying out the other responsibilities assigned to it by the Delta Reform Act, the Delta Plan assigns other tasks that will further refine the Delta Plan to the Council. These tasks are described in the following recommendations: G R1 (Chapter 2), WR R5 (Chapter 3), WR R15 (Chapter 3), DP R7 (Chapter 5), DP R19 (Chapter 5), RR R4 (Chapter 7), and FP R1 through R3 (Chapter 8).

Additional Council Authorities in Implementing the Delta Plan
The Delta Reform Act enumerated a range of specific authorities for the Council related to the implementation of the Delta Plan (as shown on Figure 2-1). A full list of authorities can be found in Water Code section 85210 and in various sections of the Delta Reform Act. In implementing the Delta Plan, the Council has the authority to:

- **Comment on environmental impact reports.** The Council has a role in commenting on any State agency environmental impact reports (EIRs) as appropriate to the mission of the Council.

- **Comment on policies related to the coequal goals and implementation of the Delta Plan.** As appropriate, the Council may comment formally on any proposed policies or regulations that will impact the achievement of the coequal goals and the implementation of the Delta Plan.

- **Advise local governments.** The Council has a role in advising local and regional planning agencies regarding the consistency of their planning documents with the Delta Plan. As described in Chapter 5, the Council will review sustainable community strategies and regional transportation plans to prevent conflicts with the Delta Plan and to coordinate metropolitan development with actions in the Delta.

- **Request reports from State, federal, and local agencies.** The Council has the authority to request reports from agencies on issues related to the implementation of the Delta Plan.

- **Hold hearings.** The Council has the authority to hold hearings in all parts of the state and to subpoena witnesses.

- **Develop, coordinate, and promote the use of science through the Delta Science Program.** The Council has a role in providing the best available unbiased scientific information to inform water and environmental decision making in the Delta by funding research, synthesizing and communicating scientific information to policy makers and decision makers, promoting independent peer review, and coordinating with Delta agencies to promote science-based adaptive management.

- **Make consistency determinations upon appeal.** The Legislature intended that State and local actions that would have a significant impact on the coequal goals or a government-sponsored flood control program be consistent with the Delta Plan. The Council has the authority to implement the Delta Plan in part through the enforcement of consistency of covered actions with the Delta Plan upon appeal. The Delta Reform Act also gave the Council a specific appellate role with respect to the BDCP and its future incorporation into the Delta Plan. The Council’s appellate roles, the definition of a covered action, and the consistency determination process and appeals process are described in detail in the Covered Actions and Delta Plan Consistency section later in this chapter.
Monitoring Progress toward Achieving the Coequal Goals

The Council will use existing monitoring efforts (such as the efforts of the Interagency Ecological Program, California Water Quality Monitoring Council, and California Statewide Groundwater Elevation Monitoring) and new monitoring efforts to inform progress toward achieving the performance measures in the Delta Plan. The Council will monitor the progress of programs and projects toward achieving the administrative, output, and outcome performance measures in the current Delta Plan and those developed in the future. Working with others, in particular the Interagency Implementation Committee, the Council will use coordinated information about relevant status and trends and progress toward meeting the coequal goals to inform revisions to the Delta Plan. The Council’s monitoring activities will be reported on the Council website.

When updating the Delta Plan, the Council will consider information from other adaptive management activities in the Delta; evaluation of Delta Plan policies and recommendations; performance measures; other completed plans related to the Delta; and coordination, hearings, and oversight. The Council will rely in large part on the Delta Science Program for determining the relevance, value, and reliability of the best available science, and organizing that information for its use in the Council’s decisions. The Council has the final responsibility for determining the best available science used in support of its actions, including when a choice among competing interpretations of available science must be made.

Reporting on Delta Plan Performance Measures

This Delta Plan contains preliminary performance measures developed to monitor performance of Delta Plan policies and recommendations. (See sidebar, Performance Measures in the Delta Plan, for more detailed information.) Upon adoption of the Delta Plan, staff will take the lead, working with scientific, agency, and stakeholder experts to continue to refine the Delta Plan’s performance measures. Delta Plan performance measures will be periodically reviewed by independent expert review panels and will be sent to the Delta ISB for further review and comment. The resulting updated performance measures will be developed no later than December 31, 2014, for consideration by the Council for incorporation into the Delta Plan. The Council will issue periodic public reports on the status of performance measures.

Evaluate and Respond: Updating and Amending the Delta Plan

The third phase of Delta Plan adaptive management is “Evaluate and Respond.” According to the Delta Reform Act, the Council must review the Delta Plan at least once every 5 years and can revise it as the Council deems appropriate. This authority is consistent with the Council’s obligation to base the Delta Plan on the best available scientific information and to use an adaptive management approach in updating the Plan as new information becomes available.

Data collection related to the Delta and water management in California is already occurring, although more is needed. The Council, through the Interagency Implementation Committee and working with stakeholders, will report regularly on Delta Plan performance measures and the Delta Plan’s progress in advancing the coequal goals. These reports will be made available to the public.
PERFORMANCE MEASURES IN THE DELTA PLAN

The performance measures included in this Delta Plan are primarily administrative measures focused on implementation of near-term actions (generally, actions contained within policies and recommendations of the Delta Plan) that support the coequal goals. This initial set of performance measures will be expanded and refined after adoption of the Delta Plan and will be considered for inclusion in subsequent updates of the Delta Plan.

Delta Plan performance measures have been placed into three general classes:

• Administrative performance measures describe decisions made by policy makers and managers to finalize plans or approve resources (funds, personnel, projects) for implementation of a program or group of related programs.
• Output (also known as “driver”) performance measures evaluate the factors that may be influencing outcomes and include on-the-ground implementation of management actions, such as acres of habitat restored or acre-feet of water released, as well as natural phenomena outside of management control (such as a flood, earthquake, or ocean conditions).
• Outcome performance measures evaluate responses to management actions or natural outputs.

Administrative performance measures are included in Appendix E. Output and outcome performance measures, where appropriate, are included at the end of individual chapters.

Development of informative and meaningful performance measures is a challenging task that will continue after the adoption of the Delta Plan. Performance measures need to be designed to capture 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 Council will improve all performance measures, but will focus on outcome measures through a multiyear effort, using successful approaches for developing performance measures employed by similar efforts elsewhere (such as the Kissimmee River Restoration, The State of San Francisco Bay, and Healthy Waterways Southeast Queensland, Australia) as positive examples (see Appendix C for more information).

Communication and the Delta Plan

Keeping the public and decision makers informed as future Delta Plan changes are proposed and considered is a vital step. The Council is committed to open communication of current understanding gained through the evaluation of performance measures, monitoring, science, and adaptive management. This communication will be continuous as the Council receives and produces information that will be used to adapt its strategy toward meeting the coequal goals and updating the Delta Plan.

The Council’s website and meetings will remain the central hub for communicating information about progress toward meeting the coequal goals and the objectives of the Delta Plan. Information learned from the analysis, synthesis, and evaluation of how well the policies and recommendations in the Delta Plan are meeting their intended goals will be gathered and communicated through a number of media and forums that may include:

• The Council’s meetings and workshops, website, social media, and newsletter
• Staff reports on the status and trends of the Delta Plan performance measures
• Reports, presentations, and correspondence presented to the Council
• Interagency Implementation Committee meetings and products
• The Delta Science Program website, Science News; the online journal, San Francisco Estuary & Watershed Science; brown bag seminars; and Biennial Bay-Delta Science Conference
• Delta ISB meetings and products

Covered Actions and Delta Plan Consistency

The Delta Reform Act directs the Council to develop a legally enforceable long-term management plan for the Delta
(this Delta Plan) and includes a mechanism for enforcement of Delta Plan policies over State and local actions identified as covered actions (Water Code sections 85001(c) and 85022). The Council has taken a hybrid approach to developing the Delta Plan by including both regulatory policies and nonregulatory recommendations. This section presents a discussion of the process and general requirements for certifying consistency with the Delta Plan through compliance with its regulatory policies, and includes examples of covered actions and exemptions.

Delta Plan regulatory policies are not intended and shall not be construed as authorizing the Council or any entity acting pursuant to this section to exercise their power in a manner that will take or damage private property for public use without the payment of just compensation. These policies are not intended to affect the rights of any owner of property under the Constitution of the State of California or the United States. None of the Delta Plan policies increases the State’s flood liability.

**Covered Actions Must Comply with Delta Plan Policies**

The Delta Reform Act requires State and local actions that fit the legal definition of a covered action to be consistent with the policies included in the Delta Plan. The mechanism for determining consistency is the filing of a certification of consistency. Not all actions that occur in whole or in part in the Delta are covered actions. Only certain activities qualify as covered actions, and the Delta Reform Act establishes specific criteria and exclusions, discussed in this chapter. Furthermore:

- The State or local agency that carries out, approves, or funds a proposed action (“proponents”) needs to certify consistency with the policies included in the Delta Plan.
- In the case of all other actions (those that do not meet the criteria of being a covered action or are otherwise explicitly excluded), the Delta Plan’s policies, where applicable, are recommendations.

**What Is a Covered Action?**

For a State or local agency to determine whether its proposed plans, programs, or projects are covered actions under the Delta Plan and, therefore, subject to the regulatory provisions in the plan, it must start with the Delta Reform Act, which defines a covered action as (Water Code section 85057.5(a)):

> ...a plan, program, or project as defined pursuant to Section 21065 of the Public Resources Code that meets all of the following conditions:

1. Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh;
2. Will be carried out, approved, or funded by the state or a local public agency;
3. Is covered by one or more provisions of the Delta Plan;
4. Will have a significant impact on the achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and state interests in the Delta.

Figure 2-3 shows the steps to follow for identifying whether a proposed plan, project, or program is a covered action.

**Screening Criteria for Covered Actions**

As used in this Delta Plan, the statutory criteria for covered actions under the Delta Plan are collectively referred to as “screening criteria.” Before using the screening criteria, a
project proponent should first determine whether its proposed plan, program, or project is exempt from covered action status under either the Council’s administrative exemptions or the Delta Reform Act’s statutory exemptions, discussed below. Early consultation with Council staff is encouraged and can assist in this determination.

1. **Is a “Project,” as defined by section 21065 of the Public Resources Code.** A proponent’s first step in determining whether a plan, program, or project is a covered action is to identify whether it meets the definition of a project as defined in Public Resources Code section 21065. That particular provision is the section of the California Environmental Quality Act (CEQA) that defines the term “project” for purposes of potential review under CEQA. If the plan, program, or project does indeed meet the definition of a project under CEQA, the next step in determining a covered action is to review the four additional screening criteria in the definition of covered action, all of which must be met by a proposed plan, program, or project for it to qualify as a covered action (see sidebar, What Does CEQA Consider a “Project”?).

2. **Will occur in whole, or in part, within the boundaries of the Delta or Suisun Marsh.** To qualify as a covered action, a project must include one or more activities that take place at least partly within the Delta or Suisun Marsh. This means, for example, that the diversion and use of water in the Delta watershed that is entirely upstream of the statutory Delta or Suisun Marsh would not satisfy this criterion. By contrast, this criterion would be met if water intended for use upstream were transferred through the statutory Delta or Suisun Marsh (pursuant, for example, to a water transfer longer than 1 year in duration).

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2 It is important to note that CEQA’s various statutory and categorical exemptions—which are considered only after the threshold determination of a CEQA “project” is made—are not similarly incorporated by cross-reference in the definition of covered action. Therefore, the Delta Plan must expressly incorporate a CEQA exemption for it to apply to the Delta Plan.
3. **Will be carried out, approved, or funded by the State or a local public agency.** If these screening criteria are met, it is recommended that the “significant impact” criteria be analyzed next.

4. **Will have a significant impact on the achievement of one or both of the coequal goals or the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta.** In addition, a proposed project must have a “significant impact” as defined under Water Code section 85057.5(a)(4) to qualify as a covered action. For this purpose, significant impact means a substantial positive or negative impact on the achievement of one or both of the coequal goals or the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta, that is directly or indirectly caused by a project on its own or when the project’s incremental effect is considered together with the impacts of other closely related past, present, or reasonably foreseeable future projects. The coequal goals and government-sponsored flood control programs are further defined in Chapters 3, 4, and 7.

The following categories of projects will not have a significant impact for this purpose:

- “Ministerial” projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(1);
- “Emergency” projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(2) through (4);
- Temporary water transfers of up to 1 year in duration. The Council contemplates that any extension would be based upon DWR and the SWRCB’s participation with stakeholders to identify and implement transfer measures, as recommended in WR R15;
- Other projects exempted from CEQA, unless there are unusual circumstances indicating a reasonable possibility that the project will have a significant impact under Water Code section 85057.5(a)(4). Examples of unusual circumstances could arise in connection with, among other things:
  - Local government general plan amendments for the purpose of achieving consistency with the DPC’s Land Use and Resource Management Plan; and
  - Small-scale habitat restoration projects, as referred to in CEQA Guidelines, section 15333 of Title 14 of the California Administrative Code, proposed in important restoration areas, but which are inconsistent with the Delta Plan’s policy related to appropriate habitat restoration for a given land elevation.

### WHAT DOES CEQA CONSIDER A “PROJECT”?*

Public Resources Code section 21065 (which is incorporated by reference in the Delta Reform Act) defines the term “project” in the following manner:

21065. “Project” means an activity which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment, and which is any of the following:

(a) An activity directly undertaken by any public agency.

(b) An activity undertaken by a person which is supported, in whole or in part, through contracts, grants, subsidies, loans, or other forms of assistance from one or more public agencies.

(c) An activity that involves the issuance to a person of a lease, permit, license, certificate, or other entitlement for use by one or more public agencies.

The Council will consider, as part of its ongoing adaptive management of the Delta Plan, whether these exemptions
remain appropriate and/or whether the Delta Plan should be amended to include other types of projects.

If the above four screening criteria are met, then for purposes of the Delta Plan, the plan, program, or project is referred to as a “proposed action.” Although a proposed action meets the first four screening criteria, the action has not yet been reviewed by the State or local agency to determine whether it meets the fifth screening criterion: is the proposed action covered by one or more Delta Plan policies? If the proposed action is covered by at least one Delta Plan regulatory policy, then the proposed action is a “covered action.” If the proposed action is not covered by any Delta Plan regulatory policy, it is not a covered action.

5. **Is covered by one or more provisions of the Delta Plan.** This means that the proposed action must be covered by one or more regulatory policies contained in Chapters 3 through 7 of the Delta Plan. Each of those regulatory policies specifies the types of proposed actions that they cover. If the proposed action is covered by one or more provisions of the Delta Plan—the final criteria—the proposed action is, therefore, a covered action.

**Statutory Exemptions**

Certain actions are statutorily excluded from the definition of covered action and are exempt from the Council’s regulatory authority (Water Code section 85057.5(b)). A complete list is included in Appendix F. These exemptions include:

- A regulatory action of a State agency (such as the adoption of a water quality control plan by the SWRCB, or the issuance of a California Endangered Species Act take permit by DFW)
- Routine maintenance and operation of the State Water Project or the Central Valley Project
- Routine maintenance and operation of any facility located, in whole or in part, in the Delta, that is owned or operated by a local public agency (such as routine maintenance of levees by a reclamation district)

Although a regulatory action by another State agency is not a covered action, the underlying action regulated by that agency can be a covered action (provided it otherwise meets the definition). The Council has concurrent jurisdiction over covered actions when that action is also regulated by another State agency. For example, the issuance of a California Endangered Species Act take permit by DFW is a regulatory action of a State agency and, therefore, is not a covered action. However, the underlying action requiring the take permit could be a covered action, and, if it is, it must be consistent with the Delta Plan’s policies. Therefore, even when a covered action is regulated by another agency (or agencies), the covered action still must be consistent with the Delta Plan. In the situation where a covered action is governed by multiple agencies and laws, the action must comply with all relevant legal requirements.

**Who Determines Whether a Proposed Plan, Program, or Project Is a Covered Action?**

A State or local agency that proposes to carry out, approve, or fund a plan, program, or project is the entity that must determine whether that plan, program, or project is a covered action. That determination must be reasonable, made in good faith, and consistent with the Delta Reform Act and relevant provisions of this Plan. If requested, Council staff will meet with an agency’s staff during early consultation to review consistency with the Delta Plan and to offer advice as to whether the proposed plan, program, or project appears to be a covered action, provided that the ultimate determination in this regard must be made by the agency. If an agency determines that a proposed plan, program, or project is not a covered action, that determination is not subject to Council regulatory review, but is subject to judicial review as to whether it was reasonable, made in good faith, and is consistent with the Delta Reform Act and relevant provisions of this Plan.
Mitigation of Significant Adverse Impacts on the Environment

Public Resources Code section 21081.6 requires a public agency to adopt a mitigation monitoring or reporting program (MMRP) to ensure compliance with the mitigation measures adopted by the agency at the time of project approval. The MMRP is a working implementation document to ensure that mitigation measures are implemented. The MMRP for the Delta Plan Program Environmental Impact Report (PEIR), as amended, ensures compliance with all mitigation measures adopted and incorporated into the Delta Plan. The Delta Plan MMRP lists all mitigation measures adopted and incorporated into the Delta Plan, when they need to be implemented, who is responsible for implementing them, and who reports on compliance. As specified in policy G P1 of the Delta Plan, any covered action that is not exempt must include either all applicable mitigation measures adopted and incorporated into the Delta Plan; substitute mitigation measures that the proposing agency finds to be equally or more effective than the Delta Plan mitigation measures; or an explanation of why any Delta Plan mitigation measure is not feasible. Monitoring and/or reporting on implementation of the adopted Delta Plan mitigation measures will be accomplished through the certification of consistency process as part of the certification forms. The MMRP can be found on the Council’s website at http://deltacouncil.ca.gov/ and as Appendix O.

Certifications of Consistency

Once a State or local agency has determined that their plan, program, or project is a covered action under the Delta Plan, they are required to submit a written certification to the Council, with detailed findings, demonstrating that the covered action is consistent with the Delta Plan (Water Code section 85225 et seq.). Furthermore:

- The first policy in the Delta Plan, G P1, describes requirements to be included in the certification of consistency for all covered actions and is included in this chapter.
- The certification of consistency must be submitted to the Council prior to initiating implementation of the covered action.
- The certification of consistency should not be submitted to the Council until the covered action has been fully described and the impacts associated with the covered action have been identified; this coincides with the completion of the CEQA process.
- Should the covered action project change substantially, the agency will be required to submit a new certification of consistency to the Council.

The Council has developed a discretionary checklist that agencies may use to facilitate the process, as well as certification forms and related materials, available on the Council website.

Bay Delta Conservation Plan Covered Activity Consistency Certification

The Delta Reform Act describes a specific process for the potential incorporation of BDCP into the Delta Plan. If BDCP is incorporated, an agency proposing a qualifying “covered activity” under BDCP that also meets the statutory definition of a covered action must file a short form certification of consistency with findings indicating only that the covered action is consistent with the BDCP. Consistency for these purposes shall be presumed if the certification filed by the agency includes a statement to that effect from DFW.

Covered Action Consistency Appeals

In contrast to how many other governmental plans are implemented, the Council does not exercise direct review and approval authority over covered actions to determine their consistency with the regulatory policies in the Delta Plan. Instead, State or local agencies self-certify Delta Plan consistency, and the Council serves as an appellate body for those determinations.
Any person, including any member of the Council or its Executive Officer, who claims that a covered action is inconsistent with the Delta Plan and, as a result of that inconsistency, will have a significant adverse impact on the achievement of one or both of the coequal goals or implementation of government-sponsored flood control program, may file an appeal with regard to a certification of consistency submitted to Council.

The Council has appellate authority to determine the consistency of covered actions with the Delta Plan if they are challenged. The Council is required to apply the standard of substantial evidence when reviewing covered action appeals. State or local agencies are required to submit detailed findings upon filing their consistency determination, described previously. These findings and the record will provide the basis for the Council’s decision making. Per statute, an appeal must be filed within 30 days; if a valid appeal is filed, the Council is responsible for subsequent evaluation and determination—as provided in statute and the Council’s Administrative Procedures Governing Appeals—of whether the covered action is consistent with the Delta Plan’s policies. More than one policy in the Delta Plan may apply to a covered action. If no person appeals the certification of consistency, the State or local public agency may proceed to implement the covered action.

In the event of an appeal of a covered action, the Council may consult with the DPC consistent with Public Resources Code section 29773.

Upon receiving an appeal, the Council has 60 days to hear the appeal and an additional 60 days to make its decision and issue specific written findings. If the covered action is found to be inconsistent, the project may not proceed until it is revised so that it is consistent with the Delta Plan.

The appeals process is described in statute and further defined in the appeals procedures adopted by the Council; it is attached for reference purposes as Appendix D.
POLICIES AND RECOMMENDATIONS

State and local agencies approve many important plans, programs, and projects annually that are in or otherwise affect the Delta. Interagency coordination is often limited and, despite the Delta’s special status, there are no overarching guidelines or coordinated best management practices to ensure that all significant actions use best available science or adaptive management in particular. The Delta Reform Act, in describing a process for coordinating actions under the Delta Plan, requires that State or local government actions are consistent with the Delta Plan and supported by detailed findings. Policy G P1 describes compliance requirements for covered actions that are to be included in the project proponent’s written findings.

Problem Statement

Independent and disparate actions by individual agencies can lead to conflict and reduce successful achievement of the coequal goals. Lack of uniform use of best available science and adaptive management for water supply and ecosystem projects can lead to unintended consequences, reduced likelihood of project success, and increased likelihood of adverse environmental impacts. In addition, management actions can be delayed when uncertainty exists, while adaptive management allows for flexible decision making despite uncertainty.

In some cases, project proponents do not carefully plan for the resources and costs of monitoring and tracking, and full adaptive management does not occur. Failure of significant Delta-related actions to comply with existing law can thwart the successful achievement of the coequal goals.

Policies

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

G P1. Detailed Findings to Establish Consistency with the Delta Plan

(a) This policy specifies what must be addressed in a certification of consistency filed by a State or local public agency with regard to a covered action. This policy only applies after a “proposed action” has been determined by a State or local public agency to be a covered action because it is covered by one or more of the policies contained in Article 3. Inconsistency with this policy may be the basis for an appeal.

(b) Certifications of consistency must include detailed findings that address each of the following requirements:

(1) Covered actions, in order to be consistent with the Delta Plan, must be consistent with this regulatory policy and with each of the regulatory policies contained in Article 3 implicated by the covered action. The Delta Stewardship Council acknowledges that in some cases, based upon the nature of the covered action, full consistency with all relevant regulatory policies may not be feasible. In those cases, the agency that files the certification of consistency may nevertheless determine that the covered action is consistent with the Delta Plan because, on whole, that action is consistent with the coequal goals. That determination must include a clear identification of areas where consistency with relevant regulatory policies is not feasible, an explanation of the reasons why it is not feasible, and an explanation of how the covered action nevertheless, on whole, is consistent with the coequal goals. That determination is subject to review by the Delta Stewardship Council on appeal;

(2) Covered actions not exempt from CEQA must include all applicable feasible mitigation measures adopted and incorporated into the Delta Plan as amended April 26, 2018 (unless the measure(s) are within the exclusive jurisdiction of an agency other than the agency that files the certification of consistency), or substitute mitigation measures that the agency that files the certification of consistency finds are equally or more effective;

(3) As relevant to the purpose and nature of the project, all covered actions must document use of best available science;

(4) Ecosystem restoration and water management covered actions must include adequate provisions, appropriate to the scope of the covered action, to assure continued implementation of adaptive management. This requirement shall be satisfied through both of the following:

(A) An adaptive management plan that describes the approach to be taken consistent with the adaptive management framework in Appendix 1B, and
CHAPTER 2 THE DELTA PLAN

(B) Documentation of access to adequate resources and delineated authority by the entity responsible for the implementation of the proposed adaptive management process.

(c) A conservation measure proposed to be implemented pursuant to a natural community conservation plan or a habitat conservation plan that was:

1. Developed by a local government in the Delta; and
2. Approved and permitted by the California Department of Fish and Wildlife prior to May 16, 2013

is deemed to be consistent with sections 5005 through 5009 of this Chapter if the certification of consistency filed with regard to the conservation measure includes a statement confirming the nature of the conservation measure from the California Department of Fish and Wildlife.

23 CCR Section 5002
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85225, 85225.10, 85020, 85054, 85302(g), and 85308, Water Code.

Problem Statement
Currently, science efforts related to the Delta are performed by multiple entities with multiple agendas and without an overarching plan for coordinating data management and information sharing among entities. Increasingly, resource management decisions are made in the courtroom as conflicting science thwarts decision making and delays action. Multiple frameworks for science in the Delta have been proposed, but a comprehensive science plan that organizes and integrates ongoing scientific research, monitoring, analysis, and data management among entities has yet to be fully formulated.

Recommendations
G R1. Development of a Delta Science Plan
The Delta Stewardship Council’s Delta Science Program should develop a Delta Science Plan by December 31, 2013. The Delta Science Program should work with the Interagency Ecological Program, Bay Delta Conservation Plan, California Department of Fish and Wildlife, and other agencies to develop the Delta Science Plan. To ensure that best science is used to develop the Delta Science Plan, the Delta Independent Science Board should review the draft Delta Science Plan.

The Delta Science Plan should address the following:
- A collaborative institutional and organizational structure for conducting science in the Delta
- Data management, synthesis, scientific exchange, and communication strategies to support adaptive management and improve the accessibility of information
- Strategies for addressing uncertainty and conflicting scientific information
- Prioritization of research and balancing of the short-term immediate science needs with science that enhances comprehensive understanding of the Delta system over the long term
- Identification of existing and future needs for refining and developing numerical and simulation models along with enhancing existing Delta conceptual models (e.g., the Interagency Ecological Program (IEP) Pelagic Organism Decline (POD) and the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) models)
- An integrated approach for monitoring that incorporates existing and future monitoring efforts
- An assessment of financial needs and funding sources to support science

Timeline for Implementing Policies and Recommendations
Figure 2-4 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.
### Timeline for Implementing Policies and Recommendations

<table>
<thead>
<tr>
<th>ACTION (REFERENCE #)</th>
<th>LEAD AGENCY(IES)</th>
<th>NEAR TERM 2012–2017</th>
<th>INTERMEDIATE TERM 2017–2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed findings to establish consistency with the Delta Plan (G P1)</td>
<td>Varies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of a Delta Science Plan (G R1)</td>
<td>Council</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Delta Plan Interagency Implementation Committee</td>
<td>Council</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Agency Key:**
- Council: Delta Stewardship Council

Figure 2-4
References


Interagency Ecological Program for the San Francisco Estuary.


**Photo Credits**

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Page 31: ZoArt Photography

Page 45: Delta Stewardship Council
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ABOUT THIS CHAPTER

This chapter provides an overview of California’s water supply, where it comes from, and how it is used. It also describes California’s water policy foundations, including federal, State of California (State), and local policies, laws, and programs, and the need for continued improvements in local water planning, management, and information. It explains the special role of the Sacramento-San Joaquin Delta (Delta) in California’s water, including its history, conflicts and challenges, and necessary investments and changes to achieve flexibility, improve resiliency, and increase water supply reliability.

As a starting point for this Delta Plan, four core water strategies must be implemented throughout the state to achieve the coequal goal of providing a more reliable water supply for California:

■ Increase water conservation and expand local and regional supplies
■ Improve groundwater management
■ Improve conveyance and expand storage
■ Improve water management information

These core strategies form the basis of the 2 policies and 19 recommendations found at the end of the chapter.

In 2018, the Delta Stewardship Council amended the Delta Plan to promote options for water conveyance\(^1\), storage systems, and the operation of both as required by Water Code Section 85304, based on historical information and the best currently available science\(^2\). The additional recommendations for Delta water management system operations and supporting infrastructure
improvements, together and in combination with existing Delta Plan policies and recommendations, will further the coequal goals. The amendment recommendations are based upon the 19 Principles for Water Conveyance in the Delta, Storage Systems, and for the Operation of Both to Achieve the Coequal Goals adopted by the Delta Stewardship Council in November 2015 and input from Council members and the public.

1 “Conveyance” is defined in the Delta Plan as the movement of water from one place to another. Conveyance infrastructure includes natural watercourses as well as canals, pipelines, and control structures including weirs. See also Glossary.

2 “Best available science” means the best scientific information and data for informing management and policy decisions (23 California Code of Regulations Section 5001).

3 http://deltacouncil.ca.gov/docs/19-principles-water-conveyance-delta-storage-systems-and-operation-both-achieve-coequal-goals
The Sacramento-San Joaquin Delta Reform Act of 2009 declares State policy for California’s water resources and the Delta (Water Code section 85054):

"Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

The Legislature declares the following objectives inherent in the coequal goals for management of the Delta (Water Code section 85020):

(a) Manage the Delta’s water and environmental resources and the water resources of the State over the long term.

(d) Promote statewide water conservation, water use efficiency, and sustainable water use.

(f) Improve the water conveyance system and expand statewide water storage.

The Legislature declared that:

85004(b) Providing a more reliable water supply for the state involves implementation of water use efficiency and conservation projects, wastewater reclamation projects, desalination, and new and improved infrastructure, including water storage and Delta conveyance facilities.

Reduced reliance on the Delta for water supplies is established as State policy, along with an associated mandate for regional self-reliance (Water Code section 85021):

The policy of the State of California is to reduce reliance on the Delta in meeting California’s future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.

Water Code sections 85302, 85303, 85304, and 85211 provide direction on measures that must be included in the Delta Plan to meet the statewide water supply policy goals and objectives, and ultimately the coequal goal of increased water supply reliability:

85302(d) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:

(1) Meeting the needs for reasonable and beneficial uses of water.

(2) Sustaining the economic vitality of the State.

(3) Improving water quality to protect human health and the environment.

85303 The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.

85304 The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.

85211 The Delta Plan shall include performance measurements that will enable the council to track progress in meeting the objectives of the Delta Plan. The performance measurements shall include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends...

(b) The reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.

The longstanding constitutional principle of reasonable use and the Public Trust Doctrine form the
foundation of California’s water management policy, and are particularly applicable to the Delta watershed and to the others areas that use Delta water as the basis for resolving water conflicts (Water Code section 85023). The constitutional principle is defined in Section 2 of Article X of the California Constitution as:

The right to water or to the use or flow of water in or from any natural stream or water course in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water.

Water Code sections 85031 and 85032 provide clarification that existing water rights, procedures, or laws are not affected:

85031(a) This division does not diminish, impair, or otherwise affect in any manner whatsoever any area of origin, watershed of origin, county of origin, or any other water rights protections, including, but not limited to, rights to water appropriated prior to December 19, 1914, provided under the law. This division does not limit or otherwise affect the application of Article 1.7 (commencing with Section 1215) of Chapter 1 of Part 2 of Division 2, Sections 10505, 10505.5, 11128, 11460, 11461, 11462, and 11463, and Sections 12200 to 12220, inclusive.

(b) For the purposes of this division, an area that utilizes water that has been diverted and conveyed from the Sacramento River hydrologic region, for use outside the Sacramento River hydrologic region or the Delta, shall not be deemed to be immediately adjacent thereto or capable of being conveniently supplied with water therefrom by virtue or on account of the diversion and conveyance of that water through facilities that may be constructed for that purpose after January 1, 2010.

(c) Nothing in this division supersedes, limits, or otherwise modifies the applicability of Chapter 10 (commencing with Section 1700) of Part 2 of Division 2, including petitions related to any new conveyance constructed or operated in accordance with Chapter 2 (commencing with Section 85320) of Part 4 of Division 35.

(d) Unless otherwise expressly provided, nothing in this division supersedes, reduces, or otherwise affects existing legal protections, both procedural and substantive, relating to the state board’s regulation of diversion and use of water, including, but not limited to, water right priorities, the protection provided to municipal interests by Sections 106 and 106.5, and changes in water rights. Nothing in this division expands or otherwise alters the board’s existing authority to regulate the diversion and use of water or the courts’ existing concurrent jurisdiction over California water rights.

85032 This division does not affect any of the following:

(a) The Natural Community Conservation Planning Act (Chapter 10 (commencing with Section 2800) of Division 3 of the Fish and Game Code).

(b) The California Endangered Species Act (Chapter 1.5 (commencing with Section 2050) of Division 3 of the Fish and Game Code).

(c) The Fish and Game Code.

(d) The Porter-Cologne Water Quality Control Act (Division 7 (commencing with Section 13000).

(e) Chapter 8 (commencing with Section 12930) of Part 6 of Division 6.

(f) The California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code).

(g) Section 1702.

(h) The application of the public trust doctrine.

(i) Any water right.

(j) The liability of the state for flood protection in the Delta or its watershed.
In California, the conflicts over water are legendary. The connotations of wealth and power associated with control over water were captured in dramatic fashion in the 1974 film *Chinatown*. A decade later, Marc Reisner’s bestselling nonfiction book, *Cadillac Desert*, described vast, arid California land tracts turned to lush, productive fields through the modern magic of water diversion and irrigation. California is known for many things: the urban, cultural giant that is Los Angeles; the great Central Valley, breadbasket to the world; cutting-edge technological advances hailing from Silicon Valley; and the fertile human-made islands of the Delta. The thread that ties these places together is a supply of fresh water from the Sacramento-San Joaquin watershed. Similarly, dozens of fish species—some of them threatened by extinction—and a diverse palette of flora and fauna also depend on this water. As described in Chapter 1, at the heart of California’s water troubles are scarcity of supply and competing uses—in particular, conflict with the water needs of the ecosystem. This dynamic of conflict characterizes the essential debate over management of the Delta.

Building on the foundations of California water policy, the Delta Reform Act established the goal of providing “a more reliable water supply for California.” This is coequal with the goal of “protecting, restoring, and enhancing the Delta ecosystem.” Both must be accomplished while protecting and enhancing the unique values of the Delta as an evolving place. (See sidebar, What Does It Mean to Achieve the Goal of Providing a More Reliable Water Supply for California?)

The Delta Reform Act recognizes that the “Delta watershed and California’s water infrastructure are in crisis and existing Delta policies are not sustainable” (Water Code section 85001(a)). The economies of major regions of the state are reliant upon the ability to use water within the Delta watershed or on water imported from the Delta watershed. Yet, the long-term impacts of these diversions, on the Delta and its watershed, in combination with many other factors, are causing native fisheries to decline. In recent years, the populations of salmon and several other fish species have reached their lowest numbers in recorded history, and many of California’s salmon runs are now listed as endangered by the State or federal government. The courts have responded by imposing constraints, particularly in dry years, on water diversions through the Delta. As a result, water deliveries—particularly those that come from the State Water Project (SWP) and the federal Central Valley Project (CVP)—have become increasingly unpredictable.

The Delta and California’s water supply systems are in crisis (Nichols et al. 1986; Service 2007; Moyle et al. 2013, 2016; Moyle 2014; Luoma et al. 2015), and existing Delta water management practices are not sustainable (Lund, 2016). The recent drought followed by record precipitation underscores this crisis (Medellín-Azuara et al. 2015; Lund 2016). For decades, human-produced alterations to the Delta’s landscape and the operations of water management projects in the Delta and throughout the watershed have combined with multiple other factors to create stressors that imperil the Delta ecosystem and state-wide water supply reliability (Hanak et al. 2013; Mount et al. 2012).
The Delta Reform Act mandates many strategies that the Delta Plan must address to improve water supply reliability for California:\footnote{See Water Code sections 85004(b), 85020(d) and (f), 85021, 85023, 85302(d), 85303, and 85304.}

- Promote, implement, and invest in water efficiency and conservation
- Implement and invest in wastewater reclamation and water recycling
- Increase and invest in desalination and advanced water treatment technologies
- Promote and implement options for improved water conveyance
- Expand and invest in storage
- Improve water quality to protect human health and the environment
- Invest in local and regional water supply projects and coordination
- Prohibit waste and unreasonable use, consistent with Article X, Section 2 of the California Constitution, and protect public trust resources consistent with the Public Trust Doctrine

California’s precipitation is extremely variable, and both droughts and floods are not uncommon, even occurring in back-to-back years. Therefore, the State must adapt its water infrastructure and operations in the Delta to make better use of the greater volumes of water that are and, in the future, will continue to be available during wet years, and to take less water during dry years when conflicts with the Delta ecosystem and in-Delta water quality are at their greatest. Concurrently, the development and careful management of local water resources hold tremendous potential for improving water reliability and must be a priority for California.

Management of any natural resource is a continual balancing act. Establishment of the coequal goals provides policy priorities when it comes to managing water, but continuing disputes are inevitable. Given that water in California is scarce, actions that occur in one corner of the state can have ripple effects hundreds of miles away. Levee failures in the Delta may interrupt water supplies to industry in San Diego. Conversely, the way Southern California regions manage their water may affect California’s water-dependent ecosystems. The management of a salinity regime to benefit the environment has implications for in-Delta water users. Upstream water use can affect the quality and quantity of water for all downstream users—urban, agricultural, or environmental. Decades-old decisions to drain swamps, build intrastate water projects, and mine gold have left legacy imprints on California’s water and ecosystem management.

Although exports from the Delta account for only a fraction of California’s water supplies, the Delta is of widespread importance given its geographic location and influential role in ecosystem dynamics. Those who live in the Delta watershed are concerned about how management actions in the Delta may affect them; those who live in the Delta are keenly aware of others’ interest in their backyard; and those who rely fully or partially on Delta exports, in some cases located hundreds of miles from the Delta itself, fear the impacts of reduced water supply reliability on their local economies and standard of living.

The broad influence of the Delta is precisely why the Delta crisis cannot be resolved by taking actions in the Delta alone. The Delta Reform Act establishes a new policy for California of reducing “reliance on the Delta in meeting California’s future water supply needs” (Water Code section 85021). Reduced reliance is to be achieved through a statewide strategy of investing in improved local and regional supplies, conservation, and water use efficiency so that “each region that depends on water from the Delta watershed shall improve its regional self-reliance.” The State’s water planning document, the California Water Plan – Update 2009, estimates that California could reduce water demand and increase water supply in the range of 5 to 10 million acre-feet (MAF).
by 2030 just through the implementation of existing strategies and technology (DWR 2009). This amount of water is more than enough to meet the projected water demands of California’s growing population through 2050. An integrated approach that includes increased water efficiency, local and regional diversification of water supplies, reduced reliance on water from the Delta, improved regional self-reliance, and concurrent improvements to storage and Delta infrastructure will build the resiliency and reliability of California’s water supply.

Accordingly, the Delta Stewardship Council (Council) envisions a future in which California has achieved the coequal goal of improved water supply reliability. In the future:

- California’s water resources will be better managed, consistent with the State’s Reasonable Use and Public Trust Doctrines.
- Improved efficiency and a greater diversity of sources will make more water available to meet the state’s demands.
- Groundwater resources will be sustainably managed, and critical overdraft in groundwater basins will have been eliminated.
- Water suppliers in regions that use water from the Delta watershed will have reduced their reliance on this water and improved their regional self-reliance. California will be better prepared to meet the challenges of climate change and catastrophic events that may affect future water deliveries.

WHAT DOES IT MEAN TO ACHIEVE THE GOAL OF PROVIDING A MORE RELIABLE WATER SUPPLY FOR CALIFORNIA?

Achieving the coequal goal of providing a more reliable water supply for California means better matching the state’s demands for reasonable and beneficial uses of water to the available water supply.

- This will be done by promoting, improving, investing in, and implementing projects and programs that improve the resiliency of the state’s water systems, increase water efficiency and conservation, increase water recycling and use of advanced water technologies, improve groundwater management, expand storage, and improve Delta conveyance and operations. The evaluation of progress toward improving reliability will take into account the inherent variability in water demands and supplies across California.

Regions that use water from the Delta watershed will reduce their reliance on this water for reasonable and beneficial uses, and improve regional self-reliance, consistent with existing water rights and the State’s area of origin statutes and Reasonable Use and Public Trust Doctrines.

- This will be done by improving, investing in, and implementing local projects and programs that increase water conservation and efficiency, increase water recycling and use of advanced water technologies, expand storage, improve groundwater management, and enhance regional coordination of local and regional water supply development efforts.

Water exported from the Delta will more closely match water supplies available to be exported, based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem.

- This will be done by improving conveyance in the Delta and expanding groundwater and surface storage both north and south of the Delta to optimize diversions in wet years when more water is available and conflicts with the ecosystem less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. Delta water that is stored in wet years will be available for water users during dry years, when the limited amount of available water must remain in the Delta, making water deliveries more predictable and reliable. In addition, these improvements will decrease the vulnerability of Delta water supplies to disruption by natural disasters, such as earthquakes, floods, and levee failures.
In the future, water exports from the Delta will more closely match water supplies available to be exported, consistent with California’s variable hydrology and the coequal goal of protecting, restoring, and enhancing the Delta ecosystem. Conveyance facilities in the Delta will be improved, and additional groundwater and surface storage, both north and south of the Delta, will help optimize diversions in wet years when more water is available and conflicts with the ecosystem are less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. These patterns of Delta exports will be consistent with more natural flow patterns in the Delta, which will aid native species and reduce regulatory uncertainty. At the same time, deliveries of Delta water will be more predictable due to use of storage to deliver wet-year water that is exported and stored for future use. Flexibility of export operations will be enhanced through implementation of local and regional water efficiency, improved conveyance to reduce conflicts with the ecosystem, and water supply projects that reduce pressure on the Delta and reliance on these deliveries.

Califonia’s Water Supply Picture

California’s water supply picture makes it unlike any other state in the nation. Geography, hydrology, circumstance, and governance have shaped the political landscape of California water in a manner that has both intrigued and frustrated people for decades. Engineering alterations have enabled urban metropolises to thrive—and sprawl—and expansive agricultural regions with global influence to flourish with supplemental water, imported in some cases from hundreds of miles away and across county and even state boundaries. A complex and sometimes conflicting system of laws and policies means that in dry years, frequent in California, a given water district might have surplus supplies with which to grow lettuce or alfalfa, while a district next door battles drought conditions and the associated economic and environmental impacts.

A growing awareness of how past water management practices have led to current environmental conflicts and overall competition for water supplies, combined with the knowledge that past climate patterns are not necessarily indicative of the next century’s hydrograph, are shaping how California plans for its water future (see Figure 3-1).

Today, our existing and planned conveyance and storage projects must be operated to meet multiple objectives. The 2009 Delta Reform Act signaled a resolve by the State to implement solutions that would achieve the coequal goals.

Coequal goals means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. –Water Code section 85054
How California’s Water Is Used

Where California’s Water Comes From
Most of California’s water comes from rain and snow that falls in the northern and eastern parts of the state.

Only Some Is Available to Meet California’s Water Demands
About half of the 200 million acre-feet (MAF) California receives is used by vegetation or goes to evaporation. Another 20 MAF stays in North and Central Coast streams.

Where California’s Water Goes
About 65 MAF is available to meet California’s agricultural, urban, and Central Valley environmental needs.

Figure 3-1  Sources: Adapted from DWR 2009, USGS 2010
The Delta Plan includes a portfolio of policies and recommendations intended to build regional water supply reliability; reduce reliance on the Delta; improve the Delta’s ability to support viable populations of native resident and migratory species and to protect and restore habitats for these species; promote statewide water conservation and water use efficiency and sustainability; and improve water quality to protect human health and meet drinking water needs. The Plan also seeks to protect and enhance the unique characteristics of the Delta as an evolving place.

Our current water management system, as constructed and operated today, is not capable of achieving the Delta Plan’s coequal goals. In particular, the use of existing south Delta intake facilities as the sole point of diversion for two large water conveyance systems—the SWP and the CVP—continues to result in entrainment\(^5\) of native fish and changes to water quality and Delta food webs, posing fundamental challenges to improving ecosystem health and providing better water management (Mount et al. 2012).

Continuation of the status quo in the Delta is not sustainable with respect to ecosystem health or water supply reliability. The state’s most recent drought resulted in severe impacts to listed fish species and a precipitous decline in the delta smelt population (Lund et al. 2008). Concurrently, historically low contract allocations and water exports via SWP and CVP facilities caused severe water shortages to some urban and agricultural areas. The drought also triggered the first ever imposition of state-wide emergency water conservation regulations. The experience and impacts of this recent five-year drought, the second multiyear near state-wide drought in less than ten years, underscores the state’s and the Delta’s vulnerability if the status quo is maintained. It also illustrates the pressing need to implement solutions to achieve the coequal goals.

The current decline of aquatic resources in the Delta and the erosion of water supply reliability will continue as the state’s changing climate places additional stressors on ecosystem and water management. Extended, intense droughts and more extreme floods are expected to occur more frequently in the future due to climate change (Mann et al. 2017; Das et al. 2013; Pierce et al. 2013; Berg and Hall 2015; Cook et al. 2015; Differbaugh et al. 2015; Savrchenko et al. 2015; Stewart et al. 2015; Williams et al. 2015; Jepsen et al. 2016; Udall and Overpeck 2017). Since 2007, California has experienced nine years of below average runoff and only two years out of eleven have had precipitation amounts above the long-term average. As noted above, California’s recent five-year drought has reinforced our understanding of the harmful effects of sustained dry periods on ecosystem health and the correlation between Delta exports and overall State water supply reliability (Hanak et al. 2015; Medellín-Azuara et al. 2015; Chang and Bonnette 2016; Lund 2016; Moyle et al. 2016).

In stark contrast, historically high combined rainfall and snowpack in late 2016 and early 2017 has called to question the capacity of flood management systems to accommodate future precipitation extremes. Water management and ecosystem sustainability strategies must recognize these climatic trends and work to improve system robustness and resiliency (Jenkins et al. 2004; Opperman et al. 2009; Cahill and Lund 2013; Kiparsky et al. 2014; Null et al. 2014; Lund 2015; Dettinger et al. 2015; Dettinger et al. 2016b).\(^6\)

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\(^5\) “Entrainment” is defined by the National Marine Fisheries Service as “the incidental trapping of any life stage of fish within waterways or structures that carry water being diverted for anthropogenic use.” See also Glossary.

\(^6\) “Resilience” is defined in the California Water Plan as the capacity of a resource or natural system to adapt to and recover from changed conditions after a disturbance (DWR 2013).
The experience of two prolonged droughts in the last ten years has also reinforced the need to implement a comprehensive strategy that increases the diversity of regional water supply portfolios, creates more sustainably managed local water sources, and achieves greater water use efficiency (Aghakouchak et al. 2014; Ayars 2013; Cahill and Lund 2013; Null et al. 2014; Bachand et al. 2016; Elias et al. 2016; Fournier et al. 2016; Hanak et al. 2017). The benefits of water storage during an extended drought were also demonstrated, as were the detriments to water supply reliability, ecosystem health, and groundwater levels when storage is not adequate or is ineffectively managed (Reclamation 2015). Further, the Sustainable Groundwater Management Act (SGMA) has prioritized the need to address severe overdraft of groundwater basins in many areas of California. There is an urgent need to conjunctively manage surface water and groundwater supplies as part of a comprehensive approach to statewide water management, and support the recovery of critically overdrafted basins (Jenkins et al. 2004; Castle et al. 2014; Lund 2016; Pulido-Velazquez et al. 2016).

This section provides an overview of where California’s water comes from and how it is used, the state’s vast water supply infrastructure system, and the implications of climate change on California’s water supplies.

**Sources of California’s Water Supply**

Variability and uncertainty are the dominant characteristics of California’s water resources. Precipitation is the primary source of California’s water supply. However, this precipitation varies greatly from year to year, as well as by season and where it falls geographically in the state, which makes management of the state’s water resources complex and challenging. Groundwater, which is often connected to surface supplies, contributes to a significant portion of California’s water use, on average supplying 8 MAF (20 percent) of California’s urban and agricultural uses; but in some areas, this figure is considerably higher and can be as much as 60 to 80 percent of a region’s water supply (DWR 2009). Groundwater, and implications for its overuse, is discussed in greater detail later in this chapter.

The total amount of precipitation in an average year provides California with about 200 MAF of surface water falling as either rain or snow (DWR 2009). The actual volume of water the state receives each year varies dramatically depending on whether the year is dry or wet. California may receive less than 100 MAF of water during a dry year and more than 300 MAF in a wet year (Western Regional Climate Center 2011a).

The term “average water year” in California is useful for explanatory purposes, but can be misleading as a measurement for planning. In fact, California experiences the most unpredictable pattern of precipitation in the nation, with the bulk of its annual water falling within just 5 to 15 days (Dettinger et al. 2011). This means that in years when fewer storms pass over California, the state faces the problem of too little water; conversely, a few extra storms may result in flooding. For example, between 2005 and 2008, Los Angeles experienced both its driest and wettest years on record (California Natural Resources Agency 2008). The historical record shows that California has frequently experienced long multiyear droughts, as well as extremely wet years that coincide with substantial flooding and consequent risk to people and property (Hanak et al. 2011).

Most of California’s precipitation occurs between November and April, yet most of the state’s agricultural and urban water demand is in the hot, dry months of summer and early fall, creating a management challenge. In addition, most of the precipitation falls in the mountains in the middle to northern half of the state, far from major population and agricultural centers. In some years, the far north of the state can receive 100 inches or more of precipitation while the southernmost

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7 Includes up to 10 MAF of precipitation that occurs in Oregon, Mexico, and the Colorado River and is imported into California.
regions receive only a few inches (Western Regional Climate Center 2011b). These basic characteristics of precipitation in California—seasonal timing and geography—and their fundamental disconnect with where and when Californians demand water provide the basic explanation for why water in California is such a complicated and controversial matter.

### How California’s Water Is Used

The amount of water available to meet agricultural, urban, and ecosystem water demands starts with the state’s annual precipitation. On average, about half of this water evaporates; is used by surface vegetation for transpiration; or flows to deep subsurface areas, saline sinks, or the ocean (DWR 2009). The rest of this water—known as “dedicated water”—is used to supply urban municipal and industrial uses, agricultural irrigation, water for ecosystem protection and restoration, and for storage in surface and groundwater reservoirs (DWR 2009).

Patterns of how and when water is used in the state vary with the type of water year. In fact, although best available estimates are included in this Delta Plan, state water managers often work with limited or incomplete information related to water use. The California Department of Water Resources (DWR) uses five water year–type classifications for planning and management purposes: wet, above normal, below normal, dry, and critically dry. In wet years, due to plentiful local rainfall, agricultural and urban landscape irrigation water demands are generally lower. Water demands are usually highest in years of reduced rainfall and because local supplies are low (DWR 2009). Ironically, agricultural and urban water demands may be lower during critically dry years because of short-term water use reduction actions, such as rationing or cropland fallowing to cope with water shortages. In an average water year, this dedicated water totals approximately 80 to 85 MAF. Again, the fluctuations between wet and dry years can be extreme, with wet years providing more than 95 MAF and critically dry years producing less than 65 MAF of available supply (LAO 2008, DWR 2009, USGS 2010).

However, not all of the 80 to 85 MAF is available to meet water demands within the Central Valley, Bay Area, and Southern California. In the late 1970s, the California Legislature secured State and federal protection of California’s North Coast rivers and, in doing so, precluded major diversions from these rivers, including parts of the Trinity, Scott, Salmon, Eel, and Klamath rivers. Water from these rivers is now largely mandated to the environment by law, with the exception of diversions from the Trinity River to the Sacramento River for CVP supplies that are limited by federal law (Hanak et al. 2011). As a result, in an average year, approximately 20 MAF (out of the available supply of 80 to 85 MAF) are reserved for Wild and Scenic Rivers and other instream flow requirements in the North Coast and San Francisco Bay regions and some Central Coast and South Coast areas. Most of this water falls outside the Delta watershed. Although original State water plans and State and federal water contracts envisioned its capture and conveyance, permanent legal protections now prohibit it. (See the CVP and SWP Water Delivery Challenges section.)

This means that the remaining water supply (of 60 to 65 MAF in an average year) goes to meet agricultural and urban demands and Central Valley environmental needs. In an average year, irrigated agriculture uses approximately 34 MAF (54 percent) of this water, urban areas use about 9 MAF (14 percent), and 20 MAF (32 percent) is mandated to meet instream flow requirements, including model runs prepared for DWR State Water Project Reliability Studies (DWR 2010b, DWR 2011c).

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8 DWR uses the terms “dedicated” and “developed” interchangeably in their publications. DWR identifies California’s average annual dedicated water supply as 85 MAF.

9 All statewide average water use values were calculated using information in Volume 5 DWR Water Plan 2009 (including average values for years 1998 through 2005) and results from CALSIM II model runs prepared for DWR State Water Project Reliability Studies (DWR 2010b, DWR 2011c).

10 Data are from 2000, which DWR categorized as an “average” rainfall year for the state.

11 The “remaining water” of approximately 60 to 65 MAF, (62.4 MAF for purposes of percentage calculations) is referred to throughout this chapter as “total water use,” unless otherwise specified. Total
State Water Resources Control Board (SWRCB) Delta water quality requirements and Central Valley wildlife refuge commitments (DWR 2009).

Accounting for how much water each sector actually uses is complicated because water may be reused several times for different purposes or it may be taken from surface or groundwater storage held from previous years. The lack of consistent and accurate estimates of statewide water use is a significant challenge that has important implications for improved water management in California.

Future population and economic growth is expected to result in increased water demand. Today, California’s water supply supports a population of 36.5 million people, an economy of $1.9 trillion, and diverse natural resources (LAO 2011). The largest economic sectors in the state are trade, transportation, and financial services, with agricultural services contributing about $38 billion (2 percent). Projections by the California Department of Finance in 2010 forecast that the population may grow to 60 million people by 2050, but the rate of growth is slowing and could be much lower. As more development occurs, water use will continue to shift away from agricultural toward urban uses (DWR 2005, DWR 2009, LAO 2008, Hanak et al. 2011). At the same time, increasing water needs for ecosystem protection will likely exacerbate conflicts with agricultural and urban water demands.

California’s Water Supply Infrastructure

To provide more reliable water supplies despite the state’s hydrologic variability and diverse geography, and also to manage floods during wet years, State, federal, and local agencies have built a vast, interconnected infrastructure system throughout California (see Figure 3-2). The Delta, because of its geographic location and role in conveying water supplies, is often described as the “linchpin” of California’s water infrastructure. Rivers and dredged channels act as conveyance canals, and pumping plants provide the momentum to move stored water to areas south. California’s overall system includes a range of surface reservoirs, aqueducts, pumping plants, operable gates, groundwater wells, and water treatment facilities constructed over the last hundred plus years.

water use includes urban, agricultural, and Central Valley environmental uses such as instream flow requirements and non-CVP-managed wetlands.

12 For example, water that is dedicated to instream flows often becomes available for downstream diversion to agricultural and urban uses. Some portion of the water that is used for agricultural irrigation or drinking water is returned to the ecosystem through agricultural tailwater releases, infiltration of irrigation water into groundwater, and discharges from sewage treatment plants. The State does not have a system for documenting these multiple uses.

13 Growth projections by the California Department of Finance are regularly revised and over the past 2 decades reflect a trend toward slower expected growth for the state. Between 1993 and 2004, the California Department of Finance’s population projections for 2040 declined by 12 million people, from 62 million to 50 million.
Moving and Storing California’s Water

Figure 3-2

Large State, federal, and local dams and canal systems play an important role in storing and conveying water throughout California to meet a variety of urban and agricultural water demands.

Source: Adapted from DWR 2009
Californians have long adapted to the state’s highly variable hydrology, characterized by sustained long-term droughts and occasional massive floods (Dettinger and Ingram 2013; Dettinger 2016a; Kelley 1989). In fact, the state has the most variable annual precipitation patterns of any state within the United States (Dettinger et al. 2011). The existing State and federal water systems were designed principally to address the state’s geographic imbalance between abundant, seasonal water supplies north of the Delta, and emerging agricultural, municipal and industrial water demands to the south (Barnes and Chung 1986; Reclamation 2008). In these systems, Delta channels work in combination with water management infrastructure both inside and outside the Delta, including reservoirs, water intakes, pumping facilities, pipelines, and canals.

On average, local and regional water supplies account for 52 MAF (84 percent) of the state’s total water use. Of the 52 MAF, about 44 MAF (84 percent) of the water supply comes from local surface water storage and deliveries, and includes sources such as the Santa Ana, Los Angeles, and Ventura river watersheds in Southern California; local diversions from the Sacramento and San Joaquin rivers; and stream drainages in the central coastal areas. In addition, groundwater supplies about 8 MAF (13 percent) of the state’s total water use in average years (20 percent of urban and agricultural water use), and during droughts, can provide up to 60 percent or more for specific regions (DWR 2009). A small but rapidly growing percentage of local water comes from recycled water and water reuse projects.

Supplemental water supplies are conveyed from wetter regions of California, primarily through diversions of runoff from the great Sierra Nevada mountain range and some water from the Trinity River in the north state. In most regions, these imported water supplies augment local and regional sources, especially in dry years and dry seasons. On average, approximately 10.1 MAF (16 percent) of the state’s total water use comes through a combination of major conveyance and storage facilities from water sources within California and from other states, with the SWP and CVP making up the majority of these imports (5.1 MAF, about 8 percent), and Hetch Hetchy (0.2 MAF), Mokelumne (0.3 MAF), and the Los Angeles Aqueduct (0.2 MAF) comprising the remaining in-state imports. A significant portion of the state’s water supplies are imported from outside California, primarily from the Colorado River (4.3 MAF) through the Colorado River Aqueduct, which serves agricultural and urban demand in Southern California.

The network of infrastructure to store and convey water in California is impressive by modern standards and compared to other states. The state’s single largest “reservoir” is the Sierra Nevada snowpack, which holds approximately 15 MAF per year on average (DWR 2009). However, for comparison, local, State, and federal agencies in California have constructed more than 1,200 major reservoirs with a combined storage capacity of 43 MAF, about half the average annual runoff for the entire state (Hanak et al. 2011, DWR 2011a).

Most of California’s largest surface storage reservoirs are owned and operated by the federal government and total approximately 17 MAF of storage capacity. The largest federal facility, part of the CVP, is Shasta Lake, which holds 4.5 MAF. The State’s single largest storage facility and key-stone feature of the SWP, Lake Oroville Dam on the Feather River, has a capacity of 3.5 MAF (LAO 2008). Operating with other reservoirs as a system, these multibenefit facilities reduce the potential for floods at the same time that they make water available for seasonal water agricultural and urban demand, particularly in the summer and fall. They also generate clean electricity. Although these storage facilities provide many benefits, they have also significantly altered the natural ecology of these rivers. Dams and their associated facilities can present barriers to migrating fish and reduce or eliminate downstream gravel and sediment replenishment to the detriment of native species such as salmon. Moreover, reservoir operations have significantly modified the amount and timing of instream flows, as well as water temperature,
further contributing to the decline of the state’s native fish and ecological resources.

Looking to the future, fewer high-yielding surface storage sites are available in the state now because most of these areas have already been developed (NRC 2012). However, there are significant opportunities throughout California to expand groundwater storage and to reoperate surface storage in conjunction with groundwater storage (also known as conjunctive management or groundwater banking) and other programs to maximize the water supply and environmental benefits of these systems.

Conveyance, system storage, and operations are part of a broad and integrated portfolio of actions described in the Delta Plan. They are water management tools that are inextricably linked to the management of habitat conditions given the variable nature of the state’s water supplies. Deploying one tool independent of the others is ineffective. It is only through the combination of new and improved Delta conveyance, the effective management of existing and expanded surface water and groundwater storage, and the balanced operations of both – combined with other actions and recommendations contained in the Delta Plan – that the coequal goals can be achieved.

**Climate Change Complicates Management of California’s Water**

With climate change, the state’s water supply will become even more erratic. Weather patterns are expected to become more extreme with long, multiyear droughts becoming more frequent as well as extremely wet years. Since 1906, California has seen “dry or critically dry” years one-third of the time. This trend is increasing (California Data Exchange Center 2011).

By 2050, temperature increases of 1 to 3 degrees Celsius are expected to cause more winter precipitation to fall as rain, as opposed to snow, and to reduce the Sierra Nevada snowpack (the source of much of California’s runoff) by 25 to 40 percent (DWR 2010d). Runoff patterns will shift, leading to greater cool-season runoff and decreased warm-season runoff (Reclamation 2011a). The pattern of spring runoff is also expected to change, with a more rapid spring snowmelt leading to a shorter, more intense spring period of river flow and freshwater discharge accompanied by higher flooding risks (Knowles and Cayan 2004, Knowles et al. 2006, Null et al. 2010, Willis et al. 2011). Because the Delta watershed provides a portion of the water supply for approximately 27 million Californians and irrigates millions of acres of farmland, rising sea levels leading to increased salinity intrusion, along with changes in the form of precipitation and timing of snowmelt, will profoundly alter the way water is managed in California.

Specifically, an anticipated shift in runoff patterns will present a management challenge to existing reservoir operations, with large runoff events increasingly putting pressure on reservoirs managed for multiple benefits, including flood control. Reduced natural water storage in the form of snowpack will diminish statewide carryover storage capacity, making the state increasingly vulnerable during prolonged dry periods and negatively affecting water supply reliability.

Sea level rise, as much as 55 inches by 2100 (OPC 2011), will result in high salinity levels in the Delta interior, which will impair water quality for agricultural and municipal uses, and change habitat for fish species. Maintaining freshwater conditions in the Delta could require unanticipated releases of water from storage, which will reduce available water supplies for fish. Rising seas also will dramatically increase the risk of catastrophic interruption of water exports as a result of levee failure and flood events, particularly in the interior Delta where substantial subsidence has already occurred. Warmer temperatures throughout the state will cause higher evaporation rates, particularly during the hot summer and early fall months, contributing to reduced streamflows, drier soils, reduced groundwater infiltration, higher losses of water from surface reservoirs, increased urban and agricultural demand for irrigation water, and more water needed for...
ecosystem protection (California Natural Resources Agency 2008).

The precise local impacts of climate change on regional water resources remain less certain. Many communities in the state already experience water shortages during droughts (California Environmental Protection Agency 2006, LAO 2009). Improved modeling, especially downscaling of global climate change information to regional and local levels, will help communities to evaluate the extent of their vulnerability and to develop water management strategies that will increase the resilience of their water supply systems (USEPA and DWR 2011).

Foundations of Water Policy in California

Over the past 160 years, the California water rights system has evolved into a complex mix of public and private rights and contractual obligations that were intended to create more certainty about how water is to be allocated among urban, agricultural, and environmental uses during droughts, catastrophic interruptions in water supplies, and other times of scarcity. (See sidebar, California’s Complex Water Rights System.) Yet some of these rights and obligations conflict, and now, in many years, there is insufficient water in California to support them all.

California’s legal system recognizes limitations on water rights based on the longstanding doctrines of Reasonable Use and Public Trust (NRC 2012). The Delta Reform Act reiterates that the principles of reasonable use and public trust “shall be the foundation of state water management policy” and that they are “particularly important and applicable to the Delta” (Water Code section 85023). The coequal goals of improving water supply reliability for the state and restoring the Delta cannot be achieved by actions in the Delta alone. Every region in California, along with the cities and farms that receive Delta water, will need to improve their management of the state’s scarce water resources.

This section discusses the legal foundations for California water policy, explains the state’s system of water rights, and describes new water policies and priorities, including reduced reliance on the Delta and improved regional self-reliance, established by the Delta Reform Act.

Reasonable Use and the Public Trust Doctrines

The Reasonable and Beneficial Use and Public Trust Doctrines, in combination with existing water rights and the State’s area of origin statutes, have long been the legal and policy foundation for water management in California. The State’s Reasonable and Beneficial Use Doctrine specifically limits all water rights and water use in California to “such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water” (California Constitution, Article X, Section 2).

The SWRCB is the primary agency responsible for ensuring that water is not wasted and that the reasonable use standard is not violated. However, DWR also shares with them the duty to “take all appropriate proceedings and actions…to prevent waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion in this state” (Water Code section 275). The SWRCB also is responsible for determining whether any water remains available in a stream or watershed for appropriation and whether the water is being fully used for “beneficial uses,” consistent with State law that identifies the types of water uses that are permitted.14 The State can review and modify existing water rights as well as consider approval of new permits and water rights

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14 Beneficial uses recognized in California include domestic, fire protection, fish and wildlife, industrial, irrigation, municipal, power production, recreation, and other uses (SWRCB 2010).
to reflect new conditions, including California statutes that require efficient water use and improved water management.

The Public Trust Doctrine provides the State with additional authority to reconsider past water allocation decisions in light of new information and changing water demands and social values, and to modify or revoke previously granted water rights if warranted. In a 1983 landmark legal decision, the California Supreme Court unanimously affirmed that the state’s navigable lakes and streams are resources that are held in trust for the public and are to be protected for navigation, commerce, fishing, recreational, ecological, and other public values. The State “has an affirmative duty to take the public trust into account in the planning and allocation of water resources and to protect public trust uses whenever feasible” (National Audubon Society v. Superior Court, 33 Cal. 3d 419, 658 P.2d 709, 189 Cal. Rptr. 346, 1983 Cal.). This has significant implications for governance of water resources. In fact, both the Public Policy Institute of California and Appeals Court Associate Justice Ron Robie recently called for the establishment of a public trust advocate at the SWRCB to ensure that the State’s duty to protect California’s public trust resources is being performed adequately (Robie 2012, Hanak et al. 2011).

**California’s Water Rights System and Use Reporting**

California’s water rights system is of great legal significance. However, our water rights system does not and cannot guarantee a supply of water that exceeds what nature provides. Nor does any individual, business, industry, or agricultural enterprise “own” the water they use.

The amount of water used in California’s stream systems is not fully known because water users under pre-1914 and riparian water rights have not been required, until recently, to submit annual reports accounting for their diversions. In 2009, the State adopted statewide water diversions reporting requirements (Water Code section 5100 et seq.); and in 2010, the SWRCB adopted regulations requiring online reporting of water use by all water rights holders, including all surface and groundwater users. In addition, there is limited information available to the State on consumptive use or the number of times that water is used within a stream system.

Discussed previously, the SWRCB has the authority to determine when a river or stream has been “over-appropriated,” in other words, whether the amount of water available in a stream is less than the demands placed on that water. A right to use water represents potential diversions and uses. Actual water use in many rivers and streams is frequently far less than the total volume of asserted water rights. The difference between water rights and water received can be explained by restrictions or conditions in the permits/licenses, operation restrictions on the storage and transport facilities themselves, physical and economic limitations, non-consumptive uses such as hydroelectric power generation, and the use and reuse of water.

Understanding and reconciling the human demands for water to the supply available, while providing enough water to ensure desired and legally protected environmental and water quality goals, is a difficult process. This process is nonetheless essential to achievement of the coequal goals.
CALIFORNIA’S COMPLEX WATER RIGHTS SYSTEM

Whatever the type of water right that is held by an individual, business, or public agency, no one “owns” the water they use in California (Littleworth and Garner 2007). All water within the state is held in trust for the benefit of all the people of California (Water Code sections 102, 1201). Water rights holders have the right to “take and use water, but they do not own the water and cannot waste it” (Central and West Basin Water Replenishment District v. Southern California Water Co. (2003) 109 Cal. App. 4th 891, 905).

Riparian Rights – Landowners who own property that abuts a natural water course are entitled to make reasonable use of water on or flowing past their property. The water must be from a natural flow (not released stored water). Water cannot be stored under a riparian right and may only be used on property that is within the drainage of the water’s source. If there is not enough water in a watershed to satisfy both riparian and appropriative rights, then riparian rights must be fulfilled first. In times of shortage, riparian right holders allocate the reduced water supply by sharing the shortage among the riparian users.

Appropriative Rights – An appropriative right is typically used when the prospective water user intends to use water on nonriparian land or the water user needs to store water for later use. Pre-1914, these rights were asserted in a manner similar to the filing of a mining claim; a water user filed a public notice of his or her intent to divert water and then diverted the water for a legally recognized beneficial use such as mining, irrigation, or drinking water. In times of shortage, appropriative right holders allocate the reduced water supply among themselves under a first in time, first in right priority system. Generally, water received through appropriative rights is more predictable than riparian rights, but appropriative rights can be lost through nonuse (because beneficial use is the basis for receiving the right), and shortages are allocated based on seniority (NRC 2012). California law recognizes water conservation as a “reasonable beneficial use” so that water efficiency improvements cannot be used as a reason to reduce appropriative rights held by a water user (Water Code section 1011(a)).

CVP and SWP Contractors – The Bureau of Reclamation and DWR hold appropriative water rights for the operation of the CVP and SWP, respectively. In many instances, these project rights are junior in priority to the rights held by water users in the Delta and within the Delta watershed. This means that during droughts and other periods of water shortages, the ability of the SWP and CVP to divert water from the Delta is limited by riparian owners and by more senior appropriative water rights.

Area of Origin Laws – Several statutes provide protections to areas within the Delta and the Delta watershed where the rivers originate (Littleworth and Garner 2007). Also known as “watershed protection” statutes, these laws provide the opportunity for water users in these areas to obtain water rights with a more senior priority than the SWP and CVP contractors so that local demands might be met before water becomes available for export.

Reasonable Use and Public Trust Doctrines – The SWRCB has the authority to review and modify existing water rights as well as approve new rights. This is an important principle because it enables the State to consider what is “reasonable” based on modern societal values, the need to protect other water users, protect the environment, and prevent the waste and unreasonable use of water. This authority derives in part, from the Public Trust Doctrine, under which the State has an ongoing duty to protect the navigable waters of the state for environmental protection, fishing, navigation, and commerce; and from the Reasonable Use Doctrine of the California Constitution, a provision mandating the reasonable and beneficial use of all waters in the state (Article X, Section 2).

The Coequal Goals and Reducing Reliance on the Delta

In 2009, California further defined its water policy priorities as they relate to the Delta, including express recognition that the Delta crisis cannot be resolved by taking action in the Delta alone. Given the interconnected nature of the Delta with the water use patterns of large parts of Northern, Central, and Southern California, the new coequal goals of statewide water supply reliability and an improved, protected, and restored Delta ecosystem will fundamentally reshape California water management over the course of this century. Achieving these coequal goals is expected to be done, in significant part, through compliance with the Delta Reform Act’s various mandates and goals relating to statewide water conservation, efficiency, and sustainable use, including the State’s new policy to reduce reliance on the Delta and related mandate to improve regional self-reliance.
In particular, the Delta Reform Act mandates many statewide strategies that the Delta Plan must address to achieve the coequal goals, including water efficiency and conservation; wastewater reclamation and recycling; desalination and advanced water treatment technologies; improved water conveyance, surface, and groundwater storage; improved water quality; and implementation of local and regional water supply projects (Water Code sections 85004(b), 85020(d) and (f), 85021, 85023, 85303, and 85304). These measures help achieve the requirements of Water Code section 85021, which declares that the State’s policy is “to reduce reliance on the delta in meeting California’s future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency.” That section also mandates that “[e]ach region that depends on water from the delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.” Consequently, to achieve the statewide water supply mandates and the coequal goal of statewide water supply reliability, regions located outside the Delta also must take actions outside the Delta to increase water efficiency and develop sustainable local and regional sources of water, which will contribute to improved water supply reliability. Individual actions by water suppliers throughout the state will be vital to success in this regard. The implementation of programs and projects that result in a significant reduction in the amount of water used, or in the percentage of water used, from the Delta watershed (evaluated at the local, regional, and statewide levels) will be the foundational measures for assessing the State’s progress in achieving these policies. The baseline for this evaluation will be existing water use and supplies, as documented in the most recently adopted urban and agricultural water management plans. (See Appendix G, Achieving Reduced Reliance on the Delta and Improved Regional Self-Reliance.)

It is important to recognize that reliance on water from the Delta and the Delta watershed varies throughout California, from region to region, and supplier to supplier. (See sidebar, Reliance on the Delta Varies by Region.) Some water suppliers have greater access to alternative water supplies or have a greater ability to implement a diverse range of water efficiency and water supply projects. Others, particularly in the upper watershed, may have a narrower range of options. The key is that every supplier is doing its part and is taking appropriate action to contribute to the achievement of the coequal goals, including the State’s policy of reduced reliance and associated mandate to improve regional self-reliance.

The Delta’s Role in California’s Water Supply

The Delta is the terminus for California’s largest watershed, which encompasses the western slopes of the Sierra Nevada, the eastern slopes of the coastal range, and the valleys that lie between these ranges. Water in the Delta watershed starts as precipitation in the Sacramento River and San Joaquin River watersheds and, unless diverted or otherwise used, flushes San Francisco Bay and flows out to the ocean under the Golden Gate Bridge. Once again, this estuarine delta where California’s two largest rivers meet is at the geographic and political center of water in California.

The CVP and the SWP rely on the Delta’s artificial network of channels to convey water stored in upstream reservoirs to regions south of the Delta including the Bay Area, San Joaquin Valley, Tulare Lake Basin, Central Coast, and Southern California. (See sidebar, Reliance on the Delta Varies by Region, and Figure 3-3.)
Local Water Sources Meet Most of California’s Water Needs

Figure 3-3 The vast majority of California’s water comes from local sources. Exports from the Delta comprise 8 percent of California’s water use. Yet, the Delta supply is important to many regions south of the Delta.
RELIANCE ON THE DELTA VARIES BY REGION

Water exported from the Delta supplies about 8 percent of the state’s total water use, and local and regional water supplies provide over 84 percent on average. However, reliance on water from the Delta watershed varies throughout California from region to region, supplier to supplier, and user to user.

For example, in the Sacramento and San Joaquin river watersheds, including water uses on the valley floor, foothills, mountain communities, and the Delta, the vast majority of the water supply comes from local sources: the rivers and reservoirs that flow into the Delta or from local ground-water resources that are replenished from runoff within the Delta watershed. Most of this water is used for irrigated agriculture, although increasing amounts are being shifted to drinking water and other municipal uses by the cities and towns that are growing in these regions. High-growth areas surrounding the Delta, including Fairfield, Sacramento, Stockton, and Tracy, are increasing urban water use and decreasing agricultural water use as the communities are developed.

Other regions, including the Tulare Lake region of the Central Valley, the San Francisco Bay Area, the South Coast, and the Central Coast, receive some portion of their water supply from diversions from the Delta’s eastern tributaries or from water that is pumped from the Delta to supplement their limited local surface water and groundwater supplies. These exports vary by region and, for specific water users, the significance of these exports varies dramatically. For example:

1. **Tulare Lake**: This region relies upon exports delivered through the Central Valley Project (CVP) and State Water Project (SWP) for 27 percent of its regional water supply, and most of this water use is for irrigated agriculture (on average 96 percent of CVP water deliveries and 89 percent of SWP deliveries). Kern County Water Agency, a water wholesaler, has the largest SWP import contract in the Tulare Lake Basin at nearly 1 million acre-feet (MAF) (DWR 2009).

2. **San Francisco Bay Area**: This region’s predominant water supply is from local sources (57 percent from surface and groundwater alone). However, diversions from the Delta’s tributary streams provide up to 27 percent of this region’s water, and CVP and SWP exports account for another 16 percent (DWR 2009). The reliance of the region’s individual water suppliers on water from the Delta varies dramatically; the Marin Municipal Water District uses none (MMWD 2010), and the Zone 7 Water Agency in Alameda County receives as much as 82 percent of its water from SWP exports (Zone 7 2010).

3. **Southern California**: This region is home to 50 percent of the state’s population (with most in densely urbanized areas), and 80 percent of its water use is for drinking water, municipal, and industrial uses. SWP exports from the Delta account for roughly 25 percent of the region’s water supplies, and local sources (groundwater, surface water, and increasingly recycled water) comprise another 50 percent, and imported water from the Colorado River about 25 percent (DWR 2009). Within the Metropolitan Water District of Southern California, the largest wholesaler in Southern California, the dependence of its member agencies on SWP imports can vary dramatically. Some agencies have few alternative water sources, while others have sufficient local supplies and are now planning to reduce their future reliance on imported water or to roll off the system completely (WBMWD 2010, City of Santa Monica 2012).

With increasing uncertainty over the reliability of Delta water exports, many communities have developed plans and projects to increase and diversify local water supplies and to increase water efficiency. Even with improvements in Delta operations that provide more reliable Delta water exports, regions will need to implement additional local and regional water management strategies to reliably meet their future water demands.
Because of the Delta’s central location, the water demands of many Californians are connected in some way to the Delta. Water diverted from the Delta watershed provides some portion of water supply for more than 27 million of the state’s residents and approximately 3 million irrigated acres of farmland (DWR 2007a, DWR 2009, DWR 2011c, Reclamation 2011b). This water plays a critical role in helping to sustain a major portion of the state’s $1.9 trillion economy.

This section provides an overview of water use and water infrastructure in the Delta watershed, followed by a description of water project operations in the Delta and the challenges and conflicts associated with these. The section concludes with a discussion of the importance of improving the flexibility of project operations, through improved conveyance, storage, and water management, in achieving the coequal goals.

**Use of Water from the Delta Watershed**

About half the state’s runoff flows through the Delta watershed. Since the 1849 Gold Rush, communities throughout California have planned and constructed facilities to tap into this water to support economic development.

Many diversions in the Delta watershed occur in the upper watershed. On average, approximately 31 percent of the flow from the Delta watershed is diverted before it ever reaches the Delta (DWR 2011c). See Figure 4-5 in Chapter 4. These diversions are done through an extensive network of locally constructed dams, canals, and diversion structures that have been built over the past 160 years on nearly every stream and drainage within the Delta watershed (California Natural Resources Agency 2010). Some of the water diverted from Delta tributaries is returned to the tributaries through wastewater effluent and agricultural return flows, albeit at a degraded quality.

Water from these diversions sustains the economies of the residents, businesses, and growers who live in the areas where the water comes from—the “area of origin”—as well as the economies in the export areas. Some of these historical diversions occur through two large aqueduct and reservoir systems that were constructed early in the twentieth century to serve the growing water demands of San Francisco and East Bay Area communities. These facilities divert water before it reaches the Delta and convey it directly to reservoirs, treatment facilities, or customers in the Bay Area region. The Hetch Hetchy reservoir system on the Tuolumne River, and the Pardee and Camanche reservoirs system on the Mokelumne River account on average for approximately 0.5 MAF, or about 1.6 percent of the flow from the Delta watershed, of annual water deliveries from the Delta’s upper watershed (DWR 2009).

Within the Delta, growers and residents historically have relied on water from the Delta. In-Delta water use has remained relatively constant over the past 100 years (DWR 2007a) and averages about 4 percent (0.9 MAF) of inflows into the Delta. Most of this water is used for agricultural irrigation, and small and large communities throughout the Delta.

The CVP and SWP export systems became operational in the late 1940s after much of the local Delta development had occurred. Exports from the Delta now range from approximately 3 MAF in dry years to around 6.5 MAF in wet years (DWR 2009, Reclamation 2011b, Reclamation 2011c). In total, the SWP and CVP facilities export on average approximately 5.1 MAF per year from the Delta. These water diversions account for 24 percent of the inflows into the Delta (see Figures 3-4a and 3-4b).
Where Delta Water Comes From and Goes

Over the past century, the combination of regional diversions from within the Delta watershed and water diverted directly from the Delta has transformed the Bay-Delta ecosystem, reducing historical outflows by an average of 50 percent. 

Data presented as a long-term average. Information based on DWR CALSIM II modeling, which includes projected conditions to protect fisheries.

Delta-Suisun in-Delta use includes water to the Contra Costa Canal and to the Mokelumne and Hetch Hetchy aqueducts.

Sources: LAO 2008, Reclamation 2011b, DWR 2011c
Joint Federal and State Delta Operations

The federal CVP and California SWP were born out of long-range planning documents developed from the 1870s through the 1920s, including the 1919 Marshall Plan completed by U.S. Geological Survey and the 1930 Division of Water Resources Bulletin No. 25, “Report to the Legislature of 1931 on State Water Plan.” These planning investigations developed and evaluated alternatives to provide:

- Fresh water to industries in Contra Costa and Alameda counties along Suisun and San Pablo bays
- Irrigation water to portions of the San Joaquin Valley that have substantial and increasing groundwater over-draft conditions, especially in the Tulare Lake region
Supplemental water for Southern California urban development totaling 2 million acres in San Diego, Orange, and Ventura counties and the San Gabriel and San Bernardino valleys with water from Owens Valley, Mono Basin, and Colorado River.

The California Legislature approved this plan in 1941 as the first State Water Plan (now the current California Water Plan), which included a description of facilities that would eventually be constructed as part of the CVP and SWP. Although design and construction of storage and conveyance facilities was done separately for CVP and SWP, both are operated in a coordinated manner for Delta operations.

Central Valley Project

Congress appropriated $20 million in Emergency Relief Appropriation Funds and authorized construction of the CVP by the U.S. Army Corps of Engineers (USACE) as part of the Rivers and Harbors Act of 1935. When the Rivers and Harbors Act was reauthorized in 1937, the construction and operation of the CVP was instead assigned to the Bureau of Reclamation (Reclamation).

Construction of the CVP by the federal government began in 1937. The first water was sold from the CVP to the City of Antioch from the initial reaches of the Contra Costa Canal in 1940, to support shoreline industries.

By the late 1940s, it had become apparent that California’s rapid urban, agricultural, and industrial growth would quickly increase demands for water and power to levels that exceeded the initial CVP system capacity. In response, Congress authorized additional federal reservoirs and conveyance facilities over the next few decades, including Folsom Dam along the American River, Tehama-Colusa Canal along the west side of the Sacramento Valley, Trinity River Dam to provide additional water from the Trinity River into the Sacramento River for CVP operations, and New Melones Dam on the Stanislaus River. In 1960, the San Luis Unit, in the western San Joaquin Valley, was authorized by Congress to be constructed under a contract between the federal government and the State.

The CVP is the largest surface water storage and delivery system in California, with a geographic scope covering 35 of the state’s 58 counties. The project includes 20 reservoirs with a combined storage capacity of approximately 11 MAF, 8 power plants and 2 pumping-generating plants, 2 pumping plants, and approximately 500 miles of major canals and aqueducts. The CVP provides water through water service contracts and water rights agreements for a total of about 9.6 MAF per year (including water service contractors that use water from the Stanislaus River and San Joaquin River).

State Water Project

In 1947, the State began an investigation to consider the next phases of the State Water Plan to meet the state’s anticipated supplemental water demands through development of the SWP and to control salinity intrusion in the Delta. In 1953, the State adopted the Abshire-Kelly Salinity Control Barrier Act to evaluate placement of a saltwater barrier near Suisun Bay to protect Delta water users and allow transfer of fresh water from the Sacramento Valley to the San Joaquin Valley. This plan was not implemented primarily due to costs and technical considerations, but alternatives continue to be evaluated today.

In 1957, Bulletin No. 3 was published, which described the need for SWP facilities to convey water from the Sacramento Valley to water-short areas of California. The report identified an urgency to expand statewide water facilities because of projected population growth and to support a balanced economy; major industrial growth; 6,875,000 acres of irrigated agriculture, or approximately 25 percent of all agricultural acreage in the United States; and flood control in Northern California. The study identified that there was a “seasonal deficiency” of 2,675,000 acre-feet of water in 1950 that had been met with groundwater pumping primarily from overdrafted aquifers. In 1960, California voters authorized the Burns-Porter Act to construct the initial projects of...
the SWP, including Oroville Dam and Lake Oroville on the Feather River, San Luis Dam and Reservoir to be jointly constructed and operated with Reclamation, the North and South Bay aqueducts, and the 444-mile California Aqueduct. Notably, DWR continues to project a 1- to 2-MAF deficit in average annual groundwater pumping from overdrafted aquifers (DWR 2009). A more detailed discussion of groundwater is provided later in this chapter.

**Delta Operations**

Prior to the 1960s, the CVP and SWP operated in the Delta unrestrained by environmental regulations. However, beginning in the 1970s, with the passage of environmental laws, including the federal Clean Water Act, Endangered Species Act, Central Valley Project Improvement Act, Porter-Cologne Water Quality Control Act, California Endangered Species Act, Wild and Scenic legislation, and many others, protection of the ecosystem became an explicit legal obligation for the SWP and CVP in addition to delivery of fresh water for agricultural and urban use.

In the modern context, CVP and SWP facilities operate according to a complex web of permits, licenses, and, in some cases, court orders that impose explicit conditions on how, when, and how much water can be exported from the Delta. Some of the entities that regulate water project operations in and upstream of the Delta include:

- The SWRCB and regional boards require the SWP and CVP to meet specific water quality criteria that result in operational standards within the Delta and the Delta watershed. The SWRCB also sets instream flow standards.
- USACE sets operational “rule curves” for reservoirs that provide flood protection upstream of the Delta. The Central Valley Flood Protection Board regulates encroachments on designated floodplains and floodways. (See Chapter 7.)
- The presence of threatened and endangered species in California’s waterways and landscapes requires the California Department of Fish and Wildlife (DFW), U.S. Fish and Wildlife Service, and National Marine Fisheries Service to regulate water project operations in the Delta. Federal biological opinions that govern agency regulatory activities have been the subject of extensive recent litigation by water agencies and other interested parties.

To comply with these regulations and to optimize system efficiencies, DWR (for the SWP) and Reclamation (for the CVP) jointly coordinate their pumping operations in the Delta under the 1986 Coordinated Operating Agreement (COA). One of the benefits of the COA is that it resulted in improved reliability of deliveries for the SWP (DWR 2008). They also jointly manage portions of the water delivery facilities in the Central Valley. There are times when the CVP may use SWP export capacity or that the SWP may need to use CVP export capacity. This close coordination has resulted in flexible operation of the Delta facilities to improve reliability of Delta water deliveries as well as to reduce system vulnerability to disruption.

Additional operational changes are on the horizon for the CVP and SWP. The SWRCB has initiated a phased process to review and amend—or to adopt new—water quality and flow objectives for the Delta by 2014. Phase 1 of that review is focused on southern Delta water quality and San Joaquin River flows. Phase 2 is focused on other changes that may be needed to the remainder of the Bay-Delta Water Quality Plan to protect fish and wildlife beneficial uses. See Chapter 4 for more information on flow in the Delta and the relationship to ecosystem health, and Chapter 6 for more information on the Council’s recommendations on the SWRCB process to update the Bay-Delta Water Quality Plan. Furthermore, conveyance alternative projects could mean large-scale changes to Delta infrastructure and operations.
Challenges and Conflicts in the Delta

Over time, the Delta has been transformed, mostly by human hands, to serve many purposes. As mentioned, the SWP and CVP were originally engineered to reliably deliver water to water service contractors and water rights holders without commensurate consideration for impacts on native species. The Delta is the only saltwater estuary in the world that is used as a conveyance system to deliver fresh water for export. This creates substantial water supply and ecosystem conflicts.

Legal changes in recent decades, combined with growing societal awareness and scientific understanding of water project operations on ecosystem health, had major implications for water operations in the Delta. The collision of changing societal values, growing demands for water deliveries from the Delta, and declining health of the Delta ecosystem have resulted in numerous complex and often bitter legal challenges that have increasingly shifted critical Delta water management decisions to the courts.

Today, demands on water infrastructure have fundamentally changed (Lund 2016) as California’s population and diversified economy has grown, societal values informing how water and other natural resources are managed has evolved, our climate is changing, and water needs have increased. In addition, populations of several endangered and threatened fish species have declined drastically since the construction of the State and federal water systems and other infrastructure in the Delta watershed. The declines are due to multiple factors (Mount et al. 2012), including: entrainment, changes to natural flow regimes and flow direction, water exports (particularly in dry years), disconnection of rivers and streams from adjacent lands resulting from levee construction and channelization, habitat loss and alteration, urbanization, a warming climate, food availability, predation, and invasive species (Healey et al. 2016; Mount et al. 2012). Among these many factors, CVP and SWP diversions represent one of the most directly observable sources of fish mortality (Grimaldo et al. 2009). Consequently, our water management systems are now called upon to meet ecosystem needs not envisioned when they were originally built in an increasingly complex regulatory environment (Reclamation 1992).

This conflict came to a crisis point in 2007 when a federal court significantly curtailed water deliveries south of the Delta to protect delta smelt. This launched a seven-year process in the federal courts examining the balance between fish protection requirements under the Endangered Species Act and water operations. Differing federal court orders ensued, some of which protected native fish and restricted water exports, while others recognized urban and agricultural water needs and ordered increased water exports. This period of litigation and court ordered operations of the water projects highlighted the difficulty in resolving this conflict under the status quo system of water conveyance. Reviews by federal and State wildlife agencies have shown that maintaining status quo conditions will likely result in further deterioration of threatened and endangered fish populations, which will necessitate additional restrictions on water supply exports (National Marine Fisheries Service (NMFS) 2009; NMFS 2014; U.S. Fish and Wildlife Service 2009). If not addressed, this trend may be irreversible and make the achievement of the coequal goals infeasible.

Conflicting Operational Priorities

A fundamental conflict exists today between water operations for ecosystem management (temperature and flow), water quality (both in-Delta and for water exported from the water exports (especially during dry periods), and physical changes to the Delta (channelization, sedimentation, and land use changes). Changes to flow regime have directly affected habitat conditions – including habitat diversity, quality, and extent – and proven harmful to native species. Sources: Bunn and Arthington (2002), Petts (2009), SWRCB (2010).
Delta), and water supply reliability. This conflict is magnified during critically dry periods and periods of lower flow when the ecosystem is under increased stress and water suppliers are most vulnerable to shortages. Conflicts in the use and timing of water movement through the Delta for multiple purposes could be more easily addressed by improved water conveyance and storage infrastructure with greater capacity and operational flexibility, combined with investments in regional self-reliance as cited throughout the Delta Plan. This includes increased capacity to safely convey water through the Delta during wetter periods such that exports can be curtailed when fish are at risk, and expanded water storage capacity throughout the state to manage Delta flows and water temperature, and carry over water supplies from wet periods for use in dry periods. Additional storage and conveyance capacity would provide the flexibility needed to adapt to dynamic future conditions and our revolving understanding of ecosystem needs.

An example of this conflict relates to degraded water quality in the Delta during periods of lower flow, which affects the treatability of water for municipal and industrial uses and creates public health concerns that often must be addressed through higher-cost water treatment processes. Water quality for exports can be improved by moving diversion locations, but doing so also has the potential to degrade water quality for in-Delta uses. These impacts must be carefully monitored and mitigated. Improving, monitoring, and adaptively managing the operation of water systems in the Delta would augment our capacity to balance these priorities and further achievement of the coequal goals.

**CVP and SWP Water Delivery Challenges**

Overall, exports from the Delta have been rising over the past 4 decades (see Figure 3-5). Historically, the SWP and CVP have pumped more water from the Delta during dry years than wet years; but over time, exports have increased in all water year types, except in critically dry years. The SWP and CVP have each reached record exports in the past 10 years. In part, this is because recent increases in surface and groundwater storage south of the Delta have enabled more water to be taken during wet years. Increased south-of-Delta storage has also led to more agricultural-to-urban water transfers, which help improve the flexibility of operations in the Delta.

Yet, many factors threaten the ability of State and federal water managers to continue pumping water through the two projects at current export levels. Subsidence of the agricultural lands on the Delta islands, rising sea level, and earthquakes threaten the physical integrity of the Delta ecosystem and the levees that protect the export water quality. The location of the two pumping stations (one each for the CVP and SWP) in the south Delta is a problem for fisheries. Described previously, most of the water enters the Delta from the north through the Sacramento River. Pumping stations for the CVP and SWP are located in the south Delta and, when operating, frequently cause a net “flow reversal” in the central and south Delta channels. (See Chapter 4 for more details.) This reverse flow affects fish movement, including migration through the Delta, and often results in species that are free-floating or have weak swimming capability being drawn into the pumping facilities where they can be entrained (Grimaldo et al. 2009).
Overall exports from the Delta have been rising over the past 4 decades, while in-Delta uses have remained fairly constant. Exports by the CVP and SWP have reached record levels in the past 10 years.
Water quality is an issue too. A portion of the water flowing into the Delta is specifically allocated to Delta outflow to help repel salinity intrusion from the San Francisco Bay and to maintain low-salinity water near the western edge of the Delta. This means that water that might otherwise be used for exports must be released from upstream reservoirs to help control salinity (NRC 2012).

Conflicts over water use are further complicated by original SWP and CVP contracts that assumed greater water export quantities than consistently can be delivered. Since 1990, the CVP has fulfilled 100 percent of its contract water allocations only three times, and the SWP has delivered 100 percent of its contract amounts only twice (Reclamation 2011c, DWR 2010b). The CVP’s ability to meet maximum contracted amounts, particularly during dry years, has diminished since the addition of new municipal and industrial contractors who have priority over agricultural water deliveries. Also, the 1992 passage of the Central Valley Project Improvement Act dedicated up to 800,000 acre-feet of CVP exports for wildlife refuges and environmental needs (Public Law 102-575, section 3406(b)(2)). The original SWP contract amounts were based on assumptions that additional major new dams and conveyance facilities would be constructed at a later date, which did not occur. As a result, even though the SWP had contracted to supply 4.2 MAF, average SWP exports between 1996 and 2006 were just 2.9 MAF (DWR 2008).

The reality is that the State and federal systems have never been able to reliably deliver the full contract amounts. Now, additional court-ordered and regulatory restrictions on State and federal pumping of export water, in combination with the 2007 through 2009 drought, further reduced the reliability of Delta water exports to SWP and CVP contractors. According to DWR, SWP deliveries are now expected to average 60 percent of maximum contract amounts in future years, down from 66 to 69 percent estimated in 2005 (DWR 2010b).

The process for allocating water shortages within the State and federal projects also impacts the extent to which various contractors experience different levels of Delta water supply reliability. Within the SWP, shortages are uniformly distributed across all water contractors. Within the CVP, municipal and industrial water users have a higher priority than agricultural water users. As a result, in dry years, CVP water rights contractors, such as the Sacramento River Settlement Contractors, may receive 100 percent of their water allocations while non-water rights contractors, including Westlands Water District, may receive as little as 10 percent.

North-to-south water transfers across the Delta can be an important tool for improving water supply reliability. However, transfers require the use of SWP or CVP facilities and, as such, are subject to the regulatory constraints on Delta exports. Because Delta pumping windows of opportunity are shorter and generally filled by contract deliveries, excess capacity for water transfers is increasingly hard to come by.

Although lesser known, an increasing challenge to Delta export reliability relates to the operations and maintenance of the large, complex facilities that make up the SWP. The SWP has experienced a significant and growing decline in operational reliability that has directly impacted DWR’s ability to store and move water, produce electricity, and export water from the Delta when the appropriate hydrological conditions present themselves (DWR 2010b). These challenges include maintaining SWP delivery capabilities under continued manpower resource limitations, aging infrastructure, and constraints in providing competitive employee compensation despite adequate SWP funding. Further resource challenges

16 Additional municipal and industrial water contracts were implemented in the late 1980s for the CVP San Felipe Unit and in the last 10 years for the CVP American River Division.
are attributed to complex and cumbersome State contracting processes and State hiring freezes.

Much of the State’s water infrastructure is also aging and vulnerable to natural hazards, and planned components of the State and federal systems were never completed (Lund et al. 2007). Recent events, including damages sustained at the Oroville Dam flood control spillway and at the Clifton Court Forebay intake structure during 2017, have also highlighted the need to inspect and adequately maintain water infrastructure, and ensure adequate long-term funding for ongoing inspections and maintenance.

**Continued Delta Ecosystem Decline**

Human activities and their associated effects on land and water management over the last century and a half have irrevocably changed California’s aquatic ecosystems. This is profoundly evident in the Delta, where natural flow patterns have been altered and water has been confined to canalized channels where shallow wetlands once existed (Whipple et al. 2012; SFEI 2014). Under the existing configuration for water export, which features single, adjacent points of water diversion in the south Delta for both the SWP and CVP, operations result in direct fish losses at the pumps, change the way water and fish move through the Delta, create harmful reverse flow conditions, and place fish at greater risk of predation (NMFS 2014; Castillo et al. 2012; Gingras 1997). These effects have been compounded by the influx of invasive non-native species and changes to habitat quality and quantity upstream from the Delta. The result has been a dramatic decline in native species, including some aquatic species now on the brink of extinction.

Despite recent restoration efforts and investments, aquatic species continue to decline (Moyle et al. 2010, NMFS 2014). These species also remain highly vulnerable to changing hydrologic conditions such as warmer water temperatures, longer water residence time, increased water clarity, and reduced flow. Further, significant uncertainty exists regarding the effects of projected climate on the hydrology of the Delta watershed and its ecological health.

Water temperatures have warmed and water quality in the Delta has changed over time, as was particularly evident during California’s recent drought. Water quality degradation affects not only the Delta ecosystem, but also the ability of waterways to support sustainable agriculture, recreation, and other quality of life amenities for residents and local communities. Water dedicated to the environment, including storage reserved for water temperature and flow management in the Delta and its tributaries, will become increasingly important over the coming century (Hanak et al. 2012).

**Improving Delta Water Supply Reliability through Investments in System Flexibility**

Because California’s annual precipitation is remarkably variable, the past expectation that each year—wet or dry—should yield the same quantity of water exported from the Delta watershed is unrealistic and can be an obstacle to necessary improvements in water supply reliability.

The greatest conflicts between the water needs of people and fish within the Delta occur during dry years. That is when the least amount of water is flowing into the Delta and, historically, when exports have been a much larger percentage of Delta inflows than in wet years (see Figure 3-6). On average, exports have diverted about 17 percent of Delta inflows in wet years and about 36 percent during dry years (DWR 2011c). In past years, exports have exceeded 60 percent of Delta inflows in some dry months, but recent regulatory decisions now constrain such operations.

The recovery of the Delta ecosystem and listed species will help reduce regulatory restrictions on Delta exports and increase the long-term stability and predictability of rules governing Delta pumping.
Historical Delta Inflow and Delta Exports

Figure 3-6  In many years, water flowing into the Delta greatly exceeds the amount of water that is exported from or used in the Delta. However, in dry years, total exports and in-Delta use have averaged as much as 36 percent of inflows.

*Source: DWR 2012a*
More natural flow patterns in the Delta can be compatible with improving the reliability of water deliveries from the Delta. More water can be taken in wet years when more water is available, less water will be taken in dry years when it is needed for in-Delta water quality and environmental protections, and operations can be improved to increase seasonal flexibility to avoid impacts on Delta species and habitat. Many local water management actions that help reduce reliance on the Delta and improve regional self-reliance are also essential to improving overall flexibility of Delta operations and improving reliability of water supplies during periods when pumping is constrained.

Upstream, downstream, and in-Delta improvements can all add to export system flexibility, producing both water supply and ecosystem benefits. Storage capacity, however, is a current limitation to this scenario, and will worsen under anticipated climate change conditions. Were sufficient storage available, flows that exceed water needed to meet environmental and other requirements could be captured and stored. This stored water could then be released later in the year or carried over into subsequent years.

Fish predation and mortality at the export pumps could be reduced if the diversion points of the State and federal water projects in the Delta were moved or modified. Risks to a reliable source of fresh water conveyed through the Delta could be reduced through conveyance alternatives that could provide multiple diversion locations in the Delta and through strategic levee investments.

New and improved conveyance, water storage, and the operations of both—alongside other actions and policies identified in the Delta Plan—are integral to managing the Delta and achieving the coequal goals. They are part of an integrated approach that uses all available water management tools to provide operational flexibility, while striving to achieve a balance among Delta uses recognized by the State. The cost of new and improved major storage and conveyance infrastructure will be significant, but the risk of taking no action is unacceptably high and will lead to additional, irreparable damage to the ecosystem and insufficient water supplies to support a healthy state economy (Hanak et al. 2017). Under climate change alone, average annual south of Delta SWP and CVP export reliability is expected to fall from about 4.9 MAF to about 4.6 MAF; this decline could be substantially larger should additional regulatory restrictions be placed on exports (Hanak et al. 2015; Hanak et al. 2011). Maintaining the status quo will make achieving the coequal goals impossible in the future. To address the challenges and to meet the coequal goals, water managers operating California’s water supply systems need to integrate their operation to take advantage of regional supply sources and leverage the use of new and existing facilities for conveyance, system storage, and the optimal operations of both (Lund 2016; Gray et al. 2015; Lund et al. 2014; Null 2016).

It is important to note that storage can increase the benefits of conveyance improvements, and conveyance improvements may be limited without the benefit of added storage. Improved operational flexibility, consistent with ecosystem restoration, can result in more reliable water supplies for all beneficial uses from year to year and, when managed for multiple benefits, can also ensure adequate flows to meet public trust needs, including the protection of the Delta ecosystem.

To achieve the coequal goals, there is a need to change the way water is managed and water systems are operated in the Delta. Maintaining the status quo will make achieving the coequal goals impossible in the future, and poses a significant risk of continued habitat and species decline and uncertainty in water supplies exported from the Delta. The magnitude of operational changes needed to achieve the coequal goals will not be possible without new investments in water infrastructure, namely improvements to water conveyance and storage facilities.

Further, operational and infrastructure improvements need to progress together and in coordination with other actions.
identified in the Delta Plan, such as those related to restoring and enhancing the Delta ecosystem (Chapter 4), improving water quality (Chapter 6), achieving greater regional self-reliance and reduced reliance on the Delta (Chapter 3 and Appendix G), and reducing risks to people and property (Chapter 7).

There is no single solution to water management in California, as a whole, and in the Delta in particular (Luoma et al. 2015). Rather, a combination of near-term and long-term improvements to water conveyance, system storage, and operations are needed (Hanak et al. 2017). These improvements should seek to balance what can often be competing operational objectives (e.g., protecting threatened fish species and providing reliable water supplies) while minimizing conflicts and protecting the Delta’s unique values. Further, as our knowledge of the Delta ecosystem continues to grow there remains significant uncertainty over the effectiveness of planned actions to protect, restore, and enhance the Delta. Consequently, adaptive management consistent with the framework outlined in the Delta Plan is essential for all actions that seek to further the coequal goals.\textsuperscript{17}

\textbf{The Role of Storage in Increased Flexibility}

Water storage is an effective water management tool available to even out the variability of the state’s hydrology across time and space, and to optimize the benefits of improved conveyance for both the environment and water supply reliability.

Statewide water storage capacity, both above and below ground, is currently inadequate, especially south of the Delta, to facilitate export of water at times of surplus when the impacts on the Delta’s ecosystem are reduced and the only impediment is lack of available storage capacity (DWR 2009). For example, in 2010, the SWP and CVP pump operations were slowed even though water was available to be pumped at a time when it would not have conflicted with endangered species or other water quality requirements. The SWP and CVP could not convey the surplus water through the Delta at that time because storage capacity south of the Delta was full.

Improved water storage in both surface reservoirs and groundwater is needed to accommodate changing hydrology throughout the Delta watershed, to better achieve the beneficial functions of more natural and variable flows, to maintain better temperature conditions in the Delta and its tributaries, to allow the storage of water supplies for later use during dry periods, and to sustainably manage the state’s aquifers. Moreover, improvements to conveyance and storage must be operated in an integrated manner (Null et al. 2014) that further’s achievement of the coequal goals while protecting and enhancing the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

Throughout California, water managers are actively pursuing opportunities to implement integrated strategies and improvements to water conveyance, system storage, and the operations of both to achieve local and regional goals.

California’s interconnected network of surface water and groundwater storage lacks the capacity and conveyance flexibility to manage ecosystem, water reliability, and public safety needs under the state’s highly variable climate. New and expanded surface water reservoirs, improved groundwater storage, and the conjunctive management of both are critical to provide reliable water supplies for all uses, including flow and temperature management to benefit the Delta ecosystem in the face of increasingly intense drought and a changing climate (Reclamation 2016; Ho et al. 2017).

\textsuperscript{17} Water Code section 85052 defines “adaptive management” as a framework and flexible decision making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives. See also Appendix C.
### Applying Adaptive Management To Water Management Decisions

An adaptive management approach for water management decisions should be taken to plan for and assess the water supply outcomes of conveyance and storage improvement actions. The following is a hypothetical example of how the Council’s three-phase and nine-step adaptive management framework (see Appendix C) could be applied to a water management decision.

<table>
<thead>
<tr>
<th>Adaptive Management Step</th>
<th>Hypothetical Water Supply Reliability Improvement Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Define/redefine the problem</td>
<td>Current storage and conveyance configuration is not adequate for providing a more reliable water supply to south-of-Delta users under modern operating rules.</td>
</tr>
<tr>
<td>2 Establish goals and objectives</td>
<td><strong>Goal:</strong> Improve water supply reliability for south-of-Delta water users. <strong>Objective:</strong> Optimize storage for south-of-Delta water users in wet years so that interruptions in deliveries are reduced and the amount of water delivered during wet years can be increased consistent with environmental regulations in the Delta.</td>
</tr>
<tr>
<td>3 Model linkages between objectives and proposed action(s)</td>
<td>There are inadequate options for south-of-Delta water users to optimize storage in wet years, leading to vulnerability to interruptions and reduced capacity to divert water when it is available. The San Luis Reservoir is the only CVP water source for San Luis Unit, Cross-Valley Contractors, and San Felipe Division (SFD) water users. SFD serves water to Santa Clara and San Benito counties. As the San Luis Reservoir is drawn down during the summer and into the late fall (when predictable water supplies are needed most), a dense layer of algae develops near the surface. As the water level lowers, this algae gets captured by SFD intakes. The algae degrade water quality and make water more difficult to treat. As a result, SFD deliveries can be interrupted when the reservoir falls below 300,000 acre-feet. It is hypothesized that improving the San Luis Reservoir low-point intake would increase the predictability of water deliveries and make more water available to south-of-Delta users during dry years. Alternatives to improving the low-point intake could include expanding the Pacheco Reservoir to provide storage for SFD water users. As a result of taking one or a combination of these actions, progress would be made toward improving water supply reliability for south-of-Delta water users by (1) reducing potential for interruptions, (2) diverting more water during wet years, and (3) making this water available during dry years when water from the Delta may not be available.</td>
</tr>
</tbody>
</table>
| 4 Select action(s) (research, pilot, or full-scale) and develop performance measures | **Selected Action:** Conduct feasibility analyses and modeling to determine which option would enable the highest increase in the reliability of water conveyance for south-of-Delta users in compliance with environmental requirements. **Performance Measures:**  
- Administrative – Complete feasibility analyses and modeling.  
- Output – Select and implement an improvement project (e.g., improve the low-point intake at San Luis Reservoir only).  
- Outcome – Progress toward improving water supply reliability by (1) reducing potential for interruptions, (2) diverting more water during wet years, and (3) making this water available during dry years when water from the Delta may not be available. |
| 5 Design and implement action(s) | Design and implement the feasibility analyses and modeling. |
| 6 Design and implement monitoring plan | Design and implement the monitoring plan, including baseline monitoring, and measurement of (1) reduced interruptions of SFD deliveries when the reservoir falls below 300,000 acre-feet, (2) the amount of increased delivery of water during wet years, and (3) the amount of increased water deliveries from the reservoir during dry years to offset reduced Delta diversions. |
| 7 Analyze, synthesize, and evaluate | Analyze, synthesize, and evaluate the feasibility analyses and model outputs, and make recommendations for selecting a project or adjusting the conceptual model. |
| 8 Communicate current understanding | Provide project manager(s) and decision makers with synthesized information learned. For example, present information on the extent to which interruptions would be reduced, the value of the reduced interruptions, and the benefits of a specific operation scheme as part of a cost-benefit analysis. |
| 9 Adapt | The DWR, Reclamation, and SFD contractors decide on a pilot- or full-scale improvement project. |
With climate change, reservoirs in the Delta watershed will need to adjust their operations to accommodate warmer and more intense winter storms, more precipitation occurring as rainfall, and earlier spring snowmelt (Anderson et al. 2008; Huang et al. 2012; Berghuijs et al. 2014; Goulden and Bales 2014; Van Lienden et al. 2014; Savtchenko et al. 2015; Jepsen et al. 2016; Udall and Overpeck 2017). These changes will make it increasingly difficult to meet water temperature and flow objectives for native fish and water supply reliability for municipal, industrial, and agricultural uses. With current facilities and management practices, shifts in precipitation and runoff will directly affect deliveries and reservoir storage levels for the SWP and CVP. Lower carryover storage is projected for both the SWP and CVP, presenting risks for water supply reliability, hydropower production, and cold water pool storage for fish protection. The warmer climate and significant shift in seasonal runoff will result in consistently lower water delivery capability (Anderson et al. 2008). Further, warmer and more intense winter storms will require adjustments to reservoir operations to provide adequate space for floods and protect public safety, which may come at the risk of environmental and water supply needs if reservoirs cannot be refilled later in the season. Without new or expanded storage, current conflicts between the use of water for ecosystem management (flow and temperature), water quality (for in-Delta use and exporters), and supply reliability could intensify (Wilson et al. 2016).

New or expanded surface water and groundwater storage across the state can contribute in different ways to achieving the coequal goals. Improved water storage in the Delta watershed – both seasonal and permanent – can help manage flow and water quality conditions to support a healthier Delta ecosystem, while maintaining water quality for agricultural and municipal users, recreation, and fish. Native fish species may benefit from improved water storage in the Delta watershed, including storage space dedicated to ecosystem benefits such as flow management, water temperature management, other water quality benefits, or providing water supplies to wildlife refuges. However, it is recognized that opportunities for increased surface water storage on on-stream reservoirs may be limited by potential ecological impacts. Studies indicate that the average annual amount of water available for storage in the Delta watershed is about 10 MAF, increasing to as much as 22 MAF in wet years (Association of California Water Agencies 2017; DWR 2017). As described in the Delta Plan (see page 74), the availability of water for diversion to storage or use is subject to the restrictions or conditions of specific water rights, as well as the operation restrictions of storage and transport facilities, physical and economic limitations, nonconsumptive uses (such as hydroelectric power generation), and the use and reuse of water.

New and expanded surface water and groundwater storage – within the Delta watershed, and within the Delta water export area – is needed to support reduced reliance on the Delta, achieve greater regional self-reliance, and sustainably manage the state’s aquifers. Increased storage can allow water to be moved through the Delta when there are sufficient flows to support ecosystem needs and water can be more safely exported, for storage and later delivery when exports must be reduced to protect water quality and native fish. This shift in the timing of water movement and increased ability to carry over stored water from season to season can reduce reliance on the Delta during critical periods.

Groundwater provides about 40% of California’s average annual total water supply, a figure that increases significantly during droughts and when surface water supplies are limited. Sustainable management of the state’s groundwater resources is an important component of providing safe and reliable water supplies, contributing to reducing reliance on the Delta, and improving regional self-reliance. While difficult to quantify, available groundwater storage capacity in the state is estimated to exceed 200 MAF (DWR 2015). However, surface water supplies must be conjunctively managed with groundwater to leverage this available capacity and avoid groundwater overdraft, which can lead to subsidence.
and permanent loss of aquifer capacity. Expanded surface water storage can contribute to sustainable groundwater management by providing surface water at the right time for recharge and replenishment, providing water for in-lieu use to allow aquifers to recharge, and facilitate groundwater banking and exchange. This is particularly true in the San Joaquin Valley, where replenishment of aquifers and conjunctive use are limited by the availability of surface water supplies for recharge.

In the past decade, the State has spent tens of millions of dollars on integrated studies to evaluate how large surface storage and conveyance may be improved. DWR is now completing surface storage investigations that were initiated under CALFED more than 10 years ago (DWR 2010a). The three proposed new major surface storage reservoirs that are being evaluated are the North-of-the-Delta Offstream Storage (Sites Reservoir), Los Vaqueros Reservoir Expansion, and Upper San Joaquin River Basin Storage investigation (Temperance Flat Reservoir). DWR expects to make its decision on recommended projects by 2014.

In the meantime, smaller facility improvements, particularly for storage, are being implemented. Since 1995, more than 1.2 MAF of additional surface storage has been constructed at the regional level, including the Diamond Valley, Seven Oaks, and Olivenhain reservoirs in Southern California, and the Los Vaqueros Reservoir in Contra Costa County. The sidebar, Applying Adaptive Management to Water Management Decisions, provides a hypothetical example of an approach to providing more reliable water supplies.

A legacy of both overdraft and water quality contamination has compromised groundwater storage in many regions of the state; however, important improvements are being made through expanded regional groundwater storage north and south of the Delta. Notably, an assessment of groundwater storage in 2000 identified more than 21 MAF of potential groundwater storage in Southern California and the southern portion of the San Joaquin groundwater basin (AGWA 2000). A more detailed discussion of groundwater management in California is included later in this chapter.

Significant opportunities are available to improve the operation of existing storage and conveyance facilities, build small-scale storage projects, or enhance opportunities for groundwater conjunctive management and water transfers in the next 5 to 10 years that are consistent with the coequal goals. DWR is leading a System Reoperation Task Force with Reclamation; USACE; and other State, federal, and local agencies to study and assess opportunities for reoperating existing reservoir and conveyance facilities to improve flood protection and capture of available water runoff, particularly in the context of climate change. Reservoir reoperation is also addressed in Chapter 7.

The value of new and/or expanded storage infrastructure should be assessed along with its connectivity to other surface storage, conveyance systems, and groundwater systems to maximize water supply and ecosystem benefits. Conveyance system integration affects the ability to make use of existing and new storage capacity in different parts of the state. Given the state’s variable hydrology, the ability to operate conveyance in the Delta in a “big gulp, little sip” manner that balances ecosystem and water supply reliability needs is dependent on the availability of storage capacity in reservoirs and aquifers, and of conveyance infrastructure to move water supplies to and from storage facilities.

Many local storage and conjunctive management projects were identified through competitive State and federal grant funding application processes in the past decade. Most of these projects could not be funded because of limited funding and restrictions in some of the grant provisions. Later in this chapter, the New Water for California section provides

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18 Contra Costa Water District will complete a 160,000-acre-foot expansion of Los Vaqueros Reservoir in 2012. The feasibility of an additional 275,000-acre-foot expansion is still under consideration by State and federal agencies.
further detail on the range of options and describes necessary steps that regions should take to improve regional self-reliance and reduce reliance on the Delta.

**The Role of Conveyance in Increased Flexibility**

Conveyance improvements can enhance the operational flexibility of the Delta system to divert and move water at times and from locations that are less harmful to fisheries, or to reliably transport environmental water supplies to specific locations at times when it can benefit fish and water quality (California Natural Resources Agency 2010). Existing configurations of Delta water conveyance and associated conveyance facilities do not provide adequate long-term reliability to meet current and projected water demands for SWP and CVP water exports from the Delta watershed (DWR 2009).

Conveyance improvements in the Delta are needed so that water supplies can be safely moved when they are available and conflicts between water supply deliveries and species protection can be avoided. This will allow exports to be reduced in dry periods when aquatic ecosystem needs are magnified, and promote more effective use of surface and groundwater storage to carry over supplies from wet to dry periods. Conveyance improvements outside the Delta are also needed to better leverage periods when conflicts between water exports and species protection are reduced, such that exported supplies can be managed conjunctively with local surface and groundwater supplies and storage facilities (Hanak et al. 2017).

The current system of natural and engineered conveyance infrastructure in the Delta lacks sufficient capacity and flexibility to manage water operations to benefit the ecosystem and enhance water supply reliability. System capacity and operational flexibility are needed to create more natural, variable flows and improve temperature conditions to support ecosystem health, maintain water quality for in-Delta uses, and move more water during wetter periods when supplies are available for both environmental and consumptive uses such that water can be sported less from the Delta in dryer periods when native fish are more vulnerable.

Current water conveyance infrastructure is also aging and Delta channels are vulnerable to earthquakes, floods, and other hazards as further discussed in Chapter 7 of the Delta Plan. Failure of this infrastructure poses significant risks for environmental harm and water supply disruption (Working Group on California Earthquake Probabilities 2003; Mount and Twiss 2005; Sneed et al. 2013; Farr et al. 2015; Robinson and Vahedifard 2016; Vahedifard et al. 2016). Climate change also is altering precipitation patterns in the Delta watershed and changing the timing and amount of stream flow, affecting water available for both ecosystem management and supply reliability. Sea level rise will increase salinity intrusion into the Delta, degrade water quality for agricultural and municipal uses in and outside the Delta, and alter ecosystem conditions (Anderson et al. 2008; Fleenor and Bombardelli 2013; Van Lienden et al. 2014).

For well over 50 years, State, local, and federal entities have worked to identify long-term solutions to protect the beneficial uses of the Delta, including new and improved water conveyance in the Delta. Conveyance options considered over time have taken many different routes, forms, sizes, and configurations (DWR and Reclamation 2016). They have included isolated conveyance (moving water across or around the Delta via tunnels, pipelines, and aqueducts); improvements to existing Delta channels and new Delta channels; and combinations of both isolated conveyance and through-Delta channels (also known as dual conveyance). Numerous operational scenarios have also been considered and evaluated that incorporate a range of upstream and in-Delta flow objectives, changed reservoir operations, changes to the timing of water conveyance and exports (seasonally and by year type), and many other regimes.
In accordance with Water Code section 85304, to promote options for improved conveyance in the Delta, the Delta Plan recommended that State and federal agencies complete the Bay Delta Conservation Plan (BDCP) and receive incidental take permits by December 31, 2014. Had that recommendation been fulfilled, the BDCP’s conveyance provisions could have been incorporated automatically into the Delta Plan pursuant to Water Code section 85320(a).

In 2015, however, the State announced a new preferred alternative that would not complete the BDCP as a Natural Community Conservation Plan and Habitat Conservation Plan, but instead would pursue conveyance facilities through a DWR and Reclamation initiative called California Water-Fix. A parallel effort called California EcoRestore was concurrently proposed to accelerate implementation of a suite of habitat restoration actions in the Delta.

In response to this new alternative, the Council began to review the issue of conveyance as well as storage and operations per Water Code section 85304:

“The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.”

The Council developed the Conveyance, Storage Systems, and the Operation of Both (CSO) Amendment to meet the Water Code requirement. The recommendations from the CSO Amendment are included in this chapter in WR R12, and the entire Amendment has been included as an exhibit (Exhibit A) to this chapter.

Conveyance improvements are being evaluated as part of the California Water-Fix project. Once decisions are made regarding whether to build and, if so, in what manner to build conveyance improvements, construction of these facilities will likely take at least a decade or more and will not provide near-term reliability improvements. This means that Delta operations and deliveries of export supplies will continue to be constrained by existing infrastructure for at least the next 15 years.

A great body of work exists exploring the potential positive and negative effects, risks, and uncertainties associated with different Delta conveyance options:

- If managed for conservation objectives, an isolated conveyance facility (one that moves water over, under, or around the Delta via artificial means) could facilitate more variable flow patterns, operating in a way that more closely mimics the natural flows that existed before the CVP and SWP export facilities were constructed and reducing entrainment—two actions scientists consider quite promising (Hanak et al. 2013; Moyle and Bennett 2008; Fleenor et al. 2010). Construction of screened diversion and intake facilities in multiple locations in the Delta would also reduce reliance on the State and federal export facilities in the south Delta. Operation of the existing CVP and SWP export facilities draws water toward the south Delta, which can reverse the natural direction of flow in Old River, Middle River, and other Delta channels. These flow reversals disorient and reposition vulnerable fish populations, resulting in fish losses from entrainment, predation, and capture and release practices. Access to one or more intakes in the northern Delta would provide operational flexibility to reduce south Delta exports and limit harmful reverse flow conditions, particularly during periods of lower flow, while at the same time managing water quality. Needed improvements to Delta hydrodynamic conditions and aquatic habitat will be more difficult without some suitably operated form of isolated water conveyance (Lund et al. 2008; Hanak et al. 2011; Moyle et al. 2012).

- Improvements to through-Delta conveyance alone are insufficient to provide effective protection for native fish, and to mitigate current water operation conflicts with listed species that result in export curtailments. Operational history and scientific studies indicate that exclusive dependence on south Delta pumping facilities will continue to cause reverse flow conditions in Old...
and Middle rivers, drawing salmon and smelt into the interior channels of the Delta where they are vulnerable to predation and entrainment. Further, anticipated changes associated with sea-level rise, land subsidence, invasive species, climate change, and earthquakes will make it impossible to preserve the Delta in its current state (Moyle et al. 2012). Significant cost and uncertainty is associated with maintaining existing through-Delta conveyance and export operations, including operation and maintenance of aging export facilities and costs to repair and improve levees and channels. In addition, increased salinity will impose higher water treatment costs on Delta water users on the order of hundreds of millions of dollars per year. The cost of a large-scale levee failure from an earthquake, though difficult to estimate, would also be very high - both in terms of repair and restoration of affected levees and in terms of habitat loss and environmental harm (Lund et al. 2008). Although physical improvements to through-Delta conveyance can complement isolated conveyance by providing additional fish protection measures, sole reliance on improved through-Delta conveyance is unlikely to result in achievement of the coequal goals.

Even with the construction of some form of new isolated conveyance, through-Delta conveyance will remain an important component of California’s water supply system. The implementation of isolated conveyance without consideration of flow needs within existing Delta channels and waterways has the potential for detrimental effects on water quality and associated resources (such as aquatic habitat and species, recreation, and in-Delta water uses). Depending on the location of new intakes, dual conveyance may decrease the salinity of exported water but additional flow releases from upstream reservoirs may be required to meet in-Delta salinity standards. Analyses of different options for dual conveyance indicate that some in-Delta agricultural water users may encounter more frequent periods of high salinity while others may experience the opposite (Fleenor and Bombardelli 2013). With sea level rise, crop revenue losses in the Delta are estimated to be similar (less than 0.5%) with either through-Delta conveyance or dual conveyance of Delta exports (Medellin-Azuara et al. 2014). To provide flexibility to adapt to changing conditions, conveyance solutions (both through-Delta and isolated conveyance) should be integrated and operated in tandem with enhanced water storage in the Delta watershed to optimally achieve the coequal goals while protecting and enhancing the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

California’s hydrology is highly variable, requiring flexibility in water management operations to adjust to changing conditions. Adaptive management of new conveyance infrastructure in the Delta and its watershed can provide a framework for adjusting operations to changing conditions and our evolving understanding of ecosystem needs (Georgakakos et al. 2012). Adaptive management is a central component of the Delta Plan, and a requirement for covered actions under the plan’s regulatory policy G P1.

Large infrastructure projects ultimately have effects on the local environment and communities where the facilities are located. Above-ground isolated conveyance, in either a canal or above-ground pipeline, would permanently impact the landscape of the Delta—including native habitat, agriculture, transportation, recreation, and local communities. In comparison, below-ground conveyance reduces these impacts over the long-term (DWR and Reclamation 2016). However, below-ground conveyance – depending on its location, size, design, and associated physical details – will have impacts on Delta communities, including legacy communities during extended construction periods that would span years. Several existing Delta Plan policies (which are regulatory) and recommendations (which are not

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19 A “legacy community” is a rural community registered as a Historic District by either a State or federal entity. Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, Locke, and Walnut Grove are the Delta’s legacy communities (Public Resources Code section 32301(f)).
regulatory) promote protection of Delta communities, land uses, and restoration opportunity areas that may be affected by new infrastructure.

- Delta Plan regulatory policy DP P2 requires water management infrastructure to be sited to avoid or reduce conflicts with existing land uses and those uses described in general plans.

- Delta Plan recommendation DP R5 addresses the need to plan for the provision of adequate infrastructure, including streets and roads. A large-scale infrastructure project – taking place in multiple locations, on land and on waterways, over a decade or more – will impact existing and future planned infrastructure. Plans should be made to accommodate the goals of transportation planning in the affected area, as well as to mitigate those impacts.

- Delta Plan recommendation DP R14 is aimed at enhancing nature-based recreation within the Delta, and recommendation DP R17 promotes enhancing opportunities for visitor-serving businesses. Construction of new conveyance and future maintenance activities can negatively affect visitor-serving recreation and businesses, and thoughtful and collaborative planning is needed to minimize these impacts such that the intent of these recommendations can be achieved, even during an extended construction period.

- Delta Plan recommendation DP R3 encourages planning for the vitality and preservation of legacy communities.

- Delta Plan regulatory policy G P1 requires covered actions not exempt from CEQA to include applicable feasible mitigation measures identified in the Delta Plan’s Program Environmental Impact Report, including those related to impacts to Delta communities.

Advice from the Delta Protection Commission, affected local communities and local governments, and agencies responsible for protecting and restoring the Delta environment must be considered in selecting conveyance alternatives and mitigation measures. Minimizing impacts during construction to the normal, daily course of business in the affected communities and minimizing disruptions during normal operations and maintenance activities should be a priority for facility planners. A phased construction schedule, developed in coordination with local governments and communities in the Delta, could help minimize disruptions from large-scale infrastructure construction activities. Mitigation measures appropriate to the physical scale of new conveyance facilities, the length of the construction period, and anticipated maintenance needs should be planned in collaboration with the affected communities to minimize disruptions to residents and businesses. Further, collaboration, communication, and public engagement should continue throughout design, construction and, ultimately, operation and maintenance of new facilities.

There is a need to address impacts to terrestrial and aquatic species from new infrastructure development in the Delta. Delta Plan regulatory policy ER P3 requires avoidance of or mitigation for significant adverse impacts to high priority habitat restoration areas, including designing projects such that they will not preclude or interfere with future habitat restoration projects in these areas. Habitat mitigation projects should be implemented in advance of construction activities, such that replacement habitat is establishing and functioning prior to the start of construction. Furthermore, project proponents should design new or improved Delta conveyance infrastructure to enhance ecosystem restoration opportunities, flood risk reduction, recreation, and quality of life for Delta communities. More natural flow patterns linked with connections to improved habitat areas can create opportunities to re-establish important ecological processes associated with interactions between land and water that more closely resemble historical conditions.
within the Delta (Whipple et al. 2012; Lund et al. 2008). Conveyance infrastructure can and should be designed to enhance the connectivity of surrounding riparian and floodplain habitats, as well as in-Delta habitats, to better support native ecosystems (Opperman et al. 2009; Hanak et al. 2013; DiFrancesco and Tullos 2014, 2015).

It will take many years to implement large-scale improvements to conveyance infrastructure in the Delta and, even with the construction of such facilities, the CVP and SWP pumping facilities in the south Delta will continue to operate. Various studies have examined the feasibility of installing fish screens at Clifton Court Forebay or the entrance channels to the CVP and SWP pumping facilities. Most fish screens rely on sweeping flows moving past (parallel to) the screen to prevent impingement and entrainment; additionally, the terminal location and large pumping capacity of the CVP and SWP export facilities make it difficult to design a facility with sufficient sweeping flows to safely screen delta smelt and salmon. Further, fish screens would not address the effect that pumping operations have in reversing flows in some Delta channels and drawing fish toward the south Delta, where they would remain subject to predation and other harmful conditions. Given this, there is a need to identify and implement near-term actions to protect native fish and reduce fish losses associated with existing water export facilities, particularly in the south Delta (California Natural Resources Agency 2016). This includes evaluating structural changes to the export facilities, improving salvage and release operations, and identifying, monitoring, and adaptively managing actions to address predation (Grossman 2016; NMFS 2014; Gingras 1997).

Based on the findings and considerations identified above, new conveyance in the Delta should:

- Be a combination of new isolated conveyance and improved through-Delta conveyance facilities (dual conveyance) with access to multiple points of diversion, including one or more screened diversions;
- Be resilient to current and future hazards;
- Be adaptively managed and operated to adjust to changing conditions and scientific understanding, providing flexibility in operations to help achieve the coequal goals today and into the future;
- Be designed to avoid or minimize adverse effects while preserving and enhancing opportunities for ecosystem restoration, recreation, sustainable agriculture, and resilient local economies and communities;
- Be constructed and operated to minimize disruptions to the normal, daily course of business in affected communities, including minimizing disruptions during routine operations and maintenance; this includes implementing formal, collaborative processes with local governmental representatives to develop detailed construction implementation plans and policies that are responsive to the needs of affected communities, their economic activities, and quality of life during construction and beyond; and
- Be paired with near-term actions to address native fish losses at Delta export facilities.

Improved conveyance in the Delta can contribute to reducing fish losses and improving delivery reliability; however, conveyance alone is unlikely to provide the flexibility necessary to provide the water flow, temperature, and quality in the Delta and its watershed that are needed to achieve ecological goals. Similarly, improved Delta conveyance can improve export reliability but alone may not provide the flexibility needed for water managers to reduce reliance on the Delta and improve regional self-reliance. New conveyance in and outside the Delta should be developed and operated in coordination with existing and expanded storage systems (both surface storage and groundwater) to maximize the water management benefits and contributions to the coequal goals. However, improvements to conveyance alone are not sufficient to eliminate conflicts between water exports and species protection, or to optimize water system operations. Those conflicts are at their height during hydrologic extremes, such as droughts and floods. For this reason, improvements to conveyance must be considered along with
increased water storage to ensure that flow, temperature, and water quality needs can be managed in the Delta, now and into the future.

Steps must also be taken to implement local water management programs and projects, described later in this chapter. Additionally, the State needs to address the continuing vulnerability of the Delta levee system and make improvements to protect the existing in-Delta conveyance system from catastrophic failure. (See Chapter 7 for a discussion of the benefits and vulnerabilities of Delta levees.) In particular, immediate improvements to the Delta levee system are critical because of the current instability and interdependence of the levees—the failure of one can affect the entire system (NRC 2012).

The Role of Integrated, Coordinated Operations of Storage and Conveyance

To develop a robust water management system that provides flexibility to adapt to changing conditions, conveyance should be integrated and operated in tandem with enhanced water storage in the Delta watershed and the Delta export area to optimally achieve the coequal goals while protecting and enhancing the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

The operation of water management projects in and tributary to the Delta are subject to laws and regulations administered and enforced by a variety of agencies, including water flow and quality standards as defined by the State Water Resources Control Board. These laws and regulations effect the operation of upstream reservoirs to meet flow and quality standards, and govern the timing and volume of water that may be conveyed through and exported from the Delta. Water operations are also subject to the conditions associated with individual water rights. Within this regulatory environment, a complex system of State, federal, and local water management infrastructure in the Delta and its watershed is operated to meet diverse and increasingly competing needs (Lund 2016).

Many of the State’s conveyance and storage systems are inextricably linked by the Delta and surrounding environments, and conveyance and storage must be operated in an integrated manner to realize their full and combined potential. This includes operations to take better advantage of periods of ample supply such that less water is exported during critical dry periods. Operational flexibility of conveyance and storage systems is particularly important when considering climate change and uncertainties associated with future water demands (Georgakakos et al. 2012). Further, sustained drought conditions are expected to intensify in the future, putting additional stress on the operation of Delta conveyance and water storage infrastructure to meet both ecosystem and water supply needs.

Given these challenges and uncertainties, adaptive management is critical to successfully operating water management facilities in the Delta to achieve the coequal goals, as described in the Delta Plan. Adaptive management should address specific and measurable operating objectives for ecosystem and water quality requirements, changing climate conditions, and changing water demands (Georgakakos et al. 2012; Null et al. 2014; Kistenmacher and Georgakakos 2015; Null and Prudencio 2016; Rheinheimer et al. 2016). Further, for adaptive management to be effectively implemented, adequate funding must be provided to monitor conditions before, during, and after projects are implemented.

Water management systems in the Delta must be operated to reduce hydrodynamic and biological impacts of exporting water through Jones and Banks pumping plants and minimize the frequency, magnitude, and duration of reverse flows in Old River and Middle River in order to reduce the likelihood that fish will be diverted from the San Joaquin or Sacramento rivers into the southern or central Delta substantially increasing their likelihood of mortality (NMFS 2014,
STUDIES SUGGEST THAT SWP AND CVP WATER DIVERSION IMPACTS ON FISH CAN BE MITIGATED BY ALTERING THE TIMING OF EXPORTS, AND THAT FISH LOSSES CAN BE MINIMIZED BY MINIMIZING REVERSE FLOWS DURING PERIODS WHEN DELTA SMELT AND OTHER FISH ARE MIGRATING INTO THE DELTA (GRIMALDO ET AL. 2009). CONVEYANCE OPERATIONS MUST ALSO BE COORDINATED WITH STORAGE OPERATIONS TO PROVIDE ADEQUATE FLOWS IN THE DELTA TO MEET THE NEEDS OF FISH AND OTHER NATIVE SPECIES.


A RECENT STUDY BY THE ASSOCIATION OF CALIFORNIA WATER AGENCIES INDICATES THAT INTEGRATING THE OPERATION OF EIGHT PROPOSED STORAGE PROJECTS (BOTH NORTH AND SOUTH OF THE DELTA) WITH EXPANDED CONVEYANCE IN THE DELTA CAN IMPROVE DELIVERY RELIABILITY AND CONTRIBUTE TO SUSTAINABLE GROUNDWATER MANAGEMENT OVER EXPANDING STORAGE ALONE, WHILE MEETING REGULATORY FLOW AND WATER QUALITY REQUIREMENTS. FOR EXAMPLE, THE STUDY ESTIMATED AN AVERAGE ANNUAL INCREASE IN WATER DELIVERIES WITH THE PROPOSED STORAGE PROJECTS ALONE OF ABOUT 400 THOUSAND ACRE-FEET (TAF); THIS FIGURE INCREASED TO ABOUT 800 TAF WHEN SIMULATED IN COMBINATION WITH IMPROVED DELTA CONVEYANCE. SIMILARLY, THE STUDY SHOWED REDUCED GROUNDWATER PUMPING AND INCREASED RECHARGE WITH A COMBINATION OF STORAGE AND CONVEYANCE. GROUNDWATER STORAGE INCREASED BY ABOUT 250 TAF ANNUALLY WITH NEW STORAGE PROJECTS ALONE, INCREASING TO 460 TAF ANNUALLY WITH A COMBINATION OF STORAGE AND IMPROVED DELTA CONVEYANCE (ASSOCIATION OF CALIFORNIA WATER AGENCIES 2017). OTHER STUDIES HAVE SUGGESTED THAT GROUNDWATER STORAGE IN THE SAN JOAQUIN VALLEY ALONE COULD INCREASE BY AS MUCH AS 500 TAF WITH A COMBINATION OF NEW SURFACE STORAGE AND CONVEYANCE IMPROVEMENTS (LAND ET AL. 2014).

A RECENT STUDY BY DWR SHOWS MORE THAN 1 MAF OF SURFACE WATER AVAILABLE ON AN AVERAGE ANNUAL BASIS FOR GROUNDWATER REPLACEMENT WITHIN THE DELTA WATERSHED AND AREAS RECEIVING DELTA EXPORT SUPPLIES (DWR 2017). CONVEYANCE IMPROVEMENTS WITH EXPANDED SURFACE STORAGE CAN INCREASE THE ABILITY TO CAPTURE AND TRANSPORT SURFACE WATER SUPPLIES FOR GROUNDWATER RECHARGE AND REPLACEMENT AND/OR IN-LIEU RECHARGE. SURFACE STORAGE CAN BE OPERATED TO STORE WATER DURING WET PERIODS, FOR DELIVERY IN LATE SPRING AND SUMMER AND DURING DRY PERIODS AS IN-LIEU SUPPLY FOR EXISTING GROUNDWATER USERS; THIS OPERATION INCREASES THE USE OF AVAILABLE GROUNDWATER STORAGE CAPACITY, PROVIDING GREATER WATER SUPPLY BENEFITS THAN IF SURFACE AND GROUNDWATER FACILITIES WERE OPERATED INDEPENDENTLY (LAND ET AL. 2014).

BY TAKING INTO ACCOUNT EFFECTS ON THE DELTA, CONVEYANCE OUTSIDE OF THE DELTA CAN BE OPERATED TO COMPLEMENT DELTA CONVEYANCE AND EXPANDED STORAGE. LOCAL CONVEYANCE IMPROVEMENTS AND SUSTAINABLE WATER MANAGEMENT ACTIONS TAKEN OUTSIDE THE DELTA CAN CONTRIBUTE TO THE COEQUAL GOALS THROUGH A COMPREHENSIVE, INTEGRATED WATER MANAGEMENT APPROACH THAT CONSIDERS MULTIPLE WATER SUPPLY SOURCES, INCLUDING BUT NOT LIMITED TO SURFACE WATER STORAGE, GROUNDWATER, STREAM FLOW, IMPORTED WATER, WATER TRANSFERS, STORMWATER, DESALINATED WATER, AND RECYCLED WATER, AS APPLICABLE (HOWITT ET AL. 2010; HANAK ET AL. 2012; HOWITT ET AL. 2015).
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Changing Conditions

Conflicting priorities in water and ecosystem management will be intensified by climate change, which will alter the magnitude, timing, duration, frequency, and rate of change of stream flows in the Delta watershed (Anderson et al. 2008; Huang et al. 2012; Berghuijs et al. 2014; Goulden and Bales 2014; Van Lienden et al. 2014; Savtchenko et al. 2015; Jepsen et al. 2016; Udall and Overpeck 2017).

Climate change will result in higher ambient temperatures, reduced Sierra Nevada snowpack, more precipitation falling as rain rather than snow, snow melting earlier and more rapidly, warmer stream temperatures, and higher amounts of water loss through evapotranspiration (Anderson et al. 2008; Huang et al. 2012; Berghuijs et al. 2014; Goulden and Bales 2014; Van Lienden et al. 2014; Savtchenko et al. 2015; Jepsen et al. 2016; Udall and Overpeck 2017; Ficklin et al. 2013). Climate change is also expected to trend toward more frequent and extended periods of drought as well as more frequent and intense floods (Das et al. 2013; Pierce and Cayan 2013; Pierce et al. 2013; Seager et al. 2013; Berg and Hall 2015; Cook et al. 2015; Differbaugh et al. 2015; Stewart et al. 2015; Walton et al. 2017).

Climate change will also contribute to rising sea levels along California’s coast and within its estuaries (Griggs et al. 2017). Rising sea levels will place additional burdens on the water management system in the Delta in the years to come (Cayan et al. 2008; NRC 2012b; Van Lienden et al. 2014). Through-Delta conveyance is very likely to experience salinity increases with sea level rise, which will ultimately rise above appropriate concentrations for drinking water and irrigation in some areas of the western Delta if freshwater outflows are not increased (Fleenor and Bombardelli 2013). It is projected that salinity at Jersey Point could increase by 23% in the early 21st century (2012-2040) and 88% by the end of the century, assuming an estimated mean sea level rise of 36 inches (92 centimeters (cm)) (Van Lienden et al. 2014). For the SWP and CVP, a projected 11.8 inches (30 cm) rise in sea level by the mid-21st century would raise salinity enough to reduce by 10% the amount of time that the projects can operate (Anderson et al. 2008). Reservoir releases to repel salinity are expected to reduce Delta water exports by about 10% by 2050 and by about 25% by 2100 (Dettinger. 2016a). In other words, a 1-foot (30 cm) rise in sea level would require almost 500,000 acre-feet of additional Delta outflow to meet current Delta salinity requirements (Healey et al. 2016; Mount et al. 2012). With sea level rise and increasing temperatures, new and expanded water storage will play a critical role in providing adequate flows in the Delta to manage water flow and water quality (salinity) for all uses.

In addition, California’s population is expected to increase from about 39 million in 2016 to more than 44 million by 2030 (California Department of Finance 2016). Population growth and increased economic activity, in combination with land-use changes, economically-driven grower choices that favor permanent crops, and demand hardening from advances in conservation and water use efficiency, will alter water demand patterns (Kiparsky et al. 2014; Bauer et al. 2015; Dettinger et al. 2015; Wilson et al. 2016). Continued progress in urban conservation is likely to offset some demand increases due to population growth (Wilson et al. 2016; Lund 2016), and agricultural water demand is expected to decrease over time. Environmental water demands, however, are expected to increase in the coming years (Hanak et al. 2012). All of these factors will place stress on the existing system of conveyance and storage in the state. This creates a much more difficult situation in which to maintain a healthy Delta ecosystem while providing reliable water supplies.

20 “Climate change” is defined in the Delta Plan as any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from (1) natural factors, including changes in the sun’s intensity or the Earth’s orbit around the sun, (2) natural processes within the climate system, or (3) human activities that change the composition of the atmosphere. See Glossary.

21 “Environmental water” use is defined in the Delta Plan as Water dedicated to instream environmental needs. See Glossary.
Reducing Reliance on the Delta

Many regions of the state rely on the Delta, to varying degrees, to meet their water supply needs. Reducing reliance on the Delta for water supply is essential to providing more flexibility in both meeting water supply reliability goals and protecting the ecosystem, especially in times of lower flow when there is maximum stress on both goals. Reducing reliance on the Delta is State policy, along with an associated mandate for improving regional self-reliance (Water Code section 85021), and reducing reliance is a prominent component of the Delta Plan (reflected in Chapter 3, which includes regulatory policy WR P1, Appendix G, and performance measures). Many agencies have made significant investments in developing their local and regional supplies, including groundwater banking, on- and off-stream surface water storage, recycled water, and desalinated supplies, while also achieving significant decreases in imported water demand through conservation and water use efficiency efforts. Reduced reliance on the Delta can be achieved through diversification of water supply portfolios at the regional and local levels, can improve overall supply reliability through providing alternative sources of supply during periods when water exports from the Delta are reduced (Hanak et al. 2015; Hanak et al. 2011).

Not all areas of the state have the same opportunities and resources to uniformly reduce reliance on Delta exports. Inland agricultural regions may not produce enough wastewater to replace agricultural irrigation with recycled water, although opportunities to use recycled water for groundwater recharge may be available. Other areas may be challenged by limited ability to dispose of brine, a byproduct of brackish and recycled water desalination, or geology and geography may limit the ability to store significant amounts of water during wetter periods. The cost effectiveness of any local supply strategy is of major importance and a valid criterion for any decision to implement a new local supply, as is avoiding or mitigating significant environmental impacts in the local area. Although new supply development opportunities may vary throughout the state, all regions reliant on Delta exports can reduce their reliance by increased water efficiency and aggressive water conservation.

New and improved conveyance, system storage, and the operations of both can complement water conservation and local supply development activities by providing a more stable and reliable source of supply. Combined with existing Delta Plan regulatory policy WR P1 and associated strategies for reduced reliance (see Chapter 3 and Appendix G), conveyance and storage can provide the flexibility local water managers need to sustainably manage their local supplies and reduce reliance on the Delta, especially during dry periods when the ecosystem is most vulnerable, water quality is degraded, and exports are limited.

New Water for California

The fact that water is a scarce resource does not mean that California is “running out of water” (NRC 2012). It does mean that California will need to develop plans, and implement programs and projects that can adapt to a highly variable and uncertain water future. The primary source of new water supplies for California in the future will come from local and regional sources. This section discusses local water supply opportunities, the importance of local and regional water management planning, and the need for improved groundwater management and water data so that the state can better match its water demands to the available supplies.
California’s Wealth of Water Opportunities

California has many new and underused water resources that can be developed to improve regional self-reliance. In 2009, DWR estimated that the state could further reduce water demand and increase water supplies in the range of 5 to 10 MAF by 2030 through the use of existing strategies and technologies (see Figure 3-7).\(^2^2\) If the state developed only half this water (about 5 MAF) through water efficiency and new local supplies, it would be sufficient to support the addition of almost 30 million residents, more than the population growth that is expected to occur by 2050.\(^2^3\)

Nearly all these potential supplies will come from a combination of improved conservation and water use efficiency in the urban and agricultural sectors, local groundwater and surface storage, conjunctive management, recycled water, drinking water treatment, groundwater remediation, and desalination. DWR has identified 27 “resource management strategies” that water suppliers should consider when expanding their water management programs throughout the diverse regions of the state (DWR 2009).

Resource managers can combine these strategies into a response package, crafting them to provide multiple water resource benefits, diversify their water portfolio, and become more regionally self-reliant.

Often, the new local and regional water supplies have the additional advantage of being available even during extreme drought conditions, making them some of the most reliable sources of water for urban and agricultural uses. In particular, recycled water and the treatment and reuse of poor-quality groundwater are two of the most resilient water supplies under conditions of drought and climate change. The treatment of poor-quality groundwater also can significantly improve drinking water supplies, especially for rural and economically disadvantaged communities that have limited alternatives to secure clean water. In 2012, the California Legislature enacted Assembly Bill (AB) 685, declaring the established State policy that “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes” (Water Code section 106.3 (a)). For more about drinking water quality, see Chapter 6.

For some local water resources, California has adopted specific targets, including:

- **Urban water conservation.** The State’s goal is to achieve a reduction in statewide per capita urban water use of 20 percent, from a 2005 baseline of an estimated 198 gallons per capita daily (GPCD) to 166 GPCD (DWR 2012b). This represents a potential annual water savings of approximately 1.8 MAF per year that will be accomplished by 2020. This is consistent with DWR’s 2009 estimate that 2.1 MAF can be conserved in roughly the same period through increased use of water-efficient appliances, reduced water use for landscaping, and tiered rate structures, such as increasing block rates or budget-based rate structures.

\(^{22}\) The range of 5 to 10 MAF is a conservative estimate and is consistent with recent studies that assess California’s potential for increased water savings and water supplies. DWR provides a cautionary note that the water supply benefits summarized in the California Water Plan are not intended to be additive, recognizing the same resource management strategies may complement or compete with one another for funding, system capacity, or other elements that are necessary for implementation. In addition, unlike the 2005 version, DWR did not include in the 2009 California Water Plan an estimate for water supply benefits from improved conveyance. Instead, DWR states that the main benefits of conveyance improvements are increased water supply reliability, water quality protection, and operational flexibility (DWR 2009).

\(^{23}\) Under California law, water conservation is considered a source of supply (Water Code section 1011(a)). A 2006 report from the Los Angeles Economic Development Corporation found that “using water more efficiently reduces demand, which has the same effect as adding water to the system.” For Southern California, the report concludes that “urban water conservation could have an impact equivalent to adding more than 1 MAF of water to the regional supply (about 25 percent of current annual use)” (LAEDC 2008).
Recycled water. The State’s goal is to increase the use of recycled water over 2002 levels by at least 1 MAF per year by 2020, and by at least 2 MAF per year by 2030 (DWR et al. 2010). DWR’s 2009 estimate indicates that as much as 2.25 MAF could be recovered, about half of the amount of wastewater that is treated and released to flow to the ocean.

Stormwater runoff. The State’s goal is to increase capture and reuse of stormwater by at least 500,000 acre-feet per year by 2020, and at least 1 MAF per year by 2030 (DWR et al. 2010). The 2008 Scoping Plan for California’s Global Warming Solutions Act of 2006 (AB 32) finds that up to 333,000 acre-feet of stormwater could be captured on an annual average for reuse in Southern California alone (CARB 2008).

California’s Wealth of New Water Supplies

Figure 3-7 DWR estimates that California could further reduce its water demands and increase water supplies by 5 to 10 MAF per year over the next 30 years through the use of existing technologies.

Source: DWR 2009
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CALIFORNIA WATER ACTION PLAN

The California Water Action Plan (California Natural Resources Agency et al., 2014; http://resources.ca.gov/california_water_action_plan/) lays out decisive actions needed to meet three broad objectives: developing more reliable water supplies, restoring important species and habitats, and providing a more resilient, sustainably managed water resources system (water supply, water quality, flood protection, and environment) that can withstand anticipated and unforeseen pressures in the coming decades. The plan further highlights the need for adaptive management in operating water facilities and in implementing conservation actions, particularly during drought. Action is required throughout California, but the Delta’s central role in water management for many regions and citizens of the state makes success in Delta foundational to overall success. The comprehensive actions in the California Water Action Plan include:

• Make conservation a California way of life
• Increase regional self-reliance and integrated water management across all levels of government
• Achieve the coequal goals for the Delta
• Protect and restore important ecosystems
• Manage and prepare for dry periods
• Expand water storage capacity and improve groundwater management
• Provide safe water for all communities
• Increase flood protection
• Increase operational and regulatory efficiency
• Identify sustainable and integrated financing opportunities.

Fortunately, California has taken several steps to implement these actions, as described in the California Water Action Plan 2016 Update (California Natural Resources Agency et al. 2016; http://resources.ca.gov/california_water_action_plan/).

The Importance of Local Water Management Planning

Over the past few decades, the State has built on successful local water management planning and, when possible, has provided funding for local districts to develop and implement water management plans. These plans are of benefit to all regions, not just those who rely on the Delta or Delta watershed.

These programs and projects increase the reliability of water supplies by increasing water efficiency and diversify the portfolio of water sources for urban and agricultural water suppliers that are more resilient under conditions of drought, emergency shortage, and climate change. Water developed through these activities can help reduce conflicts among urban, agricultural, and environmental uses, and can contribute to the ability of regions in California to reduce their reliance on water from the Delta watershed.24

The responsibility for implementing most of these water management strategies and achieving State objectives lies with over 600 local water agencies, including several privately owned and operated companies, plus wastewater districts, community service districts, and other special districts. The sheer number of local agencies engaged in water management makes it difficult to monitor and account for the

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24 As used in the Delta Plan, “regions” refer to the 10 hydrologic areas identified by DWR that correspond to the state’s major water drainage basins, and included the two regional overlays for the Mountain Counties area and the Delta. The use of these regions as planning boundaries allows consistent tracking of their natural water runoff and accounting of surface and groundwater supplies.
significant new amounts of water supplies and increased water efficiency that is being implemented. Later in this chapter, the Informed Decision Making Requires Information section details this challenge and associated water management implications.

Since the mid-1980s, California has enacted progressively more stringent water conservation, efficiency, and water planning requirements for urban and agricultural water suppliers (see Appendix H). Beginning in 1983, wholesale and retail municipal water suppliers (those with at least 3,000 connections or delivering at least 3,000 acre-feet per year) have been required by the Urban Water Management Planning Act to prepare 20-year urban water management plans to guide investments in future water reliability. This law has been strengthened through several revisions to include specific water conservation goals (such as the 20 percent reduction in urban per capita water usage by 2020 adopted in 2009), compliance with demand management measures including adoption of rate structures that promote water conservation (AB 1420 in 2007), landscape conservation requirements (AB 1881 in 2006), and required installation of water meters (AB 2572 in 2004).

Existing law requires that urban water suppliers include a water supply reliability element and water shortage provisions in their urban water management plans, recognizing that suppliers need to prepare for extended droughts, the effects of climate change, and potential catastrophic interruption of deliveries caused by earthquakes or other events.

Water suppliers must evaluate whether their water sources may be available at a consistent level of use and describe their plans for supplementing or replacing these sources, to the extent practicable with alternatives or water demand management measures (Water Code section 10631(c)(2)). Water suppliers must also describe the tools and options that will be used to maximize resources and minimize the need to import water from other regions (Water Code section 10620(f)).

Agricultural water suppliers (those that provide water to 25,000 or more irrigated acres, or 10,000 irrigated acres and who receive State funding to implement the plan provisions) have a requirement similar to urban suppliers and must prepare agricultural water management plans. The Agricultural Water Management Planning Act was adopted in 2009 (Senate Bill X7 7 [SBX7 7]). Requirements include reporting on farm gate water deliveries, adoption of rate structures that promote water conservation, and identification and implementation of locally cost-effective and technically feasible water efficiency measures.

Since 2000, the State has also promoted voluntary integrated regional water management plans (IRWMPs), recognizing that collaboration among multiple agencies, especially within watersheds, provides opportunities for better water management decisions and coordinated infrastructure investments. Significant bond funding has been made available to support implementation of projects identified through these IRWMPs. A 2006 report on the investments made for IRWMP projects identified over 1.2 MAF of water benefits in combined water supply and demand reductions that have been achieved through the expenditure of $1 billion in State bond funds in local and regional projects (DWR 2009). An additional $1 billion or more of local dollars were leveraged because of this State investment. Applicants for IRWMP funding must now demonstrate how their plans help reduce their region’s dependence on water imported from outside their region (DWR 2010c).
As climate change begins to affect California’s water supplies, the U.S. Environmental Protection Agency (Region 9) and DWR are encouraging water managers to plan for these impacts and to take steps to adapt to them. IRWMPs, and the agricultural and urban water management plans provide an excellent framework for addressing water-related climate change impacts (USEPA and DWR 2011). Because each region is unique, there is no single “correct” planning approach. Key concepts include risk assessment, such as the potential for interruption of water supplies for up to 36 months due to catastrophic events impacting the Delta, including earthquakes or floods. For example, DWR identified the potential for some portion of Delta deliveries to be interrupted for up to 36 months if a catastrophic earthquake occurred (DWR 2010b). Although this would have a primary impact on water suppliers that rely on water from the Delta, it might also affect upstream water suppliers that may be called upon to release more water into the Delta during the crisis.

Another useful tool is the regional water balance. According to DWR, the purpose of a regional water balance is to provide an accounting of all water that enters and leaves a specific hydrologic region, how it is used, and how it is exchanged between regions. A regional water balance can be used to compare how water supplies and uses in a region can vary between wet and critically dry hydrologic conditions, and how each region’s water balance compares with other regions and with the state’s overall water balance. This is important to all water planning activities and provides a basis for evaluating unsustainable water management practices and making appropriate improvements (DWR 2009).

The Human Right to Water

The Delta Plan must “promote statewide water conservation, water use efficiency, and sustainable use of water” (Water Code section 85303) and include measures to promote a more reliable water supply by meeting water needs, sustaining the economic vitality of the state, and improving water quality to protect human health. The Council must consider incorporating actions in the Delta Plan to implement specific subgoals and strategies, including improving water quality to meet drinking water goals. These requirements relate closely to California’s policy in Water Code Section 106.3 that “every human being has the right to, safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes.” The Delta Plan acknowledges that the Council must consider this policy. In addition, the eight inherent objectives for management of the Delta include protecting and enhancing the Delta as an evolving place. This goal indicates that the evolving needs of the people who rely on the Delta must be considered.

The human right to water extends to all Californians, including disadvantaged individuals and groups, and communities in rural and urban areas. Disadvantaged communities are disproportionately affected by water resource challenges related to groundwater, as many small and rural communities rely on groundwater for all or a large portion of their supplies (SWRCB 2013). Further, many small and rural communities rely on impaired or contaminated groundwater for their water supplies, and struggle with the cost of providing safe drinking water. During the recent 2012 to 2016 drought, about two-thirds of drought-impacted public water systems and household water outages were in disadvantaged communities, and nearly one-third of drought-impacted systems served cumulatively burdened communities. These impacted communities are concentrated outside the Delta, in the San Joaquin Valley, the North Coast, and the Central Coast. Similar geographic trends were also reported for drought-impacted household water systems (systems with fewer than 15

Disadvantaged communities have a median household income of less than 80 percent of the state median. Cumulatively Burdened Communities are those that rank in the top quarter of census tracts in the state for environmental burdens and socioeconomic vulnerability. Source: Feinstein et al. 2017. An interactive map of disadvantaged communities within California can be found at https://gis.water.ca.gov/app/dacs/.
household connections, including individual household wells or water supplies)( https://mydrywatersupply.wa­
ter.ca.gov/report/publicpage). Improvements to
conveyance, system storage, and the operations of both can
support sustainable water management in many areas of the
state, especially disadvantaged communities, and help assure
the right to safe, clean, affordable and accessible water for
human consumption and domestic use.

Implementing a Path to Success in Local Water
Management

Many agricultural and urban water suppliers are taking
commendable action to improve water conservation and
efficiency, and to expand their local and regional water
supplies. (See sidebar, Regional Success Stories.) However,
others are not.

For example, despite longstanding State laws that require
preparation and implementation of urban water management
plans, many water suppliers still regard these plans as volun­
tary because the only consequence of not completing them
has been ineligibility to receive State grant and loan funding
to implement water projects. In the 2005 round of urban
water management plan submittals, this incentive increased
the number of plans submitted over previous years;
however, only 75 percent of agencies that should submit
plans actually did as of December 31, 2006, and more than
50 percent of these failed to include required conservation or
drought contingency plans (DWR 2006). In the 2010 round
of urban water management plan submittals, 66 percent of
the agencies required to submit plans actually did by the
August 2011 deadline. One year later, this percentage had
increased to 85 percent, but no assessment for completeness
has been performed (DWR 2012b).

Widespread compliance with existing water management
laws alone would achieve great progress in improving water
supply reliability for California. Compliance with all State
water efficiency and management statutes and policies, at a
minimum, should be the starting point for assessing a water
supplier’s reasonable use of California’s water. In particular,
water suppliers that do not engage in efficient use of water,
particularly where the implementation of proven measures
and technologies are economically justifiable, locally cost
effective, and do not harm other water users, should be held
accountable for wasting water. The SWRCB should be
encouraged to use its authority to prevent waste and unreas­
onable use by seeking enforcement of these requirements.
The potential for this type of action was anticipated in the
Water Conservation Act of 2009 (SBX7 7), which explicitly
recognized that the failure of urban water suppliers to reduce
urban per capita water demand consistent with the State’s
20 percent by 2020 conservation targets can be used after
January 2021 to establish a violation of the law for the pur­
poses of State administrative or judicial proceedings (Water
Code section 10608.8(a)(2)).

Importantly, for those who prepare them, urban water man­
agement plans and integrated regional water management
plans appear to be working. As a result of these efforts and
increased irrigation efficiency, the amount of water needed
to meet future urban and agricultural demands has changed.
Since 1980, the total volume of water used in the urban and
agricultural sectors has declined. Urban areas that have
implemented the strongest water conservation programs
show the greatest improvements in water efficiency and the
largest reductions in water use (see Figure 3-8).
CHAPTER 3 A MORE RELIABLE WATER SUPPLY FOR CALIFORNIA

REGIONAL SUCCESS STORIES

Significant improvements in water management are being implemented throughout California, especially in regions that rely upon water from the Delta and the Delta watershed. The 2010 urban water management plan updates and voluntary IRWMP grant applications filed in 2010 provide insight into what individual water agencies and regional planning efforts are doing to improve water efficiency and develop additional local water supplies. Examples of successful strategies to reduce reliance on the Delta and improve regional self-reliance follow.

In Southern California:

- **West Basin Municipal Water District.** Increased water efficiency and diversification of the district’s water supplies between 2010 and 2035 will enable West Basin Municipal Water District to reduce its potable water demand despite expected future population growth. The total volume of imported water usage is projected to decline by 40,000 acre-feet over this period, and conservation, recycled water, and ocean desalination will expand the district’s water resources by over 60,000 acre-feet (RMC Water and Environment 2011).

- **City of Los Angeles.** Today the City of Los Angeles uses less water than it did 30 years ago, despite population growth of more than 1 million residents. In 2011, per capita water usage was 123 gallons daily—the lowest in Los Angeles in more than 40 years and the lowest among any United States city with a population over 1 million (LADWP 2012). Through regional watershed planning efforts, the city is bringing together local and county public works departments, planning agencies, local and regional water supplies, and citizen groups to develop integrated multibenefit projects. In 2004, the city overwhelmingly approved Proposition O, which authorized $500 million in local bonds to fund water efficiency, stormwater capture, water treatment, recycled water, flood protection, open space, recreation, and other projects.

In the central San Joaquin Valley and Tulare Lake regions:

- **Poso Creek Regional Water Management Group.** The IRWMP focuses on more effective coordination of each participating irrigation district’s water assets, recognizing that competition for the three sources of water that meet the region’s demands (local supplies/Kern River, CVP, and SWP) is increasing. Proposed improvements include 400 acres of spreading ponds and additional conveyance (canals, pipelines, and pumping plants) between the Friant-Kern Canal and California Aqueduct and among irrigation districts, which will enable the region to take advantage of wet-year (unscheduled) water diversions from the Delta and reduce diversions in dry years (Semitropic Water Storage District 2011).

In the Delta:

- **East Contra Costa County.** Located entirely within the statutory Delta, all the water suppliers that participate in this IRWMP rely upon the Delta for more than 80 percent of average-year water demands, with three water suppliers receiving 100 percent. The IRWMP priorities for reducing reliance on the Delta include expanded use of recycled water, installation of water meters, increased water conservation, and new wellhead treatment for groundwater supplies (Contra Costa Water District 2011).

In the Bay Area:

- **City and County of San Francisco.** Increased water efficiency has resulted in general decline in total consumption and per capita water use since the mid-1970s to record low levels in the state despite growth in the county’s population. Recognition of the vulnerability of the city’s Hetch Hetchy Reservoir and aqueduct system to earthquakes and other emergencies, San Francisco is working to diversify its local water supplies, including increased conservation, new local groundwater wells, expansion of recycled water, use of gray water, rainwater harvesting, and participation in the Bay Area Regional Desalination Project with Contra Costa Water District, East Bay Municipal Utility District, Santa Clara Valley Water District, and Zone 7 Water Agency (San Francisco Public Utilities Commission 2011).

In the Delta upper watershed:

- **American River Basin.** The IRWMP features reduced reliance on water in the Delta’s American River tributaries through expanded conjunctive use operations, development of recycled water, and increased water conservation. More water will be diverted during wetter periods and made available as groundwater in drier periods, which will help increase regional water supply reliability while improving flow and temperature conditions that benefit salmon and steelhead fisheries in the lower American River (Regional Water Authority 2011).
CHAPTER 3 A MORE RELIABLE WATER SUPPLY FOR CALIFORNIA

Trends in California’s Water Use

Figure 3-8

California’s water use is declining, primarily due to increased water efficiency in both agricultural and urban areas. The City of Los Angeles, like many other cities, reports that it is using the same amount of water as it did over 30 years ago, even though its population has grown by more than 1 million people.

Sources: Hanak et al. 2011; adapted from DWR 2009

Groundwater Overdraft Is an Impediment to the Coequal Goals

Groundwater is a major source of water supply for nearly every region in California and a vital component of the state’s water storage system, particularly during droughts (DWR 2009). More than 40 percent of Californians rely on groundwater for part of their water supply, and many small-to moderate-sized towns and cities are entirely dependent on groundwater for their drinking water systems (DWR 2003a, SWRCB 2015). The state’s most significant groundwater use occurs in regions that also rely on water from the Delta watershed, including the San Joaquin Valley, Tulare Lake, Sacramento Valley, Central Coast, and South Coast (see Figures 3-9 and 3-10). The Tulare Lake region alone accounts for more than one-third of the state’s total groundwater pumping (DWR 2009). Because of historical groundwater overdraft26 and resulting land subsidence experienced in these regions, water users switched to using surface water from the CVP and SWP when the water projects were completed in the late 1960s. However, groundwater pumping withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions. See Glossary.

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26 “Groundwater overdraft” is defined in the Delta Plan as The condition of a groundwater basin in which the amount of water...
and overdraft continued to become more severe as water demands continued to exceed available supplies. Recent satellite imaging revealed that the Central Valley lost approximately 25 MAF of stored groundwater during the period of October 2003 to March 2010 (Famiglietti et al. 2011).

As a result of use continually exceeding recharge, many of California’s groundwater basins are in overdraft, and groundwater levels are declining over the long term (Faunt 2009). In some areas, overdraft can lead to a permanent loss of groundwater storage. According to DWR, a groundwater basin is in a state of “critical overdraft” when continuation of present water management practices would result in significant adverse overdraft-related environmental, social, or economic impacts. DWR estimates statewide average overdraft of about 1 to 2 MAF per year (DWR 2009).

Groundwater use is also increasing, and is expected to grow at a faster rate in future decades as climate change reduces the reliability of surface water deliveries and increases the potential for extended droughts (DWR 2009). Without more efficient management, the state’s groundwater resources will be significantly impacted, and in severe overdraft conditions, the aquifer’s capacity to store groundwater may be irretrievably lost (DWR 2003a). Improved management is also needed to take advantage of opportunities to store water underground, particularly to aid flexibility when done in coordination with improved operations in the Delta.

California has established laws, regulations, and programs to protect the quality of its groundwater resources. Despite the major importance of this water supply to California, however, the quantity of groundwater used by agencies or individuals is largely unregulated at the State level. Except for Texas, California is the only state where use of its groundwater resources is managed at the local rather than State level. The lack of State oversight means that limited and often incomplete information is available to the public about how California’s groundwater basins are being managed. So little is known, that in 2003, DWR was unable to revise the designation of critically overdrafted basins in its update on California’s groundwater (DWR 2003a). Lacking current information and having limited resources to complete additional investigations, DWR simply republished the list of 11 basins identified in 1980.

Some regions appear to be making significant progress in developing sustainable groundwater management programs through regional water balances and voluntary groundwater management plans (known as AB 3030 plans), local ordinances, and court adjudications (Nelson 2011). In 2009, the State created a mandatory statewide program for local reporting of groundwater elevation data, the California Statewide Groundwater Elevation Monitoring Program. This program will collect reported groundwater elevations and make the data available online.

27 The State encourages additional voluntary development of locally controlled groundwater monitoring programs and related management plans through AB 3030 (1992), AB 303 (2000), AB 599 (2001), and SB 1938 (2002); through the IRWMP Program (through funding provided by Propositions 13, 50, and 84); and by limiting availability of State funding for water infrastructure to those agencies that have adequate groundwater management plans in place. The State also provides technical assistance to help local agencies more efficiently and sustainably manage groundwater resources, and has identified 14 required and recommended components for groundwater plans. Prior to 2002, there were no required elements for groundwater plans.
Critically Overdrafted Groundwater Basins

Figure 3-9

Groundwater overdraft is a critical water supply problem, especially in the Central Valley. More than 40 percent of Californians rely on groundwater for some portion of their supply, and many small- and moderate-sized communities are entirely dependent on groundwater for drinking water.
San Joaquin Groundwater Pumping Is Unsustainable

Figure 3-10  Estimated cumulative annual changes in groundwater storage in the Tulare Lake Basin due to over-pumping are more than 60 MAF since 1960. Serious land subsidence and loss of groundwater storage capacity impacts more than half of this region.

Source: Faunt 2009
GROUNDWATER AND DROUGHT

As demonstrated during California’s recent drought, heavy reliance on groundwater can lead to groundwater overdraft, subsidence due to falling groundwater levels, and loss of access to groundwater in some communities. Extraction of groundwater in the Central Valley region, in particular, has reduced both the groundwater level and underground storage capacity due to subsidence (Famiglietti et al. 2011; Weiler 2014).

Groundwater pumping in the Central Valley during the drought was estimated to be about five million acre-feet (MAF) in 2014 and about six MAF in 2015 (Howitt et al. 2015). Conjunctive management of surface and groundwater supplies, including passive and active groundwater recharge and in-lieu recharge, is an important tool for sustainable groundwater management (Fournier et al. 2016). “In-lieu recharge” is the process of decreasing the amount of groundwater pumped from an aquifer in combination with a proportional increase in surface water deliveries or recycled water deliveries. Decreased groundwater pumping allows the aquifer to naturally recharge and be available for use during dry years.

Recent estimates of water available for replenishment of groundwater demonstrate that some surface water may be available for replenishment in each of the state’s hydrologic regions and many of the planning areas, especially during relatively high flow events (California Department of Water Resources (DWR) 2017). Improvements to conveyance, system storage, and the operations of both can support conjunctive management and contribute to sustainable groundwater management in many areas of the state.

Figure 3-11 Soil Agricultural Groundwater Banking Index Identifying Potential Areas for Groundwater Banking on Agricultural Lands

Informed Decision Making Requires Information

One of the greatest challenges to California water management is the lack of consistent, comprehensive, and accurate estimates of actual water use by the type of use (agricultural, urban, and environmental) and by hydrologic region. The water use that is reported to the State is a combination of measured uses and estimated use that are not measured, with limited verification of actual water use. This means that California does not have a clear understanding of its water demands, the amount of water available to meet those demands, how water is being managed, and how that management can be improved to achieve the coequal goals for the Delta.

Key concerns include:

■ Not all water uses are required to be monitored and measured. Many water rights were issued decades ago when water measurement was not required. Until reforms were approved by the California Legislature in 2009, water rights holders were not required to provide detailed information on water diversions and use. As a result, total diversion amounts are currently unknown and may be over-allocated in some locations or during dry periods (SWRCB 2008, SWRCB 2011, NRC 2012). Similarly, many groundwater withdrawals are not monitored or reported.

■ Not all water users report data even when they are required to do so. A 2009 report prepared for the Legislature by the SWRCB on the development of a coordinated measurement database indicated that historically, about 67 percent of water permit and license holders actually report their water use information, and fewer than 35 percent of other water right claimants who are required to report actually do so (SWRCB 2009).

■ SWP contractors are not required by DWR to provide data similar to that collected by Reclamation for CVP contractors. Reclamation has established best management practices for water efficiency, consistent with the federal Reclamation Reform Act and the Central Valley Project Improvement Act, and performs a “Water Needs Assessment” for each federal contractor with input from that contractor. Reclamation also requires contractors to submit an annual report that includes a full water balance (production from all sources, system losses, and changes in storage and water), and implement an effective water conservation and efficiency program based on the contractor’s approved water conservation plan (Reclamation 2011b).

■ SWP contract amendments in the past have not always been developed and approved in a transparent manner, and have resulted in litigation over implications for the management of the state’s water supplies. In 2003, as part of a legal settlement, DWR adopted policies for how future contracts and contract amendments would be reviewed and adopted through an open and transparent process (DWR 2003b). Consistent application of this policy is important (see Appendix B).

■ More detailed information on changes in groundwater levels, rates of groundwater extraction, and the location of basins with severe and chronic overdraft is needed as a baseline for the State’s water resource management efforts. Basic groundwater management data (estimates of safe yield, monitoring of changes in storage in the aquifers and water quality conditions, and identification of replenishment sources and connections with surface water supplies) need to be quantified for many areas, but especially in those regions that rely upon water from the Delta watershed (DWR 2003a). The State’s goal should be to sustainably maintain and maximize long-term reliability of these groundwater supplies, with a focus on preventing significant degradation of groundwater quality (DWR 2003a, ACWA 2011).

Recent legislation has resulted in significant improvements to the State’s water monitoring and reporting requirements. However, time and resources will be necessary to assess the results from these improvements, which will also serve to inform future Delta Plan updates. For example, recently enacted provisions are now being implemented for:
■ Groundwater monitoring (Water Code section 10920 et seq.)
■ In-Delta and statewide water diversion reporting (Water Code section 5100 et seq.)
■ In-Delta enforcement investigations under the authority of the Delta Watermaster (Water Code section 85230)
■ Compliance with the State’s goal of achieving a 20 percent reduction in statewide urban per capita water use by 2020 (Water Code section 10608 et seq.)
■ Improved reporting on agricultural water use efficiency measures (Water Code section 10608 et seq. and 10800 et seq.)

In late 2010, the SWRCB also adopted regulations requiring online reporting of water use by all water rights holders, including appropriative, riparian, and pre-1914 surface water users, and groundwater users. Since 2008, DWR, SWRCB, and the California Department of Public Health have been working to develop a coordinated database to track the urban and agricultural water use data that are provided to each agency. This tool is central to the development of a statewide integrated system for streamlined data collection and analysis that will support improved water management in California.
An assessment of future water supply reliability is now required in urban water management and agricultural water management plans, as well as in voluntary regional water planning documents known as IRWMPs. In areas that rely upon water from the Delta watershed, water suppliers will need to identify, evaluate, and implement locally cost-effective and technologically feasible measures that reduce their reliance on the Delta and improve regional self-reliance.

Problem Statement
The lack of participation by some water suppliers throughout California to implement laws, programs, and projects that improve water efficiency, expand local and regional water supplies, and reduce reliance on the Delta and the Delta watershed contributes to higher water demands, less water supply to meet these demands, greater pressure on the Delta ecosystem for its water, and more vulnerability to the impacts of climate change and catastrophic events. Given the Delta Reform Act mandates to improve water supply reliability for California, reduce reliance on the Delta, and improve regional self-reliance, at a minimum, all water suppliers should demonstrate full compliance with State water efficiency and management laws, goals, and regulations to demonstrate reasonable and beneficial use of the state’s water resources. California’s success in achieving the policy of reduced reliance on the Delta and improving regional self-reliance will be demonstrated through a significant reduction in the amount of water used or in the percentage of water used from the Delta watershed. See Appendix G for additional information regarding how to achieve reduced reliance on the Delta and improved regional self-reliance.

Policies

WR P1. Reduce Reliance on the Delta through Improved Regional Water Self-Reliance
(a) Water shall not be exported from, transferred through, or used in the Delta if all of the following apply:

POLICIES AND RECOMMENDATIONS

Policies and recommendations for providing a more reliable water supply for California are based on four core strategies:

- Increase water conservation and expand local and regional supplies
- Improve groundwater management
- Improve conveyance and expand storage
- Improve water management information

Increase Water Conservation and Expand Local and Regional Supplies

Approximately 84 percent of California’s water supplies come from local and regional sources, including surface runoff, groundwater, recycled water, and water made available through advanced treatment. Improved management of these resources, including water conservation and efficiency, is central to the state’s ability to better match its demands to the amount of supply that is available. Over the next 30 years, the California Water Plan Update 2009 estimates that, with the use of existing technology, the state can reduce its demands and increase its water supplies in the range of 5 to 10 MAF. This is more than enough water to meet California’s projected water demands beyond 2050 and to sustain its economic vitality.

The State’s constitutional principle of reasonable use and the Public Trust Doctrine form the legal foundation for California’s water management policies. Importantly, along with the coequal goals, the Delta Reform Act also established a new policy for California of reducing reliance on the Delta and improving regional self-reliance in meeting California’s future water supply needs. The Delta Reform Act mandates many strategies that the Delta Plan must address to improve water supply reliability for California including water efficiency and conservation, wastewater reclamation and recycling, desalination and advanced water treatment technologies, improved water conveyance, surface and groundwater storage, improved water quality, and implementation of local and regional water supply projects and coordination (see Water Code sections 85004(b), 85020(d) and (f), 85201, 85023, 85303, and 85304).
(1) One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c);

(2) That failure has significantly caused the need for the export, transfer, or use; and

(3) The export, transfer, or use would have a significant adverse environmental impact in the Delta.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to export water from, transfer water through, or use water in the Delta, but does not cover any such action unless one or more water suppliers would receive water as a result of the proposed action.

(c) (1) Water suppliers that have done all of the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:

(A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;

(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and

(C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).

(2) Programs and projects that reduce reliance could include, but are not limited to, improvements in water use efficiency, water recycling, stormwater capture and use, advanced water technologies, conjunctive use projects, local and regional water supply and storage projects, and improved regional coordination of local and regional water supply efforts.

23 CCR Section 5003

NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 10608, 10610.2, 10610.4, 10801, 10802, 85001(c), 85004(b), 85020(a), 85020(d), 85020(h), 85021, 85022(d)(1), 85022(d)(5), 85023, 85054, 85300, 85302(d), 85303, and 85304, Water Code.

Recommendations

WR R1. Implement Water Efficiency and Water Management Planning Laws
All water suppliers should fully implement applicable water efficiency and water management laws, including urban water management plans (Water Code section 10610 et seq.); the 20 percent reduction in state-wide urban per capita water usage by 2020 (Water Code section 10608 et seq.); agricultural water management plans (Water Code section 10608 et seq. and 10800 et seq.); and other applicable water laws, regulations, or rules.

WR R2. Require SWP Contractors to Implement Water Efficiency and Water Management Laws
The California Department of Water Resources should include a provision in all State Water Project contracts, contract amendments, contract renewals, and water transfer agreements that requires the implementation of all State water efficiency and water management laws, goals, and regulations, including compliance with Water Code section 85021.

WR R3. Compliance with Reasonable and Beneficial Use
The State Water Resources Control Board should evaluate all applications and petitions for a new water right or a new or changed point of diversion, place of use, or purpose of use that would result in new or increased long-term average use of water from the Delta watershed for consistency with the constitutional principle of reasonable and beneficial use. The State Water Resources Control Board should conduct its evaluation consistent with Water Code sections 85021, 85023, 85031, and other provisions of California law. An applicant or petitioner should submit to the State Water Resources Control Board...
Board sufficient information to support findings of consistency, including, as applicable, its urban water management plan, agricultural water management plan, and environmental documents prepared pursuant to the California Environmental Quality Act.

WR R4. Expanded Water Supply Reliability Element

Water suppliers that receive water from the Delta watershed should include an expanded water supply reliability element, starting in 2015, as part of the update of an urban water management plan, agricultural water management plan, integrated water management plan, or other plan that provides equivalent information about the supplier’s planned investments in water conservation and water supply development. The expanded water supply reliability element should detail how water suppliers are reducing reliance on the Delta and improving regional self-reliance consistent with Water Code section 85201 through investments in local and regional programs and projects, and should document the expected outcome for a measurable reduction in reliance on the Delta and improvement in regional self-reliance. At a minimum, these plans should include a plan for possible interruption of water supplies for up to 36 months due to catastrophic events impacting the Delta, evaluation of the regional water balance, a climate change vulnerability assessment, and an evaluation of the extent to which the supplier’s rate structure promotes and sustains efficient water use.

WR R5. Develop Water Supply Reliability Element Guidelines

The California Department of Water Resources, in consultation with the Delta Stewardship Council, the State Water Resources Control Board, and others, should develop and approve, by December 31, 2014, guidelines for the preparation of a water supply reliability element so that water suppliers can begin implementation of WR R4 by 2015.

WR R6. Update Water Efficiency Goals

The California Department of Water Resources and the State Water Resources Control Board should establish an advisory group with other State agencies and stakeholders to identify and implement measures to reduce impediments to achievement of statewide water conservation, recycled water, and stormwater goals by 2014. This group should evaluate and recommend updated goals for additional water efficiency and water resource development by 2018. Issues such as water distribution system leakage should be addressed. Evaluation should include an assessment of how regions are achieving their proportional share of these goals.

WR R7. Revise State Grant and Loan Priorities

The California Department of Water Resources, the State Water Resources Control Board, the California Department of Public Health, and other agencies, in consultation with the Delta Stewardship Council, should revise State grant and loan ranking criteria by December 31, 2013, to be consistent with Water Code section 85021 and to provide a priority for water suppliers that includes an expanded water supply reliability element in their adopted urban water management plans, agricultural water management plans, and/or integrated regional water management plans.

WR R8. Demonstrate State Leadership

All State agencies should take a leadership role in designing new and retrofitted State-owned and -leased facilities, including buildings and California Department of Transportation facilities, to increase water efficiency, use recycled water, and incorporate stormwater runoff capture and low-impact development strategies.

Improve Groundwater Management

Groundwater is the source, on average, of 20 percent of California’s urban and agricultural water supplies. The state’s most significant groundwater use occurs in regions that also rely upon water from the Delta watershed. In many of these groundwater basins, more water is pumped than is recharged, and groundwater levels are declining over the long term. The California Water Plan Update 2009 estimates that the state, on average, overdrafts its groundwater basins by about 1 to 2 MAF per year and that the level of unsustainable groundwater pumping is increasing.

Problem Statement

The continued existence of major California groundwater basins in a chronic condition of overdraft combined with key regions of the state that depend on water from the Delta watershed and have poor groundwater practices, including unsustainable groundwater pumping, water quality contamination, irreversible loss of groundwater storage, and no groundwater plan for addressing...
these problems, is a major impediment to the achievement of the coequal goals.

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

Recommendations

WR R9. Update Bulletin 118, California’s Groundwater Plan
The California Department of Water Resources, in consultation with the Bureau of Reclamation, U.S. Geological Survey, the State Water Resources Control Board, and other agencies and stakeholders, should update Bulletin 118 information using field data, California Statewide Groundwater Elevation Monitoring (CASGEM), groundwater agency reports, satellite imagery, and other best available science by December 31, 2014, so that this information can be included in the next California Water Plan Update and be available for inclusion in 2015 urban water management plans and agricultural water management plans. The Bulletin 118 update should include a systematic evaluation of major groundwater basins to determine sustainable yield and overdraft status; a projection of California’s groundwater resources in 20 years if current groundwater management trends remain unchanged; anticipated impacts of climate change on surface water and groundwater resources; and recommendations for State, federal, and local actions to improve groundwater management. In addition, the Bulletin 118 update should identify groundwater basins that are in a critical condition of overdraft.

WR R10. Implement Groundwater Management Plans in Areas that Receive Water from the Delta Watershed
Water suppliers that receive water from the Delta watershed and that obtain a significant percentage of their long-term average water supplies from groundwater sources should develop and implement sustainable groundwater management plans that are consistent with both the required and recommended components of local groundwater management plans identified by the California Department of Water Resources Bulletin 118 (Update 2003) by December 31, 2014.

WR R11. Recover and Manage Critically Overdrafted Groundwater Basins
Local and regional agencies in groundwater basins that have been identified by the California Department of Water Resources as being in a critical condition of overdraft should develop and implement a sustainable groundwater management plan, consistent with both the required and recommended components of local groundwater management plans identified by the California Department of Water Resources Bulletin 118 (Update 2003), by December 31, 2014. If local or regional agencies fail to develop and implement these plans, the State Water Resources Control Board should take action to determine if the continued overuse of a groundwater basin constitutes a violation of the State’s Constitution Article X, Section 2, prohibition on unreasonable use of water and whether a groundwater adjudication is necessary to prevent the destruction of or irreparable injury to the quality of the groundwater, consistent with Water Code sections 2100 and 2101.

Improve Conveyance, Expand Storage, and Improve the Operation of Both

The greatest conflicts between the water needs of people and fish within the Delta occur during dry years. That is when the least amount of water is flowing into the Delta and, historically, when exports have been a much larger percentage of Delta inflows compared with wet years. The timing and pattern of Delta diversions must be shifted so that more water can be exported during wet years, when there is significantly more water available for diversion, and less is taken in dry years, when the water is needed for in-Delta water quality and ecosystem protections.

The ability to export larger amounts of water from the Delta during wet years will require improved conveyance to increase operational flexibility as well as more storage both north and south of the Delta so that this water can be captured, stored, and ultimately delivered to meet the water needs of both people and fish. With these improvements, Delta operations and, importantly, Delta export deliveries will become more predictable.

As an interim step toward increasing California’s water supply reliability, the State should identify, prioritize, and implement smaller and more incremental operational, conveyance, and storage improvements (such as expanding existing facilities or constructing new ones) that can be accomplished quickly, preferably within the next 5 to 10 years.
With regard to new and improved infrastructure—relating to water conveyance in the Delta, water storage systems, and the operation of both to achieve the coequal goals—the Delta Plan promotes the design, implementation, and operation of new and improved water conveyance infrastructure and new or expanded water storage that are consistent with the criteria in the recommendations below. To develop a robust water management system that provides flexibility to adapt to changing conditions, conveyance should be integrated and operated in tandem with enhanced water storage in the Delta watershed and the Delta export area to optimally achieve the coequal goals while protecting and enhancing the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. These recommendations contain a suite of actions to be collectively pursued in an integrated manner with existing Delta Plan policies and recommendations. All promoted options should be managed so Delta water supplies further the coequal goals and incorporate the best currently available science and adaptive management. Further, Delta Plan performance measures can assist the Council in tracking progress in meeting its objectives, including those related to conveyance, storage systems, and the operation of both.

**Problem Statement**

The state’s interconnected network of surface and groundwater storage is insufficient in volume, conveyance capacity, and flexibility to achieve the coequal goals. The implementation of major new Delta conveyance improvements and surface and groundwater storage facilities are needed but may take many years to implement, which will require more near-term actions to improve Delta operations and reduce the state’s vulnerability to potential disruptions in water exports from the Delta due to floods and earthquakes or the need for additional regulatory protections for the environment.

**Policies**

No policies with regulatory effect are included in this section. See Appendix A, The Delta Stewardship Council’s Role Regarding Conveyance.

**Recommendations**

**WR R12a. Promote Options for New and Improved Infrastructure Related to Water Conveyance**

Subject to completion of environmental review and approval by the lead agency, and applicable regulatory approvals from other public agencies, the following infrastructure options are hereby promoted:

1. The California Department of Water Resources (DWR) the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), and local beneficiary agencies should pursue a dual-conveyance option for the Delta. Dual conveyance is a combination of through-Delta conveyance and isolated conveyance to allow operational flexibility. Dual conveyance alternatives should be evaluated, and a selected plan designed and implemented, consistent with WR R12b, below. Dual conveyance should incorporate existing and new intakes and facility improvements for both isolated, below-ground conveyance and through-Delta conveyance of State Water Project (SWP) and Central Valley Project (CVP) water supplies from the Sacramento River to the south Delta, as follows:

   a. The isolated conveyance should incorporate one or more new screened intakes that protect native fish and that are operated to minimize harmful reverse flow conditions in Old and Middle rivers while maintaining water quality for in-Delta uses. Isolated conveyance should complement existing and improved through-Delta conveyance to promote operational flexibility, protect water quality, and support ecosystem restoration.

   b. To protect the Delta ecosystem, the State Water Resources Control Board should ensure that operational criteria for new and improved conveyance facilities comply with applicable State Water Resources Control Board requirements, including any flow criteria adopted pursuant to Water Code 85086(c)(2).

   c. Dual conveyance requires continued maintenance and further improvement of through-Delta conveyance. Through-Delta conveyance improvements may include channel improvements consistent with the Delta Plan and additional facilities that could provide for improved operations for native fish protection.
(2) DWR in collaboration with local beneficiary agencies should pursue new intake and conveyance facilities for conveying SWP supplies from the Sacramento River to SWP contractors in Solano and Napa Counties. This is both to protect native fish and improve the quality and reliability of water supplies delivered via the North Bay Aqueduct.

(3) Local agencies, in coordination with DWR and Reclamation, should pursue new conveyance facilities or conveyance facility improvements that allow use of multiple Delta intakes associated with the Los Vaqueros Project. This would increase operational flexibility for local, SWP, and CVP municipal and environmental water supplies conveyed from the south Delta.

(4) DWR, Reclamation, and local beneficiary agencies, in coordination with the California Department of Fish and Wildlife, National Marine Fisheries Service and U.S. Fish and Wildlife Service, should evaluate and identify for near-term implementation feasible actions to contribute to reducing fish losses associated with existing pumping operations at the Banks Pumping Plant and Jones Pumping Plant, consistent with the 2009 Biological Opinion and Conference Opinion on the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan; the 2009 Biological Opinion on the Coordinated Operations of the Central Valley Project and State Water Project in California; and the 2014 Recovery Plan for Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. These actions may include, but are not limited to:

(a) Implementing changes to the operations and physical infrastructure of the facilities where such changes can improve fish screening and salvage operations and reduce mortality from entrainment and salvage.

(b) Evaluating and implementing effective predator control actions, such as fishery management or directed removal programs, for minimizing predation on juvenile salmon and steelhead in Clifton Court Forebay and in the primary channel at the Tracy Fish Collection Facility.

(c) Evaluating and implementing effective predation reduction actions associated with salvage operations, such as transporting and releasing fish in multiple locations in the Delta.

(d) Installing equipment to monitor for the presence of predators and to monitor flows at the fish collection facilities.

(e) Modifying Delta Cross Channel gate operations and evaluating methods to control access to Georgiana Slough and other migration routes into the interior Delta to reduce diversion of listed juvenile fish from the Sacramento River and the San Joaquin River into the southern or central Delta.

WR R12b. Evaluate, Design, and Implement New or Improved Conveyance or Diversion Facilities in the Delta

(1) In selecting new and improved Delta infrastructure for conveying SWP, CVP, and market transfer water supplies from the Sacramento River to the south Delta, project proponents should analyze and evaluate a range of alternatives including, but not limited to the following:

(a) A reasonable range of flow criteria, rates of diversion, and other operational criteria required to satisfy applicable requirements of State and federal fish and wildlife agencies and the State Water Resources Control Board, and other operational requirements and flows necessary for protecting, restoring, and enhancing the Delta ecosystem under a reasonable range of hydrologic conditions (as described under WR R12h, below). This includes identifying water available for export and other beneficial uses, consistent with water quality requirements of the State Water Resources Control Board.

(b) A reasonable range of dual-conveyance alternatives, including options for the number and location of new intakes, a range of isolated conveyance capacities, through-Delta conveyance improvements, and other facilities that could improve operations for native fish and in-Delta water quality, as applicable.

(c) The potential effects of climate change on the conveyance alternatives under consideration, including possible precipitation and runoff pattern changes, temperature, and sea level rise estimates consistent with guidance provided by the California Natural Resources Agency, National Research Council, or other appropriate projections.
(d) The potential effects on migratory fish and aquatic resources and habitats.
(e) The potential effects on Sacramento River and San Joaquin River flood management.
(f) The resilience and recovery of Delta conveyance alternatives to catastrophic failure caused by earthquake, flood or other natural disaster.
(g) The potential effects of each Delta conveyance alternative on Delta water quality, flows, and water levels, including the effects of these changes on in-Delta water users.
(h) The operational benefits and/or detriments of providing multiple intake locations.
(i) The potential short-term and long-term effects of each Delta conveyance alternative on terrestrial species.
(j) The potential effects of each Delta conveyance alternative on the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.
(k) The cost-effectiveness of the alternatives in furthering the coequal goals. Cost-effectiveness means the degree to which a project or action is effective in achieving desired outcomes in relation to its cost.

(2) Project proponents should design and implement new or improved conveyance infrastructure in the Delta consistent with the following parameters:

(a) Located in areas with seasonally favorable freshwater conditions, and areas that are less vulnerable to degradation during sustained droughts and under anticipated future climate change and sea level rise conditions.

(b) Located to avoid impacts to and, where possible, improve conditions for habitat restoration opportunities in priority restoration areas identified in the Delta Plan, and other important restoration opportunity areas identified by the California Department of Fish and Wildlife.

(c) Located, designed, and operated to minimize adverse conditions for native aquatic and terrestrial species, including but not limited to those conditions related to flow direction and water quality.

(d) Designed to avoid or minimize native fish entrainment and impingement.
(e) Designed to balance adverse project impacts against the project’s long- and short-term benefits.
(f) Designed to minimize disruptions to transportation and business activities during routine maintenance activities, with consideration given to scheduling planned maintenance activities in consultation with local governments to minimize impacts to residents and businesses, and establishing communication protocols to notify residents of planned and unplanned maintenance activities.
(g) Designed to complement the Delta landscape and minimize aesthetic impacts, including visual impacts of spoils material stockpiles.
(h) Designed to maximize beneficial reuse of spoils materials to the extent practicable and feasible.
(i) Implemented in accordance with detailed project implementation plans developed in cooperation with affected communities, local governments, the Delta Protection Commission, and stakeholders to minimize and/or mitigate adverse environmental effects consistent with Delta Plan Policy GP 1, and avoid or reduce conflicts with existing or planned land uses consistent with Delta Plan Policy DP P2, and in consideration of Delta Plan recommendations DP R14, DP R16 and DP R17. Project implementation plans should consider and protect the unique character and historical importance of legacy communities, be consistent with the State’s policy regarding the human right to water, and incorporate good neighbor policies to avoid negative impacts on agricultural lands, residents, and business. Items that should be addressed in the plans include, but are not limited to, the following:

i. Construction sequencing or phasing;
ii. Temporary and long-term spoils placement;
iii. Plans for temporary traffic routing that are consistent with local transportation plans, including consideration of permanent improvements to transportation and alternative transportation routes to avoid the most severe impacts to levels of service during construction;
iv. Effects of construction activities on recreation and other visitor-related activities and businesses, including disruptions to transportation, temporary waterway closures, aesthetic and noise effects, and access to marinas, parks, and other recreation facilities;

v. Effects on local surface water and groundwater supplies during construction;

vi. Mechanisms for communicating with landowners, communities, and local governments before and during construction;

vii. Mechanisms by which community members and stakeholders can raise concerns during construction and in association with ongoing facility operations and maintenance; and

viii. Legally-permissible project delivery methods which are cost effective and provide for an expedited design and construction timeline that minimizes disruption to affected communities.

WR R12c. Improve or Modify Through-Delta Conveyance

(1) Project proponents should design, implement, and adaptively manage improved or modified through-Delta conveyance and appurtenant facilities (such as gates, permanent barriers, or fish handling facilities) to:

(a) Substantially lessen or avoid impacts and provide net improvements to riparian habitat and channel margin habitat along anadromous fish migratory corridors and, where feasible, enhance conditions for native fish.

(b) Substantially lessen or avoid impediments and provide net improvements to anadromous fish migration.

(c) Substantially lessen or avoid impacts to public safety and include or contribute to levee improvements along Old and Middle Rivers consistent with Chapter 7 of the Delta Plan.

(d) Modify the conveyance capacity or hydraulic characteristics of existing Delta waterways (e.g., improving levees and/or dredging) in a manner that provides multiple benefits, including: taking advantage of periods when water flow and quality conditions are favorable for improving water supply delivery reliability, quality, and flexibility and for protecting, restoring, and enhancing the Delta ecosystem; improving floodplain values and functions; improving habitat conditions during fish migration; and reducing flood risks.

WR R12d. Promote Options for New or Expanded Water Storage

Subject to completion of environmental review and approval by the lead agency, and applicable regulatory approvals from other public agencies, options for new or expanded water storage are hereby promoted as follows:

(1) Within the Delta watershed, project proponents should design and operate new or expanded offstream or onstream surface water storage projects consistent with the criteria in WR R12h to:

(a) Provide water supply reliability, water quality, operational flexibility to adapt to changing conditions, and ecosystem benefits under variable hydrologic conditions, and, where possible, flood risk management benefits.

(b) Improve resilience to the effects of climate change, sea level rise, higher stream temperatures, long-term drought conditions, and emergency supply disruptions.

(c) Allow greater flexibility in storing water supplies during periods when more water is available for carryover into periods when less water is available and/or Delta exports are reduced.

(d) Take advantage of periods when the water flow, quality, and environmental requirements of State and federal agencies are being met, for improving water supply delivery reliability and flexibility and protecting, restoring, and enhancing the Delta ecosystem.

(e) Contribute to improved conjunctive management of both surface and groundwater resources to maximize efficient water use and contribute to sustainable management of groundwater basins, consistent with the Sustainable Groundwater Management Act.

(2) Within the Delta water export area, project proponents should implement new or expanded surface water storage projects that improve resilience to the effects of climate change and drought and are operated to allow storage of exported and local surface water supplied during wetter
periods for use during dryer periods when exports from the Delta are reduced. Opportunities to store stormwater and recycled water supplies of suitable quality should also be promoted as a strategy for improved regional water management and reduced reliance on the Delta. This includes projects in the San Francisco Bay Area, San Joaquin Valley, Central Coast region, and Southern California.

(3) Within the Delta watershed and Delta water export area, project proponents should implement groundwater storage and extraction projects, including facilities for groundwater withdrawal, recharge, injection, and monitoring that are consistent with the criteria in WR R12f, below.

(4) The State Water Resources Control Board should review and consider revisions to existing regulations to facilitate the safe use of recycled water, stormwater, and other local water supplies for groundwater replenishment.

WR R12e. Design, Construct and Implement New or Expanded Surface Water Storage

(1) Project proponents should design, implement, and adaptively manage new or expanded surface storage projects in the Delta, its watershed, and Delta water export areas to:

(a) Improve resilience of the State’s water supply system through demonstration of benefits under current and anticipated future conditions, including climate change, changing water demands, and regulatory conditions.

(b) Contribute to regional self-reliance and reduced reliance on the Delta.

(c) Demonstrate contributions to the goals of the Sustainable Groundwater Management Act by promoting conjunctive use to achieve long-term groundwater basin sustainability.

(d) Enable participation in water exchanges and transfers that benefit the Delta ecosystem and improve regional water supply reliability.

(e) Demonstrate cost-effectiveness, where cost-effectiveness means the degree to which a project or action is effective in achieving desired outcomes in relation to its cost.

(f) Minimize and mitigate the impacts of storage on stream flows and water quality, including impacts during construction.

(2) Project proponents should design and implement new or expanded surface water storage projects in the Delta and Delta watershed, where feasible, to further achievement of the coequal goals by:

(a) Providing for the dedicated storage of water during wet periods for carry over and later use during dry periods, while balancing the benefits of providing more natural, functional flows to the Delta and its tributaries, meeting other ecosystem needs and providing flood risk management benefits.

(b) Enhancing water temperature management on Delta tributaries either directly or through coordinated operations with other facilities.

(c) Incorporating storage space dedicated to ecosystem benefits, such as flow management, water temperature, other water quality benefits, or providing water supplies to wildlife refuges.

(d) Integrating new and/or expanded storage with other existing or planned storage and conveyance systems to increase ecosystem and water supply benefits. This includes developing and/or updating coordinated operations plans, and/or agreements with other storage and conveyance systems.

(e) Contributing to the protection of water quality in the Delta and its watershed for all beneficial uses consistent with the State Water Resources Control Board’s Bay-Delta Plan.

(f) Contributing to more natural, functional flows that support ecosystem health.

(3) Project proponents should design and implement, where feasible, new or expanded surface water storage projects outside the Delta watershed, but within the Delta water export area, such as projects within the San Joaquin Valley, Central Coast, or Southern California regions, to:

(a) Contribute to reduced reliance on the Delta and regional self-reliance and, particularly during dry periods, through storage of available water supplies during wet periods for use during dry periods.

(b) Promote conjunctive management of surface and groundwater resources, and contribute to achieving
groundwater sustainability goals established pursuant to the Sustainable Groundwater Management Act or applicable local plans, as appropriate.

(c) Contribute to a comprehensive, integrated water management approach that considers multiple water supply sources including, but not limited to, stream flow, groundwater, imported water, stormwater, and recycled water, as applicable.

WR R12f. Implement New or Expanded Groundwater Storage

(1) Funding, planning, and technical support provided by State and regional agencies for groundwater projects should:

(a) Promote multiple benefits, minimize harmful effects to the ecosystem, help achieve Bay-Delta Plan objectives, as applicable, and be consistent with guidance from the State Water Resources Control Board and DWR for implementing the Sustainable Groundwater Management Act.

(b) Promote increased groundwater recharge using locally available water, such as recharge via stream-aquifer interactions, floodwater or stormwater capture, recharge using recycled water, or others, provided such actions do not result in harmful impacts to functional flows in local streams.

(c) Promote conjunctive management of surface water and groundwater resources, including in-lieu recharge.

(d) Promote new or expanded groundwater banking and exchange projects.

(e) Promote the construction of new or improved local conveyance infrastructure to convey water to and from groundwater recharge and recovery facilities.

(f) Promote the construction of new or improved conveyance infrastructure that interconnects Delta export conveyance facilities with local conveyance facilities.

(g) Promote implementation of the Central Valley Salt and Nitrate Management Plan and achievement of management goals and priorities for protection of water quality, where appropriate.

(h) Promote wellhead treatment, access to conjunctively-managed surface supplies, or other means of providing access to safe, clean, and affordable water supplies for communities relying on impaired groundwater.

(i) Demonstrate consistency with applicable Groundwater Sustainability Plans under the Sustainable Groundwater Management Act.

(j) Include new infrastructure that is consistent with WR R12f (1)(a)-(c), above.

(k) Assess the ecosystem and water supply impacts and benefits to the Delta, including providing mitigation, as appropriate.

(l) Promote opportunities for storage of flood waters (e.g., floodplain storage) or stormwater that can be managed for groundwater recharge.

(2) DWR should develop a model ordinance for groundwater recharge that urges cities and counties to incorporate groundwater recharge and storage into land-use planning and zoning, and to protect areas with the highest potential for groundwater recharge from incompatible uses. (Note: A representative map showing the soil suitability index for groundwater banking projects on agricultural lands is shown in Figure 3-11.

(3) DWR or the State Water Resources Control Board should prepare a proposal for an incentive program, in coordination with the Department of Conservation or the U.S. Department of Agriculture’s conservation programs, for landowners to protect lands with high groundwater recharge potential for the purpose of contributing to sustainable groundwater management.

WR R12g. Promote Options for Operations of Storage and Conveyance Facilities

Subject to completion of environmental review and approval by the lead agency, the following options for the operation of conveyance and storage are hereby promoted:

(1) DWR, in coordination with Reclamation, should develop a Drought Water Operations Strategy for the SWP and CVP to meet State Water Resources Control Board-specified flow and water quality criteria during extended drought conditions lasting up to six years, or for the extended timeframe recommended by the Real Time Drought Operations Team (RTDOT) describing opportunities and tools to improve routine operations to adapt to drought conditions. In developing the Strategy, DWR and
Reclamation should include criteria for defining appropriate levels or stages of drought affecting the SWP and CVP, in coordination with the RTDOT agencies and the North, Central, and South Delta Water Agencies. The Strategy should consider in-Delta actions and activities, and operations and storage of other facilities or projects that support achievement of the coequal goals. This strategy should be submitted to the Delta Stewardship Council by 2020 and be updated following future declarations of emergency associated with extreme hydrological conditions pursuant to the California Emergency Services Act (Government Code Sections 8550-8668), within one year of completing an After-Action Report, or when physical or regulatory changes necessitate an update.

(2) DWR and Reclamation should use an adaptive management approach, consistent with the Delta Plan’s adaptive management framework and in alignment with existing collaborative adaptive management efforts, for the coordinated operation of SWP and CVP through-Delta conveyance to promote the coequal goals, including considerations for protecting, enhancing, and restoring the ecosystem and maintaining adequate flows, flow direction, water levels, and water quality for Delta agriculture, recreation, and communities.

(3) Lead agencies for new or modified conveyance facilities, and new and expanded storage facilities—including those options identified in WR R12a and WR R12d should develop operational plans consistent with WR R12h, below.

(4) To improve water management flexibility and to support coordinated operations with new storage facilities, local agencies—in coordination with DWR and Reclamation, as appropriate—should pursue the following new or improved conveyance facilities outside of the Delta, to reduce reliance on the Delta and promote regional self-reliance:

(a) Facilities that promote the movement or exchange of SWP, CVP, and local water supplies, such as between the east and west sides of the San Joaquin Valley or between other regions.

(b) Facilities that increase groundwater banking or exchange, or that promote increased use of stormwater, recycled water, desalinated water, or other local water supplies in regions tributary to, or that rely on, Delta water supplies.

WR R12h. Operate Delta Water Management Facilities Using Adaptive Management Principles

(1) Project proponents should develop plans for the operation or reoperation of water conveyance and control facilities in the Delta, or new or modified storage facilities in the Delta and its watershed, that incorporate adaptive management consistent with the Delta Plan’s adaptive management framework and further achievement of the coequal goals by:

(a) Including specific and measurable operating objectives (consistent with State Water Resources Control Board’s Bay-Delta Plan objectives), that address:

i. Protection for and enhancements to the Delta ecosystem, including improved water temperature management, while reliably delivering water.

ii. Avoidance or mitigation of adverse effects on in-Delta recreation and in-Delta water quality, including identifying salinity targets for the south Delta that are designed to prevent severe water quality degradation and toxic events in dry and critically dry years.

iii. Avoidance or mitigation of adverse effects on stream flows and water quality.

iv. Avoid or mitigate adverse effects on agriculture in the Delta, including identifying salinity targets suitable for the types of crops grown in the Delta.

v. Protection of the quality, reliability, and affordability of water supplies for communities relying on impaired water supplies, including disadvantaged communities, consistent with California Water Code section 106.3.

(b) Enabling diversions during periods when Delta water flow, quality, and environmental requirements are being met for improving water supply delivery reliability and environmental conditions, and for protecting, restoring, and enhancing the Delta ecosystem.
(c) Incorporating adaptive management plans, consistent with the Delta Plan’s adaptive management framework and developed in coordination with operators and applicable regulatory agency staff, for modifying operations to meet State Water Resources Control Board flow and water quality requirements, and California Department of Fish and Wildlife conservation and recovery goals, under the following:

   i. Extended drought conditions (more than three years in duration).
   
   ii. Changed climate conditions including sea level rise and changed hydrologic conditions over the anticipated project life.
   
   iii. Extreme wet years and flood events.

(d) Demonstrating that projects can contribute to a more reliable water supply, and can protect, restore, and enhance the Delta ecosystem under a range of future conditions, including changing climate and sea level rise projections from the California Natural Resources Agency or National Research Council, or other appropriate projections.

(e) Evaluating the applicability of forecast-informed reservoir operations.

(f) Considering coordination and integration of operations with existing and/or planned conveyance and water storage facilities to maximize their potential to contribute to the goals of the Sustainable Groundwater Management Act, and the goals of other applicable programs and plans related to sustainable groundwater, stormwater, and floodwater management.

(g) Reviewing and updating, as needed, the flood space reservation guidelines for upstream reservoirs in coordination with the U.S. Army Corps of Engineers and reservoir owners or operators.

(2) Project proponents should develop operation plans for new water conveyance facilities in the Delta, and new or expanded storage facilities in the Delta watershed, that:

   (a) Ensure that operations are adequately monitored, evaluated, and revised using adaptive management to make progress towards achieving defined performance measures.

   (b) Be based upon accurate, timely, and transparent water accounting and budgeting.

   (c) Ensure that operations provide water levels, water flow, and water quality suitable for in-Delta agricultural and recreational uses.

WR R12i. Update the Bay-Delta Plan and Consider Drought

(1) In developing and implementing updates to the Bay-Delta Plan, and flow requirements for priority tributaries to the Delta to protect beneficial uses in the Bay-Delta watershed, the State Water Resources Control Board should:

   (a) Consider and contribute to achievement of applicable Delta Plan performance measures.

   (b) Require water diverters in the Delta and its watershed that are responsible for meeting Bay-Delta Plan requirements, including but not limited to DWR and Reclamation, to develop a process and plan for meeting applicable flow and water quality requirements during extended drought conditions (characterized by multiple, successive dry years) to further the coequal goals and minimize reliance on temporary urgency change petitions and related requests.

WR R12j. Operate New or Improved Conveyance and Diversion Facilities Outside of the Delta

(1) Conveyance facilities outside the Delta should be operated in consideration of effects on Delta water quality, the timing and magnitude of flows in the Delta, water supplies available for export from the Delta, and effects on opportunities to protect, restore, and enhance the Delta ecosystem.

(2) In allocating funding for new water conveyance and conveyance improvement projects outside the Delta that support regional self-reliance, the State should give preference to projects that:

   (a) Reduce reliance on the Delta for water supply during dry and critically dry years by the specific designation, in operational agreements or plans, of carryover storage for beneficial use during these periods.

   (b) Improve conjunctive management of surface and groundwater resources and contribute to achieving groundwater sustainability goals established pursuant
to the Sustainable Groundwater Management Act or local plans, as appropriate.

(c) Support ecosystem enhancement and/or provide more natural, functional flows in the Delta and its tributaries.

(d) Improve the ability of regions that rely on the Delta, for all or a portion of their water supplies, to withstand and adapt to changing current and future hydrologic conditions.

(e) Improve the quality, reliability, and affordability of water supplies for communities relying on impaired water supplies, including disadvantaged communities, consistent with California Water Code section 106.3.

(f) Contribute to a comprehensive, integrated water management approach that considers multiple water supply sources including, but not limited to, stream flow, groundwater, imported water, stormwater, desalinated water, water saved through increased efficiency, and recycled water, as applicable.

(g) Improve flexibility to accommodate water market transfer and exchange opportunities that benefit the environment.

WR R12k. Promote Water Operations Monitoring Data Management, and Data Transparency

In meeting the requirements of the 2016 Open and Transparent Water Data Act, DWR should coordinate with the Council to incorporate information related to Delta Plan performance measures and links to the Council’s online tracking and reporting tools, as appropriate, in an effort to promote transparency and accessibility of data in tracking progress toward achieving the coequal goals.

WR R13. Complete Surface Water Storage Studies

The California Department of Water Resources should complete surface water storage investigations of proposed off-stream surface storage projects by December 31, 2012, including an evaluation of potential additional benefits of integrating operations of new storage with proposed Delta conveyance improvements, and recommend the critical projects that need to be implemented to expand the state’s surface storage.

WR R14. Identify Near-term Opportunities for Storage, Use, and Water Transfer Projects

The California Department of Water Resources, in coordination with the California Water Commission, Bureau of Reclamation, State Water Resources Control Board, California Department of Public Health, the Delta Stewardship Council, and other agencies and stakeholders, should conduct a survey to identify projects throughout California that could be implemented within the next 5 to 10 years to expand existing surface and groundwater storage facilities, create new storage, improve operation of existing Delta conveyance facilities, and enhance opportunities for conjunctive use programs and water transfers in furtherance of the coequal goals. The California Water Commission should hold hearings and provide recommendations to the California Department of Water Resources on priority projects and funding.

WR R15. Improve Water Transfer Procedures

The California Department of Water Resources and the State Water Resources Control Board should work with stakeholders to identify and recommend measures to reduce procedural and administrative impediments to water transfers and protect water rights and environmental resources by December 31, 2016. These recommendations should include measures to address potential issues with recurring transfers of up to 1 year in duration and improved public notification for proposed water transfers.

Improved Water Management Information

One of the greatest challenges to improved management of California’s water supplies is the lack of consistent, comprehensive, and accurate estimates of actual water use in the state, both by sector of use (agricultural, urban, and environmental) and by regions within the state. The sheer number of water management agencies in California is a key logistical factor. Current data reported to various State agencies is a combination of measured uses and estimated uses, with limited verification of actual water use. This means that California does not have a clear understanding of its water demands, the amount of water available to meet those demands, how water is being managed, and how that management can be improved to achieve the coequal goals.
CHAPTER 3 A MORE RELIABLE WATER SUPPLY FOR CALIFORNIA

Problem Statement
Accurate, timely, consistent, and transparent information on the management of California water supplies and beneficial uses is an important tool used in the achievement of the coequal goals. The State needs sufficient information to assess the current reliability of its water supplies or to meaningfully measure progress toward achievement of more reliable water supplies for California.

Policies
The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

WR P2. Transparency in Water Contracting
(a) The contracting process for water from the State Water Project and/or the Central Valley Project must be done in a publicly transparent manner consistent with applicable policies of the California Department of Water Resources and the Bureau of Reclamation referenced below.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers the following:

(1) With regard to water from the State Water Project, a proposed action to enter into or amend a water supply or water transfer contract subject to California Department of Water Resources Guidelines 03-09 and/or 03-10 (each dated July 3, 2003), which are attached as Appendix 2A; and

(2) With regard to water from the Central Valley Project, a proposed action to enter into or amend a water supply or water transfer contract subject to section 226 of P.L. 97-293, as amended or section 3405(a)(2)(B) of the Central Valley Project Improvement Act, Title XXXIV of Public Law 102-575, as amended, which are attached as Appendix 2B, and Rules and Regulations promulgated by the Secretary of the Interior to implement these laws.

23 CCR Section 5004
NOTE: Authority cited: Section 85210(i), Water Code.

Recommendations
WR R16. Supplemental Water Use Reporting
The State Water Resources Control Board should require water rights holders submitting supplemental statements of water diversion and use or progress reports under their permits or licenses to report on the development and implementation of all water efficiency and water supply projects and on their net (consumptive) use.

WR R17. Integrated Statewide System for Water Use Reporting
The California Department of Water Resources, in coordination with the State Water Resources Control Board, California Department of Public Health, California Public Utilities Commission, Bureau of Reclamation, California Energy Commission, Bureau of Reclamation, California Urban Water Conservation Council, and other stakeholders, should develop a coordinated statewide system for water use reporting. This system should incorporate recommendations for inclusion of data needed to better manage California’s water resources. The system should be designed to simplify reporting; reduce the number of required reports where possible; be made available to the public online; and be integrated with the reporting requirements for the urban water management plans, agricultural water management plans, and integrated regional water management plans. Water suppliers that export water from, transfer water through, or use water in the Delta watershed should be full participants in the database.

WR R18. California Water Plan
The California Department of Water Resources, in consultation with the State Water Resources Control Board and other agencies and stakeholders, should evaluate and include in the next and all future California Water Plan updates information needed to track water supply reliability performance measures identified in the Delta Plan, including an assessment of water efficiency and new water supply development, regional water balances, improvements in regional self-reliance, reduced regional reliance on the Delta, and reliability of Delta exports, and an overall assessment of progress in achieving the coequal goals.

WR R19. Financial Needs Assessment
As part of the California Water Plan Update, the California Department of Water Resources should prepare an assessment of the state’s water infrastructure. This should include the costs of rehabilitating/replacing existing...
infrastructure, an assessment of the costs of new infrastructure, and an assessment of needed resources for monitoring and adaptive management for these projects. The California Department of Water Resources should also consider a survey of agencies that may be planning small-scale projects (such as storage or conveyance) that improve water supply reliability.
Timeline for Implementing Policies and Recommendations

Figure 3-12 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.

<table>
<thead>
<tr>
<th>ACTION (REFERENCE #)</th>
<th>LEAD AGENCY(IES)</th>
<th>NEAR TERM 2012–2017</th>
<th>INTERMEDIATE TERM 2017–2025</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POLICIES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce reliance on the Delta through improved regional water self-reliance (WR P1)</td>
<td>Water suppliers</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Transparency in water contracting (WR P2)</td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Implement water efficiency and water management planning laws (WR R1)</td>
<td>Water suppliers</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Require State Water Project contractors to implement water efficiency and water management laws (WR R2)</td>
<td>DWR</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Compliance with reasonable and beneficial use (WR R3)</td>
<td>SWRCB</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Expanded water supply reliability element (WR R4)</td>
<td>Water suppliers receiving Delta water</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Develop water supply reliability element guidelines (WR R5)</td>
<td>DWR</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Update water efficiency goals (WR R6)</td>
<td>DWR and SWRCB</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Revise State grant and loan priorities (WR R7)</td>
<td>DWR, SWRCB, and DPH</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Demonstrate State leadership (WR R8)</td>
<td>State agencies</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Update Bulletin 118, California’s Groundwater Plan (WR R9)</td>
<td>DWR</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Implement groundwater management plans in areas that receive water from the Delta watershed (WR R10)</td>
<td>Water suppliers receiving Delta water and uses groundwater</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td><strong>RECOMMENDATIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recover and manage critically overdrafted groundwater basins (WR R11)</td>
<td>Local and regional agencies</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Promote options for conveyance, storage, and the operation of both (WR R12) (see Exhibit A Delta Plan Amendment for Conveyance, Storage Systems, and the Operation of Both)</td>
<td>Federal, State, and local agencies</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Complete surface water storage studies (WR R13)</td>
<td>DWR</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Identify near-term opportunities for storage, use, and water transfer projects (WR R14)</td>
<td>DWR</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Improve water transfer procedures (WR R15)</td>
<td>DWR</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Supplemental water use reporting (WR R16)</td>
<td>SWRCB</td>
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</tr>
<tr>
<td>Integrated statewide system for water use reporting (WR R17)</td>
<td>DWR</td>
<td>●</td>
<td>●</td>
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<tr>
<td>California Water Plan (WR R18)</td>
<td>DWR</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Financial needs assessment (WR R19)</td>
<td>DWR</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Agency Key:
Council: Delta Stewardship Council
DWR: California Department of Water Resources
RWQCB: Regional Water Quality Control Board(s)
SWRCB: State Water Resources Control Board
Water suppliers: refers to both urban and agricultural water suppliers
Science and Information Needs

An improved understanding of the state’s hydrologic systems, patterns of water use, and effects of climate change, especially within the Delta watershed and areas that receive water from the Delta, is essential to improving the management of California’s water supplies to achieve the coequal goals. Key areas of needed research include:

- Improved projections for and measurement of surface water flows (amounts, timing, quality) and how they may be impacted by environmental regulations, changing land uses, and climate change
- Improved water supply and demand forecasting models that incorporate vulnerability to extreme events (droughts, floods, earthquakes) and account for the impacts of climate change
- Improved methods for downscaling climate change models (including dynamic downscaling) and improved models for water scenario planning that incorporates these data
- Improved information on effective watershed management actions to restore and enhance capacity of rural and urban landscapes to process stormwater for water quality and water supply benefits
- Improved models for assessing the interaction between water management scenarios in the Delta and ecosystem function, including implications of revised instream flow requirements on inflows to the Delta and revised wet year/dry year export scenarios
- Improved information on changing water use patterns in response to urban and agricultural water efficiency measures, including water pricing, and implications for future water demands
- Improved characterization of groundwater basins and subbasins, and improved estimates of groundwater supplies (amounts, quality)
- Improved models of aquifer and surface-groundwater relationships, which include the effects of climate change on evaporation, runoff, groundwater recharge, subsurface interactions, and the implications of these effects for safe yield and implementation of conjunctive use and water transfer programs

Issues for Future Evaluation and Coordination

Additional areas of interest and concern related to water supply and the Delta may deserve consideration in the development of future Delta Plan updates, including:

- Delta water delivery predictability. A Delta Delivery Predictability Index should be developed that depicts, by hydrologic year types, the estimated streamflows entering the Delta and suggested levels of water exports that would be consistent with in-Delta and ecosystem protections. As part of the index, a system for tracking the use of stored Delta water also should be developed. The index will lead to a better understanding of how water exported and stored during wet years would be available to urban and agricultural users during dry years to offset reduced exports. This information is key to better understanding how investments in new storage and improved conveyance contribute to improved reliability of California’s water supplies.
- Performance measures for reduced reliance on the Delta. The Delta Plan identifies two core measures for assessing progress in reducing reliance on the Delta: (1) a significant reduction in the amount of water used from the Delta watershed, or (2) a significant reduction in the percentage of water used from the Delta watershed. The Council will collaborate with DWR, SWRCB, and stakeholders to develop a standardized method or methods by which progress to reduce reliance on the Delta and improve regional self-reliance should be reported (1) in the urban and agricultural water management plans; (2) in IRWMPs; and (3) in the California Water Plan. Potential additional measures should be identified and evaluated that will benefit the amount of water, quality of water, and timing of flows in and...
through the Delta, and contribute to reduced reliance on the Delta and improving regional self-reliance consistent with Water Code section 85021.

- **Evaluation of urban and agricultural water management plans.** The Council will work with DWR and the State Legislature to identify resources and secure authority, if necessary, to conduct further evaluation of water management information contained in urban and agricultural water management plans. The goal of these actions is to improve knowledge about water management in California and, specifically, to facilitate the aggregation and evaluation of water management data over time to gauge success toward reducing reliance on the Delta, increasing regional self-reliance, and achieving the coequal goals.

- **Integrated water resource management.** The value of integrated regional water management planning is widely recognized, but information on how to implement effective integrated water management projects is not well understood. The number of conjunctive management programs that combine green urban design, flood control, stormwater infiltration, water conservation, recycled water, and groundwater elements are increasing. Information about the successful integration of water management infrastructure needs to be shared and consideration given as to how to effectively promote implementation of these integrated strategies.

- **Agricultural and urban water efficiency.** Improved demand management through urban and agricultural water conservation and efficiency is the fastest and least expensive strategy for making more water available to the Delta through inflows and reducing the pressure to export more water from the Delta. Additional best management practices should be identified and promoted, including evaluation of new water conservation-based rate structures and how they contribute to water savings while maintaining more stable revenue for water suppliers.

- **Delta Watermaster.** The Delta Watermaster is in the process of completing an assessment of potential illegal water diversions within the Delta. This assessment should be expanded to evaluate illegal water diversions throughout the Delta watershed.

- **Reoperation of upstream reservoirs.** DWR is working with USACE and other agencies to develop a coordinated proposal for the reoperation of reservoirs above the Delta to address the impacts of climate change on flood protection and water supply operations. This proposal should include consideration of improved watershed management actions that will also help attenuate flood flows as well as improve ecosystem functions and water supply availability.

# Performance Measures

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

## Output Performance Measures

- Water suppliers that receive water from the Delta watershed have documented the expected outcome for a measurable reduction in reliance on the Delta and improvement in regional self-reliance. (WR R1, WR R4)
- Progress made in achieving existing water conservation and water supply performance goals, and setting expanded future goals for local, regional, and statewide
water conservation, water use efficiency, and water supply development. (WR R6)

- Information in updated Bulletin 118 is included in the next (2013) California Water Plan Update and in the 2015 urban water management plans and agricultural water management plans. (WR R9)

**Outcome Performance Measures**

- Progress toward increasing local and regional water supplies, measured by the amount of additional supplies made available (reported in 5-year increments from 2000). (WR P1)

- Progress toward meeting California’s conservation goal of achieving a 10 percent reduction in statewide urban per capita water usage by 2015 and a 20 percent reduction by 2020. (WR R1)

- Progress toward improved reliability of Delta water exports and reductions in the vulnerability of Delta exports to disruption. (WR R12, ER P1, RR P1)

- Progress toward increasing the predictability of water deliveries from the Delta in a variety of water year types. (WR R12, WR R14)

- Progress toward achieving California’s goal for the increased use of stormwater runoff of at least 500,000 acre-feet per year by 2020 and by at least 1 MAF per year by 2030. (WR R6)
References


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DWR (California Department of Water Resources), and Reclamation (Bureau of Reclamation). 2016. *Bay Delta Conservation Plan/California WaterFix Final EIS/EIR*. Appendix 3A.


Chapter 3 A More Reliable Water Supply for California


Robie, Ronald B. 2012. Effective implementation of the Public Trust Doctrine in California water resources decision-making: A view from the bench. 45 U.C. Davis L. Rev. 1155, 1176.


SWRCB (State Water Resources Control Board). 2011. Email from Tom Howard to Joe Grindstaff, responding to request for information pertaining to the allocation of water in California and the Delta watershed, prepared by SWRCB staff. August 9.

SWRCB (State Water Resources Control Board). 2013. Communities that Rely on a Contaminated Groundwater Source for Drinking Water.


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CHAPTER 4

Protect, Restore, and Enhance
ABOUT THIS CHAPTER

This chapter describes the Sacramento-San Joaquin Delta (Delta) ecosystem and the factors that affect and too often degrade it. It proposes policies and recommendations for restoring the Delta ecosystem organized into five core strategies to achieve the coequal goals of the Delta Reform Act:

- Create more natural functional flows
- Restore habitat
- Improve water quality to protect the ecosystem
- Prevent introduction of and manage nonnative species impacts
- Improve hatcheries and harvest management

These core strategies form the basis of the five policies and nine recommendations found at the end of the chapter.
The coequal goals for the Delta (Water Code section 85054) are relevant to ecosystem restoration:

“Coequal goals” means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

Eight objectives in Water Code section 85020 are inherent in the coequal goals. Section 85020(a), (c), and (e) are relevant to this chapter:

85020 The policy of the State of California is to achieve the following objectives that the Legislature declares are inherent in the coequal goals for management of the Delta:

(a) Manage the Delta’s water and environmental resources and the water resources of the state over the long term.

(c) Restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem.

(e) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

The coequal goals and inherent objectives seek broad protection of the Delta. Achievement of these broad goals and objectives requires implementation of specific strategies. Water Code sections 85022 and 85302 provide direction on the implementation of specific measures to promote the coequal goals and inherent objectives related to the Delta ecosystem restoration.

85022(d)(5) Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.

(6) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

85302(c) The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem.

(1) Viable populations of native resident and migratory species.

(2) Functional corridors for migratory species.

(3) Diverse and biologically appropriate habitats and ecosystem processes.

(4) Reduced threats and stresses on the Delta ecosystem.

(5) Conditions conducive to meeting or exceeding the goals in existing species recovery plans and state and federal goals with respect to doubling salmon populations.

85302(d) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:

(1) Meeting the needs for reasonable and beneficial uses of water.

(3) Improving water quality to protect human health and the environment.

85302(e) The following subgoals and strategies for restoring a healthy ecosystem shall be included in the Delta Plan.

(1) Restore large areas of interconnected habitats within the Delta and its watershed by 2100.

(2) Establish migratory corridors for fish, birds, and other animals along selected Delta river channels.

(3) Promote self-sustaining, diverse populations of native and valued species by reducing the risk of take and harm from invasive species.

(4) Restore Delta flows and channels to support a healthy estuary and other ecosystems.

(5) Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.

(6) Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.
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CHAPTER 4

Protect, Restore, and Enhance the Delta Ecosystem

In the Delta Reform Act, the goal of protecting, restoring, and enhancing the Delta ecosystem is coequal to the goal of providing a more reliable water supply for California. Both must be accomplished while protecting and enhancing the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

Some past land and water uses have put these goals in conflict. For example, reliable water supplies have been associated with artificially stabilized flows and a complex human-made system of infrastructure that includes dams, levees, and channelized rivers and sloughs. Yet healthy rivers and estuaries, and the native species that live in them depend on naturally variable water flows and a dynamic landscape. Many native species also depend on wetlands that have been drained for farming and other human uses.

Despite these conflicts, the Delta Stewardship Council (Council) must work to achieve the goal of protecting, restoring, and enhancing the Delta ecosystem. Inherent in that goal is the objective to “restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem” (Water Code section 85020(c)). (See sidebar, What Does It Mean to Achieve the Goal of Protecting, Restoring, and Enhancing the Delta Ecosystem?)

The Council envisions a future in which the Delta ecosystem has the following characteristics:

- Native species, including algae and other plants, invertebrates, fish, birds, and other wildlife, are self-sustaining and persistent.
- The tidal channels and bays in the Delta and Suisun Marsh connect with freshwater creeks, upland grasslands, and woodlands.
- The Sacramento and San Joaquin rivers and other Delta tributaries include reaches where streams are free to meander and connect seasonally to functional floodplains.
- Habitats for resident and rearing migratory fish, birds, and upland wildlife are connected by migratory corridors, including areas with high-quality cover and feeding opportunities.
- More natural variations in water flows and conditions make aquatic habitats, tidal marshes, and floodplains more dynamic, encourage survival of native species, and resist invasions by weeds and animal pests.
- The ecosystem is resilient enough to absorb and adapt to current and future effects of multiple stressors without significant declines in ecosystem services.
- The Delta will provide more reliable water supplies, in part because survival of its wildlife, fish, and plants do not require extraordinary regulatory protection.
- Californians recognize and celebrate the Delta’s unique natural resource values through wildlife observation, angling, waterfowl hunting, and other outdoor recreation.

This future Delta will differ from the Delta that greeted the first Californians and will probably be different from the current ecosystem. Not every species or natural area now found in the Delta may persist through the changes ahead, including climate change, but Californians’ use and management of the Delta will be directed and coordinated to sustain conditions that make species’ survival more likely while maintaining the many other benefits provided by the Delta ecosystem.
CHAPTER 4 PROTECT, RESTORE, AND ENHANCE THE DELTA ECOSYSTEM

WHAT DOES IT MEAN TO ACHIEVE THE GOAL OF PROTECTING, RESTORING, AND ENHANCING THE DELTA ECOSYSTEM?

Achieving the coequal goal of ecosystem protection, restoration, and enhancement means successfully establishing a resilient, functioning estuary and surrounding terrestrial landscape capable of supporting viable populations of native resident and migratory species with diverse and biologically appropriate habitats, functional corridors, and ecosystem processes.

For this purpose, the term “restoration” is defined in Water Code section 85066 as follows:

“the application of ecological principles to restore a degraded or fragmented ecosystem and return it to a condition in which its biological and structural components achieve a close approximation of its natural potential, taking into consideration the physical changes that have occurred in the past and the future impact of climate change and sea level rise.”

Restoration actions may include restoring interconnected habitats within the Delta and its watershed, restoring more natural Delta flows, or improving ecosystem water quality.

“Protection” means preventing harm to the ecosystem, which could include preventing the conversion of existing habitat, the degradation of water quality, irretrievable conversion of lands suitable for restoration, or the spread of invasive nonnative species.

“Enhancement” means improving existing desirable habitat and natural processes. Enhancement might include flooding the Yolo Bypass more often to support native species, or to expand or better connect existing habitat areas. Enhancement includes many fish and wildlife management practices, such as managing wetlands for waterfowl production or shorebird habitat, installing fish screens to reduce entrainment of fish at water diversions, or removing barriers that block migration of fish to upstream spawning habitats.

A Restored Delta Ecosystem Is Key to a Reliable Water Supply

Delta water supplies can be more reliable only when the Delta ecosystem is restored. The water projects that rely on the Delta were developed without contemporary understanding of the Delta’s ecology or anticipation of the value that Californians now place on a healthy environment. As the effects of the projects on the Delta ecosystem became apparent, a series of adjustments in their operation has been put in place. Each adjustment affected the water diversions, altering volume and timing to reduce damage, but without fully mitigating harm to the Delta ecosystem. The perilous condition of salmon, delta smelt, and other species remains a key limit on project operations. Only as these populations recover will water project operations become more flexible and reliable.

To restore the Delta ecosystem, Californians will need to use water management facilities in new ways. Reservoirs will need to hold and release water for ecosystem purposes as well as for water users. Storage and the development of alternative supplies will be needed to help reduce reliance on the Delta and improve regional self-reliance. Multipurpose bypasses and levees will provide habitat while also controlling flooding. Channels and water controls will need to be able to deliver water for habitats as well as for farms and cities. Modern water diversions will need to protect fish while providing reliable water supplies. For these reasons, restoring the Delta ecosystem will require new investment in water facilities and alternative supplies, not just regulation of water project operations or restoration of habitats for fish and wildlife. Other actions undertaken to protect the ecosystem can also benefit water users; for example, vigilance in preventing invasive species introduction can avoid future costs to manage mussel infestations in pipelines or other water structures. Tradeoffs may be necessary as we better match demands to the supply available, consistent with ecosystem protection, and match our expectations about the ecosystem to the changing climate.

A restored Delta ecosystem is also important to the Delta’s future as an attractive place to live, work, and recreate. Water flows are important not just to water exporters, fish, and
aquatic environments, but also to the Delta’s municipal, industrial, and agricultural waters users, who will need consideration as system changes are planned and implemented. Restoration actions will require careful design so they are attuned to local needs: locating habitats to minimize conflicts with existing and planned uses; working with farmers by promoting wildlife-friendly farming; providing buffers between wildlife areas and farms; working with landowners regarding how to manage restored wildlife populations on or near their lands; and improving opportunities for outdoor recreation, including boating, angling, and hunting, that are enjoyed by residents and also attract visitors. Integrating habitat improvements when levees are rebuilt or flood channels are improved can draw new sources of funds to strengthen the Delta flood control system. In essence, a systems approach that recognizes tradeoffs and the value of balance will be necessary for California to achieve the coequal goals.

The Delta Ecosystem, Past and Present

In the Delta, the Central Valley’s great rivers—the Sacramento from the north and San Joaquin from the south—join the Cosumnes, Mokelumne, and Calaveras here in a vast and complex estuary influenced by tides and river currents (see Figure 4-1).

Before the early 1800s, the rivers flowed through approximately 400,000 acres of tidal wetlands and other aquatic habitats that connected with several hundred thousand acres of nontidal wetlands and riparian forest. Flows of the Delta’s rivers and tidal channels varied by season and year-to-year, sometimes pouring from the Sierra in great floods whose fresh waters overflowed wetlands and floodplains, and at other times declining as droughts shriveled rivers and brackish tidewaters pushed inland. To the west, the rivers joined to discharge through marsh-fringed Suisun Bay to the Carquinez Straight, San Francisco Bay, and the Pacific Ocean.

The Delta’s historical landscape also varied from north to south (see Figure 4-2). In the north Delta, flood basins occurred where the Sacramento River intertwined with tidal channels. A vast area of freshwater wetlands dominated by tules transitioned into tidal wetlands. Shallow perennial ponds and lakes, broad riparian forests along natural levees, and seasonal wetlands at the upland edge were also common. The central Delta was characterized by large, tidal islands that flooded during spring tides (or more frequently) intersected by networks of branching tidal channels. Channel banks were low and covered by the willows, grasses, sedges, shrubs, and ferns that also grew in island interiors. The south Delta contained a complex network of channels formed predominantly by riverine processes. The floodplain comprised emergent wetlands, perennial and seasonal ponds, willow thickets, and seasonal wetlands. Driftwood and other woody debris filled some channels, likely from riparian forest along the San Joaquin River’s natural levees.

Historical records show a rich and complex Delta with habitats supporting diverse and abundant native plants and animals (Grossinger et al. 2010, Whipple et al. 2010, Whipple 2011). Some fish, including smelt, schooled in the open waters of the western Delta’s bays and channels, moving east when brackish water intruded from San Francisco Bay. Other resident wildlife and plants also prospered: rails in tidal and tule marshes, giant garter snakes in freshwater wetlands and ponds, and riparian brush rabbits and wood rats in willow thickets and riparian forests. Each fall, salmon and steelhead, drawn by the swelling Sacramento and San Joaquin rivers, migrated inland from the ocean and navigated upstream to spawning areas in their tributaries. As river flows receded, their young, emerging from these tributaries’ spawning gravel, would return downstream and shelter in driftwood-lined eddies or undercut riverbanks and feed in Delta sloughs, marshes, and floodplains before returning to the sea. Waterfowl, cranes, and shorebirds migrated through the Delta along a north-south route that stretched from the Arctic to Mexico or beyond. Songbirds followed a similar
path through riparian woodlands that connected from the Sacramento Valley through the Delta to the San Joaquin Valley.

To immigrants arriving in the nineteenth century, the Delta and Central Valley appeared a wild and dangerous place that had to be “reclaimed” to support the agricultural way of life they had inherited from their ancestors. The rapid transformation of the historical Delta over 160 years involved many changes. Over 1,000 miles of levees were constructed to drain wetlands and protect islands from damaging floods. Channels were cut between sloughs or through islands to ease navigation and encourage drainage without regard to effects on the estuary. Forests were cut and land leveled for farming (Hanak et al. 2011). This transformation produced the rich agricultural economy and rural culture of the Delta described in Chapter 5. But it came at a cost: loss of the original estuarine ecosystem and its species, and native people.

Comparison of Historical (early 1800s) and Modern Delta Waterways

The map at left shows the complexity of early 1800s Delta hydrography (black) within tidal wetland (gray). The modern hydrography at right shows major differences such as channel widening, meander cuts, cross levees, and loss of within-island channel networks and tidal wetland.

Source: San Francisco Estuary Institute 2012
Primary Landscapes in the Historical Delta

The historical Delta can be divided into three primary landscapes: flood basins in the north Delta, tidal islands in the central Delta, and distributary rivers (rivers with multiple branches flowing away from main channels) in the south Delta. Transitions between these landscapes occurred gradually, across broad areas. Though these landscapes held many habitat types in common, characteristics and spatial patterns varied greatly—these large-scale patterns are what helped define the landscapes, which in turn provided different functions for native species. Understanding these major landscape types is a valuable framework for evaluating current and future restoration strategies in the Delta, providing a baseline between the current landscapes and the long-established historical patterns.

Source: Whipple 2011
Nearly all the rivers historically flowing to the Delta were dammed, creating Shasta, Folsom, Millerton, and Oroville lakes and other impoundments described in Chapter 3. These dams, together with levees constructed to prevent flooding, blocked access to spawning areas and other habitats critical to salmon, splittail, and other fish. The once pronounced seasonal and year-to-year variability of river flows has given way to more stable, artificially regulated conditions. The formerly complex Delta sloughs have been replaced by a simplified grid of straightened channels, cuts, and often rock-lined rivers fixed in space and time, and used for water conveyance and shipping. Pumps to divert water for irrigation or municipal use south or west of the Delta further disrupted the estuary (see Figure 4-3).

Ecosystem restoration cannot restore the historical Delta. Its alteration is too complete to reverse and could not occur without damage to other beneficial uses of its water and land. The Delta Reform Act recognizes these limitations and defines restoration as a “...close approximation of its natural potential...” (Water Code section 85066).

Ecosystem Stressors

Many factors stress the Delta’s ecosystem (Baxter et al. 2010). Stressors are actions or factors, whether caused by humans or nature, that negatively affect the ecosystem processes and functions. Stressors include altered flows, habitat loss, entrainment in Delta diversions, degraded water quality, harmful nonnative species, migration barriers, and impacts from hatcheries. Reducing one stressor, or even several stressors, is unlikely to solve all environmental problems in the Delta (Delta ISB 2011, see Appendix I). Many restoration projects fail because multiple stressors have been insufficiently considered (Palmer et al. 2005). Because of uncertainty over cause and effect, ecosystem restoration must address as many stressors as possible through adaptive management, as described in Chapter 2 and Appendix C. Organizing stressors into categories, such as those developed by the Delta Independent Science Board (ISB), helps resource managers to think about, assess, and manage them. (See sidebar, Stressor Categories to Help with Management Options.) Ecosystem stressors and their effects can be categorized by what causes them (sources of stress) or by what can be done about them. The Delta Plan’s ecosystem restoration strategies address the following current stressors:

- Delta flows
- Habitat
- Ecosystem water quality
- Nonnative species
- Hatcheries and harvest management

**STRESSOR CATEGORIES TO HELP WITH MANAGEMENT OPTIONS**

The Delta ISB developed categories that put Delta stressors into broad context to help assess management options (for example, what can be done about them) (Delta ISB 2011). Management options are stressor reduction, elimination, or mitigation. When this is not possible, adaptation to stressors must be promoted. The Delta ISB has proposed the following categories:

- **Current stressors** result from ongoing human activities that at least in some cases can be eliminated (for example, fish entrainment at water diversions and pollution from point sources).
- **Legacy stressors** result from past actions that cannot be undone, but their impact can sometimes be reduced or mitigated (for example, mercury pollution from historical gold mining and past introductions of nonnative species).
- **Globally determined stressors** result from large-scale human activities or natural processes that cannot be eliminated or mitigated within the purview of the Delta Plan and require larger-scale planning and adaptation (for example, global climate change and human population growth).
- **Anticipated future stressors** require preparation (for example, future land subsidence, urban expansion, and new invasions by nonnative species).

These categories have some overlap; for example, a globally determined stressor such as sea level rise also can be an anticipated future stressor.
Changes in Historical Flows Challenge Delta Ecology

Habitat for native species has been shaped in the past by natural cycles of river flows. Since the 1960s, our water system, with its upstream reservoirs, diversions, and other management facilities, has changed these patterns in two ways. First, seasonal flows are much less variable and encourage nonnative fish and vegetation, which can crowd out native species that thrive in a more varied environment. Second, peak flows now come at lower magnitudes and occur earlier on the San Joaquin; this shift affects water temperatures, salinity, and access to habitat, causing stress on native species.

Natural flow is runoff that would have occurred had the landscape and waterways remained unaltered. Our best estimate of natural Delta inflow is "unimpaired flow," the flow that would be expected if reservoirs were removed but the contemporary watershed and valley land uses remained. However, natural and unimpaired Delta inflow are not the same, and the difference between them could be substantial at times.
CHAPTER 4 PROTECT, RESTORE, AND ENHANCE THE DELTA ECOSYSTEM

Climate Change

Climate change will cause major stresses on the Delta ecosystem. Rising sea level could inundate freshwater marshes and other freshwater aquatic habitats, potentially with brackish water, reducing habitat for native plants, fish, and wildlife. In addition to rising sea level, the amount of ideal low-salinity habitat for native fish such as the delta smelt will be affected by changes in runoff timing and intensity, which will also affect erosion and sedimentation patterns, again altering fish habitat. Increased water temperature will negatively affect smelt, salmon, and other coldwater-dependent fish, and will likely increase the range of invasive species (Healey et al. 2008, Villamanga and Murphy 2010). In terrestrial habitats, warming could create soil moisture deficits, change plant community composition, and even disrupt timing between pollinators and plants (California Natural Resource Agency 2009). Overall climate change will exacerbate current challenges to the protection and restoration of Delta ecosystems.

Ecosystem Restoration

Restoration of the Delta ecosystem does not mean a return to predevelopment conditions with only its native plants and animals. That is beyond human ability. Instead, restoration seeks to return areas to a close approximation of their natural potential, including re-establishing natural habitat and ecosystem functions, as feasible, within the context of the current configuration of the Delta, the current biological communities, and the permanent modifications to Delta land forms and hydrology. Successful ecosystem restoration rehabilitates key elements—the living and nonliving features such as soils, elevation, waterways, species, populations, and habitats—and the structure and processes that connect them. This section summarizes the principles of and considerations for ecosystem restoration in the Delta.

Much work has been done to develop ecological principles specific to the Delta. (See sidebar, Delta Ecological Principles.) Restoration projects that adhere to these principles are more likely to achieve their goals and objectives.

The Delta Reform Act’s definition of restoration recognizes that the ecosystem will be dynamic, changing in response to restoration actions and future climate change (Healey et al. 2008, Delta ISB 2011). The desired future condition is an evolving ecosystem that supports communities of both native and nonnative species, and continues to provide value such as clean water, flood storage, or recreational fishing. A dynamic, restored Delta ecosystem can be a natural complement to the Delta as an “evolving place” described in Chapter 5.

To increase the likelihood of ecosystem restoration success, plans and actions must incorporate the principles of adaptive management (see Chapter 2 and Appendix C for a detailed discussion). This begins with a clear, practical vision of what will be achieved for the ecosystem, together with human need for water supply reliability and flood risk reduction. Additional examples are provided in the sidebar, Current Delta Ecosystem Restoration Efforts.
DELTA ECOLOGICAL PRINCIPLES

The following are ecological principles for the Delta adapted from those developed for the Delta Vision Blue Ribbon Task Force by former CALFED Lead Scientist Michael Healey (2007a, 2007b) and for the Bay Delta Conservation Plan (BDCP) Steering Committee by the BDCP Independent Science Advisors (2007).

**Principle 1: Humans are part of the Delta ecosystem.** Human activities over the past 160 years have produced a Delta ecosystem that is different from the historical ecosystem, and will remain so even as human-induced stressors are modified.

*Management implications:* Strategic management of human activities, and uses of the landscape and water in the Delta will be integral to the successful protection, restoration, and enhancement of the Delta ecosystem.

**Principle 2: The Delta ecosystem is part of larger ecosystems.** The Delta ecosystem affects and is affected by surrounding ecosystems. High year-to-year variability in precipitation and river flows are, in part, caused by climate patterns that span the entire Pacific Ocean. In addition, many animals that use the Delta do so for only part of their life cycles, spending other parts upstream in the rivers, in the ocean, or as far as away as South America and northern Canada.

*Management implication:* Management of the Delta cannot occur independently of structures and events upstream and in the ocean, in regional and state economies, or in the wider governance context.

**Principle 3: The Delta ecosystem is a mosaic of smaller terrestrial and aquatic ecosystems.** These ecosystems interact in important ways (for example, exchange of material, energy, and species). This landscape mosaic determines overall performance of the ecosystem. The size, shape, arrangement, and connections within the mosaic are critical to the way the Delta functions.

*Management implication:* Management plans and decisions need to be informed by a landscape perspective that recognizes interrelationships among patterns of land and water use, patch size, location and connectivity, and species success. The landscape perspective needs to be developed at several physical and temporal scales.

**Principle 4: The Delta ecosystem is naturally dynamic.** This includes disturbances and extreme events such as very wet and very dry years. Changes in one part of the Delta may have far-reaching effects in space and time.

*Management implication:* The Delta cannot be managed as a homogenous or static system.

**Principle 5: Native Delta species are adapted to a naturally dynamic Delta ecosystem.** The natural Delta is dynamic and variable, and the organisms living there are adapted to that variability.

*Management implication:* In order to successfully protect, restore, and enhance the Delta, management needs to include actions that mimic, to some extent, the historical natural variability.

**Principle 6: Each native Delta species has particular tolerances for habitat variables** such as temperature, dissolved oxygen, salinity, turbidity, and toxic substances. Species distributions may shift if conditions change and exceed these tolerances. Increase of air and water temperature by even 2 degrees may make the Delta uninhabitable for some local species and also make it potentially inhabitable for species from warmer regions.

*Management implication:* Loss of some species from the ecosystem may be inevitable. For local species, refugia may have to be located in cooler regions if extinction is to be prevented. Additional actions may be necessary to alleviate a potential increase in nonnative invasive species.
CURRENT DELTA ECOSYSTEM RESTORATION EFFORTS

Several significant ecosystem restoration planning and implementation efforts are worth noting:

- The draft Ecosystem Restoration Program (ERP) Conservation Strategy was released by the California Department of Fish and Wildlife (DFW) in 2011 (DFG 2011) to update the CALFED ERP plans from 2000. DFW collaborates with its federal fish agency partners, the U.S. Fish and Wildlife Service and National Marine Fisheries Service, to implement the ERP, including providing grants for Delta and Suisun Marsh restoration research and implementation.

- DFW and the California Department of Water Resources (DWR) are continuing to implement and plan for ecosystem restoration projects begun under the CALFED Bay-Delta Program located in Suisun Marsh, at Dutch Slough, at Cache Slough, in the Yolo Bypass, and at the Cosumnes Preserve’s North Delta project.

- The Suisun Marsh Habitat Management, Preservation, and Restoration Plan is a comprehensive approach to restoring 5,000 to 7,000 acres of tidal wetlands and maintaining managed wetlands and their functions consistent with the CALFED program, the Suisun Marsh Preservation Agreement, applicable species recovery plans, and other interagency goals.

- The Bay Delta Conservation Plan (BDCP) is an overarching approach to large-scale ecosystem restoration now in the planning process (see sidebar, Bay Delta Conservation Plan and Delta Ecosystem Restoration).

- Several Habitat Conservation Plans (HCP) and Natural Community Conservation Plans (NCCP) for parts of the Delta are in place or under development in the Delta. These plans’ purpose is to minimize and mitigate the impact of authorized incidental take of the endangered or rare species and their habitats. Completed HCPs and NCCPs in the Delta include the San Joaquin HCP and East Contra Costa County HCP/NCCP. The BDCP, Yolo County HCP/NCCP, South Sacramento HCP, and Solano Multispecies HCP are under development.

- The State Water Resources Control Board (SWRCB) is updating its Bay-Delta Water Quality Control Plan (Bay-Delta Plan). The first phase focuses on objectives to protect water quality for south Delta agriculture and San Joaquin River flow objectives to protect fish and wildlife. The second phase focuses on other changes to its Bay-Delta Plan to protect fish and wildlife, including Delta outflow objectives, Sacramento River flow objectives, export/inflow objectives, Delta Cross Channel Gate closure objectives, Suisun Marsh objectives, potential new reverse flow objectives for Old and Middle rivers, potential new floodplain habitat flow objectives, potential changes to the monitoring and special studies program, other potential changes to the program of implementation, and issues identified through the BDCP process. As part of the SWRCB’s review of its Bay-Delta Plan, it will consider information developed as part of its 2010 staff technical report, Development of Flow Criteria for the Sacramento–San Joaquin Delta Ecosystem (SWRCB 2010) along with information about other factors, such as coldwater pool requirements and other water uses.

- In 2009, the Legislature established the Sacramento–San Joaquin Delta Conservancy (Delta Conservancy) as a primary State agency to implement ecosystem restoration in the Delta, along with supporting efforts that advance environmental protection and the economic well-being of Delta residents. The Delta Conservancy adopted a strategic plan to guide its planning and implementation efforts in March 2012.

- DWR’s Delta Levees Special Flood Control Projects program provides funding to local agencies in the Delta for habitat projects linked to flood management improvements. Similarly, DWR’s 2012 Central Valley Flood Protection Plan proposes new or enhanced flood bypasses, levee setbacks, and fish passage improvements that provide both flood risk reduction and habitat. This effort is discussed in more detail in Chapter 7.

Delta Flows

The Delta is the upstream portion of the San Francisco Estuary, where ecosystems dominated by the Central Valley’s rivers transition to the more ocean-influenced ecosystem of the downstream portions of the estuary. Water flow is a “master variable,” driving the ecological health of rivers and their ability to support valued environmental services (Poff et al. 1997, Postel and Richter 2003). In estuaries, the interaction of river flows and ocean tides produces a salinity gradient from fresh water to brackish and salty water. River flows and ocean tides also deposit and erode sediment to shape the estuarine landscape and its habitats. Estuarine species are adapted to the complex natural flow, salinity, and sediment dynamics in their native estuaries.

Delta flows can be divided into three categories: (1) river and floodplain flows, (2) in-Delta net channel flows, and (3) net Delta outflows (SWRCB 2010). Each category has different ecological effects. (See sidebar, Flow Is More than Just Volume.)
The parties seeking permits pursuant to the Bay Delta Conservation Plan (BDCP) are attempting to formulate a 50-year plan that, if successful, would ultimately contribute to the recovery of priority species, restoration of a more naturally functioning Delta ecosystem, and establishment of a secure and reliable water supply from the Delta for human use.

As discussed in the Chapter 3 sidebar, BDCP and Water Supply Reliability, the BDCP is a planning process intended to result in the issuance of permits from the California Department of Fish and Wildlife (DFW) under the Natural Community Conservation Planning Act and from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service pursuant to Section 10 of the federal Endangered Species Act (ESA). In addition, the Bureau of Reclamation will use the information developed from this process to obtain incidental take authorization through an ESA Section 7 process. The BDCP proposes to contribute to the restoration of the health of the Delta’s ecological systems by contributing to a more natural flow pattern than existing conditions within the Delta and by implementing a comprehensive restoration program.

As currently proposed, the BDCP takes an approach to supporting landscape-level processes by creating a reserve system consisting of a mosaic of natural communities that would be adaptable to changing conditions (including sea level rise) to sustain populations of covered species and maintain or increase native biodiversity (BDCP 2012). The proposal considers protection of at least 31,000 acres of existing natural communities, and restoration or creation of at least 72,809 acres of natural communities, including at least 65,000 acres of tidally influenced natural communities. In addition, the BDCP is intended to improve the Delta ecosystem by taking actions such as:

- Protecting and improving habitat linkages to promote the movement of native species
- Accommodating future sea level rise by providing transitional areas that allow future upslope establishment of tidal wetlands
- Allowing natural flooding to promote the regeneration of vegetation and related ecosystem processes
- Connecting rivers and their floodplains to recharge groundwater, provide fish spawning and rearing habitat, and increase food supply
- Managing the distribution and abundance of nonnative predators to reduce predation on native special-status species

Examples of elements of the BDCP strategy to support natural communities include:

- Controlling invasive nonnative plant species
- Restoring or creating 5,000 acres of riparian forest
- Restoring corridors of riparian vegetation along 20 miles of channel margin
- Restoring 2,000 acres of grassland
- Protecting at least 20,000 acres of cultivated land to support suitable habitat for native species

The BDCP also plans to propose comprehensive programs for monitoring, research, and adaptive management.

If the process is successful and DFW approves the BDCP as a natural community conservation plan pursuant to Chapter 10 (commencing with Section 2800) of Division 3 of the Fish and Game Code, and determines that the BDCP meets the requirements of this section, and the BDCP has been approved as a habitat conservation plan pursuant to the federal ESA (16 United States Code section 1531 et seq.), the Council shall incorporate the BDCP into the Delta Plan (Water Code section 85320(e)). The Council has a potential appellate role regarding the inclusion of the BDCP in the Delta Plan.

As of this publication, the final public draft of the BDCP and the related environmental impact report/environment impact statement are expected to be released in late 2013. The Council is a Responsible Agency for California Environmental Quality Act purposes.
1. River and floodplain flows. The Sacramento and San Joaquin rivers and their tributaries provide fresh water into the Delta. Along the margins of the Delta, these rivers seasonally inundate floodplains. Inundated floodplains stimulate the food web by enhancing plant growth, triggering aquatic invertebrate production, exporting food that becomes available to animals downstream, and providing spawning and rearing habitat on the floodplain for fish such as salmon and splittail. In recent decades, floodplains like the Yolo Bypass are flooded primarily by very high flows that flood the Yolo Basin about one year in three. Floodplain restoration could re-establish topographic connections that flood the bypass more often and at lower flows.

2. In-Delta net channel flows. Delta flows are primarily driven by tides affected by the moon’s cycles, river inflows, in-Delta agricultural diversions, and water exports through the Central Valley Project (CVP) and the State Water Project (SWP). Averaging these influences in any Delta channel over about 1 day gives the “net flow.” Locations near the CVP and SWP export pumps, such as parts of Old River and Middle River in the south Delta, experience net “reverse” flows when export pumping by the water projects exceeds these channels’ normal downstream flows. The average flow in these channels actually runs backward at times, which affects the Delta’s aquatic ecosystems both directly and indirectly (see Figure 4-4). Reverse flow in the southern Delta is associated with increased entrainment of some fish species (Grimaldo et al. 2009) and disruption of migration cues for migratory fish (see the Migratory Corridors for Native Species section for more detail). Reverse and otherwise altered flows caused by upstream reservoir operations, the constraints of artificially connected Delta channels, plus water exports affect Delta habitat largely through effects on water residence time, water temperature, and the transport of sediment, nutrients, organic matter, and salinity (Monsen et al. 2007). These reverse flows could, in turn, affect the behavior of migrating fish, and habitat suitability for resident and migratory fish and other species. Finally, aquatic organisms often get drawn (entrained) into water pumping facilities, as described later in this chapter.

3. Net Delta outflows. Net Delta outflow is the sum of all inflows to, and diversions from, the Delta. It is the flow out of the Delta that would occur in the absence of tides (Oltmann 1988). During dry periods, outflow is a low percentage of the instantaneous tidal flow in the western Delta. Nevertheless, over periods longer than 2 weeks, Delta outflow transports river-derived organic matter to Suisun Bay (Jassby and Cloern 2000) and controls the location of the salinity gradient (Jassby et al. 1995). Delta outflow objectives are based on the monthly average location of the low-salinity zone in the western Delta. Outflow variability is recognized as a key factor promoting diverse native fish communities (Moyle and Mount 2007, Moyle et al. 2010).

FLOW IS MORE THAN JUST VOLUME

Flow is not simply the volume of water, but also the direction of flow, the timing of flow, the frequency of specific flow conditions, the duration of various flows, and the rate of change in flows.

Bunn and Arthington (2002) present four key principles underlying the links between hydrology and aquatic biodiversity and the impacts of altered flow regimes: (1) flow determines physical habitat, (2) aquatic species have evolved life history strategies based on natural flow regimes, (3) upstream-downstream and lateral connectivity are essential to organism viability, and (4) invasion and success of nonnative species is facilitated by flow alterations. Altered flow regimes have been shown to be a major source of degradation to aquatic ecosystems worldwide (Petts 2009).
Flow Direction in South Delta

Present-day Delta flows are very different from historical, natural flows. Water flows have been altered by water supply and flood control infrastructure, including dams on the Sacramento and San Joaquin rivers and their tributaries; levees along these rivers and the Delta’s channels; and draining of floodplains, wetlands, and groundwater basins (see Figure 4-5). Flows sometimes have not reflected the Fish and Game Code section 5937 requirement that dam owners should allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, to pass over, around, or through the dam, to keep in good condition any fish that may have been planted or that exist below the dam (DFG 2012). Flows are now closely managed by releases from reservoirs to supply water for agricultural and urban uses, control salinity, and reduce floods. In the Delta, flows have also been rerouted through artificial channels. Flow management and modified Delta channel geometry have altered the salinity and sediment regimes in the Delta (Enright and Culberson 2010, Wright and Schoellhamer 2004), managing salinity for human uses rather than for fish and wildlife. Low winter-spring flows disrupt turbidity and salinity cues for migrating fish (Grimaldo et al. 2009), reduce access to spawning and rearing habits in tributaries and floodplains (Sommer et al. 1997, Feyrer 2004, Feyrer et al. 2007), and limit success for young fish trying to follow natural migration patterns (Feyrer and Healy 2003). Current flow management regulations provide some protection for ecological functions and native species, but the current Delta flow regime is generally harmful to many native aquatic species while encouraging nonnative aquatic species (SWRCB 2010).
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Effects of Dams and Diversions on Delta Inflows and Outflows

**UNIMPAIRED by Dams and Diversions**

- Sacramento River: 21.1 MAF
- East Side Tributaries: 1.0 MAF
- In-Delta Use: 0.9 MAF
- San Joaquin River: 8.5 MAF
- Outflow to Bay: 30.6 MAF

**ALTERED by Dams and Diversions**

- Sacramento River: 16.1 MAF
- East Side Tributaries: 0.8 MAF
- Yolo Bypass: 1.8 MAF
- In-Delta Use: 0.9 MAF
- San Joaquin River: 3.1 MAF
- Outflow to Bay: 15.8 MAF
- Exports: 5.1 MAF

Data presented as a long-term average. Information based on DWR CALSIM II modeling, which includes projected conditions to protect fisheries. Delta-Suisun in-Delta use includes water to the Contra Costa Canal and to the Mokelumne and Hetch Hetchy aqueducts.

MAF = millions of acre-feet

**Figure 4-5**

Water flows more closely approximating the timing, frequency, duration, volume, and rate of change of flow produced naturally by a region’s climate are best for native aquatic communities (Poff et al. 1997, Bunn and Arthington 2002, Carlisle et al. 2010). Flow is a major environmental input that shapes ecological processes, habitat, and biotic composition in riverine and estuarine ecosystems such as the Delta. Returning to a more naturally variable hydrograph is a key component of ecosystem restoration because the hydrograph works hand-in-hand with habitat restoration to produce diverse and interconnected food webs, refuge options, spawning habitat, and regional food supplies (Carlisle et al. 2010). Flows should provide species benefits and water supply reliability in the context of current hydrological conditions and degraded habitat. In some cases, flows to benefit the ecosystem will deviate from historical...
“natural” flows, because the channel geometry, land-water connectivity, and infrastructure limits our ability to mimic historical conditions. Flows will also need to be modified as habitat areas are restored. The Delta Plan, therefore, calls for “more natural functional flows” in the Delta as an important aspect of ecosystem restoration. (See sidebar, More Natural Functional Flow, for a description.)

Flow-related stressors can be reduced or mitigated through improved flow management and concurrent reduction of other stressors. Improved flow management comes from better use of current or improved water infrastructure. The challenge in managing flows is to both restore the Delta ecosystem and improve water supply reliability. Flow-related stressors are likely to increase as population grows and the climate changes. Preparation for these changes must start now.

The State Water Resource Control Board’s (SWRCB’s) Bay-Delta Water Quality Control Plan (Bay-Delta Plan) identifies water quality objectives to protect beneficial uses of the Bay and Delta, and an implementation program including control of salinity (caused by saltwater intrusion, municipal discharges, and agricultural drainage) through water projects operations. This is a contentious issue of public policy, and the Delta Reform Act directed the SWRCB to develop its new flow criteria using the best available science (Water Code section 85086).

The SWRCB is updating the 2006 Bay-Delta Plan with these steps: (1) review and update water quality objectives, including flow objectives, and the program of implementation in the 2006 Bay-Delta Plan, and (2) make any needed changes to water rights and water quality regulation consistent with the program of implementation. Updating the water quality objectives for the Delta, including an update of flow objectives, is important to protect the Delta ecosystem and the reliability of the Delta’s water supplies. The sooner these objectives are set, the earlier the ecosystem can be protected and restored, the greater the possibility that a successful Bay Delta Conservation Plan (BDCP) will be approved, the earlier a more reliable water supply can be improved, and, therefore, the earlier the coequal goals can be achieved. That is why the Delta Plan calls upon the SWRCB to complete its work by specified deadlines. A more detailed explanation of the SWRCB’s development of water quality objectives, including flow objectives, is included in Chapter 6.

**Entrainment Is One Effect of Altered Flows**

Entrainment occurs when fish and other aquatic life are drawn into a water diversion intake and are unable to escape. In the Delta, entrainment occurs primarily at the CVP facilities (Tracy Fish Facility and the nearby Delta-Mendota Canal) and the SWP facilities (including Clifton Court Forebay and the Skinner Fish Facility), as well as other smaller Delta intakes.

Much of the time, net channel flows in most of the south Delta are toward the pumps. This increases the probability that small, weak-swimming young smelt or salmon will be entrained. Depending on the type and size of the fish, the closer a fish is to the pumps, the more likely it is to be entrained. Greater reverse flows caused by pumping in the south Delta increase the numbers of fish entrained.

Some of the entrained fish are “salvaged,” meaning they are caught in facilities at the pumps and then trucked and released to an area beyond the pumps’ influence. The salvage process decreases the mortality of entrained fish (including salmon). Unfortunately, however, many fish, including delta smelt, are not able to survive the collection, handling, transport, and release.
Alteration of water flows also leads to losses of fish from predation. High rates of predation occur at the pumps, and the sloughs and channels near the pumps. Small fish drawn into this part of the Delta have a very low chance of survival. Juvenile salmon drawn into the central Delta through the Delta Cross Channel or Georgiana Slough also have a lower chance of survival than fish staying in the Sacramento River’s mainstem. Whether the effects of flow on fish are direct through entrainment or indirect through increased mortality caused by altered flows and predation, the results are the same: fish lost as a result of Delta diversions.

Because of all these factors, managing flows within the Delta is a difficult but important tool for protecting fish. For example, the SWRCB requires reductions in diversions and increases in San Joaquin River inflows during springtime to increase the survival of outmigrating juvenile salmon. The biological opinions for salmon and smelt include measures to reduce entrainment and indirect loss of fish due to altered flows caused by the SWP and CVP diversions. These actions include restrictions on reverse flows in the Old River and Middle River channels in the south Delta and requirements for closing the Delta Cross Channel gates.

Entrainment does not just occur at the Delta pumps. It also can occur at other diversions upstream from the Delta. Larger diversions upstream and in the Delta are screened, but many smaller diversions are not. In-Delta unscreened diversions do not currently appear to entrain substantial numbers of salmon or smelt.
Habitat

Appropriate habitat is required for any organism to survive and reproduce (Hall et al. 1997). Because no two species have exactly the same requirements, habitats are species-specific components of ecosystems.

Expanding habitats for native species is an essential part of restoring the Delta’s ecosystem. Recent biological opinions controlling long-term operations of the CVP and SWP require restoration of at least 8,000 acres of intertidal and associated subtidal habitats in the Delta, including Suisun Marsh (USFWS 2008). They also require restoration of 17,000 to 20,000 acres of floodplain rearing habitat for salmon in the Yolo Bypass and lower Sacramento River, including side channels and re-created floodplain terrace areas (NMFS 2009). Some of the tidal marsh acreage may also fulfill requirements for restored floodplains, depending on its location.

Habitat restoration, like water flow, is not just about quantity (or extent), but also about quality, connectivity, and diversity. Land cover types, such as open-water and riparian vegetation, vary greatly and are only one element of habitat (Lindenmayer et al. 2008); an organism’s habitat is much more than just land cover. For example, the area of the Delta covered by open water has not changed substantially during the last few decades, but several open-water fish have declined steeply (Sommer et al. 2007, Baxter et al. 2010). This suggests that some of the Delta’s open waters have become inhospitable to these certain fish species. The functional habitat available to these open-water fish has shrunk even though the area covered by open water has remained fairly stable. This means that simply changing land cover (for example, increasing riparian habitat) does not automatically increase target species. Other stressors such as poor water quality, predation, or entrainment may make these areas unsuitable.

Habitat loss and fragmentation resulting from human land use causes species loss worldwide (Foley et al. 2005). In estuaries and coastal areas, habitat destruction, coupled with exploitation such as overfishing, are the leading causes of species declines and extinctions (Lotze et al. 2006). Habitat restoration can help recover native species, particularly when other stressors such as altered flows, degraded water quality, or predation by introduced species are also reduced (Carlisle et al. 2010, Lotze et al. 2006).

Taking a large view of an ecosystem, habitats are species-specific “patches” in spatially varied landscapes. The survival and success of organisms is closely associated with the total amount of usable habitat, as well as with habitat patch sizes, shapes, and arrangements (Hannon and Schmiegelow 2002). Habitats that are too small, fragmented, or isolated may not provide long-term support for specific organisms. In general, more, larger, and better-connected patches of a specific habitat create the conditions for persistence or recovery of the species associated with that habitat (Lindenmayer et al. 2008). (See sidebar, Landscape Ecology: A Fundamental Tool for Restoration Planning.)

Much of the original habitat for the Delta’s native fish, wildlife, and plants has been urbanized or converted to agriculture over the past 160 years (Healey et al. 2008, Moyle et al. 2010, Baxter et al. 2010). This habitat loss is one of the largest legacy stressors to the Delta ecosystem. The current Delta ecosystem continues to be productive, but its habitat types and conditions support a much different mix of species than the historical Delta. Many of the thriving species are nonnative, such as largemouth bass and the Brazilian water weed Egeria densa. Some consider a few nonnative species, such as bass prized by anglers, to be desirable. But too many nonnative plants and animals can upset an ecosystem’s balance, creating conditions unsuitable for native aquatic and terrestrial species (Sommer et al. 2007, Healey et al. 2008, Baxter et al. 2010). This conflict and the inadequate habitat for native species that reside in and migrate through the Delta is an important current ecosystem stressor that must be addressed.
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LANDSCAPE ECOLOGY: A FUNDAMENTAL TOOL FOR RESTORATION PLANNING

Landscape ecology examines the influence of spatial patterns on ecological processes (Wiens 2002) and considers the ways that species use the landscape for finding food and refuge, and for adapting to change (Simenstad et al. 2000, Lindenmayer et al. 2008). The mosaic of landscape features—or “patches”—and the connections between patches affect species’ locations, food and cover, the energy required to obtain those resources, and, ultimately, survival. The landscape perspective considers connections and exchanges between uplands; riversides and wetland edges; and the sloughs, channels, and bays that make up estuarine aquatic habitats. The food webs of these adjacent systems exchange organisms and energy that, in turn, can increase the productivity of each (Cloern 2007). Native estuarine species—terrestrial, semiaquatic, and aquatic—are adapted to the rhythms of the landscape’s mosaic of connected habitats and its dynamic processes.

From a landscape perspective, “form begets function.” Therefore, correct spatial structure and patterns are prerequisites for restoring and maintaining desired ecosystem processes and functions, and for providing appropriate habitat for native species. In the long term, restoring spatial patterns at ecologically appropriate scales can promote the “self-repair” of ecosystem processes and functions (Teal et al. 2009) and increase resilience to stressors. Consequently, this approach could reduce the operating and maintenance costs of restoration in an era of limited resources. Planning for ecosystem restoration should always consider appropriately large spatial scales (regional or larger), but restoration actions can proceed at smaller scales to optimize the benefits that can be achieved with the often limited opportunities and resources available for restoration (Hermoso et al. 2012).

Additionally, landscape ecology considers people’s role in shaping landscape patterns and processes (Turner 1989). Restored landscapes often have agricultural and urban neighbors. Each land use affects the other because they are connected by air, land, and water. Yet humans often want conflicting things (nature areas nearby with abundant wildlife, but also with convenient recreation facilities, no mosquitoes, and no impacts on adjoining farms). A functioning ecosystem depends on many things, including understanding and dealing with its relationship to human activities. The current regulatory and political framework for restoration projects often puts short-term benefits, such as low acquisition cost or immediacy of land availability, before long-term benefits of connectivity and appropriateness of scale. Landscape ecology provides a set of tools for assessing and prioritizing limited restoration opportunities. For example, using the principles of landscape ecology, decisions about land acquisitions for restoration must address how small parcels that become available for restoration might be connected and combined to maximize ecological benefits over the long term.

The Importance of Land Elevation in Habitat Restoration

Opportunities for habitat restoration in the Delta are constrained first and foremost by the elevation of land, which determines the potential of an area to be restored. As described in Chapter 5, much of the Delta has subsided too deeply to restore its original ecological functions (see Figure 4-6).

Deeply subsided Delta lands can provide terrestrial and wetland habitat for native species only at great cost and with intensive management. They offer few opportunities to recover native ecosystem forms and functions. However, deeply subsided islands could include seasonal wetlands for waterfowl and wildlife-friendly agriculture. Actions that promote carbon sequestration, subsidence reversal, and improved migratory bird habitat are especially valuable.

The most promising restoration opportunities are found in the less-subsided flood basins, river corridors, and brackish tidal marshes on the Delta’s perimeter, leading the Council to recommended six priority habitat restoration areas:

- **Yolo Bypass, from the Fremont Weir south toward the Delta.** Winter and spring flooding of the Yolo Bypass provides substantial benefits for spawning and rearing of Sacramento splittail and rearing of salmon (Sommer et al. 2001, Moyle et al. 2007). Projects in the planning stage include fish passage improvements and various approaches, such as notching the Fremont Weir to increase the frequency and duration of inundation during times of the year critical for spawning and rearing of native fish. Restoration of the Yolo Bypass can create conditions that promote enhanced growth and survival of juvenile spring- and winter-run salmon, among other species, and can benefit other migrating salmon.
Habitat Types Based on Elevation, Shown with Developed Areas in the Delta and Suisun Marsh

Figure 4-6

Source: Adapted from DFG 2011
CHAPTER 4 PROTECT, RESTORE, AND ENHANCE THE DELTA ECOSYSTEM

- **Cache Slough Complex, southwest of the Yolo Bypass.** The flood basins entering the Cache Slough Complex are at the interface between river and tidally influenced portions of the Delta. A restoration project in this area is Liberty Island, which is being allowed to passively restore to marsh after floods breached the island’s levees in 1997. Projects in the planning stage include California Department of Water Resource’s (DWR’s) Prospect Island restoration project. Habitat restoration at Cache Slough can create conditions that help recover delta smelt and that benefit migrating salmon. See the sidebar, Applying Adaptive Management to Ecosystem Restoration, for a hypothetical example implementing principles of adaptive management in projects such as these.

- **Cosumnes River–Mokelumne River confluence.** An existing restoration project is the Cosumnes River Preserve floodplain. Projects in the planning stage include DWR’s North Delta Flood Control and Ecosystem Restoration Project on McCormack-Williamson Tract. Restoration here can benefit migrating salmon and contribute to the Delta’s food webs.

- **Lower San Joaquin River floodplain between Stockton and Manteca.** Historically, the south Delta and its connection to the lower San Joaquin River contained a complex network of channels with low natural berms, large woody debris, willows, and other shrubs with upland areas supporting open oak woodlands. Projects in the planning stage include the Lower San Joaquin Flood Bypass proposed by the South Delta Levee Protection and Channel Maintenance Authority and its partners. Restoration to a mix of tidal marsh, riparian habitats, and wildlife-friendly agriculture could create conditions to recover riparian brush rabbits and Swainson’s hawks, benefit migrating salmon, and serve to reduce the risks from flooding for urban areas.

- **Suisun Marsh.** This is the largest wetland area on the West Coast of the contiguous United States. Suisun Marsh is mostly managed for waterfowl, with levees that disconnect its wetlands from the estuary. An ongoing restoration project is DWR’s Blacklock Restoration Project. Projects in the planning stage include California Department of Fish and Wildlife’s (DFW’s) Hill Slough Restoration Project. Restoration of tidal marsh and associated habitats here can create conditions that contribute to food webs in Suisun and Honker bays, and aid the recovery of longfin smelt and spring- and winter-run salmon.

  Unique local benefited species would also include Suisun song sparrows, saltmarsh harvest mice, and plants such as soft bird’s-beak and Suisun thistle. Enhanced management of wetlands can reduce impacts on water quality while still maintaining or improving habitat for waterfowl of other wildlife.

- **Western Delta/Eastern Contra Costa County.** Some islands and tracts at appropriate elevations may be desirable sites for restoration of tidal marsh and channel margins to support food webs and provide habitat for native species. Decker Island is a recent restoration project in this area, and restoration at Dutch Slough is planned. Additional restoration of other islands or tracts may be considered in the BDCP or in local Natural Community Conservation Plans/Habitat Conservation Plans.

These six regions have been highly altered by more than a century of human use and exposure to multiple stressors. Returning a portion of these altered regions to habitat for native species requires a careful assessment of opportunities and challenges. Recommendations provided later in this chapter include actions to prevent or mitigate adverse impacts on opportunities for habitat restoration in these priority restoration areas.
### Applying Adaptive Management To Ecosystem Restoration

An adaptive management approach to ecosystem restoration should be used to plan for and assess the ecological outcomes of the restoration action. The following is a hypothetical example of how the Council’s three-phase and nine-step adaptive management framework (see Appendix C) could be applied to an ecosystem restoration project in the Cache Slough Complex.

<table>
<thead>
<tr>
<th>Adaptive Management Step</th>
<th>Hypothetical Cache Slough Ecosystem Restoration Project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plan</strong></td>
<td></td>
</tr>
<tr>
<td>1 Define/redefine the problem</td>
<td>The Cache Slough Complex includes high biodiversity; however, ecological processes and habitat that benefit native species in the Cache Slough Complex are degraded.</td>
</tr>
</tbody>
</table>
| 2 Establish goals, objectives, and performance measures | Goal: Re-establish natural ecological processes and habitats to benefit native species in the Cache Slough Complex.  
Objective: Re-establish the hydrologic, geomorphic, and ecological processes necessary for the long-term sustainability of native habitats, and the plant and animal communities that depend upon them. Improve floodplain connectivity and aquatic habitat quality for native estuarine species, including delta smelt, longfin smelt, Sacramento splittail, and Chinook salmon, by offering a suite of natural habitats and improving the food web fish require. |
| 3 Model linkages between objectives and proposed action(s) | The Cache Slough Complex provides high potential for restoration success because of its physical and biological attributes (such as tidal range, elevation, high amounts of suspended sediment, abundant zooplankton, and observed use by delta smelt). It is hypothesized that improved vernal pool and grassland habitats along with broad nontidal, freshwater, emergent-plant-dominated wetlands that grade into tidal freshwater wetland, shallow subtidal, and deep open-water habitat will increase the amount and quality of food for native species in the estuary. It is hypothesized that restoring tidal channel, wetland, and upland networks will improve conditions for native fishes. It is hypothesized that increases in the quality and quantity of food for native species will lead to increases in native species populations in the estuary. Native species expected to benefit from this restoration include delta smelt, juvenile Chinook salmon, Sacramento splittail, and longfin smelt. |
| 4 Select action(s) (research, pilot, or full-scale) and develop performance measures | Pilot-scale restoration project in the Cache Slough Complex: restore a subset of the processes supporting the creation of tidal channel, wetland, and upland networks to support native fishes.  
**Performance measures:**  
- Administrative – Properties are identified for the pilot study. Funding sources and budgets for the project and monitoring are in place. Properties are acquired. Restoration planning and design is completed. Environmental compliance permits are obtained. Restoration contractors are selected.  
- Output – Pilot-scale Delta habitat restoration project is implemented. Progress toward restoring diverse and interconnected habitats for native resident and migratory species in the Cache Slough Complex.  
- Outcome – Progress toward achieving viable populations of native resident and migratory species. Trends in native Delta species are upward over the next decade. |
| **Do**                  |                                                        |
| 5 Design and implement action(s) | Design and implement the pilot-study restoration project. |
| 6 Design and implement monitoring plan | Design and implement the monitoring plan, including baseline monitoring of food abundance for pelagic organisms. Monitor the extent and quality of targeted habitats, connectivity of habitats, and abundance and diversity of species. |
| **Evaluate and Respond**|                                                        |
| 7 Analyze, synthesize, and evaluate | Analyze, synthesize, and evaluate the status and trends of changes in habitats, connectivity of habitats, abundance, and species health and diversity. |
| 8 Communicate current understanding | Provide project manager(s) and decision makers with annual reports of synthesized information learned. For example, provide a score card of the status and trends of species abundance and diversity, habitat connectivity, and so on. |
| 9 Adapt | The managers and implementers of the restoration project reconsider their understanding of the problem statement and conceptual model, and decide whether or not to expand from a pilot-study project to a larger-scale restoration effort. |
Habitat restoration often targets resident species that use the restored habitat year-round. Successful restoration, however, must also consider species that only periodically use particular habitat patches and corridors. The historical Delta provided migration corridors and rearing habitat for many migratory bird and fish species, including the threatened greater sandhill crane, many species of ducks and geese, salmon, sturgeon, and the introduced striped bass.

In the past, the Delta was a migration route and also an important nursery area for young salmon (or “smolts”). Much of the Delta today presents real risks to migrating salmon; it is no longer a suitable nursery for salmon smolts (Williams 2006). Some Delta channels do provide a greater chance of fish survival than others. For example, salmon leaving the Sacramento River and entering the interior Delta through the Delta Cross Channel have significantly lower survival than fish that stay in the river (Newman 2008), demonstrating that the central Delta has become a gauntlet of risk instead of a viable migratory corridor.

Entrainment at the CVP and SWP southern Delta pumps and increased predation kill salmon smolts. Toxic contaminants and periods of low dissolved oxygen can be harmful. Important factors for route selection and survival of salmon smolts on their way to the ocean include differences in flows through different channels, feeding opportunities, growth rates, and vulnerability to predation (Perry et al. 2009).

On their way back from the ocean to spawn, adult salmon must navigate a maze of Delta waterways where water from many different sources is mixed in artificially connected channels, and where rivers sometimes flow backward (reverse net flows in Old and Middle rivers; see the Delta Flows section) (Monsen et al. 2007). A unique problem is presented by the San Joaquin River, whose polluted and reduced flows are often drawn to the SWP and CVP pumps as a result of reverse flows. During these times, almost no water from the San Joaquin River reaches the confluence with the Sacramento River. Instead, water from the Sacramento River and its tributaries fills most of the Delta, obscuring and confusing the chemical and flow cues that salmon and other migratory fish depend on to find their destinations.

In addition to altered water flow and chemical disruption, migratory fish encounter dams, reservoirs, and other physical barriers that hinder their historical migration. The most formidable barriers are upstream on the Sacramento and San Joaquin rivers and their tributaries, especially the many large and small dams associated with reservoirs, including Shasta, Folsom, and Millerton lakes and Lake Oroville. In the Central Valley, less than one-fifth of the historical spawning habitat is still accessible to Chinook salmon and steelhead (Reynolds et al. 1993, Yoshiyama et al. 1996).

Physical barriers in the Delta help maintain water supplies for agriculture but interrupt fish migration; structures with ledges and drops, such as bridge pilings, boat docks, narrow channels with riprapped edges, or the intakes of the SWP and CVP pumps, create attractive spots for predatory fish to feed on migrating species. The Delta Cross Channel is an example. Sometimes, a barrier can have positive effects. Federal, State, and local officials have recently tested novel bio-acoustic fish fences (BAFFs) at Old River and Georgiana Slough that use light, sound, and air bubbles to steer migrating fish into channels that are thought to provide better habitat and a greater chance of survival.

Some high-quality migratory fish rearing and migration habitat remains at the margins of the Delta, if not in its core. The Yolo Bypass and Cosumnes River floodplains provide good migratory and rearing habitat for salmon, and important habitat for other native fish, birds, and bats. DFW manages the Vic Fazio Yolo Wildlife Area, a 16,000-acre public-private restoration project in the Yolo Bypass, to promote waterfowl and other bird populations. The 46,000-acre Cosumnes River Preserve is jointly owned and operated by The Nature Conservancy, Ducks Unlimited, the Bureau of Land...
Management, DFW, DWR, Sacramento County, and private owners to create, enhance, and protect a variety of habitats. These are good illustrations of ecosystem and flood risk reduction projects working together. Wildlife-friendly agriculture also occurs in these floodplain preserve areas and their surroundings. During winter and early spring floods, these floodplains provide plentiful food for migrating salmon and native fish such as splittail, prickly sculpin, and Sacramento sucker (Sommer et al. 2001, Crain et al. 2004). Salmon migrating through these floodplains grow faster and have greater survival. (See sidebar, Better Habitat Equals Greater Growth.) Native fish do particularly well when flows through these floodplains follow more natural patterns. Early February through April, strong flood flows with cool water temperatures benefit many young native fish. Nonnative fish benefit more from later and lower flows with higher temperatures. Floodplain restoration should thus focus on early flooding followed by careful draining. This provides important migration and nursery habitat for native species while keeping nonnative species, including predators, at bay.

Actions above and below the Delta also complement actions in the Delta to restore migratory corridors for fish and wildlife. The Bureau of Reclamation, U.S. Fish and Wildlife Service, and DFW have modified Shasta Dam to release colder water for salmon and trout, removed barriers to fish migration such as the Red Bluff Diversion Dam, screened water diversions to reduce entrainment, restored riparian habitats at the Sacramento River National Wildlife Refuge (NWR) and San Joaquin River NWR, and improved habitats in Sacramento and San Joaquin river tributaries where salmon spawn. Efforts to restore flows in the San Joaquin River also can rebuild these migratory corridors.

For example, on Battle Creek, actions to remove multiple dams and fish ladders are being implemented through the Battle Creek Salmon and Steelhead Restoration Project. The primary objective of the restoration project is to restore the ecological processes that would allow the recovery of steelhead and Chinook salmon populations in Battle Creek while minimizing the loss of clean and renewable hydroelectric power through modifications to the hydroelectric project. This project is among the largest coldwater anadromous fish restoration efforts in North America and will restore approximately 42 miles of habitat in Battle Creek and an additional 6 miles of habitat in its tributaries. It will also help restore critically imperiled winter- and spring-run Chinook salmon and Central Valley steelhead. Additional restoration actions are planned for other Sacramento River tributaries including Clear Creek, Deer Creek, and Mill Creek.

On the mainstem of the San Joaquin River between Friant Dam and its confluence with the Merced River, the San Joaquin Settlement Agreement will increase flows, expand channel capacity, and remove barriers to migration to restore spring-run Chinook salmon runs. This long-term action is expected to occur in stages over 20 years. On the Tuolumne River, the largest tributary of the San Joaquin River, the Central Valley Project Improvement Act (CVPIA)
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Restoration Plan actions focus on restoring spawning, rearing, and floodplain habitat. The Bobcat Flat Restoration Project includes excavation of 48,500 cubic yards of gravel and coarse material that will be used to restore 1.6 miles of fall-run Chinook salmon and Central Valley steelhead spawning and rearing habitat. Similar habitat restoration projects have been implemented or are planned on other tributaries of the San Joaquin River and the Delta, including the Merced, Stanislaus, Calaveras, and Mokelumne rivers.

However, 16 years after the creation of the CVPIA restoration fund, a panel of independent scientists issued a report on the CVPIA Fisheries Program (Reclamation and USFWS 2008) concluding that more could be done to effectively address the most serious impediments to survival and recovery of salmonids.

Wetlands bordering San Pablo Bay downstream of the Delta are home to a host of native and nonnative fish, waterfowl, shorebirds, other wildlife, and endangered plants and important stopping points on the Pacific Flyway. Uncommon species found in and around San Pablo Bay wetlands include longfin smelt, delta smelt, salt marsh harvest mouse, California clapper rail, San Pablo song sparrow, and black rail. All Central Valley anadromous fish migrate through the bay and depend on its open water and marshes for some critical part of their life cycle. The bay and its adjacent marshes are also important nursery grounds for many marine, estuarine, and anadromous fish. More than 40,000 acres of diked baylands and wetlands bordering the San Pablo Bay have been protected and are being restored.

In the Sacramento and San Joaquin valleys, actions to protect, restore, and enhance wetlands carried out by the Central Valley Joint Venture have significantly increased wildlife habitat resources for migratory waterfowl, shorebirds, waterbirds, and riparian songbirds in accordance with conservation actions identified in the Joint Venture’s Implementation Plan. The Joint Venture establishes population objectives for these migratory birds then determines the appropriate amount of food, habitat, and water supply necessary to meet the objectives. Wetland restoration becomes a priority when habitat and forage needs for population objectives are not being met.

Successful recovery of native species requires effective habitat restoration. In addition to restoring physical habitat and corridors for movement, reducing other stressors is important too. Together, they help in achieving the coequal goal of a healthier Delta ecosystem.

**Riparian and Shaded Riverine Aquatic Habitat**

Fish and birds migrating through the Delta need abundant floodplains and appropriate water flows; but they also need streamside trees and shrubs that shade and cool the rivers; undercut riverbanks where smolts and other small fish rest and hide; and trees that drop insects and leaves that contribute to the food web and provide cover, food, and nest sites for songbirds and other wildlife. Unfortunately, along most of the Sacramento and San Joaquin rivers, levees are near the water’s edge, not set back from rivers, leaving little room for these habitat features, which often are provided only by trees growing immediately adjacent to or even on the levees themselves.

Because of the importance of these streamsides, water supply or flood risk policies and projects that affect the Delta’s rivers and other channels should consider the impact on remaining riparian and shaded riverine habitat. Setting back levees can create additional area for habitat and increased capacity for flood flows. Setting back levees, however, can be expensive and difficult. At the same time, there is considerable controversy over the current policy of the U.S. Army Corps of Engineers (USACE) to require removal of trees and most shrubs from levees under their jurisdiction. A technical manual issued by the Federal Emergency Management Agency (FEMA) for earthen dams has been relied upon heavily to support this vegetation removal policy (FEMA 2005). There is little riverine habitat left. If implemented as proposed, the USACE’s order would destroy much of what remains. The Delta Plan calls for the
USACE to reconsider and change its policy in order to protect riverine habitat.

**Safe Harbor Agreements**

Voluntary safe harbor agreements between wildlife agencies and landowners can contribute to the recovery of species protected by the State or federal Endangered Species Acts. These agreements assure the landowners that the presence of endangered species on their property will not result in restrictions on other activities undertaken on their land. Facilitating and creating standard rules for these agreements with Delta landowners may encourage more landowners to participate in conservation programs.

**Suisun Marsh and the Bay Conservation and Development Commission**

The Suisun Marsh is one of the Delta Plan’s priority habitat restoration areas. It is one of the largest contiguous estuarine wetlands in North America; an important nursery for fish; a wintering and nesting area for waterfowl and waterbirds; and an essential habitat for plants, fish, and wildlife, including several scarce and sensitive species. Suisun Marsh offers unique restoration opportunities because of its position in the Delta ecosystem and the diversity of physical processes it hosts. Suisun Marsh harbors a greater percentage of native fish than the remainder of the Delta, in part because its brackish water limits nonnative species. Additionally, the marsh has many diverse tidal sloughs that provide options for food and refuge (Moyle et al., 2010).

Unlike the deeply subsided Delta, much of the Suisun Marsh is still at elevations suitable for restoration of intertidal habitat, including tidal marsh and shallow water habitat. This area provides the brackish portion of the estuary with the potential to support productive and complex food webs, and with space to adapt to sea level rise. State and local land use policies should reflect the unique role that Suisun Marsh can play.

The San Francisco Bay Conservation and Development Commission (BCDC) is responsible for protecting San Francisco Bay and its shoreline, including Suisun Marsh, through the San Francisco Bay Plan, as described in Chapter 5. It is developing regional strategies to address the impacts of sea level rise and climate change on the Bay. BCDC provides special protection of the Suisun Marsh under the Suisun Marsh Preservation Act through the Suisun Marsh Protection Plan (SMPP). BCDC recently amended the San Francisco Bay Plan to address climate change and sea level rise. The climate change policy, among other things, incorporates sea level rise projection ranges consistent with those developed by the California Ocean Protection Council (2011) and calls for development of a long-term regional strategy to address sea level rise and storm activity. The SMPP and the Suisun Marsh Local Protection Program should also be amended to address climate change and rising sea level.

**Ecosystem Water Quality**

Chapter 6 deals with water quality issues and contains many recommendations for action. Impaired water quality makes it much harder to restore a healthy Delta ecosystem. Recommendations in Chapter 6 regarding salinity and environmental water quality cover key linkages between ecosystem restoration and water quality.

Consistently good water quality is crucial for successful restoration of aquatic habitats, sustenance of native plants and animals, and other beneficial uses of Delta water. Salinity should be more consistent, with a naturally variable estuarine hydrograph with high-quality river inflows. Nutrient composition and concentrations should not cause excessive growth of nuisance aquatic plants or blooms of harmful algae, and should support diverse and productive aquatic food webs. Dissolved oxygen levels, water temperatures, turbidity, and other attributes should meet the needs of native species. At all times the Delta should be free of substances that exceed toxic concentrations. Discharge of treated wastewater, urban
runoff, or agricultural return flows should not adversely affect the Delta.

Chapter 6 focuses on four key areas where the best available science shows the need to protect and improve water quality to achieve the coequal goals (see Chapter 6 for a complete discussion):

- Requiring Delta-specific water quality protection
- Protecting beneficial uses by managing salinity
- Improving drinking water quality
- Improving environmental water quality

**Nonnative Species**

Among the world’s estuaries, the Delta and San Francisco Bay are among the most invaded by nonnative species (Cohen and Carlton 1998). Some nonnative species have been in the Delta for more than a century and seem to be a permanent feature of the Delta ecosystem. Because it is nearly impossible to eradicate nonnative species once they are established, many can be considered legacy stressors that can be managed but not eliminated.

However, the introduction of any new nonnative species has consequences, particularly for native species. Nonnatives can take over habitat space, compete for food and nutrients, alter food webs, modify the physical habitat structure, or prey upon native species (DFG 2011). In wetlands and riparian areas, nonnative vegetation often crowds out native plants and reduces diversity used by resident and migrating birds and other animals (PRBO CalPIF 2008). The result is that nonnative plants, invertebrates, and fish may replace native species, and that change on their native counterparts is often combined with the other stressors such as altered flow, impaired habitat, and poor water quality.

Significant nonnative species in the Delta include (DFG 2008):

- **Overbite clam.** The overbite clam, a bottom-dwelling filter feeder, entered the Delta in the late 1980s and adapted well to its brackish areas. Overbite clams contribute to the reduction of algae and some invertebrates in the Delta, especially in Suisun Bay (Kimmerer 2006), causing loss at the base of the food web, which contributes to the decline of delta smelt and other open-water fish (Sommer et al. 2007).

- **Asian clam.** The Asian clam was first found in the Delta in 1946 (USGS 2001). This clam does not tolerate saline water, but is abundant in freshwater parts of the Delta and in the mainstems of the Sacramento and San Joaquin rivers. Ecologically, this species can alter channel bottoms and competes with native freshwater mussels for food and space (Claudi and Leach 2000). Overbite and Asian clams cannot be effectively controlled, according to many experts (Healey et al. 2008), but they may be managed by manipulating environmental conditions such as flow or salinity to seasonally control their distribution.

- **Zooplankton.** Surveys of Delta waters reveal that introduced zooplankton, probably discharged in ocean ship ballast water in the San Francisco Bay and Delta, have almost completely replaced the original native zooplankton (Winder and Jassby 2011). The success of nonnative zooplankton species was accompanied by an overall decline in zooplankton biomass and size that suggests a decrease in their nutritional value for fish (Winder and Jassby 2011).

- **Nonnative invasive aquatic plants.** The floating water hyacinth, imported as a landscaping plant, proliferated in the Delta in the early 1980s. The Brazilian waterweed was introduced in the 1960s, probably from home aquariums, but did not reach nuisance levels until after the 1987-1992 drought (Jassby and Cloern 2000). These and other nonnative aquatic weeds in the Delta, including water pennywort, Eurasian water milfoil, and parrot feather, pose serious problems to native plants and animals, and hinder boating. The weeds flourish in a wide area where they act as powerful “ecosystem engineers” (Jones et al. 1994, Breitburg et al. 2010) through alteration of habitats, sometimes creating dense mats or thickets that displace native plants, reduce the food web...
productivity, reduce turbidity, and interfere with water conveyance and flood control facilities. These invasive plants benefit nonnative predatory fish like largemouth bass. Areas of dense, submerged aquatic vegetation (SAV) may reduce the abundance of native fish larvae and adults (Grimaldo et al. 2004, Nobriga et al. 2005, Brown and Michniuk 2007). Restoration of aquatic habitats must be designed and managed to reduce nonnative SAV if conservation goals are to be met (Nobriga and Feyrer 2007).

**Bass and sunfish.** Several species of nonnative fish have been introduced in the Delta. Largemouth and smallmouth bass, sunfish including bluegills and warmouth, crappies, and other fish in the centrarchid family are the best examples. They prey on salmon smolts, smelt, and other native fish. The increase in SAV, especially in and around “flooded islands” in the central Delta, enhances bass and bluegill populations (Brown and Michniuk 2007) and possibly populations of other nonnative predators (Grimaldo et al. 2009). Centrarchids harm native fish through predation and competition (Nobriga and Feyrer 2007, Brown and Michniuk 2007). The distribution of centrarchids may be modified by managing conditions such as water velocity, nutrients, salinity, and turbidity to reduce SAV.

The invasion of nonnative species is in the category of globally determined stressors because these species’ arrival in the Delta is the result of large-scale natural processes and human activities that are beyond the purview of the Delta Plan. Nonnative species have persisted because they found favorable environments in which to live. Native species are adapted to the varied, complex floodplains, marshes, and other habitats of the historical Delta, with its tidal currents and river flows that constantly change physical, chemical, and biological conditions. In contrast, the stabilized flow pattern, altered habitats, and impaired water quality of the modern Delta often favor nonnative species. Reducing the impacts of nonnative species in the Delta will require addressing flow alterations, pollution (especially nutrients), and physical habitat characteristics.

Future invasions by zebra and quagga mussels are likely and will require considerable preparation, followed by interagency coordination and action. These mussels are an example of an “anticipated stressor” under the Delta ISB’s classification of stressor types. Neither has been observed in the Delta yet, but they have proven to be highly invasive when conditions are right. They pose threats comparable to threats from the overbite and Asian clams. They can colonize hard and soft surfaces, often in large densities (greater than 2,800 individuals per square foot) that impede the flow of water through canals and pipes. These mussels also remove particulates in the water, unnaturally enhancing water clarity.

Once introduced, nonnative species are difficult and expensive to control, and often impossible to eradicate. The California Department of Boating and Waterways supports programs to control Brazilian waterweed and water hyacinths where they hinder boating, but only where conditions create the worst nuisances. The best way to prevent new infestations is to avoid the introduction of new species. Improvements in managing ballast water by shipping companies have been instituted recently, but likely more needs to be done.

There is no agreement about the value—or lack of value—of nonnative species. Opinions vary depending on the species and the interest of Delta users. Striped bass are nonnative but prized for their sport and economic value. Introduced to the Delta in the nineteenth century, they prey on native open-water fish such as delta smelt, longfin smelt, and juvenile salmon and steelhead. Striped bass are at the center of an ongoing debate about whether fishing regulations for introduced species should conserve the fish or should be less restrictive to reduce their abundance (DFG 2011).

The draft Ecosystem Restoration Program (ERP) Conservation Strategy acknowledges that many nonnative species will likely remain in the Delta, and emphasizes prevention and adaptation strategies such as public education, preventing establishment of additional nonnative species, and reducing the impacts of established nonnative species. DFW issued its *California Aquatic Invasive Species Management Plan* in 2008,
which aims to coordinate the various State efforts to minimize harmful ecological, economic, and human health impacts from aquatic invasive species (DFG 2008).

**Hatcheries and Harvest Management**

In the Delta, people have harvested fish and shellfish for millennia. Today, fishing, crabbing, crawdaddling, and clamming are important recreation activities. Central Valley salmon—most raised in hatcheries—migrate through the Delta and support an economically and culturally important coastal fishery. In the Delta and its tributary rivers, recreational fishing for salmon, sturgeon, striped bass, largemouth bass, shad, and other fish attracts anglers from throughout California and the world. Fishing in the Delta is a centerpiece of the unique cultural, recreational, and natural heritage that makes the Delta a special place (see Chapter 5).

The use of hatcheries to breed fish and regulations to limit overfishing have long been important tools for aquatic resource management. But they carry their own risk. Hatcheries can allow interbreeding, weakening the genetic fitness of a fish species (Israel et al. 2011). Harvest of hatchery-enhanced fish stocks can pose additional risks to native species. Overfishing itself reduces genetic diversity. Fishing regulations generally protect fish from overharvest, but regulations can also help or hurt other fish species. For example, DFW recently proposed changes to striped bass sport fishing regulations to allow greater harvest of striped bass in the hopes of reducing bass predation on native fish, especially salmon. These changes were rejected by the Fish and Game Commission, but it is likely other regulations will be recommended, particularly as the emphasis on saving native fish from nonnative invasives continues. Future proposals should be based on an improved understanding of anglers’ behavior as well as a better understanding of the likely response in populations of striped bass and other predators. Harvest regulations and management practices must consider broader effects on nontarget species, including other predators, and the ecosystem.

Striped bass, for example, are not the only animals that prey on salmon. Predators are natural parts of any ecosystem, and predation is a basic ecosystem process. Fish predators in the Delta include many water birds, mammals, and fish such as native pikeminnows and introduced largemouth bass, smallmouth bass, striped bass, catfish, and other species. Nonnative fish consume salmon and other species of concern in the Delta and its tributaries (Lindley and Mohr 2003). Acoustic tagging studies in the San Joaquin River and southern Delta suggest significant predation on hatchery-reared salmon smolts. Survival of tagged salmon smolts released in the lower San Joaquin River was estimated to be only 5 percent in 2010, with much of the loss attributed to predation (San Joaquin River Group Authority 2010). However, despite the evidence of locally high predation, the overall contribution of predation to the decline of salmon, steelhead, and smelt populations is not clear, and the effect of predator controls will remain uncertain without additional study.

**Hatchery Management**

Another important tool for harvest management is raising fish in hatcheries, later to be released into natural waterways.

In California, hatcheries are particularly important to compensate for dams that block migration routes for salmon and steelhead (see previous Ecosystem Restoration section). The first salmon hatchery in the state was on the McCloud River. Today, California hosts two federal and twenty-one State hatcheries for salmon, steelhead, or trout. In recent years, “conservation hatcheries” for various threatened and endangered species were considered to prevent extinction of a species while restoration and stressor reduction activities are under way.

Hatcheries are important tools, but they involve genetic and ecological risks:

- **Genetic risks.** Human intervention in the rearing of wild animals has the potential to cause genetic change in fish such as salmon (Israel et al. 2011). These changes can impact fish diversity and the health of fish.
Inbreeding in a fish hatchery can occur when a limited stock is used at the hatchery. Inbreeding can affect the survival, growth, and reproduction of fish. Ironically, conditions in the hatchery may favor fish that best survive in hatchery, not natural, environments. When released, hatchery-produced fish mix with naturally spawned fish, resulting in a lower survival rate once fish are released into rivers and streams. Finally, loss of genetic diversity is a documented effect of overfishing (Holmes 2011), which some have suggested is encouraged by the use of hatchery fish.

Ecological risks. Wild and hatchery fish of the same species often compete in nature. For example, wild and hatchery-reared Chinook salmon share the same habitat and diet. Hatchery-released salmon are larger than wild salmon, resulting in possible predation on wild salmon of the same age. Hatchery production of salmon masks the decline of wild salmon, contributes to the genetic dilution and loss of wild salmon, and increases competition for limited freshwater and ocean resources on which wild salmon depend (McGinnis 1994). Throughout the world, overfishing has led to collapsing fish stocks and food web disruptions (Pauly et al. 1998). Hatchery and harvest effects often also interact. Harvest of salmon from waters where both hatchery and wild fish occur has put wild salmon and steelhead at risk (Lackey 2003). Wild salmon mortalities occur even with controlled fishing regulations. A portion of all fish released after being hooked and caught do not survive. Capture methods such as use of barbless hooks and use of landing nets can help reduce mortality of released fish.

Hatcheries and harvest are not the root problem of species declines in the Delta and Central Valley (DFG and NMFS 2001). Despite considerable fishing pressure in the first part of the twentieth century, striped bass, salmon, and steelhead remained abundant in California. Large declines followed the construction of dams on almost all Central Valley rivers, which greatly reduced access to spawning and rearing habitat. Once fish populations are low and habitat is damaged, their harvest can be an especially important control factor. Hatcheries were intended to substitute for lost spawning and rearing habitat, but nature cannot be so easily mimicked. Artificial propagation can provide abundant fish for restocking, but it cannot replace the abundance, productivity, life history diversity, and broad distribution of viable populations. Successful hatchery propagation will work best if it goes hand in hand with habitat restoration. Ultimately, fish produced in hatcheries must thrive and naturally reproduce once they have left the hatchery (Israel et al. 2011).

Accordingly, close attention needs to be paid to genetic management to reduce genetic risks.

Hatchery and harvest regulations, and management practices related to those regulations must be based on the best available science and follow adaptive management protocols for monitoring and evaluating the results. Evaluations of hatchery fish impacts would be aided by better hatchery fish-marking techniques and more extensive marking.
POLICIES AND RECOMMENDATIONS

Policies and recommendations for restoring the Delta ecosystem include the following core strategies to reduce the impact of ecosystem stressors:

- Create more natural functional Delta flows
- Restore habitat
- Improve water quality to protect the ecosystem
- Prevent introduction of and manage nonnative species impacts
- Improve hatcheries and harvest management

Success of Delta ecosystem restoration depends on considering and addressing all stressor categories as well as completing and implementing the BDCP described in Chapter 3. Because reducing or eliminating some stressors, especially the globally determined and legacy stressors, will be difficult, adaptation to unmitigable stressors is also imperative.

Create More Natural Functional Flows

Water flow in the Delta is critically important because flow affects the reliability of water supplies and the health of the Delta ecosystem. The best available science demonstrates that flow management is essential to restoration of the Delta ecosystem. Several important ecosystem stressors, including entrainment, are linked to altered water flows. Greater reverse flows in the south Delta increase the numbers of fish entrained.

Problem Statement

Altered flows in the Sacramento and San Joaquin rivers and their tributaries change flows within and out of the Delta, and affect salinity and sediment in the Delta. Fish and other aquatic species native to the Delta are adapted to natural flow, salinity, and sediment regimes. Current flow, salinity, and sediment regimes harm native aquatic species and encourage nonnative species. The best available science suggests that currently required flow objectives within and out of the Delta are insufficient to protect the Delta ecosystem (SWRCB 2010). Additionally, uncertainty regarding future flow objectives for the Delta impairs the reliability of water supplies that depend on the Delta or its watershed. The predictability of water exports cannot be improved, and the BDCP cannot be implemented without timely SWRCB action to update flow objectives.

Policy

ER P1. Delta Flow Objectives

(a) The State Water Resources Control Board’s Bay Delta Water Quality Control Plan flow objectives shall be used to determine consistency with the Delta Plan. If and when the flow objectives are revised by the State Water Resources Control Board, the revised flow objectives shall be used to determine consistency with the Delta Plan.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, the policy set forth in subsection (a) covers a proposed action that could significantly affect flow in the Delta.

23 CCR Section 5005
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85054, 85086, 85087, 85300, and 85302, Water Code.

Recommendations

ER R1. Update Delta Flow Objectives

Development, implementation, and enforcement of new and updated flow objectives for the Delta and high-priority tributaries are key to the achievement of the coequal goals. The State Water Resources Control Board should update the Bay Delta Water Quality Control Plan objectives as follows:

(a) By June 2, 2014, adopt and implement updated flow objectives for the Delta that are necessary to achieve the coequal goals.

(b) By June 2, 2018, adopt, and as soon as reasonably possible, implement flow objectives for high-priority tributaries in the Delta watershed that are necessary to achieve the coequal goals. ¹

¹ SWRCB staff should work with the Council and DFW to determine priority streams. As an illustrative example, priority streams could include the Merced River, Tuolumne River, Stanislaus River, Lower San Joaquin River, Deer Creek (tributary...
Flow objectives could be implemented through several mechanisms including negotiation and settlement, Federal Energy Regulatory Commission relicensing, or adjudicative proceeding.\(^2\)

Prior to the establishment of revised flow objectives identified above, the existing Bay Delta Water Quality Control Plan objectives shall be used to determine consistency with the Delta Plan. After the flow objectives are revised, the revised objectives shall be used to determine consistency with the Delta Plan.

**Restore Habitat**

Loss of habitat is one of the largest stressors to the Delta ecosystem. The Delta Plan adopts the approach of the multiagency ERP Conservation Strategy (DFG 2011), which includes a map and accompanying text identifying appropriate habitat restoration types within the Delta and Suisun Marsh based on land elevation, included in the Delta Plan within Appendix B. Delta Plan Figure 4-6 is based on the ERP Conservation Strategy map. Policy ER P3 requires habitat restoration actions to use this figure and accompanying text (see Appendix B for additional information). For example, restoring tidal marsh habitat would generally not be appropriate outside the areas labeled “intertidal” on Figure 4-6 unless they connect other tidal marshes into large habitat areas or can recover elevation over time by natural processes.

An integrated, adaptive approach to restoring habitat must address several issues. Each problem statement below highlights one of these issues, followed by specific policies and recommendations intended to address it.

**Problem Statement**

Features of the Delta landscape, particularly the condition of its waterways, the elevation of its land, and other environmental conditions, have changed dramatically over the past 160 years. Damage to the habitats that support native species in the Delta has led to declines in native animal and plant populations, affecting both resident and migratory species.

To Sacramento River), Lower Butte Creek, Mill Creek (tributary to Sacramento River), Cosumnes River, and American River. Implementation through hearings is expected to take longer than the deadline shown here.

Implementation through adjudicative proceedings or FERC relicensing is expected to take longer than the deadline shown here.

**Policies**

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

**ER P2. Restore Habitats at Appropriate Elevations**

(a) Habitat restoration must be carried out consistent with Appendix 3, which is Section II of the Draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (California Department of Fish and Wildlife 2011). The elevation map attached as Appendix 4 should be used as a guide for determining appropriate habitat restoration actions based on an area’s elevation. If a proposed habitat restoration action is not consistent with Appendix 4, the proposal shall provide rationale for the deviation based on best available science.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that includes habitat restoration.

**ER P3. Protect Opportunities to Restore Habitat**

(a) Within the priority habitat restoration areas depicted in Appendix 5, significant adverse impacts to the opportunity to restore habitat as described in section 5006, must be avoided or mitigated.

(b) Impacts referenced in subsection (a) will be deemed to be avoided or mitigated if the project is designed and implemented so that it will not preclude or otherwise interfere with the ability to restore habitat as described in section 5006.

(c) Impacts referenced in subsection (a) shall be mitigated to a point where the impacts have no significant effect on the opportunity to restore habitat as described in section 5006. Mitigation shall be determined, in consultation with the California Department of Fish and Wildlife, considering the size of the area impacted by the covered action and the type and value of habitat that could be restored on that area, taking into account existing and proposed restoration plans, landscape attributes, the elevation map shown in Appendix 4, and other relevant information about habitat restoration opportunities of the area.

(d) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions in the priority habitat restoration areas depicted in Appendix 5. It does not cover proposed actions outside those areas.
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23 CCR Section 5007
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85022, 85054, 85300, 85302, and 85305, Water Code.

Figure 4-7 provides examples of ways a project can implement ER P3.

ER P4. Expand Floodplains and Riparian Habitats in Levee Projects

(a) Levee projects must evaluate and where feasible incorporate alternatives, including the use of setback levees, to increase floodplains and riparian habitats. Evaluation of setback levees in the Delta shall be required only in the following areas (shown in Appendix 8): (1) The Sacramento River between Freeport and Walnut Grove, the San Joaquin River from the Delta boundary to Mossdale, Paradise Cut, Steamboat Slough, Sutter Slough; and the North and South Forks of the Mokelumne River, and (2) Urban levee improvement projects in the cities of West Sacramento and Sacramento.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to construct new levees or substantially rehabilitate or reconstruct existing levees.

23 CCR Section 5008
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85022, 85054, 85300, 85302, and 85305, Water Code.

Recommendations

ER R2. Prioritize and Implement Projects that Restore Delta Habitat

Bay Delta Conservation Plan implementers, California Department of Fish and Wildlife, California Department of Water Resources, and the Delta Conservancy should prioritize and implement habitat restoration projects in the areas shown on Figure 4-8. Habitat restoration projects should ensure connections between areas being restored and existing habitat areas and other elements of the landscape needed for the full life cycle of the species that will benefit from the restoration project. Where possible, restoration projects should also emphasize the potential for improving water quality. Restoration project proponents should consult the California Department of Public Health’s Best Management Practices for Mosquito Control in California.

How Projects Can Comply with ER P3

ER P3 requires projects located in the priority habitat restoration areas (shown on Figure 4-8) to protect opportunities to restore habitat. This figure shows conceptual examples of how to implement this policy.
Recommended Areas for Prioritization and Implementation of Habitat Restoration Projects

Priority habitat restoration areas are large areas within which specific sites may be identified for habitat restoration based on assessments of land use and other issues addressed through further feasibility analysis.

Source: DFG 2011
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- **Yolo Bypass.** Enhance the ability of the Yolo Bypass to flood more frequently to provide more opportunities for migrating fish, especially Chinook salmon, to use this system as a migration corridor that is rich in cover and food.

- **Cache Slough Complex.** Create broad nontidal, freshwater, emergent-plant-dominated wetlands that grade into tidal fresh-water wetlands, and shallow subtidal and deep open-water habitats. Also, return a significant portion of the region to uplands with vernal pools and grasslands.

- **Cosumnes River–Mokelumne River confluence.** Allow these unregulated and minimally regulated rivers to flood over their banks during winter and spring frequently and regularly to create seasonal floodplains and riparian habitats that grade into tidal marsh and shallow subtidal habitats.

- **Lower San Joaquin River floodplain.** Reconnect the floodplain and restore more natural flows to stimulate food webs that support native species. Integrate habitat restoration with flood management actions, when feasible.

- **Suisun Marsh.** Restore significant portions of Suisun Marsh to brackish marsh with land-water interactions to support productive, complex food webs to which native species are adapted and to provide space to adapt to rising sea level action. Use information from adaptive management processes during the Suisun Marsh Habitat Management, Preservation, and Restoration Plan’s implementation to guide future habitat restoration projects and to inform future tidal marsh management.

- **Western Delta/Eastern Contra Costa County.** Restore tidal marsh and channel margin habitat at Dutch Slough and western islands to support food webs and provide habitat for native species.

**ER R3. Complete and Implement Delta Conservancy Strategic Plan**

As part of its Strategic Plan and subsequent Implementation Plan or annual work plans, the Delta Conservancy should:

- Develop and adopt criteria for prioritization and integration of large-scale ecosystem restoration in the Delta and Suisun Marsh, with sustainability and use of best available science as foundational principles.

- Develop and adopt processes for ownership and long-term operations and management of land in the Delta and Suisun Marsh acquired for conservation or restoration.

- Develop and adopt a formal mutual agreement with the California Department of Water Resources, California Department of Fish and Wildlife, federal interests, and other State and local agencies on implementation of ecosystem restoration in the Delta and Suisun Marsh.

- Develop, in conjunction with the Wildlife Conservation Board, the California Department of Water Resources, California Department of Fish and Wildlife, Bay Delta Conservation Plan implementers, and other State and local agencies, a plan and protocol for acquiring the land necessary to achieve ecosystem restoration consistent with the coequal goals and the Ecosystem Restoration Program Conservation Strategy.

- Lead an effort, working with State and federal fish agencies, to investigate how to better use habitat credit agreements to provide credit for each of these steps: (1) acquisition for future restoration; (2) preservation, management, and enhancement of existing habitat; (3) restoration of habitat; and (4) monitoring and evaluation of habitat restoration projects.

- Work with the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to develop rules for voluntary safe harbor agreements with property owners in the Delta whose actions contribute to the recovery of listed threatened or endangered species.

**Problem Statement**

Current USACE policy requires removal of vegetation from Delta levees, which would reduce already sparse riparian and shaded aquatic habitat along the channels.

**Policies**

No policies with regulatory effect are included in this section.

**Recommendation**

**ER R4. Exempt Delta Levees from the U.S. Army Corps of Engineers’ Vegetation Policy**

Considering the ecosystem value of remaining riparian and shaded riverine aquatic habitat along Delta levees, the U.S. Army Corps of Engineers should agree with the California Department of Fish and Wildlife and the California Department of Water Resources on a variance that exempts Delta levees from the U.S. Army Corps of Engineers’ levee vegetation policy where appropriate.
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Problem Statement
The SMPP and the Local Protection Program components of the SMPP do not yet include climate change provisions. Without these amendments, it is unclear if and how Suisun Marsh will be managed to adapt to rising sea level.

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

Recommendations
Recommendations for improving ecosystem water quality are included in Chapter 6.

Prevent Introduction of and Manage Nonnative Species Impacts

Problem Statement
Nonnative species are a major obstacle to successful restoration of the Delta ecosystem because they affect the survival, health, and distribution of native Delta wildlife and plants. There is little chance of eradicating most established nonnative species, but management can reduce the abundance of some. The resilience of native species is reduced by ongoing introductions of nonnative species and management actions that enhance conditions for nonnative species.

Policy
ER P5. Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species
(a) The potential for new introductions of or improved habitat conditions for nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem.
(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that has the reasonable probability of introducing or improving habitat conditions for nonnative invasive species.

23 CCR Section 5009
NOTE: Authority cited: Section 85210(i), Water Code.

Recommendations
ER R6. Regulate Angling for Nonnative Sport Fish to Protect Native Fish
The California Department of Fish and Wildlife should develop, for consideration by the Fish and Game Commission, proposals for new or revised fishing regulations designed to increase populations of listed fish species through reduced predation by introduced sport fish. The proposals should be based on sound science that demonstrates these
management actions are likely to achieve their intended outcome and include the development of performance measures and a monitoring plan to support adaptive management.

**ER R7. Prioritize and Implement Actions to Control Nonnative Invasive Species**

The California Department of Fish and Wildlife and other appropriate agencies should prioritize and fully implement the list of “Stage 2 Actions for Nonnative Invasive Species” and accompanying text shown in Appendix J taken from the Conservation Strategy for Restoration of the Sacramento–San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011). Implementation of the Stage 2 actions should include the development of performance measures and monitoring plans to support adaptive management.

**Improve Hatcheries and Harvest Management**

**Problem Statement**

Hatcheries and harvest regulation are important tools in fisheries management, but they also pose genetic and ecological risks to native species and the Delta ecosystem. These practices need to employ adaptive management strategies to predict and evaluate outcomes, and minimize risks.

**Policies**

No policies with regulatory effect are included in this section.

**Recommendations**

**ER R8. Manage Hatcheries to Reduce Genetic Risk**

As required by the National Marine Fisheries Service, all hatcheries providing listed fish for release into the wild should continue to develop and implement scientifically sound Hatchery and Genetic Management Plans (HGMPs) to reduce risks to those species. The California Department of Fish and Wildlife should provide annual updates to the Delta Stewardship Council on the status of HGMPs within its jurisdiction.

**ER R9. Implement Marking and Tagging Program**

By December 2014, the California Department of Fish and Wildlife, in cooperation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, should revise and begin implementing its program for marking and tagging hatchery salmon and steelhead to improve management of hatchery and wild stocks based on recommendations of the California Hatchery Scientific Review Group, which considered mass marking, reducing hatchery programs, and mark selective fisheries in developing its recommendations.

**Timeline for Implementing Policies and Recommendations**

Figure 4-9 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.
### Timeline for Implementing Policies and Recommendations

<table>
<thead>
<tr>
<th>ACTION (REFERENCE #)</th>
<th>LEAD AGENCY(IES)</th>
<th>NEAR TERM 2012–2017</th>
<th>INTERMEDIATE TERM 2017–2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta flow objectives (ER P1)</td>
<td>SWRCB</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Restore habitats at appropriate elevations (ER P2)</td>
<td>DFW, DWR, Delta Conservancy</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Protect opportunities to restore habitat (ER P3)</td>
<td>DFW</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Expand floodplains and riparian habitats in levee projects (ER P4)</td>
<td>DWR, USACE</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Avoid introductions of and habitat improvements for invasive nonnative species (ER P5)</td>
<td>DFW, DWR, Delta Conservancy</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Update Delta flow objectives (ER R1)</td>
<td>SWRCB</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Prioritize and implement projects that restore Delta habitat (ER R2)</td>
<td>DFW, DWR, and Delta Conservancy</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Complete and implement Delta Conservancy Strategic Plan (ER R3)</td>
<td>Delta Conservancy</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Exempt Delta levees from U.S. Army Corps of Engineers' Vegetation Policy (ER R4)</td>
<td>USACE, DWR, DFW</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Update the Suisun Marsh Protection Plan (ER R5)</td>
<td>BCDC</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Regulate angling for nonnative sport fish to protect native fish (ER R6)</td>
<td>DFW, CA Fish and Game Commission</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Prioritize and implement actions to control nonnative invasive species (ER R7)</td>
<td>DFW</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Manage hatcheries to reduce genetic risk (ER R8)</td>
<td>DFW</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Implement marking and tagging program (ER R9)</td>
<td>DFW</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

#### Agency Key:
- **BCDC**: San Francisco Bay Conservation and Development Commission
- **BDCP**: Bay Delta Conservation Plan
- **Delta Conservancy**: Sacramento-San Joaquin Delta Conservancy
- **Council**: Delta Stewardship Council
- **DFW**: California Department of Fish and Wildlife
- **DWR**: California Department of Water Resources
- **RWQCB**: Regional Water Quality Control Board(s)
- **SWRCB**: State Water Resources Control Board
- **USACE**: U.S. Army Corps of Engineers

**Figure 4-9**
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Issues for Future Evaluation and Coordination

Additional areas of interest and concern related to the Delta ecosystem may deserve consideration in the development of future Delta Plan updates:

- **Landscape-scale conceptual models.** The Delta Science Program will collaborate with other agencies, academic institutions, and stakeholders to develop landscape-scale conceptual models for the six priority restoration areas identified in ER R2.

- **Workshops to address stressor impacts.** The Delta Science Program, in collaboration with other agencies, academic institutions, and stakeholders, will hold workshops to develop additional recommendations to the Council for measures to reduce stressor impacts on the Delta ecosystem that would support and be consistent with the coequal goals. Recommended measures could be adopted as policies or recommendations by the Council into an amended Delta Plan.

- **Above-the-Delta migration corridors.** The Council will consult with fish and wildlife agencies and others as they complete or update plans to restore habitats for migratory species, such as anadromous fish or songbirds in the Sacramento and San Joaquin valleys above the Delta.

Science and Information Needs

The Delta ecosystem is not static; therefore, additional information is needed for decision making and adaptive management. Specifically, the following information is needed in the following areas:

- Landscape-scale conceptual models for Delta ecosystem restoration.

- Assessment of how flows benefit or harm native wildlife and plants.

- Effects of changing habitat quality and quantity on Delta fish and invertebrates. Examples might include (1) threadfin shad in the south and central Delta, (2) comparison of shallow shoal habitat and deep channel habitat to food resources of young striped bass, and (3) relationship between water turbidity and native fish migration, survival, growth, and/or reproduction.

- Hatchery, harvest, and/or predation impacts on natural fish populations.

- Tools to assess native fish response to restored habitats.

- Entrainment effects on fish populations.

- Tools to assess potential impacts of climate change and sea level rise to viability of species in intertidal habitats.

Performance Measures

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

The Delta Reform Act specifies some performance measures for large-scale ecosystem restoration within the Delta. Ecosystem performance measures should address progress in achieving the objectives set forth in Water Code sections 85302(c) and 85302(e).

Note that performance measures for ecosystem water quality are provided in Chapter 6.
Output Performance Measures

- The SWRCB adopts Delta flow objectives by June 2, 2014. (ER R1)
- The SWRCB adopts flow objectives for the major tributaries by 2018 (or soon as reasonably possible). (ER R1)
- Pilot-scale Delta habitat restoration projects are developed and initiated in the priority areas described in ER R2 by 2015. These projects include tidal brackish and freshwater marsh as well as floodplain restoration, and have clear adaptive management plans aimed at improving outcomes and providing lessons for the development of large-scale restoration projects. Metrics: acres restored by habitat type, and lessons learned. (ER R2)
- Progress, measured in acres of restored or enhanced habitat, is being made toward the biological opinions’ targets of restoring 8,000 acres of tidal marsh and 17,000 to 20,000 acres of floodplain rearing habitat. (ER R2)
- The DFW and other appropriate agencies fully implement the list of “Stage 2 Actions for Nonnative Invasive Species.” (ER R7)

Outcome Performance Measures

- Progress toward restoring in-Delta flows to more natural functional flow patterns to support a healthy estuary. Metrics: results from hydrological monitoring and hydrodynamic modeling. (ER R1)
- Progress toward decreasing annual trends in both the number of new and existing aquatic and terrestrial nonnative species, and the abundance and distribution of existing aquatic and terrestrial nonnative species in the Delta over the next decade. These trends will be derived from long-term animal and plant monitoring surveys conducted by the Interagency Ecological Program agencies, the California Department of Boating and Waterways, the U.S. Department of Agriculture, the San Francisco Estuary Institute, and others. (ER P5)
- Progress toward the documented occurrence and use of protected and restored habitats and migratory corridors by native resident and migratory Delta species. Trends in occurrence, use, and performance of native species in protected and restored habitats and corridors will be upward over the next decade. These trends will be derived from animal and plant monitoring surveys that are conducted as part of adaptive management strategies for the protection and restoration of these areas. (ER R2)
- Progress toward achieving the State and federal “doubling goal” for wild Central Valley salmonids relative to 1995 levels. Trends will be derived from long-term salmonid monitoring surveys conducted by the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and others. (ER R2)
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References


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Page 126: California Department of Water Resources
CHAPTER 5

Protect and Enhance the Unique Cultural,

[Images of various scenes, including a coastal town, a bird's-eye view of a marina, wind turbines, and a field of crops.]
ABOUT THIS CHAPTER

This chapter describes the unique values that distinguish the Sacramento-San Joaquin Delta (Delta) and make it a special region. It also outlines the Delta Stewardship Council’s (Council) five core strategies for protecting and enhancing these values:

■ Designate the Delta as a special place worthy of national and state attention

■ Plan to protect the Delta’s lands and communities

■ Maintain Delta agriculture as a primary land use, a food source, a key economic sector, and a way of life

■ Encourage recreation and tourism that allow visitors to enjoy and appreciate the Delta, and that contribute to its economy

■ Sustain a vital Delta economy that includes a mix of agriculture, tourism, recreation, commercial and other industries, and vital components of state and regional infrastructure

The 2 policies and 19 recommendations to carry out these strategies are found at the end of the chapter. Protecting the Delta as a place also depends on the strategies to reduce flood and other risks to the Delta that are described in Chapter 7.
RELEVANT LEGISLATION

The Sacramento-San Joaquin Delta Reform Act of 2009 declared State policy for the resources and values of the Delta (Water Code section 85054):

“Coequal goals” means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

The Legislature declares the following objectives inherent in the coequal goals for management of the Delta (Water Code section 85020):

(a) Manage the Delta’s water and environmental resources and the water resources of the state over the long term.

(b) Protect and enhance the unique cultural, recreational, and agricultural values of the California Delta as an evolving place.

Water Code section 85302(h) provides direction on the implementation of measures to promote the coequal goals and inherent objectives:

(h) The Delta Plan shall include recommendations regarding state agency management of lands in the Delta.

The Delta Reform Act states (Water Code section 85022(d)):

(d) The fundamental goals for managing land use in the Delta are to do all of the following:

(1) Protect, maintain, enhance, and, where feasible, restore the overall quality of the Delta environment and its natural and artificial resources.

(2) Ensure the utilization and conservation of Delta resources, taking into account the social and economic needs of the people of the state.

(3) Maximize public access to Delta resources and maximize public recreational opportunities in the Delta consistent with sound resources conservation principles and constitutionally protected rights of private property owners.

(4) Encourage state and local initiatives and cooperation in preparing procedures to implement coordinated planning and development for mutually beneficial uses, including educational uses, in the Delta.

(5) Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.

(6) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

Public Resources Code section 29703.5 describes the Delta Protection Commission’s role in providing recommendations to the Delta Stewardship Council:

(a) The Delta Protection Commission created pursuant to Section 29735 provides an existing forum for Delta residents to engage in decisions regarding actions to recognize and enhance the unique cultural, recreational, and agricultural resources of the Delta. As such, the commission is the appropriate agency to identify and provide recommendations to the Delta Stewardship Council on methods of preserving the Delta as an evolving place as the Delta Stewardship Council develops and implements the Delta Plan.

(b) There is a need for the five Delta counties to establish and implement a resources management plan for the Delta and for the Delta Stewardship Council to consider that plan and recommendations of the commission in the adoption of the Delta Plan.
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The Delta Reform Act provides that the coequal goals of providing a more reliable water supply and protecting, enhancing, and restoring the Delta ecosystem shall be achieved in a manner that protects the unique cultural, natural, recreational, resource, and agricultural values of the Delta as an evolving place. Achieving this objective begins with recognizing the values that make the Delta a distinctive and special place:

- The Delta’s geography of low-lying islands and tracts, many below the water level and shaped by sloughs, shipping channels, and rivers; tidal influences; levees; and other water controls is unique among California landscapes.

- The Delta retains a rural heritage, characterized by farms and small towns linked by navigable waterways and winding country roads.

- The Delta’s agricultural economy is vital to the region and contributes to California’s important agricultural economy.

- The Delta is a region where maritime ports, commercial agriculture, and expanding cities coexist with a unique native ecosystem that is home to many species of wildlife and fish.

- The Delta is a place of multicultural tradition, legacy communities, and family farms.

- The Delta provides opportunities for recreation and tourism because of its unique geography, mix of activities, and rich natural resources.

The Delta’s uniqueness, however, does not exempt it from change. Increasing pressures of growing populations, shifting commodity markets, climate changes, and rising sea level will require new ways of adaptation for this region. Some changes are driven by the Delta’s location at the center of California’s water systems and are required to meet statewide goals of restoring the Delta’s ecosystem and improving water supply reliability. Other changes may be caused by floods, earthquakes, or other events that threaten the Delta’s levees and islands. Some changes can be managed by policies that shape how the Delta’s traditions are honored and its history preserved; guide new development; enhance recreation and tourism; and encourage agriculture, business expansion, and economic development.

Protecting the Delta as an evolving place means accepting that change will not stop, but that the fundamental characteristics and values that contribute to the Delta’s special qualities and that distinguish it from other places can be preserved and enhanced while accommodating these changes (Delta Vision Blue Ribbon Task Force 2008). It does not mean that the Delta should be a fortress, a preserve, or a museum.
The Council envisions a future where the Delta’s unique qualities are recognized and honored. Agriculture will continue to thrive on the Delta’s rural lands; and its cities, ports, and rural villages will be desirable places to live, work, and do business. Visitors to the region will enjoy recreation on and in its waterways, marshes, resorts, parks, and historic legacy communities. The Delta’s land uses and development will be resilient, protecting the rural character of the area, reducing risks to people and property, adjusting to changing conditions, and promoting the ability to recover readily from distress. The Delta’s economic vitality will provide resources to respond to change and to support the families and businesses that make the Delta home. The vision of the Delta as an evolving place also acknowledges the role of Delta residents in shaping the future of the region through active and effective participation in Delta planning and management.

Creating a Common Vision of the Delta as a Place

The Delta Reform Act recognizes not only the uniqueness of the region, but also that it is managed and influenced by many State of California (State), federal, and local agencies, often with differing views about the Delta and with overlapping and sometimes conflicting jurisdictions. Through the Delta Plan, the Council intends to foster a common vision for the future of the Delta as a place and to promote more effective coordination among these agencies. (See sidebar, Looking at the Delta.)

Fashioning this common vision has begun by drawing much of the information and many of the strategies of this chapter from these agencies’ reports and recommendations, including the following documents:

- The Proposal to Protect, Enhance, and Sustain the Unique Cultural, Historical, Recreational, Agricultural, and Economic Values of the Sacramento-San Joaquin Delta as an Evolving Place developed by the Delta Protection Commission (DPC) (DPC 2012a)
- The DPC’s Economic Sustainability Plan for the Sacramento-San Joaquin Delta (ESP) (DPC 2012b)
- The Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh (Recreation Proposal) developed by California State Parks (California State Parks 2011)
- The Sacramento-San Joaquin Delta Conservancy’s Strategic Plan

The Public Resources Code (section 29703.5(a)) names the DPC as “the appropriate agency to identify and provide recommendations to the Council on methods of preserving the Delta as an evolving place.” The DPC is an agency created in 1992 by the Delta Protection Act to plan for and guide natural resource conservation and enhancement in the legal Delta while sustaining agriculture and meeting increased recreational demand.

Looking at the Delta

The Delta presents itself from three vantages that display alternative aspects of its character.

From the water, the Delta is a thicket of sloughs, rock-lined channels, and open waterways where the land lies unseen behind tall levees and riparian vegetation. This is a Delta of recreational boating and oceangoing freighters, piers and lift bridges, diversions and water control structures, fish and diving ducks, resorts and marinas.

Another view of the Delta is a predominantly rural, agricultural landscape dotted with historic villages and where waterways are hidden on the other side of the levee, to be glimpsed only from bridges and levee-top roads. This is a Delta of vineyards, orchards, farm fields, ditches, and waterfowl hunting clubs; of historic farmsteads and one-of-a-kind shops and restaurants; and of farm machinery and bicyclists.

A third view of the Delta looks out from its metropolitan areas: Stockton, Manteca, Lathrop, Tracy, Contra Costa County’s shoreline suburbs, Suisun City, Fairfield, Sacramento, and West Sacramento. This is a Delta of downtowns, neighborhoods, and new suburbs; cooling summer breezes and clammy winter fog; waterfront parks and a catch of striped bass in the freezer; and ports, warehouses, offices, and other job sites.
As provided in Water Code section 85301, the DPC developed the Proposal to Protect, Enhance, and Sustain the Unique Cultural, Historical, Recreational, Agricultural, and Economic Values of the Sacramento-San Joaquin Delta as an Evolving Place (DPC 2012a). This proposal was submitted to the Council for incorporation into the Delta Plan. The proposal includes a plan to recognize the Delta as a place of special significance by applying for a federal designation of the Delta as a National Heritage Area (NHA). The NHA designation is granted by the U.S. Congress to places where natural, cultural, historic, and recreational resources combine to form a distinctive landscape and tell a nationally important story about the country and its experience.

The DPC also recommends strategies to support increased investment in agriculture, recreation, tourism, and other resilient land uses in the Delta. These strategies are derived from the ESP (DPC 2012b). Established in 2009, the Delta Conservancy is responsible for implementing ecosystem restoration projects protecting and preserving agriculture and working landscapes; increasing recreation and tourism opportunities; promoting legacy communities and economic vitality; and protecting, conserving, and restoring the region’s physical, agricultural, cultural, historical, and living resources (Public Resources Code section 32322). Careful coordination between the DPC and Delta Conservancy can maximize the impact of both agencies’ economic development activities.

Protecting the Delta as an Evolving Place Is Inherent in the Coequal Goals

Protecting the Delta as an evolving place is inherent in the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. This is partly because attaining these two goals will necessitate a growing awareness among Californians of the Delta and its values, including its agriculture, recreation, natural resources, and unique culture. It is also because Delta residents benefit from the levees that help convey fresh water through the Delta; enjoy the wildlife, fish, and recreation that the Delta ecosystem produces; and work for its water management agencies and facilities. Changes required to provide a more reliable water supply or restore the ecosystem will influence the kind of place the Delta becomes, especially if structures to improve conveyance or areas of restored habitat significantly alter the Delta’s familiar farming landscape. At the same time, the needs to protect the Delta’s land uses and people will shape and constrain decisions about water supplies and ecosystem restoration, including allocation of water supplies, flow and salinity objectives, levee priorities, and how impacts to communities and land uses are mitigated.

Water for agricultural, municipal, and industrial uses is a key to the Delta as a place. Delta communities are the most dependent of all Californians on Delta water supplies, which support its residents, businesses, and farms. They, like other Californians, can often do more to use water more efficiently and to develop alternative supplies through recycling, conjunctive use of groundwater, or participation in regional water supply projects. Because the communities and economy of the Delta require water of reliable quality as well as amount, updates to the Bay-Delta Water Quality Control Plan have special influence on the region. The Delta is also influenced by other Central Valley water quality plans because they protect the quality of water for Delta consumers, farmers, and recreationists and the costs Delta residents and businesses pay to meet clean water standards.

A healthy ecosystem is also important to the Delta’s communities. Residents find joy and relaxation in outdoor recreation and the connection with nature that the Delta ecosystem provides. Visitors drawn to its scenery, waterways, fish, and wildlife support tourism businesses. Protecting the ecosystem maintains these benefits and restoring it can expand them, especially when it can be accomplished in ways that enhance the Delta’s working landscape. Coordinating
restoration with planning for flood control can help control costs for levee improvement and management, draw on multiple sources of funds for multipurpose flood control investments, and provide alternate uses for areas that cannot be protected cost effectively. Restoring marshes, riverbanks, and riparian areas will alter how some land is used, but the impacts of these changes on the Delta’s unique values can be managed through cooperation, careful design to lessen or avoid adverse effects, or reasonable mitigation of unavoidable impacts.

The Delta as a Place

The California Delta is a unique place distinguished by its geography, legacy communities, a rural and agricultural setting, vibrant natural resources, and a mix of economic activities. This section describes the features that make the Delta unique. Its 839,640 acres of land, sometimes centered on a wide river but laced with a network of narrow channels and sloughs, stretch to the horizon, bounded only by the levees that were built to drain the Delta’s marshes and flood-prone riversides. The Legislature has found that the Delta’s uniqueness is particularly characterized by its hundreds of miles of meandering waterways and the many islands adjacent to them, and has described the Delta’s highly productive agriculture, recreational assets, fisheries, and wildlife as invaluable resources (Water Code section 12981(b)). These natural assets, including the ecosystem and water resources as described in Chapters 3, 4, and 6, are among the Delta’s important values.

The Delta is composed of three areas recognized in California law. The Primary Zone is the largest and includes 490,050 acres at the heart of the Delta (Public Resources Code section 29728). It is primarily rural farmland, but also includes several small towns established in the nineteenth and twentieth centuries. The Secondary Zone includes 247,320 acres surrounding the Primary Zone (Public Resources Code section 29731). It also includes farmland, but is increasingly dominated by the region’s cities and suburbs. Suisun Marsh lies northwest of the Primary Zone, encompassing 106,570 acres (Public Resources Code section 29101) primarily of managed wetland. The Suisun Marsh overlaps the boundary of the Delta by about 4,300 acres (see Figure 5-1).

The Legislature has declared that the Delta is a natural resource of statewide, national, and international significance, and that the cities, towns, and settlements within the Delta are of significant historical, cultural, and economic value (Public Resources Code sections 29701 and 29708). However, not all Delta users, visitors, or residents recognize or appreciate the Delta’s values. In a recent survey, 78 percent of Californians said they had not heard of or did not know about the Delta (Probolsky Research 2012). A survey in 2007 found that nearly half of Stockton residents had only a vague idea—or none at all—that they lived in or near the Delta (Stockton Record 2012).

This lack of a clearly recognized, widely communicated identity for the Delta is described as the lack of a “brand.” Delivering a coordinated message about the Delta and its resources is difficult because responsibilities for the Delta are divided among so many agencies. Many visitors and even some residents of Delta cities and suburbs are unfamiliar with the region beyond their travel route or community, or know it only in name from news media reports about conflicts over its water and natural resources. To some, the Delta’s flat agricultural landscape is dull and monotonous, and its resources are “out of sight and out of mind.” Access into the Delta by first-time visitors can be difficult because of its winding roads and lack of amenities that signify a special region; simplify wayfinding; educate travelers about an area’s history, culture, and natural resources; or encourage public access and recreation.
Delta Primary and Secondary Zones and Suisun Marsh

Figure 5-1
CHAPTER 5 PROTECT AND ENHANCE THE UNIQUE CULTURAL, RECREATIONAL, NATURAL RESOURCE, AND AGRICULTURAL VALUES OF THE CALIFORNIA DELTA AS AN EVOLVING PLACE

The Delta’s People

About 570,000 people reside in the Delta, according to the 2010 Census. Ninety-eight percent of them live in the Delta’s Secondary Zone, with the remainder in the Primary Zone. Prior to the recent recession, the population of the Delta’s Secondary Zone had been growing rapidly, increasing almost 56 percent since the 1990 Census, a rate twice as fast as the state as a whole. Much of that increase occurred in new communities in previously unincorporated county areas, such as Discovery Bay; rapidly growing towns and communities such as Brentwood and Oakley on State Route 4; and cities such as Sacramento, West Sacramento, Stockton, and Lathrop. The age and household composition of the Delta’s population is similar to California as a whole, but with slightly younger and larger families. About half the Delta’s population is between the ages of 21 and 54, and about 29 percent are younger than 18 years old (DPC 2012b).

In contrast, the population of the Primary Zone has been essentially unchanged over those 20 years. The Primary Zone is also composed primarily of older people without children, living in smaller households.

Today, most Delta residents describe themselves as white or Hispanic, with the next largest groups being Asian, other races, and African-American or black. About one-third describe themselves as Hispanic. This diverse population reflects the many United States regions and foreign lands from which settlers emigrated to the Delta, including Mexico, China, Japan, Portugal, the Philippines, and other countries. These origins are reflected in communities and neighborhoods like Locke, an early twentieth century town built primarily by Chinese farmworkers. Cultural events honor many ethnic traditions in the Delta, including Chinese and Cambodian New Years, Portuguese festas, Greek holidays, Indian Diwali celebrations, Filipino fiestas, Cinco de Mayo events, and Juneteenth commemorations. Other festivals feature Delta agriculture, such as the Courtland Pear Fair and the Stockton Asparagus Festival (California State Parks 2011).

The Delta’s Communities

The region’s urban communities include the cities of Sacramento, West Sacramento, Stockton, Lathrop, Manteca, Tracy, Oakley, Brentwood, Antioch, Pittsburg, Benicia, Fairfield, Suisun City, Rio Vista, and Isleton, and the unincorporated communities of Freeport, Mountain House, Byron, Discovery Bay, Bethel Island, and Knightsen. They are located entirely or partially in the Delta’s Secondary Zone or in the secondary management area of Suisun Marsh. Unincorporated communities in the Primary Zone include Clarksburg, Courtland, Hood, Locke, Walnut Grove, and Ryde. Appendix B includes maps of these unincorporated communities.

The general plans of Delta cities and counties describe where development of these communities may occur. These plans or actions by the local area formation commissions describe “spheres of influence” (SOIs) for each jurisdiction and often identify an urban limit line beyond which intense development cannot occur without amendment of the plan. About 26,000 acres of the Delta within these SOIs are expected to undergo urbanization (DPC 2012b) (see Figure 5-2). To encourage the location of new development within these SOIs rather than in rural areas, Chapter 7 policies exempt development in these areas from policies to increase flood protection standards. The Delta Plan includes no policies or recommendations to control land use or density in these communities.

Among the Delta’s unincorporated communities, Bethel Island warrants a special note because of its flood risks, the development planned there, and its lack of public services. Its developed area occupies part of the 3,500-acre island, most of which is planned for rural agricultural or visitor-serving commercial uses. About 2,100 people reside on the island in about 1,300 residences concentrated on the island’s south central shoreline, four mobile home parks, or 13 commercial marinas. Approximately 15 miles of levees surround the island, which is below sea level, limiting the drainage of floodwaters in the event of a levee breach.
A single road, Bethel Island Road, links the island to the mainland at the city of Oakley, complicating emergency response or evacuation in the event of flooding. Although the entire island is included in the urban limit line that Contra County’s voters approved in 2006, development on the island clusters around Delta Coves, a 495-unit water-oriented residential development that was permitted in 1973, but that still remains unfinished, in part because of the bankruptcy of its developer. Other development includes mobile home parks and retail areas. Rural uses include single-family homes along the island’s shoreline, marinas, resorts, a golf course, rural residential uses, and farmland. Contra Costa County’s General Plan seeks to preserve and enhance the rural quality of Bethel Island and still allow for planned residential and commercial growth related to water-oriented recreation. The general plan notes that development other than a single home on existing parcels must await resolution of several issues, including improvement of the community’s public services, levees, and emergency evacuation routes. Because of its flood risks and its rural character, Bethel Island is not excluded from the Delta Plan policy limiting new urban development. Restrictions on development on Bethel Island are consistent with the Contra Costa County General Plan.

As described in Chapter 2, covered actions subject to the Delta Reform Act do not include plans, programs, or projects within the Delta’s Secondary Zone that a metropolitan planning agency has determined are consistent with a sustainable communities strategy adopted under California planning law. These sustainable communities strategies will, in part, accomplish the following:

- Identify areas within the region sufficient to house an 8-year projection of the regional housing need for the region.
- Identify a transportation network to serve the transportation needs of the region.
- Gather and consider information regarding resource areas and farmland in the region.
- Set forth a forecast development pattern, which, when integrated with the transportation network and other transportation measures and policies, will reduce greenhouse gas emissions from automobiles and light trucks. The sustainable community strategy development pattern will need to be based upon “current planning assumptions” that include the information in local general plans and SOI boundaries.

As provided in Water Code section 85212, the Council will cooperate with local and regional planning agencies to provide timely advice about sustainable community strategies and other local and regional plans for consistency with the Delta Plan. This will include reviewing their consistency with the ecosystem restoration needs of the Delta and whether these plans set aside sufficient lands for natural resource protection to meet the Delta’s ecosystem needs. Through this coordination, decisions about locating and planning new urban development in the Secondary Zone can be coordinated to meet local communities’ housing and other needs, as Water Code section 85022(d)(4) provides, while protecting and enhancing the Delta as an evolving place.
Figure 5-2

The map shows land uses designated by city and county general plans. Within cities’ SOIs, the map shows land use designations proposed in city general plans, where available. In cases where cities have not proposed land uses within their SOIs, the map shows land uses designated by county general plans.

The Delta’s Legacy Communities

Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, Locke, and Walnut Grove are the Delta’s legacy communities (Public Resources Code section 32301(f)). They are the residential, commercial, processing, and retail centers of the Delta, and resonate with its history and culture. Each community has its own character. Bethel Island is a recreation destination. Clarksburg and Courtland are centers for wine and pear production. Freeport and Hood were transportation centers, with river landings and rail spurs to move goods. Locke and Walnut Grove had large Asian populations who worked at packing sheds and surrounding local farms. Ryde is known for its landmark hotel, and Isleton is known for festivals and visitor-serving businesses. Rio Vista is the largest community, and Knightsen is a small community known for several nearby horse ranches. All legacy communities except Freeport, Isleton, and Bethel Island are in the Primary Zone. Rio Vista is partly in the Primary Zone and partly outside the Delta. The DPC ESP highlights the rich cultural histories of these distinctive communities and notes the importance of enhancing their legacy themes and creating better awareness of them. It highlights planning to strengthen these communities by building on the agricultural uses that surround them. It also recommends enhancing the Delta’s recreation and tourism opportunities by improving these towns’ lodging, entertainment, and retail options; encouraging agritourism; restoring historic buildings; and promoting context-sensitive infill development, including housing for the Delta’s workforce.

Flood risks in these communities are higher than in the Delta’s cities, as noted in Chapter 7, and they are too small to be capable of financing major levee improvements without significant assistance. According to the ESP, opportunities for residential or visitor-serving recreation developments in these communities may be impaired if flood risks are too high or development regulations are unpredictable or too burdensome. Although improvements to these communities’ historic structures are exempt from Federal Emergency Management Agency (FEMA) floodproofing standards (FEMA 2008), flood risks, floodproofing standards for new development, and flood insurance costs can be barriers to business investment or development.

Climate Change

Historical, cultural, and economic resources of the Delta are subject to the impacts of climate change. An increase in sea level of up to 55 inches is projected to occur by 2100. Along with increased flood risk associated with rising sea levels and changes in runoff timing and intensity, levees, highways, and other infrastructure that support the Delta’s communities and economy will be threatened. In addition, land use...
planning is complicated by the prospect of rising sea levels and increased flooding that may accompany climate change. Rising water levels and more severe flooding will increase hazards to land uses and developments, and confound efforts to identify safe locations for new homes and businesses.

Impacts on agriculture, such as decreasing revenues, are also likely if Delta water supplies increase in salinity (Lund et al. 2007) and water demand increases. Impacts on agriculture from warming temperatures could reduce yields and increase vulnerability to weeds and pests (California Resources Agency 2008), as well as increase soil subsidence rates through increased rates of organic matter oxidation. In addition, Delta recreation and tourism could be affected by changes in Delta fisheries.

**Land Use Planning in the Delta and Suisun Marsh**

The land uses in the Delta are the result of myriad decisions made by residents, businesses, investors, and others since its settlement. These decisions are shaped today by local and State agencies that are responsible for planning or regulating land use or development. Primary authority for land use planning rests with the Delta’s twelve cities and five counties, which are required to adopt comprehensive long-range general plans to guide development. In addition, the Legislature has authorized three State agencies to oversee land use planning by local governments or directly regulate land use actions in the Delta and the Suisun Marsh: the Council, the DPC, and the San Francisco Bay Conservation and Development Commission (BCDC). The Council and the DPC have concurrent jurisdiction in the Delta’s Primary Zone, while the Council and BCDC have concurrent jurisdiction in the Suisun Marsh. The DPC and BCDC must ensure that local land use planning is consistent with their own laws and plans, and must also certify that any covered actions that they carry out or approve, such as updating their plans, are consistent with the Delta Plan (see Table 5-1).

**The Council’s Role**

The Legislature has declared that existing developed uses and future developments that are carefully planned and developed consistent with Delta Reform Act policies are essential to Californians’ economic and social well-being, especially those who live or work in the Delta. The Delta Reform Act includes six goals for managing land use (Water Code section 85022(d)):

1. **Protect, maintain, enhance, and, where feasible, restore the overall quality of the Delta environment and its natural and artificial resources.**
2. **Ensure the utilization and conservation of Delta resources, taking into account the social and economic needs of the people of the state.**

**State Agencies with Land Use Jurisdiction in the Delta**

<table>
<thead>
<tr>
<th>State Agency</th>
<th>Law</th>
<th>Plan</th>
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<tbody>
<tr>
<td>Delta Stewardship Council</td>
<td>Sacramento-San Joaquin Delta Reform Act of 2009</td>
<td>Delta Plan</td>
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</tbody>
</table>
(3) Maximize public access to Delta resources and maximize public recreational opportunities in the Delta consistent with sound resources conservation principles and constitutionally protected rights of private property owners.

(4) Encourage state and local initiatives and cooperation in preparing procedures to implement coordinated planning and development for mutually beneficial uses, including educational uses, in the Delta.

(5) Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.

(6) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

Goals 2, 3, and 4 are addressed in this chapter.

In addition, Water Code section 85305(a) provides, in part:

The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting...appropriate land uses.

Water Code section 85022(a) directs “state and local land use actions identified as covered actions pursuant to section 85057.5 be consistent with the Delta Plan” and that the section’s “findings, policies, and goals apply to Delta land use planning and development.” Thus, the Council’s role in reviewing land use actions is to consider the full range of State interests in the Delta, including the economic and social well-being of Californians, environmental protection, use and conservation of resources, public access and recreation, habitat restoration and enhancement, water quality, and flood protection.

The DPC’s Role

The DPC Land Use and Resource Management Plan for the Primary Zone of the Delta (2010) guides land uses in the Primary Zone. Local government general plans must be consistent with the DPC’s land use and resource management plan. Local government land use actions may be appealed to the DPC for review of consistency with the land use and resource management plan. Chapter 2 describes the special role that the Delta Reform Act gives to the DPC to review and comment on significant projects or programs, such as ecosystem restoration or flood control projects, under consideration by the Council. The referral of projects to DPC for its review and comment and the membership of the DPC chair on the Council assure that the Delta communities will have a voice concerning actions’ effects on existing and planned uses of the Delta.

The DPC’s management plan states these goals for land use in the Primary Zone (DPC 2010):

- Protect the unique character and qualities of the Primary Zone by preserving the cultural heritage, strong agricultural/economic base, unique recreational resources, and biological diversity of the Primary Zone. Direct new non-agriculturally oriented non-farmworker residential development within the existing unincorporated towns (Walnut Grove, Clarksburg, Courtland, Hood, Locke, and Ryde).

- Encourage a critical mass of farms, agriculturally-related businesses and supporting infrastructure to ensure the economic vitality of agriculture within the Delta.

DPC’s management plan also acknowledges the importance of balancing urban development with the protection of agriculture and other rural lands (DPC 2010):

- The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth increases the demand for developable land, particularly in areas near the Bay area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. Increasing concern exists regarding the potential for urbanization and projects in the Secondary Zone to impact the Primary Zone.
Thus, the DPC’s role in land use review is primarily to protect agricultural land, recreational uses, and biological diversity in the Delta’s Primary Zone from urban development, direct most residential development within existing towns, and ensure the economic vitality of Delta agriculture.

**BCDC’s Role**

The BCDC was established by the McAteer-Petris Act in 1965. The agency prepared the *San Francisco Bay Plan* to guide the conservation of the Bay’s natural resources and development of its shoreline. In 1977, BCDC’s authority was expanded to protect wildlife use and retain biological diversity of the Suisun Marsh under the Suisun Marsh Preservation Act. With respect to land use, the Suisun Marsh Preservation Act (Public Resources Code section 29003(e) and (f)) calls for:

- Development and implementation of plans and policies to protect the marsh from degradation by excessive human use
- Definition and establishment of a buffer area consisting of upland areas that have high wildlife values themselves and also contribute to the integrity and continued wildlife use of the wetlands within the marsh

BCDC’s *Suisun Marsh Protection Plan* (SMPP) guides land use and development in the Marsh (BCDC 1976). The SMPP designates an 89,000-acre primary management area of waterways, including Suisun, Honker, and Grizzly bays, tidal marshes, and managed wetlands; and a buffer zone of upland grasslands and agricultural land composing a 22,500-acre secondary management area. Both the Bay Plan and the SMPP apply to Suisun Marsh, and the SMPP controls if there is a conflict. BCDC also is the federally designated State coastal management agency for the San Francisco Bay segment of the California coastal zone. The federal Coastal Zone Management Act (CZMA) empowers BCDC to ensure that federal projects and activities are consistent with BCDC’s laws and policies. A marsh development permit from BCDC is required to place fill, dredge, construct a structure, substantially change land use, subdivide property, or grade land in the wetlands and waterways of the Suisun Marsh.

BCDC retains planning and permitting authority in the primary management area of the Marsh, but shares authority in the secondary management area with local government agencies and special districts. The Suisun Marsh Preservation Act authorizes BCDC to delegate authority to issue marsh development permits to local agencies and special districts with jurisdiction in the marsh after BCDC has certified that their components of the Suisun Marsh Local Protection Program (LPP) are consistent with the Suisun Marsh Preservation Act and the SMPP. BCDC first certified all the components of the LPP in the early 1980s. LPP components can be amended only after BCDC holds a public hearing and votes for recertification. Permits granted by local governments for projects in the secondary management area under the authority of their LPP component may be appealed to BCDC.

Thus, BCDC’s role in the Suisun Marsh is to protect the unique natural resources of the Suisun Marsh from the potential adverse effects of development by directly regulating land use in the primary management area of the marsh and working with local government to regulate land use in the secondary management area.

**Other Agency Jurisdictions**

Land use and development in the Delta are also affected by other State and federal agencies. The State Lands Commission has jurisdiction over hundreds of miles of waterways in the Delta, and issues leases for in-stream structures and uses. The Central Valley Flood Protection Board issues permits to encroach in floodways and State flood management facilities. The State and regional water quality control boards control discharges from development to public waters. The California Department of Fish and Wildlife (DFW) regulates projects that affect waterways or habitats of State-listed endangered or rare species.
Among federal agencies, FEMA has a significant effect in the region by establishing floodproofing standards for new development in communities that participate in its National Flood Insurance Program. The U.S. Army Corps of Engineers oversees the filling of public waters and wetlands. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service regulate development that affects essential fish habitat or federally listed endangered or rare species. Some Delta landowners see these complex rules as a barrier to the development and use of private land. As described in Chapter 2, the Delta Plan Interagency Implementation Committee will improve coordination among regulatory agencies to ease some of these barriers.

**Minimizing Land Use Conflicts**

Poorly sited or designed development can also encourage additional people to place their lives and property at risk as well as restrict ecosystem restoration opportunities (see Chapter 4 and Chapter 7). Many uses are already in hazardous locations. For example, about 116,000 residential structures are located in the 100-year floodplain of the Delta, mostly near Sacramento, West Sacramento, and Stockton. Almost 8,000 residences are below mean higher high water (DWR 2008). Land use planning is complicated by the prospect of rising sea levels and increased flooding that may accompany climate changes. Some necessary water facilities, ecosystem restoration projects, or flood management facilities may need to be located on farmlands or in other locations that are inconsistent with local land use plans. State and federal agency projects are not required to secure approvals from local governments or the DPC, but nevertheless should avoid conflicts with existing and planned land uses when feasible. These projects can alter scenic views, make noise, create conflicts with adjoining land uses, generate traffic, or disrupt transportation routes if not planned carefully. Fully considering local resident views and local government positions can minimize misunderstandings, reduce avoidable conflicts, and build trust and cooperation.

**The Delta’s Economy**

This section provides an overview of the primary sectors that make up the Delta economy. The Delta’s economy is primarily urban and service oriented. The Delta is a diverse, growing, and economically integrated region that in many respects is outperforming the state as a whole. Transportation, warehousing, and utilities are important sectors. Construction, housing, and real estate are also important, but have declined with the recent recession. Retail, education, health care, and accommodations are the top employment sectors. The Primary Zone is less diverse, and depends on agriculture and, to a lesser extent, recreation and tourism. Stockton, Sacramento, and other nearby urban areas provide employment for professionals who commute from the Primary Zone, and less-skilled workers commute into the Primary Zone to jobs in agriculture and food processing.

**Agriculture and the Delta’s Economy**

The total value of Delta crops was approximately $702 million in 2009. Truck and vineyard crops account for 54 percent of crop revenues on 18 percent of acreage. The top five Delta crops in terms of value were (1) processing tomatoes, (2) wine grapes, (3) corn, (4) alfalfa, and
asparagus. The highest per-acre values in the Delta come from truck crops mainly situated in the southern Delta and deciduous crops principally located in the northern Delta. Table 5-2 summarizes top crops by gross value and acreage.

**Top Five Crops in the Delta**

<table>
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<tr>
<th>Position (2009)</th>
<th>By Gross Value</th>
<th>By Acres Grown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tomatoes</td>
<td>Corn</td>
</tr>
<tr>
<td>2</td>
<td>Wine Grapes</td>
<td>Alfalfa</td>
</tr>
<tr>
<td>3</td>
<td>Corn</td>
<td>Tomatoes</td>
</tr>
<tr>
<td>4</td>
<td>Alfalfa</td>
<td>Wheat</td>
</tr>
<tr>
<td>5</td>
<td>Asparagus</td>
<td>Wine Grapes</td>
</tr>
</tbody>
</table>

Source: DPC 2012b

When related value-added manufacturing such as wineries, canneries, and dairy products are included, the total economic impact of Delta agriculture is 13,179 jobs, $1.059 billion in value added, and nearly $2.647 billion in economic output in the five Delta counties. Including value-added manufacturing, the statewide impact of Delta agriculture is 25,125 jobs, $2.135 billion in value added, and $5.372 billion in economic output (DPC 2012b).

See the Agriculture in the Delta section for a more detailed description of agriculture and its contribution to the Delta’s way of life and economy.

**The Delta’s Recreation and Tourism Economy**

Recreation and tourism are important contributors to the Delta’s economy. DPC’s ESP estimates that Delta recreation and tourism support 3,000 jobs with $100 million in wages in the Delta counties; $312 million in direct expenditures in the Delta by anglers, hunters, boaters, picnickers, campers, hikers, bicyclists, visitors driving for pleasure, and others who recreate in parks, wildlife areas, trails, or roadways; and a total of $175 million in value added to the regional economy. Statewide, Delta recreation and tourism support 5,200 jobs and contribute $348 million in value added.

Despite these significant contributions, the Delta’s recreation and tourism economy has been relatively flat since the 1990s. The recreation and tourism sectors suffer from limited recognition and understanding of the Delta, and the lack of an overall marketing strategy for the region. Brannan Island State Recreation Area, the best improved State park, is scheduled to close due to budget constraints. Many other public lands lack facilities for visitors. Motor boat registrations have declined in the region. Participation in fishing and hunting has declined also. Private-sector recreation and tourism businesses are stagnant, with employment unchanged over 2 decades and little investment in new facilities. Inadequate levees leave key visitor attractions, including the legacy communities, at risk, as described in Chapter 7. Flood risks, flood insurance, and difficulties in designing attractive but floodproof visitor facilities hinder new investment in recreation and tourism businesses.

**Other Contributors to the Delta Economy**

The Delta’s infrastructure not only supports its residents and businesses, but also includes facilities that transport people and products through the Delta from the Sierra on the east to the Bay Area on the west, or from the Sacramento Valley on the north to the San Joaquin Valley on the south. The Delta’s economy benefits from the surface transportation, utilities, and other infrastructure that crisscross the Delta to serve local needs, provide access to regional urban markets, and, in turn, link the Delta’s economy to national and global markets.

The Delta’s most recognizable infrastructure components are its levees, which are described in Chapter 7. Key transportation corridors include Interstates 80, 5, and 205; State Routes 4, 12, and 160; and railroads operated by Union Pacific, Burlington Northern Santa Fe, Amtrak, and the Altamont Commuter Express. County roads are important for transporting crops to market and for local circulation.
The ports at Stockton and West Sacramento are served by deep water shipping channels that the U.S. Army Corps of Engineers maintains along the San Joaquin and Sacramento rivers, and the Sacramento Deep Water Ship Channel. These ports connect to San Francisco Bay and ultimately to the Pacific Ocean, providing a valuable asset to Delta communities. Rice and other crops grown in the Central Valley and other products are exported across their docks, and fertilizer and other bulk commodities are imported. The Maritime Highway Corridor is a recent initiative to expand maritime traffic between the Delta ports and the Port of Oakland, in part to reduce truck travel and its air quality impacts. Areas for water-dependent industries are located in Collinsville, Rio Vista, Pittsburg, and Antioch, where they benefit from the Delta’s abundant and high-quality water.

Other infrastructure in the Delta includes water, drainage, and wastewater treatment facilities. Stockton and Sacramento draw drinking water at least partly from the Delta and discharge wastewater there. The Delta is the site of forebays, pumps, and water control structures of the Central Valley Project and State Water Project, as described in Chapter 3. Aqueducts and other facilities serving the East Bay Municipal Utility District, the Contra Costa Water District, and other areas are located in the Delta. Natural gas wells in the Delta fuel power plants and other energy uses. Wind turbines and other renewable power sources also are located in the Delta. Electric transmission lines and fuel pipelines cross the Delta to carry energy to energy users. Communications towers support broadcasting and telecommunications. These facilities need to be planned carefully to avoid conflicts with water supply, ecosystem restoration, or flood management facilities, and existing and planned land uses.

**Delta Investment Fund**

In 2009, the Legislature established a Delta Investment Fund in the State Treasury (Public Resources Code section 29778.5). DPC’s ESP recommends forming a regional agency to manage the fund, and to implement and facilitate economic development efforts, either through expansion of the DPC’s authority or creation of a joint powers authority composed of local governments.

**Agriculture in the Delta**

Agriculture is among the qualities that define the Delta as a place. This section provides additional detail about the role of agriculture and discusses issues such as subsidence and water quality that must be considered in policy making. The Delta’s initial reclamation created farmland, and ongoing maintenance of its levees and water controls allows for continued farming in the region. Agriculture dominates the Delta landscape, as shown on Figure 5-3, and provides the setting for Delta residents’ communities, homes, and job sites. Agriculture benefits from the Delta’s productive soils, special climate, and abundant water. Delta farms provide a local source of nutritious food and forage for nearby dairies. Farming, food processing, and related industries contribute significantly to the economy, particularly in the Delta’s Primary Zone, where they predominate economic output, employment, and value-added activities. Characteristic local crops, such as pears, asparagus, and dried beans, are celebrated at annual festivals and county fairs.

Agriculture in the Delta depends on high-quality farmland. Prime farmlands with the best soils comprise about 400,600 acres, close to 85 percent of all farmland in the Delta. Another 101,760 acres are unique farmland, farmland of statewide or local importance, or farmland of potential local importance (DOC 2009). Because of the fertile peat soils and the moderating marine influence, Delta agriculture’s per-acre yields are almost 50 percent higher than the state’s average (Trott 2007). As described in Chapters 3 and 4, reliable, abundant fresh water is also an essential contributor to Delta agriculture.
Agricultural Land Use in the Delta

Figure 5-3  Source: DDC 2008
Field crops and pasture cover most of the Delta agricultural acreage. In 2010, about one-fourth of farmland in the Delta was corn, much of which is harvested as silage and used in the dairy industry. Alfalfa, the second most widely planted crop, covered about 20 percent of the Delta’s farmland. Together, these croplands comprise about 10 percent of the irrigated acreage supporting California’s dairy industry. Barley, wheat, and oats were planted on about 69,000 acres. About 41,000 acres of irrigated pasture are used by livestock. Truck crops, including processing tomatoes, asparagus, cucumbers, potatoes, pumpkins, and melons, covered nearly 52,500 acres. Almost 31,000 acres support vineyards. Orchards of pears, almonds, walnuts, and cherries grow on about 17,000 acres (DPC 2012b).

The DPC ESP forecasts that high-value crops, including truck, deciduous, and vineyard crops, are likely to increase in coming decades, potentially increasing farm incomes and economic output. Lower value crops, including field and grain crops, are likely to decline. Some traditional Delta crops are losing markets due to changing consumer preferences and competition from other regions. For example, the Bartlett pear market peaked around World War I, when 50 percent of all Bartletts were produced in California, mainly in the Delta. Until 1930, the Delta was also the world’s asparagus capital, producing 90 percent of the globe’s production (DPC 2011). Today, a mere 7,200 acres of asparagus fields remain. But growth of wine grapes and other crops, and expansion of local crop processing, particularly winemaking, could enhance agriculture’s contribution to the Delta’s economy (DPC 2012b). Urban development, ecosystem restoration, or flood control facilities that take farmland out of production could hasten the decline of agriculture.

Value is added to Delta crops when they are processed for ease of use or shipment. Examples include food and beverage manufacturing, such as the tomato canneries or sugar processors that were prominent twentieth century Delta businesses. Today’s opportunities include winemaking or emerging sectors such as olive pressing. Special local markets that serve consumers in the Delta counties or Bay Area, such as farm-to-school programs or community-supported agriculture, also may provide new markets for some Delta crops. Facilities that improve the region’s capacity to aggregate and distribute its crops to these local markets may enhance Delta agriculture (SACOG 2011). Consistent interpretation and application of regulations about food processing and distribution could help local producers and distributors establish facilities (Sumner and Rosen-Molina 2011).

Protecting Productive Farmlands

Although agriculture is the principal land use in the Delta, the total area of agricultural lands (including fallow lands) in the combined Delta and Suisun Marsh area has declined from about 549,420 acres in 1984\(^1\) to 460,450 acres in 2008, and the percentage of agricultural land has decreased from about 65 percent of this combined area in 1984 to about 55 percent in 2008 (DOC 1984, DOC 1988, DOC 1990, DOC 2008). An additional 28,000 acres of farmland may be lost in the near future under current local government general plans. The Delta Plan acknowledges this loss since it focuses growth within existing city boundaries. However, any further loss of farms to urban development is unacceptable. The continued viability of agriculture in the Delta will require the protection of sufficient farmland and fresh water to support commercially viable operations and provide ways for agriculture to coexist with habitat restoration. Policies DP P1 and DP P2 acknowledge the importance of protecting these lands. The DPC and local governments play key roles in the protection of these lands.

The loss of some farmland to urbanization, habitat, and flooding is inevitable, the DPC ESP concludes; but continued shifts to higher-valued crops and value-added activities, as well as planning restoration in appropriate locations, may help compensate if land loss is not too great. As described in Chapter 4, elevations, locations, and other factors are key

\(^1\) Data for Sacramento and San Joaquin counties were not available in the 1984 DOC report; thus, data for these counties were taken from the 1988 and 1990 reports, respectively.
determinants of the optimal sites for ecosystem restoration. When these restoration areas include farmlands, achieving the coequal goals of restoring the Delta ecosystem and improving water supply reliability may make some loss of productive agricultural lands unavoidable. Some conveyance alternatives could take farmland out of production, too. Improving flood control facilities may also unavoidably affect some farmland.

**Subsidence**

The reclamation of Delta islands and their cultivation for agriculture initiated a process of land subsidence, mostly due to oxidation of peat soils, but also from wind erosion. Drainage and cultivation dried the saturated peat, reducing its volume by approximately 50 percent. Early cultivation practices also included burning, which further reduced the volume of the soil and altered its structure. Over time, long-term oxidation reduced about 2.6 to 3.3 billion cubic yards of these peaty soils to small particles and gases. As a result, much of the central Delta today is below sea level, with some islands 12 to 15 feet below sea level. Many islands now more closely resemble bowls surrounded by water, with high sides defined by levees and deep, hollowed-out bases. Although subsidence has slowed in some areas, other regions of the Delta continue to lose soil to oxidation and wind erosion at a rate of 5 to 15 tons/acre/year. It is projected that some areas of the Delta could subside an additional 2 to 4 feet by 2050 (Deverel and Leighton 2010), resulting in the loss of up to 350 to 500 million cubic yards of soil at a rate of 5 to 15 tons/acre/year (see Figure 5-4).

Land subsidence impairs Delta agriculture, not only because of soil loss, but also by increasing the difficulty of maintaining drainage systems and levees. As described in Chapter 7, subsidence makes levees less stable and increases flood risks. The costs to recover a flooded island could be great. Some suggest that many islands would cost more to reclaim after flooding than the value of the land for agriculture. In 1998, 4,200 acres of farmland were lost when Liberty Island flooded and was not reclaimed (Reclamation District 2093 2009). Other once-farmed islands that were not reclaimed after flooding include Big Break, Franks Tract, and Mildred Island (Suddeth et al. 2010).

Oxidation of peat soils also liberates vast quantities of carbon dioxide (CO₂), contributing to global warming (Armentano 1980). Oxidation of the Delta’s agricultural soils emits about 4.4 to 5.3 million tons of CO₂ annually (Delta Conservancy 2012). For comparison, a typical 500-megawatt coal-fired power plant emits 3 million tons of CO₂ per year.

The potential to retire croplands on deeply subsided islands and manage them to rebuild peat and sequester carbon is sometimes pondered as an alternative to continued farming (Armentano 1980). State and federal agency investigations of alternative land management practices show that soils can be rebuilt, reversing subsidence and sequestering carbon, with some appropriately managed activities, such as tule farming (Miller 2008). Recent actions by the California Air Resources Board, under the California Global Warming Solutions Act of 2006 (Health and Safety Code section 38500 et seq.), provide for the development of a carbon market program, whereby certain activities may be considered acceptable for providing offset credits. Although this program is still in its initial stages, future opportunities may exist for Delta farmers to gain offset credits for growing plants that promote subsidence reversal and sequester carbon.

**Agriculture and Water Quality**

The DPC’s ESP provides scenarios for how potential declines in water quality that could accompany some water conveyance, ecosystem restoration, or water quality actions could affect Delta agriculture. The potential for the agricultural economy to grow in the Delta will depend, in part, on the protection of the Delta’s abundant fresh water and the policy response. Chapter 6 contains a detailed discussion of water quality and the Council’s strategies for water quality.
CHAPTER 5 PROTECT AND ENHANCE THE UNIQUE CULTURAL, RECREATIONAL, NATURAL RESOURCE, AND AGRICULTURAL VALUES OF THE CALIFORNIA DELTA AS AN EVOLVING PLACE

.Subsidence in the Delta

Current Delta Elevations

Projected Subsidence, 2007–2050

Oxidation of peat soils through natural processes and human activities has caused the land elevation in the Delta to drop. Much of the central Delta is now at or below sea level. Future subsidence has been projected in these areas. As subsidence progresses, levees must be continually maintained, strengthened, and periodically raised to support increasing hydraulic stress.

Wildlife-friendly Agriculture

Agriculture has the potential to coexist with and even enhance restoration of the Delta ecosystem despite the conversion of some farmland to habitat. Techniques that integrate management of agriculture and wildlife habitat, often called “wildlife-friendly agriculture,” include crop rotations that include soil-building crops or fallowing; integrated pest management to reduce pesticides; cover crops; the strategic use of permanent crops, such as pasture, to reduce soil disturbance and oxidation; and conservation tillage for field and row crops (Trott 2007). Some native species have adapted to using agricultural lands as habitat in place of tidal marshes, grasslands, and seasonal wetlands. Rice and other flood-irrigated crops support a range of wildlife, especially waterfowl, shorebirds, wading birds, and giant garter snakes. Swainson’s hawk, other raptors, and coyote feed on small mammals and ground-nesting birds that inhabit alfalfa fields and other irrigated pastures. Waste grain also provides food for species such as ring-necked pheasant and greater sandhill crane (Trott 2007).

To support Delta agriculture and species recovery, farmers in the Delta are encouraged to implement management practices to maximize habitat values. Some U.S. Department of Agriculture (USDA) programs provide financial incentives for landowners to manage natural areas on their properties, including the Wildlife Habitat Incentives Program, the Environmental Quality Incentives Program, and the Conservation Reserve Program. The DFW, U.S. Fish and Wildlife Service,
and Delta Conservancy also can assist landowners who want to enhance wildlife habitat.

As described in Chapter 4, safe harbor agreements can assure these landowners that the presence of an endangered species on their property will not result in restrictions on activities on their land. Facilitating and creating standard rules for these agreements with Delta landowners may encourage more landowners to participate in conservation programs. Restoring wildlife and fish through wildlife-friendly agriculture can help achieve ecosystem restoration objectives while reducing the loss of farmland to habitat restoration.

**Agritourism**

Agritourism is another opportunity to add further value to the Delta economy from agricultural activities. Defined as recreational, educational, and other visits to working farms, agritourism is a small but fast-growing source of income for farms in the region and a growing segment of the Delta economy. In the Delta, agritourism destinations may include wineries, on-farm duck clubs, farm stands, and other places. Agritourism was estimated by USDA to generate $4 million in income for farms in the five Delta counties in 2007 (DPC 2012b). For farmers who choose to participate, agritourism can provide additional income, an opportunity to sell farm products directly to consumers, or alternative uses for unproductive lands or buildings. The Discover the Delta Foundation’s Delta Discovery Center combines several agritourism functions, including a produce stand, wine sales, and interpretive features that teach people about the Delta’s importance (Sumner and Rosen-Molina 2011).

**Recreation and Tourism in the Delta**

This section provides an overview of recreation and tourism in the Delta. DPC estimates that about 12 million activity days of recreation occur in the Delta annually (DPC 2012b). Recreational users originate from both within and outside the Delta. Visitors value the wide expanses of open land, interlaced waterways, historic towns, and the lifestyle offered by the Delta. The region’s mix of land and water offers diverse recreation experiences and facilities, including fishing, boating, birdwatching, other nature activities, hunting, enjoying restaurants, campgrounds, picnic areas, and historic towns and buildings. Recreation also benefits from the Delta’s open, agricultural landscape, with its scenic vineyards, orchards, and farmsteads. These are often backed by views of Mt. Diablo or the Montezuma Hills on the horizon, which provide a setting for outdoor photography, a scenic bike ride, or a drive along the Delta’s roads. Special events draw visitors to taste local produce and wine, and learn about this unique place. These recreation opportunities are described in more detail in the DPC’s ESP and in the Recreation Proposal that California State Parks submitted to the Council and DPC pursuant to Water Code section 85301(c)(1).

Figure 5-5 shows the locations of State parks and other protected lands in the Delta. Figure 5-6 shows the variety and distribution of some of these opportunities in the Delta.
State Parks and Other Protected Lands

Figure 5-5

Source: California State Parks 2011
CHAPTER 5 PROTECT AND ENHANCE THE UNIQUE CULTURAL, RECREATIONAL, NATURAL RESOURCE, AND AGRICULTURAL VALUES OF THE CALIFORNIA DELTA AS AN EVOLVING PLACE

Major Delta Resources and Recreation

Figure 5-6

Sources: California Chambers and Visitors Bureau 2010, California Resources Agency 2007, DPC 2006, Discover the Delta Foundation 2010, California Department of Fish and Game 2009
The DPC ESP and the California State Parks Recreation Proposal both foresee opportunities to increase recreation and tourism in the Delta as the population of surrounding areas grows, especially with improved branding and marketing. Both reports emphasize improvements of “gateways” to the region on the Delta’s urban edges and “base camps,” focal points for visitors inside the Delta at destinations such as resorts, legacy communities, and parks. They also recommend diversifying dispersed outdoor recreation “adventures” at points of interest and activity areas for boaters, nature area visitors, and others. Ecosystem restoration, as described in Chapter 4, can enhance opportunities for nature-based recreation and boating, especially by nonmotorized boats, according to both reports.

The California State Parks Recreation Proposal recommends enhancing State parks and other State agencies’ properties and programs to create a network of recreation areas in the Delta, and encourages improvement of public access along the shorelines of growing Delta communities, consistent with Water Code section 85022(d)(3). It recommends that recreation improvements be provided in new water management and habitat restoration projects unless they are inconsistent with the project purposes, in conformance with Water Code sections 11910–11915.5, or public safety. DPC’s ESP also recommends that recreation facilities be included in ecosystem restoration projects when feasible. Additionally, the ESP emphasizes growing the tourism and recreation economy through private, visitor-serving businesses, and collaboration and partnerships between public- and private-sector recreation providers.

Future prospects for Delta recreation and tourism will be strongly influenced by decisions about the Delta ecosystem, water quality, levee improvements, and governance, including land use and environmental standards. The Bay Delta Conservation Plan (BDCP), Delta water quality plans, levee investments, and other decisions yet to be made can all significantly affect recreation and tourism.

**Boating**

Navigable waterways in the Delta and Suisun Marsh are available for public access and provide many recreational opportunities. Boating activities total more than 6.4 million visitor days annually, composed of 2.13 million annual boat trips with a projected growth to 8 million visitor days by 2020, according to the Department of Boating and Waterways. Almost 100 marinas, with more than 11,000 boat slips, and almost 60 launch ramp lanes support boating in the Delta and Suisun Marsh (DBW 2002). Popular activities include powerboating on the Sacramento and San Joaquin rivers, paddling sloughs and channels in canoes and kayaks, and sailing on the open water of Suisun and Honker bays. About 116,000 boats are registered in the five Delta counties, creating a large pool of potential recreationists (California State Parks 2011).

**Public Recreation Lands**

Public lands comprise about 10 percent of the Delta. State and local parks, State or national wildlife areas and refuges, ecological preserves, and other public lands provide important sites for relaxing outdoors, a family picnic, camping, and other outdoor recreation in the Delta. California State Parks owns three properties in the Delta: Brannan Island State Recreation Area and properties at Locke Boarding House-Delta Meadows and Stone Lakes. The DFW and the State Lands Commission also manage important State-owned recreation areas. The largest State ownerships are the California Department of Water Resources (DWR) lands on Sherman and Twitchell islands, which are available seasonally for hunting.
Table 5-3 summarizes the agency responsibilities, recreation-related opportunities, and examples of recreation facilities in the Delta managed by the State. City and county parks, including those of the East Bay Regional Park District, also provide important public recreation areas. These public lands are increasingly important for Delta recreation because privately owned riverbanks and levees, which comprise most of the Delta’s shoreline, are increasingly posted to prevent trespass, reducing access to rivers and sloughs for bank fishing, nature observation, and outdoor relaxation.

### State Agencies with Responsibility for Recreation in the Delta

<table>
<thead>
<tr>
<th>State Agency Name and Role</th>
<th>Recreation-related Facilities and Opportunities</th>
<th>Delta and Suisun Marsh Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State Parks offers high-quality outdoor recreation and educational opportunities, protects natural and cultural resources, awards grants for local parks, and oversees the California Recreational Trails System.</td>
<td>Day-use picnic areas, campgrounds, marinas, trails, excursion railroads, interpretive services, heritage resource protection, restrooms</td>
<td>Brannan Island State Recreation Area, Old Sacramento State Historic Park, American Discovery Trail</td>
</tr>
<tr>
<td>California Department of Fish and Wildlife manages hunting and fishing; operates public lands for wildlife conservation, hunting, fishing, environmental education, and nature study; and encourages private conservation.</td>
<td>Ecological reserves, wildlife areas, boat launches, nature-based recreation and events, fish hatcheries.</td>
<td>Woodbridge Ecological Reserve, Grizzly Island Wildlife Area, Clarksburg boat launch.</td>
</tr>
<tr>
<td>California Department of Boating and Waterways provides public recreational boating facilities on public lands, marine patrol law enforcement, boating safety and clean and green education, and controls of aquatic invasive species.</td>
<td>Public boat launching facilities, public visitor docks, boat-in day use and overnight facilities, vessel pumpout facilities, floating restrooms, floating campsites.</td>
<td>Antioch Marina, Brannan Island State Recreation Area, Sherman Island, Belden’s Landing, Bethany Reservoir, and Rio Vista boat launch facilities.</td>
</tr>
<tr>
<td>California Department of Transportation operates state highways, historic bridges, and ferries, and designates state scenic highways.</td>
<td>Scenic highways, ferries, historic bridges.</td>
<td>State Highway 160, J-Mack Ferry, Steamboat Slough Bridge.</td>
</tr>
<tr>
<td>California Department of Water Resources manages California’s water resources, including State Water Project reservoirs, dams, land, and waterways available for recreation use.</td>
<td>Reservoirs, water conveyance infrastructure (canals, diversion sites, waterway flows), flood control projects, habitat management sites and facilities.</td>
<td>Bethany Reservoir, Sacramento River flows, Fremont Weir, Suisun Marsh salinity control structure, Dutch Slough habitat restoration project.</td>
</tr>
</tbody>
</table>
TABLE 5.3

<table>
<thead>
<tr>
<th>State Agency Name and Role</th>
<th>Recreation-related Facilities and Opportunities</th>
<th>Delta and Suisun Marsh Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacramento-San Joaquin Delta Conservancy</td>
<td>Projects that enhance natural resources, cultural resources, or economic sustainability in a manner complementary to increased recreation, tourism, and environmental education</td>
<td>The Delta Plan, Bay Delta Conservation Plan, Economic Sustainability Plan, and Delta Conservancy Strategic Plan will guide projects</td>
</tr>
<tr>
<td>State Coastal Conservancy</td>
<td>Shoreline accessways, trails, habitat protection and restoration areas, farmland and open space protection</td>
<td>Rush Ranch protection, San Francisco Bay Area water trail, Marsh Creek stream restoration and trail</td>
</tr>
<tr>
<td>Delta Protection Commission</td>
<td>Heritage resource recognition and enhancement, agritourism program, regional trails</td>
<td>National Heritage Area feasibility study, Great California Delta Trail, Economic Sustainability Plan</td>
</tr>
</tbody>
</table>

Source: California State Parks 2011

Nature-based Recreation

Many recreation opportunities depend on the region’s wildlife and fish, which support angling, nature observation, and hunting. Anglers pursue native fish, such as salmon and sturgeon, and introduced species such as striped bass, largemouth bass, and catfish. Some of the most visited public wildlife areas include the Yolo Bypass Wildlife Area, Lower Sherman Island, Calhoun and Acker Island, Stone Lakes National Wildlife Refuge, Cosumnes River Preserve, Solano County Land Trust’s Jepson Prairie and Rush Ranch, and Suisun Marsh’s wildlife management areas, including Grizzly Island and Joice Island. Hunting waterfowl is especially important in Suisun Marsh, most of which is managed by private duck clubs. Careful management of wildlife and fish is important to maintaining nature-based recreation, which can benefit from the restoration of fisheries and expansion of wildlife habitat.

Heritage Tourism

The Delta’s legacy communities and other historic sites, from house museums to twentieth century industrial sites and weather-beaten marine facilities, attract history buffs and heritage tourists. Museums, nature centers, and interpretive programs draw visitors who want to learn about the Delta’s natural and cultural resources. The region’s productive farms and wineries, and its diverse ethnic heritage are attractions for food and wine tourism, and for community festivals and other special events. (Agritourism is discussed earlier in the Agriculture in the Delta section.)

Linking these areas and providing access to them are the Delta’s waterways and roads. State Route 160 has a special role and provides visitors from metropolitan Sacramento and Contra Costa County with access to the Sacramento River, legacy communities, and the Delta’s State parks. Its attractive rural landscape is reflected in its designation as a state scenic...
highway. California State Parks’ Recreation Proposal recommends that the California Department of Transportation seek national scenic byway status for this route and prepare a scenic byway plan that would identify opportunities to improve signage, interpretation, and amenities for access, recreation, and nonautomobile circulation. A national scenic byway is a road recognized by the U.S. Department of Transportation for its archaeological, cultural, historic, natural, recreational, and/or scenic qualities. The program preserves and protects the nation’s scenic but often less-traveled roads, and promotes tourism and economic development. Funding for byway-related projects is granted annually by the Federal Highway Administration. State Routes 4 and 12 are also important for recreational travel.

The American Discovery Trail, Mokelumne Coast-To-Crest Trail, and Great Delta Trail (Public Resources Code section 5852 et seq.) are State trails that can provide recreational access for bicyclists, hikers, and others. DPC’s ESP and California State Parks’ Recreation Proposal also recommend a system of water trails to guide boaters through the Delta’s channels.

POLICIES AND RECOMMENDATIONS

The policies and recommendations presented in this section address the unique values that distinguish the Delta and make it a special region, and outline the Council’s five core strategies for protecting and enhancing these values as follows:

- Designate the Delta as a special place worthy of national and state attention
- Plan to protect the Delta’s lands and communities
- Maintain Delta agriculture as a primary land use, a food source, a key economic sector, and a way of life
- Encourage recreation and tourism that allow visitors to enjoy and appreciate the Delta and that contribute to its economy
- Sustain a vital Delta economy that includes a mix of agriculture, tourism, recreation, commercial and other industries, and vital components of state and regional infrastructure

Protecting the Delta also depends on the strategies to reduce flood and other risks, as detailed in Chapter 7.

Designate the Delta as a Special Place

Designating the Delta as a special place can build public recognition of the Delta and its unique resources. The DPC proposes to seek the Delta’s designation as an NHA to recognize and promote “Delta-as-a-Place” and to cultivate appreciation and understanding of the Delta. The DPC recommends that the NHA include the legal Delta and Suisun Marsh, as well as adjoining areas in Rio Vista and the Carquinez Strait.

The proposed NHA’s vision is “a regional network of partner sites, with interpretive/educational components, that will be linked where possible and serve as the primary attractions, on existing public properties or on private properties with the voluntary consent and involvement of the landowners.” The NHA’s goals are to “brand the Delta as a region of national significance to educate the public about ‘Delta-as-a-Place,’ and build more support for preserving, protecting, and enhancing the Delta.” Other goals relate to economic development, public access, historic preservation, interpretation, and more.

Although State Route 160 is already recognized as a state scenic highway, national scenic byway status under the U.S. Department of Transportation and a scenic byway plan would provide opportunities to improve signage, interpretation, and amenities for access, recreation, and nonautomobile circulation. The byway...
program would qualify the route for special funding from the Federal Highway Administration.

**Problem Statement**

Because the Delta is different, it is sometimes unappreciated and misunderstood. Without a clear message about the Delta and its importance, the region and its resources can suffer from inattention or misuse. If the Delta’s unique cultural, recreational, and agricultural values are not recognized, they are unlikely to be protected and enhanced.

**Policies**

No policies with regulatory effect are included in this section.

**Recommendations**

**DP R1. Designate the Delta as a National Heritage Area**

The Delta Protection Commission should complete its application for designation of the Delta and Suisun Marsh as a National Heritage Area, and the federal government should complete the process in a timely manner.

**DP R2. Designate State Route 160 as a National Scenic Byway**

The California Department of Transportation should seek designation of State Route 160 as a National Scenic Byway, and prepare and implement a scenic byway plan for it.

**Plan to Protect the Delta’s Lands and Communities**

Protecting the Delta’s lands and communities involves a multipronged policy approach. In the coming years and decades, the Delta will face increasing pressures from a growing population, changes in commodity markets, and changes in climate and sea level that will require flexibility and adaptation.

Some changes will be driven by the Delta’s role in California’s water systems, and they will be required to meet statewide goals of restoring the Delta’s ecosystem and improving water supply reliability. These and other changes will shape how the Delta’s communities and history are preserved, guide new development, affect recreation and tourism, and influence agriculture, business expansion, and economic development.

The policies and recommendations below reflect the Council’s approach to fostering land uses and development that are resilient to these changes, reduce risks to people and property, adjust to changing conditions, and recover readily from distress. Protecting the Delta also depends on sustaining its economic vitality and maintaining the region as a desirable place to live, do business, and visit.

The maps that the following policies and recommendations reference are based on the best information available to the Council, but they may not precisely match either the built environment or local government land use plans. Where uncertainty exists with respect to the boundaries of areas referenced in these policies, the following rules should be considered in making determinations:

- The areas depicted should be assumed to generally follow parcel lines or other major landmarks, such as a road or highway, or river and stream.
- Local government general plans, including their land use diagrams, in effect at the time of the Delta Plan’s adoption, may be consulted.

**Problem Statement**

Poorly sited or designed projects can detract from the values that contribute to the Delta’s distinctive character, including its primarily rural, agricultural landscape; conflict with established uses, including farming and tourism; reduce opportunities for ecosystem restoration; or increase flood risks. By limiting significant new development to areas currently designated for development in cities, their SOIs, and unincorporated towns, the Council intends to foster a land use pattern that enhances the Delta’s unique sense of place by protecting agriculture and the open, rural landscape while reducing risks to people and property.

Outside the urban areas and towns mentioned above, in areas designated as agriculture, open space, recreation, natural preserve or marsh, or public/quasi-public, minor projects that are consistent with local land use designations, such as farmworker housing in areas designated as agriculture, are also appropriate. Similar limitations are already in place in the Primary Zone of the Delta, where the Delta Protection Act requires that new development must be consistent with the DPC’s Land Use and Resource Management Plan. Additional protections for the Secondary Zone are needed. Diligent local
implementation of State law regarding flood protection in urban, urbanizing, and rural lands, and the National Flood Insurance Program will provide complementary flood protection benefits. New residential subdivisions, if any, in rural areas will also need to include adequate flood protection, as described in RR P2.

Therefore, outside the urban areas and towns mentioned above, in areas that are designated as agriculture, open space, recreation, natural preserve or marsh, or public/quasi-public, the Council intends to enable counties to move forward with approval of minor projects that are consistent with these designations, such as farmworker housing in areas designated as agriculture. However, any proposals to site new residential development in rural areas will need to include adequate flood protection, as described in RR P2.

Careful planning for development in legacy communities is needed to protect their unique character and overcome barriers to investment. The Delta’s urban areas will also continue to need sites for housing, employment, and businesses, supported by adequate roads and other infrastructure. Water management facilities, ecosystem restoration actions, and flood control projects will need to be accommodated in the Delta, too. Avoiding condemnation of property for water management, ecosystem restoration, and flood management facilities, when feasible, can promote better relations with Delta residents and local governments.

Policies

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

**DP P1. Locate New Urban Development Wisely**

(a) New residential, commercial, and industrial development must be limited to the following areas, as shown in Appendix 6 and Appendix 7:

(1) Areas that city or county general plans as of May 16, 2013, designate for residential, commercial, and industrial development in cities or their spheres of influence;

(2) Areas within Contra Costa County’s 2006 voter-approved urban limit line, except no new residential, commercial, and industrial development may occur on Bethel Island unless it is consistent with the Contra Costa County general plan effective as of May 16, 2013;

(3) Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or

(4) The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove.

(b) Notwithstanding subsection (a), new residential, commercial, and industrial development is permitted outside the areas described in subsection (a) if it is consistent with the land uses designated in county general plans as of May 16, 2013, and is otherwise consistent with this Chapter.

(c) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve new residential, commercial, and industrial development that is not located within the areas described in subsection (a). In addition, this policy covers any such action on Bethel Island that is inconsistent with the Contra Costa County general plan effective as of May 16, 2013. This policy does not cover commercial recreational visitor-serving uses or facilities for processing of local crops or that provide essential services to local farms, which are otherwise consistent with this Chapter.

(d) This policy is not intended in any way to alter the concurrent authority of the Delta Protection Commission to separately regulate development in the Delta’s Primary Zone.

23 CCR Section 5010

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85022, 85300, 85302, and 85305, Water Code.

**DP P2. Respect Local Land Use When Siting Water or Flood Facilities or Restoring Habitats**

(a) Water management facilities, ecosystem restoration, and flood management infrastructure must be sited to avoid or reduce conflicts with existing uses or those uses described or depicted in city and county general plans for their jurisdictions or spheres of influence when feasible, considering comments from local agencies and the Delta Protection Commission. Plans for ecosystem restoration must consider sites on existing public lands, when feasible and consistent with a project’s purpose, before privately owned sites are purchased. Measures to mitigate conflicts with adjacent uses may include, but are not limited to, buffers to prevent adverse effects on adjacent farmland.
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(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve the siting of water management facilities, ecosystem restoration, and flood management infrastructure.

23 CCR Section 5011
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85022, 85054, 85300, and 85305, Water Code.

Recommendations

DP R3. Plan for the Vitality and Preservation of Legacy Communities

Local governments, in cooperation with the Delta Protection Commission and Delta Conservancy, should prepare plans for each community that emphasize its distinctive character, encourage historic preservation, identify opportunities to encourage tourism, serve surrounding lands, or develop other appropriate uses, and reduce flood risks.

DP R4. Buy Rights of Way from Willing Sellers When Feasible

Agencies acquiring land for water management facilities, ecosystem restoration, and flood management infrastructure should purchase from willing sellers, when feasible, including consideration of whether lands suitable for proposed projects are available at fair prices.

DP R5. Provide Adequate Infrastructure

The California Department of Transportation, local agencies, and utilities should plan infrastructure, such as roads and highways, to meet needs of development consistent with sustainable community strategies, local plans, the Delta Protection Commission’s Land Use and Resource Management Plan for the Primary Zone of the Delta, and the Delta Plan.

DP R6. Plan for State Highways

The Delta Stewardship Council, as part of the prioritization of State levee investments called for in Water Code section 85306, should consult with the California Department of Transportation as provided in Water Code section 85307(c) to consider the effects of flood hazards and sea level rise on State highways in the Delta.

DP R7. Subsidence Reduction and Reversal

The following actions should be considered by the appropriate State agencies to address subsidence reversal:

- State agencies should not renew or enter into agricultural leases on Delta or Suisun Marsh islands if the actions of the lessee promote or contribute to subsidence on the leased land, unless the lessee participates in subsidence reversal or reduction programs.

- State agencies currently conducting subsidence reversal projects in the Delta on State-owned lands should investigate options for scaling up these projects if they have been deemed successful. The California Department of Water Resources should develop a plan, including funding needs, for increasing the extent of their subsidence reversal and carbon sequestration projects to 5,000 acres by January 1, 2017.

- The Delta Stewardship Council, in conjunction with the California Air Resources Board (CARB) and the Delta Conservancy, should investigate the opportunity for the development of a carbon market whereby Delta farmers could receive credit for carbon sequestration by reducing subsidence and growing native marsh and wetland plants. This investigation should include the potential for developing offset protocols applicable to these types of plants for subsequent adoption by the CARB.

Maintain Delta Agriculture

Agriculture is the principal land use in the Delta; however, in recent decades, the total area of agricultural lands has declined, as has the overall percentage of lands in agricultural use. The continued viability of agriculture in the Delta will require the protection of sufficient farmland and fresh water to support commercially viable operations and provide ways for agriculture to coexist with habitat restoration. Policies DP P1 and DP P2 acknowledge the importance of protecting these lands. Farming in the Delta will have to respond to changing conditions and new challenges in the coming years. Among these challenges are shifting commodity markets and consumer demand, changes in climate and water supplies, and subsidence of reclaimed agricultural lands. To support both Delta agriculture and species recovery, farmers in the Delta are encouraged to implement “wildlife-friendly” management practices to maximize habitat values. Restoring wildlife and fish through wildlife-friendly agriculture can help achieve ecosystem restoration objectives while reducing the loss of farmland to habitat restoration. Agritourism is a small but fast-growing source of income for farms in the region. It is another opportunity to add further value to the Delta economy from agricultural activities.
Problem Statement

Agriculture in some parts of the Delta is threatened by urbanization, subsidence, and changing markets due to increased competition from other countries and regions, and shifting consumer preferences. The impacts from water conveyance facilities, ecosystem restoration, changing water quality, and flood management plans are yet to be determined, but rapid and significant changes could disrupt agriculture. Farmers are concerned that regulations and other barriers to conducting business and using their land also threaten the continued viability of agriculture.

Policies

No policies with regulatory effect are included in this section.

Recommendations

DP R8. Promote Value-added Crop Processing
Local governments and economic development organizations, in cooperation with the Delta Protection Commission and the Delta Conservancy, should encourage value-added processing of Delta crops in appropriate locations.

DP R9. Encourage Agritourism
Local governments and economic development organizations, in cooperation with the Delta Protection Commission and the Delta Conservancy, should support growth in agritourism, particularly in and around legacy communities. Local plans should support agritourism where appropriate.

DP R10. Encourage Wildlife-friendly Farming
The California Department of Fish and Wildlife, the Delta Conservancy, and other ecosystem restoration agencies should encourage habitat enhancement and wildlife-friendly farming systems on agricultural lands to benefit both the environment and agriculture.

Encourage Recreation and Tourism

The Delta region offers diverse recreation experiences and facilities such as fishing, boating, birdwatching, other nature activities, hunting, campgrounds, parks and picnic areas, and historic towns and buildings. DPC and California State Parks foresee opportunities to improve and increase recreation and tourism in the Delta. Both agencies recommend improvements of “gateways” to the region on the Delta’s urban edges and “base camps” inside the Delta at destinations such as resorts, legacy communities, or parks that are focal points for visitors. Building on the reports of the DPC and California State Parks, the Council recommends protecting and improving existing recreation opportunities while seeking ways of providing new, and better coordinated, opportunities. Ecosystem restoration, as described in Chapter 4, can also enhance opportunities for nature-based recreation and boating. Future prospects for recreation and tourism will be influenced by decisions about the Delta ecosystem, water quality, levee improvements, and governance, including land use and environmental standards. The BDCP, Delta water quality plans, levee investments, and other decisions yet to be made can all significantly affect recreation and tourism.

Problem Statement

Recreation opportunities abound, but many have not been fully developed due to inadequate visitor information, aging and inadequate facilities, and restricted access to public lands. Limited cooperation in marketing, planning, and public-private partnerships between public recreation providers, other government land managers, businesses, and others hinders recreation and tourism, and impedes expansion of visitor-serving businesses.

Policies

No policies with regulatory effect are included in this section.

Recommendations

DP R11. Provide New and Protect Existing Recreation Opportunities
Water management and ecosystem restoration agencies should provide recreation opportunities, including visitor-serving business opportunities, at new facilities and habitat areas whenever feasible; and existing recreation facilities should be protected, using California State Parks’ Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh and Delta Protection Commission’s Economic Sustainability Plan for the Sacramento-San Joaquin Delta as guides.
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DP R12. Encourage Partnerships to Support Recreation and Tourism

The Delta Protection Commission and Delta Conservancy should encourage partnerships between other State and local agencies, and local landowners and business people to expand recreation, including boating, promote tourism, and minimize adverse impacts to nonrecreational landowners.

DP R13. Expand State Recreation Areas

California State Parks should add or improve recreation facilities in the Delta in cooperation with other agencies. As funds become available, it should fully reopen Brannan Island State Recreation Area, complete the park at Delta Meadows-Locke Boarding House, and consider adding new State parks at Barker Slough, Elkhorn Basin, the Wright-Elmwood Tract, and south Delta.

DP R14. Enhance Nature-based Recreation

The California Department of Fish and Wildlife, in cooperation with other public agencies, should collaborate with nonprofits, private landowners, and business partners to expand wildlife viewing, angling, and hunting opportunities.

DP R15. Promote Boating Safety

The California Department of Boating and Waterways should coordinate with the U.S. Coast Guard and State and local agencies on an updated marine patrol strategy for the region.

DP R16. Encourage Recreation on Public Lands

Public agencies owning land should increase opportunities, where feasible, for bank fishing, hunting, levee-top trails, and environmental education.

DP R17. Enhance Opportunities for Visitor-serving Businesses

Cities, counties, and other local and State agencies should work together to protect and enhance visitor-serving businesses by planning for recreation uses and facilities in the Delta, providing infrastructure to support recreation and tourism, and identifying settings for private visitor-serving development and services.

Sustain a Vital Delta Economy

Many of the policies and recommendations in this chapter deal with aspects of the Delta’s economy such as maintaining agriculture and encouraging recreation and tourism. The Delta’s economy also benefits from the surface transportation, utilities, and other infrastructure that crisscross the Delta to serve local needs and link the Delta to regional, national, and global markets. Facilities such as natural gas wells, wind turbines, other renewable power sources, electric transmission lines, and fuel pipelines need to be planned carefully to avoid conflicts with water supply, ecosystem restoration, or flood management facilities and existing and planned land uses. The ports at Stockton and West Sacramento are valuable assets to Delta communities and the state. Areas for water-dependent industries are located in Collinsville, Rio Vista, Pittsburg, and Antioch.

Problem Statement

Other economic opportunities in the Delta, including port and energy uses, could suffer if unplanned development, flooding, or other land uses interfere with them.

Policies

No policies with regulatory effect are included in this section.

Recommendations

DP R18. Support the Ports of Stockton and West Sacramento

The ports of Stockton and West Sacramento should encourage maintenance and carefully designed and sited development of port facilities.


The California Energy Commission and California Public Utilities Commission should cooperate with the Delta Stewardship Council as described in Water Code section 85307(d) to identify actions that should be incorporated in the Delta Plan by 2017 to address the needs of Delta energy development, storage, and distribution.

Timeline for Implementing Policies and Recommendations

Figure 5-7 lays out a timeline for implementing the policies and recommendations described in the previous sections. The timeline emphasizes near-term and intermediate-term actions.
## Timeline for Implementing Policies and Recommendations

### POLICIES

<table>
<thead>
<tr>
<th>ACTION (REFERENCE #)</th>
<th>LEAD AGENCY(IES)</th>
<th>NEAR TERM 2012–2017</th>
<th>INTERMEDIATE TERM 2017–2025</th>
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<tr>
<td>Locate new urban development wisely (DP P1)</td>
<td>Local governments</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Respect local land use when siting water or flood facilities or restoring habitats (DP P2)</td>
<td>Local governments and State agencies</td>
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<tr>
<td>Designate the Delta as a National Heritage Area (DP R1)</td>
<td>DPC</td>
<td>●</td>
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</tr>
<tr>
<td>Designate State Route 160 as a National Scenic Byway (DP R2)</td>
<td>Caltrans</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Plan for the vitality and preservation of legacy communities (DP R3)</td>
<td>Local governments, DPC, Delta Conservancy</td>
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<td>Buy rights of way from willing sellers when feasible (DP R4)</td>
<td>Local, State, and federal agencies</td>
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</tr>
<tr>
<td>Provide adequate infrastructure (DP R5)</td>
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<td>Plan for State highways (DP R6)</td>
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<td>Subsidence reduction and reversal (DP R7)</td>
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<td>Expand State Recreation Areas (DP R13)</td>
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<td>Promote boating safety (DP R15)</td>
<td>Boating and Waterways</td>
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<tr>
<td>Enhance opportunities for visitor-serving businesses (DP R17)</td>
<td>Local governments and State agencies</td>
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<tr>
<td>Support the Ports of Stockton and West Sacramento (DP R18)</td>
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<tr>
<td>Plan for Delta energy facilities (DP R19)</td>
<td>California Energy Commission and PUC</td>
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### RECOMMENDATIONS

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<th>INTERMEDIATE TERM 2017–2025</th>
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</thead>
<tbody>
<tr>
<td>Protect and enhance the unique cultural, recreational, natural resource, and agricultural values of the California Delta as an evolving place</td>
<td></td>
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</table>

### Agency Key:

- Boating and Waterways: California Department of Boating and Waterways
- Delta Conservancy: Sacramento-San Joaquin Delta Conservancy
- Caltrans: California Department of Transportation
- Council: Delta Stewardship Council
- DFW: California Department of Fish and Wildlife
- DPC: Delta Protection Commission
- DWR: California Department of Water Resources
- Parks: California State Parks
- PUC: California Public Utilities Commission

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Figure 5-7
Science and Information Needs

Better information about recreation and tourism in the Delta and additional research into best practices for managing farmlands in the Delta can contribute to efforts to protect the Delta’s unique values. These needs include the following:

- Surveys of Delta recreation at regular intervals, such as every 5 years, to inform marketing and planning for recreation and tourism
- Assessments of opportunities to control or reverse subsidence of farmland
- Analysis of land and water use by agriculture, including land ownership (resident vs. absentee; age of owner; size of holding, etc.), cropping patterns, soil types, and other factors to identify the Delta’s agricultural regions, their competitive advantages, threats and opportunities
- Analysis of farm labor housing needs.

Issues for Future Evaluation and Coordination

Many Delta agencies and residents are concerned that the region’s economy may suffer if agriculture or other uses decline significantly due to habitat restoration or water conveyance projects, especially the BDCP described in Chapter 3, or changes in State priorities for levee investment resulting from the studies recommended in Chapter 7. DPC’s ESP forecasts adverse economic impacts from farmland loss based on a scenario of how these decisions may affect the region. Its Proposal to Protect the Delta as a Place recommends that the Delta Investment Fund support protection of the Delta economy, and be administered by the DPC and guided by an investment committee appointed by the DPC’s commissioners (DPC 2012a). The Delta Conservancy will also play a role in some economic development efforts, as provided in Public Resources Code section 32322(b).

Because BDCP and new levee investment priorities are not yet complete, the magnitude of any impacts to farmland, other uses, or the Delta’s economy cannot reasonably be forecast. If significant adverse impacts to the Delta economy do result from farmland losses or other impacts due to habitat restoration, water conveyance, or revised levee investment priorities, then measures to compensate for these losses may warrant consideration. This consideration should include creation of a regional agency to implement and facilitate economic development efforts, guided by the DPC’s ESP. The agency’s responsibilities could include the following:

- Branding and marketing the Delta
- Coordinating with counties and cities to encourage planning and infrastructure development that is aligned with economic sustainability strategies
- Providing regulatory assistance to reduce impediments to priority activities, including visitor-serving developments, dredging, levee construction, and ecosystem restoration, to reduce impediments and lower costs of these activities
- Encouraging value-added processing of Delta crops, agritourism, visitor-serving commercial businesses, and preservation of the historic buildings in legacy communities
- Recommending and overseeing expenditures from the Delta Investment Fund

Performance Measures

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

Recommended performance measures for protection and enhancement of the unique cultural, recreational, natural resources, and agricultural values of the Delta as an evolving place are described below.

Output Performance Measures

■ Congress designates the Delta and Suisun Marsh as an NHA by January 1, 2014. (DP R1)

■ Water management, ecosystem restoration, and flood management projects minimize conflicts with adjoining uses by including adequate mitigation measures to avoid adverse effects. (DP P2)

■ Recreation facilities are included in new ecosystem restoration projects. (DP R9)

■ The DWR and others increase the extent of their subsidence reversal and carbon sequestration projects to 5,000 acres by January 1, 2017. (DP R7)

Outcome Performance Measures

■ No further rural farmland in the Delta is lost to urban development. (DP P1)

■ Progress toward protecting the Delta legacy communities, as indicated by renovation of historic structures, floodproofing, and other reductions in flood hazards, and maintenance or growth of small businesses and population. (DP R3)

■ Increasing tonnage of cargo and the number of jobs at the ports of Stockton and West Sacramento. (DP R18)

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City of Tracy. 2011b. City of Tracy Sphere of Influence provided in GIS format. Delivered via file transfer protocol from Victoria Lombardo, Senior Planner, City of Tracy, to Jessica Law, Urban and Environmental Planner, AECOM, on March 10, 2011.


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CHAPTER 5 PROTECT AND ENHANCE THE UNIQUE CULTURAL, RECREATIONAL, NATURAL RESOURCE, AND AGRICULTURAL VALUES OF THE CALIFORNIA DELTA AS AN EVOLVING PLACE


Yolo County. 2010b. Yolo County General Plan 2030 layer provided in GIS format. Delivered via file transfer protocol from Marcus Neuvert, GIS Specialist, Yolo County DITT, to Dillon Cowan, Staff Engineer, CH2M HILL, Inc., on July 1.

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CHAPTER 6

Improve Water Quality to Protect Human Health and the Environment
ABOUT THIS CHAPTER

This chapter discusses the trade-offs and conflicts inherent in managing water quality for multiple objectives. It recommends strategies to make balanced improvements primarily through the prioritization of projects and programs. It also provides support to related information in Chapters 3, 4, and 5.

Other State of California (State) agencies have broad authority to protect and regulate water quality. This chapter sets forth priority Sacramento-San Joaquin Delta (Delta)-specific recommendations for those agencies and focuses on four core strategies where best available science shows the need for improved water quality to achieve the coequal goals:

- Require Delta-specific water quality protection
- Protect beneficial uses by managing salinity
- Improve drinking water quality
- Improve environmental water quality

These core strategies form the basis of the 12 recommendations found at the end of this chapter. These major aspects are critical to protecting human health and improving the environment. Salinity is discussed in a separate section because of its importance as a defining characteristic of the estuary and its implications to ecosystem health, its linkage to water project operations, and its historical importance in the Delta.
The protection and improvement of water quality is inherent to meeting the coequal goals of the State. Water quality plays a critical role in the achievement of a more reliable water supply and protection, restoration, and enhancement of the Delta ecosystem. Water quality also contributes to the values of the Delta as an evolving place. The Sacramento-San Joaquin Delta Reform Act of 2009 calls for improving water quality as follows:

85020 The policy of the State of California is to achieve the following objectives that the Legislature declares are inherent in the coequal goals for management of the Delta: ... (e) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

85022(d) The fundamental goals for managing land use in the Delta are to do all of the following: ... (6) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

85302(d) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following: ... (3) Improving water quality to protect human health and the environment.

85302(e) The following subgoals and strategies for restoring a healthy ecosystem shall be included in the Delta Plan... (5) Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.
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CHAPTER 6

Improve Water Quality to Protect Human Health and the Environment

The Delta Reform Act acknowledges water quality as an important element of a reliable water supply and directs the Delta Stewardship Council (Council) to improve water quality to protect human health and the environment. In general, water quality is an abstract concept unless it is discussed relative to protection of the beneficial uses of that water. The Delta Reform Act highlights drinking water, agriculture, and ecosystem goals as important beneficial uses for the purpose of the Delta Plan. The Council’s role with respect to water quality is to ensure that the policies and recommendations in the Delta Plan balance the protection of myriad—and sometimes competing—beneficial uses of water.

In California, the entities primarily responsible for managing water quality in the state are the nine regional water quality control boards (RWQCBs) and the State Water Resources Control Board (SWRCB). The RWQCBs are responsible for water quality planning, permitting and enforcement, and financial assistance, when funds are available. The SWRCB is responsible for statewide plans, permits, and policies, and serves as a review body for RWQCB decisions. The SWRCB also has the important and challenging task of administering the State’s complex water rights system of permits and licenses. As part of these duties, the SWRCB sets water quality objectives for major waterways, including the tributaries of the Delta, as described in Chapter 4. The Central Valley RWQCB is the regional board with primary jurisdiction in the Delta and Delta watershed.

Water quality in the Delta is influenced by many factors. Seasonal rainfall, snow runoff, and reservoir releases flow in from several rivers and streams, primarily the Sacramento and the San Joaquin rivers. During very high flows, some of this water flows across floodplains before it enters the Delta. Tides can bring saline waters into the Delta from the San Francisco Bay. There are also discharges from cities, industries, and agricultural lands. As all of these flows enter the Delta, they bring with them a variety of contaminants. Additionally, water is diverted from the Delta, either for use within the Delta or for use in Central and Southern California and other service areas. The timing and physical qualities of these flows into and out of the Delta affect the water quality needed to support the beneficial uses of Delta waters.

In achieving the coequal goals, the Council envisions a Delta where improved water quality supports a healthy ecosystem and the multiple beneficial uses of water, including municipal supply and recreational uses such as fishing and swimming. To support a more resilient and healthy Delta ecosystem, salinity patterns should be consistent with more natural flow patterns with inflows of high-quality water. Nutrient concentrations should support diverse and productive aquatic food webs, and should not cause excessive growth of nuisance aquatic plants or blooms of harmful algae. Physical attributes of the aquatic environment, such as dissolved oxygen (DO) concentrations, temperature ranges, and turbidity levels, should support the needs of native species. At all times, the Delta should be free of harmful concentrations of toxic
substances. Discharges of treated wastewater, urban runoff, or agricultural return flows should be regulated so that they do not have a negative effect on the Delta. High water quality is imperative to the coequal goals and crucial for protecting the beneficial uses of Delta water, successful restoration of aquatic habitats, and sustenance of native plants and animals.

Beneficial Uses of Water in and from the Delta

A goal of the Delta Plan is to maintain water quality at a level that supports and enhances designated beneficial uses. Table 6-1 lists the beneficial uses for water in the Delta as specified in the SWRCB’s 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary (Bay-Delta Plan).

The most important part of any water quality discussion is identifying the existing and potential uses of the water in question. These uses drive the level of water quality that must be attained, and what requirements and limitations must be placed on dischargers and diverters of that water to protect those uses. Specific discharge limitations are based on adopted science-based objectives necessary to protect associated beneficial uses. These limitations are then included in discharge permits.

Factors Influencing Water Quality in the Delta

This section provides an overview of factors that influence water quality in the Delta and existing water quality regulations. Water quality in the Delta is influenced by factors such as:

- Freshwater inflows and outflows
- In-Delta land use
- Dredging
- The Delta levee system
- Tides
- Point source inputs of pollutants
- Nonpoint source inputs of pollutants
- In-Delta water use
- Export diversions and operations
## Delta Water Beneficial Uses

<table>
<thead>
<tr>
<th>Beneficial Use</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal and Domestic Supply</td>
<td>Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.</td>
</tr>
<tr>
<td>Industrial Service Supply</td>
<td>Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.</td>
</tr>
<tr>
<td>Industrial Process Supply</td>
<td>Uses of water for industrial activities that depend primarily on water quality.</td>
</tr>
<tr>
<td>Agricultural Supply</td>
<td>Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.</td>
</tr>
<tr>
<td>Groundwater Recharge</td>
<td>Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.</td>
</tr>
<tr>
<td>Navigation</td>
<td>Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.</td>
</tr>
<tr>
<td>Water Contact Recreation</td>
<td>Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing, white-water activities, fishing, or use of natural hot springs.</td>
</tr>
<tr>
<td>Non-contact Water Recreation</td>
<td>Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion is reasonably possible. These include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.</td>
</tr>
<tr>
<td>Shellfish Harvesting</td>
<td>Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.</td>
</tr>
<tr>
<td>Commercial and Sport Fishing</td>
<td>Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.</td>
</tr>
<tr>
<td>Warm Freshwater Habitat</td>
<td>Uses of water that support warmwater ecosystems including, but not limited to, preservation of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.</td>
</tr>
<tr>
<td>Cold Freshwater Habitat</td>
<td>Uses of water that support coldwater ecosystems including, but not limited to, preservation or enhancements of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.</td>
</tr>
<tr>
<td>Migration of Aquatic Organisms</td>
<td>Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.</td>
</tr>
<tr>
<td>Spawning, Reproduction, and/or Early Development</td>
<td>Uses of water that support high-quality aquatic habitats suitable for reproduction and early development of fish.</td>
</tr>
<tr>
<td>Estuarine Habitat</td>
<td>Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).</td>
</tr>
<tr>
<td>Wildlife Habitat</td>
<td>Uses of water that support estuarine ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.</td>
</tr>
<tr>
<td>Rare, Threatened, or Endangered Species</td>
<td>Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under State or federal law as being rare, threatened, or endangered.</td>
</tr>
</tbody>
</table>

Source: SWRCB 2006
Generally, water quality is better in the northern Delta than in the central and southern Delta because higher-quality Sacramento River inflows are greater than inflows from the San Joaquin River, and the proportion of agricultural water use and drainage in the San Joaquin Valley is greater than in the Sacramento Valley. The SWRCB has listed Delta waterways (various streams, rivers, and sloughs in the Delta), the Carquinez Strait, and San Francisco Bay as having impaired water quality pursuant to the federal Clean Water Act (CWA) section 303(d) list (SWRCB 2010). Pollutants of concern include insecticides, herbicides, mercury, selenium, nutrients, and legacy organic pollutants such as dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyls (PCBs). Additional water quality issues in the Delta include temperature, salinity, turbidity, low DO, bromide, dissolved organic carbon, pathogens, and harmful algal blooms (HABs).

Amounts of these constituents that are too high (or in some cases too low) can impair the ability of these waters to support beneficial uses, such as municipal water supply, recreational use, agricultural water supply, and habitat that supports healthy fish and wildlife populations. See Chapter 4 for additional discussion on how these water quality stressors can affect the Delta and its ecosystem.

Protecting Water Quality Is a Balancing Act

Water quality is central to the State’s goals for the Delta – restoring the Delta ecosystem and providing for a more reliable water supply, while protecting and enhancing the Delta as a unique and evolving place. Conditions that affect water quality must be managed and balanced in a way that allows these goals to be met simultaneously. When one use is protected, steps must be taken to minimize impacts on other uses. The following examples of this interconnectedness illustrate the difficulty of the challenge at hand.

Water supply for agricultural, municipal, and industrial use requires control of chemical constituents such as salinity, and certain pollutants that could pose a threat to human health. Efforts to protect, enhance, and restore the Delta ecosystem, however, require the management of volume and timing of flows to provide beneficially variable salinity for certain species and sufficient fresh water for others. This management regime must also consider management of nutrients and suspended solids to ensure a viable food chain within the Delta.

Protecting the communities within the Delta and their water use involves many of these same salinity and pollutant controls that are important for any water supply, but water quality in the Delta must also support recreational uses such as swimming, fishing, and boating. Cumulative discharges of pollutants from Delta communities and from recreational craft can affect in-Delta uses. Sea level rise caused by climate change will affect in-Delta water use and the manner in which flows are managed to meet water quality demands. Levee construction and placement is important to guard against flooding that could threaten in-Delta and exported water supplies. In addition, levee construction can either disrupt ecosystem processes or help provide important habitat benefits, depending on the project’s location and individual attributes.

Climate Change

Impacts on water quality from climate change are difficult to predict. However, a recent analysis by the U.S. Geological Survey (USGS) suggests that climate change poses a significant threat to water quality (Cloern et al. 2011). Increases in sea level would increase salinity intrusion into the Delta, threatening water quality for agricultural and municipal uses. Increased air and water temperatures would result in increased runoff amounts in winter, with less in spring and summer. Warmer water can directly affect the life cycle of many fish species and stimulate growth of nuisance aquatic plants or blooms of harmful algae, which can lead to
decreases in DO and increases in organic carbon. Increased runoff in the winter could result in more erosion and greater pulses of pollutants.

**Existing Water Quality Regulations**

Many different agencies have a role in the regulation of water quality in the Delta. The SWRCB and the RWQCBs have primary responsibility over discharges affecting beneficial uses of water in California with the oversight of the U.S. Environmental Protection Agency (USEPA). Drinking water supply is regulated by the California Department of Public Health, also with oversight by USEPA. Additionally, the California Department of Pesticide Regulation regulates the sale and use of pesticides, which affect water quality. (See sidebar, A Water Quality Success Story.)

**A WATER QUALITY SUCCESS STORY**

Widespread use of the organophosphorus pesticide diazinon in the Central Valley and episodes of aquatic toxicity caused the Central Valley RWQCB to add the Sacramento and Feather rivers to its list of impaired water bodies in 1994. A total maximum daily load for diazinon was adopted in 2003. Stakeholders also took action to implement a diazinon control strategy, and the USEPA and California Department of Pesticide Regulation took steps to restrict approved uses of diazinon. Grants from the USEPA, the former CALFED Bay-Delta Program, and other agencies provided funding support for control program implementation and research throughout the Central Valley region, including the San Joaquin River.

These water quality control efforts have helped to reduce levels of diazinon to the point that violations of water quality standards in the Sacramento and San Joaquin rivers are rare. Although pesticide pollution is still a problem in parts of some Central Valley streams and rivers, the experience with diazinon shows that programs to address these and other water quality problems can be effective (USEPA 2010).

The RWQCBs develop water quality control plans (known as Basin Plans) that establish water quality standards and implementation plans for achieving standards for all surface water and groundwater in their respective regions. Water quality standards include identification of beneficial uses, numeric and narrative water quality objectives to protect those uses, and water quality control policies. The RWQCBs issue discharge permits and requirements that specify the amounts of pollutants that may be discharged based on these objectives. Although these permits are intended to ensure protection of these beneficial uses, some water bodies continue to exceed standards, and beneficial uses are not being protected. These impaired water bodies are identified and listed pursuant to federal CWA section 303(d).

Placement of a water body on the CWA 303(d) list initiates a process to develop a pollution limit, or total maximum daily load (TMDL), to address each pollutant causing the impairment. A TMDL defines how much of a pollutant a water body can tolerate and still meet water quality standards. The TMDL must account for all sources of a pollutant, including point sources and nonpoint sources (discharges from wastewater treatment facilities; runoff from urban areas, agricultural inputs, and streets or highways; “toxic hot spots”; and aerial deposition). In addition to accounting for past and current activities, TMDLs may also consider projected future population growth that could increase pollutant levels. The TMDL identifies allocations for point sources and for nonpoint sources, and includes a margin of safety to account for uncertainty. An implementation plan is developed that specifies a set of actions that must be carried out to ensure that the TMDL results in achievement of water quality standards. TMDLs are usually implemented through amendments to the appropriate Basin Plan, which, in turn, will result in changes to discharge permits as they are reissued. Once a TMDL is approved, it may be some time before the necessary studies are completed to set and apportion specific discharge limitations among all dischargers and potential dischargers.
The 2008-2010 Integrated Report (SWRCB 2010), which includes the 303(d) list, prioritizes TMDLs to be developed for each water body-pollutant combination on the CWA section 303(d) list, and establishes schedules for completion of the TMDLs. Approved TMDLs and TMDLs under development are listed in Table 6-2.

On February 10, 2011, the USEPA issued an Advanced Notice of Proposed Rulemaking (USEPA 2011) as part of an effort to assess the effectiveness of current water quality programs designed to protect aquatic species in the San Francisco Bay and the Delta (referred to here as the Bay-Delta). The document identified key water quality issues affecting Bay-Delta aquatic resources and summarized current research for each of these issues, including total ammonia, selenium, pesticides, emerging contaminants, and other parameters affecting estuarine habitat and the migratory corridors of anadromous fish. The notice was intended to solicit public comment on possible USEPA actions to address water quality conditions affecting the Bay-Delta. USEPA may make changes to programs in the Bay-Delta through a formal rulemaking process as a result of further evaluation and consideration of public comment. These changes could affect federal water quality programs administered by the State.

Water quality in the Delta is also regulated by the San Francisco Bay Conservation and Development Commission (BCDC), which has jurisdiction on all tidal areas of the Bay, including Suisun Bay and Suisun Marsh. BCDC policies regarding water quality are intended to prevent the release of pollution into Bay waters to the greatest extent feasible. The BCDC makes decisions regarding water quality impacts based on evaluation by and the advice of the San Francisco Bay RWQCB. The BCDC reviews State and federal actions, permits, projects, licenses, and grants affecting the Bay, including Suisun Marsh, pursuant to the federal Coastal Zone Management Act.

In the Delta and the Suisun Marsh, the Bay-Delta Plan establishes water quality objectives for which implementation is achieved through assigning responsibilities to water right holders and water users (SWRCB 2006). (See sidebar, Water Board Regulation and the Bay-Delta Plan.) This is because the parameters to be controlled are significantly affected by flows and diversions; these responsibilities were established in Water Rights Decision 1641 in 1999. The Bay-Delta Plan also provides protection for beneficial uses that require control of salinity and operations of the various water projects in the Delta, including the State Water Project (SWP) and Central Valley Project (CVP) (SWRCB 2006).
### TMDLs Approved and under Development in the Central Valley, Delta, and Suisun Bay

<table>
<thead>
<tr>
<th>Water Bodies</th>
<th>Pollutants</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>American River</td>
<td>Mercury</td>
<td>Under Development</td>
</tr>
<tr>
<td>Cache Creek, Bear Creek, Harley Gulch</td>
<td>Mercury</td>
<td>Approved</td>
</tr>
<tr>
<td>Central Valley</td>
<td>Organochlorine Pesticides</td>
<td>Under Development</td>
</tr>
<tr>
<td>Central Valley</td>
<td>Pesticides</td>
<td>Under Development</td>
</tr>
<tr>
<td>Clear Lake</td>
<td>Mercury</td>
<td>Approved</td>
</tr>
<tr>
<td>Clear Lake</td>
<td>Nutrients</td>
<td>Approved</td>
</tr>
<tr>
<td>Grasslands</td>
<td>Selenium</td>
<td>Approved</td>
</tr>
<tr>
<td>North San Francisco Bay (includes Suisun Bay)</td>
<td>Selenium</td>
<td>Under Development</td>
</tr>
<tr>
<td>Sacramento and Feather Rivers</td>
<td>Diazinon</td>
<td>Approved</td>
</tr>
<tr>
<td>Sacramento County Urban Creeks</td>
<td>Diazinon and Chlorpyrifos</td>
<td>Approved</td>
</tr>
<tr>
<td>Sacramento-San Joaquin River Delta</td>
<td>Diazinon and Chlorpyrifos</td>
<td>Approved</td>
</tr>
<tr>
<td>Sacramento-San Joaquin River Delta</td>
<td>Mercury</td>
<td>Approved</td>
</tr>
<tr>
<td>Salt Slough</td>
<td>Selenium</td>
<td>Approved</td>
</tr>
<tr>
<td>San Francisco Bay (includes Suisun Bay)</td>
<td>Mercury</td>
<td>Approved</td>
</tr>
<tr>
<td>San Francisco Bay (includes Suisun Bay)</td>
<td>PCBs</td>
<td>Approved</td>
</tr>
<tr>
<td>San Francisco Bay Area Urban Creeks</td>
<td>Diazinon/Pesticide Toxicity</td>
<td>Approved</td>
</tr>
<tr>
<td>San Joaquin River</td>
<td>Salt and Boron</td>
<td>Approved</td>
</tr>
<tr>
<td>San Joaquin River</td>
<td>Diazinon and Chlorpyrifos</td>
<td>Approved</td>
</tr>
<tr>
<td>San Joaquin River</td>
<td>Selenium</td>
<td>Approved</td>
</tr>
<tr>
<td>Stockton Deep Water Ship Channel (Phase 1)</td>
<td>Dissolved Oxygen</td>
<td>Approved</td>
</tr>
<tr>
<td>Stockton Deep Water Ship Channel (Phase 2)</td>
<td>Dissolved Oxygen</td>
<td>Under Development</td>
</tr>
<tr>
<td>Stockton Urban Sloughs</td>
<td>Dissolved Oxygen</td>
<td>Under Development</td>
</tr>
<tr>
<td>Stockton Urban Water Bodies</td>
<td>Pathogens</td>
<td>Approved</td>
</tr>
<tr>
<td>Suisun Marsh</td>
<td>Dissolved Oxygen</td>
<td>Under Development</td>
</tr>
<tr>
<td>Suisun Marsh</td>
<td>Mercury</td>
<td>Under Development</td>
</tr>
<tr>
<td>Upper Sacramento River</td>
<td>Cadmium, Copper, and Zinc</td>
<td>Approved</td>
</tr>
</tbody>
</table>

Sources: Central Valley RWQCB 2011; San Francisco Bay RWQCB 2011a
The SWRCB and RWQCBs are the regulatory agencies with statutory authority to adopt water quality control plans, including regulating waters for which water quality standards are required by the federal CWA (Water Code sections 13170 and 13240). The Council recognizes the SWRCB’s role and authority in regulating water quality, and supports and encourages the timely development and enforcement of programs (for example, water quality objectives and waste discharge requirements [WDRs], TMDLs, and National Pollutant Discharge Elimination System [NPDES] permits) to reduce pollutant loads that are causing water quality impairments in the Delta. The Council also supports and encourages the completion of the elements of the SWRCB’s 2010 Update to Strategic Plan 2008-2012 (June 2010) and the Strategic Workplan for Activities in the San Francisco Bay/Sacramento–San Joaquin River Delta Estuary (July 2008) prepared by the SWRCB, Central Valley RWQCB, and San Francisco Bay RWQCB.

**WATER BOARD REGULATION AND THE BAY-DELTA PLAN**

**Water Quality Criteria, Objectives, and Standards.** The SWRCB and RWQCBs have primary responsibility for the regulation of discharges and control of pollutants that affect California’s surface and groundwater resources.

The water boards do this by using scientific studies and information to first determine the water quality criteria that are needed for specific beneficial uses of that water. Examples of beneficial uses include drinking water use, agricultural use, recreation, and others listed in the Bay-Delta Plan. The water quality criteria are then used to develop water quality objectives.

Water quality objectives account for additional information such as economic impacts, effects on other uses, available technology, and similar factors. Water quality objectives are considered equivalent to water quality standards required by the USEPA. The RWQCBs adopt water quality control plans that contain these objectives; they identify specific beneficial uses of each water body covered by that plan and specific water quality objectives to protect those uses. These plans are then used to issue general or site-specific discharge permits with specific pollutant discharge limitations.

Section 303(d) of the federal CWA requires that California create a listing of impaired water bodies that are not meeting water quality standards. Water bodies on this 303(d) list require development of a TMDL, which establishes a limitation on the amount of pollution that water body can be exposed to without adversely affecting its beneficial uses. This TMDL allocates proportions of the total limitation among dischargers to the impaired surface water. TMDLs typically result in changes to water quality control plans, so that existing and future permits contain pollutant limits or other provisions necessary to ensure that the water quality standards are met.

**Flow Objectives.** The SWRCB is responsible for administering and overseeing the right to take and use water in California. Where storage, transport, diversion, and use of water threaten to adversely affect water quality and beneficial uses, the SWRCB may adopt plans that set objectives for water quality and flow where necessary to protect beneficial uses. As a special kind of water quality objective, flow objectives are developed on the basis of scientifically developed information and account for other factors, such as economic impacts, physical constraints, and effects on other uses such as water supply and agricultural use.

**The Bay-Delta Plan.** In the case of the Delta, the SWRCB has adopted the Bay-Delta Plan. This plan contains water quality objectives, including flow objectives. The Delta Reform Act required that certain flow criteria be developed, which the SWRCB completed in 2010.

In early 2012, the SWRCB officially launched the comprehensive review of the Bay-Delta Plan. The water quality control planning phase of this review will include review of potential modifications to current objectives included in the Bay-Delta Plan, the potential establishment of new objectives, and modifications to the program of implementation for those objectives. It will also include potential changes to the monitoring and special studies program included in the Bay-Delta Plan. The water quality control planning process will not include amendments to water rights and other measures to implement a revised Bay-Delta Plan. A separate environmental impact report will be prepared for these actions. In addition, a separate substitute environmental document is being prepared to address updates to the water quality objectives for the protection of southern Delta agricultural beneficial uses, San Joaquin River flow objectives for the protection of fish and wildlife beneficial uses, and the program of implementation for those objectives.
Salinity in the Delta

The Delta is an estuary, and like any estuary, fresh water from rivers and tributaries flows downstream where it mixes with salt water. The location, extent, and dynamics of the freshwater-saltwater interface are important drivers of many estuarine (ecological) processes and important considerations in water management for human uses. The geographic extent of water of the correct salinity is important to many estuarine species as it is an important characteristic of their habitat. Crops vary in their tolerance of salt content in water used for irrigation, and salinity can reduce yields of sensitive crops at relatively low levels. Salt in municipal water supplies increases corrosion of pipes and appliances, can affect taste, and can contribute to the formation of disinfection byproducts that are harmful to human health. The management-intensive regulation of salinity in the Delta for multiple benefits is another example of the highly altered system the Delta has become. This section provides a summary of the history of Delta salinity problems and the effects of salinity on agricultural, municipal, and industrial water use.

History and Causes of Delta Salinity Problems

The location of the freshwater-saltwater interface in the estuary shifts with the seasons and the tides and from year to year depending on the amount of precipitation, water diversions, and Delta outflow (Kimmerer 2004; Malamud-Roam et al. 2007; Stahle et al. 2011). The location, extent, and dynamics of this freshwater-saltwater gradient have changed over the past 150 years because of landscape modification, water management and flood management infrastructure such as dams and conveyance facilities, channel dredging, and climate change.

Figure 6-1 is a representation of salinity over a range of concentrations relevant to suitability for water supply. It shows the salinity gradient in the western Delta under high and low outflow conditions. Changes in seasonal inflow to the Delta caused by upstream diversions, storage of water behind the State and federal water project dams, and operation of the State and federal Delta pumps have generally shifted the salinity gradient upstream and have changed seasonal and interannual salinity patterns. Even with these measurable shifts in salinity caused by diversion, storage, and conveyance of water, a primary driver of seasonal and annual salinity variability in the western Delta and Suisun Marsh continues to be the amount of precipitation in the watershed (Enright and Culberson 2010).

The examination of tree rings throughout the mountains of California provides a good indicator of precipitation over the last 650 years, but tree rings alone cannot accurately reproduce the details of Delta salinity over this period (Stahle et al. 2011). However, strong evidence indicates that the western Delta was a freshwater ecosystem for 2,500 years before human modification in the nineteenth and twentieth centuries (Malamud-Roam and Ingram 2004). Channel dredging, significant reductions in tidal marsh area, and levee construction have changed Delta salinity by increasing the strength of tides in the Delta, increasing connections between channels, and reducing the moderating effects of wetlands and floodplains on outflow. Consequently, simply allowing more variability in Delta outflow will not produce the same salinity patterns that existed before development.

Although sea water is the primary source of salinity in the western Delta and Suisun Marsh, it is not the only source. Agricultural drainage is another significant source of salinity, particularly in the San Joaquin Valley. Municipal and industrial discharges also can locally increase salinity, although such salinity increases are generally small compared to increases from brackish water inputs. All surface waters and groundwaters contain some amount of salt, and this salt is concentrated with use through evaporation and transpiration of water by plants (Central Valley Drinking Water Policy Workgroup 2007). The remaining water in drainage, agricultural return flows, or percolated groundwater has a higher salt concentration than the supply water. This normal increase in salinity with water use is exacerbated in some parts...
Salinity in the Delta Varies by Inflow Volumes

Salinity in the Delta Ecosystem

The role of water quality characteristics in ecosystem function, including salinity, temperature, turbidity, and DO, is discussed in detail in Chapter 4. Salinity is a defining characteristic of habitat for estuarine organisms and perhaps the most important water quality characteristic affecting municipal, industrial, and agricultural water use. However, salinity patterns that benefit native species are sometimes in conflict with human uses of water.

The salinity tolerances and preferences of fish vary by species. Delta smelt spawn in fresh water, but juveniles and adults generally show a preference for salinity in the range of 0.5 to 5 parts per thousand (ppt). Adult longfin smelt tolerate a much wider range of salinity and thrive in salinities greater than

Source: Central Valley Drinking Water Policy Workgroup 2007; images created by Resource Management Associates

Figure 6-1 Delta salinity varies with inflow and outflow. Very high flows (left) push fresh water well into Suisun Bay and produce low-salinity conditions throughout the Delta. During very low flow periods (right), sea water can be seen pushing into the interior Delta from Suisun Bay with high salinity also entering from the San Joaquin River in the southeastern Delta.
than 5 ppt. Splittail do well in a wide range of salinities from fresh water up to 18 ppt (Moyle 2002). Largemouth bass and bluegill, introduced species, prefer fresh water and are rarely found at salinities greater than 1 to 2 ppt. The location, extent, and dynamics of the freshwater-saltwater interface in the Bay-Delta is an important factor in the distribution and abundance of many fish, invertebrate, and plant species, and is largely determined by the amount of fresh water flowing from the Delta west into Suisun Bay.

The interface between fresh water and salt water is a critical region of the estuary for many native fish and other organisms. Although there is no broadly accepted definition, the low salinity zone (LSZ) of the estuary is generally considered to be the region with salinity ranging from fresh water up to about 5 ppt, about one-seventh the salinity of sea water. The part of the salinity gradient centered on 2 ppt is considered to be of particular importance because it is hypothesized to be an area where suspended particulate matter and organisms accumulate. The location in the Bay-Delta where the tidally averaged salinity at 1 meter from the bottom is 2 ppt is known as X2 (measured as distance in kilometers from the Golden Gate Bridge) and serves as a water quality objective to regulate Delta outflow. The endangered Delta smelt show a preference for the LSZ. Their distribution during most of the year is centered near X2 (Nobriga et al. 2008). The position of X2 is also correlated with the abundance of several estuarine fish and invertebrates such as the bay shrimp and longfin smelt. That is, higher outflows (X2 located closer to the Golden Gate Bridge) are correlated with greater abundance of longfin smelt and bay shrimp (Kimmerer 2004). However, the processes linking greater Delta outflow with the abundance of estuarine species in the Bay-Delta system are not clearly understood, and continue to be studied and debated.

One proposed mechanism for the benefits of X2 as a regulatory marker for Delta smelt and other pelagic species is its relationship to the extent of low-salinity habitat. Lower values of X2 place it in the vicinity of Grizzly and Suisun bays, which results in a much larger area of low-salinity habitat than when X2 is located upstream of the confluence of the Sacramento and San Joaquin rivers. One of the potential negative effects of climate change will be a reduction in the availability of suitable low-salinity habitat for Delta smelt. The combined effects of sea level rise and changes in other aspects of estuarine habitat caused by climate change and increased water diversions are likely to pose a significant threat to the future survival of Delta smelt (Feyrer et al. 2011). Additional information on the relationship between flows in the Delta, the low-salinity zone, and implications for ecosystem health is included in Chapter 4.

**Effects of Salinity on Agricultural Water Use**

As noted in Chapter 5, agricultural use of water in the Delta is a significant factor in the health of the Delta’s regional economy. The effect of salinity on agricultural water use varies by crop, soil type, and other factors (Hoffman 2010). The existing water quality objective, designed to protect the most sensitive crops, is set by the SWRCB at 700 microsiemens per centimeter (µS/cm) during the irrigation season and 1,000 µS/cm for the remainder of the year in southern Delta channels. At 700 µS/cm, water is relatively fresh, approximately equivalent to a salinity of 0.37 ppt (about 1 percent). The SWRCB is reviewing this objective based on the most recent information about the impacts of salinity on typical Delta crops. Salts from upstream and in-Delta agricultural drainage and from seawater intrusion from the Bay can affect agricultural water use in the Delta. Poor flow circulation in some parts of the Delta resulting from water diversions and historical channelization can exacerbate salinity problems.

Water quality to protect agricultural water use in the southern Delta is controlled through a combination of San Joaquin River inflow, export pumping, and Delta outflow changes. When salinity threatens to exceed water quality objectives for the San Joaquin River near Vernalis, additional high-quality water is released from New Melones Reservoir.
The effect of these releases is tempered by the installation and operation of flow barriers in the southern Delta to benefit agriculture. Salinity from seawater intrusion is reduced through a combination of reservoir releases, gate closures, and export pumping changes that, when necessary, control Delta outflow. Any significant changes to the way that water moves into or through the Delta, such as sea level rise, changed conveyance, changed inflow, or changed outflow, will change salinity patterns in the Delta.

Water quality at the SWP and CVP export pumps in the southern Delta, while usually meeting all applicable standards for municipal and agricultural use, is significantly higher in salinity than Sacramento River inflow to the Delta. Allowing salinity to vary in a way that might benefit native species could affect agricultural and municipal uses of Delta water.

Effects of Salinity on Municipal and Industrial Water Uses

Salinity contamination of municipal water supplies, as described in the following section on drinking water quality, can make water unpalatable, contributes to the formation of harmful disinfection byproducts, and increases corrosion of pipes and equipment. The existing objectives for protection of municipal and industrial beneficial uses in the southern Delta, expressed as limits on concentration of chloride, were developed to protect former industrial uses, but have been retained because they also protect drinking water quality. Secondary standards (standards that apply to aesthetic properties) for drinking water supplies also apply to water exported from the Delta by the CVP and SWP.

Under the current salinity regulations and operations practices for Delta water, municipal and industrial water supplies generally meet all salinity objectives. However, sea level rise, Delta levee failures, and increasing salt from upstream all threaten Delta municipal and industrial water supplies. Removing salts from water supplies is technically possible, although difficult and expensive; and disposing of the concentrated salt waste stream remains a key challenge.

Increased salinity further affects the reliability of municipal and industrial water supplies by reducing opportunities for water reuse and recycling (Healey et al. 2008), in turn potentially increasing reliance on imported surface water. Moving Delta intakes upstream, away from the influence of seawater intrusion and San Joaquin River inflow, could substantially reduce these water supply threats and is the subject of analysis under the current Bay Delta Conservation Plan process.

The salinity regime in the Delta is driven by natural flows, water management, and human land and water uses in the Delta and its watershed. Achieving the coequal goals will require updated comprehensive flow objectives and water quality control programs for salinity that balance ecosystem and water supply needs. The SWRCB must pay significant attention to the examination and resolution of these water quality issues in its development of new Delta flow requirements and as new plans for Delta conveyance are developed.

Drinking Water Quality

Water moving through the Delta contributes some part of the drinking water supplies for more than 25 million Californians. It is also used extensively for body-contact recreation such as swimming and water skiing. At the current locations where Delta water is diverted for municipal use, the water sometimes contains relatively high concentrations of bromide, organic carbon, nutrients, and dissolved solids (salinity). These drinking water constituents of concern are not directly harmful in drinking water, but they lead to formation of harmful chemicals during drinking water treatment, or contribute to taste, odor, or other municipal water supply problems. Sources of these drinking water constituents of concern include natural processes, such as tidal mixing of sea water into the Delta, and the flux of water and organic matter from wetlands, as well as urban runoff, agricultural runoff, and municipal wastewater discharge. Pathogenic (infectious) protozoa, bacteria, and viruses are
also present in Delta waters and are a disease risk for both drinking water and body-contact recreation.

The future of water quality is a major concern for municipalities using Delta water. Current water quality regulations and policies for surface waters do not directly apply to many of the drinking water quality constituents of concern. Sea level rise, levee failure, salinity variability, agricultural water use, and increased urban runoff due to population growth in the watershed all pose a threat to drinking water quality. Clear policies regarding the protection of water quality relevant to the drinking water quality constituents of concern are needed to prevent such degradation. The Central Valley RWQCB is developing a drinking water policy that is, in part, intended to prevent the degradation of high-quality drinking water sources (Central Valley RWQCB 2010).

**Disinfection Byproducts**

Treatment of public water supplies is necessary to prevent disease caused by pathogenic organisms. However, bromide and organic carbon in municipal water supplies contribute to the formation of harmful disinfection byproducts when water is treated for domestic use (Healey et al. 2008, AWWA 2011). (See sidebar, Disinfection Byproducts.) The disinfection byproducts of primary concern in tap water, such as trihalomethanes (THMs), haloacetic acids, and bromates, are carcinogens subject to stringent public health standards. Treatment of water from the Delta is particularly challenging because it can contain elevated levels of both bromide and organic carbon (DWR 2007). Changes to drinking water treatment processes to reduce the amounts of disinfection byproducts in tap water are technologically challenging and can significantly increase the cost of drinking water treatment (Chen et al. 2010).

Organic carbon (total or dissolved) is an aggregate measure of the amount of a wide variety of organic compounds in water. In fresh water, these compounds typically come largely from decaying plant material. Along with bromide, elevated concentrations of organic carbon contribute to formation of disinfection byproducts. The amount of disinfection byproduct varies with the type and source of organic carbon, but total organic carbon concentration is nearly always correlated with disinfection byproduct formation. Large-scale restoration of wetlands could increase the amount of disinfection byproducts formed in Delta

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**DISINFECTION BYPRODUCTS**

Disinfection byproducts are formed when disinfectants used in water treatment plants react with bromide and/or natural organic matter (decaying vegetation) present in the source water. Different disinfectants produce different types or amounts of disinfection byproducts. Disinfection byproducts identified in drinking water include THMs, haloacetic acids, and bromates. The USEPA has established regulations for these contaminants and set the maximum contaminant levels (MCLs) to prevent health effects (40 Code of Federal Regulations Part 141).

**Trihalomethanes (THM)** are a group of four chemicals formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. The THMs are chloroform, bromodichloromethane, dibromochloromethane, and bromoform. THM violations are the primary difficulty for drinking water systems that use water from the Delta, especially the smaller systems. Some people who drink water containing total THMs in excess of the MCL over many years could experience liver, kidney, or central nervous system problems and increased risk of cancer.

**Haloacetic acids** are a group of chemicals formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. Haloacetic acids include monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increased risk of cancer.

**Bromate** is a chemical formed when ozone used to disinfect drinking water reacts with bromide in source water. Bromate formation is a problem for drinking water systems that use ozone as the primary disinfectant. Bromate violations are uncommon, but are a concern during low-flow years when seawater intrusion causes bromide concentrations in Delta water to increase. Some people who drink water containing bromate in excess of the MCL over many years may have an increased risk of cancer.
water used for municipal supplies due to an increased amount of total organic carbon and the greater disinfection byproduct formation potential of wetland-derived organic carbon (Kraus et al. 2008).

**Salinity**

Salinity, frequently measured as electrical conductivity or total dissolved solids, has several significant effects on the use of water for domestic uses. Salts make water unpalatable at relatively low concentrations, with 500 parts per million total dissolved solids set as the recommended maximum level in the California secondary drinking water standards (California Code of Regulations, Title 22, section 64449). Salinity also increases the cost of treatment and costs to the consumer due to corrosion and other factors (Howitt et al. 2009). One common component of sea water, bromide, is a disinfection byproduct precursor that forms THMs and haloacetic acids with chlorine or chloramine disinfection, and forms bromate with ozone disinfection.

**Pathogens**

Pathogenic organisms and pathogen indicators are found in most surface waters. Two common protozoan pathogens that cause gastroenteritis, *Giardia lamblia* and *Cryptosporidium parvum*, have been found in Delta waters (at generally low levels) with respect to drinking water sources or body-contact recreation (Tetra Tech 2007). Source waters that exceed drinking water regulatory thresholds for *Cryptosporidium* trigger additional pathogen removal requirements (USEPA 2004). Although available data do not demonstrate that such conditions currently exist at Delta municipal water supply intakes, future plans that move or create new water intakes could result in increased treatment costs. Pathogen indicators such as fecal coliforms or *E. coli* are frequently at levels of concern in urban stormwater runoff. Several urban creeks and Delta water bodies that receive urban runoff are listed as impaired due to the presence of these indicator bacteria.

**Nutrients**

In the Delta, drinking water supplies with excessive levels of nutrients are primarily of concern because they, along with other factors such as residence time and temperature, can stimulate algae growth in the Delta and in reservoirs (Tetra Tech 2006a, Izaguirre and Taylor 2007). Algal blooms in storage reservoirs can disrupt treatment processes, and cause taste and odor problems. Taste and odor complaints associated with Delta water supplies have been attributed to algae growth in reservoirs or in the Delta itself (DWR 2007).

**Drinking Water Intakes**

The quality of Delta water with respect to drinking water use varies considerably both geographically and over time. Average organic carbon and bromide concentrations are very low in the Sacramento River where it enters the Delta. San Joaquin River water is moderately high in bromide, salinity, and nutrients, and moderately high in organic carbon. Intakes in the west Delta can be strongly influenced by the estuarine salinity gradient. An intake for the City of Antioch is frequently out of use because of salinity intrusions. The North Bay Aqueduct intake on Barker Slough in the northwest Delta is strongly affected by the local watershed and has the highest average organic carbon concentrations of any Delta municipal water supply intake (Tetra Tech 2006b). In addition to the drinking water quality problems at the current North Bay Aqueduct intake location, the intake may also have a negative effect on the ecosystem because it is located in an area that is otherwise high-quality habitat for listed native fish species.

**Groundwater Quality Concerns**

The drinking water supply from groundwater for many communities in the Delta and areas served by water exported from the Delta is contaminated by nitrates and other pollutants, particularly in the San Joaquin Valley. Survey findings show that a high financial burden is borne by low-income households when it comes to nitrate-contaminated water.
The high cost of accessing water from alternative sources, coupled with the low earnings of these households, often makes safe drinking water in these communities unaffordable (Pacific Institute 2011). Small community and private water systems throughout the Central Valley and in the Delta rely on groundwater as their primary source of drinking water. They are affected by groundwater contamination to a greater degree than larger public water systems because many are in areas that are vulnerable to contamination (SWRCB 2011). Their wells are often shallower than larger community systems, and they have limited resources to treat or respond to contaminated groundwater problems. The California Legislature explicitly recognized these issues when, in 2012, it enacted Assembly Bill 685, declaring the established State policy that “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes” (Water Code section 106.3(a)). More information on groundwater and how it relates to the Delta can be found in Chapter 3.

Environmental Water Quality

The Delta ecosystem is affected by a variety of pollutants discharged into Delta and tributary waters. Pollutants of concern affecting Delta biological species and ecosystem processes include nutrients, pesticides, mercury, selenium, and other persistent bioaccumulative toxic substances. Newly identified pollutants of potential concern (often referred to as emerging contaminants) also need to be investigated.

Nutrients

Nutrients, and their potential benefits and problems, have become an increasingly important component in the discussion of water quality issues in the Delta. The role of nutrients and nutrient loading for the Delta and Suisun Marsh is a subject of debate. Plant nutrients of concern in water are primarily nitrogen and phosphorus compounds including ammonia, ammonium, nitrite, nitrate, and phosphate. Excessive amounts (over fertilization) or altered proportions of these nutrients in streams, rivers, lakes, estuaries, or the coastal ocean can have detrimental effects on ecosystems. Die-offs of algae that deplete oxygen and cause fish kills are a well-known example, but even less obvious effects of nutrients can have important impacts on aquatic ecosystems. Changes in the types of algae that form the base of the aquatic food web, including growth of toxic algae, have been linked to excessive amounts or altered ratios of plant nutrients. Recent and current research is reconsidering the role of nutrients for aquatic ecosystems of the Delta, as follows:

- **Ammonium.** Ammonium in Delta waters has been shown to affect ecosystem water quality. Dugdale et al. (2007) has determined that ammonium concentrations may be having a significant impact on phytoplankton composition and open-water food webs because of suppression of diatom blooms in the Bay-Delta. Ammonium concentrations in Suisun Bay and the Delta have been increasing, primarily due to point source discharge loading from wastewater treatment facilities. It is not known, however, how much this inhibition extends to freshwater algae in the Delta.

- **Nutrient ratios.** Ratios of nutrients in Delta waters are thought to be a primary driver in the composition of aquatic food webs in the Bay-Delta (Gilbert et al. 2011). The effect of ammonium on food webs in the Delta remains an open question, and much active research and healthy scientific debate continue.
Harmful algal blooms. HABs create a toxic environment for aquatic organisms and the organisms that eat them. The emergence of HABs over the past decade threatens environmental water quality. The shift toward greater abundance of cyanobacteria in the Delta includes known HABs such as *Microcystis aeruginosa*. *Microcystis aeruginosa* has become a common bloom-forming component of the phytoplankton of the Delta during the warm summer and early fall months (Lehman et al. 2005, 2008). Interactions between nutrients and HABs in the Delta warrant additional study and are currently being investigated.

Nonnative aquatic plants. Nutrients affect the productivity of aquatic macrophytes (plants visible to the naked eye) and the structure of the aquatic plant community (Wetzel 2001). Two nonnative aquatic plants, Brazilian waterweed and water hyacinth, have become particularly problematic in the Delta. Scientific studies have documented the distribution and spread of these invasive aquatic plants in the Delta (Underwood et al. 2006, Hestir et al. 2008, Khanna et al. 2011, Santos et al. 2011). The role of nutrient enrichment in the spread and productivity of these nonnative aquatic plants is unknown. Further research is required on the potential links between invasive aquatic plants in the Delta and nutrient inputs.

The effects of increased nutrient inputs also need to be considered in light of anticipated changes in the Delta with regard to lowered turbidity and warming temperatures. Figure 6-2 shows increasing nutrients in the Delta over time. As discussed in the following section, nutrients have been implicated in DO depletion in Delta channels due to the stimulation of plant growth with subsequent death and decay, and the microbial conversion of total ammonia to nitrate through the process of nitrification.

Dissolved Oxygen

DO in water is essential to the survival of most fish and many other aquatic organisms. Depletion of DO in a water body because of decaying organic matter is a classic water quality problem that can result in clear signs of pollution, including fish kills and foul odors. Low DO concentrations also can have less obvious effects. DO events occur regularly in the channels of Suisun Marsh and the Stockton Deep Water Ship Channel (SDWSC) and sporadically elsewhere in the Delta, with several waterways listed as impaired by the RWQCB.

One of the most significant water quality issues affecting the Delta in recent decades has been low DO episodes (DO concentrations less than regulatory objectives) in the SDWSC reach of the San Joaquin River in the Delta, which were thought to act as a barrier to salmon migration (Central Valley RWQCB 2005). Until the last few years, low DO events were a regular occurrence in this part of the Delta primarily during the summer and fall months.

The SDWSC DO problem has existed since at least the 1960s. The Central Valley RWQCB added this segment of the Delta to its list of impaired water bodies in 1998, and adopted a TMDL in 2005 that follows a phased approach requiring studies and initial actions followed by reconsideration of TMDL requirements in 2012. Extensive studies have identified several contributing factors, including inputs of algae from upstream (probably related to nutrient loads), discharges of total ammonia from the Stockton Regional Wastewater Control Facility (RWCF), increased channel depth due to dredging, and reduced net flows (Central Valley RWQCB 2005). See sidebar, Applying Adaptive Management in Water Quality Decisions, for more information about an adaptive management approach to DO in the SDWSC.

The improved wastewater treatment processes at the RWCF were fully operational starting in 2006. This, along with other discharge reductions upstream, appears to have greatly reduced the frequency and severity of low DO episodes in the SDWSC. The California Department of Water Resources (DWR) aeration facility also has been shown to be an effective remedy for the occasional DO depletion problem that might occur under current conditions. The actions taken to
Nutrients Create Delta Water Problems

Figure 6-2  Nitrate concentrations at the point where the San Joaquin River enters the Delta dating back to 1908 show how much this important plant nutrient has increased. High nutrient concentrations are linked to a variety of problems including DO depletion, growth of nuisance aquatic plants, and taste and odor problems in drinking water.

Source: Adapted by the Delta Stewardship Council with data provided by USGS

comply with the current TMDL, along with improved flows and load reductions in the San Joaquin River watershed, appear to have provided a solution to this longstanding water quality problem. If continued, the actions taken to comply with the SDWSC TMDL should be sufficient to prevent future DO depletion problems.

The DO depletion problems in Suisun Marsh are caused by seasonal operations of ponds and wetlands managed for waterfowl hunting. For most of the year, duck club ponds are drained and occasionally flooded to promote the growth of plants that are the favored food of waterfowl. When these ponds are flooded for hunting in the late summer and fall, the decay of accumulated plant matter followed by tidal exchanges of water with adjoining channels can cause severe DO depletion. Some of these low DO events have caused documented fish kills. The San Francisco Bay RWQCB has started the TMDL process to address DO depletion in Suisun Marsh.

The best pathways to address other Delta low DO problems will vary with local conditions and causes, but likely will be a combination of reduced loadings of oxygen-demanding substances and changes to flow conditions, under the framework of adaptive management. As TMDLs are developed to address low DO concentrations in the Delta, actions needed to improve DO conditions will be implemented through SWRCB and RWQCB programs, including NPDES permits, stormwater NPDES permits, WDRs, waivers of WDRs, and water rights. Low DO conditions in the Delta need to be addressed to prevent these conditions from increasing in extent and severity.
CHAPTER 6 IMPROVE WATER QUALITY TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

Applying Adaptive Management in Water Quality Decisions

An adaptive management approach to water quality control decisions should be taken to plan for and assess their outcomes. The following is an example of how the Council’s three stage, nine step adaptive management framework (see Appendix C) was used for water quality decision making in the TMDL process to improve DO concentrations in the SDWSC.

<table>
<thead>
<tr>
<th>Adaptive Management Step</th>
<th>Improving DO Concentrations in the SDWSC</th>
</tr>
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<tbody>
<tr>
<td><strong>1 Define/redefine the problem</strong></td>
<td>Low concentrations of DO in the SDWSC periodically exceeded the Central Valley Basin Plan water quality objectives for DO for many years. Low DO acted as a barrier to migrating salmon.</td>
</tr>
<tr>
<td><strong>2 Establish goals, objectives, and performance measures</strong></td>
<td>Goal: Meet the water quality objectives for DO in the SDWSC. Objectives: Maintain minimum DO concentrations of 5 milligrams per liter (mg/L) at all times and 6 mg/L September through November.</td>
</tr>
<tr>
<td><strong>3 Model linkages between objectives and proposed action(s)</strong></td>
<td>Hydrodynamic and water quality models informed the development of a Physical and Chemical Processes Conceptual Model and a Biological and Ecological Effects Conceptual Model. The models identified at least four primary factors or processes influencing oxygen concentrations: (1) San Joaquin River flow through the SDWSC, (2) SDWSC volume, (3) algae and oxygen-demanding substances from the San Joaquin River upstream of the SDWSC, and (4) oxygen-demanding substances, including ammonia discharged from the RWCF. <a href="http://www.sjrdotmdl.org/concept_model/index.htm">http://www.sjrdotmdl.org/concept_model/index.htm</a></td>
</tr>
</tbody>
</table>
| **4 Select action(s) (research, pilot, or full-scale) and develop performance measures** | Selected Actions: (1) Conduct studies to identify causes for the low DO levels and assign responsibility to correct the problem; (2) reduce RWCF ammonia discharges to the San Joaquin River; and (3) construct a Demonstration Dissolved Oxygen Aeration Facility (Aeration Facility). Performance Measures:  
  - Administrative – Implement Phase 1 TMDL actions.  
  - Output – Implement studies; select wastewater treatment improvements to reduce ammonia discharges including engineered wetlands and nitrifying bio-towers; develop pilot-scale aeration project.  
  - Outcome – DO concentrations are maintained at or above the water quality objectives for DO. Aquatic life, including resident and migratory fish, is not affected by low DO conditions. |
| **5 Design and implement action(s)** | Selected Actions: (1) Conduct ongoing studies to improve the conceptual models; (2) add engineered wetlands and two nitrifying bio-towers to the RWCF; and (3) design, build, and operate the Aeration Facility at Rough and Ready Island to determine its applicability for increasing DO concentrations in the SDWSC. |
| **6 Design and implement monitoring plan** | Collect baseline DO data prior to aerator operations. Conduct ongoing studies to test the understanding of linkages in the conceptual models. Conduct compliance monitoring at the RWCF as required by the permit. Conduct performance monitoring of the Aeration Facility to measure achievement of the target (increased DO concentrations in the SDWSC). |
| **7 Analyze, synthesize, and evaluate** | Technical Working Group will assess the study results and aeration pilot study results. |
| **8 Communicate current understanding** | Technical reports, study results, and web-based conceptual models were developed and maintained on a website. Pilot Report Aeration System and staff presentation to the Central Valley RWQCB (February 3, 2011). |
| **9 Adapt** | Development of a revised control program (Phase 2 TMDL) including identification of additional or modified actions. Development of an aeration agreement with long-term funding for operation and maintenance of the Aeration Facility, including possible future modifications. Development of a system-level (long-term) monitoring plan for the Aeration Facility. Periodic review of control program actions and aerator operations. |
Pesticides

Pesticides include insecticides, herbicides, fungicides, and various other substances used to control pests. In the Bay-Delta region, the primary pesticides of concern include the organophosphorus pesticides (for example, diazinon and chlorpyrifos), pyrethroid insecticides, and the legacy organochlorine pesticides (for example, DDT, chlordane, and dieldrin). These substances are known to have adverse impacts on aquatic organisms or, in some cases (as with the organochlorine pesticides), birds and mammals.

The Sacramento, San Joaquin, and Feather rivers; the Delta; and numerous agriculturally dominated streams in the Central Valley are either listed as impaired or are covered under an existing TMDL for pesticides (Central Valley RWQCB 1998, 2006). Delta waterways were placed on the CWA section 303(d) list for diazinon and chlorpyrifos due to aquatic toxicity (SWRCB 2010).

Smaller agriculturally dominated waterways and urban creeks are particularly vulnerable to toxicity from pesticides. Although agriculture is considered the primary source of pesticide impairment in the Central Valley and Delta, urban sources are also locally important (Kuivila and Hladik 2008). Some of the highest pesticide concentrations have been observed in residential area creeks and waters receiving urban runoff (Weston et al. 2005). Pyrethroid insecticides, which are common replacements for the organophosphorus pesticides, have been implicated as the principal pesticides causing toxicity in surface water samples collected from throughout California (Hunt et al. 2010).

Aquatic invertebrates in the water column are the organisms most affected by chlorpyrifos and diazinon exposure (Giddings et al. 2000); however, pyrethroids—because of their high potential to stick to organic matter—also can affect sediment-dwelling organisms (Werner and Oram 2008, Weston et al. 2004). Pyrethroid pesticides from multiple runoff sources have been found at levels toxic to aquatic invertebrates (Weston et al. 2005, Weston 2010).

Contaminants cannot be eliminated as a possible contributor to the declines in open-water fish populations in the Delta (known as pelagic organism decline [POD]). Johnson et al. (2010) reported that insufficient data are available to determine whether contaminants played an important role in the POD. Research on the role of contaminants in the POD continues with efforts under way to better define the presence of contaminants in the environment, the effects of contaminant mixtures, sublethal effects of contaminants on the POD species, and the effects of contaminants on prey organisms (Baxter et al. 2010). Synergistic effects of pesticide mixtures have been demonstrated for other species including juvenile salmon (Laetz et al. 2009).

Mercury

The Delta and many Delta tributaries are included in the SWRCB’s section 303(d) list of impaired water bodies due to mercury contamination (Central Valley RWQCB 2009). Historical mercury mining in California’s Coast Ranges and mercury use associated with gold mining in the Sierra Nevada over a century ago have left an environmental legacy of pervasive mercury contamination in many Northern California watersheds (Alpers and Hunerlach 2000). The current regulatory approach for mercury includes the mercury TMDL adopted by the San Francisco Bay RWQCB in 2006 and the Delta methylmercury TMDL adopted by the Central Valley RWQCB in 2010. Unfortunately, however, mercury is likely to persist in California’s environment for many years to come.

Mercury is transformed into methylmercury by bacteria in the environment. Methylmercury, initially present at very low concentrations, enters the aquatic food web and can accumulate to levels of concern in long-lived fish at the top of the aquatic food chain, such as striped bass and largemouth bass. Methylmercury has been found in some types of Delta fish at concentrations that may be harmful to human health. The State has issued health advisories for fish consumption due to mercury contamination for a number of water bodies in
the Delta and its watersheds. Mercury contamination of fish is of particular concern for people who are frequent consumers of Delta fish (Shilling 2009).

There is general concern that increased concentrations of methylmercury in water, sediment, and plants and animals might result from restoration of wetland and floodplain habitats in the Delta and, thus, must be carefully planned and monitored to minimize the production of methylmercury. For instance, the restoration of wetlands, particularly in areas where the abundance of mercury in soils or sediments is elevated, could accelerate the production of methylmercury and increase the contamination of aquatic plants and animals (Naimo et al. 2000, Wiener and Shields 2000). Additionally, flooding of wetlands or uplands, or fluctuating water levels during tidal cycles could stimulate methylmercury production and transport, thereby increasing concentrations of methylmercury in water and in plants and animals (Hecky et al. 1991, Hall et al. 1998, Paterson et al. 1998, Bodaly and Fudge 1999). Increased methylmercury production is a significant concern for planned wetland and floodplain ecosystem restoration projects, and should be monitored.

Further study is needed to determine the dominant processes affecting methylmercury concentrations in food webs in the Delta. The CALFED Ecosystem Restoration Program developed a framework (Mercury Strategy) for monitoring, research, risk communication, and adaptive management to address mercury problems in the Bay-Delta system (Wiener et al. 2003). The approach taken by the Central Valley RWQCB in its Delta Mercury Control Program, adopted April 22, 2010, is consistent with the Mercury Strategy (Central Valley RWQCB 2010).

**Selenium**

Selenium, a naturally occurring element, is an essential nutrient at low concentrations for humans and other organisms. However, higher concentrations can be toxic to fish and wildlife. Once selenium enters the aquatic environment, it has a high potential to bioaccumulate in zooplankton and benthic (bottom-dwelling) invertebrates and, subsequently, to biomagnify in the food web as it reaches top-level predators such as fish, birds, and mammals (Skorupa and Ohlendorf 1991, Fan et al. 2002, Hamilton 2004, Stewart et al. 2004, Paveglio and Kilbride 2007).

The major source of selenium loading to San Francisco Bay is the San Joaquin River, which receives selenium-laden agricultural drainage waters from the western San Joaquin Valley (Luoma and Presser 2000). Other sources of selenium loading include oil refineries, municipal and industrial wastewater, urban and nonurban runoff, atmospheric deposition, and erosion and sediment transport from within the north San Francisco Bay. Improved wastewater treatment at petroleum refineries discharging into San Francisco Bay has reduced the amount of selenium discharged, but these facilities are still the most significant point source of this pollutant (San Francisco Bay RWQCB 2011b).

Recent monitoring results indicate that selenium water column concentrations in the north San Francisco Bay are much lower than the current 5-parts per billion objective for chronic exposure (San Francisco Bay RWQCB 2011b). However, levels of selenium in aquatic organisms and fish show that the current regulatory criteria may not be sufficient. Despite progress to reduce selenium in the Bay-Delta system, levels in the food chain are still of concern. Selenium has been identified as a possible contributing factor to the observed decline of white sturgeon, Sacramento splittail, starry flounder, and diving ducks such as surf scoters. The focus of regulatory efforts at the State and national level is shifting from water-column concentrations to the concentration of selenium in the tissues of affected organisms (San Francisco Bay RWQCB 2011b).

Historically, portions of the San Joaquin River downstream of Grasslands, Salt Slough, and Mud Slough contained elevated levels of selenium from agricultural drainage (Saiki et al. 1993). The discharge of selenium from this area also has been significantly reduced from historical levels under a
control program administered by Central Valley RWQCB, with plans for further reductions through 2019 (Reclamation 2009).

**Contaminants of Emerging Concern**

The term “contaminants of emerging concern” refers to a broad class of largely unregulated compounds for which there is concern that adverse effects might occur at environmentally significant concentrations. Examples of manufactured chemicals frequently found in water bodies and organisms include flame retardants, pesticides, human and veterinary pharmaceuticals, and ingredients in personal care products (Kolpin et al. 2002, Daughton 2004, Hoenicke et al. 2007).

Contaminants of emerging concern include many manufactured chemicals. These manufactured chemicals have the potential to alter water quality because of their widespread use, pathways to the environment, and potency. The primary sources for most contaminants of emerging concern include effluent from wastewater treatment plants, agricultural fields, and stormwater runoff. Many chemicals identified as contaminants of emerging concern have not been tested for their potential toxic effects on aquatic life. Most emerging pollutant maximum concentrations in the environment are well below established lethal concentration values for even the most sensitive aquatic species. Sublethal and chronic low-level exposures are of primary concern (Oros 2003, Brander et al. 2009, Ostrach 2009).

Regulatory and chemical monitoring programs should adapt to the quickly changing mix of contaminants of emerging concern identified through current studies and the peer-reviewed scientific literature (best available science). Effective management of contaminants of emerging concern in the Delta will require responsible agencies to perform appropriate scanning-level activities to prioritize a specific list of pollutants of highest concern and to develop or require work plans for special studies, and to conduct or require monitoring in accordance with the work plans. To this end, in 2011, the SWRCB established a Science Advisory Panel to address contaminants of emerging concern in aquatic ecosystems. The panel completed a report in April 2012 that included several recommendations for how the SWRCB should monitor and assess potential impacts of contaminants of emerging concern (Anderson et al. 2012).
POLICIES AND RECOMMENDATIONS

Policies and recommendations to address the water quality issues discussed in the preceding sections are based on the following strategies:

- Require Delta-specific water quality protection
- Protect beneficial uses by managing salinity
- Improve drinking water quality
- Improve environmental water quality

These major aspects of water quality are critical to achieving the coequal goals. The approach described here includes augmenting or accelerating existing programs where it is feasible to address an existing or anticipated water quality problem. The SWRCB and RWQCBs have broad authority to protect and regulate water quality; therefore, this chapter sets forth priority Delta-specific recommendations and does not contain regulatory policies at this time.

Require Delta-specific Water Quality Protection

Water flow, water quality, water supply, and habitat conditions in the Delta are distinctly different from other parts of the watershed and from San Francisco Bay downstream. The Delta is the most valuable estuary and wetland ecosystem on the West Coast of North and South America (Water Code section 85002), and is the primary habitat for a number of special-status species. Many communities in and around the Delta draw their drinking water directly from Delta waterways. Delta waterways also receive urban stormwater, treated wastewater, agricultural drainage, and drainage from managed wetlands. Studies have shown that such discharges can have significant impacts on water quality. These impacts are often more severe near the point of discharge. Stormwater, wastewater, and agricultural drainage discharges into the Delta should be managed so that they do not pose a significant risk to the beneficial uses of water in the Delta.

Problem Statement

Water quality management approaches developed for general application statewide or in other regions may not be sufficient for the unique and dynamic conditions of the Delta, its biological resources, and critical water supply services. Water supplies and habitats for special-status species require proactive and anticipatory measures for water quality protection consistent with their importance in achieving the coequal goals.

Policies

No policies with regulatory effect are included in this section.

Recommendations

WQ R1. Protect Beneficial Uses

Water quality in the Delta should be maintained at a level that supports, enhances, and protects beneficial uses identified in the applicable State Water Resources Control Board or regional water quality control board water quality control plans.

WQ R2. Identify Covered Action Impacts

Covered actions should identify any significant impacts to water quality.

WQ R3. Special Water Quality Protections for the Delta

The State Water Resources Control Board or regional water quality control board should evaluate and, if appropriate, propose special water quality protections for priority habitat restoration areas identified in recommendation ER R2 or other areas of the Delta where new or increased discharges of pollutants could adversely impact beneficial uses.
Protect Beneficial Uses by Managing Salinity

Beneficial uses within the Delta include drinking water, agriculture, and ecosystem protection. Salinity potentially affects these uses, but to varying degrees. The primary sources of salinity in the Delta are from tidal seawater intrusion from the Pacific Ocean through the San Francisco Bay, and to a lesser extent from agricultural and other discharges in the Central Valley. Historically, natural flows through the Delta regulated salinity in a way that favored the Delta ecosystem. Today, salinity in the Delta is dominated by the effects of upstream water diversions and use of the Delta to convey flows to Central and Southern California. The SWRCB is responsible for ensuring protection of beneficial uses through regulation of pollutant discharges, and regulation of water diversions and flows under their water rights authority.

Problem Statement

Salinity affects Delta agricultural, municipal, and environmental beneficial uses, but in different ways. Salinity and flow conditions in the Delta are affecting ecosystem, agricultural, and municipal uses. The timing and distribution of salinity is primarily affected by flow, which is largely determined by water management in the Delta and its watersheds as determined by applicable flow objectives. Delta conditions have changed since the current Delta flow objectives were adopted, and new scientific information about salinity, flow, and their effects on beneficial uses is available.

Policies

ER P1 in Chapter 4 on the SWRCB’s Delta Flow Objectives addresses this issue.

Recommendations

ER R1 in Chapter 4 on the SWRCB’s Update of Delta Flow Objectives addresses this issue.

Improve Drinking Water Quality

Millions of Californians entirely or partially rely on the Delta as a drinking water supply, and the future quality of that water supply is uncertain. Contamination of groundwater supplies places greater demand on surface waters that are tributary to the Delta for urban and agricultural users. Current water quality regulations and policies for surface waters do not apply directly to many of the drinking water quality constituents of concern. Sea level rise, levee failure, salinity variability, agricultural water use, and increased urban runoff from population growth in the watershed all pose a threat to drinking water quality. To prevent such degradation, we need clear policies regarding the protection of water quality relevant to the drinking water quality constituents of concern. The Central Valley RWQCB’s anticipated drinking water policy is intended, in part, to prevent the degradation of high-quality drinking water sources (Central Valley RWQCB 2010).

In 2006, the SWRCB, the Central Valley RWQCB, and stakeholders began a joint effort to address salinity and nitrate problems in California’s Central Valley and adopt long-term solutions that will lead to enhanced water quality and economic sustainability. Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) is a collaborative basin planning effort aimed at developing and implementing a comprehensive salinity and nitrate management program.

Problem Statement

Delta drinking water supplies are degraded by inputs from sea water, regional soils, and sediments; from agricultural, urban, and industrial sources from the watershed; and from in-Delta sources.

Policies

No policies with regulatory effect are included in this section.

Recommendations

WQ R4. Complete Central Valley Drinking Water Policy

The Central Valley Regional Water Quality Control Board should complete the Central Valley Drinking Water Policy by July 2013.
WQ R5. Complete North Bay Aqueduct Alternative Intake Project
The California Department of Water Resources should complete the North Bay Aqueduct Alternate Intake Project Environmental Impact Report by December 31, 2012, and begin construction as soon as possible thereafter.

WQ R6. Protect Groundwater Beneficial Uses
The State Water Resources Control Board should complete development of a Strategic Workplan for protection of groundwater beneficial uses, including groundwater use for drinking water, by December 31, 2012.

WQ R7. Participation in CV-SALTS
The State Water Resources Control Board and Central Valley Regional Water Quality Control Board should consider requiring participation by all relevant water users that are supplied water from the Delta or the Delta watershed or discharge wastewater to the Delta or the Delta watershed to participate in the Central Valley Salinity Alternatives for Long-Term Sustainability Program.

Improve Environmental Water Quality
A variety of pollutants are discharged into Delta and tributary waters. These pollutants affect Delta biological species and ecosystem processes. Pollutants of concern include nutrients, pesticides, mercury, selenium, and other persistent bioaccumulative toxic substances. Newly identified pollutants of potential concern (emerging contaminants) also need to be investigated.

Problem Statement
Pollutants contained in municipal, industrial, agricultural, other nonpoint source discharges, and legacy sources flowing into the Delta and its tributary waterways, including pollutants that bioaccumulate and biomagnify in the food web, impair the Delta ecosystem. Evidence from water quality and ecosystem monitoring continues to show that significant water pollution problems persist in the Bay-Delta system and the Central Valley. Insufficient funding and support could lead to slowing or even eliminating the SWRCB and the San Francisco Bay and Central Valley RWQCBs’ engagements in regulatory processes, research, and monitoring that are essential to improving water quality in the Delta.

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

Recommendations
WQ R8. Completion of Regulatory Processes, Research, and Monitoring for Water Quality Improvement
The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards are currently engaged in regulatory processes, research, and monitoring essential to improving water quality in the Delta. In order to achieve the coequal goals, it is essential that these ongoing efforts be completed and, if possible, accelerated, and that the Legislature and Governor devote sufficient funding to make this possible. The Delta Stewardship Council specifically recommends that:

- The State Water Resources Control Board should complete development of the proposed policy for nutrients for inland surface waters of the State of California by January 1, 2014.

- The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards should prepare and begin implementation of a study plan for the development of objectives for nutrients in the Delta and Suisun Marsh by January 1, 2014. Studies needed for development of Delta and Suisun Marsh nutrient objectives should be completed by January 1, 2016. The water boards should adopt and begin implementation of nutrient objectives, either narrative or numeric, where appropriate, for the Delta and Suisun Marsh by January 1, 2018.

- The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should complete the Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for diazinon and chlorpyrifos by January 1, 2013.

- The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should prioritize and accelerate the completion of the Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for pyrethroids by January 1, 2016.

- The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards have completed Total Maximum Daily Load and Basin Plan Amendments for methylmercury, and efforts to support their implementation should be coordinated. Parties identified as responsible for current methylmercury loads or proponents of projects that may increase
methylmercury loading in the Delta or Suisun Marsh should participate in control studies or implement site-specific study plans that evaluate practices to minimize methylmercury discharges. The Central Valley Regional Water Quality Control Board should review these control studies by December 31, 2018 and determine control measures for implementation starting in 2020.

**WQ R9. Implement Delta Regional Monitoring Program**

The State Water Resources Control Board and Regional Water Quality Control Boards should work collaboratively with the California Department of Water Resources, California Department of Fish and Wildlife, and other agencies and entities that monitor water quality in the Delta to develop and implement a Delta Regional Monitoring Program that will be responsible for coordinating monitoring efforts so Delta conditions can be efficiently assessed and reported on a regular basis.

**WQ R10. Evaluate Wastewater Recycling, Reuse, or Treatment**

The Central Valley Regional Water Quality Control Board, consistent with existing water quality control plan policies and water rights law, should require responsible entities that discharge wastewater treatment plant effluent or urban runoff to Delta waters to evaluate whether all or a portion of the discharge can be recycled, otherwise used, or treated in order to reduce contaminant loads to the Delta by January 1, 2014.

**WQ R11. Manage Dissolved Oxygen in Stockton Ship Channel**

The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should complete Phase 2 of the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in the Stockton Deep Water Ship Channel by January 1, 2015.

**WQ R12. Manage Dissolved Oxygen in Suisun Marsh**

The State Water Resources Control Board and the San Francisco Bay Regional Water Quality Control Board should complete the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in Suisun Marsh wetlands by January 1, 2014.

**Timeline for Implementing Policies and Recommendations**

Figure 6-3 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.
### Timeline for Implementing Policies and Recommendations

**TIMELINE**

<table>
<thead>
<tr>
<th>ACTION (REFERENCE #)</th>
<th>LEAD AGENCY(IES)</th>
<th>NEAR TERM 2012–2017</th>
<th>INTERMEDIATE TERM 2017–2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect beneficial uses (WQ R1)</td>
<td>Varies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify covered action impacts (WQ R2)</td>
<td>Varies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special water quality protections for the Delta (WQ R3)</td>
<td>SWRCB, RWQCB</td>
<td></td>
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<tr>
<td>Complete Central Valley drinking water policy (WQ R4)</td>
<td>Central Valley RWQCB</td>
<td></td>
<td></td>
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<tr>
<td>Complete North Bay Aqueduct Alternative Intake Project (WQ R5)</td>
<td>DWR</td>
<td></td>
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</tr>
<tr>
<td>Protect groundwater beneficial uses (WQ R6)</td>
<td>SWRCB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation in CV-SALTS* (WQ R7)</td>
<td>SWRCB and Central Valley RWQCB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completion of regulatory processes, research, and monitoring for water quality improvements (WQ R8)</td>
<td>SWRCB, San Francisco Bay and Central Valley RWQCBs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implement Delta regional monitoring program (WQ R9)</td>
<td>SWRCB and RWQCBs</td>
<td></td>
<td></td>
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<tr>
<td>Evaluate wastewater recycling, reuse, or treatment (WQ R10)</td>
<td>Central Valley RWQCB</td>
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<td></td>
</tr>
<tr>
<td>Manage dissolved oxygen in Stockton Ship Channel (WQ R11)</td>
<td>SWRCB and Central Valley RWQCB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage dissolved oxygen in Suisun Marsh (WQ R12)</td>
<td>SWRCB and San Francisco Bay RWQCB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*CV-SALTS: Central Valley Salinity Alternatives for Long-Term Sustainability Program

Agency Key:  
- DWR: California Department of Water Resources  
- RWQCB: Regional Water Quality Control Board(s)  
- SWRCB: State Water Resources Control Board

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**Figure 6-3**
Science and Information Needs

Successful management of water quality depends on a well-designed, comprehensive, and consistent system of water quality monitoring. Current Delta water quality monitoring is fragmented among several different agencies and programs. The Central Valley RWQCB has initiated an effort to develop a Delta Regional Monitoring Program that will consolidate and coordinate most of the current monitoring. Developing a coordinated and thorough regional monitoring program is essential to performance measurement and adaptive management in the Delta.

As identified above, a number of outstanding science questions need to be resolved with respect to water quality. Additional study is needed on the following:

- The effects of salinity on introduced and native plant and animal species
- Trends in concentrations of drinking water constituents of concern
- The effects of nutrients on the Delta ecosystem and municipal water supplies
  - The importance of phytoplankton bloom suppression from ammonium
  - The role of nutrient loading on HABs in the Delta
  - Possible linkages between nonnative aquatic plants and nutrient inputs
- Controlling DO depletion
- The effects of the simultaneous presence of multiple pesticides, even at low levels, on species of concern
- The processes contributing to mercury and selenium compounds in food webs and their effects on the ecosystem
- The impacts of pharmaceutical compounds, personal care products, and other emerging contaminants on the ecosystem
- The combined effects of multiple contaminants and water quality conditions on the ecosystem
- Sources and impacts of pathogens on drinking water sources and recreation in the Delta
- An analysis and evaluation of existing water quality models in the Delta
- Fate and transport of water quality contaminants in the Delta

Issues for Future Evaluation and Coordination

Additional areas of interest and concern related to water quality and the Delta may deserve consideration in the development of future Delta Plan updates, including the following:

- Small and disadvantaged communities: Ensuring a safe drinking water supply can have a disproportionate cost for small and disadvantaged communities. Delta communities that are small and disadvantaged include Bethel Island, Courtland, Freeport, Hood, Isleton, Locke, and Walnut Grove. There are also small and disadvantaged communities in areas served by water exported from the Delta that are disproportionately impacted by nitrate and other groundwater pollutants. Available options to correct unsafe drinking water conditions include shared services and facilities; consolidation of several small systems into a single, larger system; centralized treatment; interim point-of-use treatment or use of bottled water; replacement of a contaminated source with an uncontaminated source; and, in the case of chemical contamination, blending of contaminated sources with uncontaminated sources. Consideration also must be given to the new State policy that “every human being has the right to safe, clean, affordable and accessible water adequate for human consumption, cooking, and sanitary purposes” (Water Code section 106.3(a)). Availability and prioritization of funding, restructuring of regulatory requirements, and
provision of technical assistance may all be part of the solution, but involve the authority of various agencies including the California Department of Public Health, SWRCB, DWR, U.S. Department of Agriculture, and local cities and counties. An integrated effort including the input and involvement of the regulatory and affected agencies will be needed to properly address these issues and to refine effective recommendations.

- **Coordinated and prioritized water quality monitoring and modeling:** Various water quality monitoring and modeling efforts are ongoing, but are not coordinated among affected agencies. Agencies involved in these efforts include the SWRCB, RWQCBs, DWR, the Interagency Ecological Program, California Department of Fish and Wildlife, and now, the Council. Collective discussion and evaluation by these and other entities will be needed in order to make recommendations regarding the need for and prioritization of water quality modeling in the Delta.

- **Contaminants of emerging concern:** The SWRCB and RWQCBs should continue ongoing efforts to address contaminants of emerging concern. This work should include development of a work plan for conducting or requiring special studies of pollutants, including emerging contaminants and causes of toxicity in Delta waters and sediments.

- **Water quality objectives for selenium:** The identified sources of selenium as a contaminant and its potential to bioaccumulate and biomagnify in the environment are ongoing concerns. The SWRCB and San Francisco Bay and Central Valley RWQCBs should continue efforts to revise water quality objectives for selenium.

**Performance Measures**

Development of informative and meaningful performance measures is a challenging task that will continue after the adoption of the Delta Plan. Performance measures need to be designed to capture important trends and to address whether specific actions are producing expected results.

Efforts to develop and track performance measures in complex and large-scale systems like the Delta are commonly multiyear endeavors. The recommended output and outcome performance measures listed below are provided as examples, and subject to refinement as time and resources allow. Final administrative performance measures are listed in Appendix E and will be tracked as soon as the Delta Plan is completed.

### Output Performance Measures

- DWR begins constructing the North Bay Aqueduct Alternate Intake Project as soon as possible after the environmental impact report is completed. (WQ R5)
- Progress toward reducing concentrations of inorganic nutrients (ammonium, nitrate, and phosphate) in Delta waters over the next decade. (WQ R8)
- TMDLs for critical pesticides (for example, diazinon, chlorpyrifos, and pyrethroids) in the waters and sediments of the Delta are met by 2020. (WQ R8)
- A Delta regional water quality monitoring program is implemented within the first 5 years of the Delta Plan. (WQ R9)

### Outcome Performance Measures

- Water quality in the Delta meets objectives established in the applicable water quality control plan. (WQ R1)
- Trends in measurable toxicity from pesticides and other pollutants in Delta waters will be downward over the next decade. (WQ R8)
- Progress toward consistently meeting applicable DO standards in the Delta by 2020. (WQ R8, WQ R11, and WQ R12)
- HABs will lessen in severity and spatial coverage in the Delta over the next decade. (WQ R3 and WQ R8)
- The spatial distribution and productivity of nuisance nonnative aquatic plants will decline over the next decade. (WQ R3 and WQ R8)
References


Central Valley RWQCB (Regional Water Quality Control Board). 2009. Clean Water Act Section 305(b) and 303(d) Integrated Report for the Central Valley Region.


CHAPTER 6 IMPROVE WATER QUALITY TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT


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ABOUT THIS CHAPTER

This chapter provides an overview of flood risk in the Sacramento-San Joaquin Delta (Delta), current flood management efforts, and the most pertinent agencies and regulations. It details the Delta Stewardship Council’s (Council) core strategies to reduce risk to people, property, and State interests in the Delta. These core strategies form the basis of the four policies and fifteen recommendations found at the end of the chapter:

- Continue to prepare for Delta flood emergencies
- Modernize levee information management
- Prioritize investment in Delta flood management
- Update funding strategies
- Manage rural floodplains to avoid increased flood risk
- Protect and expand floodways, floodplains, and bypasses
- Renew assurances of federal assistance for post-disaster levee reconstruction
- Limit State liability

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

RELEVANT LEGISLATION

Water Code sections 85305, 85306, 85307, and 85309 require the Delta Plan to include or otherwise consider specific 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 consideration for incorporation into the Delta Plan. In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

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

Reducing flood risks to people, property, and State interests is critical to achieving the Delta Reform Act’s coequal goals and protecting the Delta as a place. The Legislature has found that the Delta is “inherently flood-prone,” and that further improvements and continuing maintenance of the levee system will not resolve all flood risks (Public Resources Code section 29704). Living with risk, whether from floods, earthquakes, fires, coastal storms, or other hazards, is often part of life in California. The Delta’s hazards, however, are exceptional because they affect so many State interests, including the reliability of its water supplies, the health of the Delta’s ecosystem, and the qualities that make the Delta an attractive place to live, work, and recreate.

To reduce these risks to people, property, and State interests in the Delta, the Delta Reform Act requires that the Delta Plan promote effective emergency response and preparedness, appropriate land use, and strategic investments in levees (Water Code section 85305). The Delta Reform Act also directs the Council, in consultation with the Central Valley Flood Protection Board (CVFPB), to recommend 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 nonproject levees (Water Code section 85306).

The Council envisions a future in which risks of flooding in the Delta are reduced, despite an increase in sea levels and altered runoff patterns. The Council sees a future where Delta residents, local governments, and businesses are better prepared to respond when floods threaten. The Council envisions a future where bypasses are expanded; channels are improved; and strong, well-maintained levees protect local communities—but also protect State interests in a more reliable water supply for California and a protected and restored Delta ecosystem. These improvements will include new or expanded floodways and bypasses, maintaining and improving levees, and floodproofing new development. The Council envisions that rural areas and the Delta’s legacy communities will also be protected from flood risks by careful land use planning that discourages urban development in flood-threatened areas. The Council envisions that flood management will draw on a variety of funding tools, including
greater payments by those who benefit from the Delta’s levees. 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. Federal, State, and local agencies will respond cooperatively to flood disasters, working together to recover vital infrastructure, mitigate economic damage, restore the ecosystem, and encourage long-term resiliency.

Eliminating flood risks will be impossible, but prudent planning, reasonable land development, and improved flood management will significantly reduce risk, and serve the coequal goals of a more reliable water supply, and a protected and restored Delta ecosystem.

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

The threats 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 multipurpose reservoirs that store water for the Central Valley Project (CVP), State Water Project (SWP), and other water users. For example, a potential benefit of wide flood bypasses leading to the Delta may be greater flexibility in these reservoirs’ operations, creating new opportunities to manage water supplies or generate hydroelectric power, while also contributing to ecosystem restoration as described below.

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, wildlife, and the ecosystem. Fish and wildlife habitats can be improved by thoughtful design of levee margins bordering sloughs and river channels. 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 species rather than refuges for smelt, salmon, or other preferred species. Changes in the area protected by levees also alter water circulation through the Delta, changing the benefit of flows released to protect its ecosystem.

The Delta’s residents, farms, and businesses also depend on its levees. They shape the Delta landscape, protecting its farms and communities from destruction. The levee system is the foundation on which the entire Delta economy is built, the Delta Protection Commission’s (DPC’s) *Economic Sustainability Plan* reports (DPC 2012). Delta
residents built the levee system over generations, and they are keenly interested in its maintenance and improvement. (See sidebar, Delta Disaster Recalled, for an example of the consequences of levee failure.)

**DELTA DISASTER RECALLED (SIDEBAR)**

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 into 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).

**Flood Risk in the Delta**

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

Today, flooding of the Delta’s complex labyrinth of islands and waterways is prevented by its levees. This system of flood control is supplemented by the flood facilities of the Sacramento River and San Joaquin River flood control projects and multipurpose reservoirs such as Shasta, Folsom, and Millerton lakes and Lake Oroville on the Sacramento and San Joaquin rivers and their tributaries, which hold back floodwater and provide water supplies and other benefits described in Chapter 3.

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

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

Levee failures also could flood homes, farms, and businesses, including historic structures in the legacy communities, and interrupt recreation and tourism. As noted in Chapter 5, about 116,000 residential structures are located in the 100-year floodplain of the Delta, mostly near Sacramento, West Sacramento, and Stockton. Also, 8,000 residences are below mean higher high water (DWR 2008b). Serious consequences also could result from flood-related damage to critical infrastructure in the Delta, including radio, cellular telephone, and television transmission towers; electrical transmission lines, including Pacific Gas and Electric Company, Sacramento Municipal Utility District, and Western Area Power Administration lines; natural gas pipelines serving local gas fields and regional transmission systems; petroleum pipelines; the East Bay Municipal Utility District aqueduct; several railroads; three state highways; and three interstate highways (DWR 2011a; Arcadis 2016b).
In simplistic terms, the concept of flood risk can be described as the likelihood of a flood event occurring multiplied by the consequences of that event. To many, flood risk simply means the chance a storm event will overwhelm the flood control system to some extent. Figure 7-1 illustrates the variables, namely the probability of flooding and the financial consequences. However, there are many other causes of flood risk, and the consequences can be far more complicated than the immediate damage to property.

Understanding Delta Flood Risk

Flood risk reflects both the probability of flooding and the consequences that would result from flooding. Flood risk can be calculated as:

\[ R = \text{Probability of Flooding} \times \text{Financial Consequence} \]

The likelihood of levee failures caused by high water is substantial, based on the historical performance of these levees over the last century. During the last century,

Floods

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

The likelihood of levee failures caused by high water is substantial, based on the historical performance of these levees over the last century. During the last century,
there have been more than 140 levee failures and island inundations, most of which occurred during flood seasons (DWR 2005). High water in the Delta can overtop levees, as well as increase the hydrostatic pressure on levees and their foundations, causing instability and increasing the risk of failure due to through-levee and/or under-levee seepage. Most levee failures in the Delta have occurred during winter storms and related high-water conditions, often in conjunction with high tides and strong winds.

Earthquakes

The Delta’s levees are also threatened by the active seismic zones west of the Delta, including the San Andreas and Hayward faults. Less active faults underlie the Delta. A strong earthquake could damage Delta levees because of the potential for deformation or cracking of levees or liquefaction of levee embankments and foundations during strong ground shaking. Saturated levees composed of dredged materials in other parts of the country and the world have performed poorly during moderate to strong earthquake shaking (DWR 2009; Delta Stewardship Council Staff 2010a). Moderate earthquakes between 1979 and 1984 damaged nearby Delta levees, and many Delta islands’ levees failed during floods within a year after the 1906 San Francisco earthquake (Deverel 2016). If a levee failed on an island subsided below sea level or during high flows or if a flood were to occur soon after an earthquake, the protected area could be inundated.

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

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

The DWR Delta Risk Management Strategy Phase 1 study evaluated the performance of Delta levees under various seismic threat scenarios, and analyzed potential consequences for water supply, water quality, ecosystem values, and public health and safety. The study concluded that a major earthquake of magnitude 6.7 or greater in the vicinity of the Delta Region has a 62 percent probability of occurring sometime between 2003 and 2032 (DWR 2009). More recent investigations suggest earthquake-induced ground shaking affecting Delta levees may be less serious, but still worrisome (Delta Independent Science Board 2016; Deverel. 2016).

Figure 7-2 illustrates a potential flood scenario in which a 6.5-magnitude earthquake causes a 20-island failure. Although the probabilistic nature of earthquake prediction makes it difficult to quantify the timing and magnitude of seismic threats, it is important
to address the threats posed by earthquakes to the Delta levee system because of the potential adverse effects of such events.

**High Tides and Sunny-day Hazards**

Even without an earthquake or flood, Delta levees can fail during high tides or even on sunny days. Generally, these failures may be the result of a combination of high tide and pre-existing internal levee and foundation weaknesses caused by burrowing animals, internal erosion of the levee and foundation through time, and human interventions such as dredging or excavation at the toe of the levee (DWR 2008b). Examples of sunny-day failures include the Brannon Andrus Tract in 1972 and Upper Jones Tract in 2004. It is estimated that, based on current conditions, a sunny-day failure would occur once every 9 years on average (DWR and DFG 2008). One-third of the failures at peaty Delta islands since 1960 have been sunny-day failures (Delta Independent Science Board 2016).

Other hazards that affect the performance of Delta levees include encroachments, penetrations, and burrowing animals. Encroachments such as structures or farming practices on or close to the levee; penetrations of the levee, such as culverts or pipelines; and burrows created by rodents, especially beavers, muskrats, and squirrels, can weaken the structural integrity of levees. Because of unregulated historical construction, levees also contain many hidden hazards. Active programs of inspection, oversight, and maintenance are essential to minimize these hazards.
Simulation of Delta Salinity after a 20-island Failure Caused by a Magnitude 6.5 Earthquake

Figure 7-2  Source: MWD 2010
Land Subsidence

Because of the land subsidence described in Chapter 5, much of the central Delta is below sea level. Some islands are 12 to 15 feet below sea level, requiring levees 20 to 25 feet in height that act as dikes, holding back water continually rather than only during seasonal floods or extreme tides. As subsidence progresses, accommodation space increases, and levees must be continually maintained, strengthened, and periodically raised to support the increasing hydraulic stresses (Miller 2008; Mount and Twiss 2005). The hydraulic stress also can drive seepage through and under levees, and place levee foundations under more stress. The thinning of the peat soil layer also leads to shallow or artesian groundwater conditions. More seepage onto islands will increase the drainage costs associated with additional pumping and decrease levee stability (Deverel and Leighton 2010; Deverel, Lucero, and Bachand 2015).

One approach to addressing subsidence can be the acquisition of conservation easements that provide for fallowing land adjoining levees on islands with deep peat. Acquisition of such easements is authorized through the Delta Levees Maintenance and Special Projects (Water Code section 12987(b) and 12316(e)), enabling use of this complement to levee improvement where appropriate.

Climate Change and Flood Risk

Climate change has major implications for the Delta, and especially for flood risk management. It is estimated that by the year 2100, sea levels at the Golden Gate may rise 17 to 66 inches (National Research Council, 2012; Natural Resources Agency 2014). Recent research suggests melting glacial ice may cause even higher rises in sea levels (Dennis, B. and Mooney, C, 2016). This chapter of the Delta Plan uses the higher end of the range of sea level rise forecast by the National Research Council (Arcadis 2015), consistent with advice from the Natural Resources Agency. The scenario anticipates sea level rising by 2050 by approximately two feet at the Golden Gate and the western end of Sherman Island, 20 inches at Mandeville or Venice Islands near the San Joaquin River’s confluence with Middle and Old Rivers and six to eight inches at Walnut Grove. These higher water levels will put additional stress on levees, increasing their risk of failure. By 2050 rising sea levels will more than double the probability of flooding if levees are not just well-maintained but also improved (Arcadis. 2016b; Arcadis. 2017). Drainage of Delta islands will also be more difficult, impairing agriculture on which the finances of many reclamation districts’ rely.

Climate change will also increase hydrologic variability and uncertainty, which is likely to result in more severe flooding over time. (DWR 2016_ 2016)

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

The threats to Delta levees described above have been acknowledged for many years, but disagreements remain about the significance of the risks they pose. This update of the Delta Plan is based on the best, most up-to-date data available, compiled from more than 50 data sources and provided for public review and correction. Nevertheless, some Delta residents, reclamation district engineers, and scientists object that other reports or their firsthand knowledge provide contradictory information. In part this reflects continually changing conditions in the Delta, including land use, levee improvement and maintenance, subsidence, and other factors. In addition, the information about levee conditions and threats that is kept by the almost 100 agencies involved in maintaining the Delta levee network is not easily shared, but rather is often retained only in paper reports held by individual agencies or firms. This means that California does not have the clearest possible understanding of risks in the Delta or of how they can be most effectively reduced.

Informed decision making can be improved by gathering and widely sharing information about the Delta levee network using contemporary data management technology. Sharing this information has been urged for many years (DWR 1983; Central Valley Flood Protection Board 2016) and is required for project levees (Water Code section 9140). More transparency about the benefits gained through State-funded levee improvements can complement information about levee conditions, facilitating more comprehensive and timely assessment and reporting about the Delta levee network.

THE DELTA’S LEVEES

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

There are about 1,330 miles of project, nonproject, and other levees in the Delta and Suisun Marsh. These levees reduce flood risk for approximately 740,000 acres of land in the Delta. They define the Delta’s physical characteristics; influence the reliability of its water supplies and its ecosystem health; and are critical to the Delta’s residents, farms, businesses, cities, and legacy communities. Because many Delta levees protect land below sea level, they hold back water all day, year-round, rather than only during floods, and so are called “the hardest working levees” in America.
Differences in how levees are classified can influence reports about their length and condition. Approximately 65 percent of the levees in the Delta and all levees in the Suisun Marsh are owned or maintained by local agencies or private owners and are not part of the flood control projects on the Sacramento or San Joaquin rivers. Most of these nonproject levees maintained by local reclamation districts created and funded by landowners, initially for the purpose of draining (“reclaiming”) Delta islands and tracts. The reclamation districts continue to maintain levees and other water control facilities today. These nonproject levees are defined in Water Code section 12980(e).

The State-federal flood control projects on the Sacramento and San Joaquin rivers include approximately one-third, or about 380 miles, of the Delta’s levees. Known as “project levees,” they begin on the left bank of the Sacramento River at Sherman Island, and line most of the riverbanks, as well as the Sacramento River Deep Water Ship Channel and some connecting waterways, north to Sacramento and beyond. The Delta Cross Channel’s control gates are an important feature of this levee system, closing during high flows to keep the Sacramento River’s floodwaters out of the central Delta. The flood control project also includes the Yolo Bypass, the broad, managed floodplain in Yolo County west of West Sacramento. The wide bypass, which is confined by project levees, draws floodwater through weirs above Sacramento to lower flood heights on the Sacramento River and its tributaries, discharging back to the Delta above Rio Vista. The Yolo Bypass floods about once every 3 years, between December and February. On the San Joaquin River, project levees line the riverbanks from Old River to Stockton. Figure 7-3 shows the locations of project and nonproject levees in the Delta.

Recent evaluations show that some of the flood control project facilities on the Sacramento and San Joaquin rivers are not adequate. Because the system was intended partly to flush Gold Rush-era sediment from rivers and channels, the project levees were often built close to the riverbanks, and are prone to erosion. Many of the system’s channels have inadequate capacity to carry the flows for which they were designed, and many levees do not meet contemporary design standards (DWR 2011c).

The CVFPB, as part of its responsibility to oversee the flood control projects on the Sacramento and San Joaquin rivers, has adopted regulations to control encroachments on the project and some of the streams that flow into it. It also regulates encroachments within designated floodways, which are the channels of a river or other watercourse and the adjacent land areas that convey floodwaters (California Code of Regulations [CCR], Title 23, Division 1, Chapter 1, Article 2, Section 4). In the Delta, designated floodways include the Cosumnes River’s floodplain and the confluence of the San Joaquin River and the Stanislaus River upstream from Paradise Cut.

Some levees are neither project levees nor nonproject levees. These “unattributed levees” include hundreds of miles of levees in Suisun Marsh and the Delta, and are not part of any State-financed flood control program. They also include some levees that are no longer maintained along the perimeter of permanently flooded islands and no longer serve flood control or drainage purposes.
Other facilities throughout the Delta drain rainfall runoff from land into Delta channels. Local cities and districts own and maintain urban storm drains in developed areas. Stockton, Sacramento, West Sacramento, Lathrop, Manteca, and Tracy are Delta cities with storm drainage facilities. Most Delta islands have a network of agricultural drains and pumps to convey runoff to the Delta channels. Some Delta channels have been dredged to increase their capacity to carry floodwater and to obtain material for levee construction and maintenance.

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

Planning for Flood Management

Many planning efforts addressing flood management and emergency preparedness, response, and mitigation are under way, including the following:

- **Central Valley Flood Protection Plan (CVFPP).** This strategic plan for improving the flood control projects on the Sacramento and San Joaquin rivers recommends approaches for reducing flood risk and improving the flood control project, including expansion of the Yolo Bypass and setting back levees along Paradise Cut (DWR 2016b) (see sidebar, Central Valley Flood Protection Plan).
- **DWR’s FloodSAFE Initiative.** In 2006, DWR launched FloodSAFE California—a multifaceted initiative to improve public safety through integrated flood management.
- **Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force Report.** This report responds to Water Code section 12994.5, which called for the task force to make recommendations to the Governor about Delta multi-hazard emergency response and recovery issues.
- **CVP and SWP Reoperation Studies.** DWR’s Forecast-coordinated Operations Program and Systems Reoperation Program address reservoir operational criteria, as noted in Chapter 3.

The U.S. Army Corps of Engineers (USACE) has completed recent studies (2015) recommending improvement to the Delta’s project levees protecting Sacramento’s Pocket neighborhood and West Sacramento. Congress authorized federal participation in these projects in 2016. USACE studies are underway of potential improvements to Delta levees protecting metropolitan Stockton and at the Yolo Bypass. Another USACE study (2014) concluded there is no federal interest in the Delta’s nonproject levees’ improvement.
The Council considered the findings of these studies and incorporated them into the update of this Delta Plan chapter. The CVFPP and FloodSAFE include many concepts relevant to flood protection in the Delta.

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

WHAT IS A GOVERNMENT-SPONSORED FLOOD CONTROL PROGRAM? (Sidebar)

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:

- 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.)
- Delta Levees Special Flood Control Projects Program (Water Code section 12300 et seq.)
- Delta Levees Maintenance Subventions Program (Water Code section 12980 et seq.)
- Central Valley Flood Protection Board Authority (California Code of Regulations, Title 23, Division 1)

Central Valley Flood Protection Plan (Sidebar)

The Central Valley Flood Protection Act of 2008 directed DWR to prepare the 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 was adopted by the
CVFPB in June 2012. It is expected that the CVFPP will be updated in 2017 and every 5 years thereafter.

The CVFPP proposes a system-wide 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 the portions of the Delta covered by the SPFC, including about 65 miles of urban, nonproject 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 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 Delta Plan to the extent that those portions promote the coequal goals (Water Code section 85350).

The 2017 CVFPP is a strategic, long-range plan describing a programmatic vision for flood system improvements over time. Because it is descriptive, not decisional feasibility studies and project-specific development activities will be conducted to implement it over the coming 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.

**EXISTING LEVEE STANDARDS AND GUIDANCE**

It is more important than ever that the Delta’s levees are designed, constructed, and maintained to provide a level of flood risk reduction commensurate with the coequal goals and protection of the Delta’s unique values as a place. Over the last few decades, State and federal agencies have developed guidelines and standards for levees. These standards and guidelines generally establish minimum criteria for levee design and maintenance. The standards include (1) the level of flood protection California has prescribed for the Central Valley’s urban areas, (2) whether sufficient protection is provided by the levees to exempt development financed with federally backed mortgages from requirements to obtain flood insurance, and (3) whether property and infrastructure protected by the levees (including the levees themselves) may be eligible
for assistance in the event of a catastrophic emergency, including aid from USACE to rehabilitate levees damaged in an emergency.

Five levee standards and guidelines applicable to the Delta are discussed below (and shown on Figure 7-4); they are ordered from highest to lowest level of flood protection:

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

  Very few levees in the Delta meet this standard because most Delta levees do not protect urban areas. Under existing law, rural levees are not required to meet this standard.

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

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

- **Bulletin 192-82.** The plan for Delta levee improvement proposed by DWR when State funding for Delta levees began, Bulletin 192 (DWR 1975), proposed two levels of improvement: 100-year protection roughly equivalent to the FEMA 100-year standard for levees protecting areas with legacy communities, other unincorporated Delta towns, and other islands with more residents – Brannan, Andrus, and Bethel Islands and Hotchkiss, Shima, Wright-Elmwood, Walnut Grove, and Sargent Barnhart Tracts. Levee improvements on other islands used primarily for agriculture were to provide 50-year protection, with 1.5 feet of freeboard above the expected 300 year flood elevation. The plan anticipated that on a few islands, levee improvements would be uneconomical, a conclusion with
which the Legislature concurred (Water Code section 128981(b)). Bulletin 192 is endorsed as a conceptual plan to guide the formulation of projects to preserve the Delta levee system (Water Code section 12225). Bulletin 192-82, its update, provides guidance for the Delta Levees Maintenance Subventions Program (Water Code section 12987).

- Public Law 84-99 (PL 84-99): The PL 84-99 guideline is a minimum requirement established by USACE for levees that participate in its Rehabilitation and Inspection Program (33 United States Code 701n) (69 Stat. 186). The standard for levee geometry implies a minimum levee height and a slope stability factor of safety, but is not associated with a level of protection (such as a 100-year flood) and does not address seismic stability. Delta islands or tracts that meet the PL 84-99 criteria may be eligible for USACE funding for levee rehabilitation, island restoration after flooding, and emergency assistance, provided that the reclamation district is accepted into the USACE’s program and passes a rigorous initial inspection and periodic follow-up inspections. Eligibility for PL 84-99 was formerly based primarily on levee geometry with minimum freeboard and maximum steepness of slopes. USACE’s periodic inspection program incorporates other elements into eligibility, including presence of structure encroachments, vegetation, rodent control programs, and more. The PL 84-99 cross section is roughly equivalent to that proposed in Bulletin 192-82.

The CALFED Record of Decision set a goal of improving Delta levees to meet the PL 84-99 criteria, as does the DPC Economic Sustainability Plan, but funding has been inadequate to attain this objective. Five Delta reclamation districts, protecting about 3 percent of the legal Delta’s land behind about 41 miles of levees, meet or exceed the Delta-specific PL 84-99 criteria, and 24 more districts are more than half-way to improving levees to this standard (Arcadis 2016a; Arcadis 2016b).

- Suisun Marsh. Guidelines for levees in Suisun Marsh are established in the 1980 Suisun Marsh Local Plan of Protection, and are approved by the San Francisco Bay Conservation and Development Commission. The crowns of exterior levees are to be 2 feet above expected high water levels. Where wave action is expected, the freeboard must be at least 3 feet. The more recent Suisun Marsh Plan (U.S. Bureau of Reclamation 2012) also proposes habitat levees -- low, wide, gently sloping vegetated levees, which may be overtopped during storm surges with nominal eroding or destabilizing. Habitat levees would include benches or berms that provide wind- and wave-action protection as well as opportunities for high marsh/upland transition habitat.

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1 The 2013 Delta Plan reported that 25 reclamation districts had levees improved to the PL 84-99 criteria according to a report by DWR. That report was based only on the PL 84-99 criteria for freeboard above the base flood elevation, but did not account for the backslope required by the Delta-specific PL 84-99 criteria.
From 1987 until 2014, levee upgrades often sought improvement to meet the Federal Emergency Management Program’s Delta hazard mitigation plan (HMP), as a step towards the PL 84-99 or Bulletin 192-82 standards. Good progress was made, with more than half of Delta reclamation districts meeting the HMP criteria (CALFED Bay-Delta Program 2000; Delta Stewardship Council 2013).

No State standards currently address design criteria for flood protection of the state highways and interstate highways that traverse the Delta. Federal standards require that interstate highways must be protected from 50-year flood events to qualify for Federal Highway Administration funds (23 Code of Federal Regulations 650.115). The levee investment priorities of this chapter applied this Federal Highway Administration standard to identify acceptable risks of flooding to the Delta’s interstates and State highways 160, 4, and 12. Because most roads in the Delta were constructed before these standards were developed, they do not meet the standards. For example, sections of State Route 12 are 10 feet or more below sea level. A flood on the islands this highway traverses could interrupt transportation and trade, and put motorists at risk.
Levee Guidance

Source: Adapted from Delta Vision Blue Ribbon Task Force 2008 and DWR 2011b (update from 2013 Delta Plan - added Bulletin 192 and deleted HMP)
Historically, most discussion of levees has emphasized reducing flood risks to life and property.
Discussion has also occurred on how to more effectively accommodate ecosystem function with the current levee system, highlighting the following issues (Healey and Mount 2007):

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

Habitat and ecosystem values and functions can provide multiple benefits, and must be considered in flood management planning and actions. For example, the CVFPP includes a conservation framework that outlines how environmental elements can be integrated into flood management (DWR 2016a). Setting levees back from the riverbank can expand flood conveyance capacity and reduce flood risk while providing ecosystem restoration and recreational opportunities (USACE 2002). Setback levees also allow opportunities for construction of an improved levee foundation and section using modern design and construction practices, thereby reducing risk of failure. Integrating fish-and wildlife-friendly channel margin treatments into levee improvements can also help (Davenport, Austin, Duryea, Huang, and Livsey 2016).

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

**RECREATION**

The Delta’s levees line its greatest recreation asset – the rivers and sloughs that attract boaters, anglers, nature lovers, and other visitors. In appropriate locations, publicly
owned levees and their crown roads can provide access for bank fishing, walking, or bicycling. Private waterside resorts also provide recreation on sites adjoining Delta levees. Where levees adjoin busy highways or farmland or on private levees, and where no entity is responsible for managing recreational use, access may create conflicts that cannot be effectively mitigated. The Delta Plan’s chapter 5 calls for considering recreation and access opportunities when levee investment decisions are made.

**FLOODPLAINS AND CHANNELS**

Floodplains and channels that provide the capacity to carry and store flood flows are critical for managing flood risks, and for overall Delta water management and ecosystem integrity. Projects planned for Yolo Bypass and Paradise Cut are examples of improvements that could add capacity to convey flood flows and help manage flood risks. The CVFPB and FEMA both play roles in designating floodways and floodplains to accommodate flood flows.

The CVFPB regulates encroachment in floodplains by designating floodways in the Sacramento River and San Joaquin River drainages, including the Delta (Water Code section 8609). A “designated floodway” is the channel of the stream and that portion of the adjoining floodplain, as shown on Figure 7-5, reasonably required to provide for the passage of a specified flood. It may also be the floodway between existing levees as determined by the CVFPB.

The CVFPB regulates encroachments within designated floodways and regulated streams through its permitting authority. The encroachment permit process applies to all projects, existing and proposed (including habitat restoration projects), within State/federal flood control project levees, designated floodways, bypasses, and regulated streams (CCR, Title 23, Division 1). The CVFPB should be consulted prior to the consideration of any projects that may be in a designated floodway in the Delta. Appendix L includes a map of the CVFPB’s jurisdictional areas in the Delta.

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

In some flood channels and bypasses, dredging may have benefits because it increases channel capacity and also provides material that can be used for levee maintenance and other flood risk management activities. Because some portions of the Delta are within a tidal pool and other areas are riverine, the efficacy of dredging must be addressed on a site-specific basis and cannot simply be considered useful on a Delta-wide basis.
The benefits and impacts of dredging Delta channels are being investigated by a consortium of federal and State agencies, including U.S. Environmental Protection Agency, USACE, DWR, and the Regional Water Quality Control Boards, under the Delta Dredged Sediment Long-Term Management Strategy (LTMS) Program. The LTMS is designed to improve operational efficiency and coordination of the collective and individual agency decision-making responsibilities resulting in approved dredging and dredged material management actions in the Delta. Approved dredging and dredged material management actions will take place in a manner that protects and enhances Delta water quality, identifies appropriate opportunities for the beneficial reuse of Delta sediments for levee rehabilitation and ecosystem restoration, and establishes safe disposal for materials that cannot be reused (USACE 2007).

**Conceptual Diagrams of Floodways**

![Conceptual Diagram of a Floodway within a Floodplain](image)

**Conceptual Diagram of a Floodway within a Floodplain**

![Conceptual Diagram of Floodway within a Leveed Channel](image)

**Figure 7-5** The floodway is the channel of the stream and that portion of the adjoining floodplain reasonably required to provide for the passage of a specified flood; it is also the floodway between existing levees as determined by the CVFPB or the Legislature.

*Source: FEMA 2006*
Delta Flood Management Facilities

The map shows land uses designated by city and county general plans. Within cities’ spheres of influences, the map shows land use designations proposed in city general plans, where available. In cases where cities have not proposed land uses within their spheres of influence, the map shows land uses designated by county general plans.

Sources: City of Benicia 2003, Contra Costa County 2008, Contra Costa County 2010, DWR 2011b, DWR 2011c, DWR 2011d, City of Fairfield
INVESTMENT IN REDUCING RISK

Maintaining the Delta’s levees and improving them to reduce risk to desired levels will cost billions of dollars. State-subsidized expenditures to maintain rural Delta levees, including local matching funds, averaged $11.6 million annually between FY 2010 to FY 2014. More is spent by State and local agencies to maintain project levees. Costs to improve Delta levees towards desired criteria total about $3 billion: $1.77 billion for urban levees, according to estimates from the Central Valley Flood Protection Plan regional flood management plans, and $1.26 billion, adjusted for inflation, for rural levees (URS Corporation/Jack R. Benjamin & Associates 2011).

Because the Delta’s levees reduce risk to residents; agricultural land; water supplies; and energy, communications, and transportation facilities, the State has invested considerable funding to maintain and improve them over several decades through various legislative actions. For rural non-project levees, two State programs provide matching funds to maintain and improve Delta levees. The principal State programs are:

- DWR’s Delta Levees Maintenance Subventions Program provides technical and financial assistance to local levee maintaining agencies in the Delta for the maintenance and rehabilitation of Delta levees. It pays up to 75 percent of levee maintenance and improvement costs after a minimum cost threshold has been paid by that district. In practice most recent funding is used to subsidize maintenance, with only modest amounts disbursed for major levee rehabilitation. While the Subventions Program is primarily for non-project levees, project levees qualify if more than 50 percent of the island acreage is within the Delta primary zone. Funding assistance provided by the subventions program is governed by guidelines developed by DWR and adopted by the CVFPB. The subventions program does not fund levee maintenance or improvement in Suisun Marsh.

- DWR’s Delta Levees Special Flood Control Projects Program provides financial assistance to local levee maintaining agencies to improve or rehabilitate levees in the Delta, portions of Suisun Marsh (approximately 12 miles of levees on islands bordering Suisun Bay from Van Sickle Island westerly to Montezuma Slough) as well
as the town of Thornton (Water Code section 12311). It can fund up to 100 percent of project costs.

An estimated $530 million of State taxpayer money has been spent by DWR on Delta levee maintenance and improvements through the subventions and special projects programs since the 1970s. No federal funds are available for these non-project levees.

Outside of the primary zone, almost all Delta levees are maintained by local levee maintaining agencies without State assistance.

Because the Delta’s project levees are authorized as part of the federal flood control project, they are eligible for federal funding for improvements and significant repairs. The CVFPB serves as the nonfederal partner to USACE for the Delta’s project levees. The federal government pays between 50 and 75 percent of the total costs of flood control projects authorized by Congress, with the non-federal costs typically shared by State (70 percent) and local entities (30 percent) (Water Code 44 section 12310-12318). The cost sharing ratio varies with the kind of benefits provided. For example, federal cost-share for ecosystem restoration projects can be as much as 65 percent in urban flood risk reduction projects. Water supply, recreation, and other benefits included in flood risk reduction projects can further modify federal cost sharing. The State share of nonfederal costs also depends on the mix of benefits. State funds are distributed through several DWR programs, including its Early Implementation Program, Local Levee Assistance Program, Urban Flood Risk Reduction (UFRR) Program, and Small Communities Flood Risk Reduction Program. $613.3 million has been committed through DWR’s Early Implementation Program to improve levees that protect urban and urbanizing areas in the Delta.

The State programs that support Delta levee maintenance and improvement have grown and adjusted incrementally over the years, reflecting new needs and institutions. DWR plays the prominent role. The CVFPB approves guidelines for the Delta Levees Maintenance Subventions Program (Water Code sections 12984 and 12991). The California Water Commission is authorized to approve lists of projects that are priorities for the Special Projects Program (Water Code section 12313(b)). The Department of Fish and Wildlife guides mitigation impacts to fish and wildlife and improvement of their habitats (Water Code sections 12314 and 12987(c)). The Natural Resources Agency maintains a recreation plan to be considered in maintenance and improvement plans funded under subventions program (Water Code section12987(e) and is responsible for supervising implementation of the special projects program (Water Code section 12306.5). Simplifying these responsibilities in fewer agencies could both improve oversight and reduce the complexity of interagency coordination.

Prioritizing State Investment in Levees

The Delta Reform Act requires that the Delta Plan attempt to reduce risk to people, property and State interests in the Delta by promoting strategic levee investments and recommending priorities for State investments in the Delta’s project and non-project levees (Water Code sections 85305(a) and 85306). Priorities are needed because the
funds needed to complete desired levee improvements significantly exceed the funds currently available. History provides little reason to expect that all the funds needed will soon be provided. Even if more funds were provided, projects providing greater benefits ought to proceed before those with fewer benefits. Given the uncertainty over the amount and availability of future Delta levee program funding, the most prudent approach is to prioritize those that reduce the most significant risks, provide the most benefits and avoid the costliest consequences. Prioritizing investment ensures that limited public funds are expended first for improvements that are most critical to protecting lives, property, and State interests. These priorities, in combination with the Delta Reform Act directive that State agencies act consistently with the Delta Plan and the requirement that reimbursements for major rehabilitation of levees through the Delta Levees Maintenance Subventions Program conform to the Delta Plan (Water Code section 12986), will ensure that State spending on Delta levees reflects these priorities in the future. The Delta Reform Act provides that activities of the Council in determining priorities for State levee investments in Delta levees do not increase the State’s liability for flood protection in the Delta or its watershed (Water Code section 85032(j)).

This 2013 Delta Plan envisioned that State funds for flood management would be focused at State interests but that some of that activity would protect local interests as well. The Plan outlined a process to prioritize State investments in levee operation, maintenance, and improvements in the Delta. The Council, following a workshop with flood risk management experts and extensive agency and public comment, adopted a set of principles to provide further guidance for priority setting (Delta Stewardship Council. 2015). Principles relevant to prioritization of levee investments include:

1. The goals of State law and the Delta Plan—and, therefore, the Delta Levee Investment Strategy—are to better protect life, property, and the State’s coequal goals for the Delta.
2. State funding should not assist further urbanization of flood-prone Delta land.
3. Expenditures should reduce risk. Reducing the probability of flood damage, for example, by improving levees or creating floodways, and lowering the consequences of flooding with actions like evacuation planning or floodproofing are both important.
4. State flood management investment to protect urban areas is the first priority.
5. Water conveyance and diversion infrastructure is a high priority.
6. State funds must enhance the ecosystem even if projects cost more to the State and to reclamation districts. A programmatic approach that locates ecosystem enhancements where they provide high benefits is preferable.
7. Consider systemwide needs. Specific recommendations of the Delta Plan and the State Plan of Flood Control should be considered. These include the proposed Paradise Cut Bypass recommended in the Delta Plan, and other specified non-project levees.
8. Impacts to the Delta’s unique values should be taken into account. These include the Delta’s farmlands, historic communities, and natural and cultural resources.
9. State investments in the Delta’s flood management system must consider post-flood recovery responses by local, state, and federal agencies and the efficacy and likelihood of financial assistance after flood damage.

10. Owners of non-project levees seeking State funding have the burden to prove that they protect many people and/or assets or help achieve the coequal goals.

This guidance was applied, following an independent science review (Mitchell, Asselman, Bolte, Cutter, McCann, Michelsen, and Rose 2015), to develop a method for assessing potential levee investment priorities in this plan amendment (Arcadis 2016b). The fragility of the Delta’s levees to threats from flooding, earthquakes, and sea level rise was carefully evaluated, and the population and property the levees protect were inventoried, using census data, land use maps, assessment information, and other sources. Metrics were developed to weigh the State interests that the Council determined investments should safeguard: water conveyance and diversion infrastructure and the Delta ecosystem. Information about transportation and utility infrastructure and the Delta’s unique values including farmland and legacy communities was also gathered, so that risks to these assets could be considered. This information, totaling 1.5 million data points, was assembled into a database that is analyzed by a computer-assisted decision support tool to aid in evaluating alternative priorities. Islands and tracts where levee improvements further multiple objectives, such as protecting both water supply and the Delta ecosystem, were preferred to projects that advance only a single interest. Also considered in setting priorities were information about system wide needs, including recommendations of the Delta Plan, the Central Valley Flood Protection Plan and other proposals for the State Plan of Flood Control, and the California EcoRestore initiative. Advice from the Central Valley Flood Protection Board, DWR, other flood agencies, and Delta stakeholders has also been considered.

Gathering and evaluating the information used to recommend investment priorities has been a considerable and controversial effort. Despite the limitations of the data available, the effort has been more thorough, comprehensive, and transparent than prior studies. As data is updated and levee conditions change with improvements, the Council intends to maintain and improve its data base and decision support tool, both to track the performance of State levee investments and to support periodic reviews of the Delta Plan.

**Continue and Improve the Delta Levees Maintenance Subventions Program**

Confirmation that continued maintenance of Delta’s levees remains important is one result of this evaluation. This maintenance, including ongoing State financial support through the Delta Levees Maintenance Subventions Program, should continue. It reduces risks to lives, property and State interests and contributes to preservation of the Delta’s unique agricultural, natural, and cultural resources. This maintenance of the Delta levee network also reduces the risk that failure of one island’s levees could expose adjoining islands to increased wind waves or seepage.

**Prioritize State Levee Investments**
Investments that improve Delta levees towards applicable standards and guidelines are critical to protecting lives, property, and State interests. Priorities for these improvements are recommended in Figure 7-X and Table 7-Y. The very highest priorities are improvements to levees protecting urban and urbanizing areas of Sacramento, West Sacramento, and metropolitan Stockton, where the most lives and property are at risk. Another very high priority is improving levees on Sherman, Twitchell, Brannan-Andrus, Upper Andrus, and Grand islands along the Highway 160 corridor, where the quality of water supplies, restored marshes, transportation routes, the communities of Isleton, Ryde, and Walnut Grove, and farmland are at risk. Further north along Highway 160 levee improvement in the rural southern portion of Maintenance Area 9 is ranked as a very high priority because of risks to life, property including the communities of Freeport and Hood, and Stone Lakes National Wildlife Refuge. Bethel and Jersey Islands rank as very high priorities because both islands are important to the quality of water supplies, many people and much property are at risk on Bethel Island, and Jersey Island holds important wildlife habitat. Improving Byron Tract’s levees is a very high priority because of risks to both lives and water supply infrastructure. At Dutch Slough and the McCormack Williamson Tract, the very high priority is retiring outmoded levees by restoring the sites to marsh, contributing to the net improvement of aquatic habitats required of the Delta Levees Special Flood Control Projects Program (Water Code section 12311).

Thirty-three other islands and tracts are identified as high priorities for levee improvements. On many of these, water supplies or ecosystems are at risk, but benefits to multiple interests are not significant. Improvements on other high priority islands and tracts may reduce risks to multiple values, but benefits are lower than on very high priority areas. Levees at the Yolo Bypass (including levees bordering the bypass in Reclamation Districts 2068 and 2098), the proposed Paradise Cut Bypass, and levees protecting interstates and State highways 160, 4, and 12 are also identified as high priorities to indicate their improvement will be important when feasibility studies or CalTrans’ climate change vulnerability studies indicate upgrades are the best alternative.

Stockpiling material for emergency repairs of levees on the water export corridors along Middle and Old Rivers toward the pumps of the State Water Project and Central Valley Project or at sites serving local reclamation districts can complement these levee improvements. No foreseeable amount of improvement will make the Delta’s levees invulnerable to failures in large floods or earthquakes. Placing levee repair materials where they are readily available to repair damage is prudent preparation for disasters that may come. In the unfortunate event that a levee failure occurs, the coequal goals of providing a more reliable water supply and protecting, restoring, and enhancing the Delta ecosystem should be evaluated as part of the post-disaster response process.

Every levee is important to those whose safety or property is protected. The islands and tracts of the legal Delta that are listed as “other priorities” are not unimportant. State funds for improving their levees ought to be considered after worthy projects on very
high priority and high priority islands are funded. Some of these islands and tracts hold valuable property or have important water supply or ecosystem values, but face lower risks of failure, often because of previous State-funded levee improvements. Others may have levees with high probability of failure, but have few residents, less valuable property, or lower water supply or ecosystem values. Suisun Marsh levees, except for those bordering Suisun Bay from Van Sickle Island westerly to Montezuma Slough, are ineligible for State funds for levee improvement (Water Code section 12311), a restriction that should be maintained.

In awarding State funds to improve these levees, DWR may vary from these priorities when necessary to protect lives, property, or the State’s interests in water supply reliability, the Delta ecosystem, considering the Delta’s unique agricultural, natural, cultural, or recreational values. The reasons for any variations should be explained.

UPDATE FUNDING STRATEGIES

“Who pays what” is a key to financing all public works. The Delta Plan endorses the principles that “beneficiaries pay” and “stressors pay.” The Council’s levees investment strategy principles include:

1. The Delta Levee Investment Strategy should be based on the Delta Plan principle that beneficiaries pay. The State share of levee improvements should reflect the State interests at stake. Levee maintenance is primarily the responsibility of local reclamation districts and their property owners, not the State. The State should also take into account the ability to pay of local agencies.

2. The State should create a Delta Flood Risk Management Assessment District with the authority to charge all beneficiaries.

In practice, almost all funds for most Delta levees’ maintenance and improvement have come from two sources – landowners through assessments on lands or other property protected by the levee network, and the State’s general fund, both through direct appropriation and through the repayment of general obligation bonds. Annual funding for levee improvements and maintenance is constrained currently by annual appropriations of State funds, statewide bond measures, and by affordability and budgeting at the local level, where jurisdictions, whether urbanized or rural, face budgetary constraints and competition for tax dollars from a multitude of public needs.

Although the State contributes the majority of funds for maintaining and improving nonproject Delta levees, the concept of shared responsibility with local landowners is key to the Delta’s levees long term viability. The continued participation and financial support of local reclamation districts is essential. As noted in the Delta Reform Act’s Section 85003(b), “Delta property ownership developed pursuant to the federal Swamp Land Act of 1850, and State legislation enacted in 1861, and as a result of the construction of levees to keep previously seasonal wetlands dry throughout the year. That property ownership, and the exercise of associated rights, continue to depend on the landowners’ maintenance of those nonproject levees and do not include any right to
state funding of levee maintenance or repair.” Local cost shares are paid from property
assessments. In the rural Delta, assessments, which also cover reclamation districts’
drainage expenses, often average $10 to $40 per acre annually, with higher
assessments in districts that are matching significant State funds for levee improvement
(Delta Stewardship Council 2015). Local agencies have varying ability to pay,
influenced by the value of land that can be assessed and the desires of their voters,
who are usually property owners. In the rural Delta, where the productivity and use of
agricultural land strongly influences land values, districts’ ability to pay varies widely
(Arcadis 2017).

Most recent State funds have come from general obligation bonds, such as those,
authorized by Proposition 1E for flood risk reduction. The reliance on State bonds to
fund 75 to 100 percent of levee improvement and maintenance costs not only limits the
amount of annual funding available but is an uncertain source of future funding for these
very costly long term capital and maintenance needs. Another drawback of relying
primarily on statewide bond measures to fund Delta levee improvements and
maintenance is that the Delta’s needs must compete with other regions, increasing the
uncertainty of bond-funded appropriations.

Prior to the availability of bond funds, the subventions program was supported with
modest levels of general funds. The reliance on general fund reflects in part a proper
allocation to the State of costs to protect broad-based public benefits such as protecting
public safety, enhancing fish and wildlife habitat or safeguarding water quality. Without
another way to collect funds from water users, highway and railroad users, or utility
customers, the general fund may also approximate these broad-based classes of
beneficiaries.

The State’s cost share for levee maintenance and improvement varies among
programs. The Delta Levees Maintenance Subventions Program pays up to 75 percent
of local costs, above $1,000 per levee mile, to maintain and rehabilitate nonproject and
some project levees. The $1,000 per levee mile deductible, last updated in 1981, is an
approach to State-local cost sharing. This deductible equates to approximately $3 per
acre for reclamation districts within the Delta. If the deductible were updated for inflation
since 1981, it would be $2250 to $2500 per mile, depending on the index used to
measure rising costs or crop prices. At the upper limit of $2500 per mile, this would
equate to approximately $7 per acre for Delta reclamation districts Studies of a local
agencies’ ability to pay are supposed to inform cost-sharing between local districts and
the State, but in practice are seldom completed or applied.

Most project levees are maintained without State support by local agencies or State-
imposed maintenance areas funded by local landowners.

Improvement of nonproject levees is usually funded through the Delta Levee Special
Projects Flood Control Program, although occasionally the Delta Levees Maintenance
Subventions Program funds rehabilitation projects that improve levees. The Special
Flood Control Projects Program may pay up to 100 percent of improvement costs,
subject to cost sharing agreements it may enter into with the beneficiaries or owners of
infrastructure, such as utilities or highways that benefit from the improvement. The
USACE’s conclusion that there is no federal interest in improving non-project Delta
levees removes the CALFED Bay-Delta Program’s expectation that the federal
government might pay up to half the cost of these levees’ improvement. Improvements
to project levees usually include at least a 50 percent federal cost share, with greater
federal support when improvements provide ecosystem restoration or other benefits.

To widen other levee beneficiaries’ participation in funding levee maintenance and
improvement, the 2013 Delta Plan and the DPC’s Economic Sustainability Plan
proposed creating a regional agency with fee assessment authority to assist with the
financing, planning, and implementation of Delta flood risk reduction activities. It was
hoped that this alternative funding mechanism could provide a more stable, long-term
approach to funding in which local participation by all beneficiaries of flood risk
management is more broadly incorporated. Phase 1 of the DPC efforts, however,
suggests that such a district is infeasible because it cannot capture revenue from all
beneficiaries of Delta levees and the significant legal and political hurdles of creating an
assessment district crossing so many jurisdictional boundaries. Instead, the DPC is
exploring other approaches to involving beneficiaries in paying for levee improvements
(M.Cubed 2016). Phase 1 of the DPC effort suggests that the most feasible portfolio of
finance mechanisms is one that could generate revenue to pay for levee maintenance,
repair, rehabilitation and improvements, including new fees that would bring in revenue
from beneficiaries that do not currently pay for Delta levees in proportion to the benefits they receive. Candidates include contributions from the State Water Project or Central Valley Project for improvements protecting the conveyance of water through the Delta for export, a water use fee linked to improvement of levees protecting water quality, fees on energy or telecommunication utilities with infrastructure protected by levees, contributions from CalTrans as it implements strategies to reduce its highways’ vulnerability, reactivation of the Sacramento-San Joaquin Drainage District as proposed in the draft Central Valley Flood Protection Plan, or regional assessments to respond to sea level rise. This potential portfolio of finance mechanisms may help move toward a levee funding system based on the “beneficiary pays” principle, increasing the funds available to pay for levee maintenance or priority levee improvements. These approaches should be further investigated by the DPC in the next phase of work and pursued, if viable, along with action by the Public Utilities Commission recommended in the Delta Plan to promote cost-sharing of levee improvements by investor owned utilities.

PLANNING FOR FLOODPLAIN LAND USE

The most important step in reducing risk to people in the Delta is to stop putting more people at risk behind levees that do not meet minimum modern standards for flood protection. Actions that increase the demand for higher public spending on flood risk reduction and exacerbate flood risk (for example, urbanizing floodprone areas) should be discouraged (Galloway, et. al. 2007).

The DPC Land Use and Resource Management Plan for the Primary Zone of the Delta also includes important policies to limit development in floodprone areas of the Primary Zone:

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

As noted in Chapter 5, the legacy community of Bethel Island warrants a special note because of its flood hazards. About 2,100 people reside on the island in about 1,300 residences concentrated on the south-central shoreline and four mobile home parks. The island, which is below sea level, is surrounded by approximately 15 miles of levees, limiting the drainage of floodwaters in the event of a levee breach. A single road, Bethel Island Road, links the island to the mainland at the city of Oakley, complicating emergency response or evacuation in the event of flooding. Because developments on Bethel Island are proposed to be served by the Bethel Island Municipal Improvement District or other adjacent public services, the entire island is within the urban limit line.
adopted by Contra Costa voters in 2006. The high flood risks on the island and the
restricted evacuation opportunities, however, indicate the island has greater hazards to
lives and property than the Delta’s other areas designated for development. For this
reason, it is not excluded from the Delta Plan policy prohibiting new subdivisions unless
adequate flood protection is provided. This is consistent with provisions of the Contra
Costa County General Plan, which require that development other than a single home
on existing parcels await resolution of several issues, including improvement of the
community’s public services, levees, and emergency evacuation routes.

As described in Chapter 5, urban residential, commercial, and industrial uses should be
located in cities, other urban areas, and their spheres of influence, where strong levees
can be provided, rather than in rural lands protected only by nonproject levees. Outside
of these urban and urbanizing areas and the legacy communities, the Delta Plan
prohibits major subdivisions of five or more parcels where 200-year flood protection is
not available. In rural areas, any new rural residential subdivisions should anticipate
rising sea levels by going beyond FEMA standards to designate home sites that will be
above the sea level anticipated in 2100. Recognizing legacy community needs for
incidental growth to maintain their unique cultural values, development within
community boundaries should continue consistent with existing general plans, and
federal and local flood protection laws. Appendix B provides maps of Delta community
boundaries. Maintaining most of the Delta in rural, agricultural land use, as described in
Chapter 5, complements policies that reduce the number of properties and the
population exposed to high flood risks.

Finally, the participation of Delta counties and cities in the National Flood Insurance
Program brings with it a requirement that all residential, commercial, agricultural, and
industrial buildings comply with FEMA floodproofing standards, including elevating
structure ground floors above the 100-year flood elevation. Examples of floodproofing
are shown on Figure 7-7
Examples of Floodproofing

**Figure 7-7** Floodproofing in accordance with the National Flood Insurance Program can be achieved through several methods. The illustration on the left shows an example of floodproofing by constructing the lowest floor within a structure above the design flood elevation. The illustration on the right shows floodproofing by raising the bottom of the structure above the design flood elevation.

*Source: FEMA 1994; FEMA 2001*

**FUNDING FOR NON-STRUCTURAL RISK REDUCTION**

Flood risks to lives and property can be reduced by investing in emergency evacuation routes, flood proofing, or other actions in addition to levees. In the Delta’s unincorporated towns or rural developments, these non-structural risk reduction activities may be preferred when improving levees is not affordable or cost effective. Pursuing these alternatives can be difficult, however, because State funds are primarily available for levee improvements, rather than the full range of risk reduction activities. As the State makes additional funds available for flood risk reduction, providing funds for nonstructural risk reduction as well as levee improvement can give Delta residents more choices about how to reduce flood risks.

**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. A 200-year flood or earthquake could badly damage levees at up to 10 to as many as 40 islands (Arcadis 2016b). To reduce response time and optimize effectiveness of response efforts after such a disaster,
emergency 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 county offices of emergency 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 established by Government Code section 8607(a), and provides for effective management of multiagency and multijurisdictional emergencies in California, including flood emergencies. This system consists of five organizational levels, which are activated as necessary: (1) field response, (2) local government, (3) operational area, (4) regional, and (5) State. These levels are activated stepwise as the events warrant additional response and resources, meaning that each level of emergency responder contacts the next level above them should they deem the emergency beyond their capabilities to control. Federal resources are called upon if State resources are exhausted or additional assistance is needed. SEMS incorporates the functions and principles of the Incident Command System, the Master Mutual Aid Agreement, existing mutual aid systems, the operational area concept, and multiagency or interagency coordination. A detailed discussion of SEMS can be found in Cal EMA SEMS Guidelines (Cal EMA 2009). Local governments must use SEMS to be eligible for funding of their response-related personnel costs under State disaster assistance programs.

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

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

To further address emergency preparedness and response issues in the Delta, Water
Code section 12994.5 calls for developing and implementing multi-hazard preparedness
and response strategies for the Delta. This legislation requires the Office of Emergency
Services (CalOES) to establish the Sacramento-San Joaquin Delta Multi-Hazard
Coordination Task Force. Led by CalOES, the task force consists of representatives
from the DPC, DWR, and the five Delta counties. The task force was directed to do the
following:

- Make recommendations to CalOES about creating an interagency unified
  command system organizational framework, in accordance with the guidelines of
  the National Incident Management System (NIMS) and the Standardized
  Emergency Management System (SEMS);
- Coordinate development of a draft emergency preparedness and response
  strategy for the Delta; and
- Develop and conduct all-hazard emergency response exercises and training in the
  Delta that would test or facilitate implementation of regional coordination protocols.

The recommendations prepared by the task force include identifying potential threats
and consequences affecting the Delta, developing a Delta catastrophic flood incident
plan to guide integrated emergency response in the Delta, and the preparing a regional
mass evacuation plan.

RENEWING FEDERAL ASSURANCES OF ASSISTANCE IN RECOVERING FROM
FLOOD DISASTERS

Following a flood disaster, various federal programs can provide disaster assistance.
The federal agencies have repeatedly helped fund post-disaster repairs of Delta levees
2004, and 2006. FEMA’s Hazard Mitigation Plan (HMP) criteria must be met to be
eligible for its assistance (Delta Stewardship Council Staff 2010b). USACE has specific
criteria concerning eligibility for assistance to repair levees under PL 84-99. The Delta
HMP agreed to between California agencies and FEMA was intended to reduce risks to
the property that Delta levees protect, so that federal aid would be needed less often.
The State’s investment in Delta levee maintenance and improvement has in part been
in fulfillment of its responsibilities under the HMP.

Today, however, California can no longer rely on federal assistance to rebuild Delta
levees damaged in floods. Following Hurricane Katrina and other expensive disasters,
eligibility requirements for FEMA and USACE post-disaster assistance for levee repairs
have been tightened and more rigorously enforced. Most rural Delta project levees were
either removed from the Corps’ PL 84-99 program or are expected to become ineligible
soon. In 2014, the Delta HMP was not renewed, despite the considerable State
investment in its implementation. The agreement’s termination partly reflected FEMA’s
concern that sufficient progress had not been made toward its long-term goal of bringing levees up to the USACE Delta specific PL 84-99 standard and growing realization of the costs that flood disasters nationwide are imposing on the federal government.

Planning for levee improvement and maintenance is difficult without more certainty about the reliability of federal post-disaster recovery programs, including the criteria that could be imposed on reclamation districts seeking whatever federal levee repair assistance may be available. Revising assistance criteria to reflect the Delta’s unique setting and its water supply and ecosystem values is an important aspect of seeking renewed federal commitments. Without federal assistance, post-disaster recovery would be difficult and expensive. Landowners alone would be unlikely to repair levees damaged in a disaster on 18 to 23 Delta islands where the cost of repairs is likely to exceed the value of the islands’ property (Suddeth, et. al. 2010). Federal assistance in rebuilding these levees could significantly lower landowners’ repair costs, increasing the likelihood that damaged islands would be reclaimed. The lack of federal assistance shifts to the State the cost of aiding local agencies in levee repairs, because State law provides that post-disaster levee repair claims not paid by federal agencies may be reimbursed by the State through DWR’s Delta Levees Maintenance Subventions Program (Water Code section 12993). As risks grow with rising seas, the importance of FEMA’s hazard mitigation assistance will only increase proportionately.

LIABILITY CONCERNS

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

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

In *Arreola v. County of Monterey* (2002) (99 Cal. App. 4th 722), the court held local agencies and the California Department of Transportation (Caltrans) liable for 1995 flood damages to property owners that resulted from a failure to properly maintain levees of the Pajaro River project.
One way to reduce State liability is to expand participation in flood insurance programs. Flood insurance premiums are increasing as Congress reacts to steady program losses from recent flood disasters. High premiums, however, make flood insurance less affordable for many Delta residents. Local government participation in the flood insurance program’s community rating system can help lower rates as communities undertake activities that reduce flood risks, like evacuation planning, floodproofing, or buying out repetitively damaged properties.

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

In 2007, the Legislature amended the Water Code to address local community liability for approving development in flood prone areas. It provides that “a city or county may be required to contribute its fair and reasonable share of the property damage caused by a flood to the extent that the city or county has increased the state’s exposure to liability for property damage by unreasonably approving new development in a previously undeveloped area that is protected by a state flood control project” (Water Code sections 8307(a) and (b)).

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

**POLICIES AND RECOMMENDATIONS**

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

- Continue to prepare for Delta flood emergencies
- Modernize levee information management
- Prioritize investment in Delta levees
- Update flood management funding strategies
- Manage rural floodplains to avoid increased flood risk
- Protect and expand floodways, floodplains, and bypasses
- Renew assurances of federal assistance for post disaster response
• Limit State liability

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

**Continue to Prepare for Delta Flood Emergencies**

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

The recommendations prepared by the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force play an important role in planning efforts for the Delta.

**Problem Statement**

Levee failures and flooding can and will place human life and property in danger, and can have potentially significant implications for the State’s water supply and infrastructure, and the health of the Delta ecosystem. Investments in levee maintenance and improvement can reduce but not eliminate these risks. Appropriate emergency preparedness and response planning and implementation activities need to continue and expand.

**Policies**

No policies with regulatory effect are included in this section.

**Recommendations**

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

The following actions should be taken to promote effective emergency preparedness and response in the Delta:

• Responsible local, State, and federal agencies with emergency response authority should continue to implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5). Such actions should support the development of a regional response system for the Delta.

• Materials should be stockpiled in appropriate locations to make post-disaster repairs of breaches in levees along the water supply reliability corridor identified in the Delta Plan’s Figure 7-6, the western islands important to protection of
water quality, and other levees, to complement improvement of levees as provided in RR P1.

- Local levee-maintaining agencies, with assistance from DWR, should develop their own emergency action plans, training, and floodfight material stockpiles.
- State and local agencies, and regulated utilities that own and/or operate infrastructure in the Delta should prepare coordinated emergency response plans to protect the infrastructure from long-term outages resulting from failures of the Delta levees. The emergency procedures should consider methods that also would protect Delta land use and ecosystem.

### Modernize Levee Information Management

#### Problem Statement

Information about levee conditions is held by many parties. Data is not gathered consistently or shared widely or easily, leading to disagreements about maintenance needs and progress towards objectives for risk reduction and levee improvement. Without adequate information, planning is hindered and program performance is difficult to judge (Committee on Integrating Dam and Levee Safety and Community Resilience, 2012)

### RR R2. Modernize Levee Information Management

#### A. Require Adequate Levee Inspections.

In order to gather information about Delta levee conditions and maintenance needs, the Central Valley Flood Protection Board should update its guidelines for the Delta Levees Maintenance Subventions Program to require local levee maintaining agencies participating in the program to annually inspect their Delta levees in accordance with DWR’s guidelines for Local Agency Project and Nonproject Levee Maintenance Inspection and to file their inspection reports electronically with DWR. Costs of inspections should continue to be reimbursable through the Delta Levees Maintenance Subventions Program.

#### B. Provide Delta Levee Investment Decision Support.

The Delta Stewardship Council should use information from levee inspections reported to DWR and from DWR’s annual reports about its levee investments pursuant to this plan’s policy regarding levee investment priorities (RR P1) to maintain the decision support tool developed during preparation of this Delta Plan amendment.

### Prioritize Investment in Delta Flood Management Investment

The Delta Reform Act of 2009 charges the Council to attempt to reduce risks to people, property, and State interests in the Delta (Water Code section 85305) by promoting, in part, strategic investments in Delta levees. The Council is required to recommend in the Delta Plan priorities for investments in levee operation, maintenance, and improvements in the Delta, in consultation with the Central Valley Flood Protection Board (Water Code section 85306). The Council’s policy is to reduce flood risk in the Delta with cost-
effective investments that further the coequal goals of California law: “a more reliable water supply for California and protecting, restoring and enhancing the Delta ecosystem”, in a manner that protects and enhances the “unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place” (Public Resources Code section 29702).

Problem Statement

The Delta Reform Act (Water Code section 85306) requires the Delta Plan to recommend priorities for State investments in Delta levees, including project and nonproject levees. Currently, no comprehensive method exists to prioritize State investments in Delta levee operations, maintenance, and improvement projects. Without a prioritization, the apportionment of public resources into levees may not occur in a manner that reflects the risks to lives, property, and State interests.

Policies

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

A. Fund levee maintenance. Funding for maintenance of levees shall continue to be available throughout the Delta where authorized by Water Code section 12980 et. seq.

B Prioritize levee improvements. The priorities listed below shall guide State discretionary investments in the improvement and major rehabilitation of Delta levees. As DWR selects levee improvement projects for funding through its levee funding programs, it should fund projects at the very high priority islands or tracts, subject to its consideration of the benefits, costs, engineering considerations, and other factors, before approving projects at high priority or other priority tracts. If available funds are sufficient to fully fund levee improvements at the very high priority tracts, then funds for improvements or major rehabilitation of levees on high priority islands and tracts may be provided, and after those projects have been fully funded, then projects at other priority islands and tracts may be funded.

The Department of Water Resources shall certify projects’ consistency with this regulatory policy when its funding decisions are made and shall report annually to the Council about its decisions to award State funds for Delta levee improvements, including the location of each funded improvement, the priority of the affected islands or tracts, the improvements funded, including the relevant levee improvement type, habitat mitigation or enhancement features, estimated reduction in levee fragility, expected reduction in annual fatalities and damages, State funds awarded, and local or federal matching funds.
Preliminary Draft Delta Levees Investment Priorities
Very High Priority

<table>
<thead>
<tr>
<th>Area</th>
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<tbody>
<tr>
<td>BETHEL ISLAND, BISHOP/DLIS-14 (NORTH STOCKTON), BRANNAN-ANDRUS, BYRON TRACT, CENTRAL STOCKTON, DUTCH SLOUGH, GRAND ISLAND, JERSEY ISLAND, MAINTENANCE AREA 9 NORTH, MAINTENANCE AREA 9 SOUTH, MCCORMACK-WILLIAMSON TRACT, NORTH STOCKTON, RECLAMATION DISTRICT 17, SHERMAN ISLAND, TWITCHELL ISLAND, UPPER ANDRUS ISLAND, WEST SACRAMENTO</td>
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High Priority

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<tr>
<td>BACON ISLAND, BOULDIN ISLAND, BRADFORD ISLAND, CLIFTON COURT FOREBAY, DLIS-08 (DISCOVERY BAY AREA), DLIS-20 (YOLO BYPASS), DLIS-22 (RIO VISTA), DLIS-63 (GRIZZLY ISLAND AREA), DREXLER TRACT, GLANVILLE, HASTINGS TRACT, HOLLAND TRACT, HONKER BAY, HONKER LAKE TRACT, HOTCHKISS TRACT, JONES TRACT (LOWER AND UPPER), LITTLE EGBERT TRACT, MANDEVILLE ISLAND, MCDONALD ISLAND, MIDDLE &amp; UPPER ROBERTS ISLAND, MOSSDALE ISLAND, NEW HOPE TRACT, PALM-ORWOOD, PARADISE CUT, PARADISE JUNCTION, PESCADERO DISTRICT, STATEN ISLAND, STEWART TRACT, TERMINOUS TRACT, TYLER ISLAND, UNION ISLAND WEST, VICTORIA ISLAND, WEBB TRACT, WOODWARD ISLAND</td>
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Other Priority

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When DWR’s contributions towards levee improvements vary from these priorities, it shall identify how the funding is inconsistent with this guidance, describe why variation from the priorities is necessary, and explain how the funding nevertheless protects lives, property, and the State’s interests in water supply reliability and restoration, protection, and enhancement of the Delta ecosystem while considering the Delta’s unique agricultural, natural, historic, and cultural values. That determination is subject to review by the Delta Stewardship Council on appeal.

(a) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves discretionary State
investments in the improvement and major rehabilitation of Delta levees. Nothing in this
policy establishes or otherwise changes existing levee standards.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85300, 85305, and 85306, Water Code.

Definitions

Add the following definitions to the Delta Plan glossary

**Levee Maintenance:**

Annual or routine levee maintenance is work intended to preserve the levee system in its current condition. Examples of maintenance work include patrols, surveys and inspections, extermination and control of burrowing animals, work on the levee crown to improve access or drainage, removing vegetation or debris, control of seepage and boils, cleaning drains and toe ditches, restoring rock protection, and maintenance of levee-related habit improvements sites.

**Levee Rehabilitation:**

Rehabilitation is levee repair work needed to improve the levee integrity and preserve existing flood risk reduction benefits. Examples of rehabilitation work include raising the levee crown to offset subsidence, flattening waterside slopes, constructing landside berms, and widening levee crowns.

**Levee Improvement:**

Levee improvements are intended to reduce the probability of flooding. An example of a levee improvement would be changing a levee geometry to meet a higher levee standard such as improving a levee to reach a 200-year level of protection.

**Update Flood Management Funding Strategies**

The responsibility for securing funding for Delta levee maintenance, repairs, and improvements lies with the numerous local levee-maintaining agencies (primarily reclamation districts). These local agencies have varying ability to pay which is influenced by the value of land within the district that can be assessed and the desires of the district’s voters, who are usually property owners. Funding is generated through property assessments of local landowners and also is provided by the State under programs administered by DWR, including the Delta Levees Special Flood Control Projects and Delta Levees Maintenance Subventions programs. Federal investments match State and local funds to improve project levees that protect urban and urbanizing areas. The record of declining flooding damage and testimony to the Council reflect these programs’ value. These programs should be continued with adequate funding to provide State matching funds for addressing Delta flood risk.
Many other entities that benefit from flood risk management are not assessed, nor do they contribute to maintenance and upkeep of Delta levees, including owners of regional infrastructure that crosses the Delta. The duty of providing for Delta flood risk management should be borne by all entities benefitting from these actions, and an equitable methodology of defining and apportioning assessments should be developed and implemented.

**Problem Statement**

Currently available funds are insufficient to meet needs for levee maintenance and improvement in the Delta. Further funds are needed. Additional funding strategies need to be fully evaluated. No mechanism exists for ensuring that costs of levee maintenance are borne by all beneficiaries. Current financing emphasize levee maintenance and improvement, rather than a full array of flood risk reduction measures.

**Policies**

No policies with regulatory effect are included in this section.

**Recommendations**

**RR R3. Provide adequate State funds to support levee maintenance and improvement**

Adequate State funds to support levee maintenance and improvement should continue to be provided through the Delta Levees Maintenance Subventions Program, the Delta Levee Special Projects Program, and through programs that implement the Central Valley Flood Protection Plan.

**RR R4. Update Delta Levees Maintenance Subventions Program’s Cost-sharing Provisions**

A. **75 percent State cost share.** The Delta Levees Maintenance Subvention Program’s maximum 75 percent State cost share for maintenance and major rehabilitation projects should be extended indefinitely.

B. **Update the Delta Levees Maintenance Subventions Program Deductible Provision.** The Legislature should amend the Water Code section 12986(a)-(b) to adjust the current $1000 per mile deductible amount to account for inflation since the provision was enacted in 1981. The deductible amount should be reevaluated periodically to reflect current inflation and the needs of the program and its participants.

C. **Simplify Consideration of Local Levee Maintaining Agencies’ Ability to Pay for Levee Maintenance and Improvement.** The Central Valley Flood Protection Board should revise its guidelines for the Delta Levees Maintenance Subventions Program to provide a simplified approach to the consideration of a local levee agency’s ability...
to pay for the cost of levee maintenance or improvement, as required by Water Code section 12986(a)(3), so that reclamation districts with little ability to pay receive the full 75 percent State cost share recommended above, with reduced State cost shares for reclamation districts that are able to pay more to maintain and improve their levees.

RR R5 Finance Local Flood Management Activities

The Council, DWR, CVFPB, and the DPC, in consultation with the Corps of Engineers and the Department of Finance, should cooperate to further develop levee finance mechanisms, including those studied by the DPC, that create opportunities for “beneficiary pays”-based funding approaches that supplement State-funding for levee maintenance and improvements. Because no single financial mechanism can meet the requirements of a beneficiary-pays approach to address the full range of beneficiaries and financing needs, a portfolio of mechanisms targeted to particular levee improvements should be evaluated. These mechanisms could include assessments, public funding, water use fees, water conveyance fees, and flood prevention fees.

RR R6. New State Funding for Non-structural Risk Reduction

A hazard mitigation program, funded by the State, should be established to make grants to local governments and flood management agencies to support emergency preparedness actions, such as evacuation planning or prepositioning of flood fight materials, and non-structural flood hazard mitigation actions, such as flood-proofing of public or private buildings or the purchase and removal of flood-prone structures.

RR R7. Fund Actions to Protect Infrastructure from Flooding and Other Natural Disasters

- The California Public Utilities Commission should immediately commence formal hearings to impose a reasonable fee for flood and disaster prevention on regulated privately owned utilities with facilities located in the Delta. Publicly owned utilities should also be encouraged to develop similar fees. The California Public Utilities Commission, in consultation with the Delta Stewardship Council, the California Department of Water Resources, and the Delta Protection Commission, should allocate these funds among State and local emergency response and flood protection entities in the Delta. If a new regional flood management agency is established by law, a portion of the local share would be allocated to that agency.
- The California Public Utilities Commission should direct all regulated public utilities in their jurisdiction to immediately take steps to protect their facilities in the Delta from the consequences of a catastrophic failure of levees in the Delta, to minimize the impact on the State’s economy.
- CalTrans should be given authority by the Legislature to enter into agreements with local levee maintaining agencies to fund improvement and maintenance of
levees adjoining interstates and State highways when that is the least cost
approach to reducing flood risks to those roads.
- State agencies with projects or infrastructure in the Delta should set aside a
  reasonable amount of funding to pay for flood protection and disaster prevention.

Manage Rural Floodplains to Avoid Increased Flood Risk

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

Consistent with existing law, urban development in the Primary Zone should remain
prohibited. Urban development in the Secondary Zone should be confined to existing
urban spheres of influence where the 200-year design standard will be fully
implemented by 2025. The 2007 flood risk management legislation (SB 5) contained
provisions affecting city and county responsibilities relating to local planning
requirements, such as general plans, development agreements, zoning ordinances,
tentative maps, and other actions (Government Code sections 65865.5, 65962, and
66474.5).

Future land use decisions should not permit or encourage construction of significant
numbers of new residences in the nonurban Delta. For the legacy communities in the
Delta, structures developed in these areas are required to meet the legal standard of a
100-year minimum level of flood protection. However, developing and maintaining
adequate flood protection remains difficult.

Problem Statement

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

Policies

The appendices referred to in the policy language below are included in Appendix B of
the Delta Plan.

RR P2. Require Flood Protection for Residential Development in Rural Areas

a) New residential development of five or more parcels shall be protected through
floodproofing to a level 12 inches above the 100-year base flood elevation, plus
sufficient additional elevation to protect against a 55-inch rise in sea level at the
Golden Gate, unless the development is located within:

1) Areas that city or county general plans, as of May 16, 2013, designate for
development in cities or their spheres of influence;
2) Areas within Contra Costa County’s 2006 voter-approved urban limit line,
except Bethel Island;
3) Areas within the Mountain House General Plan Community Boundary in San
Joaquin County; or
4) The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke,
Ryde, and Walnut Grove, as shown in Appendix 7.

b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of
this Chapter, this policy covers a proposed action that involves new residential
development of five or more parcels that is not located within the areas described
in subsection (a).

23 CCR Section 5013
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85305, and 85306, Water Code.

Recommendation:

RR R8. Maintain Lower Risk Uses of Flood-Prone Rural Lands
Agricultural and natural resource land uses and recreational marinas, resorts, or parks
are the most appropriate uses for floodprone rural lands and should be maintained,
consistent with the regulatory policy Locate New Development Wisely (DP P1).

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

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

Policies

RR P3. Protect Floodways

a) No encroachment shall be allowed or constructed in a floodway, unless it can be demonstrated by appropriate analysis that the encroachment will not unduly impede the free flow of water in the floodway or jeopardize public safety.

b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in a floodway that is not either a designated floodway or regulated stream.

23 CCR Section 5014
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85302, and 85305, Water Code.

RR P4. Floodplain Protection

a) No encroachment shall be allowed or constructed in any of the following floodplains unless it can be demonstrated by appropriate analysis that the encroachment will not have a significant adverse impact on floodplain values and functions:
1) The Yolo Bypass within the Delta;
2) 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 California Department of Water Resources or the U.S. Army Corps of Engineers (California Department of Water Resources 2010); and
3) 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 California Department of Water Resources by the partnership of the South Delta Water Agency, the River Islands Development Company, Reclamation District 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.

b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in any of the floodplain areas described in subsection (a).

c) This policy is not intended to exempt any activities in any of the areas described in subsection (a) from applicable regulations and requirements of the Central
Valley Flood Protection Board.

23 CCR Section 5015
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85302, and 85305, Water Code.

Recommendations

RR R9. Fund and Implement San Joaquin River Flood Bypass
The Legislature should fund the California 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 mainstream San Joaquin River adjacent to the urban and urbanizing communities of Stockton, Lathrop, and Manteca in accordance with Water Code section 9613(c).

RR R10. 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, Appendix K), should be continued in a manner that supports the Delta Plan and the coequal goals. Appropriate dredging throughout other areas in the Delta for maintenance purposes, or that would increase flood conveyance and provide potential material for levee maintenance or subsidence reversal should be implemented in a manner that supports the Delta Plan and coequal goals. Coordinated use of dredged material in levee improvement, subsidence reversal, or wetland restoration is encouraged.

RR R11. Designate Additional Floodways
The Central Valley Flood Protection Board should evaluate whether additional areas both within and upstream of the Delta should be designated as floodways. These efforts should consider the anticipated effects of climate change in its evaluation of these areas.

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

Problem Statement
Policies and Recommendations

An updated problem statement, policies and recommendations regarding the integration of Delta levees and habitat functions will be considered as part of an amendment to the Delta Plan’s Ecosystem Restoration chapter.

Renew Federal Assistance for Post-disaster Response

Federal agencies have been essential partners in recovering from prior Delta floods. Changes in these federal programs have reduced confidence about these agencies’ assistance in recovering from future floods.

Problem Statement

The loss of federal assurances of assistance in post-flood disaster response hinders planning and may result in significant loss of Delta property and resources.

RR R12. Renew Federal Assistance for Post-disaster Response

The Council, Office of Emergency Services, DWR, Central Valley Flood Protection Board, and Delta Protection Commission should advocate for reforms of the Federal Emergency Management Agency’s rehabilitation assistance program, including a renewed hazard mitigation program for Delta levees, and the Army Corps of Engineer’s Rehabilitation and Inspection Program (PL 84-99) to account for the economic value of the Delta’s water supplies and transportation services and for the State’s commitments to reducing Delta flood risk and improving Delta levees.

To facilitate this consideration, priority should be given to research to quantify the economic value of reliable water supplies and transportation services protected by the Delta’s levees, including consideration of the levees’ contributions to the protection of water quality, water supply infrastructure, and the conveyance of water for export through levee-lined channels.

Limit State Liability

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

Problem Statement

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

Policies

No policies with regulatory effect are included in this section.

Recommendations

RR R13. Require Flood Insurance
The Legislature should require an adequate level of flood insurance for residences, businesses, and industries in floodprone areas.

Delta communities should improve their current National Flood Insurance Program Community Rating System (CRS) ranking through the implementation of risk reduction management practices, when feasible, in order to receive additional discounts on flood insurance premium rates.

RR R15. Limit State Liability
The Legislature should consider statutory and/or constitutional changes that would address the State’s potential flood liability, including giving State agencies the same level of immunity with regard to flood liability as federal agencies have under federal law.

This recommendation would be added to the Delta Plan’s Chapter 5, which addresses Delta as Place issues, including recreation:

DP RXX. Provide Public Access on Appropriately-located Delta Levees
When using state funding to improve levees in the Delta that border urban areas, unincorporated Delta towns, publicly-owned nature areas, or other public lands or that intersect with state highways, the levee designs and associated land purchases should consider public access, including but not limited to bank fishing, nature observation, or pedestrian and bicycling trails. When agencies make decisions about funding levee improvements they should identify the types of public access or recreation that may be
feasible at the levee and explain how they have considered those opportunities in their decision.

**Issues for Future Evaluation and Coordination**

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

- **Reoperation of Upstream Reservoirs and Peak Flow Attenuation**: Reservoir operations upstream of the Delta can have substantial impacts on flood flows through the Delta; therefore, operation procedures among government agencies should be well coordinated and, where possible, focused more on flexibility to prevent flooding in the Delta. Water Code section 85309 directs DWR to develop a proposal to coordinate flood and water supply operations with appropriate State and federal agencies, and this shall be considered by the Council for future inclusion in the Delta Plan.

- **Post-disaster Recovery**: Future reviews of this chapter should more thoroughly consider post-disaster flood responses, including whether not reclaiming some flooded islands could provide ecological benefits that might outweigh the advantages of recovering and dewatering the islands.

- **Utility Corridor Consolidation**: An attempt to consolidate infrastructure into "utility corridors" as facilities are added and upgraded over time should be further investigated to determine whether this can allow for better management of flood risk consequences to these critical assets.

- **Strategies to Accommodate To Climate Change and Rising Sea Levels**: The Council should continue to (a) participate in the Natural Resources Agency's Climate Action Team and adapt to changing estimates of sea level rise when they become available and (b) consult with Caltrans regarding the potential effects of climate change and sea level rise on the three state highways that cross the Delta (Water Code section 85307(c)). Opportunities to assist local Delta agencies in assessing their vulnerability to rising sea levels should be explored.

- **Governance**: Because the number and diversity of agencies involved in levee maintenance, improvement, and oversight complicates coordination and effective management of the Delta's levee network, opportunities to improve governance should be explored. This could include reorganization of State agencies' oversight responsibilities in fewer agencies. Opportunities for joint powers agencies or other consolidations of reclamation districts or other local levee maintaining agencies should also be considered.
Science and Information Needs

The Delta system and its influencing factors are not static. The analysis and data gathered to support the Delta Levees Investment Strategy provided an updated foundation of information regarding risk of levee failure in the Sacramento-San Joaquin Delta and the impacts to State interests. However, newer data are always being developed and methods of analyzing it or estimating impacts can always be improved; therefore, research is needed to better understand dynamic issues such as climate change, seismicity, sea level rise, subsidence, and other areas. Continuing investigations into the science, engineering, and economic aspects of the Delta are critical to adaptively managing for expected and unexpected changes, and can provide decision makers and stakeholders with key information for future planning and decision making. Specifically, additional information will be needed in the following areas:

- Levee conditions, including their geometry and structural makeup, in order to provide better estimates probability of failure.
- Updates of information about the population protected by Delta levees, coordinated with periodic censuses, and about Delta assets such as land use, property value and infrastructure as data becomes available.
- Possible levee failures’ potential to (a) impair water quality and disrupt water supplies, including supplies for in-Delta users and regional suppliers in addition to the SWP and CVP and (b) damage neighboring islands.
- Interactions between Delta levees and ecosystem function, including the impacts of levee failures on important Delta ecosystems.
- Improved forecasts of sea level rise and other climate change impacts on flood risk, and incorporation into risk reduction criteria.
- Effects of seismicity on levee integrity, including expanded observations of Delta ground motions, improved estimates of geologically recent displacement on faults beneath the Delta, and further identification of liquefiable materials and mechanisms beneath levees.
- Updated flood stage-probability functions.
- Understanding the impacts on floodplain ecosystems and Delta flood management from upstream flood management infrastructure operations, including reservoir operations.
- Technologies for assessing levee integrity.

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

Performance Measures

Final administrative performance measures are listed in Appendix E.
Outcome Performance Measures

No increase in loss of life in the Delta as a result of flood emergencies and decrease in expected annual fatalities or expected annual property damages. (Strategy 7.1)

Target:

- Zero lives lost from floods.
- 50 percent decrease in expected annual fatalities by 2025.
- 50 percent decrease in expected annual property damages by 2025.

Metrics:

- Number of lives lost in the Delta as a result of flood emergencies.
- Expected annual fatalities (EAF) for the Delta
- Expected annual damages (EAD) in the Delta.

Baseline:

- Number of lives lost within the Delta in recent history is zero according to the National Oceanic and Atmospheric Administration’s Storm Events Database, which details events dating back to 1950.
- Expected annual fatalities and expected annual property damages reported in 2017, as reported in Delta Levee Investment Strategy final report.

Water delivery interruptions by floods or earthquakes in the Delta. (Strategy 7.3)

Target: No water delivery interruptions.

Metrics:

- Number of water delivery interruptions caused by floods or earthquakes in the Delta.
- Acre-feet of water not delivered due to disruptions caused by floods or earthquakes in the Delta.

Baseline:

N/A because this measure has a prescribed target and is not showing a change from a baseline.

Increase in community credit points in National Flood Insurance Program (NFIP) Community Rating System. (Strategy 7.3 and Strategy 7.7)
Target: Increase in community credit points in the NFIP Community Rating System by 2025.

Metrics:

- Community Rating System credit points of Delta communities participating in the NFIP.

Baseline:

Community Rating System credit points at the time of Delta Plan adoption, May 2013 or nearest available date.

**Output Performance Measures**

Responsible local, State, and federal agencies with emergency response authority implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5) by January 1, 2014. (Strategy 7.1)

Target: 100 percent (11/11) of recommendations implemented.

Metrics: Percent of recommendations implemented.

Baseline: 0 percent (0/11) of recommendations implemented.

Level of flood risk reduction provided by Delta levees. (Strategy 7.3)

Target: 100 percent of urban communities in the Delta protected by levees meeting DWR’s urban level of flood protection criteria. 100 percent of rural Delta islands and tracts protected by levees at or above Bulletin 192-82/PL 84-99 criteria.

Metrics:

- Percent of urban communities in the Delta protected by levees meeting DWR’s urban level of flood protection criteria.
- Percent of Delta land protected by levees at or above the Bulletin 192-82/PL 84-99 standard.

Baseline:

Percent of urban communities in the Delta protected by levees meeting DWR’s urban level of flood protection criteria and percent of Delta islands and tracts protected by levees at or above the Bulletin 192-82/PL 84-99 standard at the time of Delta Plan adoption, May 2013.

Consideration of sea level rise in flood protection planning for new residential
development. (Strategy 7.4)

Target: 100 percent of proposed actions to which RR P2 are applicable meet the requirements of RR P2.

Metric: Number of proposed actions covered by the Delta Plan policy to require flood protection for residential development in rural areas (RR P2).

Baseline: N/A because this measure has a prescribed target and is not showing a change from a baseline.

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CHAPTER 8

Funding Principles to Support the Coequal Goals
ABOUT THIS CHAPTER

This chapter provides background information on federal, State of California (State), and local spending for water supply, water quality, flood management, and Delta ecosystem purposes. It proposes the development of a comprehensive finance plan to implement the Delta Plan. It also sets forth guiding principles for the development of a finance plan and proposes near-term funding for support of the Delta Protection Commission, Sacramento-San Joaquin Delta Conservancy, and the Delta Stewardship Council (Council).

A 5-year budget is included in Appendix M. And, as described in Chapter 2, successful implementation of the Delta Plan will depend upon many independent agency authorities and actions under the coordination and leadership of the Council.
Funding Principles to Support the Coequal Goals

In establishing the coequal goals, the Delta Reform Act affirmatively reset spending priorities for the Delta ecosystem and water management. Inherent in the coequal goals is a new governance structure (primarily the Council), which the Legislature intended to have the “authority, responsibility, accountability, scientific support, and adequate and secure funding to achieve these objectives.” The Council was directed to develop a long-term, legally enforceable management plan for the Delta, and in implementing the Delta Plan, to “direct actions across State agencies,” in part through the establishment of an Interagency Implementation Committee. Additionally, as addressed in the preceding Delta Plan chapters, the Delta Reform Act set forth a number of policy objectives and other requirements for how the Delta Plan must be developed and what it must contain, ranging from broad guidance on types of projects the Plan should promote, to specific performance measures for evaluating progress on ecosystem restoration. Accordingly, the Council set forth several priority recommendations and regulatory policies, which together make up this Delta Plan.

The Delta Reform Act does not require the development of a financing plan for the implementation of the Delta Plan; however, given the current economic climate, recent uneven funding for water and ecosystem investment, and the critical nature of what is at stake should the coequal goals fail to be achieved, the Council affirmed the need for a financing plan and is committed to its development.

As the Public Policy Institute of California succinctly stated in its 2011 report on water management in California, “Although money alone is not sufficient for successful water management, it is necessary” (Public Policy Institute of California 2011). In introducing any discussion on financing, particularly in the public sector, it is necessary to acknowledge the political and economic context. America is currently suffering a severe recession, and California’s economy has fared even worse. The State has experienced a multiyear budget crisis in which annual spending exceeds available revenue. As a result, financing infrastructure and new programs has become immensely challenging for State and local governments.

Today’s economic conditions may limit the ability to adequately finance a full range of water and ecosystem improvements necessary to achieve the coequal goals in the near term. However, the planning timeframe for the Delta Plan runs to the year 2100, and decisions on long-term, sustainable financing for water, ecosystem, and flood protection cannot be delayed much longer without grave and expensive consequences. A long planning horizon allows near-term foundational steps to be taken now toward improving the situation and for implementing agencies to stage actions, policies, and projects over time consistent with an adaptive management structure based on science.

Additionally, some activities to implement the Delta Plan are currently funded or can be undertaken with no additional cost, and many of the actions called for in the Delta Plan are certain to result in significant long-term cost savings.

Because of the complex nature of the policy issues and of certain funding and finance methods, a comprehensive and supportable Delta Plan finance plan will take time to develop. Thorough research is needed to identify entities that
may be assessed user or stressor fees, determine appropriate levels for these fees, establish tiered fee structures, calculate the public benefits, and work through the legal implications of any financing strategy, including the practical effects of Propositions 218 and 26 on State and local financing mechanisms.

**Background**

Since the CALFED Bay-Delta Program was instituted in 1995 to restore ecological health and improve water management in the Delta, significant expenditures have been made in the Delta. An estimated $400 million has been spent annually, on average, by federal, State, and local water users.

Traditionally, the State has financed water infrastructure with general obligation bonds. These bonds were approved by the voters, and repayment is guaranteed by the State’s general taxing power. With respect to State Water Project (SWP) debt, however, even though repayment was secured by taxes, general obligation bonds were paid back primarily by the water contractors. Since 2000, California voters have authorized $19.4 billion in water-related general obligation bonds spread over six separate bonds (LAO 2008). Several of these bonds authorize expenditures for a multitude of purposes, including assorted water projects, parkland acquisition, habitat restoration, and local assistance grants. One benefit of financing water projects with general obligation bonds is that any expenditure made for a public purpose is repaid by taxpayers, the primary beneficiaries. Currently, remaining fund balances for active bond accounts total approximately $2.2 billion out of the authorized total of $19.4 billion, only a portion of which is for Delta-related spending.

Table 8-1 summarizes the current balances for general obligation bonds by individual bond act related to water, ecosystem restoration, and flood protection. It is important to note that these remaining balances are not fungible; that is, statute generally dictates the specific types of projects or programs on which funds can be spent.

Currently scheduled for the November 2014 ballot, the Safe, Clean, and Reliable Drinking Water Supply Act of 2012 would authorize, upon voter approval, the issue and sale of $11.14 billion in general obligation bonds for financing drought relief projects, water supply reliability projects, Delta sustainability projects, water system improvements, watershed and conservation protection programs, groundwater protection and water quality projects, and water recycling projects. Key Delta projects include $2.25 billion for protection of water supplies from catastrophic levee failure, drinking water quality improvements, levee and flood control facilities improvements, lost property tax replacement, ecosystem restoration, and contaminants reduction.

### General Obligation Bonds – California (as of January 2013)

<table>
<thead>
<tr>
<th>Bond Act (Year)</th>
<th>Authorized ($ Thousands)</th>
<th>Committed ($ Thousands)</th>
<th>Balance ($ Thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposition 12 (2000)</td>
<td>2,024,486</td>
<td>6,189</td>
<td>18,456</td>
</tr>
<tr>
<td>Proposition 13 (2000)</td>
<td>2,103,000</td>
<td>1,823,874</td>
<td>279,126</td>
</tr>
<tr>
<td>Proposition 40 (2002)</td>
<td>2,471,600</td>
<td>16,556</td>
<td>26,536</td>
</tr>
<tr>
<td>Proposition 50 (2002)</td>
<td>3,382,630</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Proposition 1E (2006)</td>
<td>4,090,000</td>
<td>4,024,354</td>
<td>65,646</td>
</tr>
<tr>
<td>Proposition 84 (2006)</td>
<td>5,388,000</td>
<td>5,080,840</td>
<td>307,160</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$19,378,411</strong></td>
<td><strong>$17,221,349</strong></td>
<td><strong>$2,157,062</strong></td>
</tr>
</tbody>
</table>
Although general obligation bonds have been an important part of how California has funded water and ecosystem projects in the past, because of the uncertainty regarding voter approval of future bonds, a more sustainable and long-term financing approach for water, ecosystem, flood protection, and related projects is needed. As new revenue sources are developed, the use of revenue bonds may become more prevalent. For example, the SWP routinely sells and redeems revenue bonds to pay the costs of planning and construction, bond interest, and project operating expenses, as do many local agencies.

Federal-level expenditures in California in recent years have declined as grant programs for wastewater treatment in the late 1970s and 1980s expired, and flood control spending was reduced. It is likely that large federal budget deficits for the foreseeable future will preclude any increases in federal funds for California water projects.

Although State-level expenditures for water-related programs and projects in recent years have been almost entirely funded with general obligation bonds, this contrasts somewhat with the financing methods available to local agencies. Although many of these agencies have at times issued general obligation bonds and revenue bonds, it is more common for them to establish stable income streams by charging dedicated fees to ratepayers to pay the costs of infrastructure projects including water treatment and wastewater systems.

The ability of local agencies to fund flood control and stormwater projects, however, is specifically governed by the provisions of Proposition 218, approved by California voters in 1996. Under Proposition 218, direct voter approval by a majority of property owners or a two-thirds vote of the general public is required to raise funds for these purposes. Results of local Proposition 218 elections in recent years have been mixed, with some agencies gaining voter approval and others falling short of funding needed for local projects. For example, Sacramento voters successfully approved new assessments for flood control projects in 2007, but 1 year later, voters in Orinda (East Bay Area) and Burlingame (Bay Area) failed to approve new assessments for the same purpose (Public Policy Institute of California 2011).

A companion measure, Proposition 26, approved by voters in 2010, effectively raised voting requirements for most State and local regulatory fees from a simple majority to a two-thirds majority. Regulatory fees with a broad public purpose are considered taxes and are subject to a two-thirds vote of the Legislature. Local agencies are also required to seek a two-thirds vote of the general public.

The best available information shows that total annual federal, State, and local spending on water and wastewater treatment in California is approximately $24 billion (see Table 8-2). Operations, maintenance, and capital expenditures for water infrastructure consume significant economic resources in California. This total likely includes some overlap, but the expenditures are significant. Other sources cite higher expenditures for some of these categories. During development of the finance plan, this table will be updated to reflect the most recent data.

**Bay Delta Conservation Plan**

Described in various sections of this Delta Plan, the Bay Delta Conservation Plan (BDCP) is a massive water and ecosystem public works planning process under way in the Delta. The Council supports the completion of the BDCP according to the provisions set forth in the Delta Reform Act. The scope or type of any water facility improvements, related Delta ecosystem mitigation, and other habitat improvements to be included is very preliminary at this time.

The BDCP’s ongoing planning costs are currently funded by State and federal water contractors. Currently available information from the BDCP indicates that, once it is completed, the first 5 years of implementation will require between $5.7 and $5.9 billion total for capital outlay, of which approximately $5.2 billion is for water conveyance. Additionally, the BDCP estimates that $3.6 billion total plus $46 million annually will be required for Delta ecosystem...
### Annual Budgets/Expenditures in California for Selected Agencies

<table>
<thead>
<tr>
<th>Agency</th>
<th>Operating ($ Millions)</th>
<th>Capital ($ Millions)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local cities, counties, and special districts water</td>
<td>10,100</td>
<td>2,000</td>
<td>California State Controller 2011a, 2011b, 2011c</td>
</tr>
<tr>
<td>Local cities, counties, and special districts wastewater</td>
<td>5,400</td>
<td>1,100</td>
<td>California State Controller 2011a, 2011b, 2011c</td>
</tr>
<tr>
<td>Local cities, counties, and special districts flood control</td>
<td>1,000</td>
<td>300</td>
<td>California State Controller 2011a, 2011b, 2011c</td>
</tr>
<tr>
<td>California Department of Water Resources</td>
<td>2,267</td>
<td>232</td>
<td>California Department of Finance 2012</td>
</tr>
<tr>
<td>State Water Resources Control Board</td>
<td>714</td>
<td></td>
<td>California Department of Finance 2012</td>
</tr>
<tr>
<td>California Department of Fish and Wildlife</td>
<td>381</td>
<td></td>
<td>California Department of Finance 2012</td>
</tr>
<tr>
<td>Bureau of Reclamation</td>
<td>300</td>
<td></td>
<td>Bureau of Reclamation 2008</td>
</tr>
<tr>
<td>U.S. Army Corps of Engineers</td>
<td>100</td>
<td>100</td>
<td>U.S. Army Corps of Engineers 2008</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$20,262</strong></td>
<td><strong>$3,732</strong></td>
<td></td>
</tr>
</tbody>
</table>

Restoration (BDCP Steering Committee 2010). The BDCP will include a funding plan that will address estimated implementation costs and sources of funding that will be relied upon to cover these costs. The sidebar, Bay Delta Conservation Plan Costs and Existing Funding Sources, provides additional background information about the BDCP.

### Overview of Current State and Federal Delta-related Expenditures

The CALFED Bay-Delta Program was incorporated into the Council in 2010. However, some program elements endure because bond funds are dedicated by law for CALFED purposes. Additionally, the CALFED program is still referenced in federal statutes. For these reasons, an annual cross-cut budget showing State and federal expenditures for active CALFED programs and projects is developed each January.

Because the cross-cut budget includes State and federal expenditure details on all the CALFED programs, those data can be summarized to show expenditures for program elements displayed in the budget. The results are shown in Table 8-3.
Chapter 8: Funding Principles to Support the Coequal Goals

Annual State and Federal Expenditures in California by Program Element (2012–2013)

<table>
<thead>
<tr>
<th>Program Element</th>
<th>California</th>
<th>Federal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance</td>
<td>$21,145,596</td>
<td>$20,490,000</td>
<td>$41,635,596</td>
</tr>
<tr>
<td>Water Supply Reliability</td>
<td>$161,523,833</td>
<td>$18,774,000</td>
<td>$180,297,833</td>
</tr>
<tr>
<td>Ecosystem Restoration</td>
<td>$64,119,524</td>
<td>$92,275,000</td>
<td>$156,394,524</td>
</tr>
<tr>
<td>Water Quality</td>
<td>$6,368,631</td>
<td>$5,000,000</td>
<td>$11,368,631</td>
</tr>
<tr>
<td>Risk Reduction/Levee Integrity</td>
<td>$8,949,231</td>
<td>$45,560,000</td>
<td>$54,509,231</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$262,106,815</strong></td>
<td><strong>$182,099,000</strong></td>
<td><strong>$444,205,815</strong></td>
</tr>
</tbody>
</table>

Bay Delta Conservation Plan Costs and Existing Funding Sources

Potential future funding sources for the BDCP will likely compete with funding required for implementation of some elements of the Delta Plan, and for the plans and projects of State, federal, and local agencies. The Council does not consider any funding source to be solely available for the BDCP, or for any other program or plan. They are solely considered to be options at this stage.

Based on current information from the BDCP, the approximate costs of a facility and related ecosystem improvements needed for State and federal approval are approximately $15.8 to $16.7 billion in capital costs and an additional $4.9 to $5.6 billion in operating costs over the 50-year permit period. These costs are divided among the BDCP’s four primary functions—water conveyance, habitat restoration, management of other stressors, and program oversight—as shown in the table below. The Council notes that preliminary cost estimates are just that: preliminary. Going forward, refined estimates will be required to complete this planning process.

Options for BDCP Funding

The BDCP is premised on the pledge of participating State and federal water contractors to pay the full cost of any new Delta export facility and the associated Delta ecosystem mitigation required to meet the requirements imposed on the BDCP by federal and State laws. Habitat and ecosystem restoration activities, beyond mitigation requirements, are considered to provide a general benefit to the State and should be funded accordingly. Prior to completion of the BDCP and a full understanding of the Delta ecosystem improvements related to the BDCP, it is impossible to project the detailed funding options that might be necessary. However, it is highly likely that user fees, revenue bonds, and sources other than the State General Fund will be the primary sources of funding.

Summary of BDCP Costs and Existing Funding Sources ($ millions)

<table>
<thead>
<tr>
<th>Program Function</th>
<th>Capital Costs</th>
<th>Operating Costs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Conveyance</td>
<td>$12,691</td>
<td>$2,936</td>
<td>$15,627</td>
</tr>
<tr>
<td>Other Stressors</td>
<td>$12–$15</td>
<td>$1,213–$1,679</td>
<td>$1,225–$1,694</td>
</tr>
<tr>
<td>Program Oversight</td>
<td></td>
<td>$404–$548</td>
<td>$404–$548</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$15,811–$16,715</strong></td>
<td><strong>$4,899–$5,600</strong></td>
<td><strong>$20,710–$22,315</strong></td>
</tr>
</tbody>
</table>

*Over 50-year permit period  
*Midpoint cost estimate  
*Range of low-high estimate given

Source: BDCP Steering Committee, 2010
A Delta Finance Plan

The Council proposes to initiate development of a finance plan following adoption of the Delta Plan. This process will require the active participation of the Interagency Implementation Committee described in Chapter 2. Financing and funding mechanisms to be considered in developing the finance plan are included in Appendix N.

Guiding Principles

A finance plan to fund the Delta Plan should follow these principles:

- The finance plan should first consider currently available funds that can legally support expenditures for Delta-related projects. Spending priorities should be established that address near-term funding requirements as contained in this Delta Plan.
- Implementation of the Delta Plan will undoubtedly require an array of funding sources, including new funding sources and new statutory authority. Broad-based financing and diversity in funding sources will enhance revenue stability. Likewise, State and federal funds for activities that implement the Delta Plan must be reserved for public benefits not otherwise required for project mitigation or required by law for other purposes. Appendix N describes potential funding sources.
- The Delta Plan recommends many projects that have multiple benefits; this increases opportunities to blend fund sources and builds on the tradition of past investments in multipurpose water projects with diversified fund sources.
- A clear and analytically based methodology for assessing public benefits should be evaluated and implemented.
- Targeted finance plans should be developed for major Delta Plan plans and projects (ecosystem restoration, flood risk reduction, regional water supply investments, science, administration, and water conveyance). Beneficiaries and stressors should be identified in each of these areas, and user fees should be developed to match these stressors and beneficiaries with planned investments in each of these areas.
- Economic and financial analyses should be done as early as possible during the planning of large capital projects. This will assist agencies in the design of cost-effective projects and will help ensure that the projects are actually completed and implemented. Financial analyses should account for all of the costs of a project, both direct and indirect, including acquisition, planning, capital and interest, mitigation, science and monitoring, and operations and maintenance.

User Fees

- User fees, including beneficiary fees and stressor fees, are essential and should be established to support the coequal goals and the implementation of the Delta Plan.
- The “beneficiaries pay” principle is a common financing approach for water projects. The challenge is to determine the beneficiaries and design a cost-allocation method scaled to the benefit.
- A companion principle to “beneficiaries pay” is “stressors pay.” Human activity that causes negative operational or environmental impacts should be assessed a fee, or otherwise charged, to repair the damage. An example of the stressors pay approach might be a surcharge on pesticides that are found to negatively impact the Delta ecosystem. Capital construction projects, whether for water reliability purposes or Delta ecosystem improvements, should be undertaken simultaneously with the development of beneficiary and user fees. Delay in establishing beneficiaries/stressors fee structures will inevitably delay any needed capital improvement projects. The development of information related to financing (such as the identification of beneficiaries and stressors, and detailed financing scenarios) should be undertaken simultaneously with the development of major capital decisions so that it can inform planning efforts.
The finance plan should include mechanisms to ensure that user fees are legally dedicated to their intended purpose. Given State and federal budget constraints, statutory protections must be enacted to assure users that their assessments will not be diverted to other purposes.

The finance plan should include opportunities to generate revenue when planning projects, where possible, to ensure long-term financing stability.

To the extent possible, user fees should be based on the amount of water used or, for stressors, the volume of contaminants discharged. Tiered fee structures also should be explored where applicable.

Long-term, stable funding approaches, such as the Delta Flood Risk Management Assessment District recommended in Chapter 7 or other beneficiary user fees, should be established to support the Delta Levees Maintenance Subventions Program, Delta Levees Special Flood Control Projects Program, and implementation of the Central Valley Flood Protection Plan.

**Near-term and Annual Funding Requirements**

The following items describe activities that must be addressed and funded as soon as possible. They describe the urgent need to immediately address the steps needed to achieve the coequal goals, begin implementation of the Delta Plan, and establish annual funding for key Delta agencies:

- **Urgent expenditures for water supply reliability and ecosystem protection.** Immediate steps should be taken to protect the existing Delta water export system from flood risks and carry out ecosystem improvements being implemented pursuant to existing mitigation commitments of the SWP and the Central Valley Project. Those immediate needs are discussed in the various chapters of the Delta Plan.

- **Create a regional Delta Flood Risk Management Assessment District.** The Legislature should create a regional district with the authority to assess fees on Delta levee beneficiaries, including landowners, infrastructure owners, and other entities, to fund flood control protection, including levee maintenance and improvement, and emergency response, as recommended in Chapter 7.

- **Fund a strong Delta Science Program.** Funding is needed for continued operation of the Independent Science Board, development of the proposed Delta Science Plan, the State’s share of the Interagency Ecological Program, and other activities that support a strong science foundation for Delta Plan implementation. Funding for the Interagency Ecological Program should continue from participating agencies.

- **Fund urban and agricultural water management plans.**

- **Continue the existing operational duties imposed by the Delta Reform Act.** The Act created the Council (which includes the Delta Science Program and Independent Science Board) and the Sacramento-San Joaquin Delta Conservancy, and modified the duties of the Delta Protection Commission. Future estimated annual operating costs for these agencies are provided in Appendix M.

- **Fees for services.** The Legislature should grant authority to the Council to assess fees to cover the costs of providing specified services related to covered actions, specifically early consultations and reviewing appeals of consistency certifications.
Policies and Recommendations

Administrative performance measures for the following recommendations can be found in Appendix E.

FP R1  Conduct Current Spending Inventory
An inventory of current State and federal spending on programs and projects that do or may achieve the coequal goals will be conducted. Data sources to be used include the CALFED cross-cut budget, State bond balance reports, and the annual State budget, among others. Consideration will be given to selecting an independent agency (which could include a nongovernmental organization) to conduct the inventory.

FP R2  Develop Delta Plan Cost Assessment
Costs will be assigned to the projects and programs proposed in the Delta Plan (Chapters 2 through 7), and sources of funding will be identified.

FP R3  Identify Funding Gaps
Current State and federal funding gaps will be identified that are determined to hinder progress toward meeting the coequal goals.

Timeline for Implementing Recommendations

Figure 8-1 lays out a timeline for implementing the recommendations described in the previous section.

<table>
<thead>
<tr>
<th>ACTION (REFERENCE #)</th>
<th>LEAD AGENCY</th>
<th>NEAR TERM 2012–2017</th>
<th>INTERMEDIATE TERM 2017–2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduce current spending inventory (FP R1)</td>
<td>Council</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Develop Delta Plan cost assessment (FP R2)</td>
<td>Council</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Identify funding gaps (FP R3)</td>
<td>Council</td>
<td>●</td>
<td></td>
</tr>
</tbody>
</table>

Agency Key:
Council: Delta Stewardship Council

Figure 8-1
References


Photo Credits

Chapter divider: (clockwise from top left): California Department of Water Resources, California Department of Water Resources, and ZoArt Photography
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Appendix 1A
Best Available Science

Note: All content of this appendix is newly adopted.
**Best Available Science**

The Delta Reform Act requires the Council to make use of the best available science in implementing the Delta Plan. Best available science is specific to the decision being made and the time frame available for making that decision. Best available science is developed and presented in a transparent manner consistent with the scientific process (Sullivan et al. 2006), including clear statements of assumptions, the use of conceptual models, description of methods used, and presentation of summary conclusions. Sources of data used are cited and analytical tools used in analyses and syntheses are identified. Best available science changes over time, and decisions may need to be revisited as new scientific information becomes available. Ultimately, best available science requires scientists to use the best information and data to assist management and policy decisions. The processes and information used should be clearly documented and effectively communicated to foster improved understanding and decision making.

**Steps for Achieving the Best Science**

Science consistent with the scientific process includes the following elements:

- Well-stated objectives
- A clear conceptual or mathematical model
- A good experimental design with standardized methods for data collection
- Statistical rigor and sound logic for analysis and interpretation
- Clear documentation of methods, results, and conclusions

The best science is understandable; it clearly outlines assumptions and limitations. The best science is also reputable; it has undergone peer review conducted by active experts in the applicable field(s) of study. Scientific peer review addresses the validity of the methods used, the adequacy of the methods and study design in addressing study objectives, the adequacy of the interpretation of results, whether the conclusions are supported by the results, and whether the findings advance scientific knowledge (Sullivan et al. 2006).

There are several sources of scientific information and tradeoffs associated with each (Sullivan et al. 2006, Ryder et al. 2010). The primary sources of scientific information, in a generalized ranking of most to least scientific credibility for informing management decisions, include the following:

- Independently peer-reviewed publications including scientific journal publications and books (most desirable)
- Other scientific reports and publications
- Science expert opinion
- Traditional knowledge

Each of these sources of scientific information may be the best available at a given time and contain varying levels of understanding and uncertainty. These limitations should be clearly documented when scientific information is used as the basis for decisions.

**Guidelines and Criteria**

There have been several efforts to develop criteria for defining and assessing best available science. In 2004, the National Research Council Committee on Defining the Best Scientific Information Available for Fisheries Management prepared a report (National Research Council Report) that concluded guidelines and criteria must be defined in order to apply best available science in natural resource management (National Research Council 2004). Major findings and recommendations included establishing procedural and implementation guidelines to govern the production and use of scientific information. The guidelines were based on six broad criteria: relevance, inclusiveness, objectivity, transparency and openness, timeliness, and peer review.
Best available science for proposed covered actions and for use in the Delta Plan should be consistent with the guidelines and criteria in Table 1A-1. These criteria were adapted from criteria developed by the National Research Council. Proponents of covered actions should document their scientific rationale for applying the criteria in Table 1A-1 (i.e., the format used in a scientific grant proposal).

### Table 1A-1
Criteria for Best Available Science

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relevance</strong></td>
<td>Scientific information used should be germane to the Delta ecosystem and/or biological and physical components (and/or process) affected by the proposed decisions. Analogous information from a different region but applicable to the Delta ecosystem and/or biological and physical components may be the most relevant when Delta-specific scientific information is nonexistent or insufficient. The quality and relevance of the data and information used shall be clearly addressed.</td>
</tr>
<tr>
<td><strong>Inclusiveness</strong></td>
<td>Scientific information used shall incorporate a thorough review of relevant information and analyses across relevant disciplines. Many analysis tools are available to the scientific community (e.g., search engines and citation indices).</td>
</tr>
<tr>
<td><strong>Objectivity</strong></td>
<td>Data collection and analyses considered shall meet the standards of the scientific method and be void of nonscientific influences and considerations.</td>
</tr>
<tr>
<td><strong>Transparency and openness</strong></td>
<td>The sources and methods used for analyzing the science (including scientific and engineering models) used shall be clearly identified. The opportunity for public comment on the use of science in proposed covered actions is recommended. Limitations of research used shall be clearly identified and explained. If a range of uncertainty is associated with the data and information used, a mechanism for communicating uncertainty shall be employed.</td>
</tr>
<tr>
<td><strong>Timeliness</strong></td>
<td>Timeliness has two main elements: (1) data collection shall occur in a manner sufficient for adequate analyses before a management decision is needed, and (2) scientific information used shall be applicable to current situations. Timeliness also means that results from scientific studies and monitoring may be brought forward before the study is complete to address management needs. In these instances, it is necessary that the uncertainties, limitations, and risks associated with preliminary results are clearly documented.</td>
</tr>
<tr>
<td><strong>Peer review</strong></td>
<td>The quality of the science used will be measured by the extent and quality of the review process. Independent external scientific review of the science is most important because it ensures scientific objectivity and validity. The following criteria represent a desirable peer review process. Coordination of Peer Review. Independent peer review shall be coordinated by entities and/or individuals that (1) are not a member of the independent external review team/panel and (2) have had no direct involvement in the particular actions under review. Independent External Reviewers. A qualified independent external reviewer embodies the following qualities: (1) has no conflict of interest with the outcome of the decision being made, (2) can perform the review free of persuasion by others, (3) has demonstrable competence in the subject as evidenced by formal training or experience, (4) is willing to utilize his or her scientific expertise to reach objective conclusions that may be incongruent with his or her personal biases, and (5) is willing to identify the costs and benefits of ecological and social alternative decisions. When to Conduct Peer Review. Independent scientific peer review shall be applied formally to proposed projects and initial draft plans, in writing after official draft plans or policies are released to the public, and to final released plans. Formal peer review should also be applied to outcomes and products of projects as appropriate.</td>
</tr>
</tbody>
</table>

a. McGarvey 2007  
c. National Research Council 2004  
d. Meffe et al. 1998  
e. Adapted from Meffe et al. 1998  

It is recognized that differences exist among the accepted standards of peer review for various fields of study and professional communities. When applying the criteria for best available science in Table 1A-1, the Council recognizes that the level of peer review for supporting materials and technical information...
(such as scientific studies, model results, and documents) included in the documentation for a proposed covered action is variable and relative to the scale, scope, and nature of the proposed covered action. The Council understands that varying levels of peer review may be commonly accepted in various fields of study and professional communities.

References


Appendix 1B
Adaptive Management

Note: All content of this appendix is newly adopted.
Adaptive Management

Adaptive management is defined in the Delta Reform Act as “a framework and flexible decision making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives” (Water Code section 85052). Adaptive management can be applied at a program, plan or project level.

Adaptive management is a strategy that provides for making management decisions under uncertain conditions using the best available science rather than repeatedly delaying action until more information is available. Adaptive management allows for continuous learning resulting in management decisions based on what was learned, rather than adopting a management strategy and implementing it without regard for scientific feedback or monitoring. Adaptive management is an approach to resources management that increases the likelihood of success in obtaining goals in a manner that is both economical and effective because it provides flexibility and feedback to manage natural resources in the face of often considerable uncertainty.

To be effective, governance to support and implement adaptive management in the Delta must be flexible and have the capability to make timely changes to policies and practices in response to what is learned over time (e.g., the Delta Plan adaptive management approach described in Chapter 2). Governance for adaptive management should provide a decision-making structure that fosters communication among scientific experts, independent scientific reviewers, the relevant decision making authorities (e.g., state and federal fisheries agencies on issues related to aquatic ecosystem restoration) and a balanced approach to the involvement of interested stakeholders.

A Three-phase and Nine-step Adaptive Management Framework

The Council will use the three-phase and nine-step adaptive management framework in Figure 1B-1 that is described in detail below. The Council will use this framework to evaluate the usefulness of adaptive management for reviewing proposed covered actions involving ecosystem restoration and water management along with developing, implementing, and updating the Delta Plan (See Chapter 2). Ecosystem restoration and water management covered actions should include an adaptive management plan that considers all nine steps of this framework; however, they need not be rigidly included and implemented in the order described here and should not be used as a means to prevent action, but rather as a tool to enhance decision making. The intent is to build logical and clear information exchange and decision points into management actions that increase options and improve outcomes. In developing an adaptive management plan, the best available science should be used to inform the various steps of the adaptive management process.
Figure 1B-1
A Nine-step Adaptive Management Framework
The shading represents the three broad phases of adaptive management (Plan, Do, and Evaluate and Respond), and the boxes represent the nine steps within the adaptive management framework. The circular arrow represents the general sequence of steps. The additional arrows indicate possible next steps for adapting (for example, revising the selected action based on what has been learned). This framework and the description of each step are largely derived from Stanford and Poole (1996), CALFED Bay-Delta Program (2000), Abal et al. (2005), and the Bay Delta Conservation Plan Independent Science Advisors on Adaptive Management (2009).

Plan
The Plan phase of the adaptive management framework is presented as four steps.

1. Define/Redeﬁne the Problem
The ﬁrst step of effective adaptive management is to clearly deﬁne the problems that will be addressed in the form of a problem statement. The problem statement should clearly link to program goals and to speciﬁc objectives, which should be developed by proponents in an open manner. The boundaries of the problem (e.g., its geographic and temporal scales) should be deﬁned in the problem statement.

2. Establish Goals and Objectives
Clear goals and objectives must be established by proponents of proposed covered actions for ecosystem restoration and water management and be based on the best available science (See GP 1 in Chapter 2).
Goals are broad statements that propose general solutions. Objectives are more specific than goals, and are often quantitative, specific narrative statements of desired outcomes allowing evaluation of how well the objectives are being achieved.

3. Model Linkages between Objectives and Proposed Action(s)

Models formalize and apply current scientific understanding, develop expectations, assess the likelihood of success, and identify tradeoffs associated with different management actions. Models can be conceptual, statistical, physical, decision support, or simulation. Models link the objectives to the proposed actions and clarify why an intended action is expected to result in meeting its objectives. Models provide a road map for testing hypotheses through statements that describe the expected outcome of an action.

Both qualitative (conceptual) and quantitative models can effectively link objectives and proposed actions by illuminating if and how different actions meet specific objectives. Conceptual models are particularly useful for decision makers, scientists, and the public because they illustrate the most critical cause-and-effect pathways. Conceptual models provide an articulation of the hypotheses being tested and how various actions might achieve particular objectives. Conceptual models also help to develop performance measures, which are qualitative or quantitative information that tracks status and trends toward meeting objectives. Conceptual models should be used in adaptive management planning because they help explain how other types of models, research, and actions will be used to explore hypotheses and address specific existing and anticipated uncertainties.

Recent conceptual models developed specifically for the Delta include comprehensive models developed as part of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). The DRERIP models were designed to aid in the identification and evaluation of ecosystem restoration actions in the Delta, and include both ecosystem models (processes, habitats, and stressors) and species life history models. Another set of conceptual models was developed to plan the IEP's Pelagic Organism Decline (POD) investigations and to synthesize the POD results into "stories" about what may have happened to cause the rapid decline of multiple open-water fish species.

4. Select Action(s) (Research, Pilot, or Full-scale) and Develop Performance Measures

The process for selecting an action or several actions to meet objectives includes an evaluation of the best available science represented in the conceptual model. This evaluation should guide development of the action. Consideration should be given to the following:

♦ Level of the action(s) to be taken (research, pilot-scale project, or full-scale project)
♦ Geographical and temporal scale of the action(s)
♦ Degree of confidence in the benefits
♦ Consequences of being wrong

The scale of the action selected should be informed by the certainty of the relevant scientific information, consider the reversibility of the action, and account for the potential cost of delaying larger-scale actions. For example, when the best available science cannot predict the outcome of an action with a reasonable degree of certainty, and irreversible consequences exist for incorrectly predicting the outcomes of an action, further research or a pilot-scale action is likely more appropriate than a full-scale action, unless the cost of delaying a larger-scale action is very high (for example, a species of concern goes extinct or urban water supplies are cut off). In some instances, choosing to take no action could be the best selection (when no foreseen benefit would result from a research, pilot-scale, or full-scale action). Where possible, the action(s) selected should test cause-and-effect relationships in the conceptual model so that the model can be adapted using the information learned from implementing the action(s).
Performance measures derive from goals and objectives, and help to address the status and trends of progress toward achieving the goals and objectives. Performance measures can be placed in three general classes:

- **Administrative**: performance measures that describe decisions made by policy makers and managers to finalize plans or approve resources (funds, personnel, projects) for implementation of a program or group of related programs
- **Output (also known as driver)**: performance measures that evaluate factors that may be influencing outcomes and include on-the-ground implementation and management actions
- **Outcome**: performance measures that evaluate ecosystem responses to management actions or natural outputs

The distinction between performance measure types is not rigid. In some cases, an outcome performance measure for one purpose may become an output performance measure for another purpose.

Development of informative performance measures is a challenging task. Performance measures must be designed to capture important trends and to address whether specific actions are producing expected results. Performance measures are selected based on the conceptual model. In addition the monitoring plan should be designed so that the information collected supports performance measure analysis and reporting.

Efforts to develop performance measures in complex and large-scale systems with many ecosystem types like the Delta are commonly multi-year endeavors; however, initial performance measures provide value for initial assessments of progress made in the interim. The process for developing performance measures should address the rationale for each performance measure, metrics, method for analysis, baseline and reference conditions, expected outcomes, timeline for evaluation, and a communication/visualization element. The development of performance measures should be informed by the best available science and involve key stakeholders.

**Do**

The *Do* phase of adaptive management includes two steps that occur in parallel.

5. **Design and Implement Action(s)**

The design and implementation of action(s) include clearly describing specific activities that will occur under the selected action(s) and how they will link to the monitoring plan. Design includes creating a plan for implementing the action(s) and monitoring responses resulting from the action(s). The design of the action(s) should be informed by existing uncertainties, and should be directly linked to meeting the goals and objectives.

6. **Design and Implement Monitoring Plan**

A well-designed monitoring plan includes a data management plan. A data management plan describes the process for organizing and clearly documenting observations, including how data are collected; the methods, quality assurance, and calculations used; the time and space scales of the variables; and accurate site locations and characteristics. Data management is critical for analyses, syntheses, and evaluations.

A well-designed monitoring plan goes beyond data collection and data management. A monitoring plan often includes targeted research to answer why certain results are observed and others are not. A monitoring plan also includes clear communication of the information gathered and current understanding drawn from this information. A complete monitoring plan includes:

- Compliance monitoring (required by permits)
- Performance monitoring with pre-project monitoring (measuring achievement of targets)
Mechanistic monitoring with concurrent targeted research (testing the understanding of linkages in the conceptual model)

System-level monitoring (holistic, integrative and long term)

These types of monitoring can measure and communicate various types of information, including administrative/inputs (such as dollars awarded and spent or projects funded), compliance/outputs (such as tons of gravel added or acres exposed to tidal action), and effectiveness/outcomes (such as actual outcome expected from implementing an action at the local scale, suites of actions at the system-wide scales, and status and trends assessments). The monitoring plan design must include the development of monitoring metrics that can be integrated and summarized to inform decision makers and the public as described in step eight, Communicate Current Understanding.

Monitoring plan design requires making tradeoffs between resources spent on monitoring and resources spent on actions and analyses. To aid in this evaluation of tradeoffs, a rigorous pre-analysis using simulation models can show the information value of different variables that might be monitored. These values assessments can then be used to compare the benefits from monitoring certain variables against the benefit of using resources for other actions.

Implementation of actions and monitoring should be closely coordinated. Before an action is implemented, initial conditions should be clearly documented to the extent practical so that a baseline is established. Baseline data includes characterization of natural variation observed in the examined system over space and time. For many ecological and hydrological variables, an extensive set of baseline data is available because of the efforts of the Interagency Ecological Program and repositories of information such as those available from the U.S. Geological Survey and the California Department of Water Resources. The implementation of action(s) and monitoring should be clearly executed and communicated to the public. Status and trends metrics that compare conditions before and after action implementation are often good assessment and communication tools.

Evaluate and Respond

The Evaluate and respond phase of adaptive management includes three key steps.

7. Analyze, Synthesize, and Evaluate

Analysis, synthesis, and evaluation of the action(s) and monitoring are critical for improving current understanding. Analysis and synthesis should incorporate information on how conditions have changed, expectedly and unexpectedly, as a result of implementing the action(s). Because measurable change might not occur on short timescales, evaluations should also examine whether actions prevented further deteriorating conditions that would have occurred if no actions were taken. The evaluation should examine whether performance measures indicate that one or more of the objectives have been met as a result of the implemented action(s), and if so, why. If an objective is not met, the potential reasons why it was not met should be clearly identified and communicated. Analyses should be cumulative. As each year’s data becomes available, analyses should assess whether the probability of the desired outcome has changed and, if so, how this affects decisions about the action. The results of the analysis, synthesis, and evaluation step could be published in technical peer-reviewed papers and reports for the purpose of external review, disclosure, and accessibility where results warrant this level of communication. Scientists and technical experts will be critical for carrying out this step.

8. Communicate Current Understanding

Communication of current understanding gained through analysis, synthesis, and evaluation of implemented action(s) and monitoring is a key step for informing and equipping policy makers, managers, stakeholders, and the public to appropriately respond and adapt. This step spans the Do and the Evaluate and respond phase of adaptive management because the communication of current
understanding and related recommendations for change requires both policy and technical expertise. The information communicated should be technically sound, well synthesized, and translated into formats conducive to informing a nontechnical audience (e.g., a report card format or a general science outlet such as a newsletter). The information should then be disseminated to those directly involved in the adaptive management process for the plan, program, or project and to those interested in the outcome of the action.

Technical staff and decision makers should be regularly involved in the exchange of information as data are analyzed and synthesized. Communication should be ongoing and occur at appropriate intervals at which an improved understanding could help refine other steps of the adaptive management framework.

The key to successful communication is a skilled and dedicated interdisciplinary person or team who understands the technical information learned, the functional needs of the decision makers, and how to best transmit this information. Communication should utilize various media (e.g., web-based materials, social media, outreach opportunities, public forums, etc.) and strive to meet the goals of transparency and clarity.

9. Adapt
Proponents of covered actions for ecosystem restoration and water management should be engaged and prepared to adapt to changes in current understanding and changes in current conditions (e.g., environmental or socio-economic). Informed and equipped with new results and understanding, decision makers should reexamine the other steps of the adaptive management framework and revise these steps where current understanding suggests doing so. Possible next steps could include redefining the problem statement, amending goals and objectives, altering the conceptual model, or selecting an alternative action for design and implementation. Also, decisions to adapt might be needed at various time intervals for the same adaptive management experiment. For example, decisions might need to be made daily (e.g., Delta water operations), yearly (e.g., implementation of landscape-scale restoration), or decadal (adaptive management of landscape-scaled restoration design).

Knowing when to adapt is not always obvious. Adaptive management actions should have a planned timeframe that includes when to adapt (based on understandings of the system and its uncertainties), and that timeframe should be abandoned only if the results show that the action is doing more harm than good or the anticipated benefit is not noted within a reasonable timeframe beyond what was expected. In general, one year’s results, however anomalous, are seldom enough to demonstrate that the action should be subject to adaptive measures. Furthermore, when the analysis, synthesis, and evaluation of information learned from implementing an action indicates that no benefit results from the undertaken action, resources should no longer be spent on that action no matter how popular the action might be.

Decisions made within the adaptive management process for ecosystem restoration and water management actions should be made by decision makers for the entity responsible for implementing adaptive management. Adaptive management decisions relevant to revising and updating the Delta Plan will be made by the Council.
Appendix A
The Delta Stewardship Council’s Role Regarding Conveyance
Appendix A

The Delta Stewardship Council’s Role Regarding Conveyance

The Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act or Act) potentially gives the Delta Stewardship Council (Council) three distinct but connected roles relating to conveyance: contingent authority to approve proposed conveyance improvements, authority to generally recommend conveyance options in the Delta Plan, and authority to provide comments to other agencies during the Bay Delta Conservation Plan (BDCP) process. 

Regulatory Authority over Conveyance

As a practical matter, the Council would have occasion to decide in the first instance what conveyance improvements are permissible only if (a) an agency proposes a conveyance improvement prior to the incorporation of the BDCP into the Delta Plan, (b) the proposed conveyance improvement is a “covered action” under Water Code section 85057.5, and (c) the proposed conveyance improvement, as a covered action, is appealed to the Council as not being consistent with the Delta Plan. For reasons explained below, it is unlikely that an agency will propose a conveyance improvement prior to the completion of (or the failure of) the BDCP process. Accordingly, it would be wasteful now to include in the Delta Plan regulatory policies prescribing/limiting conveyance. If events in subsequent years reveal that the BDCP will not be successful in a timely fashion, the Council will consider then whether to amend the Delta Plan to prescribe conveyance.

The Delta Reform Act mandates that the Council’s Delta Plan “promote options” for improving conveyance and storage to meet the coequal goals (Water Code section 85303). Thus, the Council has the authority to dictate in the Delta Plan conveyance improvements it views as meeting the coequal goals. In addition, proposed conveyance improvements that are “covered actions” under the Act must be consistent with the Delta Plan, and the Council determines (upon appeal) consistency. Through specifying conveyance improvements in the Delta Plan (should the Council do so), the consistency

1. This is an attempt to summarize the Council’s relationship with the BDCP and conveyance for the purpose of clarity. However, it does not purport to summarize the Council’s complete authority in this regard. The Council retains all authority provided to it under the Delta Reform Act.

2. Proposed conveyance improvements would almost certainly be a covered action: Such a project would (1) be a California Environmental Quality Act project; (2) occur at least in part within the Sacramento-San Joaquin Delta; (3) be carried out, approved, or funded by a public agency; (4) be covered by one or more provisions of the Delta Plan; and (5) have a significant impact on the coequal goals (Water Code section 85057.5).

3. An agency proposing a conveyance covered action would have to certify that the project is consistent with the Delta Plan (Water Code section 85225). The Council would review this consistency determination if and when it was appealed to the Council (Water Code section 85225.10; Council’s Appeals Procedures).
requirement, and the Council’s appellate role over consistency determinations, the Council has the authority to regulate conveyance improvements.

This is best viewed as contingent regulatory authority. The Council may never get to exercise it. Most relevant and as a practical matter, occasion to exercise that authority is contingent in the near term on the BDCP.

Conveyance options are currently being studied in detail by the agencies and interested parties preparing the BDCP. A public draft of the BDCP Environmental Impact Statement/Environmental Impact Report is planned for release by the end of 2013. Upon successful completion of the BDCP process, and if the BDCP meets certain requirements explained in Water Code section 85320(e), the BDCP becomes part of the Delta Plan. Subsequently, if another government agency (California Department of Water Resources, most likely) proposes to implement the new conveyance project that is selected by BDCP as the preferred conveyance option and that project qualifies as a “covered action” (it would qualify, most likely), the project would be consistent with the Delta Plan regardless of whether the Delta Plan had previously endorsed a different conveyance option. Accordingly, the Council’s regulatory authority over conveyance is contingent upon conveyance being proposed prior to the BDCP’s incorporation into the Delta Plan.

It is highly unlikely that a conveyance proposal will come before the Council prior to BDCP completion, or at least the anticipated deadline for BDCP completion. The Council considers it highly unlikely that an agency will propose a new conveyance facility while the BDCP is under way. Accordingly, the Council does not expect to review a conveyance improvement consistency determination separate from the BDCP unless the BDCP process fails.

For this reason, the Delta Plan does not include any regulatory policies regarding conveyance. In addition, the BDCP has been under way since 2006; and in the last 5 years, the involved agencies and interested parties have invested significant time, resources, and expertise in that process. The lead agencies of the BDCP will also be conducting extensive environmental analysis of the various conveyance alternatives they consider. The Council has determined that the best option at this point is to encourage the lead agencies of the BDCP to complete their work in short order. It would be a wasteful and duplicative exercise for the Council now to include a regulatory policy regarding conveyance. Doing so would require the same extensive policy, scientific, and environmental analysis the BDCP is already doing.

However, should the BDCP process not be completed by January 1, 2016, the Council intends to revisit the issue of conveyance to determine how to facilitate improved conveyance facilities without the BDCP. If the Council then decides to amend the Delta Plan to include regulatory policies regarding conveyance, the Council would do so only after extensive analysis of the conveyance options and associated detailed environmental review.

### Authority to Recommend Options

Implicit in the Council’s regulatory authority relating to conveyance (that the Delta Plan shall promote options for improving conveyance) (Water Code section 85304) is its authority to recommend to other agencies conveyance options it views as meeting the coequal goals. This authority can be exercised through making Recommendations about conveyance in the Delta Plan.

The Act, therefore, gives the Council the authority to opine generally about improving conveyance as it may relate to the rest of the Delta Plan and the coequal goals. Accordingly, the Council has authority to recommend to BDCP preferred conveyance options that the BDCP should evaluate. Nevertheless, for the same reasons the Delta Plan at this time does not include any regulatory policies regarding conveyance,

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The California Department of Fish and Wildlife’s decision that the BDCP meets the requirements for incorporation into the Delta Plan may be appealed to the Council under Water Code section 85320(e).
the Delta Plan likewise does not include any Recommendations (i.e., opinion preferences) regarding conveyance. At this time, the agencies pursuing BDCP are best positioned to develop possible options, evaluate them, and decide on the best one.

**Authority to Provide Comment during the BDCP Process**

The Delta Reform Act provides the Council with a consultative and responsible agency role in the BDCP process (Water Code section 85320(c)). Thus, the Council may, separate from the Delta Plan, provide comment and guidance to lead agencies regarding BDCP, including the conveyance options those agencies consider, study, and ultimately choose.
Note: All text is new.

Article 1. Definitions.

Section 5001. Definitions.

As used in this division, the terms listed below shall have the meanings noted:

(a) “Adaptive management” means a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives.

(b) “Agricultural water management plan” means a plan prepared, adopted, and updated by an agricultural water supplier pursuant to the Agricultural Water Management Planning Act, Water Code section 10800 et seq.

(c) “Agricultural water supplier” under the Water Code refers to both agricultural retail water suppliers and agricultural wholesale water suppliers, but not the California Department of Water Resources or the United States Bureau of Reclamation, and includes both of the following:

(1) A water supplier, either publicly or privately owned, providing water to 10,000 or more irrigated acres, excluding recycled water; and

(2) A water supplier or contractor for water, regardless of the basis of the water right, that distributes or sells water for ultimate resale to customers.

(d) “Base Flood” means the flood that has a 1-percent probability of being equaled or exceeded in any given year (also referred to as the 100-year flood).

(e) “Base Flood Elevation” (BFE) means the water surface elevation associated with the base flood.

(f) “Best available science” means the best scientific information and data for informing management and policy decisions. Best available science shall be consistent with the guidelines and criteria found in Appendix 1A.

(g) “Central Valley Flood Protection Board” or “Board” means the Central Valley Flood Protection Board (formerly The Reclamation Board) of the Resources Agency of the State of California as provided in Water Code section 8521.

(h) “Coequal goals” means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. In addition, “achievement” for the purpose of determining whether a plan, program, or project meets the definition of a “covered action” under section 5001(j) is further defined as follows:
(1) “Achieving the coequal goal of providing a more reliable water supply for California” means all of the following:

(A) Better matching the state’s demands for reasonable and beneficial uses of water to the available water supply. This will be done by promoting, improving, investing in, and implementing projects and programs that improve the resiliency of the state’s water systems, increase water efficiency and conservation, increase water recycling and use of advanced water technologies, improve groundwater management, expand storage, and improve Delta conveyance and operations. The evaluation of progress toward improving reliability will take into account the inherent variability in water demands and supplies across California;

(B) Regions that use water from the Delta watershed will reduce their reliance on this water for reasonable and beneficial uses, and improve regional self-reliance, consistent with existing water rights and the State’s area-of-origin statutes and Reasonable Use and Public Trust Doctrines. This will be done by improving, investing in, and implementing local and regional projects and programs that increase water conservation and efficiency, increase water recycling and use of advanced water technologies, expand storage, improve groundwater management, and enhance regional coordination of local and regional water supply development efforts; and

(C) Water exported from the Delta will more closely match water supplies available to be exported, based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem. This will be done by improving conveyance in the Delta and expanding groundwater and surface storage both north and south of the Delta to optimize diversions in wet years when more water is available and conflicts with the ecosystem are less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. Delta water that is stored in wet years will be available for water users during dry years, when the limited amount of available water must remain in the Delta, making water deliveries more predictable and reliable. In addition, these improvements will decrease the vulnerability of Delta water supplies to disruption by natural disasters, such as, earthquakes, floods, and levee failures.

(2) “Achieving the coequal goal of protecting, restoring, and enhancing the Delta ecosystem” means successfully establishing a resilient, functioning estuary and surrounding terrestrial landscape capable of supporting viable populations of native resident and migratory species with diverse and biologically appropriate habitats, functional corridors, and ecosystem processes.

(3) “Achieving the coequal goals in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place” means accepting that change, including change associated with achieving the coequal goals, will not cease, but that the fundamental characteristics and values that contribute to the Delta’s special qualities and that distinguish it from other places can be preserved and enhanced while accommodating these changes. In this regard, the following are core strategies for protecting and enhancing the unique values that distinguish the Delta and make it a special region:

(A) Designate the Delta as a special place worthy of national and state attention;
(B) Plan to protect the Delta’s lands and communities;
(C) Maintain Delta agriculture as a primary land use, a food source, a key economic sector, and a way of life;
(D) Encourage recreation and tourism that allow visitors to enjoy and appreciate the Delta and that contribute to its economy;
(E) Sustain a vital Delta economy that includes a mix of agriculture, tourism, recreation, related industries and business, and vital components of state and regional infrastructure; and

(F) Reduce flood and other risks to people, property, and other interests in the Delta.

(i) “Commercial recreational visitor-serving uses” means a land use designation that describes visitor-serving uses, accommodations, restaurants, and shops, that respect the rural character and natural environmental setting. These uses also include campgrounds and commercial recreational facilities.

(j)(1) “Covered action” means a plan, program, or project that meets all of the following criteria (which are collectively referred to as covered action screening criteria):

(A) Is a “project,” as defined pursuant to section 21065 of the Public Resources Code;

(B) Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh;

(C) Will be carried out, approved, or funded by the State or a local public agency;

(D) Will have a significant impact on achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and State interests in the Delta; and

(E) Is covered by one or more provisions of the Delta Plan, which for these purposes, means one or more of the regulatory policies contained in Article 3.

(2) "Covered action" does not include any plan, program, or project that is exempted pursuant to Water Code section 85057.5(b).

(3) A State or local public agency that proposes to carry out, approve, or fund a plan, program, or project that may be subject to this Chapter must determine whether that proposed plan, program, or project is a covered action. That determination, which is subject to judicial review, must be reasonable, made in good faith, and consistent with the Delta Reform Act and this Chapter.

(4) Nothing in the application of the definition of a “covered action” shall be interpreted to authorize the abrogation of any vested right whether created by statute or by common law.

(k) “Delta” means the Sacramento-San Joaquin Delta as defined in section 12220 of the Water Code and the Suisun Marsh, as defined in section 29101 of the Public Resources Code.

(l) “Delta Plan” means the comprehensive, long-term management plan for the Delta to further the achievement of the coequal goals, as adopted by the Delta Stewardship Council in accordance with the Sacramento-San Joaquin Delta Reform Act of 2009.

(m) “Designated Floodway” means those floodways, as defined in California Code of Regulations, Title 23, section 4 (i), under the jurisdiction of the Central Valley Flood Protection Board.

(n) “Encroachment” means any obstruction or physical intrusion by construction of works or devices, planting or removal of vegetation, or by any means for any purpose, into or otherwise affecting a floodway or floodplain.
(o) “Enhancement” or “enhancing,” for purposes of section 5001(h)(2), means improving existing desirable habitat and natural processes. Enhancement may include, by way of example, flooding the Yolo Bypass more often to support native species or to expand or better connect existing habitat areas. Enhancement includes many fish and wildlife management practices, such as managing wetlands for waterfowl production or shorebird habitat, installing fish screens to reduce entrainment of fish at water diversions, or removing barriers that block migration of fish to upstream spawning habitats.

(p) “Feasible” means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

(q) “Floodplain” means any land area susceptible to being inundated by flood waters from any source.

(r) “Floodplain values and functions” has the same meaning as set forth in 33 Code of Federal Regulations section 320.4(l)(1).

(s) “Floodproofing” means any combination of structural and nonstructural additions, changes, or adjustments appropriate for residential structures, which reduce or eliminate risk of flood damage to real estate, improved real property, or structures with their contents.

(t) “Floodway” means the portion of the floodplain that is effective in carrying flow (that is, the channel of a river or other watercourse and the adjacent land areas that convey flood waters).

(u) “Government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta” means any State or federal strategy, project, approval, funding, or other effort that is intended to reduce the likelihood and/or consequences 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:

2. Sacramento-San Joaquin River Flood Control Projects (Flood Control Act of 1941, P.L. 77-228);
3. Local Plans of Flood Protection prepared pursuant to the Local Flood Protection Planning Act (Water Code section 8200 et seq.), that are consistent with the Central Valley Flood Protection Plan pursuant to Water Code section 9612;
4. Central Valley Flood Protection Plan (Water Code section 9600 et seq.);
5. Subventions Program, Special Projects Program (Water Code section 12300 et seq.);
6. Way Bill 1973-Subventions Program, Special Projects Program (Water Code section 12980 et seq.);
7. Central Valley Flood Protection Board Authority (California Code of Regulations, Title 23, Division 1); and

(v) “Nonnative invasive species,” for purposes of section 5009, means species that establish and reproduce rapidly outside of their native range and may threaten the diversity or abundance of native
species through competition for resources, predation, parasitism, hybridization with native populations, introduction of pathogens, or physical or chemical alteration of the invaded habitat.

(w) “Nonproject levee” means a local levee owned or maintained by a local agency or private owner that is not a project facility under the State Water Resources Law of 1945, Chapter 1 (commencing with Water Code section 12570) and Chapter 2 (commencing with section 12639 of Part 6 of the Water Code).

(x) “Project levee” means a federal flood control levee that is a project facility under the State Water Resources Law of 1945, Chapter 1 (commencing with Water Code section 12570) and Chapter 2 (commencing with section 12639 of Part 6 of the Water Code).

(y) “Proposed action” means a plan, program, or project that meets the covered action screening criteria listed in section 5001(j)(1)(A) through (D). Proposed action is also a “covered action,” and therefore subject to compliance with the regulatory policies contained in Articles 2 and 3—if the proposed action meets the covered action screening criterion listed in section 5001(j)(1)(E).

(z) “Protection” or “protecting,” for purposes of section 5001(h)(2), means preventing harm to the ecosystem, which could include preventing the conversion of existing habitat, the degradation of water quality, irretrievable conversion of lands suitable for restoration, or the spread of invasive nonnative species.

(aa) “Regulated stream” means those streams identified in Table 8.1 of California Code of Regulations, Title 23, section 112, under the jurisdiction of the Board.

(bb) “Restoration” or “restoring,” for purposes of section 5001(h)(2), has the same meaning as in Water Code section 85066. Restoration actions may include restoring interconnected habitats within the Delta and its watershed, restoring more natural Delta flows, or improving ecosystem water quality.

(cc) “Setback levee” means a new levee constructed behind an existing levee which allows for removal of a portion of the existing levee and creation of additional floodplain connected to the stream. In the Delta, a “setback levee” may not necessarily result in removal of the existing levee.

(dd) “Significant impact” for the purpose of determining whether a project meets the definition of a “covered action” under section 5001(j)(1)(D) means a substantial positive or negative impact on the achievement of one or both of the coequal goals or the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta, that is directly or indirectly caused by a project on its own or when the project’s incremental effect is considered together with the impacts of other closely related past, present, or reasonably foreseeable future projects. The following categories of projects will not have a significant impact for this purpose:

1. “Ministerial” projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(1);

2. “Emergency” projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(2) through (4);

3. Temporary water transfers of up to one year in duration. This provision shall remain in effect only through December 31, 2016, and as of January 1, 2017, is repealed, unless the Council acts to extend the provision prior to that date. The Council contemplates that any extension would be based upon the California Department of Water Resources’ and the State Water Resources Control Board’s participation with stakeholders to identify and recommend measures to reduce procedural and
administrative impediments to water transfers and protect water rights and environmental resources by December 31, 2016. These recommendations should include measures to address potential issues with recurring transfers of up to 1 year in duration and improved public notification for proposed water transfers;

(4) Other projects exempted from CEQA, unless there are unusual circumstances indicating a reasonable possibility that the project will have a significant impact under Water Code section 85057.5(a)(4), as further defined by this section. Examples of unusual circumstances could arise in connection with, among other things:

(A) Local government general plan amendments for the purpose of achieving consistency with the Delta Protection Commission’s Land Use and Resource Management Plan; and

(B) Small-scale habitat restoration projects, as referred to in CEQA Guidelines, section 15333 of Title 14 of the California Code of Regulations, proposed in important restoration areas, but which are inconsistent with the Delta Plan’s policy related to appropriate habitat restoration for a given land elevation (section 5006 of this Chapter).

(ee) “Urban area” means a developed area in which there are 10,000 residents or more.

(ff) “Urbanizing area” means a developed area or an area outside of a developed area that is planned or anticipated to have 10,000 residents or more within the next 10 years.

(gg) “Urban water management plan” means a plan prepared, adopted, and updated by an urban water supplier pursuant to the Urban Water Management Planning Act, Water Code section 10610 et seq.

(hh) “Urban water supplier” refers to both “urban retail water suppliers” and “urban wholesale water suppliers”:

(1) “Urban retail water supplier” means a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes.

(2) “Urban wholesale water supplier” means a water supplier, either publicly or privately owned, that provides more than 3,000 acre-feet of potable water annually at wholesale for municipal purposes.

(ii) “Water supplier” refers to both “urban water suppliers” and “agricultural water suppliers,” but for purposes of section 5003, does not include agricultural water suppliers during the time that they may be exempted by section 10853 of the Water Code from the requirements of Parts 2.55 and 2.8 of Division 6 of the Water Code.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85057.5, 85059, 85058, 85066, 85020, 85054, 85052, 85302(g), 85308, 85300, 10608.12, and 10853, Water Code.
Article 2. Certifications of Consistency

Section 5002. Detailed Findings to Establish Consistency with the Delta Plan.

(a) This policy specifies what must be addressed in a certification of consistency filed by a State or local public agency with regard to a covered action. This policy only applies after a “proposed action” has been determined by a State or local public agency to be a covered action because it is covered by one or more of the regulatory policies contained in Article 3. Inconsistency with this policy may be the basis for an appeal.

(b) Certifications of consistency must include detailed findings that address each of the following requirements:

1. Covered actions, in order to be consistent with the Delta Plan, must be consistent with this regulatory policy and with each of the regulatory policies contained in Article 3 implicated by the covered action. The Delta Stewardship Council acknowledges that in some cases, based upon the nature of the covered action, full consistency with all relevant regulatory policies may not be feasible. In those cases, the agency that files the certification of consistency may nevertheless determine that the covered action is consistent with the Delta Plan because, on whole, that action is consistent with the coequal goals. That determination must include a clear identification of areas where consistency with relevant regulatory policies is not feasible, an explanation of the reasons why it is not feasible, and an explanation of how the covered action nevertheless, on whole, is consistent with the coequal goals. That determination is subject to review by the Delta Stewardship Council on appeal;

2. Covered actions not exempt from CEQA must include applicable feasible mitigation measures identified in the Delta Plan’s Program Environmental Impact Report (unless the measure(s) are within the exclusive jurisdiction of an agency other than the agency that files the certification of consistency), or substitute mitigation measures that the agency that files the certification of consistency finds are equally or more effective;

3. As relevant to the purpose and nature of the project, all covered actions must document use of best available science;

4. Ecosystem restoration and water management covered actions must include adequate provisions, appropriate to the scope of the covered action, to assure continued implementation of adaptive management. This requirement shall be satisfied through both of the following:

   (A) An adaptive management plan that describes the approach to be taken consistent with the adaptive management framework in Appendix 1B; and

   (B) Documentation of access to adequate resources and delineated authority by the entity responsible for the implementation of the proposed adaptive management process.

(c) A conservation measure proposed to be implemented pursuant to a natural community conservation plan or a habitat conservation plan that was:

1. Developed by a local government in the Delta; and

2. Approved and permitted by the California Department of Fish and Wildlife prior to May 16, 2013
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is deemed to be consistent with sections 5005 through 5009 of this Chapter if the certification of consistency filed with regard to the conservation measure includes a statement confirming the nature of the conservation measure from the California Department of Fish and Wildlife.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85225, 85225.10, 85020, 85054, 85302(g), and 85308, Water Code.


Section 5003. Reduce Reliance on the Delta through Improved Regional Water Self-Reliance.

(a) Water shall not be exported from, transferred through, or used in the Delta if all of the following apply:

(1) One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c);

(2) That failure has significantly caused the need for the export, transfer, or use; and

(3) The export, transfer, or use would have a significant adverse environmental impact in the Delta.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to export water from, transfer water through, or use water in the Delta, but does not cover any such action unless one or more water suppliers would receive water as a result of the proposed action.

(c) Water suppliers that have done all of the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:

(A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;

(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and

(C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).

(2) Programs and projects that reduce reliance could include, but are not limited to, improvements in water use efficiency, water recycling, stormwater capture and use, advanced water technologies, conjunctive use projects, local and regional water supply and storage projects, and improved regional coordination of local and regional water supply efforts.

NOTE: Authority cited: Section 85210(i), Water Code.
Section 5004. Transparency in Water Contracting.

(a) The contracting process for water from the State Water Project and/or the Central Valley Project must be done in a publicly transparent manner consistent with applicable policies of the California Department of Water Resources and the Bureau of Reclamation referenced below.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers the following:

(1) With regard to water from the State Water Project, a proposed action to enter into or amend a water supply or water transfer contract subject to California Department of Water Resources Guidelines 03-09 and/or 03-10 (each dated July 3, 2003), which are attached as Appendix 2A; and

(2) With regard to water from the Central Valley Project, a proposed action to enter into or amend a water supply or water transfer contract subject to section 226 of P.L. 97-293, as amended or section 3405(a)(2)(B) of the Central Valley Project Improvement Act, Title XXXIV of Public Law 102-575, as amended, which are attached as Appendix 2B, and Rules and Regulations promulgated by the Secretary of the Interior to implement these laws.

NOTE: Authority cited: Section 85210(i), Water Code.


Section 5005. Delta Flow Objectives.

(a) The State Water Resources Control Board’s Bay Delta Water Quality Control Plan flow objectives shall be used to determine consistency with the Delta Plan. If and when the flow objectives are revised by the State Water Resources Control Board, the revised flow objectives shall be used to determine consistency with the Delta Plan.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, the policy set forth in subsection (a) covers a proposed action that could significantly affect flow in the Delta.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85054, 85086, 85087, 85300, and 85302, Water Code.

Section 5006. Restore Habitats at Appropriate Elevations.

(a) Habitat restoration must be carried out consistent with Appendix 3, which is Section II of the Draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (California Department of Fish and Wildlife 2011). The elevation map attached as Appendix 4 should be used as a guide for determining appropriate habitat restoration actions based on an area’s elevation. If a proposed habitat restoration action is not consistent with Appendix 4, the proposal shall provide rationale for the deviation based on best available science.
(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that includes habitat restoration.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85022, 85054, 85300, and 85302, Water Code.

Section 5007. Protect Opportunities to Restore Habitat.

(a) Within the priority habitat restoration areas depicted in Appendix 5, significant adverse impacts to the opportunity to restore habitat as described in section 5006, must be avoided or mitigated.

(b) Impacts referenced in subsection (a) will be deemed to be avoided or mitigated if the project is designed and implemented so that it will not preclude or otherwise interfere with the ability to restore habitat as described in section 5006.

(c) Impacts referenced in subsection (a) shall be mitigated to a point where the impacts have no significant effect on the opportunity to restore habitat as described in section 5006. Mitigation shall be determined, in consultation with the California Department of Fish and Wildlife, considering the size of the area impacted by the covered action and the type and value of habitat that could be restored on that area, taking into account existing and proposed restoration plans, landscape attributes, the elevation map shown in Appendix 4, and other relevant information about habitat restoration opportunities of the area.

(d) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions in the priority habitat restoration areas depicted in Appendix 5. It does not cover proposed actions outside those areas.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85022, 85054, 85300, 85302, and 85305, Water Code.

Section 5008. Expand Floodplains and Riparian Habitats in Levee Projects.

(a) Levee projects must evaluate and where feasible incorporate alternatives, including the use of setback levees, to increase floodplains and riparian habitats. Evaluation of setback levees in the Delta shall be required only in the following areas (shown in Appendix 8): (1) The Sacramento River between Freeport and Walnut Grove, the San Joaquin River from the Delta boundary to Mossdale, Paradise Cut, Steamboat Slough, Sutter Slough; and the North and South Forks of the Mokelumne River, and (2) Urban levee improvement projects in the cities of West Sacramento and Sacramento.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to construct new levees or substantially rehabilitate or reconstruct existing levees.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85022, 85054, 85300, 85302, and 85305, Water Code.
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Section 5009. Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species.

(a) The potential for new introductions of or improved habitat conditions for nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that has the reasonable probability of introducing or improving habitat conditions for nonnative invasive species.

NOTE: Authority cited: Section 85210(i), Water Code.


Section 5010. Locate New Urban Development Wisely.

(a) New residential, commercial, and industrial development must be limited to the following areas, as shown in Appendix 6 and Appendix 7:

(1) Areas that city or county general plans, as of May 16, 2013, designate for residential, commercial, and industrial development in cities or their spheres of influence;

(2) Areas within Contra Costa County’s 2006 voter-approved urban limit line, except no new residential, commercial, and industrial development may occur on Bethel Island unless it is consistent with the Contra Costa County general plan effective as of May 16, 2013;

(3) Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or

(4) The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove.

(b) Notwithstanding subsection (a), new residential, commercial, and industrial development is permitted outside the areas described in subsection (a) if it is consistent with the land uses designated in county general plans as of May 16, 2013, and is otherwise consistent with this Chapter.

(c) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve new residential, commercial, and industrial development that is not located within the areas described in subsection (a). In addition, this policy covers any such action on Bethel Island that is inconsistent with the Contra Costa County general plan effective as of May 16, 2013. This policy does not cover commercial recreational visitor-serving uses or facilities for processing of local crops or that provide essential services to local farms, which are otherwise consistent with this Chapter.

(d) This policy is not intended in any way to alter the concurrent authority of the Delta Protection Commission to separately regulate development in the Delta’s Primary Zone.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85022, 85300, 85302, and 85305, Water Code.
Section 5011. Respect Local Land Use When Siting Water or Flood Facilities or Restoring Habitats.

(a) Water management facilities, ecosystem restoration, and flood management infrastructure must be sited to avoid or reduce conflicts with existing uses or those uses described or depicted in city and county general plans for their jurisdictions or spheres of influence when feasible, considering comments from local agencies and the Delta Protection Commission. Plans for ecosystem restoration must consider sites on existing public lands, when feasible and consistent with a project’s purpose, before privately owned sites are purchased. Measures to mitigate conflicts with adjacent uses may include, but are not limited to, buffers to prevent adverse effects on adjacent farmland.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve the siting of water management facilities, ecosystem restoration, and flood management infrastructure.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85022, 85054, 85300, and 85305, Water Code.

Section 5012. Prioritization of State Investments in Delta Levees and Risk Reduction.

(a) Prior to the completion and adoption of the updated priorities developed pursuant to Water Code section 85306, the interim priorities listed below shall, where applicable and to the extent permitted by law, guide discretionary State investments in Delta flood risk management. Key priorities for interim funding include emergency preparedness, response, and recovery as described in paragraph (1), as well as Delta levees funding as described in paragraph (2).

(1) Delta Emergency Preparedness, Response, and Recovery: Develop and implement appropriate emergency preparedness, response, and recovery strategies, including those developed by the Delta Multi-Hazard Task Force pursuant to Water Code section 12994.5.

(2) Delta Levees Funding: The priorities shown in the following table are meant to guide budget and funding allocation strategies for levee improvements. The goals for funding priorities are all important, and it is expected that, over time, the California Department of Water Resources must balance achievement of those goals. Except on islands planned for ecosystem restoration, improvement of nonproject Delta levees to the Hazard Mitigation Plan (HMP) standard may be funded without justification of the benefits. Improvements to a standard above HMP, such as that set by the U.S. Army Corps of Engineers under Public Law 84-99, may be funded as befits the benefits to be provided, consistent with the California Department of Water Resources’ current practices and any future adopted investment strategy.
Priorities for State Investment in Delta Integrated Flood Management

Categories of Benefit Analysis

<table>
<thead>
<tr>
<th>Goals</th>
<th>Localized Flood Protection</th>
<th>Levee Network</th>
<th>Ecosystem Conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protect existing urban and adjacent urbanizing areas by providing 200-year flood protection.</td>
<td>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.</td>
<td>Protect existing and provide for a net increase in channel-margin habitat.</td>
</tr>
<tr>
<td>2</td>
<td>Protect small communities and critical infrastructure of statewide importance (located outside of urban areas).</td>
<td>Protect flood water conveyance in and through the Delta to a level consistent with the State Plan of Flood Control for project levees.</td>
<td>Protect existing and provide for net enhancement of floodplain habitat.</td>
</tr>
<tr>
<td>3</td>
<td>Protect agriculture and local working landscapes.</td>
<td>Protect cultural, historic, aesthetic, and recreational resources (Delta as Place).</td>
<td>Protect existing and provide for net enhancement of wetlands.</td>
</tr>
</tbody>
</table>

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves discretionary State investments in Delta flood risk management, including levee operations, maintenance, and improvements. Nothing in this policy establishes or otherwise changes existing levee standards.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85300, 85305, and 85306, Water Code.

Section 5013. Require Flood Protection for Residential Development in Rural Areas.

(a) New residential development of five or more parcels shall be protected through floodproofing to a level 12 inches above the 100-year base flood elevation, plus sufficient additional elevation to protect against a 55-inch rise in sea level at the Golden Gate, unless the development is located within:

1. Areas that city or county general plans, as of May 16, 2013, designate for development in cities or their spheres of influence;
2. Areas within Contra Costa County’s 2006 voter-approved urban limit line, except Bethel Island;
3. Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or
4. The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove, as shown in Appendix 7.
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(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves new residential development of five or more parcels that is not located within the areas described in subsection (a).

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85300, 85305, and 85306, Water Code.

Section 5014. Protect Floodways.

(a) No encroachment shall be allowed or constructed in a floodway, unless it can be demonstrated by appropriate analysis that the encroachment will not unduly impede the free flow of water in the floodway or jeopardize public safety.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in a floodway that is not either a designated floodway or regulated stream.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85300, 85302, and 85305, Water Code.

Section 5015. Floodplain Protection.

(a) No encroachment shall be allowed or constructed in any of the following floodplains unless it can be demonstrated by appropriate analysis that the encroachment will not have a significant adverse impact on floodplain values and functions:

(1) The Yolo Bypass within the Delta;

(2) 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 California Department of Water Resources or the U.S. Army Corps of Engineers (California Department of Water Resources 2010); and

(3) 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 California Department of Water Resources by the partnership of the South Delta Water Agency, the River Islands Development Company, Reclamation District 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.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in any of the floodplain areas described in subsection (a).

(c) This policy is not intended to exempt any activities in any of the areas described in subsection (a) from applicable regulations and requirements of the Central Valley Flood Protection Board.

NOTE: Authority cited: Section 85210(i), Water Code.
Final Regulation Text

Reference: Sections 85020, 85300, 85302, and 85305, Water Code.


Section 5016. Miscellaneous Provisions.

(a) The provisions in this Chapter are not intended and shall not be construed as authorizing the Delta Stewardship Council or any entity to exercise its power in a manner that will take or damage private property for public use without the payment of just compensation.

(b) The provisions in this Chapter are not intended to affect the rights of any owner of property under the Constitutions of the State of California or the United States.

(c) The provisions in this Chapter shall not increase the State’s flood liability.

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85032(j) and 85057.5(d), Water Code.
Appendix 1A
Best Available Science

Note: All content of this appendix is newly adopted.
**Best Available Science**

The Delta Reform Act requires the Council to make use of the best available science in implementing the Delta Plan. Best available science is specific to the decision being made and the time frame available for making that decision. Best available science is developed and presented in a transparent manner consistent with the scientific process (Sullivan et al. 2006), including clear statements of assumptions, the use of conceptual models, description of methods used, and presentation of summary conclusions. Sources of data used are cited and analytical tools used in analyses and syntheses are identified. Best available science changes over time, and decisions may need to be revisited as new scientific information becomes available. Ultimately, best available science requires scientists to use the best information and data to assist management and policy decisions. The processes and information used should be clearly documented and effectively communicated to foster improved understanding and decision making.

**Steps for Achieving the Best Science**

Science consistent with the scientific process includes the following elements:

- Well-stated objectives
- A clear conceptual or mathematical model
- A good experimental design with standardized methods for data collection
- Statistical rigor and sound logic for analysis and interpretation
- Clear documentation of methods, results, and conclusions

The best science is understandable; it clearly outlines assumptions and limitations. The best science is also reputable; it has undergone peer review conducted by active experts in the applicable field(s) of study. Scientific peer review addresses the validity of the methods used, the adequacy of the methods and study design in addressing study objectives, the adequacy of the interpretation of results, whether the conclusions are supported by the results, and whether the findings advance scientific knowledge (Sullivan et al. 2006).

There are several sources of scientific information and tradeoffs associated with each (Sullivan et al. 2006, Ryder et al. 2010). The primary sources of scientific information, in a generalized ranking of most to least scientific credibility for informing management decisions, include the following:

- Independently peer-reviewed publications including scientific journal publications and books (most desirable)
- Other scientific reports and publications
- Science expert opinion
- Traditional knowledge

Each of these sources of scientific information may be the best available at a given time and contain varying levels of understanding and uncertainty. These limitations should be clearly documented when scientific information is used as the basis for decisions.

**Guidelines and Criteria**

There have been several efforts to develop criteria for defining and assessing best available science. In 2004, the National Research Council Committee on Defining the Best Scientific Information Available for Fisheries Management prepared a report (National Research Council Report) that concluded guidelines and criteria must be defined in order to apply best available science in natural resource management (National Research Council 2004). Major findings and recommendations included establishing procedural and implementation guidelines to govern the production and use of scientific information. The guidelines were based on six broad criteria: relevance, inclusiveness, objectivity, transparency and openness, timeliness, and peer review.
Best available science for proposed covered actions and for use in the Delta Plan should be consistent with the guidelines and criteria in Table 1A-1. These criteria were adapted from criteria developed by the National Research Council. Proponents of covered actions should document their scientific rationale for applying the criteria in Table 1A-1 (i.e., the format used in a scientific grant proposal).

### Table 1A-1

**Criteria for Best Available Science**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relevance</strong></td>
<td>Scientific information used should be germane to the Delta ecosystem and/or biological and physical components (and/or process) affected by the proposed decisions. Analogous information from a different region but applicable to the Delta ecosystem and/or biological and physical components may be the most relevant when Delta-specific scientific information is nonexistent or insufficient. The quality and relevance of the data and information used shall be clearly addressed.</td>
</tr>
<tr>
<td><strong>Inclusiveness</strong></td>
<td>Scientific information used shall incorporate a thorough review of relevant information and analyses across relevant disciplines. Many analysis tools are available to the scientific community (e.g., search engines and citation indices).</td>
</tr>
<tr>
<td><strong>Objectivity</strong></td>
<td>Data collection and analyses considered shall meet the standards of the scientific method and be void of nonscientific influences and considerations.</td>
</tr>
<tr>
<td><strong>Transparency</strong></td>
<td>The sources and methods used for analyzing the science (including scientific and engineering models) used shall be clearly identified. The opportunity for public comment on the use of science in proposed covered actions is recommended. Limitations of research used shall be clearly identified and explained. If a range of uncertainty is associated with the data and information used, a mechanism for communicating uncertainty shall be employed.</td>
</tr>
<tr>
<td><strong>Timeliness</strong></td>
<td>Timeliness has two main elements: (1) data collection shall occur in a manner sufficient for adequate analyses before a management decision is needed, and (2) scientific information used shall be applicable to current situations. Timeliness also means that results from scientific studies and monitoring may be brought forward before the study is complete to address management needs. In these instances, it is necessary that the uncertainties, limitations, and risks associated with preliminary results are clearly documented.</td>
</tr>
<tr>
<td><strong>Peer review</strong></td>
<td>The quality of the science used will be measured by the extent and quality of the review process. Independent external scientific review of the science is most important because it ensures scientific objectivity and validity. The following criteria represent a desirable peer review process. Coordination of Peer Review. Independent peer review shall be coordinated by entities and/or individuals that (1) are not a member of the independent external review team/panel and (2) have had no direct involvement in the particular actions under review. Independent External Reviewers. A qualified independent external reviewer embodies the following qualities: (1) has no conflict of interest with the outcome of the decision being made, (2) can perform the review free of persuasion by others, (3) has demonstrable competence in the subject as evidenced by formal training or experience, (4) is willing to utilize his or her scientific expertise to reach objective conclusions that may be incongruent with his or her personal biases, and (5) is willing to identify the costs and benefits of ecological and social alternative decisions. When to Conduct Peer Review. Independent scientific peer review shall be applied formally to proposed projects and initial draft plans, in writing after official draft plans or policies are released to the public, and to final released plans. Formal peer review should also be applied to outcomes and products of projects as appropriate.</td>
</tr>
</tbody>
</table>

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a. McGarvey 2007
c. National Research Council 2004
d. Meffe et al. 1998
e. Adapted from Meffe et al. 1998

It is recognized that differences exist among the accepted standards of peer review for various fields of study and professional communities. When applying the criteria for best available science in Table 1A-1, the Council recognizes that the level of peer review for supporting materials and technical information
(such as scientific studies, model results, and documents) included in the documentation for a proposed covered action is variable and relative to the scale, scope, and nature of the proposed covered action. The Council understands that varying levels of peer review may be commonly accepted in various fields of study and professional communities.

References


Appendix 1B
Adaptive Management

Note: All content of this appendix is newly adopted.
Adaptive Management

Adaptive management is defined in the Delta Reform Act as “a framework and flexible decision making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives” (Water Code section 85052). Adaptive management can be applied at a program, plan or project level.

Adaptive management is a strategy that provides for making management decisions under uncertain conditions using the best available science rather than repeatedly delaying action until more information is available. Adaptive management allows for continuous learning resulting in management decisions based on what was learned, rather than adopting a management strategy and implementing it without regard for scientific feedback or monitoring. Adaptive management is an approach to resources management that increases the likelihood of success in obtaining goals in a manner that is both economical and effective because it provides flexibility and feedback to manage natural resources in the face of often considerable uncertainty.

To be effective, governance to support and implement adaptive management in the Delta must be flexible and have the capability to make timely changes to policies and practices in response to what is learned over time (e.g., the Delta Plan adaptive management approach described in Chapter 2). Governance for adaptive management should provide a decision-making structure that fosters communication among scientific experts, independent scientific reviewers, the relevant decision making authorities (e.g., state and federal fisheries agencies on issues related to aquatic ecosystem restoration) and a balanced approach to the involvement of interested stakeholders.

A Three-phase and Nine-step Adaptive Management Framework

The Council will use the three-phase and nine-step adaptive management framework in Figure 1B-1 that is described in detail below. The Council will use this framework to evaluate the usefulness of adaptive management for reviewing proposed covered actions involving ecosystem restoration and water management along with developing, implementing, and updating the Delta Plan (See Chapter 2). Ecosystem restoration and water management covered actions should include an adaptive management plan that considers all nine steps of this framework; however, they need not be rigidly included and implemented in the order described here and should not be used as a means to prevent action, but rather as a tool to enhance decision making. The intent is to build logical and clear information exchange and decision points into management actions that increase options and improve outcomes. In developing an adaptive management plan, the best available science should be used to inform the various steps of the adaptive management process.
Figure 1B-1
A Nine-step Adaptive Management Framework
The shading represents the three broad phases of adaptive management (Plan, Do, and Evaluate and Respond), and the boxes represent the nine steps within the adaptive management framework. The circular arrow represents the general sequence of steps. The additional arrows indicate possible next steps for adapting (for example, revising the selected action based on what has been learned). This framework and the description of each step are largely derived from Stanford and Poole (1996), CALFED Bay-Delta Program (2000), Abal et al. (2005), and the Bay Delta Conservation Plan Independent Science Advisors on Adaptive Management (2009).

Plan
The Plan phase of the adaptive management framework is presented as four steps.

1. Define/Redeﬁne the Problem
The first step of effective adaptive management is to clearly deﬁne the problems that will be addressed in the form of a problem statement. The problem statement should clearly link to program goals and to speciﬁc objectives, which should be developed by proponents in an open manner. The boundaries of the problem (e.g., its geographic and temporal scales) should be deﬁned in the problem statement.

2. Establish Goals and Objectives
Clear goals and objectives must be established by proponents of proposed covered actions for ecosystem restoration and water management and be based on the best available science (See GP 1 in Chapter 2).
Goals are broad statements that propose general solutions. Objectives are more specific than goals, and are often quantitative, specific narrative statements of desired outcomes allowing evaluation of how well the objectives are being achieved.

3. Model Linkages between Objectives and Proposed Action(s)

Models formalize and apply current scientific understanding, develop expectations, assess the likelihood of success, and identify tradeoffs associated with different management actions. Models can be conceptual, statistical, physical, decision support, or simulation. Models link the objectives to the proposed actions and clarify why an intended action is expected to result in meeting its objectives. Models provide a road map for testing hypotheses through statements that describe the expected outcome of an action.

Both qualitative (conceptual) and quantitative models can effectively link objectives and proposed actions by illuminating if and how different actions meet specific objectives. Conceptual models are particularly useful for decision makers, scientists, and the public because they illustrate the most critical cause-and-effect pathways. Conceptual models provide an articulation of the hypotheses being tested and how various actions might achieve particular objectives. Conceptual models also help to develop performance measures, which are qualitative or quantitative information that tracks status and trends toward meeting objectives. Conceptual models should be used in adaptive management planning because they help explain how other types of models, research, and actions will be used to explore hypotheses and address specific existing and anticipated uncertainties.

Recent conceptual models developed specifically for the Delta include comprehensive models developed as part of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). The DRERIP models were designed to aid in the identification and evaluation of ecosystem restoration actions in the Delta, and include both ecosystem models (processes, habitats, and stressors) and species life history models. Another set of conceptual models was developed to plan the IEP's Pelagic Organism Decline (POD) investigations and to synthesize the POD results into "stories" about what may have happened to cause the rapid decline of multiple open-water fish species.

4. Select Action(s) (Research, Pilot, or Full-scale) and Develop Performance Measures

The process for selecting an action or several actions to meet objectives includes an evaluation of the best available science represented in the conceptual model. This evaluation should guide development of the action. Consideration should be given to the following:

♦ Level of the action(s) to be taken (research, pilot-scale project, or full-scale project)
♦ Geographical and temporal scale of the action(s)
♦ Degree of confidence in the benefits
♦ Consequences of being wrong

The scale of the action selected should be informed by the certainty of the relevant scientific information, consider the reversibility of the action, and account for the potential cost of delaying larger-scale actions. For example, when the best available science cannot predict the outcome of an action with a reasonable degree of certainty, and irreversible consequences exist for incorrectly predicting the outcomes of an action, further research or a pilot-scale action is likely more appropriate than a full-scale action, unless the cost of delaying a larger-scale action is very high (for example, a species of concern goes extinct or urban water supplies are cut off). In some instances, choosing to take no action could be the best selection (when no foreseen benefit would result from a research, pilot-scale, or full-scale action). Where possible, the action(s) selected should test cause-and-effect relationships in the conceptual model so that the model can be adapted using the information learned from implementing the action(s).
Performance measures derive from goals and objectives, and help to address the status and trends of progress toward achieving the goals and objectives. Performance measures can be placed in three general classes:

- Administrative: performance measures that describe decisions made by policy makers and managers to finalize plans or approve resources (funds, personnel, projects) for implementation of a program or group of related programs
- Output (also known as driver): performance measures that evaluate factors that may be influencing outcomes and include on-the-ground implementation and management actions
- Outcome: performance measures that evaluate ecosystem responses to management actions or natural outputs

The distinction between performance measure types is not rigid. In some cases, an outcome performance measure for one purpose may become an output performance measure for another purpose.

Development of informative performance measures is a challenging task. Performance measures must be designed to capture important trends and to address whether specific actions are producing expected results. Performance measures are selected based on the conceptual model. In addition the monitoring plan should be designed so that the information collected supports performance measure analysis and reporting.

Efforts to develop performance measures in complex and large-scale systems with many ecosystem types like the Delta are commonly multi-year endeavors; however, initial performance measures provide value for initial assessments of progress made in the interim. The process for developing performance measures should address the rationale for each performance measure, metrics, method for analysis, baseline and reference conditions, expected outcomes, timeline for evaluation, and a communication/visualization element. The development of performance measures should be informed by the best available science and involve key stakeholders.

Do

The Do phase of adaptive management includes two steps that occur in parallel.

5. Design and Implement Action(s)

The design and implementation of action(s) include clearly describing specific activities that will occur under the selected action(s) and how they will link to the monitoring plan. Design includes creating a plan for implementing the action(s) and monitoring responses resulting from the action(s). The design of the action(s) should be informed by existing uncertainties, and should be directly linked to meeting the goals and objectives.

6. Design and Implement Monitoring Plan

A well-designed monitoring plan includes a data management plan. A data management plan describes the process for organizing and clearly documenting observations, including how data are collected; the methods, quality assurance, and calculations used; the time and space scales of the variables; and accurate site locations and characteristics. Data management is critical for analyses, syntheses, and evaluations.

A well-designed monitoring plan goes beyond data collection and data management. A monitoring plan often includes targeted research to answer why certain results are observed and others are not. A monitoring plan also includes clear communication of the information gathered and current understanding drawn from this information. A complete monitoring plan includes:

- Compliance monitoring (required by permits)
- Performance monitoring with pre-project monitoring (measuring achievement of targets)
Mechanistic monitoring with concurrent targeted research (testing the understanding of linkages in the conceptual model)

System-level monitoring (holistic, integrative and long term)

These types of monitoring can measure and communicate various types of information, including administrative/inputs (such as dollars awarded and spent or projects funded), compliance/outputs (such as tons of gravel added or acres exposed to tidal action), and effectiveness/outcomes (such as actual outcome expected from implementing an action at the local scale, suites of actions at the system-wide scales, and status and trends assessments). The monitoring plan design must include the development of monitoring metrics that can be integrated and summarized to inform decision makers and the public as described in step eight, Communicate Current Understanding.

Monitoring plan design requires making tradeoffs between resources spent on monitoring and resources spent on actions and analyses. To aid in this evaluation of tradeoffs, a rigorous pre-analysis using simulation models can show the information value of different variables that might be monitored. These values assessments can then be used to compare the benefits from monitoring certain variables against the benefit of using resources for other actions.

Implementation of actions and monitoring should be closely coordinated. Before an action is implemented, initial conditions should be clearly documented to the extent practical so that a baseline is established. Baseline data includes characterization of natural variation observed in the examined system over space and time. For many ecological and hydrological variables, an extensive set of baseline data is available because of the efforts of the Interagency Ecological Program and repositories of information such as those available from the U.S. Geological Survey and the California Department of Water Resources. The implementation of action(s) and monitoring should be clearly executed and communicated to the public. Status and trends metrics that compare conditions before and after action implementation are often good assessment and communication tools.

Evaluate and Respond

The Evaluate and respond phase of adaptive management includes three key steps.

7. Analyze, Synthesize, and Evaluate

Analysis, synthesis, and evaluation of the action(s) and monitoring are critical for improving current understanding. Analysis and synthesis should incorporate information on how conditions have changed, expectedly and unexpectedly, as a result of implementing the action(s). Because measurable change might not occur on short timescales, evaluations should also examine whether actions prevented further deteriorating conditions that would have occurred if no actions were taken. The evaluation should examine whether performance measures indicate that one or more of the objectives have been met as a result of the implemented action(s), and if so, why. If an objective is not met, the potential reasons why it was not met should be clearly identified and communicated. Analyses should be cumulative. As each year’s data becomes available, analyses should assess whether the probability of the desired outcome has changed and, if so, how this affects decisions about the action. The results of the analysis, synthesis, and evaluation step could be published in technical peer-reviewed papers and reports for the purpose of external review, disclosure, and accessibility where results warrant this level of communication. Scientists and technical experts will be critical for carrying out this step.

8. Communicate Current Understanding

Communication of current understanding gained through analysis, synthesis, and evaluation of implemented action(s) and monitoring is a key step for informing and equipping policy makers, managers, stakeholders, and the public to appropriately respond and adapt. This step spans the Do and the Evaluate and respond phase of adaptive management because the communication of current
understanding and related recommendations for change requires both policy and technical expertise. The information communicated should be technically sound, well synthesized, and translated into formats conducive to informing a nontechnical audience (e.g., a report card format or a general science outlet such as a newsletter). The information should then be disseminated to those directly involved in the adaptive management process for the plan, program, or project and to those interested in the outcome of the action.

Technical staff and decision makers should be regularly involved in the exchange of information as data are analyzed and synthesized. Communication should be ongoing and occur at appropriate intervals at which an improved understanding could help refine other steps of the adaptive management framework.

The key to successful communication is a skilled and dedicated interdisciplinary person or team who understands the technical information learned, the functional needs of the decision makers, and how to best transmit this information. Communication should utilize various media (e.g., web-based materials, social media, outreach opportunities, public forums, etc.) and strive to meet the goals of transparency and clarity.

9. Adapt

Proponents of covered actions for ecosystem restoration and water management should be engaged and prepared to adapt to changes in current understanding and changes in current conditions (e.g., environmental or socio-economic). Informed and equipped with new results and understanding, decision makers should reexamine the other steps of the adaptive management framework and revise these steps where current understanding suggests doing so. Possible next steps could include redefining the problem statement, amending goals and objectives, altering the conceptual model, or selecting an alternative action for design and implementation. Also, decisions to adapt might be needed at various time intervals for the same adaptive management experiment. For example, decisions might need to be made daily (e.g., Delta water operations), yearly (e.g., implementation of landscape-scale restoration), or decadal (adaptive management of landscape-scaled restoration design).

Knowing when to adapt is not always obvious. Adaptive management actions should have a planned time frame that includes when to adapt (based on understandings of the system and its uncertainties), and that time frame should be abandoned only if the results show that the action is doing more harm than good or the anticipated benefit is not noted within a reasonable timeframe beyond what was expected. In general, one year’s results, however anomalous, are seldom enough to demonstrate that the action should be subject to adaptive measures. Furthermore, when the analysis, synthesis, and evaluation of information learned from implementing an action indicates that no benefit results from the undertaken action, resources should no longer be spent on that action no matter how popular the action might be.

Decisions made within the adaptive management process for ecosystem restoration and water management actions should be made by decision makers for the entity responsible for implementing adaptive management. Adaptive management decisions relevant to revising and updating the Delta Plan will be made by the Council.
Appendix 2A
Transparency in Water Contracting: Water from the SWP

Note: All content of this appendix is newly adopted.

1. **Purpose:** The purpose of these guidelines is to describe the process for DWR's review of proposed permanent transfers of State Water Project Annual Table A Amounts and, by so doing, provide disclosure to SWP contractors and to the public of DWR's process and policy for approving permanent transfer of SWP Annual Table A Amounts. Such disclosure should assist contractors in developing their transfer proposals and obtaining DWR review expeditiously, and assist the public in participating in that review.

2. **Coverage:** These guidelines will apply to DWR's approval of proposed permanent transfers of water among existing SWP contractors and, if and when appropriate, to proposed permanent transfers of water from an existing SWP contractor to a new SWP contractor.

3. **Interpretation:** These guidelines are in furtherance of the State policy in favor of voluntary water transfers and shall be interpreted consistent with the law, including but not limited to Water Code Section 109, the Burns-Porter Act, the Central Valley Project Act, the California Environmental Quality Act, area of origin laws, the public trust doctrine, and with existing contracts and bond covenants. These guidelines are not intended to change or augment existing law.

4. **Revisions:** Revisions may be made to these guidelines as necessary to meet changed circumstances, changes in the law or long-term water supply contracts, or to address conditions unanticipated when the guidelines are adopted. Revisions shall be in accordance with the Settlement Agreement.
5. **Distribution:** The transfer guidelines shall be published by DWR in the next available edition of Bulletin 132, and also as part of the biennial disclosure of SWP reliability as described in the Settlement Agreement.

6. **Contract Amendment:** Permanent transfers of SWP water are accomplished by amendment of each participating contractor's long-term water supply contract. The amendment consists of amending the Table A upwards for a buying contractor and downwards for a selling contractor. The amendment shall be in conformity with all provisions of the long-term water supply contracts, applicable laws, and bond covenants. Other issues to be addressed in the contract amendment will be subject to negotiation among DWR and the two participating contractors. The negotiations will be conducted in public, pursuant to the Settlement Agreement and Notice to State Water Project Contractors Number 03-10.

7. **Financial Issues:** The purchasing contractor must demonstrate to DWR's satisfaction that it has the financial ability to assume payments associated with the transferred water. If the purchasing entity was not a SWP contractor as of 2001, special financial requirements pertain as described below, as well as additional qualifications.

8. **Compliance with CEQA:** Consistent with CEQA, the State's policy to preserve and enhance environmental quality will guide DWR's consideration of transfer proposals (Public Resources Code Section 21000). Identification of the appropriate lead agency will be based on CEQA, the CEQA Guidelines, and applicable case law, including *PCL v. DWR*. CEQA requires the lead agency at a minimum to address the feasible alternatives to the proposed transfer and its potentially significant environmental impacts (1) in the selling contractor's service area; (2) in the buying contractor's service area; (3) on SWP facilities and operations; and (4) on the Delta and areas of origin and other regions as appropriate. Impacts that may occur outside of the transferring SWP contractors' service areas and on fish and wildlife shall be included in the environmental analysis. DWR will not approve a transfer proposal until CEQA compliance is completed. The lead agency shall consult with responsible and trustee agencies and affected cities and counties and, when DWR is not the lead agency, shall provide an administrative draft of the draft EIR or Initial Study/Negative Declaration to DWR prior to the public review period. A descriptive narrative must accompany a checklist, if a checklist is used. The lead agency shall conduct a public hearing on the EIR during the public comment period and notify DWR's State Water Project Analysis Office of the time and place of such hearing in addition to other notice required by law.

9. **Place of Use:** The purchasing contractor must identify the place and purpose of use of the purchased water, including the reasonable and beneficial use of the water.
Typically, this information would be included in the environmental documentation. If a specific transfer proposal does not fit precisely into any of the alternatives listed below, DWR will use the principles described in these Guidelines to define the process to be followed. The information to be provided under this paragraph is in addition to the CEQA information described in Paragraph 8 of these guidelines.

a. If the place of use is within the contractor’s service area, the contractor should disclose the purpose of the transferred water, such as whether the water is being acquired for a specific development project, to enhance overall water supply reliability in the contractor’s service area, or some other purpose. If the transferred water is for a municipal purpose, the contractor should state whether the transfer is consistent with its own Urban Water Management Plan or that of its member unit(s) receiving the water.

b. If the place of use is outside the contractor’s service area, but within the SWP authorized place of use, and service is to be provided by an existing SWP contractor, then, in addition to Paragraph 9(a) above, the contractor should provide DWR with copies of LAFCO approval and consent of the water agency with authority to serve that area, if any. In some instances, DWR’s separate consent is required for annexations in addition to the approval for the transfer.

c. If the place of use is outside the SWP authorized place of use and service is to be provided by an existing SWP contractor, the contractor should provide information in Paragraph 9(a) and 9(b). Prior to approving the transfer, DWR will consider project delivery capability, demands for water supply from the SWP, and the impact, if any, of the proposed transfer on such demand. If DWR approves the transfer, DWR will petition State Water Resources Control Board for approval of expansion of authorized place of use. Water will not be delivered until the place of use has been approved by the SWRCB and will be delivered in compliance with any terms imposed by the SWRCB.

d. If the place of use is outside the SWP authorized place of use and service is not to be provided by an existing SWP contractor, DWR will consider the transfer proposal as a proposal to become a new SWP contractor. Prior to adding a new SWP contractor, DWR will consider project delivery capability, demands for water supply from the SWP, and the impact, if any, of the proposed transfer on such demand. DWR will consult with existing SWP contractors regarding their water supply needs and the proposed transfer. In addition to the information in Paragraph 9(a), 9(b), and 9(c), the new contractor should provide information similar to that provided by the original SWP contractors in the 1960’s Bulletin 119 feasibility report addressing hydrology, demand for water supply, population growth, financial feasibility, etc.
DWR will evaluate these issues independently and ordinarily will act as lead agency for CEQA purposes. In addition, issues such as area of origin claims, priorities, environmental impacts and use of water will be addressed. The selling contractor may not be released from financial obligations. The contract will be subject to a CCP 860 validation action initiated by the new contractor. If DWR approves the transfer, DWR will petition the SWRCB for approval of expansion of authorized place of use. Water will not be delivered until the place of use has been approved by the SWRCB and will be delivered in compliance with any terms imposed by the SWRCB.

10. **DWR Discretion**: Consistent with the long-term water supply contract provisions, CEQA, and other provisions of law, DWR has discretion to approve or deny transfers. DWR’s exercise of discretion will incorporate the following principles:

   a. As required by CEQA, DWR as an agency with statewide authority will implement feasible mitigation measures for any significant environmental impacts resulting from a transfer if such impacts and their mitigation are not addressed by other public agencies and are within DWR’s jurisdiction.

   b. DWR will invoke “overriding considerations” in approving a transfer only as authorized by law, including but not limited to CEQA, and, to the extent applicable, the public trust doctrine and area of origin laws.

If you have any questions or need further information, please contact Dan Flory, Chief of DWR’s State Water Project Analysis Office, at (916) 653-4313 or Nancy Quan of his staff at (916) 653-0190.
NOTICE TO
STATE WATER PROJECT CONTRACTORS

NUMBER: 03-10

DATE: 7/3/03

FROM: [Signature]
INTERIM DIRECTOR, DEPARTMENT OF WATER RESOURCES

SUBJECT: Principles Regarding Public Participation Process in State Water Project Contract Negotiations


1. **Policy:** Given the importance of the State Water Project to the State of California, and the key role that the long-term water supply contracts play in the administration of the SWP, DWR agrees that public review of significant changes to these contracts is beneficial and in the public interest.

2. **Types of Activities to be Covered:** Project-wide contract amendments (i.e., contracts with substantially similar terms intended to be offered to all long-term SWP Contractors) and contract amendments to transfer Table A amounts between existing SWP contractors will not be offered to the contractors for execution unless DWR has first complied with the public participation process as described in Paragraphs (3), (4), (5), and (6).

3. **The Public Participation Process:**

   1) Negotiations will be conducted in public.

   2) The public will be provided with advance notice of the time and place of the negotiations.

   3) The public will be provided the opportunity to observe negotiations and comment in each negotiating session.

4. **Timing of Public Participation:** Public participation ordinarily will precede the formulation of the project description in the California Environmental Quality Act process in order to assure that the public participation is meaningful. When DWR is a responsible agency, (e.g., when existing SWP contractors agree to transfer Table A amounts between themselves), the public participation will be scheduled to facilitate coordination with the lead agency’s CEQA process.
5. **Activities That Will Not Be Subject to Public Participation:** Informal discussions prior to exchange of formal drafts and discussion of topics that are authorized to be kept confidential by law will not be subject to the public participation process.

6. **Contract Amendments Resulting From Litigation:** If litigation has been formally initiated, and settlement negotiations result in a proposal to adopt project-wide amendments to settle the litigation, all proposed contract amendments shall be subject to the public participation process before they are approved by DWR.

Notices of public negotiations will be put on the DWR website.

If you have any questions or need further information, please contact Dan Flory, Chief of DWR's State Water Project Analysis Office, at (916) 653-4313, or Nancy Quan of his staff at (916) 653-0190.
Appendix 2B
Transparency in Water Contracting: Water from the CVP

Note: All content of this appendix is newly adopted.
SEC. 226: Public Participation

Section 9 of the Reclamation Project Act of 1939 (43 U.S.C. 485h) is amended by adding at the end the following new subsection:

“(f) No less than sixty days before entering into or amending any repayment contract or any contract for the delivery of irrigation water (except any contract for the delivery of surplus or interim irrigation water whose duration is for one year or less) the Secretary shall—
“(1) publish notice of the proposed contract or amendment in newspapers of general circulation in the affected area and shall make reasonable efforts to otherwise notify interested parties which may be affected by such contract or amendment, together with information indicating to whom comments or inquiries concerning the proposed actions can be addressed; and
“(2) provide an opportunity for submission of written data, views and arguments, and shall consider all substantive comments so received.”
Title 34, Public Law 102-575

Central Valley Project Improvement Act

Section 3405.

Water Transfers, Improved Water Management and Conservation
The Law

Section 3405. Water Transfers, Improved Water Management & Conservation

(a) Water Transfers.--In order to assist California urban areas, agricultural water users, and others in meeting their future water needs, subject to the conditions and requirements of this subsection, all individuals or districts who receive Central Valley Project water under water service or repayment contracts, water rights settlement contracts or exchange contracts entered into prior to or after the date of enactment of this title are authorized to transfer all or a portion of the water subject to such contract to any other California water user or water agency, State or Federal agency, Indian Tribe, or private non-profit organization for project purposes or any purpose recognized as beneficial under applicable State law. Except as provided herein, the terms of such transfers shall be set by mutual agreement between the transferee and the transferor.

(1) Conditions for Transfers.--All transfers to Central Valley Project water authorized by this subsection shall be subject to review and approval by the Secretary under the conditions specified in this subsection. Transfers involving more than 20 percent of the Central Valley Project water subject to long-term contract within any contracting district or agency shall also be subject to review and approval by such district or agency under the conditions specified in this subsection:

(A) No transfer to combination of transfers authorized by this subsection shall exceed, in any year, the average annual quantity of water under contract actually delivered to the contracting district or agency during the last three years of normal water delivery prior to the date of enactment of this title.

(B) All water under the contract which is transferred under authority of this subsection to any district or agency which is not a Central Valley Project contractor at the time of enactment of this title shall, if used for irrigation purposes, be repaid at the greater of the full-cost or cost of service rates, or, if the water is used for municipal and industrial purposes, at the greater of the cost of service or municipal and industrial rates.

(C) No transfers authorized by this subsection shall be approved unless the transfer is between a willing buyer and a willing seller under such terms and conditions as may be mutually agreed upon.

(D) No transfer authorized by this subsection shall be approved unless the transfer is consistent with State law.
including but not limited to provisions of the California Environmental Quality Act.

(E) All transfers authorized by this subsection shall be deemed a beneficial use of water by the transferor for the purposes of section 8 of the Act of June 17, 1902, 32 Stat. 390, 43 U.S.C. 372.

(F) All transfers entered into pursuant to this subsection for uses outside the Central Valley Project service area shall be subject to a right of first refusal on the same terms and conditions by entities within the Central Valley Project service area. The right of first refusal must be exercised within ninety days from the date that notice is provided of the proposed transfer. Should an entity exercise the right of first refusal, it must compensate the transferee who had negotiated the agreement upon which the right of first refusal is being exercised for that entity's total costs associated with the development and negotiation of the transfer.

(G) No transfer authorized by this subsection shall be considered by the Secretary as conferring supplemental or additional benefits on Central Valley Project water contractors as provided in section 203 of Public Law 97-293 (43 U.S.C. 390(cc)).

(H) The Secretary shall not approve a transfer authorized by this subsection unless the Secretary has determined, consistent with paragraph 3405(a) (2) of this title, that the transfer will not violate the provisions of this title or other Federal law and will have no significant adverse effect on the Secretary's ability to deliver water pursuant to the Secretary's Central Valley Project contractual obligations or fish and wildlife obligations under this title because of limitations in conveyance or pumping capacity.

(I) The water subject to any transfer undertaken pursuant to this subsection shall be limited to water that would have been consumptively used or irretrievably lost to beneficial use during the year or years of the transfer.

(J) The Secretary shall not approve a transfer authorized by this subsection unless the Secretary determines, consistent with paragraph 3405(a) (2) of this title, that such transfer will have no significant long-term adverse impact on groundwater conditions in the transferor's service area.

(K) The Secretary shall not approve a transfer unless the Secretary determines, consistent with paragraph 3405(a) (2) of this title, that such transfer will have no unreasonable impact on the water supply, operations, or financial
conditions of the transferor's contracting district or agency or its water users.

(L) The Secretary shall not approve a transfer if the Secretary determines, consistent with paragraph 3405(a) (2) of this title, that such transfer would result in a significant reduction in the quantity or decrease in the quality of water supplies currently used for fish and wildlife purposes, unless the Secretary determines pursuant to finding setting forth the basis for such determination that such adverse effects would be more than offset by the benefits of the proposed transfer. In the event of such a determination, the Secretary shall develop and implement alternative measures and mitigation activities as integral and concurrent elements of any such transfer to provide fish and wildlife benefits substantially equivalent to those lost as a consequence of such transfer.

(M) Transfers between Central Valley Project contractors within countries, watersheds, or other areas of origin, as those terms are utilized under California law, shall be deemed to meet the conditions set forth in subparagraphs (A) and (I) of this paragraph.

(2) Review and Approval of Transfers.--All transfers subject to review and approval under this subsection shall be reviewed and approved in a manner consistent with the following:

(A) Decisions on water transfers subject to review by a contracting district or agency or by the Secretary shall be rendered within ninety days of receiving a written transfer proposal from the transferee or transferor. Such written proposal should provide all information reasonably necessary to determine whether the transfer complies with the terms and conditions of this subsection.

(B) All transfers subject to review by a contracting district or agency shall be reviewed in a public process similar to that provided for in section 226 of Pub. L. 97-293.

(C) The contracting district or agency or the Secretary shall approve all transfers subject to review and approval by such entity if such transfers are consistent with the terms and conditions of this subsection. To disapprove a transfer, the contracting district or agency or the Secretary shall inform the transferee and transferor, in writing, why the transfer does not comply with the terms and conditions of this subsection and what alternatives, if any, could be included so that the transfer would reasonably comply with the requirements of this subsection.

(D) If the contracting district or agency or the Secretary fails to approve or disapprove a proposed transfer within ninety
days of receiving a complete written proposal from the transferee or transferor, then the transfer shall be deemed approved.

(3) Transfers executed after September 30, 1999 shall only be governed by the provisions of subparagraphs 3405(a) (1) (A) -(C), (E), (G), (H), (I), (L), and (M) of this title, and by State law.

(f) Increased Revenues.--All revenues received by the Secretary as a result of the increased repayment rates applicable to water transferred from irrigation use to municipal and industrial use under subsection 3405(a) of this section, and all increased revenues received by the Secretary as a result of the increased water prices established under subsection 3405(d) of this section, shall be covered to the Restoration Fund.

Section 3407(d)(2)(a). Restoration Fund

(d) Adjustment and Assessment of Mitigation and Restoration Payments.--

(1) In assessing the annual payments to carry out subsection (c) of this section, the Secretary shall, prior to each fiscal year, estimate the amount that could be collected in each fiscal year pursuant to subparagraphs 2(A) and (B) of this subsection. The Secretary shall decrease all such payments on a proportionate basis from amounts contained in the estimate so that an aggregate amount is collected pursuant to the requirements of paragraph (c) (2) of this section.

(2) The Secretary shall assess and collect the following mitigation and restoration payments, to be covered to the Restoration Fund, subject to the requirements of paragraph (1) of this subsection:

(A) The Secretary shall require Central Valley Project water and power contractors to make such additional annual payments as are necessary to yield, together with all other receipts, the amount required under paragraph (c) (2) of this subsection; Provided, That such additional payments shall not exceed $30,000,000 (October 1992 price levels) on a three-year rolling average basis; Provided further, That such additional annual payments shall be allocated so as not to exceed $6.00 per acre-foot (October 1992 price levels) for agricultural water sold and delivered by the Central Valley Project, and $12.00 per acre-foot (October 1992 price levels) for municipal and industrial water sold and delivered by the Central Valley Project;

Provided further, that the charge imposed on agricultural water shall be reduced, if necessary, to an amount within the probable ability of the water users to pay as determined and adjusted by the Secretary no less than every five years, taking into account the benefits resulting from implementation of this title; Provided further, That the Secretary shall impose an additional annual charge of $25.00 per acre-foot (October
1992 price levels) for Central Valley Project water sold or transferred to any State or local agency or other entity which has not previously been a Central Valley Project customer and which contracts with the Secretary or any other individual or district receiving Central Valley Project water to purchase or otherwise transfer any such water for its own use for municipal and industrial purposes, to be deposited in the Restoration Fund; And Provided further, That upon the completion of the fish, wildlife, and habitat mitigation and restoration actions mandated under section 3406 of this title, the Secretary shall reduce the sums described in paragraph (c) (2) of this section to $35,000,000 per year (October 1992 price levels) and shall reduce the annual mitigation and restoration payment ceiling established under this subsection to $15,000,000 (October 1992 price levels) on a three-year rolling average basis. The amount of the mitigation and restoration payment made by Central Valley Project water and power users, taking into account all funds collected under this title, shall, to the greatest degree practicable, be assessed in the same proportion, measured over a ten-year rolling average, as water and power users' respective allocations for repayment of the Central Valley Project.

For additional information, please contact CVPIA Program Manager (916) 978-5190
February 4, 2011

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Appendix 3
Habitat Restoration:

Note: All content of this appendix is newly adopted.

* The Council adopts this document as part of Section 5006. It therefore has regulatory effect despite the markings on the document indicating it is a ‘draft’. 
II. Habitats

ERPP Goal 4 (Habitats) is to protect and/or restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, recreation, scientific research, and aesthetics. The ERPP identified a number of key habitat types for which conservation and restoration would be pursued in the Delta. These habitat types are continuing to be reviewed and evaluated as a part of various habitat conservation plans in terms of the natural communities they seek to conserve, and within the ERP. As these evaluations are completed, scientists and managers will have a better understanding of these natural communities, and will be better able to monitor status and trends in these natural communities at a regional scale, as well as build this information into future management plans.

There were two strategies in the Delta Vision Strategic Plan associated with the creation and restoration of habitat: Strategy 3.1, “Restore large areas of interconnected habitats—on the order of 100,000 acres—within the Delta and its watershed by 2100”; and Strategy 3.2, “Establish migratory corridors for fish, birds, and other animals along selected Delta river channels”. These two strategies describe actions regarding inundation of floodplain areas, restoration of tidal and riparian habitat, and protection of grasslands and farmlands.

Development of the Delta Conservation Strategy Map. This element in the Conservation Strategy contributes to identification of restoration opportunities within the Delta, primarily based on land elevations with consideration of current urban land use constraints (Figure 4). Existing non-urban land uses, infrastructure, and other constraints at these locations were not considered for this map. These features will be addressed in future analyses of site-specific proposals. Figure 4 presents existing elevations in the Delta, which we consider a starting point for developing priorities for habitat restoration. Several broad habitat types were identified for restoration and have been classified according to three ranges of land elevation: upland areas, intertidal areas, and subsided lands/deep open water areas. Appendix E provides a crosswalk between habitat categories in this Conservation Strategy for the Delta and those in the ERP Plan.

In accordance with the recommendations in the Delta Vision Strategic Plan and in light of expected sea level rise, the areas of the Delta that are of highest priority for restoration include lands that are in the existing intertidal range, floodplain areas that
can be seasonally inundated, and transitional and upland habitats. Assuming a rise in sea level of approximately 55 inches over the next 50-100 years (Cayan et al. 2009), these areas would become shallow subtidal, seasonally inundated floodplain, and intertidal and upland habitats respectively. The next highest priority for restoration to tidal marsh would be lands below the intertidal range that are not highly subsided, and are within the range of feasibility for subsidence reversal projects. The lower elevation boundary of subsided lands appropriate for tidal marsh restoration has not been established, and may vary depending on location, configuration, availability of dredge spoils, and other factors that may promote or inhibit soil accretion associated with vegetation establishment. The most subsided lands would be the lowest priority for restoration to tidal marsh because raising elevations to the range appropriate for vegetation establishment is likely to be infeasible. However, these deeply subsided lands may have value as deep water habitat, although the benefits of increasing deep water habitat in the delta ecosystem have not been established.
Figure 4: Land elevations in the Delta and Suisun Marsh. Current land elevations will largely determine what habitat types can be accommodated.
**Delta Agricultural Lands.** It is important to note that a significant portion of the land within the Delta is dedicated to agricultural production, some of which is considered suitable for habitat restoration. Despite this, it is projected that much of this land will remain dedicated to agriculture into the future. Expected reductions in the availability of freshwater for all beneficial uses, due to changing precipitation patterns and extended droughts, means that sea level rise will increase salinity in some areas of the Delta, particularly the western and central Delta, even absent any natural perturbations such as an earthquake-induced levee breach of a major Delta island. There simply will not be enough freshwater in the future to continue maintaining all parts of the Delta as a freshwater pool year-round. It is therefore probable that Delta agriculture will adapt naturally over time to these expected changes in the Delta, through a combination of planting more drought- and salt-tolerant crops as agricultural biotechnology becomes more widely available; growing crops that can be used to produce ethanol or other biofuels; seeking more opportunities for cultural/economic diversification (e.g., ecotourism); and managing for wetlands and associated plants for wildlife benefits rather than agriculture and/or toward development of a carbon emissions offset trading market. Some U.S. Department of Agriculture programs already exist that provide financial incentives for landowners to manage natural areas on their properties, including but not limited to the Wildlife Habitat Incentives Program, the Environmental Quality Incentives Program, and the Conservation Reserve Program. While largely successful in other States, funding for implementation of these programs in California must be augmented to make participation more attractive to landowners who face higher capital and production costs. ERP will continue to fund projects on agricultural lands which benefit wildlife and help ensure that agricultural properties are conserved.

**Delta Upland Areas.** Connectivity of existing habitat to higher elevation areas will be critical for Delta habitats and species with rising sea level, global warming, and regional climate change. As the sea level rises, existing intertidal habitat will become subtidal, and adjacent uplands will become intertidal. Additionally, adjacent higher elevation habitat will be critical for wildlife to escape flooding. Changes in regional climate are expected to result in precipitation patterns of more rain and less snow, shifting tributary...
peak runoff from spring to winter, making extreme winter runoff events more frequent
and intense, and bringing about longer dry periods in summer. In light of these
expected changes, and ongoing conversion of open space lands to urban uses, some of
these higher elevation areas will be expected to accommodate additional flood flows in
new or expanded floodplain areas.

Upland areas in the Delta are best
categorized as lands well above current
sea level (i.e., greater than five feet in
elevation, depending on location). Aquatic
habitats in this category include seasonally-
inundated floodplain, seasonal wetlands
(including vernal pools), and ponds, while
terrestrial habitats in this category include
riparian areas, perennial grasslands, and
inland dune scrub, as well as agricultural
lands. Protecting and creating a mosaic of
different upland habitat types that are well
distributed, and connected to other natural
communities is important for maintaining

genetic diversity of the numerous species
which use these areas for all or part of their
life cycles. The aquatic and terrestrial habitat
types that comprise upland areas often co-
occur (e.g., agricultural lands that are
seasonally inundated to benefit waterfowl,
and perennial grasslands that support vernal
pools). Thus, this habitat category highlights
the importance of preserving and enhancing
a diversity of habitats in support of numerous species and ecological processes, as well
as allowing the system to respond to drivers of change such as sea level rise.

The rationales for protection and enhancement of seasonal wetlands, vernal pools,
riparian areas, perennial grasslands, and inland dune scrub are contained in the ERPP,
and the reader is encouraged to refer to these volumes for more information (CALKED
2000b). For the purposes of this Conservation Strategy, the discussion on restoring
upland habitats will be focused on seasonally-inundated floodplains and protection of
agricultural and open space lands for wildlife-compatible uses.

With increasing sea level, global warming, and regional climate change, uplands
adjacent to Delta tidal fresh and brackish wetlands will be important for future uphill
colonization of these wetlands. In light of these expected changes, protection of
uplands from ongoing conversion to urban uses should be a high priority to allow
adaptation to climate change and maintain sustainable natural aquatic communities into
the future.

Stage 2 Actions for Upland Areas:

Action 1: Acquire land and easement interests
from willing sellers in the East and South Delta
that will accommodate seasonal floodplain areas,
and shifts in tidal and shallow subtidal habitats
due to future sea level rise.

Action 2: Conduct research to determine scale
and balance of flow, sediment, and organic
material inputs needed to restore riverine
ecosystem function.

Action 3: Develop a better understanding of
species-habitat interactions, species-species
interactions, and species responses to variable
ecosystem conditions in order to better determine
natural versus human-induced responses of
upland habitat restoration.

Action 4: Determine contaminant and runoff
impacts of agriculture and urban areas, and
develop predictions of effects on the ecosystem
from future expansion of these land uses.

Action 5: Restore large-scale riparian vegetation
along waterways wherever feasible, including
opportunities for setback levees.
Much has been learned since 2000 about creating habitats in upland areas, particularly with respect to seasonally-inundated floodplains and their importance to many of the Delta’s aquatic species. As knowledge has increased, the risk and uncertainty associated with restoring this habitat is decreasing. Thus, restoration of seasonally-inundated floodplains is a very high priority for the Delta in the near term.

**Delta Floodplain.** A natural floodplain is an important component of rivers and estuaries that allows many essential ecological functions to occur. Healthy floodplains are morphologically complex. They include backwaters, wetlands, sloughs, and distributaries that carry and store floodwater. Floodplain areas can constitute islands of biodiversity within semi-arid landscapes, especially during dry seasons and extended droughts. The term *floodplain* as used here means the generally flat area adjoining rivers and sloughs that are inundated every 1.5 to 2 years when flows exceed the capacity of the channel (bank full discharge). Peak flows in winter and spring that occur every 1.5 to 2 years are considered by river geomorphologists to be the “dominant discharge” that contributes the most to defining the shape and size of the channel and the distribution of sediment, bar, and bed materials. Larger flood events can cause major changes to occur, but they do not happen often enough to be the decisive factor in river geomorphology.

Floodplain areas have the potential to support highly productive habitats, as they represent a heterogeneous mosaic of habitats including riparian habitat, freshwater tidal marsh, seasonal wetlands, perennial aquatic, and perennial grassland habitats, in addition to agricultural lands. During inundation floodplains are used by numerous native fish for spawning and early growth (Moyle 2002). There has been extensive research on the Yolo Bypass and lower Cosumnes River, in addition to some research in the Sutter Bypass, indicating that native resident and migratory fish show a positive physiological response (i.e., enhanced growth and fitness) when they have access to floodplain habitats (Moyle et al. 2004, Ribeiro et al. 2004, Moyle et al. 2007), which likely benefits them as they complete subsequent stages of their respective life cycles. Inundated floodplain areas provide important spawning and rearing habitat for splittail and rearing habitat for juvenile Chinook salmon (Sommer et al. 2001, Sommer et al. 2002, Moyle et al. 2007). Splittail need about 30 consecutive days of floodplain inundation to produce good survival through the larval stage and survival improves with longer durations (Moyle et al. 2004). Without access to adequate floodplain spawning habitat, splittail reproduction declines drastically as seen during the late 1980s and early-1990s.

Managing the frequency and duration of floodplain inundation during the winter and spring, followed by complete drainage by the end of the flooding season, could favor native fish over non-natives (Moyle et al. 2007, Grimaldo et al. 2004) and reduce nuisance insect problems. Frequency, timing, and duration of inundation are important factors that influence ecological benefits of floodplains. To favor splittail recruitment and benefit salmon fry and smolt growth, DFG recommends during above normal and wet years, once 10 days of floodplain inundation have been achieved based on runoff and discharge from upstream reservoirs between January 1 and May 30, then reservoir
discharges should be continued to maintain uninterrupted inundation for at least 30 days in the Yolo Bypass and at suitable locations in the Sacramento River or the San Joaquin River (DFG 2010b).

Studies on the Cosumnes and Sacramento Rivers indicate that dynamic processes are needed to support complex dynamic riparian habitats and upland systems which form the floodplain habitat (Moyle et al. 2007). Native plants and animals have adapted to the random brief floodplain events that are characteristic of California’s hydrology. Riparian habitats would be a component of these future restoration actions. Extant riparian habitats exist along levees and at the higher elevations in intertidal habitats, and in floodplain habitats – usually on fluvial soils or where levees are created with a mineral soil. The voluntary recruitment of this habitat type on Prospect Island and the higher elevation areas of Liberty Island and Little Holland Tract underscore the proclivity of natural restoration when proper soil conditions and elevation occur.

Research on the Cosumnes River also shows the many ecosystem benefits that floodplains provide. The Cosumnes River is the only remaining unregulated river on the western slope of the Sierra Nevada. The Cosumnes River Preserve comprises 46,000 acres. The free-flowing nature of the river allows frequent and regular winter and spring overbank flooding that fosters the growth of native vegetation and the wildlife dependent on those habitats. In addition to the value of floodplain habitat to the Delta’s native species, floodplains are believed to enhance the estuarine food web, as they support high levels of primary and secondary productivity by increasing residence time and nutrient inputs into the Delta (Sommer et al. 2004). Ahearn et al. (2006) found that floodplains that are wetted and dried in pulses can act as a productivity pump for the lower estuary. With this type of management, the floodplain exports large amounts of Chlorophyll a to the river. Floodplain habitat on the Cosumnes River Preserve has been shown to provide many benefits to native fish (Swenson et al. 2003, Ribeiro et al. 2004, Grosholz and Gallo 2006, Moyle et al. 2007).

Because floodplain areas are inundated only seasonally, many other habitat types that occur in upland areas can be accommodated on floodplains when high winter and early spring flows are not present. The Department of Water Resources Flood Protection Corridor Program provides grant funding to local agencies and nonprofit organizations for nonstructural flood management projects that include wildlife habitat enhancement and/or agricultural land preservation, and acquisition of flood easements. Such easements provide a way to bring floodplain benefits to species seasonally, while also

**Stage 2 Actions for Floodplains:**

**Action 1:** Continue coordination with Yolo Basin Foundation and other local groups to identify, study, and implement projects on public or private land with willing participants, to create regionally significant improvements in habitat and fish passage.

**Action 2:** Continue implementing projects at the Cosumnes River Preserve, such as restoring active and regular flooding regimes and flood riparian forest habitat; measuring flora and fauna response to restoration; and monitoring surface and groundwater hydrology and geomorphic changes in restored areas.

**Action 3:** Pursue opportunities for land and easement acquisitions in the Yolo Bypass and along the lower Cosumnes and San Joaquin Rivers, which could be utilized as floodplain inundation areas in the near term or in the future.
accommodating agricultural production in summer, fall, and early winter. Delta crops such as rice, grains, corn, and alfalfa provide food for waterfowl and other terrestrial species, and, with appropriately timed plowing and harvest, may serve as surrogate habitat in the absence of historical habitat such as tidal marsh. From Highway 99 west to the Cosumnes River Preserve is a good example of an area that provides a wildlife-friendly agriculture mix. It is the largest conservation easement acquisition funded by ERP during Stage 1. The ERP also provided funding for planning activities or property acquisitions and restoration of wildlife friendly agriculture in the Yolo Bypass, along the Cosumnes River, and along the San Joaquin River near Mossdale Crossing.

Although the benefits of floodplains have been demonstrated, there are several cautions related to restoring seasonal floodplains:

- Restoration must incorporate as much natural connection with the river as possible, to reduce potential stranding of native fish. Large-scale flooding events also help reduce stranding by creating channels on the landscape which allow for natural drainage, and multiple pulse flows help ensure fish receive the migratory cues they need. Deep drainage canals or other unnatural scour holes deeper than a couple feet should be removed. Such areas remain too cool during drainage and don’t provide the emigration cues needed for most fishes.
- The periodic wetting and drying of floodplain areas make these areas especially prone to methylmercury production and transport. Within the context of the Delta Total Maximum Daily Load (TMDL) for methylmercury that is currently being developed, floodplain restoration activities should include the investigation and implementation of Best Management Practices (BMPs) to control methylmercury production and/or transport.

**Delta-Upland Transitional Corridor.** The establishment of a corridor of protected agricultural and natural lands is needed to protect valuable habitats and to facilitate the movement of wildlife between the the Delta’s Cache Slough area and the Denverton Slough in Suisun Marsh, this area currently contains a mosaic of perennial grasslands and vernal pool areas, and has been identified by local planners as having great potential for ecological benefits from restoration.

**Dune Scrub Habitat.** Two ERP grants have been used to fund surveys to locate potential habitat restoration sites capable of supporting Antioch dunes evening primrose, Contra Costa wallflower, and Lange’s metalmark butterfly. Potential areas were located and are being assessed for enhancement, but no enhancement has been funded nor have funds for annual monitoring and reporting been identified. Continued evaluation and enhancement of dune scrub habitat is needed during Stage 2 implementation.

**Delta and Suisun Marsh Intertidal Areas.** Tidal marshes across North America have been shown to play a critical role for native fish by providing improved foraging opportunities, increased growth, and refuge from predators (Boesch and Turner 1984, Baltz et al. 1993, Kneib 1997, Madon et al. 2001). The tidal marshes of the Delta have
received relatively little study; however, research conducted in the San Francisco Estuary and elsewhere along the Pacific coast has shown tidal marsh benefits to native fish, especially salmonids (Simenstad 1982, West and Zedler 2000, Bottom et al. 2005, Maier and Simenstad 2009).

Intertidal areas in the Delta are best characterized as lands between one and seven feet above sea level, depending on location (Figure 4). All lands in the intertidal range are assumed to have the ability to support some tidal marsh habitats (either brackish or freshwater) with associated mudflats, sloughs, channels, and other open water features. Some areas are capable of supporting large areas of contiguous habitat, and others may support only small patches (e.g., mid-channel islands and shoals). Properly functioning tidal marsh habitats have subtidal open water channels with systems of dendritic and progressively lower-order intertidal channels that dissect the marsh plain. These diverse habitats provide structure and processes that benefit both aquatic and terrestrial species.

ERPP Vision for Saline Emergent Wetland: Increase the area and protect the quality of existing saline emergent wetlands from degradation or loss. Wetland habitat will be increased to assist in the recovery of special-status plant, fish, and wildlife populations. Restoration will provide high-quality habitat for other fish and wildlife dependent on the Bay-Delta.

ERPP Vision for Fresh Emergent Wetland: Increase the area and improve the quality of existing fresh emergent wetlands from degradation or loss and increase wetland habitat. Achieving this vision will assist in the recovery of special-status plant, fish, and wildlife populations, and provide high-quality habitat for other fish and wildlife dependent on the Bay-Delta.

The rationales for protection and enhancement of fresh and brackish tidal marsh areas are contained in the ERPP, and the reader is encouraged to refer to these volumes for more information (CALFED 2000a). For the purposes of this Conservation Strategy, the discussion on restoring habitats in intertidal areas will focus on what has been learned about the importance of these areas since 2000, particularly as it relates to various species’ use of tidal marsh areas and the role of these areas in enhancing the aquatic food web.

Studies of species’ use of tidal marsh habitat in the Delta are limited, but ERP and other programs have conducted several studies since the ROD that continue to augment knowledge regarding the role of intertidal habitats for desirable aquatic species. The largest effort to study tidal marsh habitat in the Delta and its benefits to native fish was a series of projects known as the BREACH studies (Simenstad et al 2000), which investigated geomorphology, sedimentation, and vegetation at four reference sites and six restored tidal marsh sites in the Delta. Of the one reference and three restored sites sampled for fish and invertebrates, relative density of both native and introduced fish species was higher at the reference marsh (Simenstad et al. 2000). Although all of the sites were dominated by the introduced fish, the abundance of native fish was highest in winter and spring (Grimaldo et al. 2004). In stomach content analyses, all life stages of chironomids (midges) were shown to be a very important food source for fish, both adjacent to tidal marsh habitats and in open water areas. Chironomid association with marsh vegetation indicates the importance of this habitat to the aquatic food web.

Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions
Overall abundance of fish larvae was highest in marsh edge habitat when compared to shallow open water and river channels (Grimaldo et al. 2004). Unfortunately, the BREACH study sites are not representative of the Delta’s large historical marshes. Most sites are small and severely degraded areas located along the edge of levees or on small channel islands.

An example of an ongoing study of species use of tidal marsh within intertidal land elevations is the ongoing monitoring associated with restoration of Liberty Island, a 5,209-acre island in the northern Delta that breached naturally nearly ten years ago. The Liberty Island project provides a good example of passive restoration of various habitat types, including some deeper, open water, subtidal, areas at the southern end and freshwater emergent tidal marsh and sloughs with riparian habitat at the higher elevations at the northern end. Liberty Island’s sloughs are populated with otters, beavers, muskrats, and numerous species of ducks and geese. Native fish species using the area include Chinook salmon, splittail, Longfin and delta smelt, tule perch, Sacramento pike minnow, and starry flounder. In some areas, native species account for up to 21 percent of the fish collected; for reference, native species only account for approximately 2 to 10 percent elsewhere (Malamud-Roam et al. 2004). Ongoing monitoring at Liberty Island for almost eight years is showing that fish species assemblages at this restored area increasingly resemble assemblages at reference marsh sites. The ERP hopes to build upon the success of this restoration project by increasing the size of the project and developing a dendritic channel system on its interior (DFG 2008b).

In many estuaries of the Pacific Northwest, including the Columbia and Fraser river estuaries, Chinook salmon fry usually occupy shallow, near shore habitats including tidal marsh, where they feed and grow and adapt to salt water (Healey 1982; Levy and Northcote 1982; Simenstad et al. 1982). They often move far up into tidal wetlands on high tides, and may return to the same channels on several tidal cycles (Levy and Northcote 1982). In estuaries throughout Washington, subyearlings and fry occur mainly in marshes when these habitats are available (Simenstad et al. 1982). Tidal marsh restoration has been shown to result in recovery of life history diversity in the Salmon River estuary of Oregon. Tidal marsh habitat in this estuary had largely been lost due to diking by the early 1960s (Gray et al. 2002). In surveys conducted in the mid-1970s, Chinook salmon juveniles were found to rear in the estuary only to a limited extent during the spring and early summer months (Bottom et al. 2005b). Three sites in the estuary were restored to tidal action between 1978 and 1996 and by the early 2000s juvenile salmon were making extensive use of restored marsh habitats for rearing, with estuarine resident times up to several months (Bottom et al. 2005b). Tidal marsh restoration expanded life history variation in the salmon population; the amount of time spent rearing in the estuary was variable and juveniles moved into the ocean over a broad range of time and at a broad range of sizes (Bottom et al. 2005b). Chinook salmon show remarkable phenotypic plasticity in their ability to adapt to new locations and form multiple life history types from a single introduction of fish (Williams 2006); with restoration of tidal marsh in the Delta, Chinook salmon in the Sacramento and San Joaquin rivers may be able to regain varied life history types over time.
A number of additional studies are demonstrating that regardless of species actual use of tidal marsh areas, these habitats could be extremely important for their possible role in augmenting the Delta’s aquatic food web, particularly in the saline portion of the estuary.

- Tagging and stomach content studies show that Chinook salmon fry may use intertidal habitat. According to Williams (2006), tagged hatchery fry remain in the Delta up to 64 days and tend to occupy shallow habitats, including tidal marsh. Stomach contents of salmon rearing in the Delta are dominated by chironomids and amphipods, suggesting that juvenile salmon are associated with marsh food production. Juvenile salmon in the Delta also undergo substantial growth (Kjelson et al. 1982, Williams 2006). These findings coincide with studies elsewhere in the Pacific Northwest (Healey 1982, Levy and Northcote 1982, Simenstad et al. 1982), which found that Chinook salmon fry usually occupy shallow, near-shore habitats including tidal marshes, creeks, and flats, where they feed and grow and adapt to salt water (Healey 1982; Levy and Northcote 1982; Simenstad et al. 1982), and that they often move into tidal wetlands on high tides and return to the same channels on several tidal cycles (Levy and Northcote 1982). Also, in estuaries throughout Washington, subyearlings and fry occur mainly in marshes when these habitats are available (Simenstad et al. 1982). In fact, Healey (1982) identified freshwater tidal marshes as the most important habitat to juvenile salmon in the Pacific Northwest. More recently, in the Columbia River estuary, emergent tidal marsh has been shown to support the greatest abundance of insects and highest stomach fullness scores for juvenile salmon, with chironomids again being the dominant prey type (Lott 2004).

- In a study of carbon types and bioavailability, tidal marsh sloughs in Suisun Bay had the highest levels of dissolved, particulate, and phytoplankton-derived carbon (Sobczak et al. 2002). Chlorophyll a concentration, used as a measure of standing crop of phytoplankton, was highest in tidal sloughs and supports the greatest zooplankton growth rate (Mueller-Solger et al. 2002) when compared to other habitat types, such as floodplains and river channels. High levels of primary production (as measured by Chlorophyll a) seen in several regions in the interior of Suisun Marsh are likely due to high residence time of water, nutrient availability, and absence of non-native clams (DFG 2008b).

- Modeling (Jassby et al. 1993 and Cloern 2007) and empirical studies (Lopez et al. 2006) show that productivity from high-producing areas, such as marsh sloughs, is exported to other connected habitats. Phytoplankton biomass location is only weakly correlated with phytoplankton growth rates across several aquatic habitats. Therefore other processes, including mixing and transport, are important in determining phytoplankton distribution in the Delta. The data shows that Suisun Marsh plays a significant role in estuarine productivity by providing an abundant source of primary production and pelagic invertebrates, both of which are significantly depleted in bay and river channel areas (DFG 2008b).

Tidal marsh may also help improve the pelagic food web by reducing the concentration
of ammonium in the water. Ammonium has been shown to inhibit phytoplankton blooms in Suisun Bay and possibly other open-water habitats in the Delta by inhibiting the uptake of nitrate by diatoms (Wilkerson et al. 2006, Dugdale et al. 2007). In a nutrient-rich estuary in Belgium, tidal freshwater marsh was shown to transform or retain up to 40 percent of ammonium entering the marsh during a single flood tide (Gribsholt et al. 2005). Nitrification (the conversion of ammonium to nitrate) accounted for a large portion of the transformation (30 percent). Nitrification rate in the marsh system was measured at 4 to 9 times that which occurs in the adjacent water column (Gribsholt et al. 2005). Increased tidal marsh habitat may, therefore, improve the base of the aquatic food web in the Delta by increasing primary production within the marshes, and by increasing the ratio of nitrate to ammonia in the estuary.

At the outset of ERP, restoration of intertidal and shallow subtidal areas (at that time, termed “shallow water habitat”, defined as water less than two meters in depth at mean lower low water) was a very high priority, and based on what has been learned since 2000, continues to be a very high priority for the Delta. However, the extensive spread of non-native submerged aquatic vegetation (SAV) in intertidal and shallow subtidal areas renders them less suitable for native fish (Nobriga et al. 2005, Brown and Michniuk 2007, Nobriga and Feyrer 2007). Brown and Michniuk (2007) reported a long-term decline in native fish abundance relative to non-native fish. This decline in native fish abundance occurred coincident with the range expansion of non-native SAV (principally Egeria densa) and non-native black bass (centrarchids), both of which are discussed further in the Stressors section below. Predation by largemouth bass is one mechanism hypothesized to result in low native fish abundance where SAV cover is high (Brown 2003, Nobriga et al. 2005). Largemouth bass have a higher per-capita predatory influence than all other piscivores in SAV-dominated intertidal zones (Nobriga and Feyrer 2007). Restoration of Delta intertidal habitats must, therefore, be designed and managed to discourage non-native SAV, or native fish may not benefit from them (Grimaldo et al. 2004, Nobriga and Feyrer 2007).

In summary, restoration of tidal marsh areas in the Delta remains a very high priority for the ERP; however, several cautions must be kept in mind. A major concern is that restored tidal marsh would be colonized by non-native species, which would in turn limit the benefits to native species. Another potential constraint facing the restoration of intertidal habitats is the methylation of mercury in sediments. Therefore, restoration of tidal marsh within intertidal land elevations should be designed as large-scale experiments, and should be rigorously monitored to establish relationships between this habitat and species population abundance. As this information continues to be collected and synthesized, the risk and uncertainty associated with restoring this habitat are expected to decrease.

**Subsided Delta Lands and Deep Open Water Areas.** Subsided land areas in the Delta are best characterized as land well below current sea level (below approximately six feet in elevation), and include both terrestrial areas (islands that have subsided over time) and deep open water areas (subsided islands that flooded in the past and were never reclaimed). Aquatic habitats in this category include seasonal wetlands and
ponds that occur within subsided land areas, in addition to deep open water areas that occur on flooded islands such as Franks Tract and Mildred Island (also called pelagic habitat).

With increasing sea level, global warming, and regional climate change, the existing configuration of Delta levees and deeply subsided islands are not expected to remain intact over the long term. A forecast rise in sea level of approximately 55 inches over the next 50-100 years (Cayan et al. 2009) is expected to increase pressure on the Delta’s levee system. Changes in regional climate and the shift of tributary peak runoff from spring to winter are expected to make extreme winter runoff events more frequent and intense, further compounding pressure on Delta levees seasonally. In light of these expected changes, in addition to human-induced impacts (e.g., increased runoff from continued conversion of open space lands to urban uses), there is a considerably higher likelihood of Delta levee failure and subsequent island flooding in the future. ERP implementation must therefore adapt to these expected pressures, including planning for optimizing the value of newly-flooded deep islands for the aquatic species that may utilize them in the future.

Terrestrial areas in this category include mainly agricultural lands, some of which are not in active agricultural production. Central Valley Joint Venture (2006) recognizes that agricultural easements to maintain waterfowl food supplies and buffer existing wetlands from urban development may become increasingly important in basins where large increases in human populations are predicted. In addition, ongoing rice cultivation may help minimize subsidence. Subsidence reversal, carbon sequestration, and wildlife-friendly agricultural projects are appropriate on these deep islands in the near term, as they are expected to provide benefits to the local economy, wildlife, and waterfowl while protecting lands from uses that may be unsustainable over the longer term.

The rationales for protection and enhancement of seasonal wetlands and wildlife-friendly agriculture are contained in the ERPP, and the reader is encouraged to refer to these volumes for more information (CALFED 2000b). For the purposes of this document, the discussion on restoring habitats on subsided lands will be focused on subsidence reversal and carbon sequestration, and on continuing to research and restore deep open water areas for the Delta’s pelagic fish species, as these deep open water habitat types are known to be important, positively or negatively, for individual native pelagic fish species.

Delta Subsidence Reversal. The exposure of the bare peat soils to air causes oxidation and decomposition, which results in subsidence, or a loss of soil elevation, on Delta islands. Flooding these lands and managing them as wetlands reduces their exposure to oxygen, so there is less decomposition of organic matter, which stabilizes

Stage 2 Actions for Subsided Lands/Deep Open Water Areas:

Action 1: Implement wildlife-friendly agriculture and wetland projects.

Action 2: Secure easements and land interests on which subsidence reversal projects can occur.

Action 3: Continue research on the creation and management of deep open water areas (e.g., Liberty Island) to evaluate physical and biological properties and species use.
land elevations. Wetland vegetation cycles lead to biomass accumulation, which sequesters carbon and helps stop and reverse subsidence (Fujii 2007). As subsidence is reversed, land elevations increase and accommodation space (the space in the Delta that lies below sea level and is filled with neither sediment nor water), on individual islands is reduced (Mount and Twiss 2005). A reduction in accommodation space decreases the potential for drinking water quality impacts from salinity intrusion in the case of one or more levee breaks on deeply subsided Delta islands.

A pilot study on Twitchell Island funded by the ERP in the late 1990s investigated methods for minimizing or reversing subsidence. The study showed that by flooding soils on subsided islands approximately one foot deep, peat soil decomposition is stopped, and conditions are ideal for emergent marsh vegetation to become established. In the Twitchell Island pilot project, researchers saw some initial soil accumulation during the late 1990s and early 2000s, and noted that accretion rates accelerated and land surface elevation began increasing much more rapidly after about seven years, as plant biomass was accumulated over time. Land surface elevation is estimated to be increasing at an annual rate of around four inches, and is expected to continue to increase (Fujii 2007).

The USGS is interested in implementing a subsidence reversal program Delta-wide, given the results of their Twitchell Island pilot study. Such a program would involve offering financial incentives to landowners to create and manage wetland areas on their lands (Fujii 2007). Large-scale, whole-island approaches to reversing subsidence would be beneficial for multiple purposes. Programs that offer incentives for 10- or 20-year studies for subsidence reversal on large tracts of land could help improve Delta levee stability and reduce the risk of catastrophic failure. Assuming that accretion rates continue at about four inches annually, estimates suggest a 50 percent reduction in accommodation space in 50 years if subsidence could be pursued throughout the Delta. This reduction in accommodation space jumps to 99 percent over the next 100 years (Fujii 2007). Some deeply subsided lands could also be used as disposal sites for clean dredged sediments, providing local flood control improvements while helping raise land elevations on subsided islands more quickly. This accommodation space reduction, in addition to helping stabilize levees over the longer term, would create additional areas for restoration of additional tidal marsh habitat.

While the primary objectives of creating wetlands on deep Delta islands would be to reverse subsidence and sequester carbon, there would be significant ancillary benefits to wildlife such as waterfowl. Delta agricultural lands and managed wetland areas provide a vital component to Pacific Flyway habitat for migratory waterfowl by increasing the availability of natural forage, ensuring improved body condition and breeding success (CALFED 2000b).

**Deep Open Water Habitat.** All permanent aquatic habitats in the Delta are occupied by fish of some type. In planning for restoration of Delta aquatic habitats, it is important to consider which fish will occupy which habitat and when; and what type of benefits fish will gain from the habitat. Fish assemblages in the Delta, each with a distinct set of
environmental requirements, include native pelagic species (e.g., delta and longfin smelt), freshwater planktivores, dominated by non-native species such as threadfin shad and inland silverside; anadromous species (e.g., salmon and steelhead), slough-residents associated with beds of SAV (e.g., centrarchide), and freshwater benthic species (e.g., prickly sculpin) (Moyle and Bennett 2008). Habitat diversity is necessary to support multiple fish assemblages in the Delta. Restoration efforts need to focus on creating habitats required by desirable species, while avoiding habitats dominated by undesirable species.

With the increasing threats of levee failure from continuing land subsidence, exacerbated by sea level rise, higher seasonal runoff, and random events such as an earthquake, the Delta is likely to have more large areas of deep, open water in the future (Moyle and Bennett 2008). Important attributes to manage to increase habitat variability and provide improved water quality conditions include salinity, contaminant inputs, and connectivity to surrounding habitats (Moyle and Bennett 2008). Fish assemblages will respond differently to future environmental changes.

New open water habitats may also result from intentional activities on a smaller and more managed scale than whole-island flooding. The intentional removal of levees on islands at the periphery of the Delta in order to create marsh habitat on intertidal land elevations would result in open water below the tidal zone similar to that which is developing at Liberty Island. Exchange of materials between the restored tidal marsh and adjacent open water could result in higher productivity in open water habitat. As mentioned in the discussion on tidal marsh restoration, the potential for SAV dominated by non-native species to establish in new shallow water environments is a concern. On Liberty Island, SAV has not become a dominant component of the open water habitat. This may be a result of tidal flow velocities, wind-induced disturbance and high turbidities, or some other factor. Continuing research and monitoring of the Liberty Island project will improve understanding of the dynamics of a large island breach at the periphery of the Delta, and help plan for future marsh or open water restoration projects.

There are many uncertainties related to future characteristics of flooded island and open water habitats (Moyle and Bennett 2008). These include configuration and location of flooded islands; physical properties such as depth, turbidity, flow, and salinity; biological properties such as productivity of phytoplankton and copepods; and susceptibility to invasion by non-native species such as *Egeria densa*, centrarchids, and invasive non-native clams. Adaptive management, combined with large-scale experimentation on new open water habitat, would help to reduce uncertainties. This could occur through the planned flooding of at least one Delta island, or through an organized study plan that would go into effect in the event of an unplanned levee breach (Moyle and Bennett 2008).
Appendix 4
Elevation Map

Note: All content of this appendix is newly adopted.
Figure 4-1
Habitat Types Based on Elevation, Shown with Developed Areas in the Delta and Suisun Marsh
Source: Adapted from DFG 2011
Appendix 5
Recommended Areas for Prioritization and Implementation of Habitat Restoration Projects

Note: All content of this appendix is newly adopted.
Figure 5-1
Recommended Areas for Prioritization and Implementation of Habitat Restoration Projects
Source: DFG 2011
Appendix 6
Delta Primary and Secondary Zones and Suisun Marsh

Note: All content of this appendix is newly adopted.
Figure 6-1
Delta Primary and Secondary Zones and Suisun Marsh
Appendix 7
Delta Communities

Note: All content of this appendix is newly adopted.
Figure 7-1
Towns of Locke and Walnut Grove
Source: Sacramento County 2011
Figure 7-2
Town of Hood
Source: Sacramento County 2011, Sacramento County 2012, Sacramento County 2013
Figure 7-3
Town of Ryde
Source: Sacramento County 2011
Figure 7-5
Town of Knightsen
Source: Contra Costa County 2011
Figure 7-6
Town of Clarksburg
Source: Yolo County 2010
Figure 7-7
City of Isleton
Source: City of Isleton 2000
Figure 7-8
City of West Sacramento
Sources: City of Sacramento 2008, Sacramento County 2011, City of West Sacramento 2010
Figure 7-9
Town of Freeport and the City of Sacramento’s Sphere of Influence
Sources: City of Sacramento 2008, Sacramento County 2012
Figure 7-10
Cities of Stockton, Lodi, Lathrop, and Manteca and their Spheres of Influence
Sources: San Joaquin County 2008, City of Stockton 2011, City of Manteca 2012, City of Lathrop 2012
Figure 7-11
City of Tracy and its Sphere of Influence, and the Community of Mountain House
Sources: City of Tracy 2011, Mountain House Community Services District 2008, San Joaquin County 2008
Figure 7-12
Cities of Fairfield, Suisun City, and Benicia and their Spheres of Influence
Sources: City of Benicia 2003, City of Fairfield 2008, City of Suisun City 2011
Figure 7-13
City of Rio Vista and its Sphere of Influence
Source: City of Rio Vista 2001
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City of Benicia. 2003. General Plan land use designations within Suisun Marsh. Digitized into GIS format by AECOM from City of Benicia Land Use map in 2012.

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Appendix 8
Setback Levee Evaluation Areas

Note: All content of this appendix is newly adopted.
Figure 8-1
Setback Levee Evaluation Areas
Appendix C
Adaptive Management and the Delta Plan
The Sacramento-San Joaquin Delta Reform Act of 2009 seeks to provide a strong science foundation to inform decisions of the Delta Stewardship Council, seen in both provisions for a science program and an independent science board (Water Code section 85280):

85280 (a) The Delta Independent Science Board is hereby established in state government

85280 (a)(3) The Delta Independent Science Board shall provide oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta through periodic reviews of each of those programs that shall be scheduled to ensure that all Delta scientific research, monitoring, and assessment programs are reviewed at least once every four years.

85280 (b)(4) The mission of the Delta Science Program shall be to provide the best possible unbiased scientific information to inform water and environmental decisionmaking in the Delta. That mission shall be carried out through funding research, synthesizing and communicating scientific information to policymakers and decisionmakers, promoting independent scientific peer review, and coordinating with Delta agencies to promote science-based adaptive management. The Delta Science Program shall assist with development and periodic updates of the Delta Plan’s adaptive management program.

The Delta Reform Act requires the inclusion of science-based adaptive management in the Delta Plan as defined and stated in Water Code sections 85308(f) and 85052:

85308(f) Include a science-based, transparent, and formal adaptive management strategy for ongoing ecosystem restoration and water management decisions.

85052 “Adaptive management” means a framework and flexible decisionmaking process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives.

The Delta Reform Act also requires that the Delta Plan is based upon and implemented using the best available science:

85308 The Delta Plan shall meet all of the following requirements:

(a) Be based on the best available scientific information and the independent science advice provided by the Delta Independent Science Board.

(e) Where appropriate, recommend integration of scientific and monitoring results into ongoing Delta water management.

85302(g) In carrying out this section, the council shall make use of the best available science.
The Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act) requires a strong science foundation to inform Delta Stewardship Council (Council) decisions. This includes providing scientific expertise to support the Council and other agencies through the Delta Science Program and Delta Independent Science Board (Water Code section 85280). The Delta Reform Act also requires that the Delta Plan be based on and implemented using the best available science (Water Code sections 85308(a) and (e) and 85302(g)), and requires the use of science-based, transparent, and formal adaptive management strategies for ongoing ecosystem restoration and water management decisions (Water Code section 85308(f)).

**Best Available Science**

The Delta Reform Act requires the Council to make use of the best available science in implementing the Delta Plan. Best available science is specific to the decision being made and the timeframe available for making that decision. Best available science is developed and presented in a transparent manner consistent with the scientific process (Sullivan et al. 2006), including clear statements of assumptions, the use of conceptual models, description of methods used, and presentation of summary conclusions. Sources of data used are cited, and analytical tools used in analyses and syntheses are identified. Best available science changes over time, and decisions may need to be revisited as new scientific information becomes available. Ultimately, best available science requires scientists to use the best information and data to assist management and policy decisions. The processes and information used should be clearly documented and effectively communicated to foster improved understanding and decision making.

**Steps for Achieving the Best Science**

Science consistent with the scientific process includes the following elements:

- Well-stated objectives
- A clear conceptual or mathematical model
- A good experimental design with standardized methods for data collection
- Statistical rigor and sound logic for analysis and interpretation
- Clear documentation of methods, results, and conclusions

The best science is understandable; it clearly outlines assumptions and limitations. The best science is also reputable; it has undergone peer review conducted by active experts in the applicable field(s) of study. Scientific peer review addresses the validity of the methods used, the adequacy of the methods and study design in addressing study objectives, the adequacy of the interpretation of results, whether the conclusions are supported by the results, and whether the findings advance scientific knowledge (Sullivan et al. 2006).
There are several sources of scientific information and tradeoffs associated with each (Sullivan et al. 2006, Ryder et al. 2010). The primary sources of scientific information, in a generalized ranking of most to least scientific credibility for informing management decisions, include the following:

- Independently peer-reviewed publications including scientific journal publications and books (most desirable)
- Other scientific reports and publications
- Science expert opinion
- Traditional knowledge

Each of these sources of scientific information may be the best available at a given time and contain varying levels of understanding and uncertainty. These limitations should be clearly documented when scientific information is used as the basis for decisions.

Guidelines and Criteria

There have been several efforts to develop criteria for defining and assessing best available science. In 2004, the National Research Council Committee on Defining the Best Scientific Information Available for Fisheries Management prepared a report (National Research Council Report) that concluded guidelines and criteria must be defined in order to apply best available science in natural resource management (NRC 2004). Major findings and recommendations included establishing procedural and implementation guidelines to govern the production and use of scientific information. The guidelines were based on six broad criteria: relevance, inclusiveness, objectivity, transparency and openness, timeliness, and peer review.

Best available science for proposed covered actions and for use in the Delta Plan should be consistent with the guidelines and criteria in Table C-1. These criteria were adapted from criteria developed by the National Research Council. Proponents of covered actions should document their scientific rationale for applying the criteria in Table C-1 (i.e., the format used in a scientific grant proposal).

Table C-1
Criteria for Best Available Science

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
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<tbody>
<tr>
<td>Relevance</td>
<td>Scientific information used should be germane to the Sacramento-San Joaquin Delta (Delta) ecosystem and/or biological and physical components (and/or process) affected by the proposed decisions. Analogous information from a different region but applicable to the Delta ecosystem and/or biological and physical components may be the most relevant when Delta-specific scientific information is nonexistent or insufficient. The quality and relevance of the data and information used shall be clearly addressed.</td>
</tr>
<tr>
<td>Inclusiveness</td>
<td>Scientific information used shall incorporate a thorough review of relevant information and analyses across relevant disciplines. Many analysis tools are available to the scientific community (e.g., search engines and citation indices).</td>
</tr>
<tr>
<td>Objectivity</td>
<td>Data collection and analyses considered shall meet the standards of the scientific method and be void of nonscientific influences and considerations.</td>
</tr>
<tr>
<td>Transparency and openness</td>
<td>The sources and methods used for analyzing the science (including scientific and engineering models) used shall be clearly identified. The opportunity for public comment on the use of science in proposed covered actions is recommended. Limitations of research used shall be clearly identified and explained. If a range of uncertainty is associated with the data and information used, a mechanism for communicating uncertainty shall be employed.</td>
</tr>
</tbody>
</table>
### Table C-1

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
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<tr>
<td><strong>Timeliness</strong></td>
<td>Timeliness has two main elements: (1) data collection shall occur in a manner sufficient for adequate analyses before a management decision is needed, and (2) scientific information used shall be applicable to current situations. Timeliness also means that results from scientific studies and monitoring may be brought forward before the study is complete to address management needs. In these instances, it is necessary that the uncertainties, limitations, and risks associated with preliminary results are clearly documented.</td>
</tr>
<tr>
<td><strong>Peer review</strong></td>
<td>The quality of the science used will be measured by the extent and quality of the review process. Independent external scientific review of the science is most important because it ensures scientific objectivity and validity. The following criteria represent a desirable peer review process. Coordination of Peer Review. Independent peer review shall be coordinated by entities and/or individuals that (1) are not a member of the independent external review team/panel and (2) have had no direct involvement in the particular actions under review. Independent External Reviewers. A qualified independent external reviewer embodies the following qualities: (1) has no conflict of interest with the outcome of the decision being made, (2) can perform the review free of persuasion by others, (3) has demonstrable competence in the subject as evidenced by formal training or experience, (4) is willing to utilize his or her scientific expertise to reach objective conclusions that may be incongruent with his or her personal biases, and (5) is willing to identify the costs and benefits of ecological and social alternative decisions. When to Conduct Peer Review. Independent scientific peer review shall be applied formally to proposed projects and initial draft plans, in writing after official draft plans or policies are released to the public, and to final released plans. Formal peer review should also be applied to outcomes and products of projects as appropriate.</td>
</tr>
</tbody>
</table>

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a. McGarvey 2007  
c. National Research Council 2004  
d. Meffe et al. 1998  
e. Adapted from Meffe et al. 1998

It is recognized that differences exist among the accepted standards of peer review for various fields of study and professional communities. When applying the criteria for best available science in Table C-1, the Council recognizes that the level of peer review for supporting materials and technical information (such as scientific studies, model results, and documents) included in the documentation for a proposed covered action is variable and relative to the scale, scope, and nature of the proposed covered action. The Council understands that varying levels of peer review may be commonly accepted in various fields of study and professional communities.

### Adaptive Management

Adaptive management is defined in the Delta Reform Act as “a framework and flexible decisionmaking process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives” (Water Code section 85052). Adaptive management can be applied at a program, plan or project level.

Adaptive management is a strategy that provides for making management decisions under uncertain conditions using the best available science rather than repeatedly delaying action until more information is available. Adaptive management allows for continuous learning resulting in management decisions based on what was learned, rather than adopting a management strategy and implementing it without regard for scientific feedback or monitoring. Adaptive management is an approach to resources management that increases the likelihood of success in obtaining goals in a manner that is both economical and effective because it provides flexibility and feedback to manage natural resources in the face of often considerable uncertainty.
Barriers to Adaptive Management

Although there have been several attempts to develop and implement adaptive management strategies in the Bay-Delta system and elsewhere, most have been unsuccessfully implemented. Adaptive management is not easy, quick, or inexpensive (NRC 2010). An adaptive management strategy for the CALFED Ecosystem Restoration Program (ERP) was developed in 2000 (CALFED Bay-Delta Program 2000), but implementation of the program’s adaptive management elements was never achieved (Healey et al. 2008). Healey (2008) identified several barriers to implementing CALFED’s adaptive management strategies. One such barrier was the struggle to change the traditional agency approach to managing problems, which limited the ability to take essential steps outside of normal agency operations, such as pre-project modeling and identification of specific outcomes, along with post-project monitoring and evaluation. Other barriers to implementing adaptive management under CALFED’s ERP included a lack of secure funding and mechanisms for implementing large-scale adaptive management experiments, lack of stakeholder buy-in in the form of landowner assurances (e.g., economic viability and compensation for land use changes), changes in support for the projects under administration changes, and high implementation costs.

Additionally, the CALFED-funded Adaptive Management Forum Scientific and Technical Panel (Panel) (2004) identified both the regulatory environment along with human resources and communication as barriers to implementing adaptive management. They found that current permitting requirements for threatened and endangered species, water quality, flows and flow regimes, and floodway management and conveyance do not allow the design flexibility and speed of response required for adaptive management. To overcome this constraint, the Panel recommended that regulatory exemptions or special status need to be negotiated for innovative and creative approaches to adaptive management. The Panel also identified the need for specialized staff to design and implement adaptive management experiments, analyze and share the results of monitoring programs, and effectively communicate lessons learned. The Panel recommended recruiting specialized staff for these purposes as a means for overcoming this barrier.

CALFED’s struggle to implement its adaptive management strategies is not uncommon. Walters (2007) concluded that nearly all 100 adaptive management efforts examined worldwide failed to implement adaptive management. Three main factors contributing to the widespread implementation difficulties in adaptive management programs were identified: (1) failure of decision makers to understand why adaptive management programs are needed, (2) lack of leadership for the complex process of implementing an adaptive approach, and (3) inadequate funding for the increased ecological (and often economic) monitoring needed to successfully compare the outcomes of alternative policies (Walters 2007). To overcome each of these barriers, Walters (2007) recommends identifying and nurturing adaptive management leaders dedicated to successful implementation, creatively investing in innovative monitoring programs, and forcing decision makers to confront uncertainty and think carefully about how to reduce risks in decision making under conditions of uncertainty.

To be effective, governance to support and implement adaptive management in the Sacramento-San Joaquin Delta (Delta) must be flexible and have the capability to make timely changes to policies and practices in response to what is learned over time (e.g., the Delta Plan adaptive management approach described in Chapter 2). Governance for adaptive management should provide a decision-making structure that fosters communication among scientific experts, independent scientific reviewers, and the relevant decision-making authorities (e.g., State and federal fisheries agencies on issues related to aquatic ecosystem restoration), and provide a balanced approach to the involvement of interested stakeholders.

A Three-phase and Nine-step Adaptive Management Framework

The Council will use the three-phase and nine-step adaptive management framework on Figure C-1 that is described in detail below. The Council will use this framework to evaluate the usefulness of adaptive management for reviewing proposed covered actions involving ecosystem restoration and water management along with developing, implementing, and updating the Delta Plan (see Chapter 2). Ecosystem restoration and water management covered actions should include an adaptive management plan that considers all nine steps of this framework; however, they need not be rigidly included and implemented in the order described here and should not be used as a means to prevent action, but rather as
a tool to enhance decision making. The intent is to build logical and clear information exchange and
decision points into management actions that increase options and improve outcomes. In developing an
adaptive management plan, the best available science should be used to inform the various steps of the
adaptive management process.

Figure C-1
A Nine-step Adaptive Management Framework
The shading represents the three broad phases of adaptive management (Plan, Do, and Evaluate and Respond), and the boxes
represent the nine steps within the adaptive management framework. The circular arrow represents the general sequence of
steps. The additional arrows indicate possible next steps for adapting (e.g., revising the selected action based on what has been
learned). This framework and the description of each step are largely derived from Stanford and Poole (1996), CALFED Bay-
Delta Program (2000), Abal et al. (2005), and the Bay Delta Conservation Plan Independent Science Advisors on Adaptive
Management (2009).

Plan
The Plan phase of the adaptive management framework is presented as four steps.

1. Define/Redefine the Problem
The first step of effective adaptive management is to clearly define the problems that will be addressed in
the form of a problem statement. The problem statement should clearly link to program goals and to
specific objectives, which should be developed by proponents in an open manner. The boundaries of the problem (e.g., its geographic and temporal scales) should be defined in the problem statement.

2. Establish Goals and Objectives

Clear goals and objectives must be established by proponents of proposed covered actions for ecosystem restoration and water management, and be based on the best available science (see G P1 in Chapter 2). Goals are broad statements that propose general solutions. Objectives are more specific than goals, and are often quantitative, specific, narrative statements of desired outcomes, allowing evaluation of how well the objectives are being achieved.

3. Model Linkages between Objectives and Proposed Action(s)

Models formalize and apply current scientific understanding, develop expectations, assess the likelihood of success, and identify tradeoffs associated with different management actions. Models can be conceptual, statistical, physical, decision support, or simulation. Models link the objectives to the proposed actions and clarify why an intended action is expected to result in meeting its objectives. Models provide a road map for testing hypotheses through statements that describe the expected outcome of an action.

Both qualitative (conceptual) and quantitative models can effectively link objectives and proposed actions by illuminating if and how different actions meet specific objectives. Conceptual models are particularly useful for decision makers, scientists, and the public because they illustrate the most critical cause-and-effect pathways. Conceptual models provide an articulation of the hypotheses being tested and how various actions might achieve particular objectives. Conceptual models also help to develop performance measures, which are qualitative or quantitative information that tracks status and trends toward meeting objectives. Conceptual models should be used in adaptive management planning because they help explain how other types of models, research, and actions will be used to explore hypotheses and address specific existing and anticipated uncertainties.

Recent conceptual models developed specifically for the Delta include comprehensive models developed as part of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). The DRERIP models were designed to aid in the identification and evaluation of ecosystem restoration actions in the Delta, and include both ecosystem models (processes, habitats, and stressors) and species life history models. Another set of conceptual models was developed to plan the Interagency Ecological Program’s Pelagic Organism Decline (POD) investigations and to synthesize the POD results into “stories” about what may have happened to cause the rapid decline of multiple open-water fish species.

4. Select Action(s) (Research, Pilot, or Full-scale) and Develop Performance Measures

The process for selecting an action or several actions to meet objectives includes an evaluation of the best available science represented in the conceptual model. This evaluation should guide development of the action. Consideration should be given to the following:

- Level of the action(s) to be taken (research project, pilot-scale project, or full-scale project)
- Geographical and temporal scale of the action(s)
- Degree of confidence in the benefits
- Consequences of being wrong

The scale of the action selected should be informed by the certainty of the relevant scientific information, consider the reversibility of the action, and account for the potential cost of delaying larger-scale actions. For example, when the best available science cannot predict the outcome of an action with a reasonable degree of certainty, and irreversible consequences exist for incorrectly predicting the outcomes of an
action, further research or a pilot-scale action is likely more appropriate than a full-scale action, unless the cost of delaying a larger-scale action is very high (e.g., a species of concern goes extinct or urban water supplies are cut off). In some instances, choosing to take no action could be the best selection (when no foreseen benefit would result from a research, pilot-scale, or full-scale action). Where possible, the action(s) selected should test cause-and-effect relationships in the conceptual model so that the model can be adapted using the information learned from implementing the action(s).

Performance measures derive from goals and objectives, and help to address the status and trends of progress toward achieving the goals and objectives. Performance measures can be placed in three general classes:

- **Administrative**: performance measures that describe decisions made by policy makers and managers to finalize plans or approve resources (funds, personnel, projects) for implementation of a program or group of related programs
- **Output (also known as driver)**: performance measures that evaluate factors that may be influencing outcomes and include on-the-ground implementation and management actions
- **Outcome**: performance measures that evaluate ecosystem responses to management actions or natural outputs

The distinction between performance measure types is not rigid. In some cases, an outcome performance measure for one purpose may become an output performance measure for another purpose.

Development of informative performance measures is a challenging task. Performance measures must be designed to capture important trends and to address whether specific actions are producing expected results. Performance measures are selected based on the conceptual model. In addition, the monitoring plan should be designed so that the information collected supports performance measure analysis and reporting.

Efforts to develop performance measures in complex and large-scale systems with many ecosystem types like the Delta are commonly multiyear endeavors; however, initial performance measures provide value for initial assessments of progress made in the interim. The process for developing performance measures should address the rationale for each performance measure, metrics, method for analysis, baseline and reference conditions, expected outcomes, timeline for evaluation, and a communication/visualization element. The development of performance measures should be informed by the best available science and involve key stakeholders.

**Do**

The *Do* phase of adaptive management includes two steps that **occur in parallel**.

5. **Design and Implement Action(s)**

The design and implementation of action(s) include clearly describing specific activities that will occur under the selected action(s) and how they will link to the monitoring plan. Design includes creating a plan for implementing the action(s) and monitoring responses resulting from the action(s). The design of the action(s) should be informed by existing uncertainties, and should be directly linked to meeting the goals and objectives.
APPENDIX C – ADAPTIVE MANAGEMENT AND THE DELTA PLAN

KISSIMMEE RIVER RESTORATION PROJECT

The Kissimmee River Restoration Project uses an adaptive management process that provides a positive example of adaptive management in practice. The project thoughtfully modeled linkages between objectives and proposed action(s), and successfully designed and implemented a comprehensive monitoring plan with clear and quantifiable expectations. As a result, the intended goals of the restoration effort are being met and documented. South Florida Water Management District Executive Director Melissa Meeker, who oversees the restoration project, has reported that, "The abundant wildlife now seen along the Kissimmee is a powerful indicator of the benefits of long-term investments in restoration. The District’s documentation of these improvements provides us and our restoration partners—as well as the public—with critical insights into the ecosystem’s ongoing recovery."1

Environmental monitoring conducted since completing phase one of restoration construction (backfilling the canal and reconnecting and recarving river channels) in 2001 has resulted in the following indicators of success as of February 2012:

- The number of wading birds observed increased by 64 percent. Three species long absent from the river are now documented regularly.
- Shorebird species commonly observed jumped from 2 to 11.
- Waterfowl sightings increased dramatically—by 29 times compared to pre-restoration sightings.
- Wetland vegetation, which once covered only 37 percent of the phase one restoration area prior to construction, has fully achieved the restoration target of 80 percent coverage.

These results suggest that after construction is complete in 2014, and hydrologic conditions are fully restored in 2015, the region is on track to achieve its goal of restored ecological integrity in the Kissimmee River and its floodplain. In the 1960s, the Kissimmee River, located in south-central Florida, was channelized for flood-control purposes (Toth et al. 1998). In the 1990s, planning began for a 15-year restoration project. The restoration design included 70 kilometers of river channel and 104 square kilometers of floodplain—the largest attempted river restoration project in the world (Dahm et al. 1995). Adaptive research, monitoring, and evaluation programs were developed to provide a scientific foundation for fine-tuning each phase of the restoration effort (Toth et al. 1998). To “model linkages between objectives and proposed action(s),” conceptual models were developed to anticipate the restored Kissimmee River ecosystem, predict patterns of response for abiotic and biotic variables, and consider methods and performance measures for evaluating progress toward restoration in the river basin (Dahm et al. 1995).

The Kissimmee River Restoration Evaluation Program (KRREP) provides a practical example of the “design and implementation of a monitoring plan” step used in adaptive management. The KRREP is a comprehensive monitoring program designed to evaluate ecosystem responses to the restoration project through comprehensive monitoring and assessment of data collected before and after major construction phases (South Florida Water Management District 2011). If the KRREP determines that changes in the river and floodplain ecosystems after construction are not achieving expected results, adaptive management strategies are considered for implementation. More information about the Kissimmee River Restoration Project is available on the program website: http://my.sfwmd.gov/portal/page/portal/xweb%20protecting%20and%20restoring/kissimmee%20river.

1 http://www.sfwmd.gov/portal/pls/portal/docs/16721677.PDF (Accessed 03/02/2012)
6. Design and Implement Monitoring Plan

A well-designed monitoring plan includes a data management plan. A data management plan describes the process for organizing and clearly documenting observations, including how data are collected; the methods, quality assurance, and calculations used; the time and space scales of the variables; and accurate site locations and characteristics. Data management is critical for analyses, syntheses, and evaluations.

A well-designed monitoring plan goes beyond data collection and data management. A monitoring plan often includes targeted research to answer why certain results are observed and others are not. A monitoring plan also includes clear communication of the information gathered and current understanding drawn from this information. A complete monitoring plan includes:

- Compliance monitoring (required by permits)
- Performance monitoring with pre-project monitoring (measuring achievement of targets)
- Mechanistic monitoring with concurrent targeted research (testing the understanding of linkages in the conceptual model)
- System-level monitoring (holistic, integrative, and long term)

These types of monitoring can measure and communicate various types of information, including administrative/inputs (such as dollars awarded and spent or projects funded), compliance/outputs (such as tons of gravel added or acres exposed to tidal action), and effectiveness/outcomes (such as actual outcome expected from implementing an action at the local scale, suites of actions at the systemwide scales, and status and trends assessments). The monitoring plan design must include the development of monitoring metrics that can be integrated and summarized to inform decision makers and the public as described in step eight, Communicate Current Understanding.

Monitoring plan design requires making tradeoffs between resources spent on monitoring and resources spent on actions and analyses. To aid in this evaluation of tradeoffs, a rigorous pre-analysis using simulation models can show the information value of different variables that might be monitored. These values assessments can then be used to compare the benefits from monitoring certain variables against the benefit of using resources for other actions.

Implementation of actions and monitoring should be closely coordinated. Before an action is implemented, initial conditions should be clearly documented to the extent practical so that a baseline is established. Baseline data include characterization of natural variation observed in the examined system over space and time. For many ecological and hydrological variables, an extensive set of baseline data is available because of the efforts of the Interagency Ecological Program and repositories of information such as those available from the U.S. Geological Survey and the California Department of Water Resources. The implementation of action(s) and monitoring should be clearly executed and communicated to the public. Status and trends metrics that compare conditions before and after action implementation are often good assessment and communication tools.

Evaluate and Respond

The Evaluate and respond phase of adaptive management includes three key steps.

7. Analyze, Synthesize, and Evaluate

Analysis, synthesis, and evaluation of the action(s) and monitoring are critical for improving current understanding. Analysis and synthesis should incorporate information on how conditions have changed, expectedly and unexpectedly, as a result of implementing the action(s). Because measurable change might not occur on short timescales, evaluations should also examine whether actions prevented further deteriorating conditions that would have occurred if no actions were taken. The evaluation should examine whether performance measures indicate that one or more of the objectives have been met as a
result of the implemented action(s), and if so, why. If an objective is not met, the potential reasons why it was not met should be clearly identified and communicated. Analyses should be cumulative. As each year’s data become available, analyses should assess whether the probability of the desired outcome has changed and, if so, how this affects decisions about the action. The results of the analysis, synthesis, and evaluation step could be published in technical peer-reviewed papers and reports for the purpose of external review, disclosure, and accessibility where results warrant this level of communication. Scientists and technical experts will be critical for carrying out this step.

8. Communicate Current Understanding

Communication of current understanding gained through analysis, synthesis, and evaluation of implemented action(s) and monitoring is a key step for informing and equipping policy makers, managers, stakeholders, and the public to appropriately respond and adapt. This step spans the Do and the Evaluate and respond phase of adaptive management because the communication of current understanding and related recommendations for change requires both policy and technical expertise. The information communicated should be technically sound, well synthesized, and translated into formats conducive to informing a nontechnical audience (e.g., a report card format or a general science outlet such as a newsletter). The information should then be disseminated to those directly involved in the adaptive management process for the plan, program, or project and to those interested in the outcome of the action.

Technical staff and decision makers should be regularly involved in the exchange of information as data are analyzed and synthesized. Communication should be ongoing and occur at appropriate intervals at which an improved understanding could help refine other steps of the adaptive management framework.

The key to successful communication is a skilled and dedicated interdisciplinary person or team who understands the technical information learned, the functional needs of the decision makers, and how to best transmit this information. Communication should utilize various media (e.g., web-based materials, social media, outreach opportunities, public forums, etc.) and strive to meet the goals of transparency and clarity.

9. Adapt

Proponents of covered actions for ecosystem restoration and water management should be engaged and prepared to adapt to changes in current understanding and changes in current conditions (e.g., environmental or socioeconomic). Informed and equipped with new results and understanding, decision makers should re-examine the other steps of the adaptive management framework and revise these steps where current understanding suggests doing so. Possible next steps could include redefining the problem statement, amending goals and objectives, altering the conceptual model, or selecting an alternative action for design and implementation. Also, decisions to adapt might be needed at various time intervals for the same adaptive management experiment. For example, decisions might need to be made daily (e.g., Delta water operations), yearly (e.g., implementation of landscape-scale restoration), or decadal (adaptive management of landscape-scaled restoration design).

Knowing when to adapt is not always obvious. Adaptive management actions should have a planned timeframe that includes when to adapt (based on understandings of the system and its uncertainties), and that timeframe should be abandoned only if the results show that the action is doing more harm than good or the anticipated benefit is not noted within a reasonable timeframe beyond what was expected. In general, one year’s results, however anomalous, are seldom enough to demonstrate that the action should be subject to adaptive measures. Furthermore, when the analysis, synthesis, and evaluation of information learned from implementing an action indicates that no benefit results from the undertaken action, resources should no longer be spent on that action no matter how popular the action might be.
HEALTHY WATERWAYS

In South East Queensland, Australia, Healthy Waterways is an organization using an adaptive management process that provides a positive example of adaptive management that might be practiced for the Delta. Healthy Waterways has excelled at two specific steps of adaptive management: “communicate current understanding” and “adapt.” Achievements of the Healthy Waterways Partnership to date include an extensive public awareness and education program, urban stormwater or catchment management plans for all major catchments in South East Queensland, and local and state government investment in upgrading 25 wastewater treatment plants leading to about a 40 percent reduction in nitrogen load to waterways.

Healthy Waterways has collaborative partnerships and works to improve the health of waterways, catchment, and ecosystems that support the livelihoods and lifestyles of the region’s people. An adaptive management framework developed by Healthy Waterways’ partners has served as the operating philosophy and cornerstone of program implementation for over a decade. Healthy Waterways’ practice of adaptive management has led to improved understanding about how to deal with resource management issues and the flexibility necessary for changing socioeconomic and socioecological relationships occurring in South East Queensland (Abal et al. 2005).

Healthy Waterways’ communication of current understanding is facilitated through a commitment to public education and outreach; annual public report cards; and the use of leading technology to analyze, interpret, and communicate information through the health-e-waterways dynamic report cards (http://www.health-e-waterways.org/). These communication efforts have led to adapting management actions based on current ecosystem understanding; these actions are subsequently evaluated in annual report cards.

Details about Healthy Waterways and its adaptive management elements are available at www.healthywaterways.org.

Healthy Waterways 2010 Annual Report Card Sample
(2010 grades are brown, 2009 grades are gray)

Decisions made within the adaptive management process for ecosystem restoration and water management actions should be made by decision makers for the entity responsible for implementing adaptive management. Adaptive management decisions relevant to revising and updating the Delta Plan will be made by the Council.
References


Appendix D

Administrative Procedures Governing Appeals, Statutory Provisions Requiring Other Consistency Reviews, and Other Forms of Review or Evaluation by the Council
[ADOPTED 9/23/2010]

DELTA STEWARDSHIP COUNCIL

I. ADMINISTRATIVE PROCEDURES GOVERNING APPEALS

II. STATUTORY PROVISIONS REQUIRING OTHER CONSISTENCY REVIEWS

III. OTHER FORMS OF REVIEW OR EVALUATION BY THE COUNCIL

PART I- ADMINISTRATIVE PROCEDURES GOVERNING APPEALS

Introduction

1. Purpose. These administrative procedures govern how the Delta Stewardship Council considers appeals with regard to:

   a) Adequacy of certifications of consistency with the Delta Plan submitted to the council by a state or local public agency pursuant to Water Code sections 85225.10 and 85225.30; and

   b) Determinations by the Department of Fish and Game that the Bay Delta Conservation Plan has met the requirements of Water Code section 85320 for inclusion in the Delta Plan.

   NOTE: Authority cited: Water Code sections 85001, 85020(h), 85022, 85057.5, 85200, 85210, 85212, 85225, 85225.5, 85225.10, 85225.15, 85225.20, 85225.25, 85225.30, 85300, 85320(e).

Review of certifications of consistency with Delta Plan

2. Any state or local public agency proposing to undertake a covered action, as defined in Water Code section 85057.5 is encouraged to consult with the council at the earliest possible opportunity, preferably no later than 30 days before submitting its certification to the council pursuant to Water Code section 85225, to ensure that the project will be consistent with the Delta Plan. The council’s staff will meet with the agency’s staff to review the consistency of the proposed action and to make recommendations, as appropriate. During this early consultation, the agency’s staff may also seek clarification on whether the proposed project is a “covered action”; provided that the ultimate determination on whether it is a covered action shall be made by the agency, subject to judicial review.

3. At least 10 days prior to its submission of a certification to the council, a state or local public agency that is not subject to open meeting laws (that is, the Bagley-Keene Open Meeting Act [Gov.Code sec.11120 et seq.] or the Brown Act [Gov.Code sec.54950 et seq.]) with regard to its certification, shall post, for public review and comment, its draft certification conspicuously on its website and in its office, mail it to all persons requesting notice, and include any public comments received in the record submitted to the council in the case of an appeal. A state or local public agency that is subject to open meeting laws with regard to its certification is encouraged to take those actions.


4. a) Any certification of consistency filed by a state or local agency pursuant to Water Code section 85225 shall set forth detailed findings that the covered action is consistent with the Delta Plan. The council shall prepare a checklist that agencies may use to assist them in preparing the certification and making the required findings.

b) A state or local agency shall submit to the council, no later than 10 days after receiving notice of an appeal pursuant to Paragraph 8, the record that was before the state or local agency at the time it made its certification, including a table of contents of documents contained therein and a brief chronology of events and actions relevant to the covered action. The record shall be certified by the state or local agency as being “full and complete.” Given the tight, statutory deadlines for hearing and deciding appeals, a state or local agency is nevertheless strongly encouraged to submit the record at the time it files its certification of consistency, to ensure the opportunity for thorough review by the council in the event of an appeal.

c) The failure by a state or local agency to submit the record to the council on a timely basis as required by subparagraph (b), shall be grounds for the council to affirm the appeal on the basis that there was not substantial evidence presented to support the certification of consistency.

d) Any filings required by this Paragraph (4) shall be submitted in electronic form to facilitate availability and public access, and shall be public records.


5. Any person, including any member of the council or its executive officer, who claims that a proposed covered action is inconsistent with the Delta Plan and, as a result of that inconsistency, that action will have a significant adverse impact on the achievement of one or both of the goals of the Act or implementation of government sponsored flood control programs to reduce risks to people and property in the Delta, may file an appeal with regard to a certification of consistency submitted to the council no later than 30 calendar days after that submittal.
6. The appeal shall clearly and specifically set forth the basis for the claim that the covered action is inconsistent with the Delta Plan. The appeal shall be in writing and set forth the following information:

a) Appellant’s name and address;

b) The name and address of the party, if any, whose proposal is the subject of the appeal;

c) A description of the covered action that is the subject of the state or local public agency certification;

d) The identity of the state or local government body whose certification is being appealed;

e) The specific grounds for appeal; and

f) A detailed statement of facts on which the appeal is based.

The appeal shall be filed in electronic form.

NOTE: Authority cited: Water Code sections 85225.10 (b), 85225.30.

7. The appeal shall be considered “filed” with the council when the appellant’s appeal is received, determined by staff to contain all of the information listed in Paragraph 6, and a hard-copy is printed and stamped “Filed” by the council staff with the date of filing indicated.


8. Within five working days of the filing of an appeal with the council, the executive officer shall:

a) Post a notice and brief description of the appeal and its effective date in a conspicuous location in the council’s office and on its website;

b) Mail to the affected state or local public agency and to any third party whose proposal is the subject of the certification, a copy of the notice and a brief description, with a copy of the appeal documents filed with the council;

c) Mail copies of the appeal to each member of the council, and to the Delta Protection Commission for informational purposes consistent with Public Resources Code section 29773; and
d) Mail notice to the appellant that the appeal has been filed and stating the effective date of filing.


9. The council or its executive officer may request from the appellant further information necessary to clarify, amplify, correct, or otherwise supplement the information submitted with the appeal, within a reasonable period. The council or by delegation its executive officer may dismiss the appeal for failure of the appellant to provide information requested within the period provided, if the information requested is in the possession of or under the control of the appellant.


10. The council or its executive officer may supplement the record submitted by the state or local agency if the council or its executive officer determines that additional information was part of the record before the agency, but was not included in the agency’s submission to the council.


11. The appellant, the state or local agency, the Delta Protection Commission, or any other person may testify before the council regarding an appeal. Presentations may be oral or in writing, shall address only whether the record supports the certification of consistency, and shall be as brief as possible. Written submissions should be provided to the council at least 10 days prior to the hearing to ensure that they, or in appropriate cases, summaries, may be circulated to council members for their review ahead of the hearing. The council’s presiding officer may establish reasonable time limits for presentations.


12. All written submissions to the council may be in electronic form.


13. The council shall hear all appeals of certifications of consistency filed pursuant to Water Code section 85225 within 60 days of filing unless:

a) The parties agree to a reasonable extension approved by the executive officer, taking into account the circumstances of the matter subject to appeal and the council’s hearing schedule and associated workload, or
b) The council, or by delegation its executive officer, determines that the issue raised on appeal is not within the council's jurisdiction or does not raise an appealable issue.


14. The council shall make its decision on the appeal within 60 days of hearing the appeal, and shall make specific written findings defining the covered action under review and either denying the appeal or remanding the matter to the state or local public agency for reconsideration of the covered action based on the finding that the certification of consistency is not supported by substantial evidence in the record before the state or local public agency that filed the certification.


15. No covered action which is the subject of an appeal shall be implemented unless one of the following conditions has been met:

   a) The council has denied the appeal;

   b) The public agency has pursuant to Water Code section 85225.5 decided to proceed with the action as proposed or modified and has filed with the council a revised certification of consistency addressing each of the findings made by the council, 30 days has elapsed and no person has appealed the revised certification; or

   c) The council or its executive officer has dismissed the appeal for one or both of the following reasons:

       1. The appellant has failed to provide information in her possession or under her control within the time requested or
       2. The issue raised is not within the council’s jurisdiction or fails to raise an appealable issue.


**Review of Bay Delta Conservation Plan**

16. If the Department of Fish and Game (department) determines that the Bay Delta Conservation Plan (BDCP) referred to in Water Code section 85053 meets all of the requirements of Water Code section 85320 for inclusion in the Delta Plan, it shall file the BDCP and its determination with the council.

17. Upon receipt of the department's determination, the executive officer of the council shall:

   a) Post a notice and brief description of the BDCP, the department's determination, the date of filing and the right of any person to appeal that determination on its website and in a conspicuous location in the council's office;

   b) Mail a notice and brief description of the BDCP, the department’s determination and the right of appeal to any person requesting notice; and

   c) Mail copies of the determination to each member of the council.

   NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

18. Any person, including any member of the council or its executive officer, may appeal to the council the determination of the department that the BDCP meets all of the requirements of Water Code section 85320 for inclusion in the Delta Plan.

   NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

19. a) Any appeal to the council made pursuant to Paragraph 18 shall be made within 30 days of the later of the following:

   1. the filing with the council of the department's determination that the BDCP meets all the requirements of Water Code section 85320 for inclusion in the Delta Plan, or
   2. the conclusion of the council’s hearing or hearings held pursuant to Water Code section 85320(d).

   b) The appeal shall be in writing and filed in electronic form. It shall clearly set forth the specific grounds for the appeal and the specific facts upon which it is based. These shall include a list of each specific requirement of Water Code section 85320 that the BDCP allegedly fails to meet. The appeal shall be considered filed with the council when the appellant’s appeal is received, determined by staff to contain all the information required in this paragraph, and a hard-copy is printed and stamped “Filed” by the council staff with the date of filing indicated.

   c) If an appeal is filed before the council publicly notices a hearing to be held pursuant to Water Code section 85320(d), the council, in its discretion, may combine the hearing on appeal and the hearing pursuant to Water Code section 85320(d).


20. Within five working days of the filing of an appeal pursuant to Paragraph 18, the executive director shall:
a) Post a notice and brief description of the appeal on its website and in a conspicuous location in the council's office;

b) Mail a notice and brief description of the appeal to any person requesting copies of such appeals; and

c) Mail copies of the appeal and a brief description of the appeal to each member of the council.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

21. The council or its executive officer may request from the appellant or the department additional information necessary to clarify, amplify, correct, or supplement the information submitted with the appeal within a reasonable period.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

22. Any appeal made pursuant to Paragraph 18 may be dismissed if the council or its executive officer determines that it does not raise an appealable issue or if the appellant has failed to provide requested information to support her charge within a reasonable time, if that information is in the possession of or under the control of the appellant.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

23. The council shall determine, based upon a preponderance of the evidence, whether the department correctly determined that the BDCP meets all of the requirements of Water Code section 85320 for inclusion in the Delta Plan. In reaching its decision, the council shall give weight to the reasoning and factual findings of the department. The council may seek clarification from the department of its reasoning and factual findings prior to the council making its final determination.

NOTE: Authority cited: Water Code section 85225.30, 85320(b), (e).

23.5 a) The council shall conduct any hearing on an appeal made pursuant to Paragraph 18 in a manner deemed most suitable to ensure fundamental fairness to all parties concerned, and with a view toward securing all relevant information and material necessary to render a decision without unreasonable delay.

b) The hearing need not be conducted according to technical rules relating to evidence and witnesses. Any relevant evidence shall be considered if it is the sort of evidence on which responsible persons are accustomed to rely in the conduct of serious affairs, regardless of the existence of any common law or statutory rule which might make improper the admission of such evidence over objection in a court proceeding.
Unduly repetitious or irrelevant evidence shall be excluded upon order of the council or its chairperson.

c) Subject to Paragraph 23, evidence before the council includes, but is not limited to, the record before the department. The record will not include a transcript of any proceedings before the department unless provided by a party to the proceedings or requested by the council.

d) Any interested person may testify before the council regarding an appeal concerning the BDCP. Speakers’ presentations shall be to the point and shall be as brief as possible. Visual and other materials may be used as appropriate. The council may establish reasonable time limits for presentations; such time limits shall be made known to all affected persons prior to any hearing. Where speakers use or submit to the council visual or other materials, such materials shall become part of the hearing record and shall be identified and maintained as such. Speakers may substitute reproductions of models or other large materials but shall agree to make the originals available upon request of the executive director.

e) Council members may ask questions of the appellant, the department's representative(s), any third party appearing at the hearing or staff. Questioning of speakers at the hearing by other persons shall not be permitted except by permission of the Chairperson.

f) Interested persons may submit written comments concerning an appeal. Any such comments will be considered by the council if they are received by the council at or before the hearing on the appeal; provided that those written comments should be submitted to the council at least 10 days prior to the hearing to ensure that they, or in appropriate cases, summaries, may be circulated to council members for their review ahead of the hearing.

g) The council may continue the hearing where it determines that a continuance would be appropriate.

NOTE: Authority cited: Water Code sections 85225.30, 85320(e).

24. The council’s decision shall include specific written findings. The council shall post its decision on its website and mail copies to the department and all parties requesting notice.

NOTE: Authority cited: Water Code sections 85225.30, 85320(e).

25. If the council decides that the department incorrectly determined that the BDCP meets all of the requirements of section 85320 for inclusion in the Delta Plan, and consequently grants the appeal, the department may revise its determination to meet the issues raised by the council, or may respond to the council's findings in detail, setting forth reasons why it has concluded that the BDCP meets all of the requirements of
section 85320 for inclusion in the Delta Plan. Unless the council decides that the department’s determination, as submitted or revised, correctly concludes that the BDCP meets all of the requirements of section 85320 for inclusion in the Delta Plan, the BDCP shall not be incorporated in the Delta Plan and the public benefits associated with the BDCP shall not be eligible for state funding.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (a), (b), (e).

Ex Parte Contact Restrictions Applicable to All Appeals

26. Hearings on appeals are subject to the ex parte communication restrictions of California Administrative Procedures Act (Gov. Code § 11430.10 et seq.). Under that Act, an ex parte communication is a "communication, direct or indirect, regarding any issue in the proceeding, to the [council or council member] from an employee or representative of an agency that is a party or from an interested person outside the agency, without notice and opportunity for all parties to participate in the communication." (Gov. Code § 11430.10.) The restrictions apply from the date that the appeal is filed to the date that the council reaches a final decision on the appeal.


27. To ensure compliance with these provisions, members should avoid ex parte communications while an appeal is pending. If they nevertheless receive one, such as by an individual sending a letter to a member concerning a pending matter, the member should notify the council’s legal adviser or executive officer so that appropriate measures can be taken.


28. At the first appropriate meeting after an appeal is anticipated or filed, the council’s legal adviser will remind the council of this restriction and answer questions about its scope.


Official Notice

29. Notwithstanding any provision of these procedures to the contrary, the council may take official notice in any hearing that it conducts, of any generally accepted technical or scientific matter within the council’s jurisdiction, and of any fact that may be judicially noticed by the courts of this State.
Filings and Mailings

30. All filings and mailings required by sections 1-29 of these procedures may be made electronically.


Consolidation of Appeals

31. The council, at its discretion, may consolidate appeals raising similar issues.


PART II—STATUTORY PROVISIONS REQUIRING OTHER CONSISTENCY REVIEWS (AFTER ADOPTION OF THE DELTA PLAN)

In several other sections of SB X7 1, the council is directed to review for consistency with the Delta Plan, various plans of specified public agencies. This Part is directed at those reviews, which fall outside the scope of the procedures covered by Part I.


Public Resources Code section 29759 requires the Delta Protection Commission (DPC), by July 1, 2011, to adopt an economic sustainability plan. That plan must include information and recommendations that inform the council’s policies regarding the socioeconomic sustainability of the Delta’s region.

Public Resources Code section 29761.5(b) requires the DPC to transmit copies of the plan to the council within 60 days of adoption. The council is required, within 180 days of the adoption of the plan, to review the plan for consistency with the Delta Plan.

2. Local and Regional Planning Documents.

Water Code section 85057.5(b)(3), excepts from the definition of “covered action”, regional transportation plans prepared pursuant to Government Code section 65080.
Paragraph (4) of that same section, excepts from the definition of “covered action”, plans, programs, projects or activities within the secondary zone of the Delta that the applicable metropolitan planning organization under Government Code section 65080 has determined is consistent with either a sustainable communities strategy or an alternative planning strategy that would achieve specified greenhouse gas emission reduction targets as determined by the Air Resources Board.

Because they are not “covered actions”, these types of local and regional planning documents are not subject to the statutory provisions governing consistency of state and local public agency actions (Water Code secs. 85225 et seq.), or the council’s Administrative Procedures Governing Appeals (Part I, above), with one exception noted in paragraph (d), below.

However, Water Code section 85212 provides a separate requirement and process for consistency review by the council of these types of local and regional planning documents.

In particular:

(a) The council is required to review and provide timely advice to local and regional planning agencies regarding the consistency of local and regional planning documents, including sustainable communities strategies and alternative planning strategies prepared pursuant to Government Code section 65080, with the Delta Plan.

(b) The council’s input must include, but not be limited to, reviewing the consistency of local and regional planning documents with the ecosystem restoration needs of the Delta and reviewing whether the lands set aside for natural resources protection are sufficient to meet the Delta’s ecosystem needs.

(c) A metropolitan planning organization preparing a regional transportation plan that includes land within the primary or secondary zones of the Delta must consult with the council early in the planning process regarding the issues and policy choices relating to the council’s advice.

(d) No later than 60 days prior to the adoption of a final regional transportation plan, the metropolitan planning organization must provide the council with a draft sustainable communities strategy and an alternative planning strategy, if any. Concurrently, the metropolitan planning organization must provide notice of its submission to the council in the same manner in which agencies file a certificate of consistency with regard to covered actions.

(e) If the council concludes that the draft strategies are inconsistent with the Delta Plan, the council must provide written notice of the claimed inconsistency to the metropolitan planning organization no later than 30 days prior to the adoption of the final regional transportation plan.
(f) If the council provides timely notice of a claimed inconsistency, the metropolitan planning organization’s adoption of the final regional transportation plan must include a detailed response to the council’s notice.

PART III--OTHER FORMS OF REVIEW OR EVALUATION BY THE COUNCIL

1. Interested parties, including federal, state and local public agencies, are encouraged to confer with the council or its executive officer over the scope and potential impacts of the interim plan developed under Water Code section 85084. Interested parties will be provided an opportunity to comment and provide input on the interim plan as it is developed.

2. Similarly, prior to adoption of the Delta Plan, project proponents are encouraged to consult with the council or its executive officer early in the planning stages of projects that may constitute “covered actions” under Water Code section 85057.5 once the Delta Plan is adopted. Subject to available resources, the council may review and comment on planning documents and environmental review documents regarding potential “covered actions”.

3. Subject to available resources, the executive officer or his designee may meet with interested parties, upon their request, to help mediate relevant disputes, including disputes, once the Delta Plan is adopted, over whether a project constitutes a "covered action" under Water Code section 85057.5. The intent of this mediation will be to provide an objective and informal forum for dispute resolution that will serve as a more efficient alternative to costly and time-consuming litigation.

4. Interested parties, including federal, state and local agencies, are encouraged to confer and coordinate with the council or its executive officer with regard to agency plans, studies, strategies, and recommendations required, or otherwise suggested, to be considered by the council for incorporation into the Delta Plan.
Appendix E
Performance Measures for the Delta Plan

Performance Measure Types
Delta Plan performance measures have been placed into three general classes:

- **Administrative** performance measures describe decisions made by policy makers and managers to finalize plans or approve resources (funds, personnel, projects) for implementation of a program or group of related programs.

- **Output** (also known as “driver”) performance measures evaluate the factors that may be influencing outcomes and include on-the-ground implementation of management actions, such as acres of habitat restored or acre-feet of water released, as well as natural phenomena outside of management control (such as a flood, earthquake, or ocean conditions).

- **Outcome** performance measures evaluate responses to management actions or natural outputs.

Core Output/Outcome Performance Measure Criteria

- **Metrics** define the unit(s) of measure and other characteristics for tracking aspects of performance over time.

- **Baselines** are standards or historical reference conditions for comparing with the current condition.

- **Targets** are the desired future conditions or trends.

Chapter 2: The Delta Plan

Administrative Performance Measures


- The initial Delta Plan and all future revisions and amendments to the Delta Plan by the Council are consistent with an adaptive management approach and are informed by the best available science, where applicable.

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1 The Council authorizes staff to make non-substantive alterations to metrics within these performance measures as follows: (1) such non-substantive alterations must be driven by the availability of new data sources or technological improvements, and (2) such non-substantive alterations must be functionally equivalent to, or better than, the existing metrics or targets. The Council expects that any substantive alterations to metrics will be brought to the Council for review and approval.
♦ A minimum of every 5 years (beginning 5 years after adoption of the Delta Plan), the Delta Plan is reviewed by the Council and revised if deemed appropriate.

♦ Governance structure is reviewed and revised (if necessary) to ensure that there is adequate institutional capacity to interact, learn, and adapt in a manner that supports adaptive management.

♦ The Delta Science Program develops a Delta Science Plan including responding to Delta Independent Science Board review and comments by December 31, 2013.

Chapter 3: A More Reliable Water Supply for California

Strategy 3.1: Increase Water Conservation and Expand Local and Regional Supplies

Strategy 3.2: Improve Groundwater Management

Strategy 3.3: Improve Conveyance and Expand Storage

Strategy 3.4: Improved Water Management Information

Outcome Performance Measures

♦ Urban water suppliers that are within the Delta watershed, or those relying on water from the Delta watershed, demonstrate reliability during single and multiple dry years through their UWMPs. Single and multiple dry year projections should account for decreased availability of supplies from the Delta watershed. Reliability can be achieved through increased use of alternative supplies, demand management, or both. (Strategy 3.1)

Metrics:

- Percentage of urban water suppliers that are within the Delta watershed, or those relying on water from the Delta watershed, projecting reliability during a single dry year (i.e., lowest water supply available to the agency for a single year). This will be evaluated at least every five years as UWMPs are updated.

- Percentage of urban water suppliers that are within the Delta watershed, or those relying on water from the Delta watershed, projecting reliability for multiple dry years (i.e., lowest water supply available to the agency for three consecutive years). This will be evaluated at least every five years as UWMPs are updated.

Baseline:

- Percentage of urban water suppliers that are within the Delta watershed, or those relying on water from the Delta watershed, projecting reliability during a single dry year in their 2015 UWMPs.

- Percentage of urban water suppliers that are within the Delta watershed, or those relying on water from the Delta watershed, projecting reliability for multiple dry years in their 2015 UWMPs.

Target:

- One-hundred percent of urban suppliers that are within the Delta watershed, or those relying on water from the Delta watershed, project shortages no greater than 20 percent during single and multiple dry years by 2020—taking into account the reduced availability of water from the Delta watershed during dry years.
A decrease in Delta exports during critically dry years, and an increase in Delta exports during wet years, with an overall average decrease in Delta exports². (Strategy 3.3)

Metrics:
- Total water exported by the State Water Project and the Central Valley Project, during each critically dry year, through the Harvey O. Banks and C.W. Bill Jones Pumping Plants in the southern Delta. This will be evaluated following critically dry years.
- Total water exported each wet year by the State Water Project and the Central Valley Project, through the Harvey O. Banks and C.W. Bill Jones Pumping Plants in the southern Delta. This will be evaluated following wet years.
- Fifteen-year average total water exported annually (for all water year types) by the State Water Project and the Central Valley Project, through the Harvey O. Banks and C.W. Bill Jones Pumping Plants in the southern Delta. This will be evaluated at least every five years.

Baseline:
- Median total water exported during critically dry years by the State Water Project and the Central Valley Project, through the Harvey O. Banks and C.W. Bill Jones Pumping Plants in the southern Delta, for the years 1975–2014.
- Median total water exported during wet years by the State Water Project and the Central Valley Project, through the Harvey O. Banks and C.W. Bill Jones Pumping Plants in the southern Delta, for the years 1975–2014.
- Average total water exported annually (for all water year types) by the State Water Project and the Central Valley Project, through the Harvey O. Banks and C.W. Bill Jones Pumping Plants in the southern Delta, for the years 2000–2014.

Target:
- A statistically significant decrease in annual total exports during critically dry years as compared to historical deliveries for critically dry years in 1975–2014. This target is to be achieved by 2030.
- A statistically significant increase in total exports during wet years compared to historical deliveries for wet years in 1975–2014. This target is to be achieved by 2030.
- Fifteen-year average total exports during all year types decreases by 5 percent or more from the average historical deliveries for the years 2000–2014 (5.1 million acre-feet (MAF)). This target is to be achieved by 2030.

**Output Performance Measures**

- Urban water suppliers that are within the Delta watershed, or those relying on water from the Delta watershed, achieve their individual targets set through the Senate Bill (SB) X7-7 process or its successor legislation or regulatory targets. (Strategy 3.1)

 Metrics:
- Gallons per capita per day of urban water use. This will be evaluated at least every five years as Urban Water Management Plans (UWMP) are updated.

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² This performance measure will be re-evaluated for consistency with the State Water Resources Control Board’s updates to the 2006 Bay-Delta Water Quality Control Plan. Phase I and II updates are currently expected to undergo review and adoption in late 2017 or early 2018 (see: http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/).
- Percentage change in urban per capita water use from SB X7-7 baseline years. This will be evaluated at least every five years as UWMPs are updated.

Baseline:
- SB X7-7 baselines established in 2010/2015 UWMPs.

Target:
- 2015 targets established in 2010/2015 UWMPs. Interim targets are set by individual suppliers, using one of four methods identified in SB X7-7, and are to be achieved by December 31, 2015, and reported in subsequent UWMPs.
- 2020 targets established in 2010/2015 UWMPs. Targets are set by individual suppliers, using one of four methods identified in SB X7-7, and are to be achieved by December 31, 2020, and reported in subsequent UWMPs.

- Urban water suppliers that are within the Delta watershed, or those relying on water from the Delta watershed, demonstrate sustained progress towards achieving their individual projections for water recycling, storm water capture, and use of advanced water technologies in their UWMPs. (Strategy 3.1)

Metrics:
- Percentage of urban water suppliers meeting their recycled water projections. This will be evaluated at least every five years as UWMPs are updated.
- Percentage of urban water suppliers meeting their storm water-use projections. This will be evaluated at least every five years as UWMPs are updated.
- Percentage of urban water suppliers meeting their desalination projections. This will be evaluated at least every five years as UWMPs are updated.

Baseline:
- Each five-year UWMP update includes projections of future water supply sources in five-year increments.

Target:
- Suppliers meet at least 75 percent of their projected beneficial use of recycled water, storm water, and desalinated groundwater or ocean water, established in their previous UWMP. Achievement of target to be met every five years as set by UWMP updates.

Administrative Performance Measures

Strategy 3.1: Increase Water Conservation and Expand Local and Regional Supplies

- Identify number of water suppliers that have undertaken covered actions that have (1) completed a current urban or agricultural water management plan that has been reviewed by the DWR for compliance with applicable legal requirements, (2) commenced implementation of identified measures which will reduce reliance on the Delta, and (3) starting in 2015, reported on the expected outcome for measureable reductions in reliance on the Delta and improvement in regional self-reliance as the reduction in the amount of water used, or the percentage of water used, from the Delta watershed.

- Identify number of urban and agricultural water suppliers that certify that they have adopted and are implementing supply planning, conservation, and efficiency measures required by State law by 2015, meeting the standards and deadlines established by code.
DWR adopts and implements a requirement for SWP contracts and transfer agreements that requires implementation of State water efficiency, water management laws, goals and regulations including compliance with water code section 85021.

SWRCB adopts a policy that requires evaluation of new water rights or a new or changed point of diversion, place of use, or purpose that result in a new or increased long-term average use of water from the Delta watershed for consistency with reasonable and beneficial use and Water Code sections 85021, 85023, and 85031 and other provisions of California law.

Identify percentage of urban and agricultural water suppliers that receive water from the Delta watershed that have incorporated an expanded Water Supply Reliability Element in their UWMP and AWMP by December 31, 2015.

DWR has developed and published guidelines for the preparation of an expanded Water Supply Reliability Element by December 31, 2014.

DWR and SWRCB have established an advisory group and identified impediments to achievement of statewide water conservation, recycled water and stormwater goals by 2014 and have evaluated and recommended update goals by 2018, including an assessment of how regions are achieving their proportional share of these goals.

State grant and loan ranking criteria have been revised by December 31, 2013.

State agencies report to DSC on an annual basis on their actions to demonstrate state leadership, to increase water efficiency, use recycled water, and incorporate stormwater runoff capture and low impact development strategies.

Meet the requirement of SB X7-7, the Water Conservation Act of 2009, which requires agricultural water suppliers to submit an Agricultural Water Management Plan (AWMP) to the State of California Department of Water Resources (DWR). (Strategy 3.1)

Metrics:
- Percentage of AWMPs submitted to DWR on time. This will be evaluated at least every five years as AWMPs are updated.
- Percentage of AWMPs submitted to DWR that include a quantification of water-use efficiency. This will be evaluated at least every five years as AWMPs are updated.

Baseline:
- Fourteen percent of the required AWMPs (8 of the estimated 56) were submitted to DWR on time for the 2012 cycle. Thirty-seven percent of required AWMPs (35 of the estimated 95) were submitted to DWR on time for the 2015 cycle.
- Zero percent of AWMPs (0 of the estimated 56 required) submitted to DWR for the 2012 cycle included a quantification of water-use efficiency improvements.

Target:
- By 2020, 100 percent of AWMPs are submitted to DWR on time.
- By 2020, 100 percent of AWMPs submitted to DWR include a quantification of water-use efficiency.
Strategy 3.2: Improve Groundwater Management

- Completion by DWR of the update of Bulletin 118 information (using field data, CASGEM, and best available science) and identification of the state’s groundwater basins which are in a critical condition of overdraft by December 31, 2014.


- Number of water suppliers in areas that receive water from the Delta watershed that have developed groundwater management plans that are consistent with the required and recommended components of groundwater management plans listed in DWR Bulletin 118-03 by 2014.

- Identify number of groundwater basins identified by DWR as being in a critical condition of overdraft that have groundwater management plans consistent with the required and recommended components of groundwater management plans listed in DWR Bulletin 118-03 by 2014.

- SWRCB report to DSC on proposed action to address groundwater basins in critical overdraft.

- Responsible State and local agencies complete the 2014 Sustainable Groundwater Management Act (SGMA) mandates. Upon completion of Groundwater Sustainability Plans (GSPs), this measure will be updated to track achievement of the measurable objectives and five-year interim milestones identified by local agencies in the plan. Groundwater levels and groundwater storage will be targeted specifically. (Strategy 3.2)
  - Metric:
    - Completion of actions required by SGMA. This will be evaluated annually until GSPs are completed.
  - Baseline:
    - N/A
  - Target:
    - The actions required by SGMA have various target dates. One-hundred percent of actions required by SGMA are completed by their target dates.³

Strategy 3.3: Improve Conveyance and Expand Storage

- DWR completes Surface Water Storages studies by December 31, 2012 with recommendations for projects to be implemented.

- DWR has completed a survey of past grant applicants to identify projects that may implemented within the next 5 to 10 years to expand existing surface and groundwater storage facilities, create new storage, improve Delta conveyance facilities, and improve opportunities for water transfers by December 31, 2012.

- California Water Commission holds hearings and provides recommendation on priority projects by December 31, 2013.

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³ Seventeen actions leading to adoption of GSPs have been identified. These actions are to be completed by the Department of Water Resources, the State Water Resources Control Board, and local agencies, with target dates ranging from January 31, 2015, to January 31, 2022. All medium and high-priority basins must be managed under a GSP by January 31, 2022. Medium and high-priority basins subject to critical conditions of overdraft must be managed under a GSP by January 31, 2020. On April 1, following GSP adoption and annually thereafter, local agencies must provide a report on progress towards sustainability to the Department of Water Resources. These reports may form the basis for a future groundwater performance measure.
DWR and SWRCB, in collaboration with the DSC, have established an advisory group and recommended measures to reduce procedural and administrative impediments to water transfers by December 31, 2016.

**Strategy 3.4: Improved Water Management Information**

- DWR and Bureau of Reclamation contracting processes have been implemented consistent with applicable policies.
- SWRCB has modified its supplemental water diversion and use or progress reports to require additional information on water efficiency, water supply projects, and net (consumptive) use.
- DWR has completed the development and initiated implementation of an integrated statewide system for water use reporting in coordination with other state agencies by 2014.
- DWR has modified the California Water Plan update to include specified categories of information to be tracked.
- Development of appropriate performance measures will be done by DSC in consultation with the agencies. These performance measures will be rolled into the California Water Plan Update.
- DWR has prepared an assessment of the State’s water infrastructure.

### Chapter 4: Protect, Restore, and Enhance the Delta Ecosystem

**Strategy 4.1: Create More Natural Functional Flows**

**Strategy 4.2: Restore Habitat**

**Strategy 4.3: Improve Water Quality to Protect the Ecosystem**

**Strategy 4.4: Prevent Introduction of and Manage Nonnative Species Impacts**

**Strategy 4.5: Improve Hatcheries and Harvest Management**

### Outcome Performance Measures

- Restoring to a healthier estuary using more natural functional flows—including in-Delta flows\(^4\) and tributary-input flow—to support ecological floodplain processes (e.g., spring peak flows along the Sacramento River, and more gradual recession flows at the end of the wet season). (Strategy 4.1)

**Metrics:**

- Area and duration of inundation in the Yolo Bypass, evaluated annually on a five-year rolling basis.
- Frequency of two-year return interval peak flows, between November 1 to April 30, evaluated annually on a five-year rolling basis, at Bend Bridge on the Sacramento River.
- Rate of change in the hydrograph on the receding limb as measured from spring high flows to summer low flows, evaluated annually on a five year rolling basis,

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\(^4\) Please see Chapter 6 *Water Quality* performance measure on salinity in-Delta flows for X2.
at Bend Bridge on the Sacramento River.\(^5\)

- 10-year rolling average slope of the Delta outflow-inflow ratio, disaggregated by seasonal, annual, and 10-year periods and evaluated annually; outflow-inflow ratio in dry and critically dry years, evaluated annually on a five-year rolling basis.

Baseline:

- Modeling, for the years 1997–2012, estimates that events with a 14-day duration inundated 45,100 acres in 33 percent of years; 19,700 acres in 50 percent of years; and 16,400 acres in 67 percent of years. Events with a duration of at least 21 days are estimated to have covered 36,300 acres in 33 percent of years; 15,800 acres in 50 percent of years; and 10,000 acres in 67 percent of years, between November 1 and May 30 (DWR 2015).\(^6\)

- Hydrograph data for the Bend Bridge gage station (USGS gage 11377100) indicate that the magnitude of flow for pre-Shasta Dam (1891–1943) and post-Shasta Dam (1960–2013) events, with 14-day duration, are similar (approximately 20,000 cubic feet per second, CFS).\(^7\) However, the pre-Shasta Dam historical 1.5-year recurrence interval peak flow (approximately 75,000 CFS) even now occurs approximately every two years, and the pre-Shasta Dam 10-year recurrence interval flow (206,200 CFS) has been nearly halved (133,842 CFS).\(^8\)

- Long-term hydrograph data from the U.S. Geological Survey gage station at Bend Bridge (USGS 11377100).

- Long-term ratio of Delta outflow to Delta inflow. The period before construction of the Central Valley Project, State Water Project, and select major dams (hydrograph between 1931–1954) had a Delta outflow-inflow ratio of 0.88. Post-completion of most components of the State Water Project (hydrograph between 1981–2015), the Delta outflow-inflow ratio was 0.75.\(^9\)

Target:

- By 2030, allow for at least 17,000 acres of inundation for at least 14 days in two out of three years, and at least 21 days in one out of two years, between November 1 and March 15.\(^10\)

- By 2030, at least one peak flow greater than 75,000 CFS, lasting at least 48 hours in duration, every two years, at Bend Bridge on the Sacramento River.\(^11\)

- By 2030, daily decrease in flow will be less than 3.5 percent per day, as calculated by a five-day rolling average during the period of spring flow

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\(^5\) For this performance measure, the focal period is from April 1 to July 31, but the start of spring flows will differ depending on water-year type and water-management actions. The definition of spring high flows, or the start of spring recession, is defined as the third consecutive day of decreasing flow following the last peak flow between March 15 and June 1. Low flows are defined as the date when the daily recession rate average, over five days, is less than 3.5 percent per day.

\(^6\) This baseline reflects the existing Fremont Weir configuration as of 2017.

\(^7\) DWR 2016, Central Valley Flood Protection Plan Conservation Strategy, Appendix H, Tables 3-1 and 4-1. Shasta Dam was completed in 1943. The dates here coincide with dates used in the Central Valley Flood Protection Plan, and are illustrative of the pre- and post-Shasta periods.

\(^8\) Michalkova et al. 2011, Constantine 2006, and Micheli et al. 2011.

\(^9\) Delta Inflow and Net Delta Outflow Index estimates for the period of 1929–1955 can be retrieved from DWR: [http://www.water.ca.gov/dayflow/](http://www.water.ca.gov/dayflow/)

\(^10\) This performance measure may be refined to ensure consistency with the State Water Resources Control Board update of the Bay-Delta Water Quality Control Plan.

\(^11\) This performance measure may be refined to ensure consistency with the State Water Resource Control Board update of the Bay-Delta Water Quality Control Plan.
recession, in at least 1 out of 5 years, at Bend Bridge on the Sacramento River. By 2030, 10-year rolling average slope of Delta outflow-inflow ratio is greater than zero (i.e., positive), and annual average Delta outflow-inflow ratio in dry as well as in critically dry years is greater than 0.5.

Progress toward achieving the State and federal “doubling goal” for wild Central Valley salmon relative to the period of 1967-1991 levels. Trends will be derived from long-term salmon monitoring surveys conducted by the U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, and others. (Strategy 4.2)

Metrics:
- Number of naturally spawned wild adult salmon by run type, annually censused for the general population in the Central Valley and selected rivers:
  - Sacramento River:
    - American River
    - Feather River
    - Sacramento River mainstem
  - San Joaquin River:
    - Tuolumne River
    - Merced River
    - Stanislaus River
    - Mokelumne River

Baseline:
- Salmon population numbers relative to average levels during the period of 1967-1991.

Target:
- As defined by the Central Valley Project Improvement Act “doubling goal” that “…natural production of anadromous fish in Central Valley Rivers and streams will be sustainable, on a long term basis, at levels not less than twice the average levels attained during the period of 1967-1991.”

Progress toward the documented occurrence in and use of protected and restored habitats and migratory corridors by native resident and migratory Delta fish and bird species. Trends in the number of native species in protected and restored habitats and corridors will be derived from monitoring surveys that are conducted as part of adaptive management strategies for the protection and restoration of these areas. (Strategy 4.2)

Metrics:
- Assess native fish:
  - Relative abundance of native fish in and near restoration project sites.
- Assess native birds:
  - Counts of native birds, including waterfowl in the Delta.

Baseline:
- Fish relative abundance as of Delta Plan adoption, May 2013.
- Breeding waterfowl for 2010-2014:

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12 Target recession rate informed by research and analyses conducted for the Environmental Flows Tool (Alexander et al. 2014) and Stillwater Sciences (2007).
13 Positive slope of the 10-year rolling average of Delta outflow-inflow ratio means an increasing portion of inflow water flowing out of the Delta over a given period of time.
14 Following the State Water Resources Control Board’s completion of updates to the Bay-Delta Water Quality Control Plan, this performance measure will be reevaluated for consistency with the Board’s regulations.
• Delta counts (5-year average): 7,414
• Suisun Marsh counts (5-year average): 23,122

Target:
- Upward trend as measured by the metrics above.

❖ Progress toward: 1) increased habitat, connectivity, and functionality; and 2) more favorable spatial distribution of habitat types. (Strategy 4.2)

Metrics:
- Assess the function ‘Provides habitat and connectivity for fish’.
  - Spatial-temporal variability of seasonal short-term and long-term flooding and tidal inundation.
  - Marsh to open water ratio.
  - Adjacency of marsh to open water by length and marsh patch size.
  - Ratio of looped to dendritic channels (by length and adjacent habitat type).
- Assess the function ‘Provides habitat and connectivity for marsh wildlife’.
  - Marsh area by patch size (patch size distribution).
  - Marsh area by nearest large (>100 ha) neighbor distance.
  - Marsh core area ratio.
  - Marsh fragmentation index.
- Assess the function ‘Provides habitat and connectivity for waterbirds’.
  - Wetted area by type in winter.
- Assess the function ‘Provides habitat and connectivity for riparian wildlife’.
  - Riparian habitat area by patch size.
  - Riparian habitat length by width class.
- Assess the function ‘Provides habitat and connectivity for marsh-terrestrial transition zone wildlife’.
  - Length of marsh-terrestrial transition zone by terrestrial habitat type.

Baseline:

<table>
<thead>
<tr>
<th>Metric</th>
<th>Baseline (“Modern” Delta)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tidal Inundation</strong></td>
<td></td>
</tr>
<tr>
<td>Dec – Feb: 3,303 ha</td>
<td></td>
</tr>
<tr>
<td>Mar – May: 3,303 ha</td>
<td></td>
</tr>
<tr>
<td>Jun – Aug: 3,303 ha</td>
<td></td>
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<tr>
<td>Sep – Nov: 3,303 ha</td>
<td></td>
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<tr>
<td><strong>Seasonal long-duration flooding</strong></td>
<td></td>
</tr>
<tr>
<td>Dec – Feb: 0 ha</td>
<td></td>
</tr>
<tr>
<td>Mar – May: 0 ha</td>
<td></td>
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<tr>
<td>Jun – Aug: 0 ha</td>
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<tr>
<td>Sep – Nov: 0 ha</td>
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<tr>
<td><strong>Seasonal short-term flooding</strong></td>
<td></td>
</tr>
<tr>
<td>Dec – Feb: 18,128 ha</td>
<td></td>
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<tr>
<td>Mar – May: 18,128 ha</td>
<td></td>
</tr>
<tr>
<td>Jun – Aug: 0 ha</td>
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<tr>
<td>Sep – Nov: 0 ha</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Baseline (“Modern” Delta)</th>
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</thead>
<tbody>
<tr>
<td><strong>Marsh area by nearest neighbor distance</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;=10 m: 1,161 ha</td>
<td></td>
</tr>
<tr>
<td>10 – 100 m: 143 ha</td>
<td></td>
</tr>
<tr>
<td>100 – 1,000 m: 87 ha</td>
<td></td>
</tr>
<tr>
<td>1,000 – 10,000 m: 630 ha</td>
<td></td>
</tr>
<tr>
<td>&gt;10,000 m: 2,317 ha</td>
<td></td>
</tr>
</tbody>
</table>
| Marsh to Open Water Ratio | Marsh: 4,296 ha  
Open water: 26,554 ha  
Marsh to Open Water Ratio: 0.16 | Marsh core area ratio | Core Habitat: 815 ha  
Edge Habitat: 3,522 ha  
Core to Edge Ratio: 0.23 |
|---|---|---|---|
| Adjacency of marsh to open water by length and marsh patch size | Marsh Patch >100 ha: 31 km  
Marsh Patch 10 – 100 ha: 236 km | Marsh fragmentation index | Areas of marsh core habitat within large marsh patch (>100 ha) or within small patches < 1km from large patch: 491 ha |
| Ratio of looped to dendritic channels | Dendritic channels adjacent to marsh: 84 km  
Dendritic channels not adjacent to marsh: 255 km  
Looped Channels: 768 km  
Fluvial or Detached: 298 km | Wetted area by type in winter | Ponds, Lakes, Channels and Flooded Islands: 26,530 ha  
Tidal Inundation: 3,303 ha  
Seasonal long-duration flooding: 0 ha  
Seasonal short-term flooding: 18,128 ha |
| Marsh area by patch size | <=10 ha: 1,427 ha  
10 – 100 ha: 1,757 ha  
100 – 1,000 ha: 1,154 ha  
1,000 – 10,000 ha: 0 ha  
>10,000 ha: 0 ha | Riparian habitat length by width class | 0 – 100m: 626 km  
100 – 500m: 87 km  
>500 m: 11 km |
| Riparian habitat area by patch size | <=20 ha: 1,991 ha  
20 – 80 ha: 1,364 ha  
80 – 320 ha: 1,470 ha  
320 – 1,280 ha: 2,066 ha  
>1,280 ha: 0 ha | | |
| Length of marsh-terrestrial transition zone by terrestrial habitat type | Willow Riparian Scrub or Shrub: 370 km  
Valley Foothill Riparian: 116 km  
Oak Woodland and Oak Savannah: 0 km  
Alkali Seasonal Wetland Complex: 19 km  
Wet Meadow and Seasonal Wetland: 30 km | Stabilized Interior Dune Vegetation: 0 km  
Grassland: 103 km  
Willow Thicket: 59 km  
Vernal Pool Complex: 4 km |

**Target:**
- Increasing extent of flooding by different inundation types throughout the year, including seasonal shallow short-term flooding, seasonal deeper long-duration flooding, and tidal inundation.
- Increasing proportion of marsh to open water habitat.
- Increasing proportion and extent of marsh-open water edge that occurs along large marsh patches (>100 ha). Decreasing proportion of marsh-open water edge that occurs along small marsh patches.
- Decreasing proportion of looped to dendritic channels.
- Increasing extent and proportion of marsh habitat that are in large size classes (>100 ha).
- Decreasing proportion of marsh that occurs in small size classes.
- Increasing proportion of marsh habitat that occurs in close proximity to a large marsh patch (>100 ha).
Increasing proportion and extent of marsh habitat that occurs in “core” habitat (at least 50 m from outside edge of marsh).

Increasing proportion and extent of marsh habitat that occurs either in core habitat of large marsh patches or in smaller patches less than 1 km from nearest large patch.

Increased extent of different types of inundation for types wintering waterfowl.

Increasing proportion and extent of riparian habitat that occur in larger patches. Decreasing proportion of riparian habitat that occurs in smaller patches.

Increasing proportion and extent of riparian habitat length that occurs in wider width size classes. Decreasing proportion of riparian habitat length that occurs in narrow width size classes.

Increasing length of marsh-terrestrial transition zone.

Prevention and reduction of key nonnative terrestrial and aquatic invasive species in the Delta and Suisun Marsh. (Strategy 4.4)

Metrics:
Metrics are to be evaluated annually:

- Number of key new nonnative invasive species of fish, plants, and invertebrates establishing populations in the Delta (e.g., Quagga and Zebra mussels, Hydrilla verticillata, and others as they are identified).

Managing nonnative fish:
  - Percentage of the total biomass of fish that are native fish species based on USFWS beach seine surveys (and other relevant surveys).
  - Percentage of total relative abundance that are native species in the Delta and Suisun Marsh based on USFWS beach seine surveys (and other relevant surveys).

Managing invasive nonnative vegetation:
  - Number of acres treated for invasive plants as defined by individual plans and projects (e.g., Central Valley Flood Protection Plan Conservation Strategy, Arundo control project, California Division of Boating and Waterways (DBW) aquatic invasive species control programs, etc.).
  - Peak coverage, in acres, of invasive nonnative plant species (e.g., Eichhornia crassipes, Ludwigia spp., Egeria densa, Arundo donax, and Phragmites australis) in the Delta and Suisun Marsh.

Baseline:

- Species reported as established in the Delta prior to 2013 Delta Plan adoption will be used for baseline identification of new invasive species established post-2013.

Fish:
  - Average percentage of total fish biomass that are native fish species based on USFWS beach seine surveys from the period of 1995-2015.

Vegetation:
  - Number of acres treated set at zero as of 2013.
Target:
To be achieved by 2030:

- Zero new nonnative invasive species of fish, plants, and invertebrates established in the Delta.
- **Fish**:  
  - 20 percent increase in the biomass of the native inshore fish community, relative to total fish biomass.
  - 20 percent increase in the relative abundance of the native inshore fish community, compared to total relative abundance.

- **Vegetation**:
  - Acreage targets for treatment of invasive plants as defined by individual plans and projects:
    - 680 acres within lower Sacramento.
    - 800 acres within lower San Joaquin.
    - 15 acres in the Cache Slough Complex (Arundo control project).
    - 5,000 acres annually, for herbicide floating aquatic vegetation treatment in the Delta.
    - 2,500 acres during treatment seasons for herbicide submersed aquatic vegetation treatment in the Delta.
  
  - A 50 percent reduction in peak nonnative invasive plant species coverage (acres), including, but not limited to: *Eichhornia crassipes*, *Ludwigia spp.*, *Egeria densa*, *Arundo donax*, *Rubus armeniacus*, *Lepidium latifolium*, and *Phragmites australis*.

Output Performance Measures

- Progress toward higher acreage of the following types: floodplain, tidal and subtidal, emergent wetland, shaded riverine aquatic and upland and riparian forest habitats. Tidal wetland and floodplain restoration projects should occur in the priority habitat restoration areas described in ER R2. (Strategy 4.2)

Metrics:
- Number of acres of restoration projects constructed by habitat type, including

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15 Fish targets were calculated and derived from Mahardja, B., Farruggia, M.J., Schreier, B., and Sommer, T. (2017). *Evidence of a Shift in the Littoral Fish Community of the Sacramento-San Joaquin Delta*. PLOS ONE, 12(1), e0170683. Percentage increase in native fish biomass and in relative abundance reflects percentage decrease in nonnative fish species of the respective metric. Nonnative fish may prey upon native species, compete for food, take over habitat space, and alter food webs.


18 See the California State Parks Division of Boating and Waterways’ Floating Aquatic Vegetation (FAV) Control Programs: [http://www.dbw.ca.gov/?page_id=28995](http://www.dbw.ca.gov/?page_id=28995).

19 This reduction in invasive vegetation is based on efforts from large scale projects that address impacts of invasive species. This includes, but is not limited to: individual plans and projects that include treatment, California EcoRestore program, and project and non-project levee vegetation management. A full list of efforts will be described in the datasheet.
progress toward the biological opinions’ targets of restoring 8,000 acres of tidal wetlands and 17,000-20,000 acres of floodplain habitat in the Priority Restoration Habitat Areas.

Baseline:
- Set at zero, the number of acres restored as of the Delta Plan’s adoption date (May 2013) to capture all the restoration actions that have been implemented after the plan was completed.

Target:
- 8,000 acres of tidal wetlands and 17,000-20,000 acres of floodplain habitat projects constructed in the Priority Restoration Habitat Areas as described in the 2008 and 2009 Biological Opinions for the state and federal water projects.

♦ All hatchery anadromous salmonids marked and tagged. (Strategy 4.5)

Metrics:
- Percent marked and tagged, as reported by National Marine Fisheries Service and California Department of Fish and Wildlife.

Baseline:
- As of May 2013 (Delta Plan adoption date):
  - 100% marked and tagged for Chinook salmon winter-run, spring-run and late-fall run.
  - 25% marked and tagged for Chinook salmon fall-run.
  - 0% tagged and 100% marked for steelhead.

Target:
- 100% of hatchery fish are marked and tagged.

**Administrative Performance Measures**

**Strategy 4.1: Create More Natural Functional Flows**

♦ Prior to the establishment of revised flow objectives identified above, 100% of proposed actions that could significantly affect flow in the Delta are consistent with the existing Bay Delta Water Quality Control Plan objectives.

♦ The SWRCB adopts Delta flow objectives that are necessary to achieve the coequal goals by June 2, 2014.

♦ The SWRCB adopts flow objectives that are necessary to achieve the coequal goals for the major tributary rivers to the Delta by June 2, 2018.

**Strategy 4.2: Restore Habitat**

♦ 100% of proposed actions that include habitat restoration in the Delta meet one of the following standards: 1) are consistent with the text of Appendix H, based on the Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011); or 2) are not consistent with the elevation map (Figure 4-6), but the deviation is supported by a rationale based on best available science.

♦ 100% of all proposed actions other than habitat restoration have clearly demonstrated that significant adverse impacts to the opportunity for habitat restoration as described in ER P2 were avoided or mitigated.
♦ 100% of proposed actions to construct new levees or substantially rehabilitate or reconstruct existing levees in the opportunity areas defined in Appendix 8, demonstrate that they have evaluated alternatives (including use of setback levees), and where feasible, have incorporated such alternatives into levee projects to increase the extent of floodplain and riparian habitat.

♦ DFW, DWR, and/or the Delta Conservancy identify number of projects and amount of funding for priority habitat restoration projects.

♦ The preponderance of proposed habitat restoration projects is within the six priority areas and considers landscape elements and improvement in water quality.

♦ 100% of proponents of habitat restoration projects consult the California Department of Public Health’s *Best Management Practices for Mosquito Control in California*.

♦ The Delta Conservancy develops and adopts criteria for prioritization and integration of large-scale ecosystem restoration in the Delta and Suisun Marsh, with sustainability and use of best available science as foundational principles.

♦ The Delta Conservancy develops and adopts processes for ownership and long-term operations and management of land in the Delta and Suisun Marsh acquired for conservation or restoration.

♦ The Delta Conservancy develops and adopts a formal mutual agreement with the Department of Water Resources, Department of Fish and Wildlife, federal interests, and other State and local agencies on implementation of ecosystem restoration in the Delta and Suisun Marsh.

♦ The Delta Conservancy develops a plan and protocol for acquiring the land necessary to achieve ecosystem restoration consistent with the coequal goals and the Ecosystem Restoration Program’s Delta Conservation Strategy.

♦ The Delta Conservancy leads an effort to investigate how to better use habitat credit agreements.

♦ The Delta Conservancy, in conjunction with DFW and USFWS, develop rules for voluntary Safe Harbor Agreements with property owners in the Delta.

♦ The U.S. Army Corps of Engineers develops an agreed-upon variance process to exempt Delta levees from the U.S. Army Corps of Engineers’ levee vegetation policy where appropriate.

♦ BCDC updates the Suisun Marsh Protection Plan to address adaptation to sea-level rise and ensure consistency with the Suisun Marsh Preservation Act, the Delta Reform Act and the Delta Plan.

♦ BCDC submits amendments of the Suisun Marsh Protection Plan to the Council for review for consistency.

♦ BCDC submits amendments of components of the Suisun Marsh Local Protection Program to the Council for review for consistency.

♦ BCDC adopts the updated Suisun Marsh Protection Plan and the Suisun Marsh Local Protection Program.

**Strategy 4.3: Improve Water Quality to Protect the Ecosystem**

See Chapter 6: Water Quality.

**Strategy 4.4: Prevent Introduction of and Manage Nonnative Species Impacts**

♦ 100% of all proposed actions that have the reasonable probability of introducing, or improving the habitat conditions for, nonnative invasive species have demonstrated that the potential for new
introductions of and/or improved habitat conditions for nonnative invasive species have been fully considered and avoided or mitigated in a way that appropriately protects the ecosystem.

- The Department of Fish and Wildlife develops for consideration by the Fish and Game Commission proposals for new or revised fishing regulations designed to increase populations of listed fish species through reduced predation by introduced sport fish.
- The Department of Fish and Wildlife and other appropriate agencies prioritize the list of “Stage 2 Actions for Nonnative Invasive Species.”
- The Department of Fish and Wildlife and other appropriate agencies fully implement the 2014 Ecosystem Restoration Program “Conservation Strategy” list for Strategic Goal 5.

**Strategy 4.5: Improve Hatcheries and Harvest Management**

- Hatcheries develop scientifically sound Hatchery and Genetic Management Plans (HGMPs).
- The Department of Fish and Wildlife provides annual updates to the Council on the status of HGMPs within its jurisdiction.
- The Department of Fish and Wildlife, in cooperation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service revises and begins implementing its program for marking and tagging hatchery salmon and steelhead to improve management of hatchery and wild stocks by December 2014.

**Chapter 5: Protect and Enhance the Unique Cultural, Recreational, Natural Resource, and Agricultural Values of the California Delta as an Evolving Place**

**Strategy 5.1: Designate the Delta as a Special Place**
**Strategy 5.2: Plan to Protect the Delta’s Lands and Communities**
**Strategy 5.3: Maintain Delta Agriculture**
**Strategy 5.4: Encourage Recreation and Tourism**
**Strategy 5.5: Sustain a Vital Delta Economy**

**Outcome Performance Measures**

- Increase acres with subsidence reversal or carbon sequestration practices. (Strategy 5.2)

  **Metrics:**
  - Acres of subsidence reversal and carbon sequestration projects, evaluated annually.
  **Baseline:**
  - Set at zero as of 2008.
  **Target:**
  - 30,000 acres by January 1, 2030 (905 acres were converted in 2008-2011 and will be included towards meeting the target).
The importance of agricultural lands, as they relate to wildlife habitat and ecosystem restoration, will be addressed through future Delta Plan review and amendment processes.  

As identified in the Farmland Mapping and Monitoring Program (FMMP), including Prime Farmland, Unique Farmland, Farmland of Statewide Importance, Farmland of Local Importance, and Grazing Land. Department of Conservation (http://www.conservation.ca.gov/dlrp/fmmp).


Developed by the Center for Regional Change at UC Davis, this index incorporates 33 indicators that measure relative opportunity, for both people and the places in which they live, and focuses on six broad domains: education, economy, housing, transportation/mobility, health/environment, and civic engagement.
- Regional Opportunity Index for People and Place, in the Primary Zone and Secondary Zone (score).

Baseline:
- Measured as of 2012.

Target:
- Regional Opportunity Index for People and Place (score), within the Delta, increases by 5 percent by 2025\(^24\).

- Increase in regional recreation opportunities throughout the Delta and Suisun Marsh. (Strategy 5.4)

Metrics:
- Number of regional Recreation Proposal recommendations and outcomes implemented within the Delta and Suisun Marsh, evaluated annually\(^25\).

Baseline:
- Measured as of the date of the regional Recreation Proposal completed in 2011.

Target:
- Implementation of the recommendations and outcomes put forward within the Recreation Proposal, to be achieved by 2025.

Output Performance Measures

- Prepare and implement plans for the vitality and preservation of each Delta legacy community. (Strategy 5.2)

Metrics:
- Number of community action plans adopted and initiated to achieve legacy community Delta Plan objectives, evaluated annually.

Baseline:
- Set at zero as of the Delta Plan’s adoption date, May 2013.

Target:
- All legacy communities have plans adopted by 2021.
- 25 percent implementation of plan objectives achieved by 2025.

Administrative Performance Measures

Strategy 5.1: Designate the Delta as a Special Place

- Delta Protection Commission completes application for designation of the Delta and Suisun Marsh as a National Heritage Area.

- The California Department of Transportation prepares a scenic byway plan and pursues National Scenic Byway status for Route 160 by January 1, 2014.

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\(^{24}\) The UC Davis Center for Regional Change will be releasing new information and features for the Regional Opportunity Index (ROI) (http://interact.regionalchange.ucdavis.edu/roi/webmap/webmap.html) which will provide the foundation to refine targets for the Delta; periodic evaluation of targets may be required in collaboration with the Delta Protection Commission.

\(^{25}\) Recommendations and outcomes proposed by California Department of Parks and Recreation in Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh, per 2009 Delta Reform Act legislative directive (http://www.parks.ca.gov/?page_id=26677).
Congress designates a National Heritage Area that includes the Delta and Suisun Marsh by January 1, 2014.

**Strategy 5.2: Plan to Protect the Delta’s Lands and Communities**

- 100% of proposed actions for urban development meet one of the following standards: 1) are located within areas that current city or county general plans as of the date of the Delta Plan’s adoption designate for development in cities or their spheres of influence; areas within Contra Costa County’s 2006 voter-approved urban limit line, except Bethel Island; areas within the Mountain House General Plan Community Boundary in San Joaquin County; or the unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde and Walnut Grove; 2) if located on Bethel Island, are consistent with the Contra Costa County general plan effective as of the date of the Delta Plan’s adoption; or 3) if located outside the areas described above, are consistent with the land uses designated in county general plans as of the date of the Delta Plan’s adoption and are otherwise consistent with Delta Plan policies.

- Water management facilities, ecosystem restoration, and flood management infrastructure are sited to avoid or reduce conflicts with existing or planned uses when feasible, considering comments from local agencies and the Delta Protection Commission. Plans for ecosystem restoration consider sites on existing public lands, when feasible and consistent with a project’s purpose, before privately owned sites are purchased.

- Local governments prepare plans for each community that emphasize its distinctive character, encourage historic preservation, identify opportunities to encourage tourism, serve surrounding lands, or develop other appropriate uses, and reduce flood risks.

- Agencies acquiring land for water management facilities, ecosystem restoration, and flood management infrastructure purchase from willing sellers, when feasible, including consideration of whether lands suitable for proposed projects are available at fair prices.

- The California Department of Transportation, local agencies, and utilities develop plans infrastructure, such as roads and highways, to meet needs of development consistent with sustainable community strategies, local plans, Delta Protection Commission’s Land Use and Resource Management Plan, and the Delta Plan.

- As part of the prioritization of State levee investments called for in RR P4, the Delta Stewardship Council consults with the California Department of Transportation as provided in Water Code section 85307(c) to consider the effects of flood hazards and sea level rise on state highways in the Delta.

- The Council, in conjunction with the California Air Resources Board (CARB) and the Delta Conservancy, investigates the opportunity for the development of a carbon market whereby Delta farmers could receive credit for growing native marsh and wetland plants.

- The Department of Water Resources has developed a plan, including funding needs, for increasing the extent of their subsidence reversal and carbon sequestration projects to 5,000 acres by January 1, 2017.

- 100% of State agencies have not renewed or entered into agricultural leases on Delta or Suisun Marsh islands if the actions of the lessee promote or contribute to subsidence on the leased land, unless the lessee participates in subsidence reversal or reduction programs.

**Strategy 5.3: Maintain Delta Agriculture**

- Local governments and economic development organizations take steps to encourage value-added processing of Delta crops in appropriate locations.
Local governments and economic development organizations take steps to support growth in agritourism, particularly in and around legacy communities.

The Department of Fish and Wildlife, the Delta Conservancy, and ecosystem restoration agencies take steps to encourage habitat enhancement and wildlife friendly farming systems on agricultural lands to benefit both the environment and agriculture.

**Strategy 5.4: Encourage Recreation and Tourism**

- Water management and ecosystem restoration agencies provide recreation opportunities, including visitor-serving business opportunities, at new facilities and habitat areas whenever feasible, and protect existing recreation facilities using California State Parks’ *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh* and Delta Protection Commission’s *Economic Sustainability Plan* as guides.

- The Delta Protection Commission and Delta Conservancy take steps to encourage partnerships between other state and local agencies, and local landowners and business people to expand recreation, including boating, promote tourism, and minimize adverse impacts to non-recreational landowners.

- Dedicated funding sources are identified to add or improve recreation facilities in the Delta.

- The Department of Fish and Wildlife, in cooperation with other public agencies, should collaborate with nonprofits, private landowners, and business partners to expand wildlife viewing, angling, and hunting opportunities.

- The Department of Boating and Waterways coordinates with the U.S. Coast Guard and State and local agencies on an updated marine patrol strategy for the region.

- Public agencies owning land increase opportunities, where feasible, for bank fishing, hunting, levee top trails, and environmental education.

- Cities, counties, and other local and state agencies work together to protect and enhance visitor serving businesses by planning for recreation uses and facilities in the Delta, providing infrastructure to support recreation and tourism, and identifying settings for private visitor-serving development and services.

**Strategy 5.5: Sustain a Vital Delta Economy**

- The ports of Stockton and West Sacramento encourage maintenance and carefully designed and sited development of port facilities.

- The Energy Commission and Public Utilities Commission cooperate with the Delta Stewardship Council as described in Water Code section 85307(d) and identify actions that should be incorporated in the Delta Plan to address the needs of Delta energy development, storage, and distribution by 2017.
Chapter 6: Improve Water Quality to Protect Human Health and the Environment

Strategy 6.1: Require Delta-Specific Water Quality Protection
Strategy 6.2: Protect Beneficial Uses by Managing Salinity
Strategy 6.3: Improve Drinking Water Quality
Strategy 6.4: Improve Environmental Water Quality

Outcome Performance Measures

- Water quality in the Delta and Suisun Marsh meets the standards of the Clean Water Act. (Strategy 6.1)

  Metrics:
  - The number of Delta watershed waterbody-contaminant combinations on the 303(d) list, evaluated every 8 years within the State Water Resources Control Board Integrated Report.

  Baseline:
  - Measured as of the 2010 Integrated Report.\(^{26}\)

  Target:
  - Reduction of 40 percent of the waterbody-contaminant combinations on the 303(d) list by 2034.

- Water management agency compliance with State Water Resources Control Board objectives for salinity in the Delta for D-1641 and X2.\(^{27}\). (Strategy 6.2)

  Metrics:
  - Monthly electrical conductivity and water temperature, and X2 in the Delta, evaluated annually.

  Baseline:
  - Average monthly electrical conductivity and water temperature, and X2, at compliance points from 1995 to 2015.

  Target:
  - Targets are to be achieved upon the adoption of these performance measures:\(^{28}\):
    - Water management agencies meet State Water Resources Control Board salinity objectives for ecosystem purposes, at least 99 percent of the time, at compliance points.

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\(^{26}\) State Water Resources Control Board, 2010 Integrated Report—Clean Water Act Section 303(d) List/305(b) Report (http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml); to be prepared on a tri-region cycle every 2 years, with data available for each region on an 8-year interval.

\(^{27}\) X2 is the distance from the Golden Gate Bridge to the point where daily average salinity is 2 parts per thousand at 1 meter off the bottom (Jassby et al., 1995). http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/usdoi/spprt_docs/doi_jassby_1994.pdf.

\(^{28}\) The targets are to be met during periods when Temporary Urgency Change Petitions (TUCPs) are not in effect (e.g., TUCPs may be in effect during severe drought).
- Water management agencies meet all other State Water Resources Control Board salinity objectives for urban and agricultural beneficial use, at least 99 percent of the time, at compliance points.
- Water management agencies maintain average X2, for September and October, at or less than 74 km in the fall following wet years, and at or less than 81 km in the fall following above normal years. The monthly average X2 must be maintained at or seaward of these values for each individual month, and cannot be averaged over the two-month period29.

Consistently meeting applicable dissolved oxygen (DO) standards in the Delta by 2020 (i.e., Stockton Deep Water Ship Channel, Suisun Marsh, and Old and Middle River). (Strategy 6.4)

Metrics:
Progress of PM metrics are to be evaluated annually:
- Milligrams of DO per liter of water (mg/L).
- Continuous, real-time DO measurements made at multiple locations throughout the Delta.

Baseline:
- Measured as of the date of the Delta Plan’s adoption, May 2013.

Target:
- Targets to be achieved upon the adoption of this performance measure:
  - Meet water quality objectives for DO in the Stockton Deep Water Ship Channel, Suisun Marsh, and Old and Middle River.
  - Maintain or exceed the minimum DO concentrations of30:
    - 5 mg/L daily average everywhere in the Delta.
    - 6 mg/L daily average, from September through November, only in the San Joaquin River between Turner Cut and Stockton.

Measurable reduction in positive toxicity tests, using standard methods, for pesticides and other pollutants in Delta waters. (Strategy 6.4)

Metrics:
- Toxicity in sediments using invertebrates determined by standard methods approved by the USEPA, as measured by the State Water Resources Control Board31.

Baseline:
- The 2008-2012 averaged levels of toxicity using combined Toxic and Highly toxic sites from the Stream Pollution and Monitoring Program Report (18.8% toxicity).

Target:
- Less than 1 percent toxicity in sediment samples from pesticides and other contaminants, using invertebrate testing, by 2034.

29 The standards of 74 km in wet years, and 81 km in above normal years, are designed to mitigate the effects of X2 encroachment upstream, in current and proposed action operations, and to provide suitable habitat for organisms using this low-salinity region. The target is referenced in the Biological Opinions: https://www.fws.gov/sfbaydelta/documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf.
30 DO concentration can peak during daylight hours and drop during nighttime hours. As a result, a daily and/or monthly average needs to consistently meet TMDL standards in the Delta.
31 The Stream Pollution Trends Monitoring Program monitors trends in toxicity and pollution for California waters, and was implemented in 2008.
Reduced spatial coverage of freshwater harmful algal blooms in waterbodies in the Delta. (Strategy 6.1 and Strategy 6.4)

**Metrics:**
Progress of PM metrics are to be evaluated annually:
- Spatial coverage (acres) of Microcystis sp. cell concentration equivalents (cells/ml), in Delta waterbodies large enough to use the SWRCB mapping tool\(^{32}\) (e.g., Discovery Bay; South Delta along Grantline Canal and Old River surrounding Fabian Tract; Big Break Regional Shoreline; and San Joaquin River between Antioch and Stockton) with densities of 100,000 cell/ml\(^{33}\) or greater.

**Baseline:**
- Spatial coverage (acres) based on satellite images during the period of 2016–2017.

**Target:**
Target to be achieved by 2034:
- Zero acres of waterbodies with densities of 100,000 cells/ml\(^{34}\).

**Output Performance Measures**

- Implementation of the North Bay Aqueduct Alternate Intake Project to improve water quality, protect native fishes, and to provide reliable water deliveries. (Strategy 6.3)

**Metrics:**
- Project status.

**Baseline:**
- The Notice of Preparation for the North Bay Aqueduct Alternate Intake Project Environmental Impact Report was published on November 24, 2009.

**Target:**
- The Department of Water Resources, in collaboration with beneficiaries, would begin constructing the North Bay Aqueduct Alternate Intake Project by the end of 2019.

- Protect groundwater beneficial uses. Groundwater meets drinking water quality standards in the Delta for levels of nitrate (10 ppm NO3-N) and arsenic (10 ppb As). (Strategy 6.3)

**Metrics:**
- Number of groundwater wells used for drinking water supply that exceed arsenic and/or nitrate drinking water limits, evaluated every 5 years.

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\(^{32}\) The State Water Resources Control Board is in the process of finalizing an interactive mapping tool used for displaying estimated concentrations of cyanobacteria in large water bodies. The satellite tool will use data from the new Sentinel3b satellite, which detects the absorption of chlorophyll in phytoplankton and provides an estimate of chlorophyll-a concentration, and can detect the presence of phycocyanin. This data can then be used to calculate the portion of the biomass associated with cyanobacteria and non-cyanobacteria. Estimates for the average baseline reported between 2016-2017 will be calculated upon the tool’s release date (expected November 2017).

\(^{33}\) The tool for maintaining spatial images and cell count can be found through the SWRCB Cyanobacteria and Harmful Algal Bloom Network page: http://www.mywaterquality.ca.gov/habs/where/satellite.html. The tool is expected to be released in November 2017, and baseline satellite images will begin between 2016-2017.

\(^{34}\) Cell densities exceeding the 100,000 cells/ml threshold constitute a high-risk exposure, with an increased probability of irritative symptoms of exposure and potential health impacts. See the WHO guideline values for relative probability of acute health effects.
Baseline:
- Number of wells within the Delta which exceed 2008 California water quality standards for levels of nitrate (not to exceed 10 ppm NO3-N) and arsenic (not to exceed 10 ppb As), between the years of 2001–2013.

Target:
A 50 percent reduction in the number of wells exceeding nitrate and arsenic standards from baseline levels, using historical data from 2001–2013, achieved by 2034.

- Reduction in number of critical pesticides in the waters and sediments of the Delta and Suisun Marsh. (Strategy 6.4)

Metrics:
- The number of Delta watershed waterbody-pesticide combinations on the 303(d) list, as evaluated every 8 years within the State Water Resources Control Board Integrated Report.

Baseline:
- Number of waterbody-pesticide combinations on the 303(d) list reported in the 2010 Integrated Report\(^\text{35}\).

Target:
- Zero Delta watershed waterbody-pesticide combinations on the 303(d) list by 2034.

- Reducing concentrations and/or loads of bio-stimulatory substances in Delta waters. (Strategy 6.4)

Metrics:
- Concentration and/or loads of bio-stimulatory substances (in organic nutrients such as ammonium, nitrate, and phosphate) Delta water quality monitoring locations, evaluated annually.

Baseline:
- Bio-stimulatory substance concentrations, loads, and trends during the period of 2004-2013.

Target:
- Meet the limits and targets identified by the Delta Nutrient Science and Research Program\(^\text{36}\) by 2034.

Administrative Performance Measures

**Strategy 6.1: Require Delta-Specific Water Quality Protection**
- There is no administrative performance measure for this policy at this time.

\(^\text{35}\) State Water Resources Control Board, 2010 Integrated Report—Clean Water Act Section 303(d) List/305(b) Report (http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml); to be prepared on a tri-region cycle every 2 years, with data available for each region on an 8-year interval.

\(^\text{36}\) The State and Regional Water Resources Control Board are finalizing research prioritization and scientific work which will provide the foundation for interim targets addressing bio-stimulatory substances (e.g., Delta Nutrient Research Plan, Biological Integrity Assessment Project, and Bio-stimulatory Substances Project, to be completed in 2018). Future evaluation of targets may be required in the case of rulemaking processes and resulting regulations by SWRCB. (http://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/delta_nutrient_research_plan/).
100% of covered actions that affect water quality in the Delta identify any significant negative water quality impacts.

SWRCB and RWQCBs evaluate and include appropriate protections in any applicable water quality control plan.

**Strategy 6.2: Protect Beneficial Uses by Managing Salinity**

See Chapter 4 Strategy 1: Create More Natural Functional Flows

**Strategy 6.3: Improve Drinking Water Quality**

- Central Valley RWQCB completes the Central Valley Drinking Water Policy by July 2013.
- The Department of Water Resources completes the North Bay Aqueduct Alternate Intake Project EIR by July 1, 2012.
- SWRCB completes development of a Strategic Workplan for protection of groundwater beneficial uses by December 31, 2012.
- Central Valley RWQCB and SWRCB adopt policies and regulations necessary to require all relevant water users that are supplied water from the Delta or the Delta Watershed or discharge wastewater to the Delta or the Delta Watershed to participation in CV-SALTS.

**Strategy 6.4: Improve Environmental Water Quality**

- SWRCB develops a proposed policy for nutrients for Inland Surface Waters of the State of CA by January 1, 2014.
- SWRCB and RWQCBs begin implementation of a study plan for the development of objectives for nutrients in the Delta and Suisun Marsh by January 1, 2013, and complete studies by January 1, 2016.
- SWRCB and RWQCBs adopt objectives for nutrients in the Delta by January 1, 2018.
- TMDLs and Basin Plan Amendments for diazinon and chlorpyrifos are completed by January 1, 2013.
- The Central Valley Pesticide TMDL is completed by January 1, 2016.
- SWRCB and RWQCBS complete TMDLs and Basin Plan Amendments for methylmercury.
- The Central Valley Regional Water Quality Control Board review the methyl mercury control studies by December 31, 2018 and determine control measures for implementation starting in 2020.
- A Delta regional water quality monitoring program is developed.
- A Delta regional monitoring program is implemented within the first 5 years of the Delta Plan.
- The Central Valley Regional Water Quality Control Board requires responsible entities that discharge wastewater treatment plant effluent or urban runoff to Delta waters to evaluate whether all or a portion of the discharge can be recycled, otherwise used, or treated in order to reduce contaminant loads to the Delta by January 1, 2014.
- The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board complete the Phase 2 control plan for the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in the Stockton Ship Channel by January 1, 2015.
The State Water Resources Control Board and the San Francisco Bay Regional Water Quality Control Board complete the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in Suisun Marsh Wetlands by January 1, 2014.

Chapter 7: Reduce Risk to People, Property, and State Interests in the Delta

Strategy 7.1: Improve Emergency Preparedness and Response
Strategy 7.2: Finance and Implement Local Flood Management Activities
Strategy 7.3: Prioritize Flood Management Investment
Strategy 7.4: Improve Residential Flood Protection
Strategy 7.5: Protect and Expand Floodways, Floodplains, and Bypasses
Strategy 7.6: Integrate Delta Levees and Ecosystem Function
Strategy 7.7: Limit State Liability

Outcome Performance Measures

- Decrease in expected annual fatalities and expected property damages from flood emergencies in the Delta (Strategy 7.1)

  Metrics:
  - Expected Annual Fatalities (EAF) in the Delta. This will be evaluated at least every 5 years.
  - Expected Annual Damages (EAD) in the Delta. This will be evaluated at least every 5 years.

  Baseline:
  - EAF for the Delta using best available data as of 2017, as reported in the Delta Levees Investment Strategy final report.
  - EAD for the Delta using best available data as of 2017, as reported in the Delta Levees Investment Strategy final report.

  Target:
  - 50 percent decrease in EAF by 2025.
  - 50 percent decrease in EAD by 2025.

- Water-delivery interruptions due to floods or earthquakes in the Delta. (Strategy 7.3)

  Metrics:
  - Number of water-delivery interruptions caused by floods or earthquakes in the Delta. This performance measure will be assessed following any major floods or earthquakes in the Delta
  - Acre-feet of water not delivered due to disruptions caused by floods or earthquakes in the Delta. This performance measure will be assessed following any major floods or earthquakes in the Delta.

  Baseline:
  - N/A because this measure has a prescribed target and is not showing a change from a baseline.

  Target:
- No water delivery interruptions. This target is to be achieved upon the adoption of this performance measure.

- Increase in community credit points in National Flood Insurance Program (NFIP) Community Rating System. (Strategy 7.8)

  **Metrics:**
  - Community Rating System credit points of Delta communities participating in the NFIP. This will be evaluated at least every 5 years.

  **Baseline:**
  - Community Rating System credit points at the time of Delta Plan adoption in May 2013, or nearest available date.

  **Target:**
  - 1 percent increase in Community Rating System credit points by 2025.

**Output Performance Measures**

- Responsible local, State, and federal agencies with emergency response authority, implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5) by end of 2018. (Strategy 7.1)

  **Metric:**
  - Percent of recommendations implemented. This will be evaluated annually.

  **Baseline:**
  - Zero percent (0/11) of recommendations implemented.

  **Target:**
  - 100 percent (11/11) of recommendations implemented by the end of 2018.

- Level of flood-risk reduction provided by Delta levees. (Strategy 7.3)

  **Metrics:**
  - Percent of urban area in the Delta protected by levees meeting DWR’s urban level of flood protection criteria. This will be evaluated at least every 5 years.
  - Percent of rural Delta islands and tracts protected by levees at or above the Bulletin 192-82/PL 84-99 standard. This will be evaluated at least every 5 years.

  **Baseline:**
  - Percent of urban area in the Delta protected by levees meeting DWR’s urban level of flood protection criteria, as of completion of the Delta Levees Investment Strategy.
  - Percentage of rural Delta islands and tracts protected by levees at or above the Bulletin 192-82/PL 84-99 standard, as of completion of the Delta Levees Investment Strategy.

  **Target:**
  - 100 percent of urban communities in the Delta are protected by levees meeting DWR’s urban level of flood protection criteria, demonstrated by 2025.
  - 100 percent of the rural Delta islands and tracts are protected by levees at or above the Bulletin 192-82/PL 84-99 standard, demonstrated by 2050.

- Consideration of sea level rise in flood protection planning for new residential development in the Delta. (Strategy 7.5)

  **Metric:**
  - Number of proposed actions covered by the Delta Plan policy to require flood
protection for residential development in rural areas (RR P2). This performance measure will be evaluated as covered actions are submitted.

Baseline:
- N/A because this measure has a prescribed target and is not showing a change from a baseline.

Target:
- 100% of proposed actions to which RR P2 are applicable meet the requirements of RR P2. This target is to be achieved upon the adoption of this performance measure.

Administrative Performance Measures

Strategy 7.1: Improve Emergency Preparedness and Response

- Responsible local, State, and federal agencies with emergency response authority consider the recommendations of the Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5) by January 1, 2014.

- The Department of Water Resources evaluates the potential of creating stored material sites by “over-reinforcing” west Delta levees by January 1, 2014.

- Local levee maintaining agencies consider developing their own emergency action plans, and stockpiling rock and flood fighting materials by January 1, 2014.

- State and local agencies and regulated utilities that own and/or operate infrastructure in the Delta prepare coordinated emergency response plans to protect the infrastructure from long-term outages resulting from failures of the Delta levees by January 1, 2014.

Strategy 7.2: Finance and Implement Local Flood Management Activities

- The Legislature creates a Delta Flood Risk Management Assessment District with fee assessment authority.

- The Public Utility Commission (PUC) does the following:
  - Holds hearings on the topic of imposing a reasonable fee for flood and disaster prevention on regulated privately owned utilities with facilities located in the Delta.
  - Directs all regulated public utilities in the PUC’s jurisdiction to immediately take steps to protect the public utilities’ facilities in the Delta from the consequences of catastrophic failure of levees in the Delta.

- The governor issues an executive order directing State agencies with projects or infrastructure in the Delta to set aside funding to pay for flood protection and disaster prevention.

Strategy 7.3: Prioritize Flood Management Investment

- The Delta Stewardship Council facilitates development of funding priorities for State investments in Delta levees by January 1, 2015.

- The Delta Stewardship Council develops funding priorities for State investments in Delta levees by January 1, 2015.
Strategy 7.4: Improve Residential Flood Protection

- 100% of covered actions that involve new residential developments of five or more parcels provide a minimum 200-year level of flood protection when the new developments are located outside specified areas described in the Delta Plan.

Strategy 7.5: Protect and Expand Floodways, Floodplains, and Bypasses

- 100% of covered actions that encroach upon a floodway do not significantly impede the free flow of water or jeopardize public safety.

- 100% of covered actions that encroach upon a floodplain do not significantly affect floodplain values and functions, per stated requirements.

- The Department of Water Resources and the Central Valley Flood Protection Board evaluate a bypass and floodways on the San Joaquin River near Paradise Cut.

- 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, Appendix G), are continued in a manner that supports the Delta Plan and the coequal goals. Appropriate dredging throughout other areas in the Delta for maintenance purposes, or that would increase flood conveyance and provide potential material for levee maintenance or subsidence reversal is implemented in a manner that supports the Delta Plan and coequal goals.

- The Central Valley Flood Protection Board evaluates whether additional areas both within and upstream of the Delta should be designated as floodways.

Strategy 7.6: Integrate Delta Levees and Ecosystem Function

- DWR develops criteria to define locations for future setback levees in the Delta and Delta watershed.

Strategy 7.7: Limit State Liability

- The Legislature requires an adequate level of flood insurance for residences, businesses, and industries in flood-prone areas.

- The Legislature considers making changes to State law and/or constitutional changes that address the State’s potential flood liability, including giving State agencies the same level of immunity with regard to flood liability as federal agencies have under federal law.

Chapter 8: Funding Principles to Support the Coequal Goals

Administrative Performance Measures

- An inventory of current State and federal spending on programs and projects that contribute to the coequal goals is conducted.

- A Delta Finance Plan has been developed and is funded.

- State and federal funding gaps have been identified that are determined to hinder progress toward meeting the coequal goals.
Appendix F
Statutory Exemptions from Covered Actions

85057.5 (a) “Covered action” means a plan, program, or project as defined pursuant to Section 21065 of the Public Resources Code that meets all of the following conditions:

(1) Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh.
(2) Will be carried out, approved, or funded by the state or a local public agency.
(3) Is covered by one or more provisions of the Delta Plan.
(4) Will have a significant impact on achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and state interests in the Delta.

(b) “Covered action” does not include any of the following:

(1) A regulatory action of a state agency.
(2) Routine maintenance and operation of the State Water Project or the federal Central Valley Project.
(3) Regional transportation plans prepared pursuant to Section 65080 of the Government Code.
(4) A plan, program, project, or activity within the secondary zone of the Delta that the applicable metropolitan planning organization pursuant to Section 65080 of the Government Code has determined is consistent with either a sustainable communities strategy or an alternative planning strategy that the State Air Resources Board has determined would, if implemented, achieve the greenhouse gas emission reduction targets established by that board pursuant to subparagraph (A) of paragraph (2) of subdivision (b) of Section 65080 of the Government Code. For purposes of this paragraph, “consistent with” means consistent with the use designation, density, building intensity, transportation plan, and applicable policies specified for the area in the sustainable communities strategy or the alternative planning strategy, as applicable, and any infrastructure necessary to support the plan, program, project, or activity.
(5) Routine maintenance and operation of a facility located, in whole or in part, in the Delta, that is owned or operated by a local public agency.
(6) A plan, program, project, or activity that occurs, in whole or in part, in the Delta, if both of the following conditions are met:
(A) The plan, program, project, or activity is undertaken by a local public agency that is located, in whole or in part, in the Delta.

(B) Either a notice of determination is filed, pursuant to Section 21152 of the Public Resources Code, for the plan, program, project, or activity by, or the plan, program, project, or activity is fully permitted by, September 30, 2009.

(7) (A) A project within the secondary zone, as defined pursuant to Section 29731 of the Public Resources Code as of January 1, 2009, for which a notice of approval or determination pursuant to Section 21152 of the Public Resources Code has been filed before the date on which the Delta Plan becomes effective.

(B) A project for which a notice of approval or determination is filed on or after the date on which the final Bay Delta Conservation Plan becomes effective, and before the date on which the Delta Plan becomes effective, is not a covered action but shall be consistent with the Bay Delta Conservation Plan.

(C) Subparagraphs (A) and (B) do not apply to either of the following:

(i) A project that is within a Restoration Opportunity Area as shown in Figure 3.1 of Chapter 3: Draft Conservation Strategy of the Bay Delta Conservation Plan, August 3, 2009, or as shown in a final Bay Delta Conservation Plan.

(ii) A project that is within the alignment of a conveyance facility as shown in Figures 1 to 5, inclusive, of the Final Draft Initial Assessment of Dual Delta Water Conveyance Report, April 23, 2008, and in future revisions of this document by the department.

(8) Leases approved by a special district if all of the following apply:

(A) The uses proposed by the lease are authorized by the applicable general plan and zoning ordinances of the city where the special district is located.

(B) The uses proposed by the lease are approved by the city where the special district is located and the city complies with Chapter 3 (commencing with Section 85225) of Part 3, if applicable, prior to approval of the lease by the special district.

(C) The special district complies with the California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) prior to approving the lease.

(9) (A) Routine dredging activities that are necessary for maintenance of facilities operated by a special district.

(B) For purposes of this paragraph, “routine dredging activities” are limited to the following:

(i) Dredging to maintain the Stockton Deep Water Ship Channel at a depth of 40 feet in the sediment trap at the confluence of the San Joaquin River, between river mile 39.3 to river mile 40.2, and to maintain the remaining Stockton Deep Water Ship Channel at a depth of 35 feet plus two feet overdredge from river mile 35 to river mile 43.

(ii) Dredging designed to maintain the Sacramento Deep Water Ship Channel at a depth of 30 feet plus 2 feet of overdredge from river mile 0.0 to river mile 30, and at a depth of 35 feet from river mile 35 to river mile 43.
(C) Except as provided by this subdivision, it is the intent of the Legislature that this exemption shall not be interpreted or treated as changing or modifying current substantive and procedural regulations applicable to the decision to approve dredging operations.

(i) For purposes of this section, “special district” means the Port of Stockton or the Port of West Sacramento.

(ii) This section shall not be interpreted to authorize the abrogation of a vested right whether created by statute or by common law.
Appendix G
Achieving Reduced Reliance on the Delta and Improved Regional Self-Reliance
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Appendix G
Achieving Reduced Reliance on the Delta and Improved Regional Self-Reliance

In 2009, the State of California (State) further defined its water policy priorities, including express recognition that the Sacramento-San Joaquin Delta (Delta) crisis cannot be resolved by actions in the Delta alone.

Given the interconnected nature of the Delta with the water use patterns of large parts of Northern, Central, and Southern California, the new coequal goals of statewide water supply reliability and an improved, protected, and restored Delta ecosystem will fundamentally reshape California water management over the course of this century. Achieving these coequal goals is expected to be done, in significant part, through compliance with the Delta Reform Act’s various mandates and goals relating to statewide water conservation, efficiency, and sustainable water use, including the State’s new policy to reduce reliance on the Delta and related mandate to improve regional self-reliance.

The Delta Reform Act promotes many statewide strategies to address coequal goals, including water efficiency and conservation, wastewater reclamation and recycling, desalination and advanced water treatment technologies, improved water conveyance, surface and groundwater storage, improved water quality, and implementation of local and regional water supply projects (see Water Code sections 85004(b), 85020(d) and (f), 85021, 85023, 85303, and 85304).

These strategies are consistent with Water Code section 85021, which declares that the State’s policy is “to reduce reliance on the Delta in meeting California’s future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency.” That section also mandates that “(e)ach region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.”

Individual actions by water suppliers throughout the state to increase water efficiency, and develop local and regional water supplies are vital to achieving the coequal goals, and complying with new State policies to reduce Delta reliance and improve regional self-reliance. To promote these actions, the Delta Plan includes a regulatory policy, WR P1, Reduce Reliance on the Delta through Improved Regional Water Self-Reliance, which specifies the measures that must be taken by water suppliers under certain conditions to reduce their reliance on the Delta and improve regional self-reliance. In addition, the Delta Plan recommends that all water suppliers within the Delta watershed voluntarily implement the measures contained in WR P1 to reduce their reliance on the Delta and improve regional self-reliance.

The Delta Plan includes performance measures for assessing the state’s progress in achieving the coequal goals and objectives of the Delta Plan. At the statewide level, California’s success in achieving reduced
reliance on the Delta and improving regional self-reliance will be demonstrated through a significant reduction in the amount of water used or in the percentage of water used from the Delta watershed.

**An Example of Achieving Compliance with WR P1, Reduce Reliance on the Delta through Improved Regional Water Self-Reliance**

The intent of WR P1, Reduce Reliance on the Delta through Improved Regional Water Self-Reliance, is to ensure that urban and agricultural water suppliers that would receive water from the Delta as a result of a proposed covered action are implementing appropriate measures to contribute to the achievement of the State’s policy of reducing reliance on the Delta and the related mandate of improving regional self-reliance. An example for how water suppliers can comply with WR P1 is provided in the sidebar, An Example of Compliance with WR P1, Reduce Reliance on the Delta through Improved Regional Water Self-Reliance.

WR P1 potentially applies to a proposed action to export water from, transfer water through, or use water in the Delta; but the measures required by WR P1 are not triggered unless one or more water suppliers would receive water as a result of the proposed action (see 23 California Code of Regulations [CCR] Section 5003 (b)).

WR P1 specifically states that water shall not be exported from, transferred through, or used in the Delta if all of the following apply (see 23 CCR Section 5003 (b)):

1. One or more water suppliers that would receive water as a result of the export, transfer or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c) of 23 CCR Section 5003;
2. That failure has significantly caused the need for the export, transfer or use; and
3. The export, transfer, or use would have a significant adverse environmental impact in the Delta.

To comply with WR P1, the regulation specifies that water suppliers have done the following: (see 23 CCR Section 5003 (c)):

A. Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;

B. Identified, evaluated and commenced implementation, consistent with the implementation schedule set forth in the management Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and,

C. Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code Section 1011(a).
AN EXAMPLE OF COMPLIANCE WITH WR P1, REDUCE RELIANCE ON THE DELTA THROUGH IMPROVED REGIONAL WATER SELF-RELIANCE

The following scenario illustrates how Water Supplier A would comply with WR P1, Reduce Reliance on the Delta through Improved Regional Water Self-Reliance.

In this example, Water Supplier A applies for a multiyear transfer of water through the Delta. Water Supplier A will receive water from the proposed transfer, as will several other water suppliers.

For the proposed water transfer to be inconsistent with WR P1, Water Supplier A would have to make three findings in the certification of consistency form:

- The proposed transfer will have a significant adverse environmental impact on the Delta.
- One or more water suppliers that will receive water from the proposed transfer have failed to complete the three WR P1 compliance requirements that demonstrate how they are contributing to reduce reliance on the Delta.
- The failure of those water suppliers was a significant cause for the need for the proposed transfer.

The steps that Water Supplier A would follow in making these findings are the following:

**First: Is the proposed water transfer a covered action?**

- If NO, then Water Supplier A is urged to comply with WR P1 voluntarily.
- If YES, then Water Supplier A would need to determine whether the proposed transfer would have a significant adverse environmental impact in the Delta.

**Second: Will the proposed transfer have a significant adverse environmental impact in the Delta?**

Water Supplier A, as the applicant for the proposed transfer, will make this determination based upon the environmental assessment it prepares for the project.

- If NO, then Water Supplier A provides the necessary documentation in the consistency certification form to substantiate this finding. Although no further action to comply with WR P1 is required, Water Supplier A is urged to implement WR P1 voluntarily.
- If YES, then Water Supplier A would need to address the three compliance requirements listed in WR P1 for all of the water suppliers that would receive water as a result of the proposed transfer.

**Third: Have one or more urban or agricultural water suppliers (see 23 CCR sections 5001(b), (c)(1) and (2), (hh)(1) and (2), and (ii)) that will receive water as a result of the proposed transfer failed to comply with the three requirements listed in WR P1?**

Water Supplier A will need to provide a finding in the consistency certification form as to whether one or more water suppliers that will receive water as a result of its proposed transfer have failed to comply with the three requirements. The three compliance requirements are:

1. **Comply with specified water management laws.** Each water supplier has a current water management plan that has been reviewed for compliance with applicable laws by the California Department of Water Resources.
2. **Analyze and implement.** Each water supplier has identified, evaluated, and commenced implementation, consistent with the schedule they identify in their plan, of the technically feasible, locally cost-effective programs and projects that will reduce reliance on the Delta.
3. **Report.** Commencing with the 2015 plan, each water supplier has documented in its current plan the expected outcome for measureable reduction in Delta reliance and improvement in regional self-reliance from the implementation of their programs and projects. This shall be reported as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed.

Water Supplier A can gather the information from other water suppliers that will be included in its consistency certification form in a number of ways. The supplier can send out a letter requesting that each additional water supplier that will receive water as a result of the proposed transfer certify the status of their compliance with WR P1. If Water Supplier A is a wholesale agency, it could request its member agencies to be responsible for submitting their own information and for obtaining the information from their sub-agencies (and the sub-agencies would be responsible for their own sub-agencies).

**Fourth: Has the failure of one or more water suppliers to comply with the three requirements listed in WR P1 significantly caused the need for the proposed transfer?**

Water Supplier A will need to provide a finding in the consistency certification form on whether the failure of one or more water suppliers to comply with the three requirements significantly caused the need for the proposed transfer. Water Supplier A will use the information collected from each of the water suppliers that will receive water as a result of the proposed transfer as the basis for making the determination. Water Supplier A will also have the opportunity in the consistency certification form to describe the region’s progress in reducing its reliance on the Delta and improving regional self-reliance, and to report on the regional reduction in the amount of water used, or in the percentage of water used, from the Delta watershed.
Key Questions Concerning Implementation of WR P1

♦ Which Urban and Agricultural Water Suppliers May Be Required to Comply with WR P1?

“Water suppliers,” as used in WR P1 and in the Delta Plan, refers to both “urban water” suppliers and “agricultural water” suppliers as defined by California law (see 23 CCR Section 5001(b), (c)(1) and (2), (hh)(1) and (2) and (ii)). WR P1 may only apply to water suppliers that receive or use water from the Delta that also meet the following definitions:

“Urban water supplier” refers to both “urban retail water suppliers” and “urban wholesale water suppliers.” An “urban retail water supplier” means a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes. An “Urban wholesale water supplier” means a water supplier, either publicly or privately owned, that provides more than 3,000 acre-feet of potable water annually at wholesale for municipal purposes.

“Agricultural water supplier” refers to both “agricultural retail water suppliers” and “agricultural wholesale water suppliers” under the Water Code, but not the Department of Water Resources, the United States Bureau of Reclamation or agricultural water suppliers during the time that they may be exempted by Section 10853 of the Water Code from the requirements of Parts 2.55 and 2.8 of Division 6 of the Water Code. An “agricultural water supplier” includes both of the following:

A water supplier, either publicly or privately owned, providing water to 10,000 or more irrigated acres, excluding recycled water; and a water supplier or contractor for water, regardless of the basis of the water right, that distributes or sells water for ultimate resale to customers.

♦ What Do Urban and Agricultural Water Suppliers Need to Do to Comply with WR P1?

There are three core compliance requirements in WR P1. Water suppliers must:

1. Comply with specified water management laws. Water suppliers must have a current urban or agricultural water management plan that has been reviewed for compliance with applicable laws by the California Department of Water Resources (DWR).

2. Analyze and Implement. Water suppliers must have identified, evaluated, and commenced implementation, consistent with the schedule they identify in their plan, of the technically feasible, locally cost-effective programs and projects that will reduce their reliance on the Delta.

3. Report. Water suppliers must report on the expected outcome for measureable reduction in the amount of water used, or in the percentage of water used, from the Delta watershed, starting in 2015.

♦ What Types of Measures Should Urban and Agricultural Water Suppliers Consider Implementing to Reduce Their Reliance on the Delta?

Measures that reduce reliance on the Delta and improve regional self-reliance include programs and projects that improve water efficiency, water recycling, stormwater capture and use, conjunctive use projects, local and regional water supply and storage projects, watershed management, and regional coordination of local and regional water supply efforts. The State Water Plan identifies 27 different water supply and management measures that water suppliers may want to consider when developing their water management plans (DWR 2009).
When Should Progress in Reducing Reliance on the Delta Be Reported?

Water suppliers must report on the expected outcome for measurable reduction in the amount of water used, or in the percentage of water used, from the Delta watershed, starting in 2015. Progress in reducing reliance on the Delta will be reported in subsequent urban or agricultural water management plans, which are due in years ending in five or zero (see Water Code section 10621(a) and Water Code section 10820 (a) and (b)).

How Will Water Suppliers Report Their Progress in Reducing Reliance on the Delta?

Starting in 2015, water suppliers will report on the expected outcome of the measures they are implementing in their urban or agricultural water management plans to reduce reliance on the Delta and improve regional self-reliance. Their progress will be reported in these plans as a reduction in the amount of water used, or in the percentage of water used, from the Delta watershed.

Do Water Efficiency and Conservation Count Toward Reducing Reliance on the Delta?

For the purposes of reporting on a water supplier’s progress in reducing reliance on the Delta and improving regional self-reliance, water conservation and efficiency measures are considered a new source of water supply, consistent with Water Code section 1011(a). State water efficiency goals and metrics have been established through State law for urban and agricultural water suppliers. Water saved through implementation of these measures counts as a new source of supply because this is water that otherwise would have been needed to meet future demand. Even if total water use is increasing as a result of population or economic growth, a water supplier can demonstrate that its water use is more efficient and is contributing to reduced reliance on the Delta and improved regional self-reliance.

What Should Water Suppliers Do if They Want to Voluntarily Implement WR P1?

Water suppliers that do not receive water directly from the Delta, such as suppliers located in the Delta’s upper watershed, are not subject to the regulatory provisions of WR P1. However, the Delta Plan recommends that all water suppliers located within the Delta watershed voluntarily implement the measures contained in WR P1 to reduce their reliance on water from the Delta watershed and improve regional self-reliance. An example of how water suppliers may voluntarily implement the measures in WR P1 is discussed below.

An Example of Voluntary Implementation of Measures to Reduce Reliance on Water from the Delta Watershed and Improve Regional Self-Reliance

Although WR P1 is a regulation that applies only under specific conditions, the Delta Plan recommends that all water suppliers within the Delta watershed voluntarily implement the actions contained in WR P1 to reduce their reliance on water from the Delta watershed and improve regional self-reliance.

It is important to recognize that reliance on water from the Delta and the Delta watershed varies throughout California, from region to region and water supplier to water supplier. Some water suppliers have greater access to alternative water supplies or have a greater ability to implement a diverse range of water efficiency and water supply projects. Others, particularly in the Delta’s upper watershed, may have a narrower range of options; indeed, for many, the only source of water is out of the Delta watershed. The key is that every supplier must do its part and take appropriate action to improve regional self-reliance and contribute to reduced reliance on water from the Delta watershed.

Improvements in regional self-reliance may be assessed at a local, regional, and statewide level. Given the Delta Reform Act mandates to improve water supply reliability for California, reduce reliance on the
Delta, and improve regional self-reliance, water suppliers should meet the existing requirements of Senate Bill X7 7, comply with applicable urban water management and agricultural water management plan laws, and other water management statutes to identify, evaluate, and commence implementation of locally cost-effective and technically feasible measures, consistent with their water management plan schedules, that will reduce reliance and improve regional self-reliance and to report on the expected outcome of implementing these measures as the reduction in the amount of water used, or the percentage of water used, from the Delta watershed.

One approach to demonstrating improved self-reliance at the regional level is to conduct a regional assessment, consistent with the “regional compliance” guidelines provided by DWR in its 2010 guidebook (DWR 2010), which incorporates information from the relevant urban and agricultural water management plans. Regions may be described as the entire hydrologic region as defined by the State Water Plan (DWR 2009), a DWR-accepted integrated regional water management planning region, a region based on the boundaries of water supplier, or another appropriate scale.

The entity leading the development of a regional plan would identify the appropriate scale and all water suppliers (and other entities) that are participating in the regional plan. Measures to be considered include programs and projects that improve water efficiency, water recycling, stormwater capture and use, conjunctive use projects, local and regional water supply and storage projects, watershed management, and regional coordination of local and regional water supply efforts as well as the 27 different water supply and management strategies identified in the State Water Plan (DWR 2009).

Regional plans should document and report on the expected outcome for measurable reduction in reliance on water from the Delta watershed and improved regional self-reliance from the implementation of the identified programs and projects. This should be reported as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed.

References


Appendix H
Key California Water Conservation and Management Laws
## Appendix H
### Key California Water Conservation and Management Laws

### MANDATED ACTIONS:

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| 2009   | Sustainable Water Use and Demand Reduction (SBX7 7) (Water Code section 10608 et seq.) | - All water suppliers – urban and agricultural – must increase water use efficiency.  
- Agricultural water suppliers must adopt Agricultural Water Management Plans by 2012 (and update in 2015 and every 5 years thereafter), which include measured volume of water delivered, adopted price structure based at least in part on volume delivered, and additional efficient water management practices.  
- Urban water suppliers must achieve a 20 percent reduction in statewide urban per capita water use by 2020 (at least 10 percent by 2015) and include per capita targets in their Urban Water Management Plans by 2011.  
- All water suppliers that fail to comply (agriculture by 2013 and urban by 2016) are not eligible to receive State grants or loans. |
| 2009   | Groundwater Monitoring (SBX7 6) (Water Code section 10920 et seq.)           | - Local agencies must establish a groundwater level monitoring program; California Department of Water Resources (DWR) will implement groundwater monitoring for them if they fail to do so (or do not submit monitoring reports as required).  
- All responsible agencies that fail to comply are not eligible to receive State grants or loans. |
| 2009   | Water Diversion Reporting Requirements (SBX7 8) (Water Code section 5100)   | - Water diverters, including those in the Sacramento–San Joaquin Delta, must provide more detailed information on location and amounts of diversions in annual reports to the State Water Resources Control Board.  
- Civil liability and monetary penalties are increased for those who fail to report. |
| 2009   | Urban Water Management Planning Act (AB 797 and subsequent amendments) (Water Code section 10631) | - Urban water suppliers must update and adopt Urban Water Management Plans every 5 years that include assessments of water supplies and needs; compliance with water conservation requirements; plans to maximize local water supplies and minimize imported water; water reliability assessments; and contingency plans for drought and catastrophic interruption of water supplies based on the past, current, and future (up to 20 years) conditions.  
- Water suppliers that fail to comply are not eligible to receive water management State grants or loans. |
### MANDATED ACTIONS:

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| 2007 | Water Efficiency Demand Management Measures (AB 1420) (Water Code section 10630 et seq.) | • Urban water suppliers must implement specific water efficiency measures, including adoption of a rate structure that promotes water conservation, and report on implementation through Urban Water Management Plans.  
• Water suppliers that fail to comply are not eligible to receive water management State grants or loans. |
| 1990 | Agricultural Water Management Measures (AB 1404) (Water Code sections 5100, 5103, 10004.6) | • Cities and counties must adopt landscape water conservation ordinances by 2010 that include water-budget requirements that are appropriate to the climate. |
| 2004 | Water Meter Installation and Use (AB 2572) (Water Code section 525 et seq.) | • Urban water suppliers must install water meters on all municipal and industrial water service connections by 2025.  
• Urban customers that have water meters must be charged based on actual volume of deliveries by 2010. |
| 2002 | Groundwater Management Planning Act (SB 1938) (Water Code section 10753 et seq.) | • To be eligible for State grants and loans, groundwater agencies must adopt a plan that meets minimum requirements, including basin management objectives and a monitoring program. |
| 2001 | “Show Me the Water” Legislation (SB 610, SB 221) (Water Code section 10631 et seq., Government Code section 65867.5 et seq.) | • For residential development projects of 500 units or more (or equivalent levels for other types of development), cities and counties must show documentation on water availability to meet development’s needs.  
  - SB 610 requires water availability assessments to be included in environmental documentation.  
  - SB 221 requires verification of water availability prior to construction. |

### VOLUNTARY ACTIONS:

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| 2008 | Integrated Regional Water Management Planning Act (SBX2 1) (Water Code section 10530 et seq.) | • Provides guidance for Integrated Regional Water Management Plans (IRWMPs) including expanded collaboration and public outreach (must include at least three agencies), and assessment of key water issues including water reliability, vulnerabilities, quality, groundwater management, sustainability of supplies and use needs of disadvantaged communities, and integration of land use and improved resource stewardship.  
• Bond funds are available for DWR-approved IRWMPs. A new 2010 funding eligibility requirement includes assessment of how the plan contributes to the region’s reduced dependence on Sacramento–San Joaquin Delta water. |
| 1992 | Groundwater Management (AB 3030) (Water Code section 10750 et seq.) | • Encourages local agencies to prepare and adopt groundwater management plans, and provides guidance on what the plans should include. |
| 1990 | Agricultural Water Suppliers Efficient Water Management Practices Act (AB 3616) (Water Code section 10900 et seq.) | • Authorizes public agencies that supply agricultural water to initiate water conservation and efficiency programs. DWR is also authorized to establish the Agricultural Water Management Council and to evaluate potential water-efficient practices. |

**Notes:**
AB = Assembly Bill  
SB = Senate Bill
Appendix I
Addressing Multiple Stressors and Multiple Goals in the Delta Plan
(memorandum)
January 26, 2011

To: Phil Isenberg, Chair, Delta Stewardship Council
Members of the Delta Stewardship Council

From: Delta Independent Science Board

Re: Addressing Multiple Stressors and Multiple Goals in the Delta Plan

On August 18, 2010, some members of the California Legislature wrote to you requesting that the Delta Science Program and the Delta Independent Science Board (Delta ISB) “…conduct an assessment of stressors on populations of native fish species in the Delta, the Sacramento and San Joaquin rivers, and the tributaries of those rivers below the rim dams of the central valley.” In your response dated September 15, 2010, you stated, “It is my intent to ask our science team, including the Independent Science Board, to develop a list of ‘stressors’ to the Delta and then prioritize the stressors.”

Based on the members’ experience, a quick survey of key environmental management efforts around the world, and information gleaned from a one-day workshop organized by the Delta Science Program, the Delta ISB notes that environmental planners, managers, and scientists worldwide are struggling with the assessment and prioritization of multiple stressors. Given the clear urgency around developing an approach to handling multiple stressors for the Delta Plan, the Delta ISB notes and advises:

1. The Council’s decisions will necessarily blend scientific and political judgment. There is at present no broadly agreed upon objective methodology for prioritizing multiple stressors, but there are scientific tools, discussed in the attached supporting material, that can add rigor to subjective prioritization.

2. The Council, with the help of the Science Program and review by the Delta ISB, needs to make sure that there are strong causal connections between the stressors addressed in the Delta Plan and particular objectives within the broad coequal goals of the Plan. Sound science and improved modeling can help further ensure these causal connections as the Plan is implemented.

3. A large number of stressors need to be addressed. The Delta ISB has found no reason to think that reducing one stressor, or several stressors, will solve even a particular problem such as the pelagic organism decline (POD). The Delta ISB has prepared a list of key stressors, provided as Attachment 2 to this memo. These are organized under the following four categories:
   a. Global drivers that cannot be controlled by the Delta Plan but whose impacts can be reduced through adaptation,
   b. Legacy stressors resulting from past actions in the Delta watershed that cannot be undone,
   c. Anticipated stressors that can be foreseen resulting from present or future activities, and

"Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.”

– CA Water Code §85054
d. Current stressors that result from ongoing activities such as water management practices, agricultural practices, and waste discharges.

4. The Council should plan around the long-term drivers that are producing multiple stressors effecting the major changes in the Delta for the foreseeable future. Climate change, population growth, and pollution are driving numerous particular stressors causing unwanted impacts. Some of these drivers and their associated stressors cannot be mitigated by local action (e.g. temperature increase and changes in precipitation patterns from climate change) and the main planning response must be adaptation. Informed planning can mitigate other drivers and stressors (e.g. patterns of urban expansion from population growth).

5. The success of the Delta Plan depends on the strength of the system of environmental monitoring and adaptive management it establishes. The response of the Delta to management actions is uncertain and will be more so as climate change and other drivers shift the Delta system into new states. The Delta Plan needs to support substantially more intensive monitoring, strong ecological analytical capability, and clear mechanisms for review and updating all aspects of policy and management over time.

6. The implementation of the Delta Plan can improve over time through better integration of Delta science. The Delta Science Program and the prior efforts under CALFED provide the primary journal, conference venue, research support, and shared modeling efforts integrating the scientific understanding of the Delta. This coordinating role needs to be strengthened and expanded. The DRERIP (Delta Regional Ecosystem Restoration Implementation Plan) models, developed as part of CALFED, provide the most relevant set of scientific tools for assessing the significance of different stressors in the Delta, but the models need further development to be useful as dynamic tools for policy and planning.

The supporting material attached elaborates on the findings of the Delta ISB. The content of this memo and supporting material was approved for transmittal to the Council by a quorum of the Delta ISB on January 24, 2011.
Attachment 1

Supporting Material

The implementing legislation for the Delta Stewardship Council and Delta Plan, SBX7-1, specifies in Section 83502(c) that: “The Delta Plan shall include measures that promote all of the following characteristics of a healthy ecosystem” including (4) “reduced threats and stresses on the Delta ecosystem.” Thus, threats and stressors and their reduction must be addressed in the Delta Plan.

Members of the Delta ISB, with assistance from the Delta Science Program, reviewed the approaches used for classifying and prioritizing stressors in a wide variety of environmental planning and management efforts in the United States and around the world. A list of key stressors was also developed. Then, the Delta Science Program and Delta ISB organized a workshop held in Sacramento on January 12, 2011, at which invited experts, members of the Delta ISB and the Science Program Lead Scientist addressed two questions: 1) Is it feasible to classify stressors in terms of their importance to the goals of Delta management; and 2) What methods could be used to accomplish that classification? The workshop also helped the Board assess the available science for use in Delta planning and recommend sustaining the science for future needs.

We elaborate on the key points of our discussion about multiple stressors and best available science as follows:

1. There is no broadly agreed upon methodology for classifying and prioritizing multiple stressors

In the collective experience of the Delta ISB, the issues of multiple stressors and multiple objectives are pervasive, are of considerable concern to scientists, and are still being evaluated in the Delta, as they are for ecosystem planning and management worldwide. For a variety of reasons noted below, the ranking of stressors is especially difficult. With present understanding, it is not possible to identify a small number of key stressors preventing the achievement of the coequal goals. Nonetheless, the Board finds that there are several approaches that can be used to assist in classifying and prioritizing stressors. Council decisions about which stressors to address at which time will involve a blend of science and political judgment. The scientific tools that can help with this process are discussed further in the following sections.

2. The importance of a stressor depends on the importance of the management objective it impedes

The Delta Reform Act of 2009 specifies four basic goals for the Delta (section 29702) and further identifies a number of subgoals and characteristics of the Delta ecosystem and reliable water supply that the Delta Plan shall address (section 85302). These goals, subgoals and characteristics suggest an integrated set of objectives that the Delta Plan must try to address. Stressors can be considered as variables or aspects of the Delta system that are obstacles to meeting the objectives. Thus, stressors and objectives are tightly linked in the sense that
objectives define the important stressors and stressors affect the difficulty, or even possibility, of reaching the objectives.

Because of this tight linkage between policy and management objectives and stressors, the relative importance of stressors cannot be assessed, or prioritized, independent of the relative importance of the objective that is stressed. Scientists rarely address the relative values of different social objectives explicitly, and, as a consequence, the scientific literature provides little information about the relative importance of stressors.

3. **Assessing, or ranking, stressors is very complex for many reasons**

For example:

   a) Multiple stressors typically affect an objective in complex, interactive ways that can make it very difficult to ascertain that one stressor is more important than another.
   b) Objectives can also be interconnected.
   c) A stressor that impedes reaching one objective may have positive effects on achieving another objective.
   d) The action and importance of a stressor can vary over seasons or from year to year, or from place to place.
   e) Objectives and stressors can vary in importance, for example, as they are assessed at different spatial and temporal scales.
   f) There are two broad categories of stressors, those that can be mitigated and those to which the Delta Plan must adapt, and prioritizing across these categories is probably counterproductive.

In developing the Delta Plan, it will be important for the Council to look closely at the relationship between stressors and objectives to ensure that the most important stressors are identified and addressed in the Plan. At the same time, for the reasons noted in a-f above, this will be difficult and will require interactive scientific and political judgment.

4. **The terminology for describing and classifying stressors is not standardized**

Some environmental scientists use quite elaborate terminology to describe how systems respond to stressors and how stressed ecosystems can be managed, splitting terms that other scientists lump together. Even when referring to the same phenomenon, such as something that has a negative effect on an ecosystem attribute, some scientists refer to them as stressors, others call them threats. The inconsistent terminology can be quite frustrating, but this is the state of the science available for crafting The Delta Plan.

The DPSIR (Driver, Pressure, State, Impact and Response) framework has been adopted by the European Environment Agency for describing the challenges of environmental management. The relationships among these components are shown in the conceptual model of section 5: [DPSIR Overview.pdf](http://enviro.lclark.edu:8002/rid=1145949501662_742777852_522/DPSIR%20Overview.pdf).
• **Drivers** are the sources or creators of stress that exert pressure on the ecosystem; for example, altered flows through the Delta.

• **Pressures** are the stressors, the factors that act to determine the condition of a system attribute of interest; for example, altered flows result in increased salinity as well as other stressors (temperature, currents, etc.).

• **Key system attributes** are the components of the system that are of interest or concern; for example, the condition (e.g., physiology, reproduction, productivity) of wetland vegetation. Other examples of key system attributes might include the specific life-history stage of a species that is affected by a particular stressor, the population size of a listed species, or the availability of irrigation water for agricultural crops.

• **Responses** are the actions that are taken to maintain or improve the condition of key system attributes. For example, this could be changing the flow regime to reduce salinity stress at critical times of the year. Responses can be directed at the drivers or the stressors, to remove or mitigate their effects, or at the key system attributes, to facilitate adaptation to the stressors. For example, one response would be to manage flows—the driver, to reduce salinity—the stressor. Other management actions could be directed at the wetland vegetation (e.g., protecting critical areas or vegetation restoration), but management directed at the stressor itself, in this case salinity, is less likely.

• **Objectives** describe preferred outcomes of management actions on key system attributes; for example, restoring or improving wetland functioning.

• **Performance measures** are metrics describing the state of key system attributes that can be used to assess progress in meeting objectives; for example, progress might be evaluated by monitoring measures of productivity, biomass, or biodiversity.

• All elements of this conceptualization – the linkages among drivers, stressors, key system attributes, responses, objectives, and performance measures – are parts of an ongoing, dynamic process of **adaptive management**.

Note that, depending on the key system attributes of interest, what is a driver of stressors in one case can be a stressor in another. This has led some scientists to lump drivers and stressors together. This is the situation for the DRERIP (Delta Regional Ecosystem Restoration Implementation Plan), in which a driver-linkage-outcome terminology is used.² The DRERIP approach also underlies the POD (Pelagic Organism Decline) studies and BDCP (Bay Delta Conservation Plan).³ The U.S. Environmental Protection Agency has developed the “Causal Analysis/Diagnosis Decision Information System” or CADDIS that uses source, stressor, outcome terminology.⁴ Each of these approaches has different strengths and weaknesses. It is important to recognize, however, that the different approaches and terminologies are conceptually rather similar. Mainly, they differ in the degree to which they may aggregate causal

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² see: [http://www.dfg.ca.gov/delta/erpdeltaplan/](http://www.dfg.ca.gov/delta/erpdeltaplan/)
⁴ [http://www.epa.gov/caddis](http://www.epa.gov/caddis)
factors and in the labels they apply to different aspects of the system linking causes to outcomes. It is important to distinguish between what is stressing a system attribute (e.g., a species population, water quality) and what is producing or driving the stress, because this could affect the likelihood of successfully realizing goals and objectives. However, management actions can target different levels in the chain of causation depending on circumstances.

5. Ecosystem management models are a critical element in the characterization and assessment of stressors

The Delta ISB believes that defining and delineating stressors is best accomplished by developing a conceptual model that clearly specifies the relationships between cause and effect with respect to the attributes of interest. Such models have been successfully used as a template for structuring an ecosystem-management approach in numerous regional assessments. For example, they have been used as a basis for management programs in the Everglades of south Florida\(^5\) (Gentile et al. 2001) and Alaska\(^6\) and are the foundation of conservation planning in The Nature Conservancy\(^7\) and the Conservation Measures Partnership.\(^8\) In these programs, the conceptual models have been used to identify risks and develop performance criteria as well as to provide a clear understanding of stressors in the systems. Conceptual models also are a prominent part of DRERIP, which includes both species life-history models and ecosystem-component models. Because they are specific to the Delta, the DRERIP models provide a valuable resource for characterizing causal linkages between stressors and objectives and for prioritizing stressors.

The following diagrams illustrate (on the left) a conceptual model of the pathways linking drivers to outcomes and objectives and how stressors fit into this causal chain and provide a hypothetical example (on the right, described in section 4) to clarify the components and linkages of this conceptualization. The elements within the oval are the components linking drivers and stressors to system attributes, management responses, and objectives. The box below the oval indicates how all of these components feed into the monitoring and performance assessment that are at the core of adaptive management, and the arrows encircling the oval indicate that adaptive management is a continuous, ongoing process.


\(^7\) see [http://conserveonline.org/workspaces/cbdgateway/cap/index.html](http://conserveonline.org/workspaces/cbdgateway/cap/index.html)

\(^8\) see [http://www.conservationmeasures.org/](http://www.conservationmeasures.org/)
This conceptual model is derived from the DPSIR approach and generally follows the approach of Gentile et al. (2001). The DRERIP models, in general, represent the left three steps within the large oval (Drivers, Stressors, Key ecosystem attribute, which in DRERIP terms are Drivers, Linkages, Outcomes).

Understanding how particular factors fit into this conceptualization – as drivers, stressors, or key system attributes – and developing scientifically sound conceptual models of the causal relationships is critical because it affects where management actions can be most effective and what to expect (and monitor) as a result of the actions. In general, actions directed at a driver (e.g., water flow) will affect multiple stressors (e.g., water temperature, seasonality, chemistry, as well as salinity), whereas actions directed at stressors will have more targeted effects. Importantly, a stressor should be defined in terms of its effect on a key system attribute and an objective for that attribute. In the above example, increased salinity may be a widespread or frequent consequence of altered flows, but it will differ in its effects (i.e., its status as a stressor) on different species or system components. Furthermore, there are temporal and spatial dimensions to the presence of a stressor; salinity levels may vary seasonally and be dependent on location in the Bay-Delta system. Finally, stressors are scale-dependent – some stressors may act broadly, others only in localized situations. Proper assessment of stressors requires consideration of temporal and spatial variation and the operating scales at which drivers are linked to stressors and attributes. Management actions need to be commensurate with the scale of the stressor.

6. Different kinds of stressors call for different kinds of responses

Stressors can be classified in various ways; in terms of origin, mode of action, spatial and temporal breadth of impact, whether or not managers have the ability to affect their action, and so on. Classifying stressors is an essential step toward understanding, and eventually to assessing
them. The Delta ISB found the following four categories of stressors to be helpful in our own discussions of the Delta:

- **Globally determined stressors**—stressors, like the effects of climate change or human population growth, which cannot be eliminated or mitigated within the purview of the Delta Plan. Management actions must adapt to the continued effects of these stressors in the Delta.
- **Legacy stressors**—stressors that result from past actions in the Delta watershed that cannot be undone. These include stressors such as the continuing effects of sediment and mercury discharge during the gold mining era. Infrastructure that causes stress on the Delta and is not likely to be significantly altered, such as upstream dams and the network of levees, can also be treated as legacy stressors. Although these stressors cannot be eliminated, management actions can reduce their effects on the Delta.
- **Anticipated stressors**—stressors that scientists can anticipate will result from present or future activities. The Delta Plan can modify these stressors in such a way as to prevent or reduce the stressor or better adapt to the stressor.
- **Current stressors**—stressors that result from ongoing activities, such as water management practices, agricultural practices, waste discharges, etc. Management actions can either change those practices, take steps to reduce their effects on the Delta, or both.

Note that the legacy stressors exist because of an historic failure by Californians to anticipate and prevent or mitigate the long-term effects of human activity. They serve as a good reminder to us of the importance of anticipating stressors and reducing them through planning.

We list “current stressors” last because The Delta Plan needs to take the long temporal view. To the extent that current stressors are expected to carry on into the future, including how water is managed, the DSC should address them.

In preparing for the workshop on January 12, the Delta ISB compiled a list of stressors affecting the Delta. These are organized in relation to the categories above in Attachment 2. The list of stressors is not comprehensive, nor has it as yet been vetted in terms of how the various stressors relate to the objectives, subobjectives and characteristics listed in SBX7-1. However, the list serves to illustrate the broad range of kinds of stressors that must be considered in developing the Delta Plan and some of the constraints on opportunities to mitigate their effects.

Some long-term stressors, such as sea level rise, cannot be mitigated and must be adapted to. In some cases, when confronted with such stressors, objectives will have to be modified to fit the reality of the stressor. In other cases, the objective might be reached, or partially reached, through adaptation, for example, by improving levees. Where adaptation is necessary, the stressor requires us to reconsider the objective.

Where mitigation is possible, specific objectives are needed simply to identify what the stressors are. For example, section 83502(c)(1) specifies the objective of having “viable populations of native resident and migratory species.” To determine which stressors are preventing viable populations of native species, one typically must look at particular species – Chinook salmon, Sandhill crane, etc. – and what has been stressing them. In the process of identifying stressors, one might logically overlook less valued species or less valued states of the environment except...
to the extent they are important to valued species or valued states of the environment. A focus on particular species (listed species, for example) may lead to management measures that are detrimental to other species. Thus, even where a stressor can be mitigated, the outcome may not be universally positive. Trade-offs will be necessary as will vigilance in assessing the broad consequences of stressor reduction.

7. Pay attention to the long-term drivers

Decision-makers need to plan management in the context of the directional changes that are occurring in the Delta as well as the potential for catastrophic change if Delta levees fail. Decision-makers need to be looking 30-50 years into the future as they develop policy. Experience has shown that the development and implementation of major policies can take more than a decade and response times to policy change are also on the order of a decade or more. In essence, policies to manage for the coequal goals will need to be flexible and nimble enough to succeed in the context of continual but uncertain long-term directional change.

Climate change is driving directional change in several key variables affecting the coequal goals. Although total precipitation is not changing much, less is falling as snow so that the winter snowpack is decreasing. Because the snowpack is the major storehouse of water for spring and summer irrigation, loss of snowpack strongly affects the amount of water that is available for human and other uses. With warming temperatures, snowpack is melting earlier and winter flows are less stable. Consequently, peak flows occur earlier and over a shorter period of time. Air temperatures are also increasing so that both patterns of inflow to the Delta and water temperature are changing over time. Rising sea level is changing the salinity of the Delta and also increasing the risk to Delta levees. In addition to changes resulting from climate change, the likelihood of an earthquake within this century that will cause catastrophic breaks in Delta levees is high. Thus, there is significant risk that a number of Delta islands may be flooded in the future. Economic considerations will influence any decision about restoration of the levees, so that the future Delta may include a number of flooded islands as large deep lakes. Such flooding of islands will have important implications for the hydrodynamics and salinity of the Delta, will affect the quality of water exported from the Delta, and will impact Delta land use. New species continue to be introduced to the Delta so scientists expect that the biological community will continue to change with uncertain implications for native species. These kinds of broad-scale changes will also affect terrestrial ecosystems; changing habitat conditions for plants and wildlife, particularly migratory birds. Exotic species are also invading terrestrial habitats, with effects on productivity and food webs for native species. Processes of continual change also derive from population growth, urban expansion, agricultural practice and a host of other human activities in and around the Delta.

These continual processes of change greatly complicate development of effective management policy to protect, restore and enhance the Delta and maintain reliable water supply. Indeed, some analysts suggest that the Delta has entered a new ecological regime significantly different from its historic regime or even the recent past. This may not be a stable regime but rather a transitory condition that will continue to change as climate change and other unmanageable stressors continue to change the Delta. As changing climate increases stress on listed species, conservation may demand more water for environmental protection, further reducing the flows available for
other uses.

8. **Policies to deal with multiple stressors have highly uncertain consequences**

Although the Delta is a relatively well-studied environmental system, our ability to predict the Delta of the future is not strong. Scientific inferences are quite uncertain because the ongoing, serial change that is occurring in the Delta makes future states difficult to predict. Relationships that appear relatively well developed at one point in time (e.g., the relationship between abundance of four species in the Pelagic Organism Decline, and $X_2$ (The distance upstream from Golden Gate of the isopleth of two practical salinity units)) tend to break down as additional years of data are accumulated. Another consequence of change and non-linear responses to stressors is that even in circumstances where there is a clear dose/response relationship between change in a stressor and response of the system in the past, removing the stressor may not result in a reversal of the observed dose response relationship. A consequence of this uncertainty is that simply relieving stressors may not lead to desired outcomes. This fact speaks strongly to the need to implement policy as adaptive management experiments in which there is a clearly developed process for gathering information on the effectiveness of the policy and a mechanism for review and updating of all aspects of the policy over time. This need includes problem definition, conceptual model, indicator variables, and policy response.

SBX7 defines adaptive management in section 85052. “‘Adaptive management’ means a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives.” This definition is a fairly standard one. In applying adaptive management to the Delta, however, it is not reasonable to assume that the system is stable over time. The directional change that is occurring in the Delta means that the adaptive approach cannot assume that uncertainty will decline as more information is gathered. Planning and management must include rigorous programs of data gathering to assess the effectiveness of policy, but it needs also to recognize that policies may fail not only because of uncertainty in system behavior but because the system is actually changing over time in fundamental ways. In practical terms this makes monitoring programs and timely analysis of the data generated more important. There will also need to be ongoing research in the Delta to identify and anticipate the emergence of conditions that could undermine the effectiveness of policy.

9. **Support Delta science**

The Delta ISB is impressed with the variety and depth of past scientific study and ongoing research in the Delta. The Delta Science Program plays a central role in communicating and coordinating Delta science as well as funding and publicizing critical scientific initiatives. But the Delta ISB is also concerned that Delta science needs stronger integration and coordination. In this sense, the Delta ISB found the DRERIP models and approach to be an especially good start with considerable potential for further development. Although designed to evaluate restoration actions, the DRERIP models also provide an objective, science-based set of tools for evaluating stressors. The models do not, as yet, cover all the aspects that are of concern to the Council and at present they are static models that require staff to work out the effects of varying a stressor qualitatively. The usefulness of these models would be greatly enhanced if they were made
dynamic and interactive. Support to accomplish this through the Delta Science Program would give the Science Program and the Council a powerful, locally designed set of tools for assessing stressors now and in the future.

10. *Expect surprises*

As noted earlier, the Delta is changing over time. Some changes, like the effects of changing hydrology and sea level rise due to climate change, can be anticipated and modeled. In addition to changing climate, the 21st century Delta faces the likelihood of earthquakes that may leave a number of islands permanently flooded. Other changes are more contingent on unforeseeable circumstances, like species invasion or levee failure by decay. Regardless, uncertainty virtually guarantees that large, unexpected events will occur from time to time. From the perspective of analysis and prioritization of drivers and stressors, this has several implications. First, scientists and managers need to be continually alert for the emergence of new drivers and stressors. Second, the governance process needs to be nimble enough to adjust policy and management to respond to emerging problems. Third, even if management is focused on a subset of stressors, monitoring should continue to gather information on a broad spectrum of stressors as a means to monitor the “pulse” of the Delta. Such broad scale monitoring also has the potential to identify emerging issues and stressors before their effects are irreversible.
Some Key Drivers and Stressors Demonstrating a Possible Classification

As noted in section 6 of Attachment 1, the Delta ISB has found the following categorization of drivers and stressors to be helpful.

- **Globally Determined stressors (Global)** - stressors, like the effects of climate change or human population growth, which cannot be eliminated or mitigated within the purview of the Delta Plan. Management actions must adapt to the continued effects of these stressors in the Delta.

- **Legacy stressors (Legacy)** - stressors that result from past actions in the Delta watershed that cannot be undone. These include stressors such as the continuing effects of sediment and mercury discharge during the gold mining era. Infrastructure that causes stress on the Delta and is not likely to be significantly altered, such as upstream dams and the network of levees, can also be treated as legacy stressors. Although these stressors cannot be eliminated, management actions can reduce their effects on the Delta.

- **Anticipated stressors (Anticipated)** - stressors that scientists can anticipate will result from present or future activities. The Delta Plan can modify these stressors in such a way as to prevent or reduce the stressor or better adapt to the stressor.

- **Current stressors (Current)** - stressors that result from ongoing activities, such as water management practices, agricultural practices, waste discharges, etc. Management actions can either change those practices, take steps to reduce their effects on the Delta, or both.

The Delta ISB also prepared a list of drivers and stressors for the Delta. We present these under the categories suggested above with notes with respect to each stressor’s impact.

**Table of Some Key Drivers and Stressors in the Bay-Delta** [Notes include both changes in state of the ecosystem as well as examples of impacts.]

**PLEASE NOTE THAT THE FOLLOWING LIST OF DRIVERS AND STRESSORS IS NOT TO BE CONSIDERED A COMPLETE LISTING OF ALL POTENTIAL DRIVERS AND STRESSORS IN THE SYSTEM. THE ORDER OF THEIR OCCURRENCE ON THIS TABLE IS NOT INTENDED TO DENOTE ANY FORM OF PRIORITIZATION.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Whether Driver (D) or Stressor (S)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D Climate change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S Reductions in inflow and outflow</td>
<td>Possibly lower water yield</td>
</tr>
<tr>
<td></td>
<td>S Alterations in hydrograph</td>
<td>Changes in seasonal patterns (earlier, smaller freshest)</td>
</tr>
<tr>
<td></td>
<td>S Higher temperatures</td>
<td>Seasonal temperature variation; altered phenology (e.g., timing mismatch between predators and prey, flower and pollinator); species and biogeochemical processes impacted</td>
</tr>
<tr>
<td>Type</td>
<td>Whether Driver (D) or Stressor (S)</td>
<td>Notes</td>
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<tr>
<td>---------------</td>
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</tr>
<tr>
<td></td>
<td>by temperature</td>
<td></td>
</tr>
<tr>
<td>S Sea level rise</td>
<td>Salinity intrusion, levee breaches, altered rates of erosion and deposition. Shifting species distribution and food web dynamics</td>
<td></td>
</tr>
<tr>
<td>S Changes in ocean conditions</td>
<td>Many Delta species spend part of their lives living or feeding in the ocean</td>
<td></td>
</tr>
<tr>
<td><strong>Global</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D Earthquakes</td>
<td>Levee and highway damage</td>
<td></td>
</tr>
<tr>
<td>D Population growth</td>
<td>Places increasing pressure on land and water resources</td>
<td></td>
</tr>
<tr>
<td>D California economy</td>
<td>Patterns of development, agriculture, recreation are driven by economics</td>
<td></td>
</tr>
<tr>
<td><strong>Legacy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S Habitat loss and alteration</td>
<td>Loss or reduction of seasonal and tidal wetlands, riparian habitats, gallery forests and native grasslands; simplified system of leveed agricultural islands separated by deep channels with leveed shorelines; small, unconnected fragments of natural habitat; channels unconnected to floodplain; uplands less connected to Delta; channels dredged, interconnected, and simplified; terrestrial diversity reduced; impacts include: changing competition and predation, loss of access to breeding sites</td>
<td></td>
</tr>
<tr>
<td>S Changed pattern of flow</td>
<td>Channel simplification and interconnection changed flow velocity and pattern; infrequent floodplain inundation; impacts include: migration barriers, altered migration corridors, improved water conveyance to south Delta, salt entrainment affects domestic water supply, loss of access to breeding sites, greater tidal excursion and salt penetration into Delta</td>
<td></td>
</tr>
<tr>
<td>S Methyl-mercury from released mercury</td>
<td>Changing Delta conditions can affect the methylation of mercury stored in sediments; impacts include mercury bioaccumulation in the foodweb</td>
<td></td>
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<tr>
<td>S Selenium</td>
<td>Past practices resulting in residual toxins in the food web</td>
<td></td>
</tr>
<tr>
<td>S Subsidence</td>
<td>Loss of peat soils in islands; impacts include increased risk of levee breaks with loss of structures and habitat</td>
<td></td>
</tr>
<tr>
<td>S Changing sediment loads</td>
<td>Sediment delivery increased with European colonization and is now declining; impacts include: turbidity declines, altered erosion and deposition, SAV expansion, smelt distribution</td>
<td></td>
</tr>
<tr>
<td>S Artificial levees</td>
<td>Isolated land and water ecosystems that made possible the development of the Delta’s cultural and economic character</td>
<td></td>
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<tr>
<td>Type</td>
<td>Whether Driver (D) or Stressor (S)</td>
<td>Notes</td>
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<tr>
<td>Legacy</td>
<td>D Water management infrastructure</td>
<td>Increases reliability of water delivery; habitat loss; altered migration corridors</td>
</tr>
<tr>
<td></td>
<td>S Levee breaks</td>
<td>Permanent flooding of multiple islands would likely raise salinity in the south Delta; native fish may not use deeply flooded islands</td>
</tr>
<tr>
<td>Legacy</td>
<td>D Upstream dams</td>
<td>Loss of access to breeding sites; existence and operation affect virtually every aspect of Delta environment, society and economy</td>
</tr>
<tr>
<td></td>
<td>D Federal-state agricultural policies</td>
<td>Ag subsidies affect land use and habitation patterns</td>
</tr>
<tr>
<td></td>
<td>D Development, zoning, building codes</td>
<td>Affects land use, lifestyle choices and many other human decisions affecting the Delta</td>
</tr>
<tr>
<td>Anticipated</td>
<td>S Invasive species</td>
<td>Low prey; changes food web; changing competition; higher predation; agricultural pests</td>
</tr>
<tr>
<td>Anticipated</td>
<td>S Subsidence</td>
<td>Loss of peat soils in islands; impacts include increased risk of levee breaks with loss of structures and habitat</td>
</tr>
<tr>
<td></td>
<td>D Landscape change</td>
<td>Delta’s habitat mosaic is constantly changing as human land and water use evolves</td>
</tr>
<tr>
<td></td>
<td>D Urban expansion</td>
<td>Affects the Delta in many ways that threaten native species and ecosystems, water quality and demand, unique Delta attributes</td>
</tr>
<tr>
<td></td>
<td>D Upstream land use</td>
<td>Affects the quantity and quality of water entering the Delta, sediment load, habitat for species migrating through Delta</td>
</tr>
<tr>
<td></td>
<td>D Upstream dams</td>
<td>Existence and operation affect virtually every aspect of Delta environment, society and economy</td>
</tr>
<tr>
<td></td>
<td>D Lifestyle choices</td>
<td>Decisions about where and how to live affect species, habitats, water demand</td>
</tr>
<tr>
<td></td>
<td>D Urban-rural migration patterns</td>
<td>Dominant human migration patterns are rural to urban and inland to coastal</td>
</tr>
<tr>
<td>Current</td>
<td>S Invasive species</td>
<td>Low prey; changed food web; changing competition; higher predation</td>
</tr>
<tr>
<td>Current</td>
<td>S Changed hydrograph; reduced inflow and outflow</td>
<td>Upstream water withdrawals; water project and in-Delta withdrawals reduce flow through Delta; reduced seasonal flow variation; improved seasonal availability of water for agriculture; impacts include: salinity intrusion, less salinity variability, seasonal temperature changes, water residence time more uniform, stranding, low DO and thermal migration barriers</td>
</tr>
<tr>
<td>Current</td>
<td>S Entrainment at pumps &amp; other diversions</td>
<td>Effect of OMR flows on fish movement and water supply; in-Delta withdrawals for agriculture, domestic water, power plants. Mortality of</td>
</tr>
<tr>
<td>Type</td>
<td>Whether Driver (D) or Stressor (S)</td>
<td>Notes</td>
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<tr>
<td></td>
<td>entrained fishes, including threatened species</td>
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</tr>
<tr>
<td></td>
<td>S More nitrate, ammonium and less phosphorus</td>
<td>Excess nutrients from agriculture and domestic waste; altered N/P ratios; impacts include: low DO, SAV expansion, <em>Microcystis</em> blooms, reduced phytoplankton production, can favor invasive species</td>
</tr>
<tr>
<td>Current</td>
<td>S Selenium release</td>
<td>Releases by agriculture and industry can be toxic through the food web</td>
</tr>
<tr>
<td></td>
<td>S Pesticide release</td>
<td>Agriculture, industry, and residential use (pyrethroids and organophosphates of concern)</td>
</tr>
<tr>
<td></td>
<td>S Other trace metals and toxics</td>
<td>Lead, chromium, copper, surfactants, endocrine mimics and disruptors introduced from agriculture, industry, domestic waste, and storm water</td>
</tr>
<tr>
<td></td>
<td>S Dredging</td>
<td>Channel dredging mobilizes sediment and toxins; impacts benthic organisms</td>
</tr>
<tr>
<td></td>
<td>S Legal harvest</td>
<td>Incidental take of threatened species</td>
</tr>
<tr>
<td></td>
<td>S Illegal harvest</td>
<td>Illegal take of threatened species</td>
</tr>
<tr>
<td></td>
<td>D Hatchery impacts</td>
<td>Alters genetic makeup affecting ability to perform in the wild and the wild conspecifics with which they breed. Introduction of diseases to wild populations</td>
</tr>
<tr>
<td></td>
<td>D Federal-state agricultural policy</td>
<td>Ag subsidies affect land use and habitation patterns</td>
</tr>
<tr>
<td></td>
<td>D Development, zoning, building codes</td>
<td>Affects land use, lifestyle choices and many other human decisions affecting the Delta</td>
</tr>
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Appendix J

Excerpt from Draft Ecosystem Restoration Program’s Conservation Strategy for Stage 2 Implementation for the Sacramento-San Joaquin Delta Ecological Management Zone (DFG 2011):

“Section III. Stressors; Non-Native Invasive Species”
from February through June when Delta inflows are typically higher (NMFS 2009a). The E/I ratio is used in management of Delta aquatic resources because it measures the influence of SWP and CVP diversions (Newman and Rice 2002, Kimmerer and Nobriga 2008). Kimmerer and Nobriga (2008) evaluated E/I ratio as a predictor of entrainment probability for neutrally buoyant particles to represent larval fish using a two-dimensional model and associated particle tracking model developed by DWR. The E/I ratio was found to be useful as a predictor of entrainment probability for organisms with limited mobility, although the model may be less applicable to more competent swimmers such as salmon smolts (Kimmerer and Nobriga 2008). Significant SWP/CVP entrainment of particles injected into the south and eastern Delta occurred at E/I rations of 0.2 and above. One criticism of using the E/I ratio to manage effects on Delta fish is that the actual volume of exports can increase substantially while maintaining the same overall E/I ratio as inflow increases. Better resolution of the relationship(s) between salvage and E/I ratio may be achieved if either the export or inflow term is held constant (NMFS 2009a). Due to their very large hydrodynamic footprint, reducing the negative effects of the SWP and CVP pumps cannot be accomplished through screening and will depend in part on the alternative conveyance chosen in the BDCP planning process.

The CALFED Science Program convened workshops in 2007 to identify and discuss key scientific and technical issues pertaining to conveying Sacramento River water through or around the Delta to the SWP and CVP export pumps. Several important broad conclusions emerged:

- All conveyance options involve trade-offs and compromises.
- Science can help select, but not choose the “best” water conveyance alternative.
- Clear objectives are critical to a thorough evaluation of conveyance alternatives.
- A coastal ocean to watershed perspective is needed to effectively evaluate conveyance alternatives.
- Through-Delta conveyance must be made to work effectively for decades into the future.
- Adaptive management should be used in implementing any conveyance alternative.
- Alternative financing must be found to fund the construction of an alternative conveyance system.

**Non-Native Invasive Species.** ERPP Goal 5 (Non-native Invasive Species) aims to prevent the establishment of additional non-native invasive species and reduce the negative ecological and economic impacts of established non-native species in the Bay-Delta estuary and its watershed. Immense ecological changes have occurred throughout the Bay-Delta ecosystem as a result of introduced non-native invasive species (NIS). They have altered food webs and habitats, they compete with native species for resources, and they directly prey upon native species. NIS represent one of the biggest impediments to restoring habitats and
populations of native species (CALFED 2000a). NIS have been introduced into the Delta over time via several mechanisms, the most common being discharge of ships’ ballast water in ports. NIS are also transported from one place to another via watercraft, fishing gear, live bait, intentionally (either legally or illegally) introduced for recreational or other purposes (e.g., centrarchids), or released from aquariums into the environment. In 2006, the State Water Resources Control Board listed the Delta, upper San Joaquin River, and Cosumnes River on its 303(d) list as impaired for exotic species and is expected to formulate a TMDL program for these waterways within the next ten years (SWRCB 2007).

The ERP has funded many projects since 2000 to try to educate the public about, and control the threat of NIS. Such projects included a study of the feasibility of ships exchanging their ballast water out in the ocean rather than destination ports. Other ERP projects provided outreach geared toward educating recreational boaters and anglers, as well as individuals involved in the aquarium trade, on the threats posed by NIS.

As part of the Bay-Delta (formerly CALFED) NIS Program, a Strategic Plan and an Implementation Plan were developed, and the Non-Native Invasive Species Advisory Council (NISAC) was established. The NISAC no longer meets; however the USFWS, DFG, and other stakeholders continue to coordinate and implement activities and projects that address NIS issues in the Bay-Delta area of concern. The USFWS is currently promoting an invasive species prevention approach known as Hazard Analysis and Critical Control Point Planning (HACCP). HACCP is a planning tool that originated with the food industry, but has been modified to include natural resource management. HACCP identifies and evaluates potential risks for introducing “non-targets”, such as invasive species, chemicals, and disease, during routine activities, and focuses attention on critical control points where “non-targets” can be removed.

As a separate effort, DFG issued its California Aquatic Invasive Species Management Plan (CAISMP) in January 2008. CAISMP’s focus is on coordinating the efforts of State agencies to minimize the harmful ecological, economic, and human health impacts from aquatic invasive species. CAISMP provides a common platform of

<table>
<thead>
<tr>
<th>Stage 2 Actions for Non-Native Invasive Species:</th>
</tr>
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<tbody>
<tr>
<td><strong>Action 1:</strong> Continue implementing DFG’s California Aquatic Invasive Species Management Plan (CAISMP) to prevent new introductions; limit or eliminate NIS populations; and reduce economic, social, and public health impacts of NIS infestation.</td>
</tr>
<tr>
<td><strong>Action 3:</strong> Continue research and monitoring programs to increase understanding of the invasion process and the role of established NIS in the Delta’s ecosystems.</td>
</tr>
<tr>
<td><strong>Action 4:</strong> Continue studies on the effectiveness of local treatment of zebra and quagga mussels using soil bacteria.</td>
</tr>
<tr>
<td><strong>Action 5:</strong> Standardize methodology for sampling programs to measure changes in NIS populations over a specific timeframe.</td>
</tr>
<tr>
<td><strong>Action 6:</strong> Collect and analyze water quality sampling data (e.g., velocity, salinity, turbidity and water temperature) for correlation analysis between NIS distribution and habitats.</td>
</tr>
<tr>
<td><strong>Action 7:</strong> Complete an assessment of existing NIS introductions and identify those with the greatest potential for containment or eradication; this assessment also would be used to set priority control efforts.</td>
</tr>
</tbody>
</table>
background information from which State agencies and other entities can work together to address the problem of aquatic invasive species, and identifies major objectives and associated actions needed to minimize these impacts in California. Depending on the species and the level of invasion, there are different management responses that could be pursued. The CAISMP includes examples of management responses to specific invasive species in the Delta. The NIS of highest management concern in the Delta includes:

**Non-Native Centrarchids.** The most common centrarchids in the Delta are largemouth bass, smallmouth bass, spotted bass, bluegill, warmouth, redear sunfish, green sunfish, white crappie, and black crappie. The increase in non-native SAV has provided conditions that likely enhanced largemouth bass and bluegill populations (Brown and Michniuk 2007), possibly others. Centrarchids, which benefit from the use of SAV, can have a large negative impact on native fish through predation and competition (Nobriga and Feyrer 2007, Brown and Michniuk 2007). The presence and distribution of some centrarchids may be manipulated by managing environmental conditions such as water velocity, salinity, and turbidity that affect the extent of SAV.

**Overbite Clam.** The overbite clam (*Corbula amurensis*) was first observed in 1986 and has since become extremely abundant in Suisun Bay and the western Delta (Carlton et al. 1990). This species is well adapted to the brackish areas of the estuary and is largely responsible for the reduction of phytoplankton and some zooplankton in the Bay-Delta region (Kimmerer 2006). This loss of primary and secondary production has drastically altered the food web and is a contributing cause of the POD (Sommer et al. 2007). Overbite clam have been shown to strongly bioaccumulate selenium (Linville et al. 2002), which could have reproductive implications for fish (e.g., sturgeon, splittail; see Stewart et al. 2004) and diving ducks that feed on overbite clam.

**Asian Clam.** The Asian clam (*Corbicula fluminea*), introduced from Asia, was first described in the Delta in 1946 (USGS 2001). This clam does not tolerate saline water. It is now very abundant in freshwater portions of the Delta and in the mainstem of rivers entering the Delta. Ecologically, this species can alter benthic substrates and compete with native freshwater mussels for food and space (Claudi and Leach 2000). The Asian clam, however, has not historically been viewed as significantly impacting the aquatic food web.

Because the overbite clam and Asian clam have become so well-established in the estuary, there is currently no known environmentally acceptable way to treat or remove these invertebrates (DFG 2008a). The only apparent management action at this time is to determine whether the manipulation of environmental variables, such as salinity, can be used to seasonally control their distribution in the estuary. There is not consensus among scientists that manipulation of salinity would do much to affect the distribution of these clams or diminish their impacts on the estuarine food web. Many experts believe that the distribution and impacts of invasive clams cannot be controlled (CALFED Science Program 2008).
**Zebra Mussel and Quagga Mussel.** Neither the zebra mussel (*Dreissena polymorpha*) nor quagga mussel (*Dreissena bugensis*) have been observed in the Delta, but given suitable environmental conditions these species have proven to be highly invasive. Establishment of dreissenid mussels is limited by salinity greater than 10 ppt (Mackie and Claudi 2010). In addition to similar threats to the ecosystem posed by the overbite clam and Asian clam, dreissenid mussels colonize hard and soft surfaces, often in high densities (greater than 30,000 individuals per square meter), and can impede the flow of water through conveyances. One of the most predictable outcomes of a dreissenid invasion, and a significant abiotic effect, is enhanced water clarity linked to a greatly diminished phytoplankton biomass. For example, rotifer abundance in western Lake Erie declined by 74 percent between 1988 and 1993, the same time that an enormous zebra mussel population became established in that area (Claudi and Leach 2000).

A State and Federal interagency coordination team was established to coordinate management responses to the threat of further quagga spread in California. Three subcommittees were established: Outreach and Education, Monitoring, and Sampling/Laboratory Protocols. The Quagga Mussel Scientific Advisory Panel was convened in April 2007 and charged with considering the full range of eradication and control options for this organism irrespective of cost. Under the direction of DFG, the San Francisco Estuary Institute performed a phased risk assessment of California waters in order to rank sites for further monitoring based on the likelihood that quagga or zebra mussels will become established.

There are a couple of relatively recent developments with respect to controlling quagga (and zebra) mussels. A common soil bacteria, *Pseudomonas fluorescens*, when applied at artificially high densities, has been demonstrated to be effective at killing mussels, with a 95 percent kill rate at treatment sites reported. The bacteria, even when dead, contain a toxin which destroys the invasive mussels’ digestive gland, killing them. Research has indicated that the bacteria do not harm non-target fish and mussel species (Science Daily 2007). Also, research is showing that a potassium salt solution may be an effective measure to control relatively localized and isolated infestations. It is possible that these control methods could be used to control both quagga and zebra mussel populations, but further evaluations are needed.

**Zooplankton.** An extensive set of monitoring data from the IEP continues to show how introduced zooplankton species have become important elements of the Bay-Delta. *Eurytemora affinis* was probably introduced with striped bass around 1880. Until the late 1980s, it was a dominant calanoid copepod in the estuary, providing on the important food source for juvenile fishes. In the last decade, however, *Eurytemora* has been replaced by two calanoid copepods introduced from China which appear to be less desirable as a food source. It has been postulated that this replacement was a result, in part, of *Eurytemora*’s greater vulnerability to overbite clam grazing (Bouley and Kimmerer 2006).

Populations of the native mysid shrimp *Neomysis mercedis*, another form of zooplankton, began dwindling in the late 1970s and crashed in the late 1980s.
subsequent to the proliferation of the overbite clam. Its population decline was affected by competition with the smaller *Acanthomysis aspera*, an introduced mysid shrimp with similar feeding habits. The decline of the native shrimp species has been identified by the POD work team as one possible cause for the food web decline in the Delta (IEP 2007b). Synthesis of IEP’s extensive modeling data could help assess trends in rates of invasion and different invasive species populations.

**Non-native Invasive Plants.** Non-native aquatic weeds in the Delta pose serious problems to native flora and fauna. Research, monitoring, mapping, and control are needed for Brazilian waterweed (*Egeria densa*), as well as water pennywort, Eurasian watermilfoil, parrot feather, and water hyacinth. These weeds flourish in a wide geographic area, sometimes in high densities, and are extremely harmful because of their ability to displace native plant species, harbor non-native predatory species, reduce food web productivity, reduce turbidity, or interfere with water conveyance and flood control systems. Areas with large densities of SAV have been implicated in reduced abundance of native fish larvae and adults (Grimaldo et al. 2004, Nobriga et al. 2005, Brown and Michniuk 2007). Restoration of habitats in intertidal areas must be designed and managed to reduce non-native SAV if conservation goals are to be met (Nobriga and Feyrer 2007).

The California Department of Boating and Waterways (CDBW) is the lead agency for the survey and control of *Egeria densa* and water hyacinth in the Delta. CDBW’s control programs use two tools to determine coverage and biomass of these aquatic weeds: hyperspectral analysis and hydroacoustic measurements. This technology has aided the assessment of *Egeria densa* coverage and biovolume, which in turn was instrumental in evaluating the effectiveness of mechanical and chemical treatment. A key asset of the technology is that it yields a very rapid, verifiable characterization of the entire water column beneath the transducer (Ruch and Kurt 2006). While this technology has been helpful in controlling localized patches of SAV, ongoing efforts of CDBW’s control program may not be successful over time because other aquatic weeds (such as Eurasian watermilfoil or curlyleaf pondweed) may replace *Egeria densa*. Both of these plants have different growth properties that may require different control techniques than those currently employed in the control program (CDBW 2006).

Other non-native plants that have been the focus of ERP NIS-related activities include giant reed (*Arundo donax*), *Tamarisk* species, and purple loosestrife (*Lythrum salicaria*) in terrestrial areas. Grazing of perennial grasslands has helped control the spread of some invasive weeds in some areas (Stromberg et al. 2007).

As mentioned earlier, NIS has become particularly problematic in the Delta. Water management has focused on maintaining a common freshwater pool for water export and in-Delta agricultural use and has reduced the historical variability under which native species evolved. It is hypothesized that periodic salinity intrusion into the Delta may help to reduce the abundance and/or distribution of certain harmful invasive species, and give native species a competitive advantage. The Pelagic Fish Action
Plan (IEP 2007b) recommends the following actions to address invasive aquatic species in the estuary:

- Support California State Lands Commission’s (CSLC) work to control ballast water, including DFG oversight of studies to determine the location and geographic range of NIS in the estuary and assessment of ballast water controls.
- Assist CSLC, DFG, and others in the development of regulations or control measures for hull-fouling.
- Support implementation of the CAISMP.

**Water Temperature.** Water temperature is a key factor in habitat suitability for aquatic organisms. Unnaturally high water temperature is a stressor for many aquatic organisms, particularly because warm water contains less dissolved oxygen. Lower water temperatures can also hinder growth and distribution of some non-native species, thus reducing their predation on, and competition for food and habitat with native species. Major factors that increase water temperature and negatively impact the health of the Delta are disruption of historical streamflow patterns, loss of riparian vegetation, reduced flows released from reservoirs, and discharges from agricultural drains.

It may be difficult to manage water temperatures in the Delta because Delta water temperatures are driven mainly by ambient air temperature. With expected localized warming of air temperatures due to regional climate change, particularly in summer, the problem of maintaining sufficiently low water temperatures in the Delta to sustain native species will become more problematic. While creating patches of riparian habitat may help cool water in small Delta sloughs through shading, and creating tidal marsh habitat may help cool water locally through nocturnal inundation of marsh plains, managers should seek to facilitate fish access to the water temperature conditions they require rather than focusing resources to achieve water temperatures in a specific area. Provided adequate floodplain and tidal habitat, it is likely that individual species distributions will change during certain times of the year as they attempt to adapt to future conditions in the Delta.

**Dissolved Oxygen.** ERPP Goal 6 (Water and Sediment Quality) is to improve and/or maintain water quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed; and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people. ERPP Goal 6, Objective 2 is to reduce loadings of oxygen-depleting substances from human activities into aquatic ecosystems in the Bay-Delta estuary and watershed to levels that do not cause adverse ecological effects. A sufficient level of dissolved oxygen (DO) is critical to the health and survival of aquatic species. Oxygen depletion is exacerbated by warm water temperatures, since warm water holds less DO than cold water. DO concentrations typically are lowest during the summer when river temperatures are warmer. Besides high water temperatures, the occurrence of decomposing aquatic vegetation, poor channel geometry, low streamflow, poor mixing of the stream water with the atmosphere, and the presence of oxygen-depleting substances (e.g., sewage,
Appendix K
Delta Dredged Sediment Long-Term Management Strategy
DELTA DREDGED SEDIMENT LONG-TERM MANAGEMENT STRATEGY
(PINOLE SHOAL MANAGEMENT AREA)
STUDY WORK PLAN

MANAGEMENT COMMITTEE REVIEW DRAFT

May 9, 2007
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<td>BMPs</td>
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<td>CBDA</td>
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EXECUTIVE SUMMARY

Background

The Delta estuary is the largest estuary on the West Coast. Covering more than 738,000 acres in five counties, it is a maze of tributaries, sloughs, and islands and a haven for plants and wildlife, supporting more than 750 plant and animal species, including more than 110 species listed as “species of concern.” The Delta is critical to California’s economy, supplying drinking water for two-thirds of Californians and irrigation water for more than 7 million acres of the most highly productive agricultural land in the world.

The Delta is also the hub of California’s two largest water distribution systems – the Central Valley Project (CVP) operated by the U.S. Bureau of Reclamation (Reclamation) and the State Water Project (SWP) operated by the California Department of Water Resources (DWR). Maintaining high quality water in the Delta is critical for drinking water supplies, agricultural irrigation, and ecosystem function. More than 1,100 miles of levees protect the water conveyance functions, ecosystem, and land uses on Delta islands. The Sacramento and San Joaquin River channels also provide important waterborne commerce access to the Ports of Sacramento and Stockton.

In recent years, conflicts about levee rehabilitation, dredging, and placement of dredged sediments have been increasing. There is an ongoing need to dredge Delta channels for navigation, water conveyance, flood control, and levee maintenance. At the same time, there are increasing regulatory concerns about the potential impacts to water quality and the ecosystem from levee work, dredging activities, and dredge materials placement and reuse.

In the last several years, agencies (Federal, State, and local), the public, political leaders, and the media have become increasingly concerned about the urgent need for levee rehabilitation in the Delta. Sediment management and reuse from dredging activities is a potential source of material for Delta levee rehabilitation. At the same time, the Delta environment is showing signs of major stress and dysfunction, as evidenced by the rapid decline of pelagic species in recent years.

Concerns about the complex and sensitive environment in the Delta have resulted in stringent regulatory requirements for dredging and sediment reuse and placement in the Delta. These two apparently conflicting objectives, protection of the Delta environment and increased dredging and sediment reuse and placement, highlight the need for better coordination and management of Delta dredging and sediment management and reuse requirements.

In late 2004, local sponsors of Delta dredging projects and the U.S. Army Corps of Engineers (Corps) met to explore the feasibility of developing a long-term management strategy (LTMS) for dredging and dredged materials placement or reuse in the Delta. A similar
process was used to successfully develop a collaborative, coordinated approach to dredging and sediment management in San Francisco Bay.

Project Goals and Objectives:

The five initial participating agencies (Corps, U.S. Environmental Protection Agency [USEPA], DWR, California Bay-Delta Authority [CBDA], and Central Valley Regional Water Board [CVRWB]) agreed to examine the sediment issues and needs within the Delta. The participating agencies drafted a three-part project purpose statement:

- The Delta Dredged Sediment LTMS development process will examine and coordinate dredging needs and sediment management in the Delta to assist in maintaining and improving channel function (navigation, water conveyance, flood control, and recreation), levee rehabilitation, and ecosystem restoration.
- Agencies and stakeholders will work cooperatively to develop a sediment management plan (SMP or LTMS) that is based on sound science and protective of the ecosystem, water supply, and water quality functions of the Delta.
- As part of this effort, the sediment management plan will consider regulatory process improvements for dredging and dredged material management so that project evaluation is coordinated, efficient, timely, and protective of Delta resources.

To achieve these goals, the Delta LTMS seeks to improve coordination and planning efforts between dredging proponents and regulatory agencies, and to streamline, wherever possible, the regulatory approval process for future Delta dredging and sediment management activities. The following lists some of the specific objectives identified through stakeholder interviews that participants would like to see achieved during the LTMS development process. Some of these items may eventually be found not to be suitable for this group, but have been retained in this document in an effort to address all stakeholder concerns:

- Develop a streamlined permitting process to facilitate and improve coordination and cooperation among agencies with dredging management responsibilities or regulatory authority over dredging and placement activities.
- Develop a Standardized Sediment Characterization Manual that addresses stakeholder concerns pertaining to appropriate tests, protocols, and methods for various disposal options.
- Review and summarize regional best management practices (BMPs) for the dredging and disposal of contaminated and non-contaminated dredged sediments.
- Review regional disposal alternatives for contaminated and non-contaminated dredged sediments.
- Identify environmental restoration and/or enhancement opportunities that are directly related to the dredging and disposal of sediments.
- Develop a Sediment Management Plan to include: (i) approved regional disposal sites and/or identify treatment alternatives; (ii) BMPs for dredging and disposal operations; (iii) a consolidated and consistent plan for regulatory review; (iv)
chemical trigger levels for sediment/elutriate testing and disposal alternative selection; and, (v) a tiered approach for site suitability to dispose dredged sediments.

- Develop a programmatic BA to facilitate dredging and placement activities while ensuring the protection of resources (fish species).
- Prepare a programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) to implement the Delta disposal management alternatives.
- Ensure that the SMP and EIS/EIR are consistent with CVRWB regulations for the surface and groundwater quality.
- Facilitate beneficial use of dredged materials for levee stabilization or other uses while protecting surface and groundwater quality.

**Organization**

The Delta LTMS is organized in a management process to include an executive committee, management committee, interagency working group, strategy review group, and science advisory teams as described in this section. In addition, public meetings will be held periodically to provide additional opportunities for input and feedback from interested parties.

**Executive Committee**

At the top level, an Executive Committee will direct the overall program, set policy direction, and provide oversight of the study. The directors of each of the following agencies will serve on the Executive Committee. The appointed executive managers should have the decision-making authority to represent the agency on the policy and regulatory issues to be addressed. The Agency Executive Committee will meet annually or as necessary to set policy direction for the study and keep abreast of the progress of the study.

- U.S. Army Corps of Engineers, Commander, South Pacific Division
- U.S. Environmental Protection Agency, Regional Administrator, Region 9
- State Water Resources Control Board (State Water Board), Chairperson
- Central Valley Regional Water Board, Chairperson
- California Department of Water Resources, Director
- California Bay-Delta Authority, Chairperson
- Delta Protection Commission, Chairperson

**Management Committee**

The Management Committee will consist of the deputy-level managers for the State and Federal agencies. The Management Committee will oversee the work of the Interagency Working Group (IWG) and the associated Strategy Review Group, review policy recommendations, study plans, budget proposals, and provide recommendations to the Executive Committee. The Management Committee will meet quarterly. Members of the Management Committee are:

- U.S. Army Corps of Engineers, District Commander, San Francisco District
- U.S. Army Corps of Engineers, District Commander, Sacramento District
- California Department of Water Resources, Deputy Director, Public Safety
• U.S. Environmental Protection Agency, Director, Water Management Division, Region 9
• California Bay-Delta Authority, Executive Director
• State Water Board, Executive Officer
• Central Valley Regional Water Board, Executive Officer
• NOAA Fisheries, Southwest Region, Executive Director
• U.S. Fish & Wildlife Service, Pacific Region, Director
• California Department of Fish & Game, Executive Director
• Delta Protection Commission

**Interagency Working Group**

An Interagency Working Group (IWG) includes program-level staff at five agencies. The IWG will serve as the primary program managers of the Delta LTMS process and steering committee for the Strategy Review Group. The IWG will coordinate with the Management Committee, the Strategy Review Group and others with an interest in Delta activities and the LTMS process. The IWG’s role is to identify study issues and questions to be addressed such as: identify technical work groups and expert resources, confirm purpose, charter, and assignments for the science advisory teams and technical review groups, discuss and review study work plans and scopes, discuss and review study budgets and resource needs, prepare and approve study reports, develop management and policy options for the Management and Executive Committees, and escalate issues to the Executive Committee that cannot be resolved at the Management Committee. The members of the IWG currently consist of the following:

- USEPA
- Corps
- CVRWB
- CBDA
- DWR

The Management Committee may identify other participants in the IWG.

**Strategy Review Group**

Study activities will be conducted in coordination with a Strategy Review Group consisting of representatives of other agencies, stakeholders, and interest groups in the Delta working in or affected by dredging and reuse activities for navigation, levee stability, or ecosystem restoration. The Interagency Working Group will coordinate meetings monthly or as needed with the Strategy Review Group to identify, review, and discuss: (1) the Delta sediment issues of concern to be addressed by the Delta LTMS study and in what order; (2) lines of inquiry that the science advisory teams (described below) will be tasked to pursue; and (3) coordinated regulatory approach for Delta dredging to be approved by the Executive Committee.
Members of the Strategy Review Group may also provide public comment at the Executive Committee meetings. In addition to the agencies on the Executive Committee, the Strategy Review Group also includes, but not be limited to the following organizations:

- NOAA Fisheries, Southwest Region
- U.S. Fish & Wildlife Service, Pacific Region
- California Department of Fish & Game
- Delta Protection Commission
- State Lands Commission
- Reclamation Board
- Reclamation Districts
- Contra Costa, Sacramento, Solano, Yolo, and San Joaquin Counties
- North, Central, and South Delta Water Agencies
- The Ports of Sacramento and Stockton
- Bay Planning Coalition
- DeltaKeeper
- The Nature Conservancy
- The Bay Institute
- Environmental Water Caucus
- California Sportfishing Protection Alliance
- California Farm Bureau Federation
- State Water Contractors
- California Delta Chamber

**Technical Work Groups**

The Management Committee will establish specific technical work groups to address Delta LTMS issues. The technical work groups will consist of agency staff with expertise in the relevant subject areas. Technical work groups are open to interested participants from any agency, interest group, or the public. With the direction and approval of the Management Committee, technical work groups will identify study needs, develop study scopes and work plans, identify resources, and review results and conclusions. The Management Committee will identify the leader for each technical group. The initial technical work groups created for the LTMS include the following:

- Regional Dredging and Reuse Permitting;
- Testing Protocols Review;
- Programmatic BA Development; and
- Disposal and Reuse Alternative Development.

**Other Stakeholders/Interested Public**

Other interested parties will have the opportunity to learn about the Delta LTMS process and activities by viewing the project website (www.deltaltms.com) and attending the public meetings to be held on an as needed basis, at project milestones.
Science Review Panel
The Management Committee will establish a Science Review Panel made up of independent scientists. The purpose of the Science Review Panel is to provide an independent science review process for Delta LTMS studies. The Management Committee will approve the leader and participants for the Science Review Panel. The Science Review Panel will evaluate existing information; identify gaps, and review results and conclusions.

Anticipated Project Tasks
Early in the development phase for Delta LTMS, a project process flow diagram was created (see Figure ES-1) to present an outline for an overall strategy for identifying and prioritizing project needs, identifying and evaluating management alternatives, forming technical work groups to contribute scientific information and policy direction, and key steps needed to successfully complete the LTMS. Similar approaches have been used successfully to develop long-term sediment management plans in San Francisco, Los Angeles, and Puget Sound. The initial technical tasks identified for this project and described in this Work Plan have been organized to follow the key tasks identified in that process diagram, including the following:

- Review and define project goals and objectives;
- Form technical work groups to address specific technical issues;
- Develop hypothetical project scenarios to frame potential management solutions;
- Formulate management alternatives;
- Evaluate management alternatives;
- Possibly conduct a programmatic EIS/EIR
- Prepare a sediment management plan to summarize project efforts; and
- Adopt and implement the LTMS sediment management plan.

Anticipated Project Schedule
The anticipated project schedule for completing the Delta LTMS sediment management plan is approximately 3 years. Several interim work products (e.g., possible formation of a Dredged Materials Management Office (DMMO), consolidated dredging permit application, sediment quality database, etc.) will be completed before that date and would be implemented upon completion.

Anticipated Project Budget
It is too early in the development process to accurately estimate the exact cost to complete the LTMS sediment management plan and associated technical studies; however, the planning level estimate based on the level of efforts required to complete similar projects in other regions is a little over $6 million.
DELTA LTMS DREDGED SEDIMENT MANAGEMENT PLAN DEVELOPMENT STEPS

1. Define Goals, Objectives, & Information Needs
2. Form Technical Work Groups
3. Develop Hypothetical Project Scenarios
4. Formulate Management Alternatives
5. Evaluate Management Alternatives
6. Possibly Conduct Programmatic EIS/EIR
7. Prepare LTMS Sediment Management Plan
8. Adopt Delta LTMS Sediment Management Plan

Footnote: ¹ Ex: Work groups include Scientific Technical Studies & Permitting Coordination Activities

Figure ES-1
Delta Dredged Sediment LTMS Development Process
Management Committee Review Draft
1 INTRODUCTION

1.1 Project Background

In late 2004, local sponsors of Delta dredging projects and the U.S. Army Corps of Engineers (Corps) met to explore the feasibility of developing a long-term management strategy (LTMS) for dredging and dredged material placement and/or reuse in the Delta. In 2005, the Corps worked with multiple stakeholders including other Federal and State agencies to define a cooperative, collaborative approach to address the problems, challenges, and opportunities related to levee repairs, dredging, and beneficial reuse of dredge materials in the Delta.

As a result of these discussions, the Corps began working with other Federal and State agencies – the U.S. Environmental Protection Agency (USEPA), the California Bay Delta Authority (CBDA), California Department of Water Resources (DWR), Delta Protection Commission (DPC), and the Central Valley Regional Water Board (CVRWB) – to develop the initial Process Framework describing a cooperative approach for developing the Delta dredged sediment LTMS (Delta LTMS) Program for the Delta region.

The Process Framework describes the overall purpose and structure of the effort so that participating agencies can assess the study objectives, gauge their level of required participation, and assign resources to assist in developing the Delta LTMS Program. As with any cooperative planning effort, the Process Framework will be refined as participation increases and implementation proceeds.

In conjunction with the Process Framework document, the five agencies listed above used the framework as the basis for establishing a charter to promote participation and commitment to achieving the goals and addressing the concerns identified in the framework process document. Agencies signing the charter agreed to fully participate in the study activities and operate under the final Charter. Copies of the Final Delta LTMS Charter and Process Framework can be found in Appendix A).

The Delta LTMS Process Framework (Corps et al. 2006) summarizes the initial framework for the Delta LTMS, identifying the following components:

- Study purpose, goals, and objectives
- Structure, participants, and roles
Introduction

- Authorities and decision making
- Related programs
- Study activities and phases

Based on those items, a Federal Project Management Plan (PMP) was developed by the Corps of Engineers to guide their internal managers on appropriate project direction, schedule, work assignments and potential costs. Because a Corps PMP follows a strict systems generated outline, not always easily understood by most non-Federal stakeholders, it was decided to also prepare this Study Work Plan to present those same topics and provide the operating framework for preparing the Delta LTMS.

1.2 Project Purpose and Need

Accurate estimates of historical dredge volumes within the Delta (Figure 1-1) are sometimes difficult to calculate because some of the smaller dredging projects do not have detailed records of the specific volumes removed and final placement destination. Accurate estimates are available, however, or all recent projects and the larger historical projects. The bulk of the dredging within the Delta (at least on a volume basis) occurs in either of the two deepwater shipping channels to the Ports of Stockton and Sacramento. Between 1966 and 2006, the average annual volume of material removed from these channels was 320,000 cubic yards (Stockton DWSC) and 593,000 cubic yards (Sacramento DWSC). Specific dredge volumes removed from the Stockton DWSC range from a low of 15,000 cubic yards in 1971 to a high of 841,000 cubic yards in 1978. Specific dredge volumes removed from the Sacramento DWSC range from a low of 35,000 cubic yards in 2005 to a high of 2.2 million yards in 1966. Additional, detailed information of historical and projected dredge volumes is provided later in this report in Section 2.2.

1.3 LTMS Structure Participants and Roles

The Delta LTMS is organized (Figure 1-2) in a management process to include an Executive Committee, Management Committee, Interagency Working Group (IWG), Strategy Review Group (SRG), Technical Work Groups (TWGs) and an Independent Science Review Panel as described in this section. In addition, public meetings will be held periodically to provide additional opportunities for input and feedback from interested parties.
Sacramento Valley
Delta Bay
San Joaquin Valley
Southern California Region
San Francisco
San Pablo Bay
San Francisco Bay
Suisun Marsh
Stockton
Sacramento River
San Joaquin River

Figure 1-1
Plan View of Delta Region
Management Committee Review Draft
Source: CALFED Bay-Delta Program
Figure 1-2
Organizational Structure
Management Committee Review Draft
Executive Committee
At the top level, an Executive Committee directs the overall program, sets policy direction, and provides oversight of the study. The directors of each of the following agencies serve on the Executive Committee. The appointed executive managers should have the decision-making authority to represent the agency on the policy and regulatory issues to be addressed. The Executive Committee will meet annually or as necessary to set policy direction for the study and keep abreast of the progress of the study.

- U.S. Army Corps of Engineers, Commander, South Pacific Division
- U.S. Environmental Protection Agency, Regional Administrator, Region 9
- State Water Resources Control Board (State Water Board), Chairperson
- Central Valley Regional Water Board, Chairperson
- California Department of Water Resources, Director
- California Bay-Delta Authority, Chairperson
- Delta Protection Commission, Chairperson

Management Committee
The Management Committee consists of the deputy-level managers for the Federal and State agencies. The Management Committee will oversee the work of the IWG and the associated Strategy Review Group, review policy recommendations, study plans, budget proposals, and provide recommendations to the Executive Committee. The Management Committee will meet quarterly. Members of the Management Committee are:

- U.S. Army Corps of Engineers, District Commander, San Francisco District
- U.S. Army Corps of Engineers, District Commander, Sacramento District
- California Department of Water Resources, Deputy Director, Public Safety
- U.S. Environmental Protection Agency, Director, Water Management Division, Region 9
- California Bay-Delta Authority, Executive Director
- State Water Board, Executive Officer
- Central Valley Regional Water Board, Executive Officer
- NOAA Fisheries, Southwest Region
- U.S. Fish & Wildlife Service, Pacific Region
- California Department of Fish and Game
Interagency Working Group

An IWG includes program-level staff at five agencies. The IWG serves as the primary program managers of the Delta LTMS process and steering committee for the Strategy Review Group. The IWG will coordinate with the Management Committee, the SRG and others with an interest in Delta activities and the LTMS process. The IWG’s role is to identify study issues and questions to be addressed such as: identify technical work groups and expert resources, confirm purpose, charter, and assignments for the science advisory teams and technical review groups, discuss and review study work plans and scopes, discuss and review study budgets and resource needs, prepare and approve study reports, develop management and policy options for the Management and Executive Committees, and escalate issues to the Executive Committee that cannot be resolved at the Management Committee. The members of the IWG currently consist of the following:

- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- Central Valley Regional Water Board
- California Bay-Delta Authority
- California Department of Water Resources
- The Management Committee may identify other participants in the IWG

Strategy Review Group

Study activities will be conducted in coordination with a SRG consisting of representatives of other agencies, stakeholders, and interest groups in the Delta working in or affected by dredging and reuse activities for navigation, levee stability, or ecosystem restoration. The Interagency Working Group will coordinate meetings monthly or as needed with the Strategy Review Group to identify, review, and discuss:

1. The Delta sediment issues of concern to be addressed by the Delta LTMS Study and in what order;
2. Lines of inquiry that the science advisory teams (described below) will be tasked to pursue; and
3. Coordinated regulatory approach for Delta dredging to be approved by the Executive Committee.
Members of the SRG may also provide public comment at the Executive Committee meetings. In addition to the agencies on the Executive Committee, the SRG also includes, but is not limited to the following organizations:

- NOAA Fisheries, Southwest Region
- U.S. Fish & Wildlife Service, Pacific Region
- California Department of Fish and Game
- Delta Protection Commission
- State Lands Commission
- Reclamation Board
- Reclamation Districts
- Contra Costa, Sacramento, Solano, Yolo, and San Joaquin Counties
- North, Central, and South Delta Water Agencies
- The Ports of Sacramento and Stockton
- Bay Planning Coalition
- DeltaKeeper
- The Nature Conservancy
- The Bay Institute
- Environmental Water Caucus
- California Sportfishing Protection Alliance
- California Farm Bureau Federation
- State Water Contractors
- California Delta Chamber

**Technical Work Groups**

The Management Committee will establish specific science and technical work groups to address Delta LTMS issues. The science and technical work groups will consist of agency staff with expertise in the relevant subject areas. Technical work groups are open to interested participants from any agency, interest group, or the public. With the direction and approval of the Management Committee, technical work groups identify study needs, develop study scopes and work plans, identify resources, and review results and
conclusions. The Management Committee identifies the leader for each technical work
group. Currently planned TWGs include the following:

- Regional Dredging and Reuse Permitting;
- Testing Protocols Review;
- Programmatic Biological Assessment (BA) Development; and
- Dredged Sediment Disposal and Reuse Alternative Development.

These work groups (discussed in more detail in Section 3.1.2) will be formed by the IWG
and authorized by the Management Committee.

**Other Stakeholders/Interested Public**

Other interested parties will have the opportunity to learn about the Delta LTMS process
and activities by viewing the project website and attending public meetings to be held on an
as needed basis, at project milestones.

**Science Review Panel**

The IWG and Management Committee will establish a Science Review Panel made up of
independent scientists. The purpose of the Science Review Panel is to provide an
independent science review process for all Delta LTMS studies. The Management
Committee will approve the leader and participants for the Science Review Panel.

**1.4 Study Goals and Objectives**

The five initial participating agencies (Corps, USEPA, DWR, CBDA, and CVRWB) agreed to
examine the sediment issues and needs within the Delta. The participating agencies drafted
a three-part project purpose statement:

1. The Delta Dredged Sediment Long-Term Management Strategy development process
will examine and coordinate dredging needs and sediment management in the Delta to
assist in maintaining and improving channel function (navigation, water conveyance,
flood control, and recreation), levee rehabilitation, and ecosystem restoration.

2. Agencies and stakeholders will work cooperatively to develop a sediment
management plan (SMP or Long-Term Management Strategy) that is based on sound
science and protective of the ecosystem, water supply, and water quality functions of
the Delta.
3. As part of this effort, the sediment management plan will consider regulatory process improvements for dredging and dredged material management so that project evaluation is coordinated, efficient, timely, and protective of Delta resources.

To achieve these goals, the Delta LTMS seeks to improve coordination and planning efforts between dredging proponents and regulatory agencies, and to streamline, wherever possible, the regulatory approval process for future Delta dredging and sediment management activities. The following lists some of the specific objectives identified through stakeholder interviews, conducted during the project planning phase by Circle Point, that participants would like to see achieved during the LTMS development process. Some of these items may eventually be found not to be suitable for this group, but have been retained in this document in an effort to address all stakeholder concerns:

a) Develop a streamlined permitting process to facilitate and improve coordination and cooperation among agencies with dredging management responsibilities or regulatory authority over dredging and placement activities.

b) Develop a Standardized Sediment Characterization Manual that addresses stakeholder concerns pertaining to appropriate tests, protocols, and methods for various disposal options.

c) Review and summarize regional best management practices (BMPs) for the dredging and disposal of contaminated and non-contaminated dredged sediments.

d) Review regional disposal alternatives for contaminated and non-contaminated dredged sediments.

e) Identify environmental restoration and/or enhancement opportunities that are directly related to the dredging and disposal of sediments.

f) Develop a Sediment Management Plan to include: (i) approved regional disposal sites and/or identify treatment alternatives; (ii) BMPs for dredging and disposal operations; (iii) a consolidated and consistent plan for regulatory review; (iv) chemical trigger levels for sediment/elutriate testing and disposal alternative selection; and, (v) a tiered approach for site suitability to dispose dredged sediments.

g) Develop a programmatic BA to facilitate dredging and placement activities while ensuring the protection of resources (fish species).

h) Prepare a programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) to implement the Delta disposal management alternatives.

i) Ensure that the SMP and EIS/EIR are consistent with CVRWB regulations for the surface and groundwater quality and resource agencies.
j) Facilitate beneficial use of dredged materials for levee stabilization or other uses while protecting surface and groundwater quality.

1.5 Federal, Non-Federal, and Public Concerns

A number of concerns related to planning needs and constraints have been identified during the plan development process for the Delta LTMS Program and are described below. Initial concerns were received through meetings and interviews with the potential sponsor(s), other agencies, dredging proponents, and interested parties.

1.5.1 Environmental/Permitting

Identified concerns with the current permitting framework include:

1. Difficulties obtaining permits for dredging and placement of material at either designated disposal sites or beneficially reusing the material (i.e., levee maintenance, restoration, construction grade) have been identified as a primary driver for developing the LTMS.

2. Clarifying agency jurisdiction to dredging stakeholders and responsibility regarding Delta dredging, disposal and beneficial reuse actions.


4. Due to perceived differences in agency policies, general permitting requirements, and overlapping jurisdiction, a need to facilitate better coordination between agencies regulating dredging, disposal, and reuse was identified by some stakeholders.

1.5.2 Technical

Technical questions and desired investigations thus far identified include:

1. As part of the overall characterization of sediment quality impacts and perceived lack of agreed upon sediment quality thresholds, the permitting/authorization process and the ability to efficiently plan dredging operations should be reviewed. Thus, developing sediment screening criteria for specific disposal/reuse applications has been identified as a task to assist in determining sediment suitability.
2. Summarizing contaminant exposure pathways for upland and wetland placement of dredged material, and potential impacts to water quality and biological resources will assist in developing a guidance manual for assessing sediment quality for various disposal options. Impacts from dredging operations could include: (i) turbidity, noise, depletion of dissolved oxygen, and/or degradation of air quality; (ii) potential resuspension of contaminants in the water column; and (iii) chemical advection and diffusion at dredge material placement sites.

3. Review BMPs to address potential construction impacts of dredge and disposal operations on air/water quality, ambient noise, turbidity, dissolved oxygen and vessel traffic, and mechanical and logistics modifications required to reduce impacts need to be identified.

### 1.5.3 Economics

Regional economic issues associated with dredging and placement of material include:

1. The cost to the Federal government, Non-Federal Sponsors and regulatory applicants for finding suitable sites for disposal and beneficial reuse of dredged material must be assessed. The desire to identify economically feasible options for disposal management and ensuring levee stability has been identified as an issue by all participants.

2. The potential economic degradation of regional and national economies due to the inability to efficiently dredge channels.

3. Reuse, redevelopment, modernization and expansion of facilities at the Ports of Stockton and Sacramento should be evaluated.

4. Potential economic impacts of levee failure should be considered when prioritizing suitable reuse alternatives.

5. A benefit-cost analysis (for Federal projects) for the dredging and disposal of sediments for levee stabilization and habitat restoration/enhancement should be established.

6. The desire to beneficially reuse dredge material has been identified as a priority for the Delta LTMS. Factors that can impact beneficial reuse of dredge material such as costs, feasibility, re-handling, and transportation need to be identified and evaluated.

7. Evaluate ways to encourage more opportunities for dredging companies to cost effectively operate in the Delta (longer dredging windows, lack of experienced crews, etc.).

8. Evaluate ways for cost effective rehandling and reuse of dredge materials.
1.5.4 Political

Identified political questions and issues include:

1. The perception that there is a lack of consensus regarding the permitting, testing, and suitability determinations for dredged material has been voiced by various participants, including some agency participants.

2. Conflicting mandates from different agencies with regard to levee repair and associated water quality and biological impacts versus the impacts of potential levee failure.

3. Identification of other stakeholder groups with an interest in the program, including resource agencies, environmental groups, and dredgers. Public perception will be crucial in the development and continued success of the program.

1.6 Adaptive Management and Integration Plan

Because planning is an iterative process, more or less funding and time may be required to accomplish the formulation and evaluation of the study objectives, specific management alternatives, and ultimately the Sediment Management Plan. With clear descriptions of the scopes and assumptions outlined in the PMP and the Work Plan, deviations are easier to identify. The impact in either time or money is easily assessed and decisions can be made on how to proceed. The PMP and Work Plan are intended to be living documents, periodically updated and revised as necessary as the project progresses and study findings require adjustments to the study program as agreed to by the Executive and Management Committees.

1.7 Summary of Work Plan Organization

Using the components of the Corps’ PMP document, this Work Plan has been arranged in the following format:

Chapter 1 – Introduction. A description of the Work Plan and the LTMS in general, including structure and goals.

Chapter 2 – Delta LTMS Study Area. A description of the Study Area, including geography, historical, and projected dredge areas and volumes, and sediment characteristics.
Chapter 3 – Delta LTMS Development Process. A detailed discussion of the tasks and coordination involved in the LTMS.

Chapter 4 – Technical Quality Control Plan. A brief description of the project Quality Control Plan.

Chapter 5 – Public Involvement and Coordination. Description of key public involvement tasks and coordination activities for the Delta LTMS Study.

Chapter 6 – Delta LTMS/SMP Agency Implementation Strategy. Describes how the agencies and stakeholders will implement the plan.

Chapter 7 – References. Lists all project references.
2 DELTA LTMS STUDY AREA

2.1 Geographic Boundaries

One of the first tasks for the Technical Work Groups to address will be to review and finalize the geographic boundaries for the Delta LTMS Study. Until the point that it is revised, this document assumes that the Study Area will be that known as the “Legal Delta” according to the Delta Vision program (www.deltavision.ca.gov). Located roughly between the cities of Sacramento, Stockton, Tracy, and Antioch (Figure 1-1), the “Legal Delta” extends approximately 24 miles east to west and 48 miles north to south, including parts of five counties (Sacramento, San Joaquin, Contra Costa, Solano, and Yolo).

The delta consists of a myriad of small natural and man-made channels (locally called sloughs), creating a system of isolated lowland islands and wetlands (defined by dikes or levees). The extensive system of earthen levees has allowed wide-spread farming throughout the delta, one of the most fertile agricultural areas in California.

Today, the Delta provides critical habitat to many of California’s fish species residing in the region, including several threatened and endangered species. Recreationally, the Delta contains 635 miles of boating waterways which are served by approximately 95 marinas containing over 11,000 in-water boat slips and dry storage space for an additional 5,000 boats.

An additional, critical early task to be addressed by the Technical Work Groups and IWG members will be to identify and prioritize which areas of the Delta may be most suitable for developing dredge material beneficial reuse opportunities for levee repairs. Figure 2-1 presents an overview of the Delta levee system showing the areas of greatest concern with regards to the Federal (project) levee system according to a recent report prepared by the Corps (Appendix B). It should be noted, however, that this map does not show the hundreds of miles of levees in need of repair that are part of the State (non-Project) flood protection system.

2.2 Historical and Projected Dredge Volumes

Additional data is still being collected to complete this section.

2.3 Sediment Physical and Chemical Characteristics

Additional data is still being collected to complete this section.
Figure 2-1

Delta Levees and Federal Areas of Concern
Management Committee Review Draft
3 DELTA LTMS DEVELOPMENT PROCESS

Early in the development phase for Delta LTMS, a project process flow diagram was created (see Figure 3-1) to present an outline for an overall strategy for identifying and prioritizing project needs, identifying and evaluating management alternatives, forming technical work groups to contribute scientific information and policy direction, and key steps needed to successfully complete the LTMS. Similar approaches have been used successfully to develop long-term sediment management plans in San Francisco, Los Angeles, and Puget Sound. The technical tasks described in this Work Plan have been organized to follow the key tasks identified in that process diagram, as described below.

3.1 List of Initial Tasks

3.1.1 Define Goals, Objectives, and Information Needs

As described in Section 1.3, a series of stakeholder meetings, one-on-one interviews and targeted outreach programs were used to develop a list of overall goals, specific project objectives, and, subsequently, informational needs required to successfully prepare a regional sediment management plan for the Delta. That task has already been completed so is not included in this section.

3.1.2 Formation and Coordination of Technical Work Groups

The technical framework of the Delta LTMS will be driven by four key TWGs:

- Regional Dredging and Reuse Permitting;
- Testing Protocols Review;
- Programmatic BA Development; and
- Disposal and Reuse Alternative Development.

A key first step in the LTMS development process, therefore, has been working to form these groups and identify the scope and direction for each. Coordination between these groups and IWG/SRG will be critical to prevent overlap and to remain focused on project priorities. Group participation will be open to all LTMS stakeholders and participants can choose to attend whenever interests arise. Overall direction and approval will be provided by on a daily basis by the IWG and, ultimately, the Management Committee.
DELTA LTMS DREDGED SEDIMENT MANAGEMENT PLAN DEVELOPMENT STEPS

Define Goals, Objectives, & Information Needs
Form Technical Work Groups
Develop Hypothetical Project Scenarios
Formulate Management Alternatives
Evaluate Management Alternatives
Possibly Conduct Programmatic EIS/EIR
Prepare LTMS Sediment Management Plan
Adopt Delta LTMS Sediment Management Plan

[Diagram with steps and review groups]

Footnote: 1/ Ex: Work groups include Scientific Technical Studies & Permitting Coordination Activities
Each TWG will be led by an appropriate agency person chosen from amongst the agency stakeholders to be the primary point-of-contact for that group. Anchor Environmental will provide a technical liaison to each TWG for purposes of meeting coordination, note taking, document production services, etc. Once the point-of-contact for each TWG is chosen, its members will assemble for an initial kick-off meeting to review the scope and direction for the group, and choose a satisfactory meeting schedule and venue for future gatherings. The following sections describe the initial direction expected for each of the four TWGs.

3.1.2.1 Regional Dredging and Reuse Permitting Work Group

The purpose of this Work Group will be to review and summarize the current procedures required for each stakeholder agency, and address perceived confusion and inefficiencies regarding the proper regulatory steps required for permitting various dredging, disposal and reuse projects within the Delta.

Five key agencies currently have jurisdiction over different aspects of the dredging process within the Delta: the Corps, National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), and the CVRWB. In addition to these organizations, various ordinances and land use restrictions of local agencies, such as the county or municipality, may apply to dredging projects with land disposal. In some cases, other agencies such as the California Department of Transportation, California Department of Conservation, and Reclamation Board also may require permits.

Prior studies conducted by the CALFED Bay-Delta Program and summarized in the June 2002 Delta Dredging and Reuse Strategy (DDRS) report identified specific areas where the current regulatory process could be enhanced, and recommended several key topics for future study. These include:

1. Developing general order Waste Discharge Requirements to help streamline the Regional Board’s approval process;

2. Prepare a programmatic EIR/EIS that addresses all of the requirements of CEQA and National Environmental Policy Act (NEPA) for all impacts associated with maintenance dredging, disposal and reuse projects – a
general order already exists for maintenance dredging of the deep water ship channels which could be used as a starting point for additional general orders;

3. Develop regional permits to reduce redundancy in the process and expedite agency review;

4. Develop programmatic biological opinions (addressed by separate Work Group); and

5. Form multi-agency review committee for dredging projects to meet routinely and review processes and potential improvements.

The members of this Work Group should use the information developed for the CALFED program as a basis for beginning this evaluation and build upon it to reach consensus among the members for making recommendations to the Management Committee.

In order for this Work Group to be successful, staff participation from the following Delta LTMS stakeholders must occur:

- Corps (Sacramento and San Francisco Districts);
- USEPA;
- DWR;
- CBDA; and/or
- CVRWB.

- Staff participation and technical contributions from other agencies (State or Federal) or stakeholders would be beneficial to assist completing the proposed tasks.

- Other agencies that will be crucial and may have permitting authority for dredging or disposal sites include: State Lands Commission, Department of Water Resources.

A total of three main deliverables are expected from this Work Group along with monthly updates in the form of progress memos or verbal updates at the IWG and/or SRG meetings.
1. Permitting Summary/Value Stream Analysis – The first deliverable will be a summary of the current permitting processes required for dredging, disposal and reuse of sediments within the Delta system, including areas where agencies overlap in their jurisdiction. This information should be separated by upper and lower reaches, and again by navigable waters and flood control channels. Input will be required from the Work Group created to identify current and future potential disposal and reuse opportunities. Core agency participants should take the lead in preparing this deliverable. The likely method to develop this summary and identify opportunities and constraints will be through a Corps directed Value Stream Analysis under the Lean-Six-Sigma program currently in use throughout the Corps’ South Pacific Division.

2. Joint Permit Application – The second deliverable will be a draft consolidated permit application including all required information to meet the needs of the appropriate agencies with jurisdiction over regional dredging projects. The goal of this deliverable will be to create a template that can be used by the Management Committee in the short-term.

3. Dredged Material Management Office (DMMO) – The third deliverable will be a review, and possibly a recommendation (if deemed beneficial), for the formation of a Delta DMMO, similar to those in place for the Bay Area and the Northwest states. If implemented, a Delta DMMO should be led by the Corps of Engineers Sacramento District, and involve assigned regulatory agency personnel from dredging stakeholder groups. If the work group ultimately recommends the formation of a DMMO, a strategy should be developed to outline issues associated with individual agency participation, jurisdiction for each dredging, disposal and reuse strategy, funding sources within each agency, meeting procedures, permit application submittal and review and approval processes. A draft Strategy should be submitted for Management Committee and IWG approval. Comments on the draft will then be incorporated into a final version for review and comment by the rest of the Delta LTMS Stakeholders.

Formation of a DMMO is a large logistical issue requiring significant input from agencies, especially the Corps and USEPA. As such, the task to decide if one is warranted for the Delta Region is included as an early step in the LTMS process to promote early coordination and allow time for resolution of staffing, funding, and other logistical issues. The DMMO formation, if it occurs, will largely be a parallel
track, and the LTMS stakeholders should expect some periodic updates from the Corps and USEPA on this task.

It is anticipated that, at a minimum, the Work Group will meet once a month to collaborate on achieving the tasks specified and addressing priority of short and long-term issues pertaining to the permitting process. Work Group participants should also anticipate a minimum of 10 hours a month to review, produce, or discuss documents relevant to the permitting deliverables listed below. The Value Stream Analysis may require a one-time commitment of 2 to 4 consecutive days by all key participants.

3.1.2.2 **Testing Protocols Review Work Group**

The Strategy Review Group identified reviewing appropriate testing protocols for the characterization of sediments proposed for dredging and disposal as a critical issue for the Delta LTMS program. Existing methods and protocols for the evaluation of dredged material will be reviewed and documented.

The DDRS provides a technical analysis of potential contaminants in dredge material related to impacts on water quality, human health and biological resources. This document provides a foundation with which the Work Group can move forward. It provides a summary of the existing information (e.g., chemistry, dredging project, etc.) and water testing protocols within the Delta (2002). The DDRS made recommendations in Chapter 6 for future research and analyses for specific tests and evaluating new contaminants of concerns. The Work Group should review and if appropriate prioritize these recommendations for implementation.

Utilizing the DDRS as a starting point, the Work Group will have a head start on the subtasks identified below:

1. **Literature Search** – The Work Group will conduct a review of the current methods and protocols used to characterize sediments proposed for dredging and disposal, as well as any information regarding the method’s technical accuracy. As previously stated, the DDRS (Volumes I and II) provides a solid foundation for this information. The Work Group will need to update this summary with current testing protocol information accessible from the
sediment database developed under a separate task as well as from other programs around the nation such as the Northwest Regional Sediment Evaluation Framework (Corp et al. 2006). Once testing protocol information has been updated, the Work Group can then identify new procedures possibly developed for other regions.

2. The Work Group will review regional sediment quality data from LTMS database.

3. A sediment characterization framework for dredging and disposal will identify a list of chemicals of concern, physical parameters; elutriate tests, and biological tests appropriate for characterizing Delta sediments. This framework will use a risk based approach, will be adaptive, and integrate new methods or processes as they are approved by the Work Group, IWG, and possibly a DMMO (if created).

4. The final report will provide recommendations for testing protocols for dredging, disposal, and beneficial use of dredged sediment in the Delta. It will also include a process for annual reviews to assess the accuracy and predictability of the testing framework. This review process will include implementation of adaptive management, introducing new methods or testing protocols where pertinent.

Overall, the key focus of this group should be to determine what testing methods most accurately characterize dredge material and their placement sites in terms of possible impacts to water quality. For example, the group should be focused on how soil conditions in the delta may attenuate contaminants at dredge placement and reuse sites. The goal is to reduce the uncertainty of dredge material placement on water quality so more informed decisions can be made by the Board and more certainty for the dischargers. In order for this Work Group to be successful, staff participation from the following stakeholders must occur:

- Corps (Sacramento and San Francisco Districts);
- USEPA;
- DWR;
- CBDA; and/or
- CVRWB.
• Experienced staff participation and technical contributions from other agencies (State or Federal) or stakeholders would be beneficial to assist completing the proposed tasks.

The primary deliverables for this Work Group are expected to include:

• A list of chemicals of concern;
• Sediment screening guidelines established using a risk based approach;
• Elutriate tests for various disposal options;
• Biological tests for various disposal options; and
• A Final Report detailing recommendations for a comprehensive characterization framework and annual review process. Recommendations for additional studies will also be included with this report.

These deliverables will focus on developing a strategy for applying the correct test to the right application rather than developing new tests. The draft report will be submitted to the IWG for review and approval. A draft final report will then be submitted to the Strategic Review Committee for review and comment. If approved, the framework will then be incorporated into each of the agencies current dredging project approval process. The Work Group chair will provide monthly updates in the form of progress memos or verbal updates at the IWG and/or SRG meetings.

It is anticipated that, at a minimum, the Work Group will meet once a month to collaborate on achieving the tasks specified and addressing priorities of short and long-term issues pertaining to the permitting process. Work Group participants should also anticipate a minimum of 10 hours a month to review, produce, or discuss documents relevant to the regional disposal and reuse alternative deliverables listed below.

3.1.2.3 Programmatic Biological Assessment Development Work Group

The Strategy Review Group identified a potential need for developing a programmatic biological opinion as a critical issue for the Delta LTMS. Currently, individual projects are reviewed by NMFS and USFWS and often have been time consuming and difficult on all parties due to the lack of data. Therefore, to address
the lack of consolidated data related to biological resources and potential impacts from dredging and disposal within the Delta, several tasks are proposed to help formulate a programmatic BA.

The Work Group will need to accomplish the following components listed below before a Programmatic Biological Assessment can be written and implemented for Delta dredging projects:

1. Literature Search/Review Summary Report – A comprehensive review of existing data related to the physical and biological baseline conditions within the Study Area will be conducted. The participating resource agencies will provide the federally- and state-listed species and critical habitat in the Delta and their status. They will also provide each species life history and population dynamics. Stakeholders and other interested parties can submit pertinent information to the group for their review and inclusion in the baseline. This baseline will be used to determine how projects may affect biological resources and physical conditions, and whether there have been significant changes in habitat values and resources compared to historical conditions. The literature search will also identify data gaps to help prioritize the need for additional studies such as biological surveys or water quality monitoring.

2. Biological Surveys – Data gaps for biological resources identified in the previous component will be prioritized. Once prioritized, the Work Group will present a study design specific for the biological resource identified. These will then be distributed to the SRG to seek support and funding for completion. Once a survey/study is completed the Work Group will review the data and integrate it into the overall BA.

3. Evaluation of Impacts – In the interim of finalizing additional studies or surveys, preliminary environmental windows could be established for species with sufficient supporting data. This approach will need to be discussed and reviewed with the resource agencies as well as other regulatory agencies. Regardless of an interim approach, the final programmatic BA will evaluate the potential impacts from proposed dredging projects (e.g., maintenance dredging) to resources and provide biological windows when dredging and disposal may occur while still providing resource protection.
In order for this Work Group to be successful, staff participation from the following Delta LTMS stakeholders must occur:

- Corps (Sacramento and San Francisco Districts);
- USEPA;
- DWR;
- CBDA; and/or
- CVRWB.
- The Resource Agencies: Marine National Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Game are critical participants in this process. Staff from these agencies must participate.
- Experienced staff participation and technical contributions from other agencies (State or Federal) or stakeholders would be beneficial to assist completing the proposed tasks.

The primary deliverables for this Work Group are expected to include:

- A list of species of concern, their life history and population dynamics;
- An environmental baseline for the Study Area (Delta);
- Proposed additional studies;
- BMP recommendations for use by the Permitting Review Work Group;
- Interim environmental windows; and
- A Final Programmatic Biological Assessment.

The Work Group chair will provide monthly updates in the form of progress memos or verbal updates at the IWG and/or SRG meetings. The Science Review Panel will be asked to review this information, as appropriate.

It is anticipated that, at a minimum, the Work Group will meet once a month to collaborate on achieving the tasks specified and addressing priority of short and long-term issues pertaining to the permitting process. Work Group participants should also anticipate a minimum of 10 hours a month to review, produce, or discuss documents relevant to the regional disposal and reuse alternative deliverables listed below.
3.1.2.4  **Dredge Material Disposal and Reuse Alternatives Development Work Group**

This Work Group will develop a list of current regional disposal sites, reuse alternatives and hypothetical project scenarios. The list will provide information on project types, sediment type and quality, volumes dredged, disposal allocations and disposal site capacities. Once this information is compiled and existing conditions are mapped out – typical and atypical project scenarios can be generated. This process will dovetail with the permitting process and may generate changes in the permitting application or testing to address standardization.

Proposed activities for the Regional Disposal and Reuse Alternatives Development Work Group shall include the following items:

- Review and summarize what alternatives currently exist for Delta projects and how often they are used;
- Determine how successful past projects have been;
- Review and evaluate alternatives from other regions for use in Delta;
- Assess recommendations for screening criteria and testing processes for reuse alternatives (See Testing Protocols);
- Identify end users and/or disposal sites for use in Delta;
- Evaluate and identify a centralized dredged material re-handling facility;
- If needed, identify improvements to existing alternatives;
- Identify long-term sediment management needs (i.e., capacity accommodations for increasing or decreasing volume of material of the next 50 years); and
- Develop a decision making policy and sediment management plan.

The members of this Work Group should use the information developed for the CALFED DDRS as a basis for beginning this evaluation and build upon it to reach consensus among the members for making recommendations to the Management Committee. Other key sources of information that should be considered include the following documents:

by U.S. Environmental Protection Agency, Region IX; U. S. Army Corps of Engineers, San Francisco District; San Francisco Bay Conservation and Development Commission; and San Francisco Bay Regional Water Quality Control Board, California State Water Resources Control Board. San Francisco, CA.


In order for this Work Group to be successful, staff participation from the following Delta LTMS stakeholders must occur:

- Corps (Sacramento and San Francisco Districts);
- USEPA;
- DWR;
- CBDA; and/or
- CVRWB.

- Experienced staff participation and technical contributions from other agencies (State or Federal) or stakeholders would be beneficial to assist completing the proposed tasks.

The primary deliverable for this Work Group will be a list of agency approved, cost effective, and technically feasible disposal and reuse alternatives for use with Delta dredging projects. Alternatives should be separated, as appropriate, by sub-region, and type of dredge scenario. Recommendations for additional study, if needed, would be developed by this Work Group and presented to the Management
Committee for approval and to assist in developing funding opportunities. The Science Review Panel will also review this information, as appropriate. The report will form the basis for the management alternatives evaluated in the EIR/EIS.

It is anticipated that at a minimum the Work Group will meet once a month to collaborate on achieving the tasks specified and addressing priority of short and long-term issues pertaining to the permitting process. Work Group participants should also anticipate a minimum of 10 hours a month to review, produce, or discuss documents relevant to the regional disposal and reuse alternative deliverables listed below.

### 3.1.3 Sediment Quality Database Development

A sediment quality database is being developed to assist in identifying and quantifying past and planned dredging activities for navigation, flood control, water conveyance, recreation, and other Delta functions. The goal of this task is to develop and document a database on sediment quality and populate it with data from the San Francisco Bay Delta. The database will be used for characterizing sediments in areas planned for dredging to assess quality and aid in selecting appropriate management approaches. Example management approaches include selection of potential material suitable for wetland creation, rehabilitation, and restoration; levee maintenance; and other dredge material beneficial re-use schemes. The database should also have the potential to support other possible purposes as well, including, but not limited to applied research.

The database will be prepared using: (1) data from the Corps which contains information prior to 2001 from Sacramento District which has already been compiled; (2) data the contractor (Exa) is in possession of for related projects; and (3) additional sources. Efforts will be focused on quality assurance of the existing pre-2001 data as well as compiling post-2001 data not already in the database. The work will incorporate the DDRS database compiled by CDFG in 2002. The work will also be coordinated with the State’s Sediment Quality Objectives (SQOs) project conducted by the State Water Board to the extent possible, and related efforts conducted by the CVRWB, and other possible partners to be identified at a later time, to optimize these efforts and provide cost sharing efficiencies.
Data from the various sources may be in a variety of digital and hard copy formats. The type of data used should include sediment contamination, toxicity, benthic fauna, fish and tissue data as well as other incidentally collected water quality (dissolved oxygen, temperature at the time of data collections) or other data that may aid in understanding sediment quality and toxicity issues. The database documentation will include a description of the elements in the database and an evaluation of its contents will also be provided.

Documentation should answer questions such as:

- Which sediment contaminants were measured?
- What collection and analytical methods were used?
- Do the method detection limits meet QA/QC guidelines?
- Are toxicity test protocols using standard ASTM methods?
- Were appropriate laboratory methods used?
- Which species, tissue type, methods used, etc.?
- Which contaminants were measured?
- Where were samples taken?

The format of the database will be easily transferable to other database types and formats, including those that can be used across a web interface and easily convertible to GIS format with measurements as attributes. Further, the database will be structured such that new data may be added in a relatively straightforward manner. The database will be easily usable by a broad range of stakeholders, including the Corps, other Federal, State, and local agencies as well as non-governmental concerns. It is anticipated that in the future, data should be available in a web-based format requiring no specialized programs and/or cost for the typical end-user. Determining such structure will be an important part of the task and should be accomplished in part with input from the Corps.

Because the quantity and quality of data available are not clearly known, a first priority will involve documenting data sources. It is realized that the product to be produced is one which will be complete and usable as delivered, but may of necessity document
steps required to incorporate data which could not be completely addressed due to logistic difficulties.

3.1.4 Develop Hypothetical Project Scenarios

The Disposal and Reuse Alternative Development TWG will lead in developing a series of hypothetical project scenarios as part of its mandate. Significant input will be required from all the Technical Work Groups, as well as the IWG and Management Committee members.

Hypothetical project scenarios consist of dredging projects that most (i.e., 75 percent or more) of the typical dredging projects in the Study Area. For example, one hypothetical scenario will likely be maintenance dredging of deep-water ship channels. This project scenario would then describe a “typical” project in terms of volume, material type, equipment, and disposal locations/issues. Once the project scenarios are developed, they become the critical element in forming the “project description” component of the LTMS EIS/EIR.

3.1.5 Identification and Evaluation of Management Alternatives

The Disposal and Reuse Alternative Development TWG will also be charged with the lead in developing a series of dredged material management alternatives (see 3.1.2.4) and evaluating them against a series of criteria, also to be developed by the group. All information developed by the work group will be presented to the IWG for comment and approval.

Example alternative evaluation criteria may include: short and long-term effectiveness, implementability, environmental impacts, environmental benefits, cost, and public acceptance. Based on these evaluations, a recommended decision framework should be developed for each hypothetical project scenario. These analyses and the decision framework will eventually form the basis of the technical evaluation in the LTMS EIS/EIR.
3.1.6 Development of a Programmatic EIS/EIR

Corps policy described in EC 1165-2-200 requires each Corps District to develop a dredged material management plan (DMMP) (or LTMS) for each harbor or jurisdiction to address dredged material management. This policy encourages the development of a range of feasible management alternatives that are cost effective and environmentally acceptable, use sound engineering techniques, and that optimize the beneficial reuse of dredged materials. The LTMS also ensures that sufficient confined disposal facilities and beneficial reuse opportunities are available for at least the next 20 years. A management plan is usually developed for an individual harbor; however, as part of the Delta LTMS program, the Corps is proposing to develop a master LTMS for the Study Area. The environmental documentation for the LTMS would take the form of a Programmatic EIS (PEIS).

The primary objective of this PEIS is to identify potential environmental impacts of the proposed LTMS on a regional basis. Components of the LTMS would summarize the future (20 years) disposal/management needs for the Region, the expected physical and chemical characteristics of the dredged material, the potential available reuse and disposal alternatives in the Region, and a strategy for evaluating and selecting the most appropriate management alternative given varying project scenarios. To accomplish this task, hypothetical project scenarios will be developed and evaluated by the technical work groups.

In order for this EIS/EIR and Sediment Management Plan to be completed, staff participation from the Corps of Engineers must include participation from the Regulatory, Real Estate, Planning, Engineering, and Programs and Project Management Functions. LTMS stakeholder agencies will provide comments on the draft and final documents, and the output of the TWGs is crucial to the EIS/EIR technical analyses (as described before). Comments will be solicited from all participating LTMS agencies and the public.

The primary deliverable will be the completed Programmatic EIS/EIR, which will be a key component of the Sediment Management Plan. It is anticipated that completion of the EIS/EIR will take between 12 and 18 months. Some of the specific subtasks for the Delta LTMS PEIS are described below.
3.1.6.1  **Environmental Baseline Conditions**

Development of the environmental baseline within the Delta is necessary for accurate evaluation of existing conditions and impacts of various alternatives. Baseline condition evaluations will include the general sediment characteristics of the region; water resources within the region; amounts and frequency of dredging; and a description of the environmental baseline for relevant NEPA/CEQA and Clean Water Act variables including all relevant aspects of the human and biological environment.

- *Sediment and Dredged Material Characteristics* – Will describe the typical characteristics of dredged material in the Study Area. Utilize the typical scenarios developed under the Hypothetical Project Scenarios Task (and Technical Work Group).

- *Biological Surveys* – The results of the Biological Assessment Work Group effort will be incorporated into an evaluation of biological resources in the region, and inform the evaluation of impacts.

3.1.6.2  **Project Scenarios and Alternatives Development**

The hypothetical project scenarios and management alternatives framework developed by that TWG will be the basis of the technical evaluation.

3.1.6.3  **Technical Analyses**

- *Real Estate Analyses/Report* – Conduct a baseline and with-project analysis of property values and potential for changes in property value resulting from potential dredging and discharge of dredged materials within the Study Area.

- *Air Quality Report* – Conduct a baseline and with-project analysis of air quality, including potential air quality impacts of dredging and discharges of dredged material at a programmatic level.

- *Cultural Resources Report* – Conduct an inventory level assessment of listed and eligible sites under the auspices of Section 106 of the National Historic Preservation Association (NHPA).

- *Geotechnical Investigation Report* – Conduct a qualitative geotechnical evaluation of the condition of levees and channels within the Study Area, consisting primarily of a detailed literature search and, possibly, new field assessments if deemed necessary by the technical working groups.
• **Hydrologic Investigation Report** – Conduct a hydrologic evaluation of the Sacramento and San Joaquin River systems.

• **Cost Estimates** – Evaluate costs associated with management alternatives presented and calculate B/C ratios.

• **Public Process Documentation** – Summarize public involvement, including progress meetings, agency coordination, NEPA/CEQA scoping, workshops, etc.

### 3.1.6.4 Impacts Analysis and Programmatic 404(b)(1) Evaluation

Based on the suite of management alternatives developed, baseline conditions identified, and technical analyses identified, conduct a NEPA/CEQA impacts evaluation and programmatic 404(b)(1) evaluation for each hypothetical dredging scenario. Discuss relative benefits and impacts of each management alternative for each hypothetical dredging scenario.

### 3.1.7 Sediment Management Plan Report Development

The results of the EIS/EIR will form the basis of the Sediment Management Plan, which will contain management level recommendations for hypothetical project scenarios and function as an Executive Summary of the process. This document will essentially become the long-term management strategy document for the Delta. It will summarize the entire development process, individual work products, stakeholder meetings, alternative development and evaluation process and conclusions made by the various committees. It is intended to be a living document that will be reviewed and updated though an adaptive management process.

### 3.2 Project Schedule and Task Relationships

Using the list of initial tasks presented in Section 3.1, and the LTMS developmental process flow chart presented in Figure 3-1, an example project schedule (Figure 3-2) was developed for each main task and key deliverable expected over the duration of the Delta LTMS Study. Where appropriate, task inter-relationships have been identified and mapped. The content and relationships presented in this figure are intended purely to describe the planned activities as of the time this Work Plan was prepared. This information will be updated frequently as additional details become available. In addition, the colors used in the figure are not of significance and are only intended to represent visual breaks in the tasks.
3.3 Estimated Task Costs

Estimated project costs have been developed purely for planning level purposes based on assumptions developed for similar efforts conducted in San Francisco, Los Angeles, and Puget Sound (Table 3-1). When possible, cost estimates have been adjusted to match the estimated level of effort expected for Delta-specific investigations. These costs should not be used for anything other than to project an expected level of effort for each of the primary steps in the development process based on the assumptions currently available. More refined estimates will be prepared as additional details become available. While Table 3-1 presents line items for specific sub-tasks, cost estimates are only provided for higher level categories.

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Summary of Estimated Costs
(continued)

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</table>

¹/ “Corps work level” is a term used in the Project Management Plan to define task levels. It has been carried over to this document to maintain consistency.
3.4 Task Responsibility Assignment

Although it has not been determined exactly which LTMS stakeholder will execute each of the tasks identified in this Work Plan, the Corps has committed (pending appropriate budget allocation) to complete most of the main categories. As such, Table 3-2 presents a responsibility matrix that identifies which specific tasks the Corps expects to complete and which tasks other stakeholders will be responsible.

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<td>Evaluation of Procedures</td>
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Table 3-2
Responsibility Assignment Matrix (continued)

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### Table 3-2
Responsibility Assignment Matrix (continued)

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</table>

2/ “Corps work level” is a term used in the Project Management Plan to define task levels. It has been carried over to this document to maintain consistency.
4 TECHNICAL QUALITY CONTROL PLAN

Maintaining strict quality control throughout the development of the Delta LTMS is critical to the entire agency stakeholder group. To assist in ensuring that all work products are of the highest scientific credibility, a technical quality control plan has been developed.

4.1 Quality Control Plan Objective
The overriding objective of the LTMS Quality Control (QC) Plan is to ensure that all project deliverables are scientifically reviewed at multiple levels to ensure not only their technical efficacy, but also their appropriate use within the development of the Delta LTMS work products. Achieving this QC Plan objective will be accomplished through internal contractor review, internal agency review with each of the IWG members, stakeholder review by the SRG members, and independent technical review by unaffiliated representatives. Sections 4.2 through 4.4 provide additional details on this process.

4.2 Guidelines Followed For Technical Review
The following guidelines will be observed for QC of Delta LTMS deliverables:

- Deliverables will be easily understood by the public and agency stakeholders, and be properly formatted and of professional quality;
- Deliverables will be scientifically accurate, i.e., unit conversions and measurements;
- Statements of fact will be supported based on peer reviewed literature, past agency studies, and the testimony of experts;
- Deliverables will contain accurate references to environmental regulations, and not propose or suggest processes that violate any regulation; and
- Deliverables will be reviewed at the appropriate level dependent on the task and responsible work group.

4.3 Document/Work Product Review Steps
All LTMS deliverables will be subject to QC Plan review. Deliverables include but are not limited to this Work Plan; all TWG deliverables; the EIS/EIR, including technical analyses/reports; sediment database; and the final Sediment Management Plan.
Table 4-1 provides a summary of the minimum review steps that must be conducted for each LTMS work product. It should be noted that this list is very conservative because there will likely be several levels of review conducted within each of the IWG member organizations that is not listed in the Table. For example, within the Corps, all primary deliverables/ work products will be reviewed by each branch assigned by the Corps' Project Manager within the San Francisco and Sacramento Districts (i.e., real estate, regulatory, planning, operations, project management, legal, construction, engineering, etc.).

### Table 4-1
Minimum Technical Review Steps for Delta LTMS Work Products

<table>
<thead>
<tr>
<th>Work Product/Function</th>
<th>Primary Review Team</th>
<th>Secondary Review Team</th>
</tr>
</thead>
</table>
| • Data Calculations   | • 100% of all calculations by internal contractor review  
                        | • Appropriate use in work product by contractor review  
                        | • IWG Review  
                        | • Independent Technical Review team |
| • Database Entries    | • See Section 4.3   | • See Section 4.3     |
| • Technical Studies   | • Internal contractor review  
                        | • IWG  
                        | • SRG  
                        | • Independent Technical Review team |
| Recommended/Conducted by TWGs |                      |                      |
| • Programmatic EIS/EIR | • Internal contractor review  
                         | • IWG  
                         | • SRG  
                         | • Independent Technical Review team  
                         | • Management Committee  
                         | • Executive Committee |
| • Final Sediment Management Plan | • Internal contractor review  
                                      | • IWG  
                                      | • SRG  
                                      | • Independent Technical Review team  
                                      | • Management Committee  
                                      | • Executive Committee |

The DREDGE Database was originally created in support of the Delta Dredging and Reuse Strategy (DDRS) document (CDFG 2002), and has been modified for use in the Delta. For every table in the DREDGE, the following checks were employed:

- The number of records were tracked – any deleted records were saved in a separate table and the reason for deletion stored;
- The uniqueness of the records were evaluated, and reason for duplicates were assessed;
- The relationships between that table and others were assessed to ensure that there were no orphan records (for example, chemistry records with no record in the sample table);
• Each field within each table was evaluated for gaps (nulls) – if possible these gaps were filled;
• Each table was evaluated for consistency among the fields within each study – details are provided below; and
• Unreasonable data was identified within possible limits, including sample depths, dates, locations, and results outside of statistical ranges – an effort was made to find the original data to check these data.

4.4 Deviations from the Approved Quality Control Plan

Any deviations from the QC Plan will be subject to the review and discretion of the IWG and/or Management Committee.
5 PUBLIC INVOLVEMENT AND COORDINATION

The LTMS group is designed to be transparent to the public and aggressive in promoting public involvement. A number of measures are/will be employed to ensure a successful public involvement process. Some of the key steps taken by the IWG members to ensure public involvement and coordination include:

- Creating an open format structure for monthly meetings held to update the project’s progress and solicit stakeholder input;
- Creating a website (www.deltaltms.com) to provide status reports, meetings schedules, meeting notes and handouts, technical reports, contact information and links to other useful websites;
- Developing fact sheets and press releases when key milestones are met to inform the public of the project’s status;
- Presenting routine updates and technical studies at regional and national conferences;
- Preparing a Programmatic EIS/EIR with all necessary NEPA/CEQA public involvement elements; and
- Seeking public comment on all technical and policy-related work products, as well as the Sediment Management Plan.

6 DELTA LTMS/SMP AGENCY IMPLEMENTATION STRATEGY

Implementation of the LTMS and SMP is expected to occur either through the development of a Sacramento Delta DMMO or, at a minimum, the development of an ad-hoc permitting agency review group. If created, the DMMO would utilize the LTMS and SMP as part of its mandate and, like in other regional DMMOs, would conduct annual review meetings to evaluate and update technical processes (e.g., biological and chemical testing protocols and screening criteria) and policy guidelines. If an actual Delta DMMO is not created, the individual permitting agencies should still plan to meet on a routine basis to review upcoming projects and discuss strategies for implementing and updating the SMP. This latter approach has been adopted successfully in Southern California by the Advisory Committee of the Los Angeles Regional Contaminated Sediments Task Force (http://www.coastal.ca.gov/sediment/sdindex.html).
7 REFERENCES


Long Term Management Strategy for Dredged Material in the Delta

(Delta LTMS)

PROCESS FRAMEWORK
Long Term Management Strategy for Dredged Material in the Delta (Delta LTMS)

Process Framework

Pinole Shoal Management Study
November 2006
# Delta LTMS Process Framework

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1 Introduction and Background

The Delta estuary is the largest estuary on the West Coast. Covering more than 738,000 acres in five counties, it is a maze of tributaries, sloughs, and islands and a haven for plants and wildlife, supporting more than 750 plant and animal species, including more than 110 species listed as “species of concern.” The Delta is critical to California's economy, supplying drinking water for two-thirds of Californians and irrigation water for more than 7 million acres of the most highly productive agricultural land in the world.

The Delta is also the hub of California’s two largest water distribution systems – the Central Valley Project (CVP) operated by the U.S. Bureau of Reclamation (Reclamation) and the State Water Project (SWP) operated by the California Department of Water Resources (DWR). Maintaining high quality water in the Delta is critical for drinking water supplies, agricultural irrigation, and ecosystem function. More than 1,100 miles of levees protect the water conveyance functions, ecosystem, and land uses on Delta islands. The Sacramento and San Joaquin River channels also provide important shipping access to the Ports of Sacramento and Stockton.

In recent years, conflicts about levee rehabilitation, dredging, and placement of dredged sediments have been increasing. There is an ongoing need to explore alternatives and find solutions that will allow dredging of Delta channels for navigation, water conveyance, flood control, and levee maintenance, while, at the same time, protecting water quality and the ecosystem from levee work, dredging activities, and dredge material placement and reuse.

In the last several years, agencies, the public, political leaders, and the media have become increasingly concerned about the urgent need for levee rehabilitation in the Delta. One possible contributor to Delta levee rehabilitation is sediment management and reuse from dredging activities. At the same time, the Delta environment is showing signs of major stress and dysfunction, as evidenced by the rapid decline of pelagic species in recent years. Concerns about the complex and sensitive environment in the Delta necessitate stringent regulatory requirements for dredging and sediment reuse and placement in the Delta. These two apparently conflicting objectives, protection of the Delta environment and increased dredging and sediment reuse and placement, highlight the need for better coordination and management of Delta dredging and sediment management and reuse requirements.

In late 2004, local sponsors of Delta dredging projects and the U.S. Army Corps of Engineers (USACE) met to explore the feasibility of developing a long-term management strategy (LTMS) for dredging and dredged material placement or reuse in the Delta under the authority of the Pinole Shoal Management Study. The LTMS process was used successfully to develop a collaborative, coordinated approach to dredging and sediment management in San Francisco Bay.

In 2005, the USACE worked with stakeholders including other federal and state agencies to define a cooperative, collaborative, and operational approach to address the problems, challenges, and opportunities related to levee work, dredging, and placement in the Delta. This Process Framework is the result of those discussions.

This document describes the initial framework for the Delta LTMS, including the following:

- Study purpose, goals, and objectives
- Structure, participants, and roles
 Authorities and decision making
 Related programs
 Study activities and phases

This framework is intended to describe the overall purpose and structure of the process so participating agencies can confirm the purpose, participation, and resources for the Delta LTMS. As with any cooperative planning process, the framework will be refined as participation increases and implementation proceeds.

To address these concerns, the U.S. Army Corps of Engineers began working with four other federal and state agencies: U.S. Environmental Protection Agency (USEPA), the California Department of Water Resources (DWR), the Resources Agency, CALFED Bay-Delta Program (CALFED), and the California Regional Water Quality Control Board, Central Valley Region (CVWQCB). These five agencies drafted this initial Process Framework to describe a cooperative approach for developing an LTMS for Delta dredging.

2 Study Purpose

2.1 Problems, Challenges, and Opportunities

The Delta plays a critical role in a number of fronts bringing unique challenges and opportunities in establishment of a Long Term Management Strategy. These challenges and opportunities are in areas of management of sediment, ecosystem integrity, water conveyance, water quality and supply, navigation, recreation, flood control, and agriculture. The following is a brief description of these challenges and opportunities as they relate to the Delta:

Dredging – Dredging in the Delta is a critical activity for maintaining the important functions of the Delta – levee stability, flood control, navigation, ecosystem quality, water supply, and recreation. Dredging activities vary in size from small marina dredging projects to major channel deepening. There is no comprehensive planning for dredging in the Delta to determine the dredging and placement needs, potential beneficial uses of dredged material, or placement sites. In the last ten years, increasing concerns about the potential impacts of dredging on fisheries, habitat, and surface and ground water quality have resulted in greater restrictions on dredging operations and the placement or reuse of dredged material. Today, the complexity of the regulatory permit process for the Delta is viewed by dredging proponents as a major contributor to escalating project costs and lengthy study and review processes by those conducting dredging projects small and large. Delta dredging could support or harm the critical Delta features described below, including the ecosystem, levees, navigation, recreation, water quality, and water supply.

Ecosystem – The Delta ecosystem is the largest estuarine ecosystem on the west coast. It supports more than 750 plant and animal species. There are more than 110 species of fish, plants, animals, and birds in the Delta that are listed by state and federal agencies as “species of concern.” For the past ten years, state and federal resource agencies have focused hundreds of millions of dollars on ecosystem restoration projects to protect and enhance the ecosystem functions. In spite of those efforts, there are indications that much more needs to be done. For example, in the last several years, populations of pelagic fish have dropped precipitously.
Continued protection and enhancement of the Delta ecosystem and threatened and endangered species is necessary.

**Levees** – Delta levees are the most important infrastructure in the Delta. More than 1,100 miles of levees protect thousands of acres of homes and farmland, protect and provide important habitat, and convey fresh water supplies through the Delta for agriculture, municipal, and industrial water supplies. Approximately 410,000 people live in communities of the Delta protected by levees. The Delta levee system is at risk of chronic and catastrophic failure as a result of deferred maintenance, earthquake, or flood. The consequences of major levee failure in the Delta are potentially devastating for water quality, water supply, the ecosystem, and local property and economic activity.

**Navigation** – The Delta is also a transportation corridor for access to deep water ports in Stockton and Sacramento. Two federally authorized shipping channels exist in the Delta, the Sacramento Deep Water Channel and the Stockton Deep Water Channel. These channels provide access to foreign markets for Central Valley exports such as sulfur, rice and wheat, and imported goods such as cement, fertilizer, and steel. In 2004, more than 325 ships and barges transported nearly 3 million tons of goods through the ports. Without regular maintenance, the deep water channels fill with silt and debris, reducing access by ship traffic.

**Recreation** – Delta channels are an important recreation resource for the region. As cited in the 1998 Economic Impact of Regional Boating and Fishing in the Delta, boating and fishing recreation accounted for over $378 million in annual expenditures. The Delta boasts more than 100 marinas and waterside resorts, parks, and campgrounds, and more than 50 boat launching facilities. Protecting and enhancing the Delta fish populations and dredging to maintain marina access are high priority goals for recreation in the Delta.

**Water Conveyance and Supply** – The Delta provides fresh water for more than 23 million Californians and 7 million acres of the most highly productive farmland in the world. Delta channels and sloughs convey water from the major river systems to intake pumps throughout the Delta. The amount and quality of water diverted from the Delta is influenced by hydrology, water operations, and other activities in the Delta. Continued protection of the water supply system is critical for public health and the economy of California.

**Water Quality** – The waters of the Delta provide for several diverse, and sometimes conflicting, beneficial uses, including drinking water, habitat, irrigation, and recreation. The natural actions of an estuary, where fresh and salt water meet, pose substantial challenges in serving these beneficial uses. These challenges are made even greater by the human activities that channel, move, divert, and return water to the Delta. Protecting and enhancing water quality for all beneficial uses is critical for public health, recreation, and the sustained health of the Delta ecosystem.

### 2.2 Study Purpose Statement

As a result of these challenges, the five initial agencies, referred to as the Interagency Working Group (IWG) (USACE, USEPA, DWR, CALFED, and CVWQCB) have agreed to examine Delta dredging, reuse, and placement needs and explore ways to operationally improve the regulatory approval process for dredging in the Delta. The agencies seek to coordinate dredging planning and dredged material management in ways that protect and enhance the Delta environment and water quality. The agencies recognize the importance of dredging projects and
the need to explore the beneficial use of dredged material to stabilize levees, maintain and improve navigation channels, support ecosystem restoration, and maintain water supply and water quality. With these needs in mind, the agencies have drafted the following three-part project purpose statement:

1. The Delta LTMS will examine and coordinate dredging needs and sediment management in the Delta to maintain and improve channel function (navigation, water conveyance, flood control, and recreation), levee rehabilitation, and ecosystem restoration, and the beneficial use of dredged material.

2. Agencies and stakeholders will work cooperatively to develop a management plan that is based on sound science and protective of the ecosystem, water supply, and water quality functions of the Delta.

3. As part of this effort, the Delta LTMS will consider regulatory process improvements for dredging and dredged material management so that project evaluation is coordinated, efficient, timely, and protective of Delta resources.

3 Goals & Objectives

3.1 Study Goals

There are four overarching goals of the Delta LTMS. These four goals represent the benefits to be achieved from a coordinated sediment material management program and an improved dredging approval process:

- Manage sediment, including exploring the beneficial reuse of dredged material, to maintain and stabilize Delta levees that protect land-based activities and water conveyance
- Manage dredging activities and beneficial reuse to protect and enhance water quality for Delta water supply and ecosystem function
- Manage dredging activities to support and maintain Delta channel functions for navigation, flood control, water conveyance, and recreation
- Manage dredging activities and beneficial reuse to protect and enhance aquatic, wetland, and terrestrial ecosystems

3.2 Study Objectives

To achieve these goals, the Delta LTMS intends to improve coordination, planning, and approvals of Delta dredging activities and sediment management to achieve these specific objectives:

- Improve operational efficiency through the coordination and cooperation among agencies with dredging management responsibilities or regulatory authority over dredging activities
- Protect surface and groundwater quality
• Protect fish species and habitat
• Study the beneficial use of dredged material for levee stabilization or other uses
• Support ecosystem restoration activities in the Delta
• Support cost-effective dredging activities

4 Structure, Participants, and Roles
The Delta LTMS is organized to include an executive committee, management committee, interagency working group, strategy review group, science and technical work groups, and a science review panel as described in this section. In addition, public meetings are held to provide additional opportunities for input and feedback from interested parties.

4.1 Executive Committee
At the top level, an Executive Committee directs the overall program, sets policy direction, and provides oversight of the study. Subject to their approvals, the directors of each of the following agencies serve on the Executive Committee. The executive managers have the decision-making authority to represent the agency on the strategic and regulatory issues to be addressed. The agency Executive Committee generally meets annually or as necessary to establish guidance for the study and keep abreast of the progress of the Delta LTMS.

Federal Agencies
• U.S. Army Corps of Engineers, Commander, South Pacific Division
• U.S. Environmental Protection Agency, Regional Administrator, Region 9

State Agencies
• State Water Resources Control Board, Board member
• California Regional Water Quality Control Board, Central Valley Region, Chairperson
• California Department of Water Resources, Director
• Resources Agency, CALFED Bay-Delta Program, Director
• Delta Protection Commission, Chairperson

4.2 Management Committee
The Management Committee consists of the deputy-level managers for the state and federal agencies. The Management Committee oversees the work of the Interagency Working Group (IWG) and the Strategy Review Group, reviews recommendations, study plans, budget proposals, and provides recommendations to the Executive Committee. The Management Committee generally meets quarterly. Subject to their approvals, members of the Management Committee are:

• U.S. Army Corps of Engineers, District Commander, San Francisco District
• U.S. Army Corps of Engineers, District Commander, Sacramento District
• California Department of Water Resources, Deputy Director, Public Safety
• U.S. Environmental Protection Agency, Associate Director, Water Division, Region 9
• Resources Agency, CALFED Bay-Delta Program, Chief Deputy Director
• State Water Resources Control Board, Executive Director
4.3 **Interagency Working Group**

The Interagency Working Group (IWG) includes program-level staff at five agencies. The IWG serves as the primary program managers of the Delta LTMS process and steering committee for the Strategy Review Group. The IWG coordinates with the Management Committee, the Strategy Review Group and others with an interest in Delta activities and the LTMS process. The IWG’s role is to identify study issues and questions to be addressed such as: identify technical work groups and expert resources, confirm purpose, charter, and assignments for the science review panel and technical work groups, discuss and review study work plans and scopes, discuss and review study budgets and resource needs, prepare and approve study reports, and develop management and strategic options for the Management and Executive Committees. Subject to their approvals, the members of the IWG consist of the following:

- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- California Regional Water Quality Control Board, Central Valley Region
- Resources Agency, CALFED Bay-Delta Program
- California Department of Water Resources
- California Department of Fish and Game

The Management Committee may identify other participants in the IWG.

4.4 **Strategy Review Group**

Delta LTMS activities are informed by the Strategy Review Group. The Strategy Review Group will consist of Interagency Work Group members and other interested governmental agencies. The meetings will be open to the public with an opportunity for interested individuals to participate. The Interagency Work Group agencies will invite stakeholders, and interest groups, and individuals working in or affected by Delta dredging and beneficial use activities for navigation, levee stability, flood control, water quality, or ecosystem restoration. The Interagency Working Group coordinates meetings monthly or as needed with the Strategy Review Group to identify, review, and discuss: 1) the Delta sediment issues of concern to be addressed by the Delta LTMS and in what order, 2) lines of inquiry that the science and technical work groups (described below) will be tasked to pursue, 3) coordinated regulatory approach for Delta dredging to be approved by the Executive Committee.

Members of the Strategy Review Group may also provide public comment at the Management and Executive Committee meetings. Subject to their approvals, the Strategy Review Group may include, but is not limited to the following agencies:

**State and Federal Agencies**

- NOAA Fisheries, Southwest Region
- U.S. Fish & Wildlife Service, Pacific Region
In addition, members of the public will be invited to participate in the meetings of the Strategy Review Group, including, but not limited to, the following groups:

**Local/Regional Agencies**
- Reclamation Districts
- Contra Costa, Sacramento, Solano, Yolo, and San Joaquin Counties
- North, Central, and South Delta Water Agencies

**Stakeholders and Interest Groups**
- The Ports of Sacramento and Stockton
- Bay Planning Coalition
- DeltaKeeper
- The Nature Conservancy
- The Bay Institute
- Environmental Water Caucus
- California Sportfishing Protection Alliance
- California Farm Bureau Federation
- State Water Contractors
- California Delta Chambers

### 4.5 Science and Technical Work Groups

The Management Committee will establish specific science and technical work groups to address Delta LTMS issues. The science and technical work groups will consist of agency staff with expertise in the relevant subject areas. Technical work groups are open to interested participants from any agency, interest group, or the public. With the direction and approval of the Management Committee, technical work groups identify study needs, develop study scopes and work plans, identify resources, and review results and conclusions. The Management Committee identifies the leader for each technical group. Some example science and technical work groups include the following:

- **Testing Protocols** – examining the appropriate procedures for testing dredged material
- **Soil and Sediment Studies** – characterizing the quality of sediments and soils in the Delta
- **Permitting Process** – identifying the regulatory approval process and opportunities for improved coordination
- **Placement and Reuse** – identifying criteria, methods, and locations for dredged material placement and reuse

These groups will be formed as determined by the Management Committee.
4.6 Science Review Panel

The Management Committee establishes a Science Review Panel made up of independent scientists. The purpose of the Science Review Panel is to provide an independent science review process for Delta LTMS studies. The Management Committee approves the leader and participants for the Science Review Panel. The Science Review Panel will evaluate existing information, identify gaps, and review results and conclusions.

4.7 Other Stakeholders/Interested Public

Other interested parties have the opportunity to learn about the Delta LTMS process and activities and to comment on them at public meetings to be held on an as needed basis, at project milestones.

5 Authorities and Decision Making

A number of state and federal agencies regulate dredging and dredged material management in the Delta. Different laws and regulations govern their roles and responsibilities, but often their purposes and goals overlap. The following summarizes the agency responsibilities for dredging, water quality, natural resources, levees, and land use. One of the early Study activities will be to document the planning, regulatory, and implementation responsibilities for Delta dredging in order to improve coordination and operational efficiency among the various Federal, State, and local agencies having jurisdictional responsibilities within the Delta. As noted in the Delta LTMS Charter, participating regulatory agencies retain their full authority to regulate dredging, reuse, and disposal activities, and nothing in the Charter or the Delta LTMS Framework shall restrict their authorities. Signatories to the Charter do not indicate their approval for any specific project that may be proposed in the future.

5.1 Dredging

The primary state and federal agencies involved in planning and permitting dredging projects are the U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (USEPA), California Regional Water Quality Control Board, Central Valley Region (CVWQCB) and the State Lands Commission (SLC).

5.2 Water Quality

The primary agencies with responsibility for overseeing compliance with water quality laws and regulations are the U.S. Environmental Protection Agency, the State Water Resources Control Board, and the California Regional Water Quality Control Board, Central Valley Region.

5.3 Natural Resources

Dredging and placement actions in the Delta will involve the review and approval by state and federal resource agencies, including the U.S. Army Corps of Engineers, U.S. Fish & Wildlife Service (FWS), the National Marine Fisheries Service (NMFS), and the state Department of Fish & Game (DFG).
5.4 Levees
If the placement of dredge material involves levees in the Delta, the USACE, the Department of Water Resources, the California Reclamation Board, and the individual Reclamation Districts have responsibilities and authorities for planning, reviewing and approving levee maintenance and dredged material placement.

5.5 Land Use
The Delta Protection Commission has regional planning and coordination responsibilities in the Delta to protect and enhance agriculture, wildlife habitat, and recreation. Five counties (Contra Costa, San Joaquin, Solano, Sacramento, and Yolo), three Councils of Government, and several cities have land use planning authority in the Delta.

6 Study Activities and Phases
The Delta LTMS will generally combine two parallel approaches – a management approach and a planning approach. These activities are designed to comply with USACE guidance for Long-Term Management Strategies and Dredged Material Management Plans, while at the same time allowing flexibility to consider and incorporate planning and evaluation activities from other federal and non-federal partners. In the near-term, these activities will focus on identifying and addressing the immediate challenges associated with dredging and protecting the Delta’s resources. In the long-term, these activities will improve the scientific understanding of the effects of dredging and measures to protect Delta resources and develop a Sediment Management Plan to coordinate dredging planning, dredge material placement and reuse, and the permitting process.

6.1 Management Approach
The management approach for the Delta LTMS is designed as an iterative approach to identify and address priority issues and needs related to Delta dredging and levee rehabilitation. The iterative approach proceeds through five activities. Stakeholders and the public will provide review and input during all activities.

1. Assessment – During the Assessment stage, the agencies will identify and prioritize dredging and dredged material management needs, opportunities and constraints, the regulatory approval process, and study and analysis needs.

2. Research and Analysis – During the Research and Analysis stage, the agencies will define and implement focused research and policy analysis activities to collect and evaluate information that will assist the Management Committee and the Agency Executive Committee address the priority issues and needs.

3. Planning – During the Planning stage, the agencies will develop and evaluate options to address the priority issues and needs related to sediment management, beneficial reuse, and regulatory process improvements.

4. Implementation – The Implementation stage will include the activities necessary to implement the actions identified during the planning activities.

5. Evaluation and Refinement – During the final stage, the agencies will review and evaluate the performance of the implemented actions. The evaluation results will be reported to
the Agency Executive Committee and stakeholders and used to prioritize activities for the next iteration of the management approach.

### 6.2 Planning Approach
In parallel with the iterative management approach to priority issues associated with Delta dredging, the Delta LTMS will proceed through five planning phases leading to a long-term Sediment Management Plan. These planning phases are consistent with federal planning guidelines.

**Phase 1 – Evaluate Management Options** – Establish goals, objectives, geographic scope, and operational boundaries. Forecast dredging requirements, material characteristics placement site capacities, and reuse and placement needs.

**Phase 2 – Formulate LTMS Alternatives** – Develop and retain all viable long-term management options that meet study goals and objectives.

**Phase 3 – Alternatives Analysis** – Complete a comparative assessment that weighs and balances engineering, economic, and environmental factors and benefits.

**Phase 4 – LTMS Implementation** – Develop and implement plan, including environmental documentation, permits, and mitigation requirements.

**Phase 5 – Review and Update LTMS** – Conduct periodic reevaluation of regulatory, economic, and environmental conditions and identify updates to the Delta LTMS.

### 6.3 Initial Issues and Topics
The following is an initial list of issues and topics planned for the Delta LTMS:

- **Regulatory Process** – Document the regulatory approval process for dredging activities and beneficial use of dredged material and identify opportunities for improved coordination.

- **Dredging Activities and Quantities** – Identify and quantify planned dredging activities for navigation, flood control, water conveyance, recreation, and other Delta functions.

- **Reuse and Placement Capacity** – Identify and quantify sediment reuse needs, sediment sources, and on-going long-term placement capacity.

- **Testing Protocols** – Identify and conduct research on evaluation of dredged material testing protocols for beneficial use of dredged sediment in the Delta.

- **Sediment Quality** – Develop and implement research on sediment quality in likely areas for dredging.

- **Emergency Procedures** – Identify existing responsibilities and procedures for response to emergency conditions in the Delta (e.g., levee failure or flooding).

### 7 Summary
The structure and process for the Delta Long-Term Management Strategy described in this document are designed to establish a collaborative framework to examine Delta dredging, beneficial use of dredged sediment for levee reconstruction and ecosystem restoration, and other
placement needs and explore ways to operationally improve the regulatory approval process for
dredging in the Delta in ways that protect and enhance the Delta environment and water quality.
In this document, the following was detailed: 1) purpose, 2) goals and objectives, 3) structure,
participants and roles of committees and working groups, 4) authorities and decision making
processes, and 5) study activities and phases for the Delta LTMS process. When taken together,
these framework components will enable participants to shape and implement a Delta LTMS
work plan and, ultimately, a Delta sediment management plan that may include dredging projects
to stabilize levees, maintain and improve navigation channels, support ecosystem restoration, and
maintain water supply and water quality. The immediate next steps include development of a
project management plan and work plan, as well as preparing a detailed scope of work for
development of the Sediment Management Plan.
Appendix A –
Related Programs

The Bay-Delta is an interconnected system that affects and is affected by numerous projects and programs related to levees, navigation, water supply, ecosystem restoration, land development, and recreation. The following is a list of the major programs in each of these areas that will influence or relate to the Delta LTMS.

Multi-Purpose Programs

**Delta Vision Process**—State-led effort to encompass and integrate many ongoing but separate planning activities for the Delta and Suisan Bay/Marsh that will assess risks and prepare a contingency and emergency response plan for near-term catastrophic events. Will develop a long-term Delta Vision for sustainable management of the Delta’s multiple uses, resources and ecosystem in cooperation with elected officials, government agencies, stakeholders, academia, and affected California communities.

**Delta Improvement Program** – As part of the CALFED Bay-Delta Program, DWR, the federal Bureau of Reclamation (USBR), and the Central Valley Project (CVP)/State Water Project (SWP) water contractors have proposed a program to improve integration of SWP/CVP operations and Delta facilities included in the CALFED Record of Decision (ROD). The program seeks to coordinate the South Delta Improvements Program (SDIP), CVP/SWP Intertie, and the Operations and Criteria Plan (OCAP) schedules, which support continuing the Environmental Water Account and define operational rules for the Banks Pumping Plant and the CVP/SWP Intertie.

**South Delta Improvements Program** – DWR and USBR are responsible for implementing CALFED’s South Delta Improvements Program. Activities include providing for more reliable long-term export capability by the state and federal water projects, protecting local diversions, and reducing impacts on San Joaquin River salmon. Specifically, the CALFED actions in the SDIP include consideration of placement of an operable gate at the head of Old River to protect salmon, up to three operable gates in south Delta channels, dredging and extension of some agricultural diversions, and increasing diversion capability of Clifton Court Forebay.

**North Delta Improvement Program** – Operated as part of the CALFED Bay-Delta Improvement Projects, the purpose of the North Delta Flood Control and Ecosystem Restoration Project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. The additional objectives include:

- Improve Water Supply Reliability for Conveyance
- Improve Water Quality for Conveyance
- Recommend Ecosystem Restoration and Science Actions
- Improve Levee Stability
- Improve and Enhance Recreation

includes findings, policies, and recommendations for maintaining and improving Delta resources in eight areas: environment; utilities and infrastructure; land use; agriculture; water; recreation and access; levees; and marine patrol, boater education, and safety programs.

**Dredging**

**National Dredging Team** – The Army Corps of Engineers and the U.S. EPA are co-chairs of the National Dredging Team (NDT). The NDT was established in 1995 to support implementation of the National Dredging Policy, promote national and regional consistency on dredging issues, and provide a mechanism for issue resolution and information exchange among Federal, State, and local agencies and stakeholders. This policy calls for establishing Regional Dredging Teams and Local Planning Groups to coordinate dredging activities and permitting. The Delta LTMS could function as one or both of these groups under the National Dredging Policy.

**Delta Dredging and Reuse Strategy** – The Delta Dredging Reuse Strategy (June 20, 2002, Central Valley Regional Water Quality Control Board) analyzed the regulatory and technical considerations for contaminants in dredged material, particularly for the Regional Board’s review of dredging projects. The technical analysis focused mainly on upland placement and beneficial use. The recommendations include identification of information gaps, recommendations for permit streamlining, and recommendations for interim screening values and test methods that may be used by Regional Board staff in future General Order Waste Placement Requirements or to assess future projects.

**San Francisco Bay LTMS** – Beginning in 1994, the USACE, USEPA, the SWRCB, the San Francisco Bay Regional Water Quality Control Board, the Bay Conservation and Development Commission (BCDC) and other agencies began developing a Long-term Management Strategy for dredging in the San Francisco Bay. This program provides useful guidance and experience for implementing the Delta LTMS.

**Levees**

**CALFED Levees Program** – The purpose of the CALFED Levees Program is to facilitate levee system integrity to protect water supplies needed for the environment, agriculture, and urban uses by reducing the threat of levee failure and seawater intrusion. This involves collaboration between CALFED, DWR, the Department of Fish and Game, USACE, and the Reclamation Board, and numerous local reclamation districts. The CALFED Authorization Act (108-361) provided further direction on the development and implementation of the Levee Stability and Improvement Program.

**Delta Risk Management Study (DRMS)** – This is a multi-year program to evaluate the ongoing and future risk of levee failure and to develop a set of alternative risk reduction plans to mitigate the consequences of levee failures. DWR has an ongoing program to reuse dredged material for Delta levee construction. Because levee construction material is in such short supply in the Delta, the primary issue for DWR associated with dredging activities is the long-term viability of this beneficial reuse program while protecting the beneficial uses of the waters of the State.
Navigation

San Francisco to Stockton Ship Channel Deepening – The San Francisco District of the Army Corps of Engineers is managing the planning process for deepening the channel from Stockton to San Francisco to accommodate larger ships of varying commodities.

Sacramento Ship Channel Deepening – Proposed improvements call for deepening the existing 300-ft- wide project from 30 to 35 ft from Sacramento River miles 12 to 20.

Water Quality

Regional Board TMDLs – The California Regional Water Quality Control Board, Central Valley Region is working on four Total Maximum Daily Load (TMDL) studies to address Delta water quality problems related to mercury, salinity, dissolved oxygen, diazinon, and chlorpyrifos. The mercury, diazinon and chlorpyrifos TMDLs are being developed. The salinity and dissolved oxygen TMDLs have been adopted by the Board and are undergoing the approval process with the State Water Resources Control Board and the Office of Administrative Law. The diazinon and chlorpyrifos TMDLs will go to the Board in June.

Stockton Dissolved Oxygen Project – A large stakeholder-driven process to find a regional solution to the seasonal dissolved oxygen depression that occurs in the San Joaquin River. Low dissolved oxygen levels can be harmful to resident aquatic life and can delay the fall salmon migration in the river. The organizational structure for the project includes several oversight committees and diverse stakeholders, including the regional water board, local governments and agencies, and state and federal agencies.

Bay-Delta Basin Plan Update – The State Water Resources Control Board has adopted a Triennial Review staff report with a commitment to review baseline monitoring, aquatic life protection, chloride objectives, flow objectives, export limits and electrical conductivity objectives, among others, over the next decade. The California Regional Water Quality Control Board, Central Valley Region also has a Water Quality Control Plan for the Sacramento River and San Joaquin River Basins with objectives for salt and other constituents in the Delta.

State Water Resources Control Board Sediment Management Program – The State Board is managing a program to characterize and manage Delta sediments to improve water quality.

Ecosystem Restoration

CALFED Ecosystem Restoration Program – One of CALFED’s program elements, the Ecosystem Restoration Program is designed to protect and restore aquatic, upland and riparian habitats, fish populations and other native species in the Delta.

CA Aquatic Invasive Species Management Plan—Document that lays out a process by which agencies would coordinate to implement control programs for aquatic invasive species. Draft plan was released in August 2006 by Dr. Karen McDowell of the San Francisco Estuary Project.

Bay-Delta Conservation Plan—Applicant-driven effort to provide for the conservation and management of aquatic species and regulatory assurances related to water supply reliability and water quality.

Local Entity HCP Programs—Local Habitat Conservation Plans (HCPs) are master plans with the key purpose of balancing the need to conserve habitat for wildlife while accommodating growth for an expanding population. An example is the San Joaquin County Multi-Species...
Habitat Conservation and Open Space Plan (SJMSCP), which has been in existence since 2001 covering 97 species with San Joaquin County.

**Land Use**

**County and City General Plans** – A city or county’s basic planning document. It provides the blueprint for development throughout the community by addressing all aspects of development, including housing, traffic, natural resources, open space, safety, land uses, and public facilities.

**DPC Appeal Authority**—Any person who is aggrieved by any action taken by a local government or other local agency in implementing the Delta Protection Commission's Land Use and Resource Management Plan for the Primary Zone of the Delta may file an appeal with the Commission.

**Recreation**

**Delta Trail** – State Senator Tom Torlakson has proposed a five-county trail network through the Delta that would stretch from the Bay Area to the heart of the Great Central Valley. The trail planning would be coordinated with levee improvement activities.

**State Parks Central Valley Vision**— California State Parks effort that began in 2003 analyzing gaps in park and recreational lands and services, specifically in the Central Valley. In 2005 State Parks held over three dozen meetings and with significant public input identified short-term actions to pursue over the next five years.

**Other**

**Irrigated Lands Program** – In July 2003, the California Regional Water Quality Control Board, Central Valley Region adopted a resolution which sets forth two Conditional Waivers of Waste Discharge Requirements (WDRs) for discharges of waste to surface water from irrigated lands. One Irrigated Lands Conditional Waiver is for Coalition Groups, the other is for individual Dischargers. The California Regional Water Quality Control Board, Central Valley Region also developed Monitoring and Reporting Program Plans for Coalition Groups, and Individual Dischargers. The Regional Board is in the process of adopting a new waiver.
Long Term Management Strategy for Dredged Material in the Delta

(Delta LTMS)

CHARTER
Long Term Management Strategy for Dredged Material in the Delta (Delta LTMS)

CHARTER

VISION

The Long Term Management Strategy is designed to improve operational efficiency and coordination of the collective and individual agency decision making responsibilities resulting in approved dredging and dredged material management actions in the Delta. Approved dredging and dredged material management actions will take place in a manner that protects and enhances Delta water quality, identifies appropriate opportunities for the beneficial reuse of Delta sediments for levee rehabilitation and ecosystem restoration, and establishes safe disposal for materials that cannot be reused.

GOALS

The Delta LTMS will facilitate development of long-term management approach for the Delta sediments based on science, enhanced communication and coordination among the stakeholders, and resolution of issues surrounding Delta dredging and beneficial use of sediments. The agency and stakeholder meetings will serve as a forum for developing a Delta Long Term Management Strategy for Delta sediments to be detailed in a Sediment Management Plan (SMP), and for promoting its implementation when adopted.

The goals of the Delta LTMS, to be finalized in the SMP, are to manage dredging and sediment management activities, including the following:

- Maintain and stabilize Delta levees that protect land-based activities and water conveyance
- Protect and enhance water quality for Delta water supply and ecosystem function
- Support and maintain Delta channel functions for navigation, flood control, water conveyance, and recreation
- Protect and enhance aquatic, wetland, and terrestrial ecosystems

OPERATING PRINCIPLES

The participating agencies of the Delta LTMS will operate under the Delta LTMS Process Framework, as last revised on November 1, 2006.
The participating agencies will work towards the timely completion and implementation of the Delta LTMS and Sediment Management Plan.

The participating agencies will continue to seek the participation of other agencies and stakeholders to the Delta LTMS Charter and Process Framework.

The agenda and issues to be addressed will be determined by the Delta LTMS agencies in consultation with other agencies and stakeholders.

The Delta LTMS will provide for peer review of technical studies through the Science Review Panel.

Information will be sought from stakeholders to help identify and clarify specific issues as well as provide factual data on the issues.

It is anticipated that the Delta LTMS will serve as a Regional Dredging Team under the National Dredging Policy.

Participating regulatory agencies shall retain their full authority to regulate dredging, reuse, and disposal activities, and nothing in this Charter or the Delta LTMS Framework shall restrict their authorities. Signatories do not indicate their approval for any specific project that may be proposed in the future.

MEMBERSHIP

The Delta LTMS is organized to include an executive committee, management committee, interagency working group, strategy review group, and science and technical groups as described in this section. In addition, public meetings will be held to provide additional opportunities for input and feedback from interested persons.

Executive Committee
At the top level, an Executive Committee directs the overall program, sets direction, and provides oversight of the study. Subject to their approvals, the directors of each of the following agencies serve on the Executive Committee. The executive managers have the decision-making authority to represent the agency on strategic and regulatory issues to be addressed, to the extent consistent with applicable laws, statutes, and regulations. The agency Executive Committee generally meets annually or as necessary to establish guidance for the study and keep abreast of the progress of the Delta LTMS.

Federal Agencies
- U.S. Army Corps of Engineers, Commander, South Pacific Division
- U.S. Environmental Protection Agency, Regional Administrator, Region 9

State Agencies
- State Water Resources Control Board, Board member
California Regional Water Quality Control Board, Central Valley Region, Chairperson
California Department of Water Resources, Director
Resources Agency, CALFED Bay-Delta Program, Director
Delta Protection Commission, Chairperson

Management Committee
The Management Committee consists of the deputy-level managers for the state and federal agencies. The Management Committee oversees the work of the Interagency Working Group (IWG) and the Strategy Review Group, reviews strategic recommendations, study plans, budget proposals, and provides recommendations to the Executive Committee. The Management Committee generally meets quarterly. Subject to their agency approvals, members of the Management Committee include:

- U.S. Army Corps of Engineers, District Commander, San Francisco District
- U.S. Army Corps of Engineers, District Commander, Sacramento District
- California Department of Water Resources, Deputy Director, Public Safety
- U.S. Environmental Protection Agency, Associate Director, Water Division, Region 9
- Resources Agency, CALFED Bay-Delta Program, Chief Deputy Director
- State Water Resources Control Board, Executive Director
- California Regional Water Quality Control Board, Central Valley Region, Executive Officer
- Delta Protection Commission, Executive Director
- NOAA Fisheries, Southwest Region
- U.S. Fish and Wildlife Service, Pacific Region
- California Department of Fish and Game

Interagency Working Group
The Interagency Working Group (IWG) includes program-level staff at five agencies. The IWG serves as the primary program managers of the Delta LTMS process and steering committee for the Strategy Review Group. The IWG coordinates with the Management Committee, the Strategy Review Group and others with an interest in Delta activities and the LTMS process. The IWG’s role is to identify study issues and questions to be addressed such as: identify technical work groups and expert resources, confirm purpose, charter, and assignments for the science advisory teams and technical review groups, discuss and review study work plans and scopes, discuss and review study budgets and resource needs, prepare and approve study reports, and develop management and policy options for the Management and Executive Committees. Subject to their approvals, the members of the IWG consist of the following:

- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- California Regional Water Quality Control Board, Central Valley Region
- Resources Agency, CALFED Bay-Delta Program
• California Department of Water Resources

The Management Committee may identify other participants in the IWG.

**Strategy Review Group**

Delta LTMS activities are informed by the Strategy Review Group. The Strategy Review Group will consist of Interagency Work Group members and other interested governmental agencies. The meetings will be open to the public with an opportunity for interested individuals and organizations to participate. The Interagency Working Group agencies will invite stakeholders, interest groups, and individuals working in or affected by Delta dredging and beneficial use activities for navigation, levee stability, flood control, water quality, or ecosystem restoration. The Interagency Working Group coordinates meetings monthly or as needed with the Strategy Review Group to identify, review, and discuss: 1) the Delta sediment issues of concern to be addressed by the Delta LTMS and in what order, 2) lines of inquiry that the science and technical work groups will be tasked to pursue, 3) coordinated regulatory approach for Delta dredging to be approved by the Executive Committee.

Members of the Strategy Review Group may also provide public comment at the Management and Executive Committee meetings. Subject to their approvals, the Strategy Review Group may include, but is not limited, to the following agencies:

**State and Federal Agencies**

- NOAA Fisheries, Southwest Region
- U.S. Fish & Wildlife Service, Pacific Region
- California Department of Fish & Game
- Delta Protection Commission
- State Lands Commission
- Reclamation Board

**Local/Regional Agencies**

- Reclamation Districts
- Contra Costa, Sacramento, Solano, Yolo, and San Joaquin Counties
- North, Central, and South Delta Water Agencies
- The Ports of Sacramento and Stockton

In addition, members of the public will be invited to participate in the meetings of the Strategy Review Group, including, but not limited to, the following groups:

**Stakeholders and Interest Groups**

- Bay Planning Coalition
- DeltaKeeper
- The Nature Conservancy
- The Bay Institute
- Environmental Water Caucus
- California Sportfishing Protection Alliance
- California Farm Bureau Federation
Science and Technical Groups
A Science Review Panel of independent scientists will be formed as determined by the Management Committee. The Management Committee may also establish science and technical work groups of agency staff, the meetings of which will be open to the public.

AGREEMENT

Participants in the Delta Long Term Management Strategy agree to participate in the study activities and will operate under this Charter. The undersigned recognize that public agency signatories to this Charter have specific statutory and regulatory authority and responsibilities, and that actions of these public agencies must be consistent with applicable procedural and substantive requirements. Nothing in this Charter or the Delta LTMS Framework is intended to, or shall have the effect of, constraining or limiting any public entity in carrying out its statutory responsibilities to regulate dredging, reuse, and disposal activities. Nothing in this Charter constitutes an admission by any party as to the proper interpretation of any provision of law or policy, nor is anything in this Charter intended to, nor shall it have the effect of, waiving or limiting any public entity’s rights and remedies under any applicable law.

The undersigned recognize that certain departments, boards, and commissions (Adjudicative Entities) have adjudicative responsibilities with respect to contested regulatory matters that are brought before them. (See California Gov. Code §§ 11400, et seq.) Such adjudicative responsibilities include the requirement that the Adjudicative Entity and its members avoid bias, prejudice, or interest in the adjudicative matters before them, e.g., they cannot decide the outcome of a matter before completion of any required hearing or equivalent proceeding.

Some such Adjudicative Entities exist within the undersigned agencies. This Charter does not in any way require or commit an Adjudicative Entity to participate in proposing a project that will come before it for approval, nor does this Charter require or imply that an Adjudicative Entity will approve a project that requires an adjudicative proceeding. Under this Charter, the role of Adjudicative Entities in connection with matters that may require an adjudicative decision is limited to promptly and diligently processing any applications, petitions, or other requests for approval. Nothing in this Charter commits an Adjudicative Entity to an approval or disapproval of any project subject to the authority of the Adjudicative Entity, nor to a term or condition in any approval of a project by the Adjudicative Entity.

Legal Consistency
All provisions of this Charter are intended and shall be interpreted to be consistent with all applicable provisions of State and Federal law.
The parties recognize that this Charter is not a contract. This Charter does not delegate to any agency, or the collective group of agencies, the authority to: (1) control another agency’s final decision on a project; (2) modify or halt an agency’s project; or (3) compromise an agency’s discretion to pursue projects according to their individual agency legal authority. This Charter facilitates cooperation and advice among the agencies; it shall not be interpreted to form a partnership, joint venture, or contract that requires federal agencies to analyze state projects and programs under the National Environmental Policy Act.

**Contingent on Appropriation of Funds and Future Actions**

The expenditure or advance of any money or the performance of any obligation of the United States under this Charter shall be contingent upon appropriation or allotment of funds in accordance with 31 USC 1341(Anti-Deficiency Act). No liability shall accrue to the United States for failure to perform any obligation under this Charter in the event that funds are not appropriated or allotted.

Activities and obligations, if any, under this charter pertaining to entities of the State of California are also subject to the availability of appropriated funds and to the independent decision-making authority of such entities. No liability shall accrue to such entities, or to the State of California, for failure to perform any action under this Charter in the event that funds are not appropriated or if any such entity declines to participate in any activity. Each participating agency’s participation under this Charter is and shall remain voluntary.

This Charter shall be effective upon the date of signature of all participating agencies listed on page 7. This Charter may be signed in counterparts.
Signed by:

General John R. McMahon  
Commander, South Pacific Division  
U.S. Army Corps of Engineers  

Wayne Nastri  
Regional Administrator, Region 9  
U.S. Environmental Protection Agency  

Lester Snow  
Director  
California Department of Water Resources  

Tam M. Doduc  
Chairperson  
State Water Resources Control Board  

Karl E. Longley  
Chairperson  
California Regional Water Quality Control Board, Central Valley Region  

Joe Grundstaf  
Director  
CALFED Bay-Delta Program (Resources Agency)  

Mike Reagan  
Commissioner  
Delta Protection Commission  

12 Feb 07  
22 Feb 07  
14 Feb 07  
2/28/07  
13 Feb 07  
2/14/07  
2/22/07
APPENDIX B

LEVEES OF FEDERAL CONCERN
Engineers: 122 levees at risk of failing Date?
By BEVERLEY LUMPKIN, Associated Press Writer

WASHINGTON – One hundred twenty-two levees from Maryland to California are at risk of failing, according to a list released Thursday by the Army Corps of Engineers.

There could be danger to people who live in communities near some of the levees as well as a chance that they will have to pay more for insurance, said Butch Kinerney of the Federal Emergency Management Agency’s national flood insurance program.

The list was released in response to Freedom of Information Act requests filed by news organizations, including The Associated Press.

If the Corps of Engineers determines a levee to be at risk of failing, homeowners in the area could be required to purchase flood insurance, though exceptions can be made.

Communities near the levees have been notified that they have received an "unacceptable maintenance inspection rating." That means a levee has one or more problems, which can include movement of floodwalls, faulty culverts, animal burrows, erosion or tree growth, according to a statement released by the Corps.

California, with 37 suspect levees, and Washington state, with 19, led the list.

FEMA’s Kinerney said he was concerned that the levees present not only a chance of higher insurance costs but a danger to those living nearby. FEMA maps flood plains and helps determine the flood risks that communities face.

Kinerney said people living near the levees should have an evacuation plan, a family emergency plan, and a disaster supply kit, along with flood insurance.

The Corps has been warning communities they need to take care of routine levee maintenance, said Larry Larson, director of the Association of State Floodplain Managers. Larson said he was glad the Corps was putting out the word on the levees.
"The feds are saying, 'Wait a minute, we haven't been doing our job,'" Larson said. "'We better get on top of this. Your people are at risk. You need to get something done.'"

The Corps historically has constructed the levees and has turned most of them over to local communities for operations and maintenance. Some communities may not have kept up with needed repairs, while others may merely lack the documentation, Kinerney said.

As the Corps decertifies the adequacy of a particular levee, it also notifies FEMA, which can take away the credit communities get on their flood insurance rate for having a levee.

Kinerney added that if residents of the communities at risk were to purchase flood insurance now, before the community's designation changes, they can still pay the cheaper rate.

The Corps can give communities 12 months to make corrections — sometimes it's just a matter of "filling gopher holes," Kinerney said.

Also, FEMA can issue for up to 24 months a provisional accreditation if a community requests it, giving it up to two years to correct the problems or contest the finding that the levee is not sound. During that period, residents are not required to purchase flood insurance.

Appendix L
State Flood Control Facilities within the Legal Boundary of the Delta
(Map showing Central Valley Flood Protection Board Jurisdictions)
NOTE: THE DELTA IS LOCATED IN THE SACRAMENTO AND SAN JOAQUIN VALLEYS.
Appendix M
Projected 5-year Budgets
(Fiscal Years 2012–2017)
for Delta Stewardship Council,
Delta Protection Commission,
and Sacramento-San Joaquin
Delta Conservancy
APPENDIX M – PROJECTED 5-YEAR BUDGETS (FISCAL YEARS 2012–2017)
FOR DELTA STEWARDSHIP COUNCIL, DELTA PROTECTION COMMISSION, AND SACRAMENTO-SAN JOAQUIN DELTA CONSERVANCY

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Note: The Delta Stewardship Council, Sacramento-San Joaquin Delta Conservancy, and Delta Protection Commission are currently developing long-term finance projections beginning in fiscal year 2013-2014. Budget projections will be updated as more information becomes available.

Table M-1
Projected 5-year Budgets (2012–2017) for Agencies Conducting Sacramento-San Joaquin Delta Projects

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| Revenues                            |          |          |          |          |          |          |
| General Fund                        | $5,505   | $5,548   | $7,000   | $7,000   | $7,000   | $7,000   |
Table M-1
Projected 5-year Budgets (2012–2017) for Agencies Conducting Sacramento-San Joaquin Delta Projects

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SACRAMENTO–SAN JOAQUIN DELTA CONSERVANCY

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Appendix N

Funding and Financing Options
Appendix N
Funding and Financing Options

This appendix describes various funding and financing schemes that will be evaluated for inclusion in the financing strategy. In examining potential sources, approaches used by other major programs around the country were explored. Some of these approaches are described here.

Capital Funding Sources

To implement Delta Plan infrastructure improvements and to fund habitat acquisitions and improvements, capital funding sources will need to be identified.

Federal Appropriations

Federal appropriations typically pay for the taxpayers’ share of capital costs. Federal authorization already exists for several Sacramento-San Joaquin Delta (Delta) programs; however, future funding to continue these programs is uncertain.

General Fund Appropriations

The General Fund includes revenues and spending not required by law to be accounted for in any other fund. Most state expenditures are made from this fund, and the California Legislature may appropriate funds for any purpose. However, the State of California’s (State’s) fiscal condition will limit the availability of these funds in the future.

Conservation Organizations

Many conservation organizations donate funds for land and water acquisition and management. The Nature Conservancy, for example, has been active in the Delta region. New nonprofit (501(c) (3)) organizations could be established to accept tax-deductible donations for Delta projects and programs.

Repayment and Operations and Maintenance Funding Sources

The Finance Plan will identify revenue sources to repay capital costs, and to pay for ongoing operations, maintenance, and replacement costs.

User Charges for Water

Water agencies generate revenue by selling water. Water sale revenues are normally used to pay for water supply and quality costs, including operations and maintenance expenses, and debt repayment for
facilities. The cost of developing new water supplies is usually factored into the price charged for water. However, surface water sale revenues are influenced by the elasticity of demand. If demand is at all elastic (price responsive), then water users will buy less water as price increases (or shift to groundwater if available), and water revenues may fall below levels needed to meet fixed operating costs. For new water supplies, the required infrastructure may be too costly for current customers given the economic returns they receive for water.

**Fines and Forfeitures**

Administrative and civil enforcement actions may result in the collection of fines and forfeitures. Water Code section 13260 authorizes the State Water Resources Control Board (SWRCB) to collect fees that are deposited in the Waste Discharge Permit Fund. For fiscal year 2008–09, revenues and expenditures were about $80 million. Most of the funds are spent for National Pollutant Discharge Elimination System permit and stormwater programs, and for waste discharge requirements. For each program, most costs are for permitting, enforcement, and compliance (SWRCB 2009). The Delta Stewardship Council (Council) should evaluate the potential for directing fees, fines, and forfeitures for actions detrimental to the Delta to Delta activities.

**Carbon Offsets/Tule Farming**

A carbon offset is a reduction in emissions of carbon dioxide made in order to compensate for or to offset an emission made elsewhere. The offsets are measured in metric tons of carbon dioxide equivalent, and one offset represents the reduction of one metric ton of carbon dioxide.

There are two markets for carbon offsets. In the large compliance market, companies and governments buy offsets in order to comply with caps on the total amount of carbon dioxide they are permitted to emit. This market was established to comply with various international agreements and protocols.

The smaller voluntary market allows individuals, governments, and companies to purchase offsets to offset their own emissions. Offsets are typically achieved through financial support of projects that reduce the emission of carbon dioxide. In other words, a project to reduce or eliminate emissions may be partially paid for by the sale of the offsets. The cost of an offset has recently ranged from $8 to $30 per ton-year (California Chapter American Society of Farm Managers and Rural Appraisers 2009).

Dead plant material, largely carbon, accumulates in the form of new peat soil on farmed Delta islands. When the farmland is converted to cattails or tules, carbon emissions may be reduced or eliminated. The Delta subsides at a rate of 1 to 3 inches per year, mostly in the form of carbon dioxide releases (Ingebritsien et al. 2000). The amount of carbon emissions from farmed Delta islands is estimated to be 2.5 to 6.5 tons per acre per year.

The U.S. Geological Survey has been measuring carbon sequestration on an experimental plot on Twitchell Island for about 15 years. The additional carbon dioxide sequestered by cattails or tules amounts to 12 to 20 tons per acre per year using high and low ranges, and potential revenue per acre is $100 to $800 per acre per year. It appears that carbon dioxide offsets might repay a significant share of Delta island acquisition and wetland restoration costs. Net revenue of $200 per acre per year is worth about $3,000 to $4,000 per acre in net present value terms as compared to the cost of land, which may be $3,000 to $10,000 per acre (California Chapter American Society of Farm Managers and Rural Appraisers 2009).

**User Fees and Stressor Fees**

User fees and stressor fees are conceptually similar but somewhat different. User fees may be assessed because the user benefits from improvements funded by the fee. Stressor fees may be assessed to reduce
unwanted stressors, and stressor fees may be assessed because the fees create an incentive to reduce stressors. User fees are assessed based on the amount of a resource used or consumed. Stressor fees are assessed based on the amount of stressor released or caused. In either case, physical measurement of the amount of use or stressor is necessary.

**Diversion Fees**

Diversion fees are commonly assessed based on both use and/or stress. That is, diversions may benefit from expenditures, but they may also contribute to stress.

A number of factors limit the feasibility of additional diversion fees in California. In particular, water users adamantly oppose any new diversion fees, unless perhaps the fees are developed by water users themselves. In 2005, for example, a letter from 39 water district and city managers to Governor Schwarzenegger included the following request (Senator Perata et al. 2005):

> ...do not include CALFED user fees as part of the 2005-06 state budget. Any such proposal is entirely inappropriate, given that all versions of the CALFED needs assessment aired to date have avoided grappling directly with the “beneficiary pays” principle. CALFED cost allocations should be proposed only after CALFED has conducted an open public hearing process in which all stakeholders have had the opportunity to present testimony on appropriate beneficiary payments. Until this process has been completed, no financing plan for CALFED can be considered complete and ready for implementation as part of the state budget.

Existing laws, such as Proposition 218, limit the ability of any State or local government to establish new diversion fees. Enabling legislation would be required.

The potential for diversion fees is also limited by the inconsistency and lack of water diversion measurement in some places. Diversions are measured by a variety of methods, and some diversions are not routinely measured. The costs of standardized measurement could be significant relative to the amount of fees collected.

Several efforts in the past estimated the revenues that could be collected if the fees were similar to Bureau of Reclamation restoration fees. In 2000, one author estimated that average non-Central Valley Project (CVP) contract diversions of 13.182 million acre-feet with fee levels similar to CVP restoration fees could provide about $105 million in annual revenues (Wahl 2000). In 2004, CALFED estimated that potential fee levels per acre-foot-year of diversion would raise $25 million in annual funds based on “normal” non-CVP contract diversions of 16.522 million acre-feet. These fee levels were $1.50 for all users, or $1.25 for agriculture and $2.50 for urban users, or $3.25 for Delta exporters and $1 for all others (CALFED 2004). CALFED also estimated that a residential fee of $1 per month per household in the CALFED solution area could raise $106 million annually.

**Fishing Fees and Payments**

From 2004 through 2009, recreational fishing within the Bay-Delta watershed below the first dam required a Bay-Delta Sport Fishing Enhancement Stamp. In 2009, about 300,000 stamps were sold at a retail cost of $6.30, and gross revenues were about $1.9 million. These funds were used for projects and activities that provided a benefit to the primary Bay-Delta sport fisheries and were leveraged with a 75 percent cost share from the federal Sport Fish Restoration Act. In 2009, Assembly Bill 1052 repealed the stamp (California Department of Fish and Game 2011a). The Council should consider supporting legislation to renew this user fee-funded program.

A stressor-based fee could be based on removals of desirable species. In 2011, inland steelhead anglers are required to purchase a Steelhead Report Card at a cost of $6.48, and a North Coast Salmon Report
Card costing $5.66 is required for all anglers taking salmon in the Smith River System or Klamath-Trinity River System (California Department of Fish and Game 2011b). Annual revenues from 2001 to 2006 from the Steelhead Report Card averaged about $200,000 (Jackson 2007). Any person fishing commercially for salmon in California must purchase a commercial fishing salmon stamp for $85.

Similar fees might be collected when substantial salmon fishing is again allowed in the Bay-Delta system. In 2006, about 500,000 freshwater and 1 million saltwater days were taken for salmon fishing (California Department of Fish and Game 2010). Revenue potential from recreational salmon cards is estimated to be $500,000 to $1 million annually.

**Hydropower Fees**

Fees could be collected from hydropower generators in the Bay-Delta system. The SWRCB collects fees from licensed Federal Energy Regulatory Commission projects at a rate of $0.017 per kilowatt of generating capacity. Higher fees will be collected from generators that recently renewed their Federal Energy Regulatory Commission licenses at higher assessment rates (SWRCB 2010). These fees must be used to cover authorized costs of the Water Rights Program. The estimated amount of revenues from increased fee assessments on hydropower generators is unknown.

**Other Stressor Fees**

A variety of stressor fees might be used to help finance programs recommended in the Delta Plan. Seven types of stressor fees could be considered:

1. **Water quality loading charge**: charge measured pollutant loads in water discharges.
2. **Land use charge**: charge land use practices that contribute to stressors.
3. **Retail sales fees**: charge retail sales of products that may become stressors.
4. **Habitat alteration fees**: charge existing or proposed land alterations that contribute to habitat stressors.
5. **Special diversion fees**: charge water diversions that contribute more than average to entainment, stranding, or flow-related habitat loss.
6. **Recreation use fees**: charge for recreation that contributes to stressors.
7. **Hatchery fees**: charge hatcheries for management practices that damage Delta resources.

Some pollutants, ammonia and certain chemicals in particular, originate known sources; and the amount of the pollutant load can be measured. The cost of removing the stressors may determine a fair and efficient charge level. There are complex measurement issues and administrative costs to consider, but these may be minor compared to revenues.

The other stressor-based fees are generally not as straightforward. With respect to a fee for land management practices that release methyl mercury, for example, the stressor being introduced is often diffuse, not well measured, and the amount may vary substantially based on location and local conditions. It may be unfair or expensive to set land use charges based on diffuse and hard-to-measure stressors. The provisions of Proposition 218 procedures must be applied to the assessment of stormwater fees, and it would likely apply to land use charges as well.

A charge on retail sales of stressor materials such as pesticides or fertilizers might also be problematic, because these materials are used in a wide variety of locations and applications. The legality of these types of charges is not clear.
There is some potential for establishing charges for certain types of habitat alteration practices, such as wetland conversions. However, these charges might also fall under Proposition 218. The special diversion charge would be difficult to justify because the amount of unusual damage via entrainment, stranding, or flow habitat loss would often be difficult to quantify and value. Hatchery management fees might be inefficient compared to other efforts to improve hatchery practices.

The revenue potential from stressor fees is unknown, but is probably minor. Also, it is likely that any stressor fees could only be spent for a very limited range of activities that would benefit the persons paying the fee under Proposition 26. There is, however, some potential for revenues in the form of fishing stamps (probably less than $5 million annually) and additional water quality loading charges.

**Water Marketing Fees**

Water marketing fees would be assessed against water transfers in the Delta watershed. These fees would be above and beyond any existing watershed diversion or export fees. The SWRCB currently collects fees associated with change in water rights that may be required for transfers. This concept can only work if water transfers can occur in a cost-efficient and timely manner.

The number of water transfers between existing water agencies is not large compared to total statewide water use. During the drought years of 2008 and 2009, about 400,000 acre-feet of cross-Delta transfers were reported annually (Smith 2009). If these transfers were assessed a fee of $10 per acre-foot, revenues could total $4 million annually. However, the volume of transfers in most years would be much less than in 2008 and 2009.

**Water Resources Fee**

A statewide assessment would feature equal application and would be comprehensive, free of loopholes, affordable, understandable, and easy and inexpensive to administer. It would be applied at the retail level with different rates for nonagricultural (acre-feet of water used) and agricultural water users (number of acres irrigated). Proceeds from the assessments would be split equally between statewide/interregional projects and regional projects. The State Board of Equalization would collect and administer the revenues.

Assessment income in the statewide account would pay for administration costs; the operations costs of the Council, the Sacramento-San Joaquin Delta Conservancy, and the Delta Protection Commission; scientific studies; and debt service on general obligation bonds for projects that provide statewide public benefits. Regional projects would qualify for funding if they are consistent with an integrated regional water management plan, a stormwater resources plan, a groundwater management plan, or a water quality control plan.

**Public Goods Charges**

In 1996, a public goods charge for electricity sold by California Public Utilities Commission-regulated for-profit public utilities was approved in California as part of the energy sector deregulation. The public goods charge is a monthly fee assessed to residential and industrial customers to fund energy efficiency programs. However, the enabling statute authorizing assessment of this fee expired at the end of 2011.

There has been some interest in a public-goods charge for water as a potential tool for achieving the objectives of Assembly Bill 32, known as “The Global Warming Solutions Act of 2006” (Griffin, Leventis, and McDonald 2010). In a study prepared for the California Public Utilities Commission by the U.C. Berkeley Goldman School of Public Policy, a public goods charge for water was proposed that consisted of a volumetric charge on individual water utility bills.

The design of a public-goods charge for water would need to be developed; and, given the passage of Proposition 26, a two-thirds vote would be required to implement it. The primary purpose of a public-
goods charge should be to fund investments or activities that have broad, statewide benefit. These might include statewide planning, ecosystem enhancements, or investments that reduce reliance on imported supplies. A public-goods charge could ensure a minimum investment by all urban and agricultural water agencies in water use efficiency and other tools that can reduce reliance on imported water. It could also provide a consistent funding stream over time. Actual activities to be funded would need to be more definitely described before it could be presented to the voters.

**Financing Methods**

**State-issued Debt**

State law authorizes the issue of two types of debt for water-related infrastructure: general obligation bonds and revenue bonds. General obligation bonds must be approved by voters, and repayment is guaranteed by the State’s general taxing power, resulting in typically low interest costs. Revenue bonds do not require voter approval because they are secured by a dedicated revenue stream, such as water sales.

**Local Government Debt**

Capital expenditures may be funded by debt issued by local agencies. Depending on the type of project being financed, local agencies may issue debt based on increased revenue streams, or may establish improvement or assessment districts.

**References**


Senators Perata and Ackerman, Speaker Nunez, and Assembly Member McCarthy. 2005. Letter to the Honorable Governor Schwarzenegger. May 11.


Appendix O
Mitigation Monitoring and Reporting Program
In November 2009, the California Legislature enacted Senate Bill X7 1, one of several bills passed at that time related to water supply reliability, ecosystem health, and the Sacramento–San Joaquin Delta (Delta). This new law became effective February 3, 2010. Division 35 of the Water Code (Wat. Code), also known as the Sacramento–San Joaquin Delta Reform Act of 2009 (Delta Reform Act, or Act), requires the development of a legally enforceable, comprehensive, long-term management plan for the Delta, referred to as the Delta Plan.

In May 2013, the Delta Stewardship Council (Council) adopted the Delta Plan. Prior to adopting the 2013 Delta Plan, the Council certified the 2013 Program Environmental Impact Report (PEIR) (2013 PEIR),1 which analyzes the potential significant impacts associated with implementing the Delta Plan at a program level of detail. The Delta Plan was subsequently amended in 2016. Several components of the Delta Plan require revisions due to changes in circumstances and conditions in the Delta, and prior commitments made in the Delta Plan adopted in 2013. The proposed Delta Plan Amendments (Proposed Project or proposed amendments) involve three components: Delta Levee Investment and Risk Reduction Strategy (DLIS); Delta Conveyance, Storage Systems, and the Operation of Both (CSO); and Performance Measures (PM).

The Delta Stewardship Council (Council), as the California Environmental Quality Act (CEQA) lead agency, prepared a PEIR for the Delta Plan Amendments in accordance with the requirements of CEQA (Public Resources Code Section 21000 et seq) and the CEQA Guidelines (California Code of Regulations, title 14, section 15000, et seq.). As an informational document, the PEIR provides full disclosure to the public and Council regarding the potential significant environmental effects of the Proposed Project. It is also intended to provide sufficient information to foster informed decision-making by the Council.

The fundamental purpose of the Delta Plan is to further achievement of the coequal goals, which are defined in Water Code section 85054, and all of the inherent subgoals and policy objectives defined by statute, as identified in the PEIR. The Delta Plan contains an integrated and legally enforceable set of policies serves as a basis for future certifications of consistency with the Delta Plan by State and local agencies with regard to specified “covered actions” as defined in Water Code section 85057.5. It also establishes a process by which any person can appeal such certifications to the Council, consistent with the Delta Reform Act and Council regulations. See Water Code sections 85225.10(a), 85225.15, 85225.30; Delta Stewardship Council, Administrative Procedures Governing Appeals section l(5).

1 State Clearinghouse Number 2010122028
Public Resources Code section 21081.6 requires a public agency to adopt a monitoring or reporting program to ensure compliance with the mitigation measures adopted by the agency at the time of project approval. This Mitigation Monitoring and Reporting Program (MMRP) is to be used by the Council to ensure compliance with the mitigation measures identified in the Delta Plan Amendments PEIR and the 2013 PEIR. Table 1 and Table 2 present the mitigation measures identified in the Delta Plan Amendments PEIR and the 2013 PEIR, respectively.

For covered actions constructed in response to the proposed amendments in the Primary and Extended Planning Areas, other public agencies would be required to implement the mitigation measures in Table 1 and Table 2 or equally effective measures, if feasible, as required by Delta Plan policy G P1 (California Code of Regulations (Cal. Code of Regs.) title 23 section 5002). Delta Plan policy G P1 (Cal. Code of Regs. title 23 section 5002(b)(2)) specifies that any covered action that is not exempt must include either the mitigation measures identified in Table 1 and Table 2 and adopted and incorporated into the Delta Plan, if applicable and feasible; substitute mitigation measures that the proposing agency finds to be equally or more effective than those identified Table 1 and Table 2; or an explanation of why such mitigation is not feasible. Monitoring and reporting on implementation of the mitigation measures is accomplished through the certification of consistency process required by policy G P1 (Cal. Code of Regs. title 23 section 5002). The 2013 PEIR Mitigation Measures were adopted and incorporated into the Delta Plan in order to reduce or avoid the significant environmental impacts of the Delta Plan. The 2013 PEIR Mitigation Measures would continue to be implemented as part of the Proposed Project and would apply to covered actions as required by Delta Plan policy G P1.

Table 1 and Table 2 are in tabular format and contain the following information:

**Mitigation Measure Number:** Lists the mitigation measures by number, as designated in the 2013 PEIR and Delta Plan Amendments PEIR, by resource.

**Mitigation Measure:** Provides the text of the mitigation measures that have been adopted by the Council and incorporated into the Delta Plan.

**Implemented By:** The Council is responsible for making sure that the mitigation measures identified in the PEIR are fully enforceable by adopting and incorporating them into the Delta Plan Pub. Resources Code section 21081.6(b).

**When Implemented:** All of the mitigation measures identified in the 2013 PEIR have been adopted and incorporated into the Delta Plan through Delta Plan Policy G P1 and are required to be implemented for covered actions pursuant to regulatory requirements (23 Cal. Code of Regs. section 5002(b)(2)), if applicable and feasible, unless equally effective substitute mitigation is implemented.

**Monitoring or Reporting Action:** Monitoring and/or reporting on implementation of the adopted mitigation measures will be accomplished through the Certification of Consistency process. In the Certification of Consistency Form submitted to the Council for every covered action, the proposing agency for the action will identify the specific mitigation measures for the covered action that correspond to each applicable mitigation
measure, or will explain why any such measures are not feasible in the context of the specific covered action and describe any substitute mitigation that is equally as effective as the pertinent mitigation measure. In addition, the Council is responsible for reviewing all appeals of a proposing agency’s certification that a covered action is consistent with the Delta Plan.
<table>
<thead>
<tr>
<th>Delta Plan Amendments Mitigation Measure</th>
<th>Delta Plan Amendments Mitigation Measure</th>
<th>Implemented By</th>
<th>When Implemented</th>
<th>Monitoring or Reporting Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetics</td>
<td>Use non-specular conductors for transmission lines and distribution lines to reduce glare.</td>
<td>Delta Stewardship Council</td>
<td>2018</td>
<td>Certification of Consistency process</td>
</tr>
</tbody>
</table>

Council adopts Delta Plan Amendments PEIR mitigation measure pursuant to Policy G P1 and initiates rulemaking amendment process (23 CCR §§ 5001 and 5002(b)(2)) in 2018.
<table>
<thead>
<tr>
<th>Water Resources</th>
<th>2013 Delta Plan Mitigation Measure Number</th>
<th>2013 Delta Plan Mitigation Measure</th>
<th>Implemented By</th>
<th>When Implemented</th>
<th>Monitoring or Reporting Action</th>
</tr>
</thead>
</table>
| 3-1            | ♦ For construction of new facilities, all typical construction mitigation measures shall be required. Typical mitigation measures include the following construction-related Best Management Practices (BMPs):  
   • Gravel bags, silt fences, etc., shall be placed along the edge of all work areas in order to contain particulates prior to contact with receiving waters.  
   • All concrete washing and spoils dumping shall occur in a designated location.  
   • Construction stockpiles shall be covered in order to prevent blowoff or runoff during weather events.  
   • Severe weather event erosion control materials and devices shall be stored onsite for use as needed.  
   • Soil stabilization, sediment control, wind erosion control, tracking control, non-storm water management, and waste management/materials pollution control  
   ♦ Apply other BMPs as determined necessary by the regulating entity (city, county).  
   ♦ Any new facility with introduced impervious surfaces shall include stormwater control measures that are consistent with the Regional Water Quality Control Board (RWQCB) National Pollutant Discharge Elimination System (NPDES) municipal stormwater runoff requirements. The stormwater control measures shall be designed and implemented to reduce the discharge of stormwater pollutants to the maximum extent practical. Stormwater controls such as bioretention facilities, flow-through planters, detention basins, vegetative swales, covering pollutant sources, oil/water separators, and retention ponds shall be designed to control stormwater quality to the maximum extent practical.  
   ♦ Mitigate sediment contaminant bioavailability impacts through (a) the exclusion of bird use or nesting areas from areas that may have excessive selenium or mercury; (b) minimization of | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
methylmercury production; and/or (c) maximization of contaminant
degradation before discharge of water, as appropriate.

For any construction activities with the potential to cause in-river sediment disturbance associated with construction:

♦ Apply BMPs to avoid or reduce temporary increases in suspended sediment. These BMPs for in-channel construction and levee disturbance may include, but are not limited to, silt curtains, cofferdams, the use of environmental dredges, erosion control on all inward levee slopes, and various levee-stabilization techniques, including revegetation. All construction sites will include preparation of a Storm Water Pollution Prevention Plan and BMPs designed to capture spills and prevent erosion to the waterbody. Turbidity shall be monitored up- and downstream of construction sites as a measure of impact.

♦ Apply bank stabilization BMPs, as needed, for any in-channel disturbance, such as:
  - A 100-foot vegetative or engineered buffer shall be maintained between the construction zone and surface water body.
  - Native and annual grasses or other vegetative cover shall be established on construction sites immediately upon completion of work causing disturbance, to reduce the potential for erosion close to a waterway or water body.

Dredging would be particularly prone to the production of re-suspended sediment and contaminants, but potential impacts could be reduced, but not necessarily fully mitigated through the use of submerged dredge cutter heads, silt curtains, and cofferdams, depending upon the site-specific soil conditions in the channel.

| 3-2 | Prior to construction, a survey should be made of all wells located adjacent to the construction site to determine location and depths of the wells and the groundwater surface. During construction of any project that requires dewatering of groundwater, monitoring wells should be installed adjacent to the groundwater dewatering wells or pumps. If the adjacent groundwater declines in a manner that would adversely affect adjacent wells following implementation of dewatering, the dewatering operations should be halted until the following measures are be implemented:
  - Install sheet piles to reduce the area influenced by shallow groundwater level declines.
  - In case sheet piles are not an option and domestic well yields are affected, water supplies shall be trucked in to satisfy the well user’s water supply needs. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
• If sheet piles are not effective and the impact on the well yield is important, such that the trucking in of water is not economically feasible, the affected well shall be deepened. Another option for a well that is deep enough would be to lower the pump bowl such that deepened water can be pumped out of the well. If these two options are not feasible, a new, deeper, replacement well shall be installed for groundwater production.

<table>
<thead>
<tr>
<th>Biological Resources</th>
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<tbody>
<tr>
<td>4-1</td>
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<tr>
<td>♦ Avoid, minimize, and compensate for reduction in area and/or habitat quality of sensitive natural communities, including wetlands, by doing the following:</td>
</tr>
<tr>
<td>• Selecting project site(s) that would avoid sensitive natural communities, including jurisdictional wetlands and other waters, vernal pools, alkali seasonal wetlands, riparian habitats, and inland dune scrub.</td>
</tr>
<tr>
<td>• Designing, to the maximum extent practicable, project elements to avoid effects on sensitive natural communities.</td>
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<tr>
<td>• Replacing, restoring, or enhancing on a “no net loss” basis (in accordance with U.S. Army Corps of Engineers (USACE) and State Water Resources Control Board (SWRCB) requirements), wetlands and other waters of the United States and waters of the State that would be removed, lost, and/or degraded.</td>
</tr>
<tr>
<td>• Where impacts to sensitive natural communities other than waters of the United States or State are unavoidable, compensating for impacts by restoring and/or preserving in-kind sensitive natural communities on-site, or off-site at a nearby site, or by purchasing in-kind restoration or preservation credits from a mitigation bank that services the project site and that is approved by the appropriate agencies, in consultation with applicable regulatory agencies (at ratios that offset temporal loss of habitat value).</td>
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<tr>
<td>• Implement advanced mitigation planning for ecosystem restoration prior to construction.</td>
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<tr>
<td>• Implement construction best management practices, including:</td>
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<tr>
<td>• Developing and implementing a Stormwater Pollution Prevention Plan (SWPPP).</td>
</tr>
<tr>
<td>• Minimizing soil disturbance, erosion, and sediment runoff from Delta Stewardship Council.</td>
</tr>
</tbody>
</table>

Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 Certification of Consistency process.
Avoiding and minimizing contaminant spills.

Minimizing visual and noise disturbance from construction activities.

Conducting biological construction monitoring to ensure that implemented Best Management Practices (BMPs) are effective.

♦ Restore areas temporarily affected by construction activities, including:
  • Preparing restoration plan for temporary impacts sites for review by resource agencies.
  • Minimizing soil disturbance and stockpiling topsoil for later use in any areas to be graded.
  • Decompacting or amending soil if necessary before planting and use native species for revegetation.
  • Restoring natural communities with similar or improved function from communities that were affected.

♦ If a project may result in conversion of oak woodlands, as identified in section 21083.4 of the Public Resources Code, one or more of the following mitigation measures shall be implemented:
  • Conserve oak woodlands, through the use of conservation easements.
  • Plant an appropriate number of trees, including maintaining plantings and replacing dead or diseased trees.
  • Contribute funds to the Oak Woodlands Conservation Fund, as established under subdivision (a) of section 1363 of the Fish and Game Code.

♦ An invasive species management plan shall be developed and implemented for any project whose construction or operation could lead to introduction or facilitation of invasive species establishment. The plan shall ensure that invasive plant species and populations are kept below preconstruction abundance and distribution levels. The plan shall be based on the best available science and developed in consultation with Department of Fish and Wildlife (DFW) and local experts, such as the University of California Extension, county agricultural commissioners, representatives of County Weed Management Areas (WMA), California Invasive Plant Council, and California Department of Food and Agriculture. The invasive species management plan will include the following elements:
• Nonnative species eradication methods (if eradication is feasible)
• Nonnative species management methods
• Early detection methods
• Notification requirements
• Best management practices for preconstruction, construction, and post construction periods
• Monitoring, remedial actions and reporting requirements
• Provisions for updating the target species list over the lifetime of the project as new invasive species become potential threats to the integrity of the local ecosystems
Select project site(s) that would avoid habitats of special-status species (which may include foraging, sheltering, migration and rearing habitat in addition to breeding or spawning habitat), and to the maximum extent practicable, (re)design project elements to avoid effects on such species.

Schedule construction to avoid special-status species’ breeding, spawning, or migration locations during the seasons or active periods that these activities occur.

Conduct preconstruction surveys (by a qualified biologist) for special-status species in accordance with U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS) and DFW survey methodologies and appropriate timing to determine presence and locations of any special-status species and their habitat, and avoid, minimize, or compensate for impacts to special-status species in coordination with DFW and USFWS or NMFS.

Establish buffers around special-status species habitats to exclude effects of construction activities. The size of the buffer shall be in accordance with USFWS and DFW protocols for the applicable special-status species. If nest tree removal is necessary, remove the tree only after the nest is no longer active, as determined by a qualified biologist.

Conduct construction monitoring (by qualified biologist) to ensure effectiveness of avoidance and minimization measures and implement remedial measures if necessary.

When appropriate, relocate special-status plant and animal species or their habitats from project sites following USFWS, NMFS, and DFW protocols (e.g., for special-status plant species or elderberry shrubs).

Where impacts to special-status species are unavoidable, compensate for impacts by restoring or preserving in-kind suitable habitat on-site, or off-site, or by purchasing restoration or preservation credits (in compliance with the California Endangered Species Act (CESA) and federal Endangered Species Act (ESA) for affected State- or federally-listed species from a mitigation bank that serves the project site and that is approved by the appropriate agencies, in consultation with the appropriate regulatory agencies (at ratios that offset the temporary loss of habitat value).

Select project site(s) that would avoid a substantial reduction in fish and wildlife species habitat.
♦ To the maximum extent practicable, design project elements to avoid effects that would lead to a substantial loss of fish and wildlife habitat.
♦ Replace, restore, or enhance habitats for fish and wildlife species that would be lost.
♦ Where substantial loss of habitat for fish and wildlife species is unavoidable, compensate for impacts by preserving in-kind habitat.

| 4-4 | ♦ Protect habitat for migratory waterfowl and shorebirds by expanding existing wildlife refuges and management areas, and establishing new ones in or near wetland areas used by migratory waterfowl and shorebirds. Manage these areas by establishing suitable vegetation, hydrology and other habitat components to optimize the use by migratory waterfowl and shorebirds.  
♦ Protect, restore and enhance connectivity of habitats, including but not limited to wetland and riparian habitats that function as migration corridors for wildlife species (similar to how has been implemented through programs such as the California Essential Habitat Connectivity Project). Acquire areas with potential to increase connectivity between existing habitats, protect these areas in perpetuity through the acquisition of conservation easements, deed restrictions, or similar tools, and restore the habitat for wildlife species in these areas. Habitat restoration might be accomplished by establishing suitable hydrology or other physical conditions for desirable vegetation, planting desirable vegetation, fencing and managing grazing, and other means.  
♦ Protect migratory pathways for migratory aquatic species such as salmon, steelhead, and sturgeon including those that use Delta tributaries and floodplain habitats by screening new diversions, and screening existing diversions and removing existing migration barriers if the specific proposed project/activity (e.g., increased intake volume through an existing unscreened diversion, new diversion, new barrier, new barrier near an existing unscreened diversion, etc.) exacerbates the negative effect on migratory aquatic species caused by the existing barrier or unscreened diversion.  
♦ Avoid or minimize alteration of flow patterns and water quality effects that could disrupt migratory cues for migratory aquatic species by implementing water management measures and establishing programs to reduce water pollution. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
Prior to construction, evaluate impacts to trees or other biological resources protected by local policies and ordinances, and abide by any permit requirements associated with these policies and ordinances.

Delta Stewardship Council

Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013

Certification of Consistency process

<table>
<thead>
<tr>
<th>Delta Flood Risk</th>
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<tbody>
<tr>
<td>♦ Prepare a drainage or hydrology and hydraulic study that would assess the need and provide a basis for the design of drainage-related mitigations, such as new onsite drainage systems or new cross drainage facilities. Prepare the study in accordance with applicable standards of Federal Emergency Management Agency (FEMA), USACE, state Department of Water Resources (DWR), Central Valley Flood Protection Board (CVFPB), as well as the local reclamation districts and flood control agencies and the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, and CVFPB. The study would identify potential increases in flood risks, including those that may result from new facilities.</td>
</tr>
<tr>
<td>♦ Provide temporary drainage bypass facilities that would reroute drainage around, along, or over the Proposed Project facilities and construction sites. The temporary bypass facilities would be designed in accordance with the results and recommendations of a drainage or hydrologic and hydraulic study and would be in place and fully functional until long-term replacement facilities are completed.</td>
</tr>
<tr>
<td>♦ Provide onsite stormwater detention storage at construction and project facility sites that would reduce project-caused short- or long-term increases in drainage runoff. The storage space placement and capacity would be designed based on the drainage or hydrologic and hydraulic study.</td>
</tr>
<tr>
<td>♦ Based on the results of the drainage or hydrologic and hydraulic study, arrange the length of any stockpiles or other construction features in the direction of the floodplain flow to maximize surface flows under flood flow conditions.</td>
</tr>
<tr>
<td>♦ Delta Stewardship Council</td>
</tr>
<tr>
<td>♦ Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013</td>
</tr>
<tr>
<td>♦ Certification of Consistency process</td>
</tr>
</tbody>
</table>
At in-stream construction sites that might reduce channel capacity, install setback levees or bypass channels to maintain channel capacity and to mitigate hydraulic impacts.

Where low channel velocities might result from construction, implement a sediment management program in order to maintain channel capacity.

Provide cross drainage, replacement drainage paths and facilities, and enlarged flow paths to reroute drainage around, under, or over the Proposed Project facilities and to restore the function of any affected existing drainage or flow paths and facilities.

Channel modifications for restoration actions would be required to be implemented to maintain or improve flood management functions and would be coordinated with the USACE, DWR, CVFPB, and other flood control agencies to assess the desirability and feasibility for channel modifications. To the extent consistent with floodplain land uses and flood control requirements, if applicable, woody riparian vegetation would be allowed to naturally establish.

For areas that would be flooded as a result of the project, or where existing flooding would be increased in magnitude, frequency, or duration, purchase a flowage easement and/or property at the fair-market value.

Provide a long-term sediment removal program at in-river structures.

To mitigate potential impacts of changes in the timing of reservoir releases or the possible combination of river peak flows, use forecasts to implement coordination of operations with existing reservoirs.

| ♦ Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design of drainage-related mitigations, such as new onsite drainage systems or new cross drainage facilities. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, CVFPB, as well as the local reclamation districts and flood control agencies and the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, and CVFPB. |
| ♦ Provide onsite stormwater detention storage at construction and project facility sites that would reduce project- caused, short- and long-term increases in drainage runoff. The storage space would |
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
be designed based on the drainage or hydrologic and hydraulic study.
Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design of drainage-related mitigations, such as new onsite drainage systems or new cross drainage facilities. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, CVFPB, as well as the local reclamation districts and flood control agencies and the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, and CVFPB.

Where high channel velocities might result from construction, provide bank protection, such as rip rap, to protect levees from erosion.

Where construction results in longer channel wind fetch lengths, install vegetative buffer zones or wave erosion protection on the water side slope of levees, such as rock or grouted rip rap, and increase levee freeboard to address higher wind and wave runup.

Based on the drainage or hydrology and hydraulics study, determine any resulting changes to available evacuation plans or emergency response times.

To reduce emergency response times and public safety risks, raise structures and major roads out of the floodplain.

Provide automated flood warning systems.

Develop and implement area-specific evacuation and emergency response plans.

Considering the results of the hydraulics study noted above, perform a seepage and stability analyses that would assess the need and act as a basis for design of other seepage- and stability-related mitigations, such as cutoff walls, adjacent levees, setback levees, berms, and subdrainage features. Perform the analyses in accordance with applicable standards of FEMA, USACE, and DWR.

Perform research and collect subsurface information in accordance with applicable standards of FEMA, USACE, and DWR and perform settlement analyses that would assess the need for monitoring and potential settlement-related mitigations, such as ground improvement or pre-construction surcharging. Perform the analyses in accordance with applicable standards of USACE.

Perform research and collect subsurface information in accordance with applicable standards of FEMA, USACE, and DWR and perform seismic and liquefaction analyses that would...
First implemented in 2004, Golden Guardian, California’s Annual Statewide Exercise Series, has become the most comprehensive state-level exercise series program in the country. The goal of Golden Guardian is to exercise and assess emergency operations plans, policies, and procedures for all-hazards/catastrophic incidents at the local, regional, and state levels, as described in subsection 5.3.7.2.2 of the Recirculated Draft EIR.

- Assess the need and provide the basis for design of other seismic-related mitigations, such as ground improvement. Perform the analyses in accordance with applicable standards of USACE and American Society of Civil Engineers and Southern California Earthquake Center.
- Prepare and implement a plan for periodic maintenance, inspections, repair, and rehabilitation of new water storage and conveyance facilities that could cause flooding upon failure.
- Provide redundancy and safety controls and devices on water storage and conveyance facilities (pump stations, canals, and tunnels) to protect against facility failure and subsequent flooding.
- To limit flooding from the unlikely event of a conveyance facility failure, limit extensive flow escape with installation of safety devices such as gated checks.
- Construct new evacuation roads and access roads, as necessary.
- Conduct Golden Guardian emergency drills.2

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2 First implemented in 2004, Golden Guardian, California’s Annual Statewide Exercise Series, has become the most comprehensive state-level exercise series program in the country. The goal of Golden Guardian is to exercise and assess emergency operations plans, policies, and procedures for all-hazards/catastrophic incidents at the local, regional, and state levels, as described in subsection 5.3.7.2.2 of the Recirculated Draft EIR.
Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design of drainage-related mitigations, such as new onsite drainage systems or new cross drainage facilities. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, CVFPB, as well as the local reclamation districts and flood control agencies and the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, and CVFPB. Provide temporary drainage bypass facilities that would reroute drainage around, along, or over the Proposed Project facilities and construction sites. The temporary bypass facilities would be designed in accordance with drainage or hydrology and hydraulic study and would be in place and fully functional until long-term replacement facilities are completed.

Based on the results of the drainage or hydrologic and hydraulic study, arrange the length of any stockpiles or other construction features in the direction of the floodplain flow to maximize surface flows under flood conditions.

At in-stream construction sites that might reduce channel capacity, install setback levees or bypass channels to maintain channel capacity and to mitigate hydraulic impacts.

Provide cross drainage, replacement drainage paths and facilities, and enlarged flow paths to reroute drainage around, under, or over the Proposed Project facilities and to restore the function of any affected existing drainage or flow paths and facilities.

Channel modifications for restoration actions would be required to be implemented to maintain or improve flood management functions and would be coordinated with the USACE, DWR, CVFPB, and other flood control agencies to assess the desirability and feasibility for channel modifications. To the extent consistent with floodplain land uses and flood control requirements, if applicable, woody riparian vegetation would be allowed to naturally establish.

Minimize physical division of existing established communities or residential areas by designing new facilities and infrastructure to be located underground or with sufficient points of visual and physical access. Examples of methods of minimizing physical division include (but are not limited to):

- Burying or visually masking new infrastructure or facilities;
- Restoring disturbed landscapes back to preconstruction conditions;
- Reestablishing access (e.g., reconnecting roads, rebuilding bridges);
- Relocating landmark buildings; or
- Implementing other feasible mitigation to reduce the disturbance to a community's physical composition, visual character, or other features integral to the community's identity.

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<tr>
<th>6-2</th>
<th>♦ Compensate for the loss or reduction in environmental values protected by the subject plan or policy. For example, if the project would result in conversion of agricultural land to a non-agricultural use, potential mitigation actions could include: ♦ Recording a deed restriction that ensures permanent conservation and mitigation on other property of equal or greater environmental mitigation value; ♦ Creating a buffer or barrier between uses; ♦ Redesigning the project or selecting an alternate location that avoids or mitigates the impact; and/or ♦ Restoring disturbed land to conditions to provide equal or greater environmental value to the land affected by the covered action.</th>
<th>Delta Stewardship Council</th>
<th>Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013</th>
<th>Certification of Consistency process</th>
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**Agriculture and Forestry Resources**

| 7-1 | ♦ Design proposed projects to minimize, to the greatest extent feasible, the loss of the highest valued agricultural land. ♦ For projects that will result in permanent conversion of Farmland, preserve in perpetuity other Farmland through acquisition of an agricultural conservation easement, or contributing funds to a land trust or other entity qualified to preserve Farmland in perpetuity (at a target ratio of 1:1, depending on the nature of the conversion and the characteristics of the Farmland to be converted, to compensate for permanent loss). ♦ Redesign project features to minimize fragmenting or isolating Farmland. Where a project involves acquiring land or easements, ensure that the remaining nonproject area is of a size sufficient to allow viable farming operations. The project proponents shall be responsible for acquiring easements, making lot line adjustments, and merging affected land parcels into units suitable for continued commercial agricultural management. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
- Reconnect utilities or infrastructure that serve agricultural uses if these are disturbed by project construction. If a project temporarily or permanently cuts off roadway access or removes utility lines, irrigation features, or other infrastructure, the project proponents shall be responsible for restoring access as necessary to ensure that economically viable farming operations are not interrupted.

- Manage project operations to minimize the introduction of invasive species or weeds that may affect agricultural production on adjacent agricultural land.

- Establish buffer areas between projects and adjacent agricultural land that are sufficient to protect and maintain land capability and agricultural operation flexibility. Design buffers to protect the feasibility of ongoing agricultural operations and reduce the effects of construction- or operation-related activities (including the potential to introduce special-status species in the agricultural areas) on adjacent or nearby properties. The buffer shall also serve to protect ecological restoration areas from noise, dust, and the application of agricultural chemicals. The width of the buffer shall be determined on a project-by-project basis to account for variations in prevailing winds, crop types, agricultural practices, ecological restoration, or infrastructure. Buffers can function as drainage swales, trails, roads, linear parkways, or other uses compatible with ongoing agricultural operations.

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<th>7-2</th>
<th>♦ Design proposed projects to minimize, to the greatest extent feasible, conflicts and inconsistencies with land protected by agricultural zoning or a Williamson Act contract and the terms of the applicable zoning/contract.</th>
<th>Delta Stewardship Council</th>
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<td>7-3</td>
<td>♦ Avoid land protected as forestland and timberland through site selection and/or project design. Where feasible, project proponents should take into account the value of the forest, not only in terms of direct products such as wood but also as part of the watershed ecosystem, when selecting a project site. Wherever possible, nonprotected sites should be preferred and selected instead of protected sites.</td>
<td>Delta Stewardship Council</td>
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<td>Certification of Consistency process</td>
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| 7-4 | ♦ For projects that will result in permanent conversion of Forestland, preserve in perpetuity other forestland through a conservation easement or by acquiring lands or contributing funds to a land trust or other agency (at a target ratio of 1:1, depending on the nature of the conversion and the characteristics of the Forestland to be converted, to compensate for permanent loss).

♦ Avoid land protected as forestland and timberland through site selection and/or project design. Where feasible, project proponents should take into account the value of the forest, not only in terms of direct products such as wood, but also as part of the watershed ecosystem, when selecting a project site. When possible, unprotected sites should be preferred and selected instead of protected sites.

♦ When removal of existing forestland or timberlands is required as part of an action, proponents must acquire the property at fair market value. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

| Visual Resources |
Use compatible colors for proposed structural features, such as intakes, pumping plants, and surge towers. Use earth tone paints and stains with low levels of reflectivity.

Minimize the vertical profile of proposed structures as much as possible. Where possible, use subgrades for floors of structures. Use landscaped berms instead of walls to mask views of structures from high-visibility sites. Use green roof design where roof structures would be highly visible.

Use vegetation plantings on proposed facility walls, such as climbing plants, espaliers, and other forms that soften the appearance of structures.

Develop a landscaping plan for all proposed structures. Provide vegetative screening to soften views of structures. Landscaping should complement the surrounding landscape.

Round the tops and bottoms of spoil disposal areas, and contour the faces of slopes to create more natural-looking landforms. Create visual diversity by planting vegetation with diverse growth forms on the spoil disposal areas; plant with more than just grasses.

Landscape parking areas at proposed facilities, and include low-impact design features, such as permeable pavers, tree basins, and bioswales, that reduce stormwater runoff and enhance visual quality.

Conduct only partial vegetative clearing of the limits of construction rather than clear the entire area; partial clearing would leave islands of vegetation and result in a more natural look. Use irregular clearing shapes with feathered edges instead of hard edges to promote a more natural effect.

Develop design form and materials with a goal to achieve aesthetic visual character instead of a strictly utilitarian objective. Use cast natural form elements or natural materials for facing to achieve texture and color compatible with the adjacent landscape; natural materials would be preferable for areas of high visibility and public use. Landscape areas adjacent to facilities. Use natural materials, such as wood and stone, for signage at proposed facilities.

Develop aesthetically pleasing landscaping for relocated roads at the shoulders, intersections, and on- and off-ramps from highways. Design turnouts and scenic vista points where appropriate for relocated roads with high visibility and high public use.
To the extent consistent with the safety and reliability of the electric grid, as well as site-specific considerations, use single-pole electrical transmission towers instead of lattice-form towers for proposed large electrical transmission lines, and put transmission lines underground along areas with high visibility and high public use.

Consider developing aesthetically well-designed visitor centers, vantage areas, or observation decks at appropriate facilities with interpretation features, walking paths, and other features. Although developing visitor centers would not reduce a visual impact, it would have the effect of making the facilities features of interest to the touring public.
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<tr>
<th>No.</th>
<th>Mitigation Measure</th>
<th>Details</th>
<th>Decision Body</th>
<th>Decision Details</th>
<th>Certification Process</th>
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<tr>
<td>8-2</td>
<td>♦ Implement elements of Mitigation Measure 8-1 for temporary construction activities and new facilities that are visible from scenic vistas and designated roads and highways as appropriate.♦ Replace all scenic resources (e.g., large trees) that would be removed for the Proposed Project, when feasible. Identify compensatory mitigation for visual or aesthetic resources by providing improvements to areas with existing diminished scenic quality.</td>
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<td>8-3</td>
<td>♦ Use shields for proposed lighting facilities, and direct lighting downward and inward toward the facilities.</td>
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**Air Quality**
♦ Use equipment and vehicles that are compliant with Air Resource Board (ARB) requirements and emission standards for on-road and off-road fleets and engines. New engines and retrofit control systems should reduce NOx and PM from diesel-fueled on-road and off-road vehicles and equipment.

♦ Minimize idling times either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage should be posted for construction workers at all entrances to the site.

♦ Maintain all equipment in proper working condition according to manufacturer's specifications.

♦ Use electric equipment when possible. Use lower-emitting alternative fuels to power vehicles and equipment where feasible.

♦ Use low Volatile Organic Compounds (VOC) coatings and chemicals; minimize chemical use.

♦ Prepare a dust control plan and apply dust control measures at the construction sites.

♦ To minimize track-out of dirt and mud from dirt and gravel roads, all trucks and equipment, including their tires, shall be washed prior to leaving the site. Only exteriors of trucks and equipment are to be washed (no engine degreasing), no detergents or chemicals shall be used in the wash water, and off-site runoff of rinse water shall be prevented.

♦ For projects involving land fallowing, land conversion, or other agricultural operations, implement applicable BMPs from agencies such as the U.S. Department of Agriculture Natural Resources Conservation Service to reduce potential dust emissions.

BMPs for fallowed lands could include, but are not limited to, the following:

♦ Implement conservation cropping sequences and wind erosion protection measures, such as:
  • Plan ahead to start with plenty of vegetation residue, and maintain as much residue on fallowed fields as possible. Residue is more effective for wind erosion protection if left standing.
  • If residues are not adequate, small grain can be seeded about the first of the year to take advantage of the winter rains and irrigated with a light irrigation if needed to get adequate...
growth.
• Avoid any tillage if possible.
• Avoid any traffic or tillage when fields are extremely dry to avoid pulverization.
♦ Apply soil stabilization chemicals to fallowed lands.
♦ Re-apply drain water to allow protective vegetation to be established.
♦ Reuse irrigation return flows to irrigate windbreaks across blocks of land including many fields to reduce wind fetch and reduce emissions from fallowed, farmed, and other lands within the block. Windbreak species, management, and layout would be optimized to achieve the largest feasible dust emissions reduction per unit water available for their irrigation. Windbreak corridors would provide ancillary aesthetic and habitat benefits.

Project-specific lists of mitigation measures should also include the recommendations or requirements of the local air district(s). For example, the Bay Area Air Quality Management District (BAAQMD) lists the following basic and additional mitigation measures to reduce emissions from project construction (BAAQMD, 2010. California Environmental Quality Act Air Quality Guidelines. December 2010. San Francisco, California. Site accessed February 8, 2011. http://www.baaqmd.gov/Divisions/Planning-and-Research/CEQA-GUIDELINES.aspx).

**Basic Construction Mitigation Measures Recommended for ALL Proposed Projects**

1. All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day.
2. All haul trucks transporting soil, sand, or other loose material off-site shall be covered.
3. All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
4. All vehicle speeds on unpaved roads shall be limited to 15 mph.
5. All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.
6. Idling times shall be minimized either by shutting equipment off.
when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage shall be provided for construction workers at all access points.

7. All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified visible emissions evaluator.

8. Post a publicly visible sign with the telephone number and person to contact at the lead agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District's phone number shall also be visible to ensure compliance with applicable regulations.

**Additional Construction Mitigation Measures Recommended for Projects with Construction Emissions Above the Threshold**

1. All exposed surfaces shall be watered at a frequency adequate to maintain minimum soil moisture of 12 percent. Moisture content can be verified by lab samples or moisture probe.

2. All excavation, grading, and/or demolition activities shall be suspended when average wind speeds exceed 20 mph.

3. Wind breaks (e.g., trees, fences) shall be installed on the windward side(s) of actively disturbed areas of construction. Wind breaks should have at maximum 50 percent air porosity.

4. Vegetative ground cover (e.g., fast-germinating native grass seed) shall be planted in disturbed areas as soon as possible and watered appropriately until vegetation is established.

5. The simultaneous occurrence of excavation, grading, and ground-disturbing construction activities on the same area at any one time shall be limited. Activities shall be phased to reduce the amount of disturbed surfaces at any one time.

6. All trucks and equipment, including their tires, shall be washed off prior to leaving the site.

7. Site accesses to a distance of 100 feet from the paved road shall be treated with a 6- to 12-inch compacted layer of wood chips, mulch, or gravel.

8. Sandbags or other erosion control measures shall be installed to prevent silt runoff to public roadways from sites with a slope greater than one percent.
9. Minimizing the idling time of diesel powered construction equipment to two minutes.

10. The project shall develop a plan demonstrating that the off-road equipment (more than 50 horsepower) to be used in the construction project (i.e., owned, leased, and subcontractor vehicles) would achieve a project wide fleet-average 20 percent NOx reduction and 45 percent PM reduction compared to the most recent ARB fleet average. Acceptable options for reducing emissions include the use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, add-on devices such as particulate filters, and/or other options as such become available.

11. Use low VOC (i.e., reactive organic gases or ROG) coatings beyond the local requirements (i.e., Regulation 8, Rule 3: Architectural Coatings).

12. Requiring that all construction equipment, diesel trucks, and generators be equipped with Best Available Control Technology for emission reductions of NOx and PM.

13. Require all contractors to use equipment that meets ARB’s most recent certification standard for off-road heavy duty diesel engines.
9-2

♦ Applicants should develop and implement a project-specific Odor Management Plan. Odor control measures that can be incorporated into this plan include, but are not limited to, the following:
  • A list of potential odor sources
  • Identification and description of the most likely sources of odor
  • Identification of potential, intensity, and frequency of odor from likely sources
  • A list of odor control technologies and management practices that could be implemented to minimize odor releases
  • A protocol for monitoring, recording, reporting and responding to odor events, including notification of the local and downwind jurisdictions of projects that may result in odor complaints, including contact numbers for responsible individuals during construction. If odor an event occurs, construction activity should be suspended until conditions change, removing the cause and resultant odors, or until alternate management practices are implemented that significantly reduce the odors.

9-3

The Air Quality Technical Report prepared for the Proposed Project should evaluate human health risks from potential exposures of sensitive receptors to substantial pollutant concentrations on a project-specific basis. The need for a human health risk analysis should be evaluated using approved screening tools, and discussed with the local Air Quality Management District (AQMD) or Air Pollution Control District (APCD) at the time of preparation of the Air Quality Technical Report.

If the health risk is determined to be significant on a project-specific basis, control measures should be implemented to reduce health risks to levels below the applicable air district threshold.

Implementation of one or more of the following requirements, where feasible and appropriate would reduce the effects of Impact 9-3a, Construction or Operation of Projects Would Expose Sensitive Receptors to Substantial Pollutant Concentrations *(from the 2013 Delta Plan Program EIR)*:

♦ Implement Mitigation Measure 9-1 to reduce air emissions and air quality impacts from construction and operations of the Proposed Project.
♦ Use equipment with diesel engines designed or retrofitted to minimize DPM emissions, usually through the use of catalytic particulate filters in the exhaust.
♦ Use electric equipment to eliminate local combustion emissions.
♦ Use alternative fuels, such as compressed natural gas or liquefied natural gas.

If the project would result in significant emissions of airborne, naturally occurring asbestos or metals from excavation, hauling, blasting, tunneling, placement, or other handling of rocks or soil, a dust mitigation and air monitoring plan would be required to specify site-specific measures to minimize emissions and that airborne concentrations of the toxic air contaminants (TACs) of concern do not exceed regulatory or risk-based trigger levels.

Cultural Resources
Before any ground-disturbing activities begin, conduct intensive archaeological surveys, including subsurface investigations to identify the locations, extent, and integrity of presently undocumented archaeological resources that may be located in areas of potential disturbance. In addition, if ground-disturbing activities are planned for an area where a previously documented prehistoric archaeological site has been recorded but no longer may be visible on the ground surface, conduct test excavations to determine whether intact archaeological subsurface deposits are present. Also conduct surveys at the project site for the possible presence of cultural landscapes and traditional cultural properties.

If potentially California Register of Historical Resources (CRHR)-eligible prehistoric or historic-era archeological resources are discovered during the survey phase, additional investigations may be necessary. These investigations could include, but not necessarily be limited to, measures providing resource avoidance, archival research, archaeological testing and CRHR eligibility evaluations, and contiguous excavation unit data recovery. In addition, upon discovery of potentially CRHR-eligible prehistoric resources, coordinate with the NAHC and the Native American community to provide for an opportunity for suitable individuals and tribal organizations, including federally recognized tribes, to comment on the proposed research.

If CRHR-eligible archaeological resources or cultural landscapes/properties are present and would be physically impacted, specific strategies to avoid or protect these resources should be implemented if feasible. These measures may include:

- Planning construction to avoid the sensitive sites
- Deeding the sensitive sites into permanent conservation easements
- Capping or covering archaeological sites
- Planning parks, green space, or other open space to incorporate the sensitive sites
- Granting of cultural easements to Native American tribes for the purpose of protecting cultural resource properties

If federal agencies are participants in the activity and Section 106 of the National Historic Preservation Act applies, conduct formal consultation with the State Historic Preservation Officer, Tribal Historic Preservation Officer (THPO) or Tribal Administrator for tribes that do not have a THPO, and the Native American community. Potential adverse effects on cultural resources recommended as eligible for listing in the National Register of

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Certification of Consistency process
Historic Places (NRHP) will be resolved through the development of a memorandum of agreement and/or a program-level agreement.

♦ As part of efforts to identify, evaluate, and consider cultural resources, including prehistoric sites, Native American human remains, and traditional cultural properties, Native Americans would be consulted. The California Native American Heritage Commission (NAHC) would be asked to provide a list of Native Americans who should be contacted concerning an identified future project. The NAHC would also be asked to search its Sacred Lands Files. Native Americans identified by the NAHC would be contacted by letter to request information on cultural resources of importance. They also would be asked to identify concerns they have about the project. THPOs and Tribal Administrators of federally recognized tribes would be contacted and asked to search their files and provide information necessary for the identification and consideration of cultural resources.

♦ Before any project-specific ground-disturbing activities begin, conduct investigations to identify submerged cultural resources. These investigations would include review of State Lands Commission (SLC) Shipwrecks Database and other SLC files, and remote sensing surveys conducted under the direction of a qualified maritime archaeologist. If avoidance of significant submerged cultural resources is not feasible, a permit from SLC may be necessary to conduct resource documentation and possible salvage of artifacts, ship components, and other data and objects.

♦ If CRHR-eligible archaeological resources, including submerged or buried shipwrecks or other maritime-related cultural resources, are discovered during construction activities, work would halt within 100 feet of the discovery until the find can be evaluated by a qualified archaeologist or maritime archaeologist as appropriate. In addition, SLC would be consulted.
The identification, evaluation, and determination of disposition of Native American human remains shall be conducted in accordance with Native American consultation procedures described below and in Mitigation Measure 10-1. The location, content, and character of Native American human remains are confidential and shall not be released to the public. Native American human remains and associated funerary objects shall be treated with the utmost respect and in accordance with the direction of the identified Most Likely Descendant (MLD).

- If human remains are encountered during ground-disturbing construction activities, stop work that would potentially affect the find and contact the county coroner.
  - In accordance with the California Health and Safety Code and the California Native American Grave Protection and Repatriation Act (CNAGPRA), if human remains are uncovered during ground-disturbing activities, the contractor shall immediately halt potentially damaging excavation in the area of the burial and notify the county coroner, a professional archaeologist to determine the nature of the remains, and a representative of California Indian tribes. The coroner is required to examine all discoveries of human remains within 48 hours of receiving notice of a discovery on private or State lands (Health and Safety Code section 7050.5[b]). If the coroner determines that the remains are those of a Native American, he or she must contact the NAHC by telephone within 24 hours of making that determination (Health and Safety Code section 7050[c]).
  - Following the coroner’s findings, the property owner, contractor or project proponent, an archaeologist, and the NAHC-designated MLD shall determine the ultimate treatment and disposition of the remains and take appropriate steps to ensure that additional human interments are not disturbed. The responsibilities for acting upon notification of a discovery of Native American human remains are identified in California Public Resources Code section 5097.9.
  - Upon the discovery of Native American remains, the landowner shall ensure that the immediate vicinity (according to generally accepted cultural or archaeological standards and practices) is not damaged or disturbed by further development activity until consultation with the MLD has taken place. The MLD shall have 48 hours to complete a site inspection and make recommendations after being granted access to the site.
  - A range of possible treatments for the remains, including

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nondestructive removal and analysis, preservation in place, relinquishment of the remains and associated items to the descendants, or other culturally appropriate treatment, may be discussed. California Public Resources Code section 5097.9 suggests that the concerned parties may extend discussions beyond the initial 48 hours to allow for the discovery of additional remains. The following is a list of site protection measures that the landowner shall employ:

1. Record the site with the NAHC or the appropriate information center.
2. Use an open space or conservation zoning designation or easement.
3. Record a document with the county in which the property is located.

- The landowner or his or her authorized representative shall rebury the Native American human remains and associated grave goods with appropriate dignity on the property in a location not subject to further subsurface disturbance if the NAHC is unable to identify a MLD or if the MLD fails to make a recommendation within 48 hours after being granted access to the site. The landowner or his or her authorized representative may also reinter the remains in a location not subject to further disturbance if he or she rejects the recommendation of the MLD and mediation by the NAHC fails to provide measures acceptable to the landowner.

- If the discovery of human remains occurs on lands owned and administered by a federal agency, the provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) will apply. NAGPRA requires federal agencies and certain recipients of federal funds to document Native American human remains and cultural items in their collections, notify native groups of their holdings, and provide an opportunity for repatriation of these materials. The act also requires planning for dealing with potential future collections of Native American human remains and associated funerary objects, sacred objects, and objects of cultural patrimony.
under the direct supervision of an architectural historian meeting the Secretary of the Interior’s Professional Qualification Standards for history or architectural history. The documentation should include conducting an intensive field survey, background research on the history of the project area, and property-specific research. Based on this research, the eligibility of historic-era resources located in the project area should be evaluated by the architectural historian using criteria for listing in the CRHR. The resources would be recorded on DPR 523 forms and the findings documented in a technical report. If federal funding or approval is required, then the project implementation agencies would comply with Section 106 of the National Historic Preservation Act.

- Identify measures to avoid significant historic resources. Avoidance through project redesign is the preferred mitigation measure for mitigating potential effects on historic-era buildings, structures, linear features, and archaeological sites that appear to be eligible for listing in the NRHP or CRHR.

- Record photographic and written documentation to Historic American Building Survey (HABS)/Historic American Engineering Record (HAER) standards. If avoidance of a significant historic resource is not feasible, the lead agency should ensure that HABS/HAER documentation is completed. Through HABS/HAER documentation, a qualified architectural historian and qualified photographer should formally document the historic resource through large-format photography, measured drawings, written architectural descriptions, and historical narratives. The completed documentation should be submitted to the Library of Congress.

- Conform to the Secretary of the Interior’s Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings in the event of relocation. If any historic buildings, structures, or levees are relocated or altered, the lead agency should ensure that any changes to significant buildings or structures conform to the Secretary of the Interior’s Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings. Implementation of this measure can mitigate potential changes to significant architectural resources.

- Conform to the Secretary of the Interior’s Guidance for the Treatment of Cultural Landscapes to preserve landscapes’ historic form, features, and details that have evolved over time.

<table>
<thead>
<tr>
<th>Mitigation Measures</th>
<th>Delta Stewardship Council</th>
<th>Council adopted Delta Plan mitigation</th>
<th>Certification of Consistency process</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-1 and 10-3</td>
<td>was completed (23 CCR § 5002(b)(2)) in 2013</td>
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</tbody>
</table>

Mitigation Measures 10-1 and 10-3 will also mitigate Impact 10-4, Disturbance or Destruction of Cultural Landscapes and Traditional Cultural Properties (from the 2013 Delta Plan Program EIR).
However, to mitigate Impact 10-4, Mitigation Measure 10-1 surveys and Mitigation Measure 10-3 inventories would focus on cultural landscapes and traditional cultural properties.

<table>
<thead>
<tr>
<th>Geology and Soils</th>
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<tr>
<td><strong>11-1</strong></td>
</tr>
<tr>
<td>♦ For construction that occurs in an Alquist-Priolo Special Studies Zone, a determination must be made by a licensed practitioner (California Certified Engineering Geologist) that no fault traces are present within the building footprint of any structure intended for human occupancy. The standard of care for such determinations includes direct examination of potentially affected subsurface materials (soil and/or bedrock) by logging of subsurface trenches. Uncertainties regarding the exact locations of future ground ruptures associated with such determinations generally are resolved by providing a minimum setback of 50 feet from any known surface trace of an active fault. For critical structures, such as hospitals, dams, and emergency facilities, more stringent mitigation measures are required, including but not limited to greater structural setbacks and heavier reinforcement against strong ground motion, in compliance not only with California regulations but in many cases in compliance with additional Federal regulations.</td>
</tr>
<tr>
<td>♦ Lead agencies shall ensure that geotechnical design recommendations are included in the design of facilities and construction specifications to minimize the potential impacts from seismic events and the presence of adverse soil conditions. Recommended measures to address adverse conditions shall conform to applicable design codes, guidelines, and standards.</td>
</tr>
<tr>
<td><strong>11-2</strong></td>
</tr>
<tr>
<td>♦ Require adherence, at minimum, to the precepts of the current approved version of the International Building Code (IBC). Included in the IBC are measures for mitigation of the impacts of strong ground motion on constructed works. In addition to the California–required conformance with the IBC, for critical structures, such as dams (including levees), hospitals, and emergency facilities, additional construction requirements are codified in federal statutes and the regulations of various federal agencies. Lead agencies will, by force of law, require conformance with these codified mitigation measures.</td>
</tr>
</tbody>
</table>

| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
For projects that would result in significant or potentially significant grading operations, a geotechnical investigation shall be performed and a geotechnical report prepared. The geotechnical report shall include a quantitative analysis to determine whether excavation or fill placement would result in a potential for damage due to soil subsidence during and/or after construction. Project designs shall incorporate measures to reduce the potential damage to an insignificant level, including but not limited to removal and recompack of existing soils susceptible to subsidence, ground improvement (such as densification by compaction or grouting, soil cementation), and reinforcement of structural components to resist deformation due to subsidence. The site-specific potential for and severity of cyclic seismic loading shall be analyzed in the assessment of subsidence for specific projects.

A geotechnical investigation shall be performed by an appropriately licensed professional engineer and/or geologist to determine the presence and thickness of potentially liquefiable sands that could result in loss of bearing value during seismic shaking events. Project designs shall incorporate measures to mitigate the potential damage to an insignificant level, including but not limited to ground improvement (such as grouting or soil cementation), surcharge loading by placement of fill, excavation, soil mixing with non-liquefiable finer-grained materials and replacement of liquefiable materials at shallow depths, and reinforcement of structural components to resist deformation due to liquefaction. An analysis of site-specific probable and credible seismic acceleration values, in accordance with current applicable standards of care, shall be performed to provide for suitable project design.

For projects that would result in construction of wells intended for groundwater extraction, a hydrogeological/geotechnical investigation shall be performed in accordance with the current standards of care for such work by an appropriate licensed professional engineer or geologist to identify and quantify the potential for groundwater extraction-induced subsidence. The study shall include an analysis of existing conditions and modeling of future conditions to assess the potential for aquifer compaction/consolidation.

For projects that would result in construction of surface reservoirs and canals a hydrogeological/geotechnical investigation shall be performed by a licensed professional engineer or geologist to identify and quantify the potential for seeps and springs to develop.
in areas adjacent to the proposed improvements and to propose mitigation measures. Mitigation of such seepage could include, without limitation, additives to concrete that reduce its permeability, construction of impervious liner systems, and design and construction of subdrainage (passive control) or dewatering systems (active control).

Geotechnical investigations and preparation of geotechnical reports shall be performed in the responsible care of California licensed geotechnical professionals including professional civil engineers, certified geotechnical engineers, professional geologists, certified engineering geologists, and certified hydrogeologists, all of whom should be practicing within the current standards of care for such work.
Any covered action that would have significant soil erosion and topsoil loss impacts (Impact 11-4) shall incorporate specific measures for future projects that would expand the use of BMPs or optional erosion control measures listed in the SWPPPs. The SWPPP shall identify an effective combination of BMPs to reduce erosion during construction and to prevent erosion during operation. Examples of typical BMPs include:

- Erosion control measures such as silt fencing, sand bags, straw bales and mats, and rice straw wattles shall be placed to reduce erosion and capture sediment. Straw used for erosion control shall be new cereal grain straw derived from rice, wheat, or barley; free of mold and noxious weed seed; and neither derived from dry-farmed crops nor previously used for stable bedding. Clearance shall be obtained from the County Agricultural Commissioner before straw obtained from outside the county is delivered to the work site. Monitoring requirements of the newly revised General Construction Permit shall be implemented, and more effective BMPs shall be identified and installed if runoff samples indicate excessive turbidity.

- During construction activities, topsoil shall be removed, stockpiled, and saved for reapplication following completion of construction. The top 6 inches shall be salvaged and reapplied to a comparable thickness. Soil material shall be placed in a manner that minimizes compaction and promotes plant reestablishment.

- If catch basins are used for sediment capture, the site shall be graded to ensure stormwater runoff flows into the basins, and basins shall be designed for the appropriate storm interval as provided in the General Construction Permit.

- Temporary work areas shall be surfaced with a compacted layer of well-graded gravel. They may be covered with a thin asphalt binder. Where expansive or compressible soils are present in temporary work areas, construction trailers shall be supported with concrete pads or footings.

- Dust control shall conform to all federal, State, and local requirements and may include use of water trucks, street sweepers, or other methods described in the SWPPP.

- Spoils shall be placed in 12-inch-thick loose lifts and compacted to reduce erosion and minimize future subsidence. Placement of peat spoils shall be on agricultural land where possible. Following construction, spoils sites shall be restored.

<table>
<thead>
<tr>
<th>Delta Stewardship Council</th>
<th>Council</th>
<th>Certification of Consistency process</th>
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<tbody>
<tr>
<td>adopted Delta Plan mitigation measures pursuant to Policy G P 1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013</td>
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<tr>
<td>11-5</td>
<td>♦ In areas where expansive clays exist, a hydrogeological/geotechnical investigation shall be performed by a licensed professional engineer or geologist to identify and quantify the potential for expansion, particularly differential expansion of clayey soils due to leakage and saturation beneath new improvements. Measures could include, but are not limited to removal and recompaction of problematic expansive soils, soil stabilization, and/or reinforcement of constructed improvements to resist deformation due to expansion of subsurface soils.</td>
<td>Delta Stewardship Council</td>
</tr>
</tbody>
</table>
| 11-6 | ♦ For projects that would result in construction of canals, storage reservoirs and other surface impoundments, project design shall provide for protection from leakage to the subsurface. Measures could include, but are not limited to rendering concrete less permeable by specifying concrete additives such as bentonite, design of impermeable liner systems, design of leakage collection and recovery systems, and construction of impermeable subsurface cutoff walls.  
♦ For ecosystem restoration projects that might cause subsurface seepage of nuisance water onto adjacent lands:  
• Perform seepage monitoring studies by measuring the level of shallow groundwater in the adjacent soils, to evaluate the baseline conditions. Continue monitoring for seepage during and after the project implementation.  
• Develop a seepage monitoring plan if subsurface seepage constitutes nuisance water to the adjacent land.  
• Implement seepage control measures if adjacent land is not useable, such as installing subsurface agricultural drainage systems to avoid raising water levels into crop root zones. Cutoff walls and pumping wells can also be used to mitigate for the occurrence of subsurface nuisance water. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
| 11-7 | ♦ For projects that would result in construction of levees, surface impoundments and other fill embankments project design shall incorporate fill placement in accordance with local and State regulations and in accordance with the prevailing standards of care for such work. Measures could include, but are not limited to blending of soils most susceptible to landsliding with soils having higher cohesion characteristics, installation of slope stabilization measures, designing top-of-slope berms or v-ditches, terrace | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § | Certification of Consistency process |
drains and other surface runoff control measures, and designing slopes at lower inclinations.

| 11-8 | ♦ A geotechnical investigation shall be performed and a geotechnical report prepared. The geotechnical report shall include a quantitative analysis to determine whether on-site soils would be suitable for an on-site wastewater treatment system. If it is determined that the soil could not support a conventional on-site treatment system, non-conventional systems shall be analyzed. Potential alternative systems include (SWRCB, 2011, Onsite Wastewater Treatment System Scoping Document. April 4, 2011. Site accessed September 1, 2011. [http://www.swrcb.ca.gov/water_issues/programs/owts/index.shtml]):  
- Containment systems that do not generate waste  
- Anoxic and anaerobic systems  
- Attached and suspended growth aerobic treatment systems  
- Natural treatment systems  
- Disinfection systems  
- Engineered-fill leach fields  
- Monitoring control systems  
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

| 11-9 | ♦ For projects that would result in significant or potentially significant risk to structures due to the presence of highly organic soils, lead agencies shall require geotechnical evaluation prior to construction to identify measures to mitigate organic soils. The following measures may be considered:  
- Over-excavation and import of suitable fill material  
- Structural reinforcement of constructed works to resist deformation  
- Construction of structural supports below the depth of highly organic soils into materials with suitable bearing strength  
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

### Paleontological Resources

| 12-1 | ♦ During the project-level analysis, a Paleontological Resources Monitoring and Recovery Plan (PRMRP) shall be developed and implemented for all actions. The PRMRP shall include protocols for paleontological resources monitoring in those areas where sediment with moderate to high paleontological sensitivity would be affected by construction-related excavations. The PRMRP also shall set forth the following procedures:  
- Confirming the paleontological sensitivity (high, moderate, or low) of the areas to be impacted through review of project- | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
level geological and geotechnical data

- The assessment and recovery of discovered fossil resources
- The preparation and curation of fossil finds

The PRMRP would provide guidelines for the establishment of a yearly or biannual monitoring program led by a qualified paleontologist to determine the extent of fossiliferous sediment being exposed and affected by erosion, and determine whether paleontological resources are being lost. If loss of scientifically significant paleontological resources can be documented, then a recovery program should be implemented.

<table>
<thead>
<tr>
<th>Mineral Resources</th>
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<td>13-1</td>
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</table>

- Ensure land use compatibility between existing mineral resource extraction activities and projects, activities or actions that may be implemented as the result of the Proposed Project.
- Maintain adequate buffer between future projects and designated MRZ-2 sectors.
- Explore opportunities to classify and designate new MRZ-2 sectors (e.g., in existing MRZ-3 sectors) to ensure that important mineral resources are conserved and continue to be available for future construction needs.
- Ensure future land use changes within designated mineral resource extraction areas recognize mineral resource extraction as a compatible use.
- Limit use of construction aggregate to local sources with sufficient capacity to meet both project and future local development needs, to the extent possible.
- Use recycled aggregate where possible, to decrease the demand for new aggregate.

5002(b)(2)) in 2013

Delta Stewardship Council
Council adopted Delta Plan mitigation measures pursuant to Policy P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013
Certification of Consistency process
Ensure access is maintained to existing, active mineral resource extraction sites both during and after project construction.

Implement recommendations identified in the Division of Oil, Gas, and Geothermal Resources of the State Department of Conservation (DOGGR) construction site well review program (DOC, 2007. Well Review Program: Introduction and Application), such as:

- For all future projects, identify all existing natural gas well sites and oil production facilities within or in close proximity to the project area.
- Identify any oil and natural gas well within 100 feet of any navigable body of water or watercourse perennially covered by water or any officially recognized wildlife preserve as a “critical well” (California Code of Regulations, Title 14, Chapter 4, Article 2, Section 1720(a)(2)(B) and (C)). The State Department of Conservation (DOC) requires that a “critical well” include more stringent blowout prevention equipment than non-critical wells based on pressure testing and rating.
- Identify safety measures to prevent unauthorized access to equipment.
- Include safety shut-down devices on oil and natural gas wells and other equipment, as appropriate.
- Notify DOC of new oil and natural gas wells or changes in oil and natural gas well operations or physical conditions, receive written approval from DOC of the changes, and receive written notification of DOC’s inspection of new or changed equipment. The approvals will be primarily related to the ability to: (1) protect all subsurface hydrocarbons and fresh water, (2) protect the environment, (3) use adequate blowout prevention equipment, and (4) use approved drilling and cementing techniques.
- If any plugged/abandoned or unrecorded oil and natural gas wells are uncovered during construction, the DOC should be notified, the wells should undergo remedial well plugging actions, and no structures should be constructed over the abandoned oil and natural gas wells.
- If oil and natural gas wells are under the jurisdiction or a lease from the California State Lands Commission, project proponents should provide additional plans and environmental documentation as required prior to modification of the oil or natural gas wells.
♦ Refueling and maintenance of vehicles and equipment to occur only in designated areas that are either bermed or covered with concrete, asphalt, or other impervious surfaces to control potential spills.
♦ Refueling of vehicles and equipment to occur only when employees are present.
♦ Vehicle and equipment service and maintenance conducted only by authorized personnel.
♦ Refueling conducted only with approved pumps, hoses, and nozzles.
♦ Catch-pans placed under equipment to catch potential spills during servicing.
♦ All disconnected hoses placed in containers to collect residual fuel from the hoses.
♦ Vehicle engines shut down during refueling.
♦ No smoking, open flames, or welding allowed in refueling or service areas.
♦ Refueling performed away from bodies of water to prevent contamination of water in the event of a leak or spill.
♦ When refueling is completed, the service truck to leave the project site.
♦ Service trucks provided with fire extinguishers and spill containment equipment, such as absorbents.
♦ Should a spill contaminate soil, the soil shall be placed in containers and disposed of as appropriate. All containers used to store hazardous materials to be inspected at least once per week for signs of leaking or failure. All maintenance and refueling areas to be inspected monthly. Results of inspections to be recorded in a logbook maintained onsite.
♦ Provision of an automatic sprinkler system for indoor hazardous material storage areas.
♦ Provision of an exhaust system for indoor hazardous material storage areas.
♦ Separation of incompatible materials by isolating them from each other with a noncombustible partition.
♦ Spill control in all storage, handling, and dispensing areas.
Separate secondary containment for each chemical storage system. The secondary containment is required to hold the entire contents of the tank plus the volume of water for the fire suppression system that could be used for fire protection for a period of 20 minutes in the event of a catastrophic spill.

In the unlikely event of a spill, the spill shall be reported to the appropriate regulatory agencies and contaminated soil shall be cleaned, treated, and/or removed in accordance with regulatory requirements. Small spills shall be contained and cleaned up immediately by trained, onsite personnel. Larger spills shall be reported via emergency phone numbers to obtain help from offsite containment and cleanup crews. All personnel working on the project during the construction phase shall be trained in handling hazardous materials and the dangers associated with hazardous materials. An onsite health and safety person shall be designated to implement health and safety guidelines and to contact emergency response personnel and the local hospital, if necessary.

If there is a large spill from a service or refueling truck, contaminated soil shall be placed into barrels or trucks by service personnel for offsite disposal at an appropriate facility in accordance with law. If a spill involves hazardous materials quantities equal to or greater than the specific Reportable Quantities as required by regulatory agencies (42 gallons for petroleum products), all federal, State, and local reporting requirements shall be followed. In the event of a fire or injury, the local fire department shall be called.
| 14-2  | To reduce the risk due to increased exposure to materials that could be released during soil disturbance, worker training programs and breathing apparatus shall be provided. Monitoring programs shall be implemented as areas are excavated to determine the potential for exposure to soil organisms or other constituents.  
To reduce risk to the community due to increased exposure to materials that could be released during soil disturbance, public outreach programs shall be conducted to educate the public of the types of construction activities and risks that could occur. In areas near extreme hazards, such as construction in areas with identified petroleum-product pipelines or soils with high concentrations of petroleum products, warning sirens shall be used at construction sites to immediately notify workers and residents. Emergency procedures shall be included in the education and outreach programs for the workers and the community. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
|-------|---------------------------------------------------------------------------------------------------|-------------------------|------------------------------------------------------------------------------|----------------------------------|
| 14-3  | Freshwater habitat management to include water-control-structure management, vegetation management, mosquito predator management, drainage improvements, and other best management practices, and coordination with the DFW and local mosquito and vector control agencies regarding these strategies and specific techniques to help minimize mosquito production.  
Maintenance of permanent ponds that increase the diversity of waterfowl yet decrease the introduction of vectors through constant circulation of water, vegetation control, and periodic draining of ponds.  
Tidal management focused on mosquito problems arising from the residual tidal and floodwaters remaining in depressions and cracked ground (Solano County Mosquito Abatement District (SCMAD), 2011. Site accessed February 6, 2011. http://www.solanomoquito.com.).  
Avoidance of ponding in tidal marsh habitat or in areas within the waterside of setback levees. Design of ecosystem restoration areas, waterfowl hunting areas, setback levees, parks, canals, and surface water storage facilities to minimize standing water, or use of other methods such as mosquito fish to reduce mosquito breeding. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
| 14-4  | Avoid creating hazardous wildlife attractants within a distance of 10,000 feet of an Airport Operations Area. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures | Certification of Consistency process |
- Maintain a distance of 5 statute miles between the farthest edge of the Airport Operations Area and hazardous wildlife attractants.

| 14-5 | Prepare and implement a fire management plan to minimize potential for wildland fires. |
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

**Noise**

| 15-1 | Limit the hours of operation at noise-generation sources located near or adjacent to noise-sensitive areas, wherever practicable, to reduce the level of exposure to meet applicable local standards. |
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

- Locate construction equipment away from sensitive receptors, to the extent feasible, to reduce noise levels below applicable local standards.
- Maintain construction equipment to manufacturers’ recommended specifications, and equip all construction vehicles and equipment with appropriate mufflers and other approved noise-control devices.
- Limit idling of construction equipment to the extent feasible to reduce the time that noise is emitted.
- Conduct individual traffic noise analysis of identified haul routes and provide mitigation, such as reduced speed limits, at locations where noise standards cannot be maintained for sensitive receptors.
- Incorporate use of temporary noise barriers, such as acoustical panel systems, between construction activities and sensitive receptors if it is concluded that they would be effective in reducing noise exposure to sensitive receptors.
Near sensitive receptors, avoid or minimize use of construction equipment known to generate high levels of groundborne vibration (for example, pile drivers).

- Conduct a preliminary groundborne vibration analysis report to determine future construction-related groundborne vibration levels based on, but not limited to, a detailed equipment list, hours of operation and distances to sensitive receptors located within 500 feet of project sites.

- Provided that future groundborne vibration results in significant impacts at sensitive receptors, the following measures shall be implemented:
  - Designate a complaint coordinator and post this person’s contact information in a location near construction areas where it is clearly visible to the nearby receptors most likely to be affected. The coordinator will manage complaints and concerns resulting from activities that cause vibrations. The severity of the vibration concern should be assessed by the coordinator and, if necessary, evaluated by a qualified noise and vibration control expert.
  - Vibration monitoring will be conducted before and during vibration generating operations occurring within 100 feet of historic structures. Every attempt will be made to limit construction-generated vibration levels during pile driving and other groundborne noise and vibration-generating activities in the vicinity of the historic structures in accordance with recommendations of the appropriate agency with authority.
  - Adjacent historic features will be covered or temporarily shored, as necessary, for protection from vibrations, in consultation with the appropriate cultural resources authority.
  - Pile driving required within a 50-foot radius of residences will use alternative installation methods where possible (e.g., pile cushioning, jetting, predrilling, cast-in-place systems, resonance-free vibratory pile drivers). This would reduce the number and amplitude of blows required to seat the pile.
  - Pile-driving activities conducted within 285 feet of sensitive receptors will occur during daytime hours to avoid sleep disturbance during evening and nighttime hours.

| 15-2 | Conduct a preliminary groundborne vibration analysis report to determine future construction-related groundborne vibration levels based on, but not limited to, a detailed equipment list, hours of operation and distances to sensitive receptors located within 500 feet of project sites. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
| 15-3 | Identify noise-sensitive receptors in the vicinity of project activities and design projects to minimize exposure of sensitive receptors to long-term, operational noise sources (for example, water pumps) to reduce noise levels below applicable local standards. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures | Certification of Consistency process |
♦ Conduct a preliminary noise analysis report to determine future operation-related noise and distances to sensitive receptors. Provided that future operation-related noise results in significant at sensitive receptors, incorporate into construction design measures such as a structure encasing the new noise generating infrastructure. Materials (masonry brick, metal shed, wood) used to house the infrastructure will be of solid construction and void of gaps at the ground, roof line, and joints. All vents will include acoustically rated louvers.

♦ Locate dog parks no closer than 200 feet from the nearest residential property line and at least 75 feet from habitat for noise-sensitive wildlife species.

♦ Locate parking lots no closer than 65 feet from the nearest residential property line and at least 25 feet from habitat for noise-sensitive wildlife species unless a detailed noise study is conducted that determines that placement of parking lots closer than the distances specified above will not result in noise levels that exceed 67 dBA at the nearest residential property line or 60 dBA from noise-sensitive habitat, or appropriate mitigation measures, including permanent noise barriers, can be incorporated to reduce noise levels to equal the ambient noise level or referenced thresholds for residential property and noise sensitive habitat.

♦ Locate playing fields no closer than located at least 125 feet from the nearest residential property line and at least 50 feet from habitat for noise-sensitive wildlife species unless a detailed noise study is conducted that determines that placement of playing fields closer than the distances specified above will not result in noise levels that exceed 67 dBA at the nearest residential property line or 60 dBA from noise-sensitive habitat, or appropriate mitigation measures, including permanent noise barriers, can be incorporated to reduce noise levels to equal the ambient noise level or referenced thresholds for residential property and noise sensitive habitat.

<table>
<thead>
<tr>
<th>Population and Housing</th>
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<tbody>
<tr>
<td><strong>16-1</strong></td>
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<tr>
<td>♦ Require compliance with applicable local policies and regulations regarding the provision of affordable housing.</td>
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<td>♦ Construct replacement housing if existing housing will be displaced.</td>
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<tr>
<td>Delta Stewardship Council</td>
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<td>Certification of Consistency process</td>
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<td>Public Services</td>
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<tr>
<td>17-1</td>
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<tr>
<td>♦ Establish construction fee schedules by local agencies for the new or modified facilities to fund additional emergency services potentially required during construction. If emergency services are not needed, a portion of the fees could be refunded.</td>
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<tr>
<td>♦ Develop worker training programs to reduce construction and operations risks.</td>
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<tr>
<td>♦ Develop appropriate emergency access routes and equipment for both land and water access, if applicable (such as in the Delta), that provides for adequate response time. If use of an existing emergency access route becomes limited due to new or modified facilities, additional routes or placement of duplicate equipment on each side of the route limitation could be considered.</td>
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<td>♦ Develop traffic plans and emergency response plans for construction and operations phases of new facilities.</td>
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<td>♦ Develop all facilities, including parks and ecosystem restoration areas, in accordance with applicable fire codes and regulations, and with adequate fire equipment access routes, occupancy limitations, and fire-protection equipment.</td>
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<tr>
<td>Recreation</td>
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<td>18-1</td>
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<tr>
<td>♦ If the substantial impairment, degradation, or elimination of recreational facilities occurs, replacement facilities of equal capacity and quality with ongoing funding provided for maintenance of these facilities.</td>
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<tr>
<td>♦ If degradation or impairment of recreational facilities, settings, and activities occur from implementation of water use efficient practices and water conservation measures at recreational areas, the park and recreation areas shall be redeveloped with drought-tolerant plant materials, water efficient irrigation systems, and synthetic turf substitutes where appropriate, in such a way as to retain recreational facilities and use areas.</td>
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<td>♦ If the volume of water exported from the Delta declines over multiple years, the lead agencies that implement local water supplies may be unable to develop a long-term replacement water supply for the south-of-Delta surface water reservoirs with</td>
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</table>
recreation uses. At these sites, facilities must be modified (including access facilities, as necessary) to accommodate lower water elevations or more frequent fluctuations in water elevations that could occur more frequently in the Proposed Project than under existing conditions.

| 18-2 | ♦ If substantial temporary or permanent impairment, degradation, or elimination of recreational facilities causes users to be directed towards other existing facilities, lead agencies shall coordinate with impacted public and private recreation providers to direct displaced users to under-utilized recreational facilities.  
♦ Lead agencies shall provide additional operations and maintenance of existing facilities in order to prevent deterioration of these facilities.  
♦ If possible, lead agencies shall provide temporary replacement facilities.  
♦ If the increase in use is temporary, once use is decreased back to existing conditions, degraded facilities shall be rehabilitated or restored.  
♦ Where impacts to existing facilities are unavoidable, compensate for impacts through mitigation, restoration, or preservation off-site or creation of additional permanent new replacement facilities. |
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

| 18-3 | ♦ Projects shall be sited in areas that would have minimal adverse physical effect on the environment.  
♦ Where impacts to the environment are unavoidable, compensate for impacts through mitigation, restoration, or preservation off-site or creation of additional permanent new replacement facilities. |
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

Traffic and Transportation
Avoid modifications to federal, State, and county highways, local roadways, and bridges that may reduce vehicle capacity, to the extent feasible.

Develop and implement a traffic control plan to reduce effects of roadway construction activities, including full and partial lane closures, bicycle and pedestrian facility closures, and reduced access to adjacent properties. Minimize lane closures during morning and evening peak hours. Limit lane closures near the affected segment. Reroute bicycle and pedestrian access around the project area. Prevent bicyclists and pedestrians from entering the work area.

As part of the traffic control plan, identify specific project-vehicle access routes that would avoid additional traffic in residential areas or would adversely affect other sensitive land uses, where feasible.

Install roadway status signs at strategic locations in the Delta to inform the public of roadway closures and limits to ingress to/egress from Delta Islands. The signs shall include maps showing the relative locations of road closures and access restrictions to other Delta features.

For project operations that increase traffic, prepare a traffic study. Determine haul routes that would be used. Evaluate the levels of service at affected intersections and road segments during the peak a.m. and peak p.m. periods. Model changes in traffic with project traffic. If the level of service is maintained at levels acceptable to the appropriate agency, then no additional mitigation is required. If project traffic causes an intersection or road segment to perform below the minimum level of service standard, then select an alternate route for project traffic or schedule project trips for non-peak-hour periods. If alternate routes are not feasible, then design and construct facility improvements to intersections or road segments to maintain the acceptable level of service.

During the planning and analysis of site-specific actions, coordinate with Caltrans and/or other local agencies with jurisdiction over transportation system features for the purpose of minimizing impacts on bridges, roadways, culverts, or other features that may be affected. Agencies responsible for constructing and maintaining levees on which a public roadway may be located shall also be consulted to ensure consistency with levee design criteria.

For roads that will be flooded during floodplain operation, prepare and implement vehicular traffic detour planning as necessary. Provide convenient and parallel vehicular traffic detours for routes.
closed because of inundation. A detour plan shall be prepared and implemented in accordance with current Caltrans Standard Plans and Specifications. (A temporary crossing structure, for example a Bailey Bridge, may be used to maintain circulation and avoid a detour plan.) The detour plan shall be implemented before roadway inundation.

The detour plan will include an assessment of existing roadway conditions, whether paved or unpaved, and provisions for repair and maintenance if the roadway conditions are substantially degraded from increased use. After the detour route is identified and before flood flows are released that would overtop roads, the condition of the detour road surface will be assessed and documented. The documentation will be submitted to the local agency responsible for maintenance of the road. After the detour is no longer needed, the condition of the road surface will be assessed and documented. The documentation will identify substantial changes in the condition of the road surface, such as potholing or rutting. Repair and maintenance actions needed to restore the road surface to predetour conditions will be identified. In coordination with the local maintenance agency, the repair and maintenance actions may be conducted by the agency conducting the floodplain operation or by the local maintenance agency to be proportionately reimbursed by the flood management authority.

The detour plan will prioritize paved roads for use as detour routes. If use of paved roadway detours is not feasible during flood flow road inundation periods, the detour plan will require that visible dust emissions from unpaved detour routes will be limited to the percent opacity indicated by the appropriate air pollution control district. The following dust control measures may be used to stabilize unpaved roadways:

- Watering
- Uniform layer of washed gravel
- Roadmix
- Paving
Any other method that can be demonstrated to the satisfaction of the appropriate air pollution control district that effectively limits visible dust emission to the local percent opacity standard and meets the conditions of a stabilized unpaved road.

Traffic impact reports shall be prepared that meet the applicable agencies’ standards to assess potential impacts on appropriate street segments and intersections. The traffic impact reports shall identify impacts that exceed the agencies’ guidelines for significance and identify appropriate mitigation. Acceptable mitigation measures may include:

- Turn restrictions
- Roadway widening to add lanes or shoulders
- Redesign of freeway on- and off-ramps
- Median construction/modification to restrict access
- Flaring of intersections to add turn lanes
- Provision of passing lanes or turnouts
- Acceleration and deceleration lanes
- Removal of obstructions
- Roundabouts
- Restriping to add lanes with or without parking removal and restrictions
- Protected left-turn pockets or free right-turn lanes
- Parking restrictions, daily or during peak hours
- Fair share contributions to approved projects identified in the agency’s Capital Improvement Plan
- Fair share contributions to traffic signals identified in the agency’s traffic signal plan.

Prepare and implement a waterway traffic control plan to ensure safe and efficient vessel navigation during construction in waterways. The plan shall identify vessel traffic control measures to minimize congestion and navigation hazards to the extent feasible. Construction areas in the waterway will be barricaded or guarded by readily visible barriers or other effective means to warn boaters of their presence and restrict access. Warning devices and signage will be consistent with the California Uniform State Waterway Marking System and effective during nondaylight hours and periods of dense fog.

Where temporary partial channel closure is necessary, a temporary channel closure plan shall be developed. The waterway
Closure plan will identify and implement alternate detour routing and procedures for notifying boaters of construction activities and partial closures, including coordination with the U.S. Coast Guard, local boating organizations and marinas.

♦ To the extent feasible, ensure that safe boat access to public launch and docking facilities, businesses, and residences is maintained.

♦ Coordinate with transit system operators to establish appropriate alternate transit system routes to be rerouted during construction activities, as appropriate.

♦ Boat passage facilities shall be provided as an integral component of operable gate facilities, when feasible. Boat passage facilities shall be designed to provide uninterrupted boat passage when gate are in the “up” position. Floating docks with mooring bits shall be provided along the shoreline on both sides of the boat passage facility for boaters to use while they await passage. Floating barriers will guide boats into the passage facility chambers.

♦ Implement a program to provide boater education on procedures for waiting at and using the boat passage facility.

♦ Minimize impacts on bicycle and pedestrian circulation where feasible by avoiding impacts, minimizing closure of paths, and providing for temporary or permanent relocation of the facility to the extent feasible. Consult with the appropriate public works department to determine the most feasible alignment for facility relocation.
| **19-2** | ♦ Develop and implement a program that will include procedures for routine inspections and emergency facility operation to allow safe navigation should the facility become damaged or malfunction. The program will include the following specific components: ♦ Routine inspections and correction procedures to ensure that facility safety features are in good working order. ♦ Routine inspections and correction procedures for navigational hazards around facilities, including floating or submerged debris and the formation of shoals. ♦ Contingency and emergency operating procedures to address the possibility that a boat colliding with the flow control facilities will damage the facilities or otherwise render them unable to operate as engineered, and provisions to allow safe navigation. |
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

| **19-3** | ♦ Coordinate with responsible local agencies to establish appropriate emergency routes during construction activities and before existing emergency routes are reclassified to a nonemergency route use. ♦ Phase construction activities, and use multiple routes to and from offsite locations to minimize the daily amount of traffic on individual roadways. ♦ Post warnings about the potential presence of slow-moving vehicles. ♦ Use traffic-control personnel when appropriate. ♦ Place and maintain barriers, and install traffic-control devices necessary for safety, as specified in Caltrans’ Manual of Traffic Controls for Construction and Maintenance Work Zones and in accordance with city and county requirements. ♦ Notify appropriate emergency service providers of project construction throughout the construction period to ensure that emergency access through construction areas is maintained. |
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |

<p>| <strong>19-4</strong> | ♦ Implement Mitigation Measure 19-1, above. The portion of the measure that addresses minimizing impacts on bicycle and pedestrian circulation also would apply to Impact 19-4a through e. |
| Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |</p>
<table>
<thead>
<tr>
<th>Utilities and Service Systems</th>
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<tbody>
<tr>
<td>20-1</td>
<td>♦ Establish construction debris disposal fee schedules to promote recycling and minimize solid waste.</td>
<td>Delta Stewardship Council</td>
<td>Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013</td>
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<td>♦ Limit disposal of construction debris and other solid waste at local landfills if the landfills have limited capacity.</td>
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<td>♦ Dispose of all construction debris at landfills and disposal facilities that are licensed for the type of wastes to be disposed. If the landfills and disposal facilities are not located near future construction sites, include analysis of transportation of solid waste in future environmental documentation for specific projects.</td>
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<td></td>
<td>♦ Require construction contractors to prepare construction debris management plans and require reuse or recycling of construction debris.</td>
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<td>♦ Develop project-specific solid waste plans to maximize practices that reduce and recycle solid waste and sludge generated by water, wastewater, and stormwater treatment facilities; and collect, recycle, or compost litter and solid waste generated at new facilities designed for visitor use (such as parks and visitor centers).</td>
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<td>20-2</td>
<td>♦ Relocate or modify existing water, wastewater, and stormwater facilities or electricity transmission systems in a manner that does not affect current operational reliability to existing and projected users.</td>
<td>Delta Stewardship Council</td>
<td>Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013</td>
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<td>♦ Coordinate utility relocation and modification with utility providers and local agencies to integrate potential other construction projects and minimize disturbance to the communities.</td>
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<td></td>
<td>♦ Verify utility locations through field surveys and services such as Underground Service Alert.</td>
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<td>Climate Change and Greenhouse Gas Emissions</td>
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<tr>
<td>21-1</td>
<td>Implement GHG mitigation measures listed in the most recent California Air Pollution Control Officers Association (CAPCOA), BAAQMD, and other air district guidance documents (e.g., CAPCOA, 2010. Quantifying Greenhouse Gas Mitigation Measures. A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures. Sacramento, California. August, p. 210-232; BAAQMD, 2011. California Environmental Quality</td>
<td>Delta Stewardship Council</td>
<td>Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was</td>
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<td>Delta Stewardship Council</td>
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Act Air Quality Guidelines. San Francisco, California. Updated May 2011, p. 8-6). Current versions of such guidance documents list the following for construction:

1. Use alternative fuels for construction equipment.
2. Use electric and hybrid construction equipment.
3. Limit construction equipment idling beyond regulatory requirements.
4. Institute a heavy-duty off-road vehicle plan.
5. Implement a construction vehicle inventory tracking system.
6. Use local building materials for at least ten percent of total materials.
7. Recycling or reusing at least 50 percent of construction waste or demolition materials.

In addition, the California Attorney General’s Office has developed a list of various measures that may reduce GHG emissions at the individual project level. A selected list of those proposed measures that could be applied to DWR projects was appended to the DWR guidance document, titled Guidance for Quantifying Greenhouse Gas Emissions and Determining the Significance of their Contribution to Global Climate Change for CEQA Purposes (DWR, 2010. Guidance for Quantifying Greenhouse Gas Emissions and Determining the Significance of their Contribution to Global Climate Change for CEQA Purposes. California Department of Water Resources Internal Guidance Document. CEQA Climate Change Committee. Sacramento, CA. January, Appendix B). As appropriate, the measures can be included as design features of a project, required as changes to the project, or imposed as mitigation (whether undertaken directly by the project proponent or funded by mitigation fees). The measures are examples; the list is not intended to be exhaustive. The following may serve as BMPs to be considered and implemented (as applicable) during design, construction, operation, and maintenance of project facilities.

**Efficiency**

1. Design buildings to be energy efficient. Site buildings to take advantage of shade, prevailing winds, landscaping and sun screens to reduce energy use.
2. Install efficient lighting and lighting control systems. Use daylight as an integral part of lighting systems in buildings.
3. Install light colored “cool” roofs, cool pavements, and strategically...
placed shade trees.
4. Install energy efficient heating and cooling systems, appliances and equipment, and control systems.
5. Install light-emitting diodes for street and other outdoor lighting.
6. Limit the hours of operation of outdoor lighting.
7. Provide education on energy efficiency.

**Renewable Energy**
1. Install solar and wind power systems and energy-efficient heating ventilation and air conditioning.
2. Install solar panels over parking areas.
3. Use combined heat and power in appropriate applications.

**Water Conservation and Efficiency**
1. Create water-efficient landscapes.
2. Install water-efficient irrigation systems and devices, such as soil moisture-based irrigation controls.
3. Use reclaimed water for landscape irrigation. Install the infrastructure to deliver and use reclaimed water.
4. Design buildings to be water-efficient. Install water-efficient fixtures and appliances.
5. Restrict watering methods (e.g., prohibit systems that apply water to non-vegetated surfaces) and control runoff.
6. Restrict the use of water for cleaning outdoor surfaces and vehicles.
7. Implement low-impact development practices that maintain the existing hydrologic character of the site to manage stormwater and protect the environment. (Retaining stormwater runoff on-site can drastically reduce the need for energy-intensive imported water at the site.)
8. Devise a comprehensive water conservation strategy appropriate for the project and location. The strategy may include many of the specific items listed above, plus other innovative measures that are appropriate to the specific project.

**Solid Waste Measures**
1. Reuse and recycle construction and demolition waste (including, but not limited to, soil, vegetation, concrete, lumber, metal, and cardboard).
2. Provide interior and exterior storage areas for recyclables and
green waste and adequate recycling containers located in public areas.

3. Recover by-product methane to generate electricity.

**Transportation and Motor Vehicles**

1. Limit idling time for commercial vehicles, including delivery and construction vehicles.
2. Use low or zero-emission vehicles, including construction vehicles.
3. Institute a heavy-duty off-road vehicle plan and a construction vehicle inventory tracking system for construction projects.
4. Promote ride sharing.
5. Provide the necessary facilities and infrastructure to encourage the use of low or zero-emission vehicles (e.g., electric vehicle charging facilities and conveniently located alternative fueling stations).
6. Increase the cost of driving and parking private vehicles by, e.g., imposing tolls and parking fees.
7. Provide shuttle service to public transit/work sites.
8. Provide information on all options for individuals and businesses to reduce transportation-related emissions.

**Carbon Offsets**

1. If, after analyzing and requiring all reasonable and feasible on-site mitigation measures for avoiding or reducing greenhouse gas-related impacts, the lead agency determines that additional mitigation is required, the agency may consider additional off-site mitigation. The project proponent could, for example, fund off-site mitigation projects (e.g., alternative energy projects, or energy or water audits for existing projects) that will reduce carbon emissions, conduct an audit of its other existing operations and agree to retrofit, or purchase carbon “credits” from another entity that will undertake mitigation.

2. The topic of offsets can be complicated, and a full discussion is outside the scope of this summary document. Issues that the lead agency should consider include:
   a. The location of the off-site mitigation. (If the off-site mitigation is far from the project, any additional, non-climate related benefits of the mitigation will be lost to the local community.)
   b. Whether the emissions reductions from off-site mitigation can be quantified and verified.
c. Whether the mitigation ratio should be greater than 1:1 to reflect any uncertainty about the effectiveness of the offset.

SmartWay Truck Efficiency
The strategy involves requiring existing trucks/trailers to be retrofitted with the best available “SmartWay Transport” and/or ARB approved technology. Technologies that reduce GHG emissions from trucks may include devices that reduce aerodynamic drag and rolling resistance. Aerodynamic drag may be reduced using devices such as cab roof fairings, cab side gap fairings, cab side skirts, and on the trailer side, trailer side skirts, gap fairings, and trailer tail. Rolling resistance may be reduced using single wide tires or low-rolling resistance tires and automatic tire inflation systems on both the tractor and the trailer.

Tire Inflation Program
The strategy involves actions to ensure that vehicle tire pressure is maintained to manufacturer specifications.

Blended Cements
The strategy to reduce CO2 emissions involves the addition of blending materials such as limestone, fly ash, natural pozzolan and/or slag to replace some of the clinker in the production of Portland cement.

Anti-idling Enforcement
The strategy guarantees emission reductions as claimed by increasing compliance with anti-idling rules, thereby reducing the amount of fuel burned through unnecessary idling. Measures may include enhanced field enforcement of anti-idling regulations, increased penalties for violations of anti-idling regulations, and restriction on registrations of heavy-duty diesel vehicles with uncorrected idling violations.
| 21-2 | ♦ Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design for flood protection of the facilities constructed along waterways. Prepare the study in accordance with applicable standards of Federal Emergency Management Agency (FEMA), USACE, DWR, Central Valley Flood Protection Board, San Francisco Bay Conservation and Development Commission (BCDC), as well as the local reclamation districts and flood control agencies and the counties and cities. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, Central Valley Flood Protection Board, and BCDC. ♦ Design intakes/diversions and outfalls to be operated at multiple surface water elevations between existing conditions and maximum projected surface water elevations during a high flow event with sea level rise for the life of the facility. ♦ Prepare a hydrogeologic study that would assess long-term groundwater recharge and safe yield of wells and wellfields under a sustainable groundwater management plan. If the wells can be used to a greater degree in some years in a manner that would support the sustainable groundwater management plan to avoid long-term groundwater overdraft, wells could be drilled to deeper depths than would be required under existing conditions. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
| 21-3 | ♦ Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design for ecosystem habitat restoration, including adjacent areas that would allow for migration of the habitat to higher elevations as the surface water elevations increase. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, and San Francisco Bay Delta Conservation and Development Commission (BCDC). Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, Central Valley Flood Protection Board, and BCDC. | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § 5002(b)(2)) in 2013 | Certification of Consistency process |
| 21-4 | ♦ Prepare a drainage or hydrology and hydraulics study that would assess the need and provide a basis for the design for projects that reduce risks of floods in the Delta. Prepare the study in accordance with applicable standards of FEMA, USACE, DWR, and BCDC. Design subsequent mitigation measures in accordance with the final study and with the applicable standards of FEMA, USACE, DWR, Central Valley Flood Protection Board, and BCDC. ♦ Based on the results of the drainage or hydrologic and hydraulic study, arrange the length of flood management facilities in the | Delta Stewardship Council | Council adopted Delta Plan mitigation measures pursuant to Policy G P1 and rulemaking was completed (23 CCR § | Certification of Consistency process |
direction of the floodplain flow to maximize surface flows under flood conditions.

♦ Install setback levees or bypass channels to maintain channel capacity and to mitigate hydraulic impacts of high flow events and higher surface water elevations due to climate change and sea level rise.

♦ Channel modifications for restoration actions would be required to be implemented to maintain or improve flood management functions and would be coordinated with the USACE, DWR, Central Valley Flood Protection Board, BCDC, and other flood control agencies to assess the desirability and feasibility for channel modifications. To the extent consistent with floodplain land uses and flood control requirements, if applicable, woody riparian vegetation would be allowed to naturally establish.
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Glossary

The first section of this glossary provides definitions that appear in 23 California Code of Regulations section 5001. The second section provides definitions and explanations of key terms, acronyms, and abbreviations used in the Delta Plan.

Definitions in 23 California Code of Regulations Section 5001

As used in this division, the terms listed below shall have the meanings noted:

(a) “Adaptive management” means a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives.

(b) “Agricultural water management plan” means a plan prepared, adopted, and updated by an agricultural water supplier pursuant to the Agricultural Water Management Planning Act, Water Code section 10800 et seq.

(c) “Agricultural water supplier” under the Water Code refers to both agricultural retail water suppliers and agricultural wholesale water suppliers, but not the California Department of Water Resources or the United States Bureau of Reclamation, and includes both of the following:

1. A water supplier, either publicly or privately owned, providing water to 10,000 or more irrigated acres, excluding recycled water; and

2. A water supplier or contractor for water, regardless of the basis of the water right, that distributes or sells water for ultimate resale to customers.

(d) “Base Flood” means the flood that has a 1-percent probability of being equaled or exceeded in any given year (also referred to as the 100-year flood).

(e) “Base Flood Elevation” (BFE) means the water surface elevation associated with the base flood.

(f) “Best available science” means the best scientific information and data for informing management and policy decisions. Best available science shall be consistent with the guidelines and criteria found in Appendix 1A.

(g) “Central Valley Flood Protection Board” or “Board” means the Central Valley Flood Protection Board (formerly The Reclamation Board) of the Resources Agency of the State of California as provided in Water Code section 8521.

(h) “Coequal goals” means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. In addition, “achievement” for the purpose of determining whether a plan, program, or project meets the definition of a “covered action” under section 5001(j) is further defined as follows:

1. “Achieving the coequal goal of providing a more reliable water supply for California” means all of the following:

   A. Better matching the state’s demands for reasonable and beneficial uses of water to the available water supply. This will be done by promoting, improving, investing in, and implementing projects and programs that improve the resiliency of the state’s water systems, increase water efficiency and conservation, increase water recycling and use of advanced water technologies, improve groundwater management, expand storage, and improve Delta conveyance and operations. The evaluation of progress toward improving reliability will take into account the inherent variability in water demands and supplies across California;
(B) Regions that use water from the Delta watershed will reduce their reliance on this water for reasonable and beneficial uses, and improve regional self-reliance, consistent with existing water rights and the State’s area-of-origin statutes and Reasonable Use and Public Trust Doctrines. This will be done by improving, investing in, and implementing local and regional projects and programs that increase water conservation and efficiency, increase water recycling and use of advanced water technologies, expand storage, improve groundwater management, and enhance regional coordination of local and regional water supply development efforts; and

(C) Water exported from the Delta will more closely match water supplies available to be exported, based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem. This will be done by improving conveyance in the Delta and expanding groundwater and surface storage both north and south of the Delta to optimize diversions in wet years when more water is available and conflicts with the ecosystem are less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. Delta water that is stored in wet years will be available for water users during dry years, when the limited amount of available water must remain in the Delta, making water deliveries more predictable and reliable. In addition, these improvements will decrease the vulnerability of Delta water supplies to disruption by natural disasters, such as, earthquakes, floods, and levee failures.

(2) “Achieving the coequal goal of protecting, restoring, and enhancing the Delta ecosystem” means successfully establishing a resilient, functioning estuary and surrounding terrestrial landscape capable of supporting viable populations of native resident and migratory species with diverse and biologically appropriate habitats, functional corridors, and ecosystem processes.

(3) “Achieving the coequal goals in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place” means accepting that change, including change associated with achieving the coequal goals, will not cease, but that the fundamental characteristics and values that contribute to the Delta’s special qualities and that distinguish it from other places can be preserved and enhanced while accommodating these changes. In this regard, the following are core strategies for protecting and enhancing the unique values that distinguish the Delta and make it a special region:

(A) Designate the Delta as a special place worthy of national and state attention;

(B) Plan to protect the Delta’s lands and communities;

(C) Maintain Delta agriculture as a primary land use, a food source, a key economic sector, and a way of life;

(D) Encourage recreation and tourism that allow visitors to enjoy and appreciate the Delta and that contribute to its economy;

(E) Sustain a vital Delta economy that includes a mix of agriculture, tourism, recreation, related industries and business, and vital components of state and regional infrastructure; and

(F) Reduce flood and other risks to people, property, and other interests in the Delta.

(i) “Commercial recreational visitor-serving uses” means a land use designation that describes visitor-serving uses, accommodations, restaurants, and shops, that respect the rural character and natural environmental setting. These uses also include campgrounds and commercial recreational facilities.

(j)(1) “Covered action” means a plan, program, or project that meets all of the following criteria (which are collectively referred to as covered action screening criteria):

(A) Is a “project,” as defined pursuant to section 21065 of the Public Resources Code;

(B) Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh;

(C) Will be carried out, approved, or funded by the State or a local public agency;

(D) Will have a significant impact on achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and State interests in the Delta; and

(E) Is covered by one or more provisions of the Delta Plan, which for these purposes, means one or more of the regulatory policies contained in Article 3.
(2) “Covered action” does not include any plan, program, or project that is exempted pursuant to Water Code section 85057.5(b).

(3) A State or local public agency that proposes to carry out, approve, or fund a plan, program, or project that may be subject to this Chapter must determine whether that proposed plan, program, or project is a covered action. That determination, which is subject to judicial review, must be reasonable, made in good faith, and consistent with the Delta Reform Act and this Chapter.

(4) Nothing in the application of the definition of a "covered action" shall be interpreted to authorize the abrogation of any vested right whether created by statute or by common law.

(k) "Delta" means the Sacramento-San Joaquin Delta as defined in section 12220 of the Water Code and the Suisun Marsh, as defined in section 29101 of the Public Resources Code.

(l) "Delta Plan" means the comprehensive, long-term management plan for the Delta to further the achievement of the coequal goals, as adopted by the Delta Stewardship Council in accordance with the Sacramento-San Joaquin Delta Reform Act of 2009.

(m) "Designated Floodway" means those floodways, as defined in California Code of Regulations, Title 4, section 14, under the jurisdiction of the Central Valley Flood Protection Board.

(n) "Encroachment" means any obstruction or physical intrusion by construction of works or devices, planting or removal of vegetation, or by any means for any purpose, into or otherwise affecting a floodway or floodplain.

(o) "Enhancement" or "enhancing," for purposes of section 5001(h)(2), means improving existing desirable habitat and natural processes. Enhancement may include, by way of example, flooding the Yolo Bypass more often to support native species or to expand or better connect existing habitat areas. Enhancement includes many fish and wildlife management practices, such as managing wetlands for waterfowl production or shorebird habitat, installing fish screens to reduce entrainment of fish at water diversions, or removing barriers that block migration of fish to upstream spawning habitats.

(p) "Feasible" means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

(q) "Floodplain" means any land area susceptible to being inundated by flood waters from any source.

(r) "Floodplain values and functions" has the same meaning as set forth in 33 Code of Federal Regulations section 320.4(i)(1).

(s) "Floodproofing" means any combination of structural and nonstructural additions, changes, or adjustments appropriate for residential structures, which reduce or eliminate risk of flood damage to real estate, improved real property, or structures with their contents.

(t) "Floodway" means the portion of the floodplain that is effective in carrying flow (that is, the channel of a river or other watercourse and the adjacent land areas that convey flood waters).

(u) “Government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta" means any State or federal strategy, project, approval, funding, or other effort that is intended to reduce the likelihood and/or consequences 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:

(1) State Water Resources Law of 1945, Water Code section 12570 et seq.;

(2) Sacramento-San Joaquin River Flood Control Projects (Flood Control Act of 1941, P.L. 77-228);

(3) Local Plans of Flood Protection prepared pursuant to the Local Flood Protection Planning Act (Water Code section 8200 et seq.), that are consistent with the Central Valley Flood Protection Plan pursuant to Water Code section 9612;

(4) Central Valley Flood Protection Plan (Water Code section 9600 et seq.);

(5) Subventions Program, Special Projects Program (Water Code section 12300 et seq.);

(6) Way Bill 1973-Subventions Program, Special Projects Program (Water Code section 12980 et seq.);

(7) Central Valley Flood Protection Board Authority (California Code of Regulations, Title 23, Division 1); and

(v) “Nonnative invasive species,” for purposes of section 5009, means species that establish and reproduce rapidly outside of their native range and may threaten the diversity or abundance of native species through competition for resources, predation, parasitism, hybridization with native populations, introduction of pathogens, or physical or chemical alteration of the invaded habitat.

(w) “Nonproject levee” means a local levee owned or maintained by a local agency or private owner that is not a project facility under the State Water Resources Law of 1945, Chapter 1 (commencing with Water Code section 12570) and Chapter 2 (commencing with section 12639 of Part 6 of the Water Code).

(x) “Project levee” means a federal flood control levee that is a project facility under the State Water Resources Law of 1945, Chapter 1 (commencing with Water Code section 12570) and Chapter 2 (commencing with section 12639 of Part 6 of the Water Code).

(y) “Proposed action” means a plan, program, or project that meets the covered action screening criteria listed in section 5001(j)(1)(A) through (D). Proposed action is also a “covered action,” and therefore subject to compliance with the regulatory policies contained in Articles 2 and 3—if the proposed action meets the covered action screening criterion listed in section 5001(j)(1)(E).

(z) “Protection” or “protecting,” for purposes of section 5001(h)(2), means preventing harm to the ecosystem, which could include preventing the conversion of existing habitat, the degradation of water quality, irretrievable conversion of lands suitable for restoration, or the spread of invasive nonnative species.

(aa) “Regulated stream” means those streams identified in Table 8.1 of California Code of Regulations, Title 23, section 112, under the jurisdiction of the Board.

(bb) “Restoration” or “restoring,” for purposes of section 5001(h)(2), has the same meaning as in Water Code section 85066. Restoration actions may include restoring interconnected habitats within the Delta and its watershed, restoring more natural Delta flows, or improving ecosystem water quality.

(cc) “Setback levee” means a new levee constructed behind an existing levee which allows for removal of a portion of the existing levee and creation of additional floodplain connected to the stream. In the Delta, a “setback levee” may not necessarily result in removal of the existing levee.

(dd) “Significant impact” for the purpose of determining whether a project meets the definition of a “covered action” under section 5001(j)(1)(D) means a substantial positive or negative impact on the achievement of one or both of the coequal goals or the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta, that is directly or indirectly caused by a project on its own or when the project’s incremental effect is considered together with the impacts of other closely related past, present, or reasonably foreseeable future projects. The following categories of projects will not have a significant impact for this purpose:

(1) “Ministerial” projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(1);

(2) “Emergency” projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(2) through (4);

(3) Temporary water transfers of up to one year in duration. This provision shall remain in effect only through December 31, 2016, and as of January 1, 2017, is repealed, unless the Council acts to extend the provision prior to that date. The Council contemplates that any extension would be based upon the California Department of Water Resources’ and the State Water Resources Control Board’s participation with stakeholders to recommend measures to reduce procedural and administrative impediments to water transfers and protect water rights and environmental resources by December 31, 2016. These recommendations should include measures to address potential issues with recurring transfers of up to 1 year in duration and improved public notification for proposed water transfers;

(4) Other projects exempted from CEQA, unless there are unusual circumstances indicating a reasonable possibility that the project will have a significant impact under Water Code section 85057.5(a)(4), as further defined by this section. Examples of unusual circumstances could arise in connection with, among other things:

(A) Local government general plan amendments for the purpose of achieving consistency with the Delta Protection Commission’s Land Use and Resource Management Plan; and,
(B) Small-scale habitat restoration projects, as referred to in CEQA Guidelines, section 15333 of Title 14 of the California Code of Regulations, proposed in important restoration areas, but which are inconsistent with the Delta Plan’s policy related to appropriate habitat restoration for a given land elevation (section 5006 of this Chapter).

(ee) “Urban area” means a developed area in which there are 10,000 residents or more.

(ff) “Urbanizing area” means a developed area or an area outside of a developed area that is planned or anticipated to have 10,000 residents or more within the next 10 years.

(gg) “Urban water management plan” means a plan prepared, adopted, and updated by an urban water supplier pursuant to the Urban Water Management Planning Act, Water Code section 10610 et seq.

(hh) “Urban water supplier” refers to both “urban retail water suppliers” and “urban wholesale water suppliers”:

1. “Urban retail water supplier” means a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes.

2. “Urban wholesale water supplier” means a water supplier, either publicly or privately owned, that provides more than 3,000 acre-feet of potable water annually at wholesale for municipal purposes.

(iii) “Water supplier” refers to both “urban water suppliers” and “agricultural water suppliers,” but for purposes of section 5003, does not include agricultural water suppliers during the time that they may be exempted by section 10853 of the Water Code from the requirements of Parts 2.55 and 2.8 of Division 6 of the Water Code.

23 CCR Section 5001

NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85057.5, 85059, 85058, 85066, 85020, 85054, 85052, 85302(g), 85308, 85300, 10608.12, and 10853, Water Code.
Amended Key Terms, Acronyms, and Abbreviations Used in the Delta Plan

Chapter 7, amended by the Council on April 26, 2018, adds the following three terms to the glossary.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levee Improvement</td>
<td>Levee improvements are intended to reduce the probability of flooding. An example of a levee improvement would be changing a levee geometry to meet a higher levee as improving a levee to reach a 200-year level of protection.</td>
</tr>
<tr>
<td>Levee Maintenance</td>
<td>Annual or routine levee maintenance is work intended to preserve the levee system in its current condition. Examples of maintenance work include patrols, surveys and inspections, extermination and control of burrowing animals, work on the levee crown to improve access or drainage, removing vegetation or debris, control of seepage and boils, cleaning drains and toe ditches, restoring rock protection, and maintenance of levee-related habit improvements sites.</td>
</tr>
<tr>
<td>Levee Rehabilitation</td>
<td>Rehabilitation is levee repair work needed to improve the levee integrity and preserve existing flood risk reduction benefits. Examples of rehabilitation work include raising the levee crown to offset subsidence, flattening waterside slopes, constructing landside berms, and widening levee crowns.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td>100-year flood</td>
<td>A flood event having a 1-in-100 chance of being equaled or exceeded in any given year.</td>
</tr>
<tr>
<td>200-year flood</td>
<td>A flood event having a 1-in-200 chance of being equaled or exceeded in any given year.</td>
</tr>
<tr>
<td>AB</td>
<td>Assembly Bill</td>
</tr>
<tr>
<td>acre-foot</td>
<td>The volume of water that would cover 1 acre of land to a depth of 1 foot; equal to 43,560 cubic feet or 325,851 gallons.</td>
</tr>
<tr>
<td>accommodation space</td>
<td>The space in the Delta that lies below sea level and is filled with neither sediment nor water.</td>
</tr>
<tr>
<td>Act</td>
<td>See Sacramento-San Joaquin Delta Reform Act of 2009</td>
</tr>
<tr>
<td>ACWA</td>
<td>Association of California Water Agencies</td>
</tr>
<tr>
<td>administrative procedure</td>
<td>Procedures adopted by the Delta Stewardship Council (Council), in accordance with Water Code section 85225.30, that govern how the Council</td>
</tr>
<tr>
<td></td>
<td>considers appeals with respect to the following:</td>
</tr>
<tr>
<td></td>
<td>(1) Adequacy of certifications of consistency with the Delta Plan submitted to the Council by a State or local agency pursuant to Water</td>
</tr>
<tr>
<td></td>
<td>Code section 85225.10, and</td>
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<tr>
<td></td>
<td>(2) Determinations by the California Department of Fish and Wildlife that the Bay Delta Conservation Plan has met the requirements of</td>
</tr>
<tr>
<td></td>
<td>Water Code section 85320 for inclusion in the Delta Plan.</td>
</tr>
<tr>
<td>advanced treatment</td>
<td>Any treatment of sewage that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients,</td>
</tr>
<tr>
<td></td>
<td>including phosphorus, nitrogen, and a high percentage of suspended solids.</td>
</tr>
<tr>
<td>Aeration Facility</td>
<td>Demonstration Dissolved Oxygen Aeration Facility</td>
</tr>
<tr>
<td>agricultural water use</td>
<td>Water used for farming, horticulture, or ranching including irrigation, stock watering, or support of vegetation for range grazing.</td>
</tr>
<tr>
<td></td>
<td>This includes water used for irrigation and nonirrigation purposes. Irrigation water use includes the artificial application of water on</td>
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<td></td>
<td>land to promote the growth of crops and pasture, or to maintain vegetative growth in recreational lands, parks, and golf courses.</td>
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<td></td>
<td>Nonirrigation water use includes water used for livestock, which includes water for stock watering, feedlots, and dairy operations,</td>
</tr>
<tr>
<td></td>
<td>and fish farming and other farm requirements.</td>
</tr>
<tr>
<td>agricultural water use</td>
<td>Defined by California Department of Water Resources as the ratio of applied water to the amount of water required to sustain</td>
</tr>
<tr>
<td>efficiency</td>
<td>agricultural productivity. Efficiency is increased through the application of less water to achieve the same beneficial productivity or</td>
</tr>
<tr>
<td></td>
<td>by achieving more productivity while applying the same amount of water.</td>
</tr>
<tr>
<td>AGWA</td>
<td>Association of Groundwater Agencies</td>
</tr>
<tr>
<td>anadromous fish</td>
<td>Fish that are born in fresh water, migrate to the ocean to mature, and then return to fresh water to spawn.</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<td>-------------------------------</td>
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</tr>
<tr>
<td>anticipated future stressors</td>
<td>Stressors that require preparation and planning for mitigation in advance of their onset (for example, future land subsidence, urban expansion, and new invasions by nonnative species).</td>
</tr>
<tr>
<td>artesian water</td>
<td>A groundwater aquifer under positive pressure. In some cases, the hydrostatic equilibrium elevation of the groundwater is higher than the elevation of the surrounding ground surface. When an artesian aquifer is penetrated by a well, the water level will rise above the top of the aquifer, and even flow out of the ground.</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>BAFF</td>
<td>bio-acoustic fish fence</td>
</tr>
<tr>
<td>base camp</td>
<td>A park, resort, or town that provides services (for example, park rangers, interpretation, and boat rentals) and facilities (for example, parking, restrooms, picnic sites, boat ramps, and campgrounds). The mix of facilities is determined by adjacent recreation opportunities and nearby public and private facilities.</td>
</tr>
<tr>
<td>basin plan</td>
<td>A water quality control plan for a specific basin or region in California. It includes a comprehensive program of actions designed to preserve, enhance, and restore water quality in that basin. The basin plan is the master water quality control planning document for the regional boards. It describes beneficial uses of surface water and groundwater, and establishes water quality objectives to protect those uses.</td>
</tr>
<tr>
<td>Bay Plan</td>
<td>San Francisco Bay Plan</td>
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<tr>
<td>Bay-Delta Plan</td>
<td>Bay-Delta Water Quality Control Plan</td>
</tr>
<tr>
<td>BCDC</td>
<td>San Francisco Bay Conservation and Development Commission</td>
</tr>
<tr>
<td>BDCP</td>
<td>Bay Delta Conservation Plan</td>
</tr>
<tr>
<td>beneficial uses</td>
<td>Uses of the waters of the state that include domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.</td>
</tr>
<tr>
<td>beneficiaries</td>
<td>Entities that benefit from using the resources of the Delta, including water supply, conveyance, and recreation.</td>
</tr>
<tr>
<td>benthic</td>
<td>The collection of organisms living on or in sea, lake, or river bottoms.</td>
</tr>
<tr>
<td>best management practices (BMPs)</td>
<td>Methods or techniques found to be the most effective and practical means of achieving an objective, such as water conservations. BMPs include, but are not limited to, structural and nonstructural controls, and operation and maintenance procedures. Examples of water conservation BMPs include tiered rate structures and water-efficient plumbing and irrigation systems.</td>
</tr>
<tr>
<td>bioaccumulation</td>
<td>The process by which a chemical is taken up by an aquatic organism, both from direct exposure to water and through the consumption of food containing the chemical.</td>
</tr>
<tr>
<td>biological opinion</td>
<td>A document stating the opinion of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service as to whether or not federal action is likely to jeopardize the continued existence of a threatened or endangered species, or result in the destruction or adverse modification of critical habitat.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>biomagnify, biomagnification</td>
<td>The sequence of processes in an ecosystem by which higher concentrations of a particular chemical, a pesticide for example, are reached in organisms higher up the food chain, generally through a series of prey-predator relationships.</td>
</tr>
<tr>
<td>BMP</td>
<td>See best management practices</td>
</tr>
<tr>
<td>bypass</td>
<td>An area of land or a large, constructed structure designed to convey excess floodwaters from a river or stream in order to reduce the risk of flooding on the natural river or stream near a city or other population center.</td>
</tr>
<tr>
<td>Cal EMA</td>
<td>California Emergency Management Agency</td>
</tr>
<tr>
<td>Caltrans</td>
<td>California Department of Transportation</td>
</tr>
<tr>
<td>CARB</td>
<td>California Air Resources Board</td>
</tr>
<tr>
<td>carbon sequestration</td>
<td>The process of removing carbon from the atmosphere and storing it. Trees and plants, for example, absorb carbon dioxide, release the oxygen, and store the carbon in their biomass. The stored biomass may eventually turn to peat, other soil-borne organic matter, and fossil fuels such as coal or petroleum that will continue to store the carbon until the fuels are burned.</td>
</tr>
<tr>
<td>CASGEM</td>
<td>California Statewide Groundwater Elevation Monitoring Program</td>
</tr>
<tr>
<td>CCR</td>
<td>California Code of Regulations</td>
</tr>
<tr>
<td>CDFA</td>
<td>California Department of Food and Agriculture</td>
</tr>
<tr>
<td>centrarchids</td>
<td>Small, carnivorous, freshwater, spiny-finned fishes of North America usually having a laterally compressed body and metallic luster (for example, largemouth bass, smallmouth bass, spotted bass, bluegill, warmouth, redear sunfish, green sunfish, white crappie, and black crappie).</td>
</tr>
<tr>
<td>certification of consistency</td>
<td>The written certification to the Delta Stewardship Council, with detailed findings, that a covered action is consistent with the Delta Plan. Certifications of consistency are submitted to the Delta Stewardship Council by the State or local agency that is proposing to carry out, fund, or approve a covered action under the California Environmental Quality Act (Water Code section 85225 et seq.).</td>
</tr>
<tr>
<td>CEQA</td>
<td>California Environmental Quality Act</td>
</tr>
<tr>
<td>cfs</td>
<td>cubic feet per second</td>
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<tr>
<td>channelization</td>
<td>(1) Natural or intentional straightening and deepening of streams through dredging or construction of levees.</td>
</tr>
<tr>
<td></td>
<td>(2) A marsh-drainage tactic that can disturb fish and wildlife habitats, aggravate flooding, and decrease the capacity to absorb pollution without suffering damage.</td>
</tr>
<tr>
<td>climate change</td>
<td>Any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from (1) natural factors, including changes in the sun’s intensity or changes in the Earth’s orbit around the sun, (2) natural processes within the climate system (such as changes in ocean circulation), or (3) human activities that change the composition of the atmosphere (for example, through burning fossil fuels) and land surfaces (for example, deforestation, reforestation, urbanization, and desertification).</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>CNDDB</td>
<td>California Natural Diversity Database</td>
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<td>CNPS</td>
<td>California Native Plant Society</td>
</tr>
<tr>
<td>CNRA</td>
<td>California Natural Resources Agency</td>
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<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>COA</td>
<td>Coordinated Operating Agreement</td>
</tr>
<tr>
<td>conceptual model</td>
<td>An explicit description of mental models, knowledge, and hypotheses about the structure and function of a system or process.</td>
</tr>
<tr>
<td>conjunctive management</td>
<td>The coordinated and planned management of both surface water and groundwater resources to maximize efficient water use. Water is stored in groundwater basins for future use by intentionally recharging the basin during years of above-average surface water supply. Surface water and groundwater resources typically differ significantly in their availability, quality, management requirements, and development and use costs. Managing both resources together, rather than in isolation from one another, allows water managers to use the advantages of both resources for maximum benefit.</td>
</tr>
<tr>
<td>conveyance</td>
<td>The movement of water from one place to another. Conveyance infrastructure includes natural watercourses as well as canals, pipelines, and control structures including weirs. Examples of natural watercourses include streams, rivers, and groundwater aquifers. Conveyance facilities range in size from small, local, end-user distribution systems to large systems that deliver water to or drain areas covering multiple hydrologic regions. Conveyance facilities require associated infrastructure including pumping plants, power supply, diversion structures, fish ladders, and fish screens.</td>
</tr>
<tr>
<td>Council</td>
<td>Delta Stewardship Council</td>
</tr>
<tr>
<td>critical habitat</td>
<td>Specific areas, both occupied and unoccupied, that are essential to the conservation of a listed species and that may require special management considerations or protection (as defined in Section 3 of the federal Endangered Species Act).</td>
</tr>
<tr>
<td>current stressors</td>
<td>Stressors that result from ongoing human activities that can, in some cases, be eliminated (for example, fish entrainment at water diversions).</td>
</tr>
<tr>
<td>CVFPB</td>
<td>Central Valley Flood Protection Board</td>
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<tr>
<td>CVFPP</td>
<td>Central Valley Flood Protection Plan</td>
</tr>
<tr>
<td>CVP</td>
<td>Central Valley Project</td>
</tr>
<tr>
<td>CVPIA</td>
<td>Central Valley Project Improvement Act</td>
</tr>
<tr>
<td>CV-SALTS</td>
<td>Central Valley Salinity Alternatives for Long-Term Sustainability Program</td>
</tr>
<tr>
<td>CWA</td>
<td>Clean Water Act</td>
</tr>
<tr>
<td>CZMA</td>
<td>Coastal Zone Management Act of 1972</td>
</tr>
<tr>
<td>DBW</td>
<td>California Department of Boating and Waterways</td>
</tr>
<tr>
<td>DDT</td>
<td>dichlorodiphenyltrichloroethane</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>dedicated (or developed) water</td>
<td>Defined by California Department of Water Resources (DWR) as water distributed among urban and agricultural uses, used for protecting and restoring the environment, or storage in surface water and groundwater reservoirs. In any year, some of the dedicated supply includes water that is used multiple times (reuse) and water that is held in storage from previous years. DWR identifies California’s average annual dedicated water supply as 85 million acre-feet. See also: total water use.</td>
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<td>Term</td>
<td>Definition</td>
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<tr>
<td>Delta Primary Zone</td>
<td>The Sacramento-San Joaquin River Delta land and water area of primary State concern and statewide significance that does not encompass either the urban limit line or sphere of influence line of any local government general plan or study existing as of January 1, 1992. The precise boundary lines of the Primary Zone include the land and water areas as shown on the map titled &quot;Delta Protection Zones&quot; on file with the California State Lands Commission. Where the boundary between the Primary Zone and Secondary Zone is a river, stream, channel, or waterway, the boundary line is the middle of that river, stream, channel, or waterway. The Primary Zone consists of approximately 500,000 acres (Public Resources Code section 29728).</td>
</tr>
<tr>
<td>Delta Reform Act</td>
<td>See Sacramento-San Joaquin Delta Reform Act of 2009</td>
</tr>
<tr>
<td>Delta Secondary Zone</td>
<td>All the Delta land and water area within the boundaries of the Delta not included within the Primary Zone, subject to the land use authority of local government, and that includes the land and water areas as shown on the map titled &quot;Delta Protection Zones&quot; on file with the State Lands Commission. The Secondary Zone consists of approximately 238,000 acres (Public Resources Code section 29731).</td>
</tr>
<tr>
<td>Delta Vision</td>
<td>Delta Vision Blue Ribbon Task Force</td>
</tr>
<tr>
<td>Delta watershed</td>
<td>The watershed of the Sacramento River Hydrologic Region and the San Joaquin River Hydrologic Region as described in the California Water Plan Update 2005, Bulletin 160-05 (Water Code section 85060).</td>
</tr>
<tr>
<td>demand management measures</td>
<td>Water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable use and reuse of available supplies.</td>
</tr>
<tr>
<td>desalination</td>
<td>A water treatment process for the removal of salt from water for beneficial use. Source water can be brackish (low salinity) or sea water.</td>
</tr>
<tr>
<td>DFG</td>
<td>California Department of Fish and Game</td>
</tr>
<tr>
<td>DFW</td>
<td>California Department of Fish and Wildlife (formerly the California Department of Fish and Game)</td>
</tr>
<tr>
<td>diversion</td>
<td>A process which, having return flow and consumptive use elements, turns water from a given path. Removal of water from its natural channel for human use. Use of part of a streamflow as a water supply. Channel constructed across the slope for the purpose of intercepting surface runoff, changing the accustomed course of all or part of a stream. A structural conveyance (or ditch) constructed across a slope to intercept runoff flowing down a hillside and divert it to some convenient discharge point.</td>
</tr>
<tr>
<td>DO</td>
<td>dissolved oxygen</td>
</tr>
<tr>
<td>DOC</td>
<td>California Department of Conservation</td>
</tr>
<tr>
<td>DPC</td>
<td>Delta Protection Commission</td>
</tr>
<tr>
<td>DPH</td>
<td>California Department of Public Health</td>
</tr>
<tr>
<td>DRERIP</td>
<td>Delta Regional Ecosystem Restoration Implementation Plan</td>
</tr>
<tr>
<td>drinking water quality</td>
<td>Drinking water quality standards are adopted by the California Department of Public Health (DPH) Drinking Water Program pursuant to the California Safe Drinking Water Act. The standards apply to public drinking water systems and to water delivered to customers, and are enforceable by DPH and local health departments.</td>
</tr>
</tbody>
</table>
### Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>drought</td>
<td>Hydrologic conditions during a defined period, greater than 1 dry year, when precipitation and runoff are much less than average.</td>
</tr>
<tr>
<td>DWR</td>
<td>California Department of Water Resources</td>
</tr>
<tr>
<td>DWR 200 Year</td>
<td>DWR 200-year Urban Levee Protection</td>
</tr>
<tr>
<td>EAD</td>
<td>See expected annual damage</td>
</tr>
<tr>
<td>ecosystem</td>
<td>A biotic community and its physical environment, considered as an integrated unit. Implied within this definition is the concept of a structural and functional whole unified through life processes. An ecosystem may be characterized as a viable unit of community and interactive habitat. Ecosystems are hierarchical and can be viewed as nested sets of open systems in which physical, chemical, and biological processes form interactive subsystems. Some ecosystems are microscopic, and the largest comprises the biosphere. Ecosystem restoration can be directed at different-sized ecosystems within the nested set, and many encompass multiple states, more localized watersheds, or a smaller complex of aquatic habitat.</td>
</tr>
<tr>
<td>ecosystem enhancement</td>
<td>The improvement of existing desirable habitat and natural processes. Enhancement might include flooding the Yolo Bypass more often, at times, to support native species, or expand or better connect existing habitat areas. Enhancement also includes many fish and wildlife management practices, including managing wetlands for waterfowl production or shorebird habitat, installing fish screens to reduce entrainment of fish at water diversions, or removing barriers that block migration of fish to upstream spawning habitats.</td>
</tr>
<tr>
<td>ecosystem protection</td>
<td>Preventing harm to an ecosystem, which could include preventing the conversion of existing habitat, the degradation of water quality, irretrievable conversion of lands suitable for restoration, or the spread of invasive nonnative species.</td>
</tr>
<tr>
<td>ecosystem restoration</td>
<td>The application of ecological principles to restore a degraded or fragmented ecosystem and return it to a condition in which its biological and structural components achieve a close approximation of its natural potential, taking into consideration the physical changes that have occurred in the past and the future impact of climate change and sea level rise (Water Code section 85066).</td>
</tr>
<tr>
<td>Ecosystem Restoration Program Conservation Strategy</td>
<td>Describes the Ecosystem Restoration Program (ERP) priorities and actions for Stage 2 of the CALFED Bay-Delta Program (summarized in Appendix B). It identifies biologically promising ecosystem restoration opportunities in the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento Valley and San Joaquin Valley regions, and it provides the rationale for restoration actions specific to each of these regions. It further provides the conceptual framework and process to guide the refinement, evaluation, prioritization, implementation, monitoring, and review of ERP actions.</td>
</tr>
<tr>
<td>ecosystem water quality</td>
<td>The Delta ecosystem is affected by a variety of pollutants discharged into Delta and tributary waters. Pollutants of concern affecting Delta biological species and ecosystem processes include nutrients, pesticides, mercury, selenium, and other persistent bioaccumulative toxic substances. Newly identified pollutants of potential concern (often referred to as emerging contaminants) also should be investigated.</td>
</tr>
<tr>
<td>EIR</td>
<td>environmental impact report</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>endangered species</td>
<td>As defined by the California Endangered Species Act, an endangered species is a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease. Any species determined by the Fish and Game Commission as endangered on or before January 1, 1985, is an endangered species (Fish and Game Code section 2062).</td>
</tr>
<tr>
<td>entrainment</td>
<td>Defined by the National Marine Fisheries Service as “the incidental trapping of any life stage of fish within waterways or structures that carry water being diverted for anthropogenic use.”</td>
</tr>
<tr>
<td>environmental water</td>
<td>Minimum flow levels of a specific quality that are needed in order to assure the continued viability of fish and wildlife resources for a particular water body. This water is used to maintain and enhance the beneficial uses related to the preservation and enhancement of fish, wildlife, and other aquatic resources or preserves as specified in the Porter-Cologne Water Quality Control Act.</td>
</tr>
<tr>
<td>environmental water use</td>
<td>Water dedicated to instream environmental needs.</td>
</tr>
<tr>
<td>EPRRP</td>
<td>Emergency Preparedness Response and Recovery Program</td>
</tr>
<tr>
<td>ERP</td>
<td>Ecosystem Restoration Program</td>
</tr>
<tr>
<td>ESA</td>
<td>Endangered Species Act</td>
</tr>
<tr>
<td>ESP</td>
<td>The Delta Protection Commission’s Economic Sustainability Plan for the Sacramento-San Joaquin Delta</td>
</tr>
<tr>
<td>estuary</td>
<td>A place where fresh and salt water mix, such as a bay, salt marsh, or where a river enters an ocean.</td>
</tr>
<tr>
<td>expanded water supply</td>
<td>Additional information water suppliers should include in their water supply reliability element, starting in 2015, as part of the update of any urban water management plan, agricultural water management plan, integrated water management plan, or other plan that provides equivalent information on the supplier’s planned investments in water conservation and water supply development. This expanded water supply reliability element must detail how water suppliers are improving regional self-reliance and reducing reliance on the Delta through investments in local and regional programs and projects, and must document actual and projected reductions in reliance on Delta exports. At a minimum, the water reliability element must include the following:</td>
</tr>
<tr>
<td>expected annual damage</td>
<td>A metric for analyzing flood risk that integrates the likelihood and consequences of flooding. Generally defined as the average annual flood damages (in dollars) weighted by the probability that a flood will occur in any given year. The U.S. Army Corps of Engineers describes EAD mathematically in Manual No. 1110-2-1619, Risk-Based Analysis for Flood Damage Reduction Studies, August 1, 1996.</td>
</tr>
<tr>
<td>(EAD)</td>
<td></td>
</tr>
<tr>
<td>FEMA</td>
<td>Federal Emergency Management Agency</td>
</tr>
<tr>
<td>FEMA 100 Year</td>
<td>FEMA 100-year (Base Flood) Protection</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
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<td>-----------------------------</td>
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</tr>
<tr>
<td>flood risk</td>
<td>The likelihood and consequence of inundation by floodwaters. Consequences may include direct or indirect economic costs, loss of life, environmental impacts, or other specified measures of flood effect. Flood risk is a function of (1) loading, which is the frequency and magnitude of flood discharge or stage; (2) limits to exposure to the loading due to flood defense measures; and (3) consequence. Therefore, flood management actions may reduce risk by changing loading, exposure, or consequence. For clarity, flood risk is commonly quantified within an identified area for a specified climate condition, land use condition, and with a flood management system (existing or planned) in place.</td>
</tr>
<tr>
<td>flow criteria</td>
<td>The development of specific criteria by the State Water Resources Control Board for flows for the Delta ecosystem, including the volume, quality, and timing of water necessary for the Delta ecosystem under different conditions (Water Code section 85086(c)(1)).</td>
</tr>
<tr>
<td>flow objectives</td>
<td>Where protection of beneficial uses requires specific flow volumes at certain times, regional water quality control boards may establish flow objectives in water quality control plans. They differ from typical water quality objectives in that they are implemented by the State Water Resources Control Board through modifications and limitations of existing or future water rights to make sure these flows are met.</td>
</tr>
<tr>
<td>flow regime</td>
<td>The regulation of ecological processes in river ecosystems: the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions (Poff and Ward 1989, Richter et al. 1996, Walker 1995). These components can be used to characterize the entire range of flows and specific hydrologic phenomena, including floods or low flows, that are critical to the integrity of river ecosystems. Furthermore, by defining flow regimes in these terms, the ecological consequences of particular human activities that modify one or more components of the flow regime can be considered explicitly.</td>
</tr>
<tr>
<td>flow requirements</td>
<td>The amount of water required for instream use by agreement, water rights permit, or State/federal law.</td>
</tr>
<tr>
<td>freeboard</td>
<td>The height of the physical top of a levee or floodwall above the median design water surface elevation.</td>
</tr>
<tr>
<td>gateway</td>
<td>A community, landmark, or signage on the edge of the Delta or Suisun Marsh that serves as a gateway providing information to visitors about recreation opportunities available in the area and equipping them with supplies.</td>
</tr>
<tr>
<td>general obligation bond</td>
<td>A bond issued by the State where the principal and interest is paid out of the General Fund. This is different than a revenue bond, where the principal and interest is paid out of a specific dedicated revenue source.</td>
</tr>
<tr>
<td>globally determined stressors</td>
<td>Stressors that result from large-scale human activities or natural processes that cannot be eliminated or mitigated within a limited purview and require larger-scale planning and adaptation (such as global climate change and human population growth).</td>
</tr>
<tr>
<td>GPCD</td>
<td>gallons per capita daily</td>
</tr>
<tr>
<td>groundwater basin</td>
<td>An alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom.</td>
</tr>
<tr>
<td>groundwater management plan</td>
<td>A comprehensive written document developed for the purpose of groundwater management and adopted by an agency having appropriate legal or statutory authority.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>groundwater overdraft</td>
<td>The condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions.</td>
</tr>
<tr>
<td>groundwater remediation</td>
<td>The extraction of contaminated groundwater from an aquifer followed by treatment and (1) replacement in the aquifer or (2) use for agricultural or municipal purposes.</td>
</tr>
<tr>
<td>groundwater storage</td>
<td>Defined three ways depending on the context: (1) the quantity of water beneath the land surface that fills the pore spaces of the alluvium, soil, or rock formation; (2) the volume of usable physical space available to store water in the pore spaces of the alluvium, soil, or rock formation beneath the land surface; or (3) the act of storing water in the pore spaces of the alluvium, soil, or rock formation beneath the land surface.</td>
</tr>
<tr>
<td>HAB</td>
<td>harmful algal bloom</td>
</tr>
<tr>
<td>habitat</td>
<td>The location and the living and nonliving surroundings where a particular plant or animal lives. Habitat includes the presence of a group of particular environmental conditions surrounding an organism including air, water, soil, mineral elements, moisture, temperature, and topography.</td>
</tr>
<tr>
<td>Habitat Conservation Plan (HCP)</td>
<td>A plan prepared under the Endangered Species Act by nonfederal parties in order to obtain permits for incidental taking of threatened and endangered species. The HCP describes ways to maintain, enhance, and protect a given habitat type needed to protect species. The plan usually includes measures to minimize impacts, and might include provisions for permanently protecting land, restoring habitat, and relocating plants or animals to another area.</td>
</tr>
<tr>
<td>habitat restoration</td>
<td>The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning the majority of natural functions to the lost or degraded native habitat.</td>
</tr>
<tr>
<td>Hazard Mitigation Plan (HMP)</td>
<td>Refers to levee guidance negotiated between various federal, State, and local agencies to assist in reducing the likelihood of repetitive flood damage to Delta levees and islands. This guidance provides geometric levee design criteria that, if maintained, make a Delta levee-maintaining agency eligible for federal disaster assistance funds in the event of a flood emergency.</td>
</tr>
<tr>
<td>HCP</td>
<td>See Habitat Conservation Plan</td>
</tr>
<tr>
<td>HGMP</td>
<td>Hatchery and Genetic Management Plans</td>
</tr>
<tr>
<td>HMP</td>
<td>See Hazard Mitigation Plan</td>
</tr>
<tr>
<td>hydraulic mining</td>
<td>The use of high-pressure jets of water to dislodge rock material or move sediment.</td>
</tr>
<tr>
<td>hydrodynamics</td>
<td>The description of the change in flow or motion of a liquid.</td>
</tr>
<tr>
<td>hydrologic region</td>
<td>A geographical division of the state based on local hydrologic basins. The California Department of Water Resources divides California into 10 hydrologic regions, corresponding to the state’s major water drainage basins: North Coast, San Francisco Bay, Central Coast, South Coast, Sacramento River, San Joaquin River, Tulare Lake, North Lahontan, South Lahontan, and Colorado River.</td>
</tr>
<tr>
<td>IEP</td>
<td>Interagency Ecological Program</td>
</tr>
<tr>
<td>incidental take permit</td>
<td>A permit issued by federal fisheries agencies that authorizes take of listed species incidental to otherwise lawful projects.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>instream flow</td>
<td>The use of water within its natural watercourse as specified in a contract, a water rights permit, a court order, a Federal Energy Regulatory Commission license, or other documentation. Instream flows support natural ecosystems, create habitat for plants and animals, and may provide additional benefits including recreation.</td>
</tr>
<tr>
<td></td>
<td><em>See also: flow requirements.</em></td>
</tr>
<tr>
<td>integrated regional water management</td>
<td>A collaborative effort to manage all aspects of water resources in a specified region. Integrated regional water management crosses jurisdictional, watershed, and political boundaries; involves multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all entities involved through mutually beneficial solutions.</td>
</tr>
<tr>
<td>integrated regional water management plan (IRWMP)</td>
<td>At a minimum, an integrated regional water management plan describes the major water-related objectives and conflicts within a region; considers a broad variety of water management strategies; identifies an appropriate mix of water demand and supply management alternatives; provides water quality protections and environmental stewardship actions to provide a long-term, reliable, and high-quality water supply; protects the environment; and identifies disadvantaged communities in the region taking into account the water-related requirements of those communities.</td>
</tr>
<tr>
<td>invasive species</td>
<td>An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112, 1999).</td>
</tr>
<tr>
<td>land reclamation</td>
<td>The process to recover land through channelization and levee construction of what was previously marsh land.</td>
</tr>
<tr>
<td>IRWMP</td>
<td>See integrated regional water management plan.</td>
</tr>
<tr>
<td>LADWP</td>
<td>Los Angeles Department of Water and Power</td>
</tr>
<tr>
<td>LAEDC</td>
<td>Los Angeles Economic Development Corporation</td>
</tr>
<tr>
<td>LAO</td>
<td>California Legislative Analyst’s Office</td>
</tr>
<tr>
<td>legacy community</td>
<td>A rural community registered as a Historic District by either a State or federal entity. Delta legacy communities include Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, Locke, and Walnut Grove (Public Resources Code section 32301(f)).</td>
</tr>
<tr>
<td>legacy stressors</td>
<td>Stressors that result from past actions that cannot be undone, but whose impact can sometimes be reduced or mitigated (for example, mercury pollution from historical gold mining).</td>
</tr>
<tr>
<td>Legislature</td>
<td>California Legislature</td>
</tr>
<tr>
<td>levee-maintaining agencies</td>
<td>Local special districts, typically reclamation districts, that are public agencies formed for the purpose of levee maintenance and improvement, among other duties, and are funded by local assessments.</td>
</tr>
<tr>
<td>levee standards</td>
<td>Standards designed to either establish minimum criteria that would make levees and the properties protected eligible for Federal Emergency Management Agency (FEMA) grants or U.S. Army Corps of Engineers (USACE) rehabilitation funds both in case of catastrophic emergency, or set minimum criteria that would allow development behind the levees. The four main applicable levee standards and guidance for the Delta are (1) FEMA Hazard Mitigation Plan Guidance, (2) USACE Public Law 84-99, (3) FEMA 100-year (Base Flood) Protection, and (4) DWR 200-year Urban Levee Protection.</td>
</tr>
<tr>
<td>LHC</td>
<td>Little Hoover Commission</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td>low salinity zone (LSZ)</td>
<td>Generally, the region in an estuary with salinity ranging from fresh water up to about 5 parts per thousand (ppt), about one-seventh the salinity of sea water. The part of the salinity gradient centered on 2 ppt is considered to be of particular importance because it is hypothesized to be an area where suspended particulate matter and organisms accumulate. The location in the Bay-Delta where the tidally averaged salinity at 1 meter from the bottom is 2 ppt is known as X2 (measured as distance in kilometers from the Golden Gate Bridge) and serves as a water quality objective regulating Delta outflow.</td>
</tr>
<tr>
<td>LPP</td>
<td>Suisun Marsh Local Protection Program</td>
</tr>
<tr>
<td>LSZ</td>
<td>See low salinity zone</td>
</tr>
<tr>
<td>LTMS</td>
<td>Delta Dredged Sediment Long-Term Management Strategy</td>
</tr>
<tr>
<td>µS/cm</td>
<td>microsiemens per centimeter</td>
</tr>
<tr>
<td>MAF</td>
<td>million acre-feet</td>
</tr>
<tr>
<td>managed wetland</td>
<td>Perched wetlands that receive human-induced seasonal flooding for marshland development.</td>
</tr>
<tr>
<td>MCL</td>
<td>maximum contaminant level</td>
</tr>
<tr>
<td>mg/L</td>
<td>milligram(s) per liter</td>
</tr>
<tr>
<td>MWD</td>
<td>Metropolitan Water District of Southern California</td>
</tr>
<tr>
<td>NAS</td>
<td>National Academy of Sciences</td>
</tr>
<tr>
<td>National Heritage Area (NHA)</td>
<td>Places designated by the United States Congress where natural, cultural, historic, and recreational resources combine to form a cohesive, nationally distinctive landscape arising from patterns of human activity shaped by geography. These areas tell important stories about the nation and are representative of the national experience through both the physical features that remain and the traditions that have evolved within them.</td>
</tr>
<tr>
<td>National Pollutant Discharge Elimination System (NPDES)</td>
<td>A permitting program required for all point sources discharging pollutants into waters of the United States. The purpose of the NPDES program is to protect human health and the environment (Clean Water Act of 1977, 33 United States Code section 1311).</td>
</tr>
<tr>
<td>Natural Community Conservation Plan (NCCP)</td>
<td>A conservation plan created to meet the requirements of the Natural Community Conservation Planning Act, which identifies and provides for the regional or areawide protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity. The primary objective of the NCCP program is to conserve natural communities at the ecosystem level while accommodating compatible land use (Fish and Game Code section 2800 et seq.).</td>
</tr>
<tr>
<td>NCCP</td>
<td>See Natural Community Conservation Plan</td>
</tr>
<tr>
<td>new water</td>
<td>Defined in part by California Department of Water Resources as water that is legally and empirically available for a beneficial use. New water can be developed through many strategies such as capturing surplus water, desalinating ocean water, and improving water efficiency.</td>
</tr>
<tr>
<td>NHA</td>
<td>See National Heritage Area</td>
</tr>
<tr>
<td>NMFS</td>
<td>National Marine Fisheries Service</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>nonpoint source pollution</td>
<td>Diffused sources that do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. The pollutants are generally carried off the land by stormwater runoff. Common categories of nonpoint sources are agriculture, forestry, mining, construction, land disposal, and salt intrusion.</td>
</tr>
<tr>
<td>NPDES</td>
<td>See National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>NRC</td>
<td>National Research Council</td>
</tr>
<tr>
<td>NWR</td>
<td>National Wildlife Refuge</td>
</tr>
<tr>
<td>OP</td>
<td>organophosphorus</td>
</tr>
<tr>
<td>OPC</td>
<td>California Ocean Protection Council</td>
</tr>
<tr>
<td><em>Paterno v. State of California</em></td>
<td><em>In Paterno v. State of California</em>, the appellate court found the State liable for flood-related damages caused by the failure of a Yuba River levee incorporated into the State system of flood control, even though the State did not design, build, or even directly maintain it (<em>Paterno v. State</em> [2003] 113 Cal. App.4th 998 [6 Cal.Rptr.3d 854]).</td>
</tr>
<tr>
<td>PCB</td>
<td>polychlorinated biphenyl</td>
</tr>
<tr>
<td>peak flow</td>
<td>Maximum instantaneous flow in a specified period.</td>
</tr>
<tr>
<td>pelagic fish</td>
<td>A fish species that spends most of its life swimming in the water column with little contact with or dependency on the bottom. Adult spawning usually occurs in open water, often near the surface.</td>
</tr>
<tr>
<td>pelagic organism decline (POD)</td>
<td>A steep decline leading to near-record low populations of four pelagic species in the San Francisco Estuary—delta smelt, young striped bass, longfin smelt, and threadfin shad—widely recognized as a serious issue by 2004.</td>
</tr>
</tbody>
</table>
| performance measures       | A quantitative or qualitative tool to assess progress toward an outcome or goal. The Delta Plan must include performance measurements that will enable the Delta Stewardship Council to track progress in meeting the objectives of the Plan. Performance measurements must include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends in all of the following:  

1. The health of the Delta estuary and wetland ecosystem for supporting viable populations of aquatic and terrestrial species, habitats, and processes including viable populations of Delta fisheries and other aquatic organisms.  
2. The reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed. |
<p>| PL 84-99                   | See Public Law 84-99                                                                                                                                                                                        |
| Plan                       | Delta Plan                                                                                                                                                                                                |
| POD                        | See pelagic organism decline                                                                                                                                                                                |</p>
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>point source</td>
<td>Any discernible, confined, and discrete conveyance including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigation agriculture or agricultural stormwater runoff (40 Code of Federal Regulations 122.2).</td>
</tr>
<tr>
<td>pollutant</td>
<td>Defined as “dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water” (Clean Water Act of 1977, 33 United States Code section 1362(6)).</td>
</tr>
<tr>
<td>pollution</td>
<td>Defined as the human-made or human-induced alteration of the chemical, physical, biological, and radiological integrity of water (Clean Water Act section 502(19); 33 United States Code section 1362(19)). Pollution is also defined in California law as an alternation of the quality of the waters of the state by waste to a degree that unreasonably affects either the waters for beneficial uses or the facilities that serve these beneficial uses (Water Code section 13050(k)(1)).</td>
</tr>
<tr>
<td>ppb</td>
<td>parts per billion</td>
</tr>
<tr>
<td>PPIC</td>
<td>Public Policy Institute of California</td>
</tr>
<tr>
<td>ppm</td>
<td>parts per million</td>
</tr>
<tr>
<td>ppt</td>
<td>parts per thousand</td>
</tr>
<tr>
<td>PRBO CalPIF</td>
<td>Point Reyes Bird Observatory California Partners in Flight</td>
</tr>
<tr>
<td>Public Law 84-99 (PL 84-99)</td>
<td>A federal levee standard developed by the U.S. Army Corps of Engineers (USACE). Meeting this standard allows the Delta island or tract to be eligible for USACE funding for levee rehabilitation, island restoration after levee failures, and island inundation, provided that the reclamation district applies for and is accepted into the USACE’s Rehabilitation and Inspection Program.</td>
</tr>
<tr>
<td>Public Trust Doctrine</td>
<td>This doctrine protects the right of the public to use State sovereign lands and waters for commerce, navigation, hunting, fishing, bathing, swimming, boating, and general recreational purposes, and also protects trust lands and waters in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments that provide food and habitat for birds and marine life, and which favorably affect the scenery and climate of the area. There is also a separate branch of the Public Trust Doctrine that protects the fishery resources in all State waters, including those in nonnavigable waterways, as public trust resources in and of themselves.</td>
</tr>
</tbody>
</table>
### Reasonable and Beneficial Use Doctrine

This doctrine states that a water right does not include the right to waste water and mandates that the water resources of the state be put to beneficial use. “It is hereby declared that because of the conditions prevailing in this State the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare. The right to water or to the use or flow of water in or from any natural stream or water course in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water. Riparian rights in a stream or water course attach to, but to no more than so much of the flow thereof as may be required or used consistently with this section, for the purposes for which such lands are, or may be made adaptable, in view of such reasonable and beneficial uses; provided, however, that nothing herein contained shall be construed as depriving any riparian owner of the reasonable use of water of the stream to which the owner’s land is riparian under reasonable methods of diversion and use, or as depriving any appropriator of water to which the appropriator is lawfully entitled. This section shall be self-executing, and the Legislature may also enact laws in the furtherance of the policy in this section contained” (California Constitution Article X section 2).

### reasonable and prudent alternative

The regulations implementing Section 7 of the Endangered Species Act define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented consistent with the scope of the action agency’s legal authority, (3) are economically and technologically feasible, and (4) would, according to the National Marine Fisheries Service, avoid the likelihood of jeopardizing the continued existence of listed species and avert the destruction or adverse modification of critical habitat (Endangered Species Act of 1973, 16 United States Code section 1536).

### Reclamation

Bureau of Reclamation

### Recreation Proposal

**Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh**

### regional self-reliance

The degree to which a region implements water management options so that it can provide for all of its needs for water from within its own borders.

### regional water supplies

Water supplies that are found or developed within a region to be used within its own borders.

### reservoir reoperation

Changes to existing operations and management procedures for existing reservoirs and conveyance facilities to increase water-related benefits from these facilities.

### resource management strategy

A project, program, or policy that helps federal, State, or local agencies manage water and related resources. Resource management strategies in the California Water Plan are grouped by intended outcomes: reduce water demand, improve operational efficiency and transfers, increase water supply, improve water quality, practice resource stewardship, and improve flood management. Although most of the resource management strategies have multiple potential benefits, any individual site-specific project or program within a resource management strategy may contribute only one, or a few, of the benefits.

### riparian area

The land adjacent to a natural watercourse such as a river or a stream. Riparian areas support vegetation that provides important wildlife habitat and important fish habitat when shading the watercourse bank.
<p>| Term                                                      | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |</p>
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>special-status species</td>
<td>Any species that is listed, or proposed for listing, as threatened or endangered by the U.S. Fish and Wildlife Service or National Marine Fisheries Service under the provisions of the Endangered Species Act; any species designated by the U.S. Fish and Wildlife Service as a “listed,” “candidate,” “sensitive,” or “species of concern”; and any species listed by the State in a category implying potential danger of extinction.</td>
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<tr>
<td>SP</td>
<td>State Park</td>
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<tr>
<td>SPFC</td>
<td>State Plan of Flood Control</td>
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<tr>
<td>SRA</td>
<td>State Recreation Area</td>
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<tr>
<td>Standardized Emergency Management System (SEMS)</td>
<td>Established throughout California to manage and coordinate any emergency response involving more than one agency or jurisdiction. It is the cornerstone of the emergency response system and the fundamental structure for the response phase of emergency management. SEMS is authorized under the California Emergency Services Act for managing multiagency and multijurisdictional responses to emergencies in California.</td>
</tr>
<tr>
<td>State</td>
<td>State of California</td>
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<tr>
<td>stormwater capture system</td>
<td>A facility operated by a public agency and designed to capture and retain stormwater flowing upon the public right-of-way, or through a public stormwater management system or a public stormwater drainage system, for subsequent use.</td>
</tr>
<tr>
<td>stressors (ecosystem)</td>
<td>Actions or factors, whether human or natural, that cause negative impacts on desirable ecosystem elements, processes, and functions.</td>
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<td></td>
<td><em>See also: globally determined stressor, legacy stressors, current stressors, and anticipated future stressors.</em></td>
</tr>
<tr>
<td>stressor fees</td>
<td>A companion principle to user fee, stressor fees are paid by persons who have been identified as stressing Delta natural systems. The fees fund regulatory and restoration programs.</td>
</tr>
<tr>
<td>subsidence</td>
<td>Sinking of the land surface due to a number of factors, including groundwater extraction, agricultural activities, or oil or gas extraction. In the Delta, land subsidence is mainly caused by oxidation of peat soils, but also from wind erosion. Drainage and cultivation dries the saturated peat, reducing its volume by approximately 50 percent.</td>
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<tr>
<td>subsidence reversal</td>
<td>The exposure of bare peat soils to air causes oxidation and decomposition, which results in subsidence, or a loss of soil elevation, on Delta islands. Flooding these lands and managing them as wetlands reduces exposure to oxygen, resulting in less decomposition of organic matter, which stabilizes land elevations. Wetland vegetation cycles lead to biomass accumulation, which sequesters carbon and helps stop and reverse subsidence. As subsidence is reversed, land elevations increase and accommodation space (the space in the Delta that lies below sea level and is filled with neither sediment nor water) on individual islands is reduced. A reduction in accommodation space decreases the potential for water quality impacts from salinity intrusion in the event of one or more levee breaks on deeply subsided Delta islands.</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>subventions</td>
<td>Payments made by the State in the form of matching funds for the purpose of maintaining and improving Delta levees. The Delta Levees Maintenance Subventions Program is a cost share program providing technical and financial assistance to local levee-maintaining agencies in the Sacramento–San Joaquin Delta for the maintenance and rehabilitation of nonproject and eligible project levees. The subventions program is authorized by Water Code sections 12980 through 12995 and is managed by the California Department of Water Resources.</td>
</tr>
<tr>
<td>surface storage</td>
<td>Reservoirs used to collect and hold water for future release and use.</td>
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<tr>
<td>surface water</td>
<td>Water naturally open to the atmosphere including rivers, lakes, reservoirs, ponds, streams, impoundments, seas, and estuaries.</td>
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<tr>
<td>sustainable communities</td>
<td>Regional transportation agencies are required to develop a sustainable communities strategy. The strategy is intended to demonstrate how the region will meet its greenhouse gas reduction target through integrated land use, housing, and transportation planning.</td>
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<tr>
<td>strategy</td>
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<td>SWP</td>
<td>State Water Project</td>
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<tr>
<td>SWRCB</td>
<td>State Water Resources Control Board</td>
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<tr>
<td>threatened species</td>
<td>As defined by the California Endangered Species Act, a threatened species is a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by the act. Any animal determined to be rare on or before January 1, 1985, is a threatened species (Fish and Game Code section 2067).</td>
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<tr>
<td>THM</td>
<td>trihalomethanes</td>
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<tr>
<td>tiered fee structures</td>
<td>Refers to a block-type fee structure where the unit price of a quantified benefit or impact, such as the amount of water used or the volume of contaminants discharged, increases with each additional block of benefit or impact.</td>
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<tr>
<td>TMDL</td>
<td>See total maximum daily load</td>
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<tr>
<td>total maximum daily load</td>
<td>A calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.</td>
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<tr>
<td>(TMDL)</td>
<td></td>
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<tr>
<td>total water use</td>
<td>In the Delta Plan, refers to 60 to 65 million acre-feet of water in California that goes to urban, agricultural, and Central Valley environmental water uses such as instream flow requirements and non-CVP managed wetlands.</td>
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<tr>
<td>tributary</td>
<td>A river or stream that flows into a larger river or stream. Usually, a number of smaller tributaries merge to form a river.</td>
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<tr>
<td>unimpaired flow</td>
<td>The natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds.</td>
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<tr>
<td>urbanization</td>
<td>The expansion of residential, commercial, and industrial development into rural areas or areas that may have previously been used for agricultural or ecosystem habitat.</td>
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<tr>
<td>urban water use</td>
<td>The use of potable and nonpotable water for urban purposes including, but not limited to, residential, commercial, industrial, recreation, energy production, military, and institutional purposes.</td>
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<td>Term</td>
<td>Definition</td>
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<tr>
<td>urban water use efficiency</td>
<td>Water management measures that are implemented in residential, commercial, industrial, and institutional settings that reduce water and per capita water use and result in the most effective use of water to prevent its waste, unreasonable use, or unreasonable method of use.</td>
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<tr>
<td>USACE</td>
<td>U.S. Army Corps of Engineers</td>
</tr>
<tr>
<td>USDA</td>
<td>U.S. Department of Agriculture</td>
</tr>
<tr>
<td>USEPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>user fees</td>
<td>Fees proposed to fund programs identified in the Delta Plan that are paid by the users or beneficiaries of those programs. Fees may be volume-based or impact-based.</td>
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<tr>
<td>USFWS</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>USGS</td>
<td>U.S. Geological Survey</td>
</tr>
<tr>
<td>UWMP</td>
<td>See urban water management plan</td>
</tr>
<tr>
<td>vector-borne disease</td>
<td>Disease that results from an infection transmitted to humans and other animals by blood-feeding anthropods, including mosquitoes, ticks, and fleas. Examples of vector-borne diseases include Dengue fever, viral encephalitis, Lyme disease, and malaria.</td>
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<tr>
<td>waste discharge requirement (WDR)</td>
<td>An order adopted by a regional water board that regulates and permits specified discharges of waste to surface water and discharges of waste to land.</td>
</tr>
<tr>
<td>water balance</td>
<td>An analysis of the total developed/dedicated supplies, uses, and operational characteristics of water in a region. The analysis is intended to determine if actual water use equals supply.</td>
</tr>
<tr>
<td>water demand</td>
<td>An economic principle that describes consumer desire and willingness to pay a price for a specific amount of water. Holding all other factors constant, the price of a good or service increases as its demand increases and vice versa.</td>
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<tr>
<td>water export</td>
<td>The amount of water that a hydrologic region transfers to another hydrologic region. See also: Delta exports.</td>
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<tr>
<td>water import</td>
<td>The amount of water brought in from another hydrologic region or regions.</td>
</tr>
<tr>
<td>water quality criteria</td>
<td>Numeric limitations or levels (for example, concentrations) or narrative statements established to protect uses of a water body under the authority of the Clean Water Act. This term has two separate meanings: (1) Water quality criteria promulgated by the U.S. Environmental Protection Agency under Clean Water Act section 303(c) are enforceable components of water quality standards. (2) Recommended water quality criteria published under Clean Water Act section 304(a) are advisory and may be used by states and tribes to develop their own water quality standards or to implement narrative criteria in water quality standards.</td>
</tr>
<tr>
<td>water quality objectives</td>
<td>Numeric limitations or levels (concentrations or narrative statements) that are established for the reasonable protection of the beneficial uses of a water body. Determination of what is reasonable may include factors that are not required in federal development of a water quality criterion. Water quality objectives are included in water quality control plans adopted by regional water boards.</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>water quality standards</td>
<td>Pursuant to the federal Clean Water Act, water quality standards are provisions of State or federal law that define the water quality goals of a water body, or portion thereof, by establishing (a) designated uses of water to be protected, and (b) water quality criteria to protect those uses. Water quality standards are enforceable in the bodies of water for which they have been promulgated.</td>
</tr>
<tr>
<td>water recycling</td>
<td>(1) The treatment of wastewater to remove solids and certain impurities to meet a beneficial use or a controlled use that would not otherwise occur, thus supplanting or augmenting a potable, or potentially potable, supply.</td>
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<td></td>
<td>(2) The treatment of municipal, industrial, or agricultural wastewater for reuse.</td>
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<tr>
<td>watershed</td>
<td>The land area that drains into a stream. The watershed for a major river may encompass a number of smaller watersheds.</td>
</tr>
<tr>
<td>water shortage contingency element</td>
<td>The Urban Water Management Planning Act requires water suppliers to include a water supply reliability and water shortage contingency element in urban water management plans, recognizing that suppliers need to prepare for extended droughts or the potential catastrophic interruption of water deliveries due to earthquakes or other events.</td>
</tr>
<tr>
<td>water supply reliability</td>
<td>See sidebar in Chapter 3, “What Does It Mean to Achieve the Goal of Providing a More Reliable Water Supply for California?”</td>
</tr>
<tr>
<td>water transfer</td>
<td>A temporary or long-term change in the point of diversion, place of use, or purpose of use due to a transfer or exchange of water or water rights. Many transfers, including transfers among contractors of the State Water Project or Central Valley Project, do not fit this definition. A more general definition of a water transfer is a voluntary change in the way water is normally distributed among water users in response to water scarcity. Compared to water exchanges, which are typically water delivered by one water user to another water user, the receiving water user will return the water at a specified time or when the conditions of the agreement are met (Water Code section 1735).</td>
</tr>
<tr>
<td>water year</td>
<td>A compilation of hydrologic records collected over a 12-month period.</td>
</tr>
<tr>
<td>water year-type classifications</td>
<td>California Department of Water Resources uses five water year-type classifications for planning and water management purposes: wet, above normal, below normal, dry, and critically dry.</td>
</tr>
<tr>
<td>WDR</td>
<td>See waste discharge requirement</td>
</tr>
<tr>
<td>Wild and Scenic River</td>
<td>A State- and federal-designated river system that includes 17 California rivers and their many forks and tributaries. Approximately 1,900 miles of river are designated wild, scenic, or recreational under the National Wild and Scenic Rivers Act (1968) and the California Wild and Scenic Rivers Act of 1972.</td>
</tr>
<tr>
<td>X2</td>
<td>The location in the Bay-Delta where the tidally averaged salinity is 2 parts per thousand.</td>
</tr>
</tbody>
</table>
References


Photo Credits

Chapter divider (clockwise from top left): Chris Austin, California Department of Water Resources, Dave Feliz
The Sacramento-San Joaquin Delta and Suisun Marsh, Figure 1-1
Legal Delta and Suisun Marsh
Delta Watershed (Water Code Sec. 85060)
Trinity River Watershed
Areas outside the Delta Watershed that use Delta water
Sacramento River & San Joaquin River
Priority Habitat Restoration Areas are large areas within which specific sites may be identified for habitat restoration based on assessments of land use and other issues addressed through further feasibility analysis.
Moving and Storing California's Water, Figure 3-2
Recommended Areas for Prioritization and Implementation of Habitat Restoration Projects, Figure 4-6

Priority Habitat Restoration Areas are large areas within which specific sites may be identified for habitat restoration based on assessments of land use and other issues addressed through further feasibility analysis.
Levees in the Delta, Figure 7-2
Planned Land Use
- Agriculture
- Open Space/Recreation
- Natural Preserve/Marsh
- Areas Designated for Development
- Public/Quasi-Public
- Cities
- Unincorporated Delta Towns
- City Sphere of Influence
- Legal Delta
- Suisun Marsh
- County Boundaries
- Contra Costa Urban Limit Line

Flood Management
- State Plan of Flood Control Bypasses and Floodways
- Other Floodplains to be Protected from Encroachment
- Water Supply Reliability Levee Projects
- State Plan of Flood Control (Project) Levees
- Urban, Non-Project Levees

Delta Flood Management Facilities, Figure 7-5