2. The Legacies of Delta History

"You could not step twice into the same river; for other waters are ever flowing on to you."

Heraclitus (540 BC–480 BC)

The modern history of the Delta reveals profound geologic and social changes that began with European settlement in the mid-19th century. After 1800, the Delta evolved from a fishing, hunting, and foraging site for Native Americans (primarily Miwok and Wintun tribes), to a transportation network for explorers and settlers, to a major agrarian resource for California, and finally to the hub of the water supply system for San Joaquin Valley agriculture and Southern California cities. Central to these transformations was the conversion of vast areas of tidal wetlands into islands of farmland surrounded by levees. Much like the history of the Florida Everglades (Grunwald, 2006), each transformation was made without the benefit of knowing future needs and uses; collectively these changes have brought the Delta to its current state.

Pre-European Delta: Fluctuating Salinity and Lands

As originally found by European explorers, nearly 60 percent of the Delta was submerged by daily tides, and spring tides could submerge it entirely.[1] Large areas were also subject to seasonal river flooding. Although most of the Delta was a tidal wetland, the water within the interior remained primarily fresh. However, early explorers reported evidence of saltwater intrusion during the summer months in some years (Jackson and Paterson, 1977). Dominant vegetation included tules—marsh plants that live in fresh and brackish water. On higher ground, including the numerous natural levees formed by silt deposits, plant life consisted of coarse grasses; willows; blackberry and wild rose thickets; and galleries of oak, sycamore, alder, walnut, and cottonwood. Few traces of this earlier plant life remain; agricultural practices and urbanization have cleared most

[1]Unless otherwise noted, the discussion in this section draws from Thompson (1957).

forested areas and levee upgrading has removed most trees and vegetation from the natural levees.

Before European settlement, the Delta also teemed with game animals and birds. Elk, deer, antelope, and grizzly bear frequented the tules and the more open countryside. Sightings of elk were reported as late as 1874, but the last of the large game animals are thought to have been destroyed by the 1878 flood.

From the reports of early explorers, it has been estimated that the native population in the Delta area was between 3,000 and 15,000. Most native villages were on natural levees on the edges of the eastern Delta and typically contained around 200 residents, although one community was thought to contain at least 1,000 residents. The native population did not practice agriculture, although they did manage the landscape with fire and other tools to favor plants they used (Anderson, 2005). Their diet consisted of the roots and pollen of the tules, acorns, and the fruit and seeds of other wild plants. Fish and game were also important staples.

European settlement of the Delta began slowly. Despite several expeditions between 1806 and 1812, the Spanish failed to locate a suitable site for missions in the region. From 1813 to 1845, most expeditions were military attempts to subdue the native population. The Hudson Bay Company sent trappers into the Delta from 1828 through 1843 but had limited success because of interference by Native Americans, priests, and local merchants. From 1835 through 1846, the Spanish established several land grants. In 1841, John Sutter was the first foreigner to be granted land in the Delta vicinity. By 1846, an estimated 150 European-Americans were in the Central Valley, mostly at Sutter's Fort near present-day Sacramento. A Dutchman living on an unconfirmed grant below Sutter's Landing was the only certain European-American resident within the Delta, with others scattered on the periphery.

Two events in 1847 set the stage for accelerated settlement of the Delta. The first was the transfer of California to the United States at the end of the Mexican-American war; many U.S. soldiers had volunteered for the war with the idea of staying in California. The second was the introduction of the steamboat, *Sutter's Sitka*. The *Sitka* reduced travel time from Sacramento to San Francisco from a typical two- to three-week trip to

just under seven days, a change that greatly facilitated trade throughout the Delta.

Reclamation: Foundations of the Modern Delta Economy

The reclamation of Delta lands began almost simultaneously with the California gold rush. Within weeks of the January 1848 discovery, the few settlements near the coast had all but emptied, and an influx of tens of thousands of people followed. Almost immediately, many miners saw surer fortunes to be made from tilling the soil than from mining. Most of them selected lands on the natural levees of the main waterways or on higher ground near streams close to heavily traveled trails. By the early 1850s, interest turned to the diking and draining of flooded Delta lands.

The reclamation era, which spanned over 80 years, was marked by frequent institutional change, as Delta interests and state and federal authorities sought to tackle problems ranging from basic levee construction, to regional flood control and maintenance of shipping channels, to salinity intrusion. Many of these problems were compounded by the presence of upstream mining activities, which sent massive volumes of debris into the Delta. Although most land reclamation was undertaken by private individuals or local groups, this era witnessed the first major public works project in the Delta—the Central Valley flood control system. By the time the last Delta island was diked and drained in the early 1930s, Delta farmers and the cities on the Delta's periphery had become firmly established interests whose concerns over water quality would figure prominently in the search for large-scale solutions to Delta water issues in subsequent decades.

Reclamation and the Rise of Delta Agriculture

Delta reclamation is a process that becomes increasingly difficult as it progresses. Each acre of drained and diked land represents the removal of floodplains, placing more stress on the remaining system by reducing space for subsequent floodwaters to occupy. Initial reclamation efforts amounted to little more than attempts to supplement natural levees to protect agricultural plots during high tides and seasonal floods. It soon became

clear that for reclamation to proceed, institutions were needed to provide land tenure security and to facilitate collective work on levees.

A primary piece of enabling legislation for the reclamation of Delta lands was the Arkansas Act of 1850, more commonly known as the Swampland Act. This law ceded federal swamplands to the states to encourage their reclamation. California received 2,192,506 acres, including nearly 500,000 acres within the Delta. Sales began in 1858. Initially, individual acquisitions were limited to 320 acres, at the price of $1 per acre (about $23 per acre in today's dollars). In 1859, the size limit was doubled to 640 acres, and limits were repealed altogether in 1868.

Although several continuous levees were built in the 1850s (notably, on Grand and Sherman Islands), collective levee building was facilitated by the creation of the Board of Reclamation in 1861, which was given the authority to form reclamation districts from collectives of smaller parcel owners (see Figure 2.1 for the location of individual islands). Between 1861 and 1866, the board authorized reclamation districts to enclose large areas that were defined by natural levees. The board also embarked on several large-scale schemes to reclaim lands and provide flood protection in the Sacramento and Yolo Basins and on several Delta islands. Although the board was dissolved before much of this work could be completed, its duties were transferred to the counties, which continued to oversee the creation of reclamation and levee maintenance districts. Ninety-three of these local agencies still operate within the Delta today, with frontline responsibility for levee maintenance.

Technology also played a central role in reclamation. A contractor in charge of levee construction on Staten Island, J. T. Bailey, developed the first mechanized equipment for levee construction in 1865 (Thompson, 1957). After 1868, when the 640 acre size limit was repealed, corporate speculators and wealthy individuals undertook large-scale reclamation and derived profits from selling the improved land. Machine power was applied to levee construction, land clearing, ditch building, and dredging, and pumps were introduced to drain the parcels.

The influence of these institutional and technological innovations on the pace of reclamation is striking (Table 2.1). In the 1870s, over 90,000 acres were reclaimed, six times more than in the preceding decade.

Table 2.1

Reclamation Growth in the Delta

Decade	Acres Reclaimed	Cumulative Acres
1860–1870	15,000	15,000
1870–1880	92,000	107,000
1880–1890	70,000	177,000
1890–1900	58,000	235,000
1900–1910	88,000	323,000
1910–1920	94,000	417,000
1920–1930	24,000	441,000

SOURCE: Thompson (1957).

Reclamation efforts in the Delta continued through the 1930s, with the last island, McCormack-Williamson Tract, reclaimed in 1934.

In the early years of reclamation, the Delta was seen as a drought-free, fertile area on which the state could depend to support its growth. Delta waterways provided natural and inexpensive transportation routes. The droughts that ruined San Joaquin Valley wheat and barley crops served to further enhance the value of Delta farmlands. An editorial in the San Francisco *Alta* of July 25, 1869, provides a characteristic view:

> In these reclaimable lands we shall have drought-proof means of life and luxurious living for the whole population of our State, were it twice as numerous. Heretofore the certainty of occasional famine years has been a dark cloud on the horizon before the thoughtful vision. Now we see salvation. All hail! to the great minds that have conceived this enterprise. God speed their success and bring them rich reward.

These high hopes waned after the major floods of 1878 and 1881, which revealed the susceptibility of reclaimed lands to recurrent inundations. By this time, however, Delta agriculture had become an important interest in its own right, with landowners seeking relief from floods and mining debris (and, eventually, from salinity intrusion) through judicial and political channels.

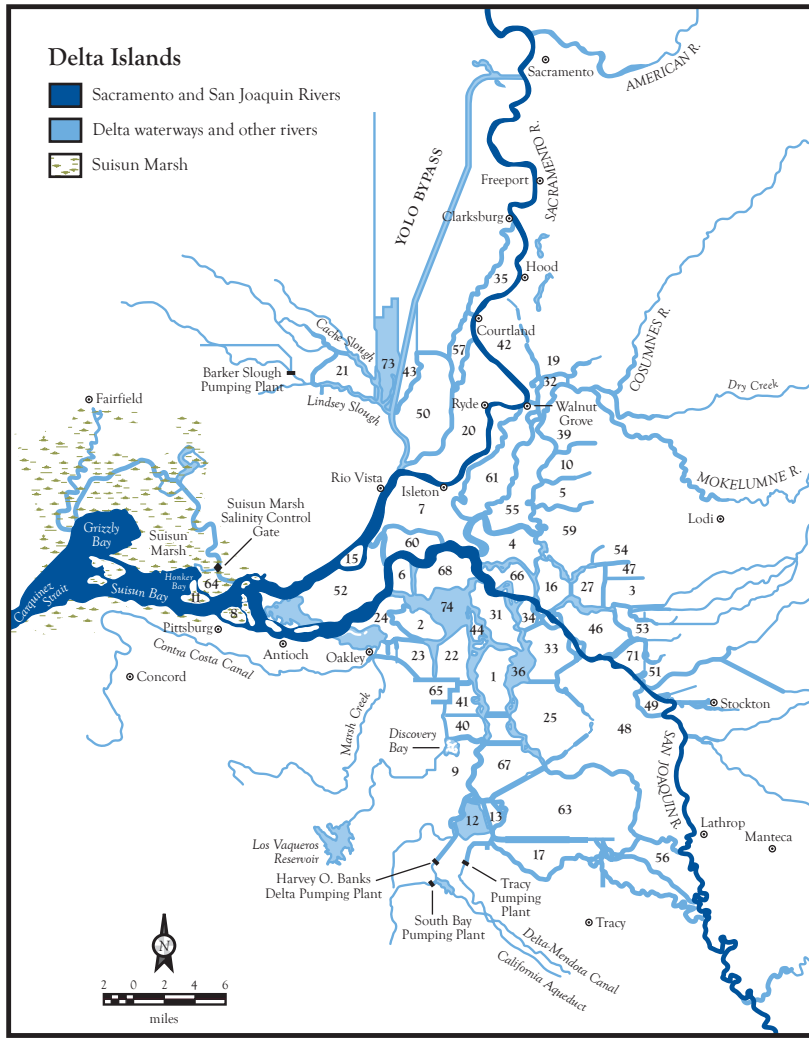

Figure 2.1—Delta Islands

Legal Battles over Upstream Mining

It is estimated that between 1860 and 1914, more than 800 million cubic yards of mining debris—enough to fill 10,000 football fields to a depth of 16 yards—passed through the Delta, primarily from hydraulic mining sites upstream of the Sacramento River watersheds. Although this

Legend for Delta Islands in Figure 2.1

Bacon Island	1	Netherlands	37*
Bethel Tract	2	Neville Island	38*
Bishop Tract	3	New Hope Tract	39
Bouldin Island	4	Orwood Tract	40
Brack Tract	5	Palm Tract	41
Bradford Island	6	Pierson District	42
Brannan-Andrus Island	7	Prospect Island	43
Browns Island	8	Quimby Island	44
Byron Tract	9	Rhode Island	45*
Canal Ranch	10	Rindge Tract	46
Chipps Island	11	Rio Blanco Tract	47
Clifton Court Forebay	12	Roberts Island	48
Coney Island	13	Rough and Ready Island	49
Deadhorse Island	14*	Ryer Island	50
Decker Island	15	Sargent Barnhart Tract	51
Empire Tract	16	Sherman Island	52
Fabian Tract	17	Shima Tract	53
Fay Island	18*	Shin Kee Tract	54
Glanville Tract	19	Staten Island	55
Grand Island	20	Stewart Tract	56
Hastings Tract	21	Sutter Island	57
Holland Tract	22	Sycamore Island	58*
Hotchkiss Tract	23	Terminous Tract	59
Jersey Island	24	Twitchell Island	60
Jones Tract	25	Tyler Island	61
Kimball Island	26*	Union Island	63
King Island	27	Van Sickle Island	64
Little Franks Tract	28*	Veale Tract	65
Little Mandeville Island	29*	Venice Island	66
Little Tinsley Island	30*	Victoria Island	67
Mandeville Island	31	Webb Tract	68
McCormack Williamson Tract	32	Winter Island	69*
McDonald Tract	33	Woodward Island	70
Medford Island	34	Wright-Elmwood Tract	71
Merritt Island	35	Liberty Island	73
Mildred Island	36	Franks Tract	74

NOTE: Numbers with asterisks denote islands not shown on map because of space limits.

debris had some positive effects—notably by bolstering levees and providing fill material—its overall consequences were decidedly negative. The debris raised and constricted the channels, worsening the reduced tidal action caused by reclamation. Consequences included transportation difficulties, increased susceptibility to flooding, and decreased agricultural productivity. (The latter problem, a result of seepage from an elevated water table, was mitigated somewhat when pumps became available in the early 1900s.)

In 1880, the state legislature formed the Board of Drainage Commissioners in an attempt to find a solution between the miners and the farmers. The board was to create drainage basin planning districts with the costs born by a statewide land tax and taxes on hydraulic mining. When this action was invalidated by the State Supreme Court the next year, the farmers instituted injunction proceedings against the miners. The first of these cases—*People v. Gold Run Ditch and Mining Company* (July 1881)—is considered a landmark piece of environmental jurisprudence. It invoked the public trust doctrine to impose an injunction on hydraulic mining. A second case, *Woodruff v. North Bloomfield Gravel Company* (January 1884), also sided with the farmers.

Public Works for Flood Control

In reaction to these rulings and to pressure from Central Valley business interests, subsequent decades saw a flurry of attempts to find a comprehensive solution to flooding issues in the Delta and the greater watersheds of the Sacramento and San Joaquin Rivers. The result was a series of major public investments, involving both the federal and state governments, which are still core elements of the Central Valley flood control system.

The 1893 Caminetti Act authorized the federal government to cooperate with California in formulating plans to prevent mining tailings from passing downstream. The California Debris Commission—a three-member body of Army engineers—was created to work with the federal government in this effort. Although the commission's primary goal was to find a way to resume mining without the tailings problem, its legacy was regional flood control (Kelley, 1989). In 1910, the commission initiated dredging of the lower Sacramento River, under what was known as the

"Minor Project."[2] A commission report submitted to Congress in 1911 formed the basis of a comprehensive flood control plan for the Sacramento River. This plan (dubbed the "Major Project") included proposals for continued channel dredging and the creation of the Yolo Bypass, which provides space for excess water flows on private farmlands.[3] The plan also specified levee heights throughout the Delta.

When California's legislature approved the Major Project in 1911, it also resumed control over reclamation authority, recreating the Board of Reclamation to coordinate state reclamation, flood control, and navigation improvement. The U.S. Congress approved the Major Project in 1917, after the state and landowners agreed to greater participation. The Federal Flood Control Act of 1928 grew from the California Debris Commission's study (as well as Mississippi River experiences) and marked congressional recognition of responsibility in flood control as well as navigation.

Today, flood control within the Central Valley continues to operate under this system of joint responsibility. Federal and state agencies have the primary charge for maintaining roughly 1,600 miles of publicly owned "project levees." Some cost-sharing of project levees is assumed by local reclamation districts and flood control agencies. Within the Delta itself, the mix of responsibilities is more complex. The Delta contains nearly 400 miles of project levees (notably the levees protecting the cities of Lathrop and Stockton) and over 700 miles of "private" agricultural levees, which have limited state cost-sharing (Figure 2.2). Concerns have recently arisen regarding many aspects of the Central Valley flood control system, including the condition of project levees surrounding Sacramento and other upstream locations, but the private Delta levees are a particularly weak link in the system.

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[2]The Minor Project widened the Sacramento to 3,500 feet and a mean flood stage of 35 feet. Horse Shoe Bend was cut off, Decker Island was created, and a narrow midstream island in front of Rio Vista was removed.

[3]Drawing on the experience with the 1907 flood, the Major Project proposed 600,000 cubic feet per second (cfs) of discharge capability for the Sacramento River. The Yolo Bypass was first proposed in a report by Manson and Grunsky for the Public Works Commission in 1894. Other flood control proposals in this period included that of the Dabney Commission in the early 1900s.

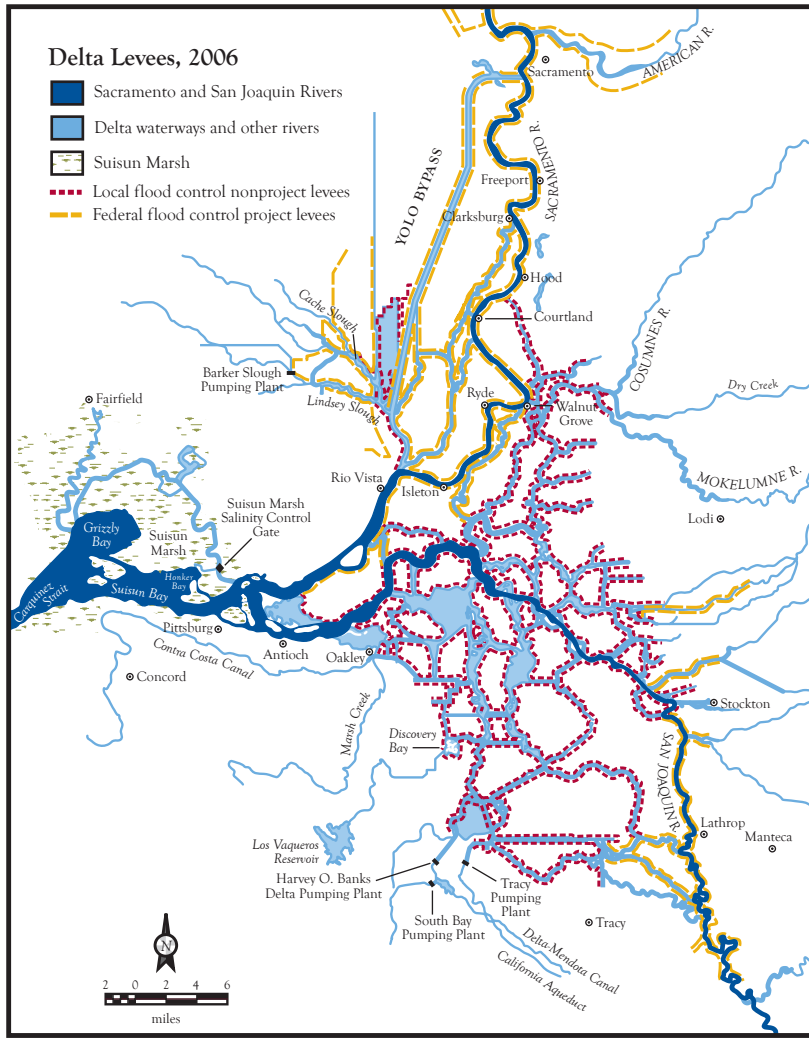


Figure 2.2—Delta Levees, 2006

The Expansion of Shipping Channels

In the early 20th century, the U.S. Army Corps of Engineers also became active in maintaining and improving shipping channels, which had suffered from debris buildup. The earliest efforts focused on the Sacramento corridor. From 1899 to 1927, the corps maintained a channel

seven feet deep between Suisun Bay and Sacramento; it was subsequently deepened to 10 feet. In 1946, Congress authorized a project to convert Sacramento into a deepwater port; the dredging of the 30-foot-deep channel was completed in 1955. Similar efforts took place to improve shipping to the eastern Delta. The Stockton channel on the San Joaquin River was maintained at nine feet from 1913 to 1933 and then dredged to 26 feet. In 1950 it was dredged to 30 feet, and in 1987 it was dredged to its current depth of 37 feet at low tide.

These deepwater shipping channels have altered water flows within the Delta.[4] As a result of dredging, water moves much more slowly through the lower Sacramento River than it does in shallower parts of the Delta, thereby providing a different environment for fish and other aquatic life. The Stockton ship channel is particularly important for east-west tidal exchange with the western Delta. Both the Sacramento and the Stockton shipping channels (particularly the Stockton channel) would be threatened by a catastrophic levee failure, which could reintroduce large quantities of sediment into them. At present, these ports are relatively minor players in California's sea trade, although Stockton handles large volumes of agricultural produce from the Central Valley.[5] Sacramento traffic is anticipated to increase under a new management arrangement with the Port of Oakland (Port of Sacramento, 2006).

The First Salinity Lawsuits

By the early 20th century, salinity intrusion had become a major concern for Delta interests. Although it is not certain how far upstream ocean salinity extended under natural conditions, salinity levels did not hamper reclamation in the Delta as they did around the San Francisco Bay (Jackson and Paterson, 1977). In the Delta, virgin reclaimed tracts did not need salts flushed out before agricultural practices began. In this period, salinity intrusion was seasonally highest in the late summer months after the mountain snowpack had melted, and salt water reached farther inland during very dry years, such as 1871 (Young, 1929). However, the

[4]The locations of both channels are depicted in Figure 1.2

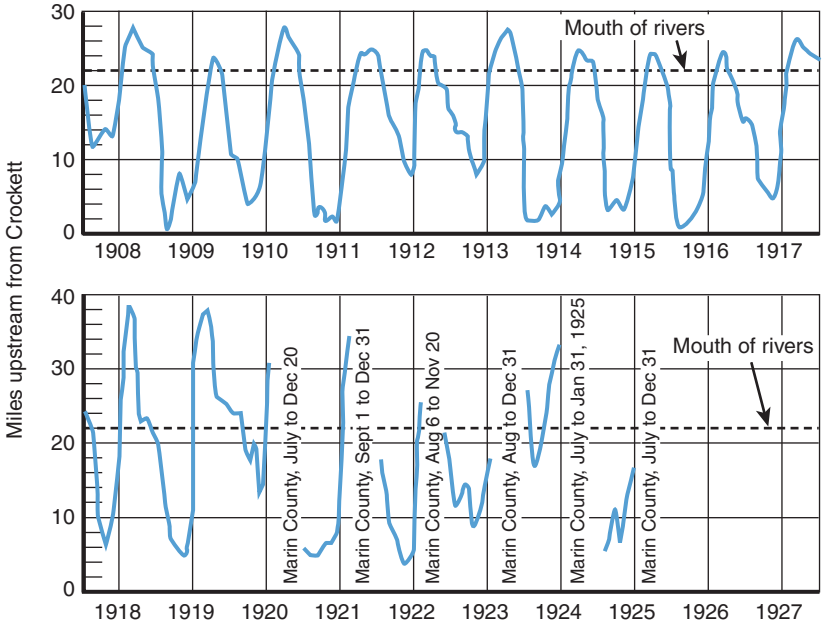
[5]In 2004, Stockton handled 1.4 percent of total volume and only 0.1 percent of total value of California's sea trade. Sacramento's shares were even lower, at 0.5 percent and 0.06 percent, respectively (www.wisertrade.org)

reduction of tidal floodplains through reclamation and mining debris deposits decreased the penetration of salt into the Delta (Matthew, 1931a). But upstream diversions for irrigation in the Sacramento Valley greatly increased salt intrusion during summer months, especially in dry years. As early as 1908, the sugar refinery at Crockett sent barges as far as 28 miles inland (well into the Delta) to gather fresh water during the dry season (Figure 2.3). During the drought years in the 1920s, salt water reached so far into the Delta that these barges were sent west to Marin instead of east into the Delta. Salt intrusion in the Delta reached its peak between 1910 and 1940, setting the stage for legal proceedings and various engineering proposals to keep the Delta fresh that have continued to this day.

The first salinity lawsuit was filed in July 1920 by the City of Antioch. The city, backed by various Delta interests, charged that upstream irrigators on the Sacramento River were diverting too much water, resulting in insufficient freshwater flows past Antioch to hold back ocean water.[6] Although the lower court initially ruled in Antioch's favor, the California Supreme Court overturned the decision on the basis of evidence showing substantial salinity incursions in the era before significant upstream irrigation.

The suit nevertheless sparked efforts to find engineering solutions to the salinity problem. Initial proposals focused on the construction of a saltwater barrier in the outer part of the estuary, near the Carquinez Strait. A report from the state Department of Public Works (1923) officially endorsed this idea, which had already been considered on several occasions in the second half of the 19th century as a way to control floodwaters and to resolve rail transportation problems across the Delta (Jackson and Paterson, 1977). Further support for a barrier came from those concerned about the effects of an invasive pest, the marine borer *Teredo*, on docks and other wooden structures in the inland ports. This pest, one of the San Francisco Estuary's first invasive species, was moving upstream with salinity incursions. In the end, however, concerns over the high financial costs of a saltwater barrier, as well as the potential harm such a barrier would cause to commercial fisheries, led to its abandonment. Instead, as described below,

[6]As discussed in Chapter 6, upstream diversions still have major effects on Delta inflows.



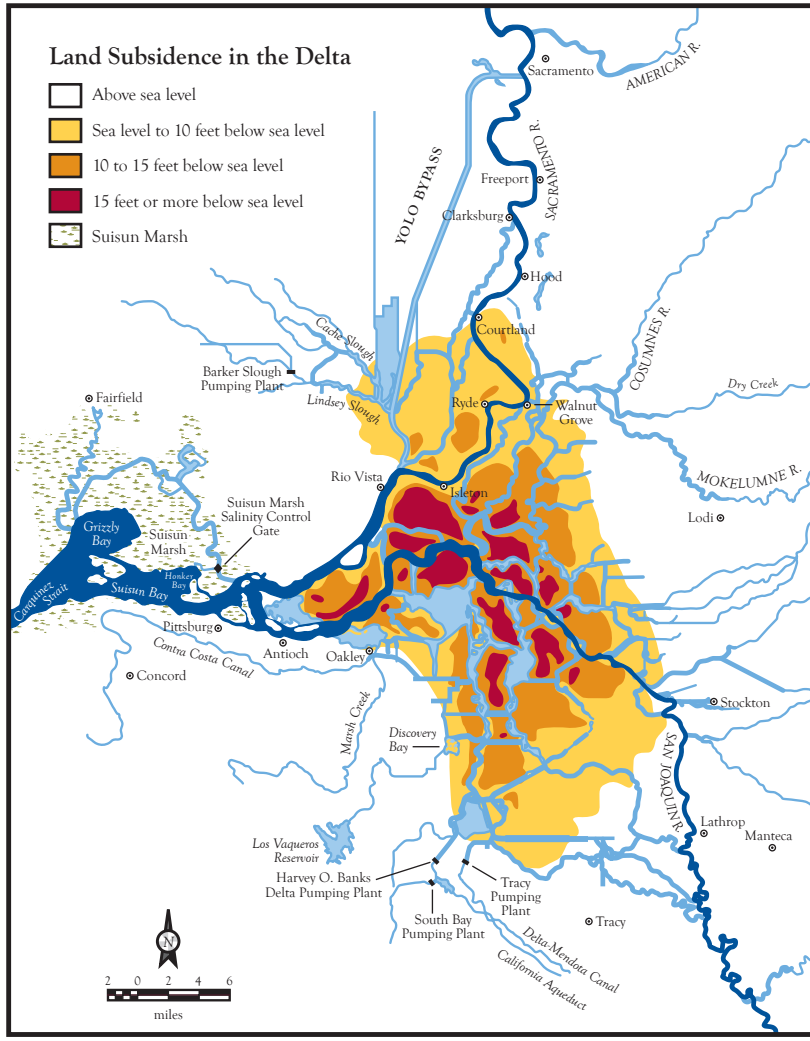
SOURCE: Young (1929), Plate 9-1.

Figure 2.3—Upstream Distance for Barges Looking for Fresh Water for Sugar Refinery at Crockett

control of Delta salinity was woven into projects to augment water supplies for users south of the Delta.

Farming and Land Subsidence

Another problem that increased in severity over time was the subsidence of Delta lands, many of which now lie well below sea level (Figure 2.4). Reclamation itself initiated the subsidence process, because much of the material used to elevate the levees was taken from the interior of reclaimed islands, thereby lowering the island while elevating its protective barrier. Soil burning, mostly associated with the potato farming that developed by 1900, also accounted for much early subsidence. Despite the benefits of burning—weed control, fertilization, and the facilitation of the seedbed—it accelerated subsidence and allowed for salt accumulation and increased wind erosion.



SOURCE: Department of Water Resources (1995).

Figure 2.4—Land Subsidence in the Delta

Subsidence added to farming costs because it required additional levee rebuilding, drainage excavation, and pumping both for regular operations and recovery after floods. One casualty of this process was Franks Tract, which was abandoned and left flooded after a 1938 levee failure. The same fate befell Mildred Island in 1983. However, in general, Delta farmers

have continued to farm subsided lands. As we will see in Chapter 3, even though the pace of subsidence has slowed in recent times, in part because some of the more destructive farming practices have ceased, subsidence of Delta islands continues and is a major contributor to levee instability.[7]

Big Water Projects Transform the Delta to a Freshwater Body

By the time reclamation of Delta lands was nearly complete in the 1920s, attention began to focus on the development of water supplies from the two major Delta watersheds, the Sacramento and San Joaquin Rivers. Elsewhere in California, major public works projects designed to move water across long distances had already been planned or undertaken, including the Los Angeles Aqueduct (from the Owens Valley to Los Angeles), the Hetch Hetchy project (bringing Sierra Nevada water to San Francisco), the Mokelumne River project (bringing Sierra Nevada water to the East Bay), and the investments along the Colorado River to deliver water to Southern California. From the 1930s to the early 1970s, the Central Valley witnessed a series of major investments in water storage and conveyance to supply agricultural and urban users. This process began with the federally sponsored Central Valley Project (CVP) and ended with the state-run State Water Project (SWP) and included some locally sponsored projects. Although some of the engineering analyses considered alternatives that bypassed the Delta, most of the investments actually undertaken relied on the Delta as a conduit for exports to points south and west (Jackson and Paterson, 1977). As we shall see, big water projects in the Delta have always generated debate, and many plans have been created, modified, and discarded. If nothing else, this process underscores the difficulties of managing the Delta—in the past as well as today.

The Central Valley Project

Since the late 19th century, various observers have recognized the potential for moving surplus Sacramento River water to the drier but

[7]Even in the 1920s, the weakness of Delta levees was seen as a major constraint on Delta solutions, including the design and operation of a saltwater barrier (Young, 1929; Matthew, 1931b).

potentially productive San Joaquin Valley (Alexander, Mendell, and Davidson, 1874). The 1923 Department of Public Works' report to the legislature noted above included proposals to build upstream storage reservoirs to permit such transfers. These plans were fleshed out in the department's 1930 *State Water Plan* ("the Plan"), which would serve as a blueprint for the Central Valley Project (Department of Public Works, 1930). The Plan concluded that upstream storage along the Sacramento River could simultaneously resolve two principal water problems: water shortages in the San Joaquin Valley, where groundwater overdraft—or pumping in excess of natural recharge—had become a serious concern, and salinity intrusion in the Delta, which would be addressed by creating a hydraulic salinity barrier, with controlled releases of water from upstream storage. Ultimately, the Plan rejected the idea of a physical salinity barrier, arguing that its construction could be postponed until the anticipated growth in San Joaquin Valley water demand used up excess reservoir water.[8] Salinity problems in the East Bay would be resolved by piping Delta supplies via a proposed Contra Costa County conduit. Investments along the Colorado River, meanwhile, were seen as the near-term solution to Southern California's additional water needs.

The Central Valley Project was approved by the legislature and the voters in 1933. Seeking to maximize federal financial contributions in the hard economic times of the Depression, the state handed over control of the project to the federal government. Although construction of one of the CVP's primary components, Shasta Dam, got under way by 1938, state and federal agencies did not agree on the final form of diversions for Sacramento River water until the following decade. USBR had proposed a new canal to route the water around the periphery of the Delta between Freeport and the Stockton area. The final outcome, closer to the state's original proposal, was to divert water through the Delta via a small cross-channel just north of Walnut Grove, from which it would travel south to the pumps. The Delta Cross-Channel, constructed by USBR in 1944, still helps to supply

[8]In reaching this conclusion, the Plan's authors drew on several studies conducted in the 1920s, including a 1925 study by the U.S. Bureau of Reclamation (USBR), a 1928 privately financed study on the economics of the barrier (the "Means Report"), a 1929 study for the Department of Public Works (Young, 1929), and the report of the joint federal-state commission appointed in 1930 (the Hoover-Young Commission). Among these, the only report to advocate a barrier was the USBR report. See Jackson and Paterson (1977).

the Contra Costa and Delta-Mendota Canals, which entered service in 1948 and 1951, respectively.

The CVP has also been responsible for some major upstream diversions of water from both the Sacramento and San Joaquin Rivers. Following the construction of the Friant Dam (1942) and the Friant-Kern Canal (1948), the CVP began diverting San Joaquin River water to supply irrigators on the east side of the San Joaquin Valley. Subsequent investments on the west side of the Sacramento Valley, notably the Tehama-Colusa Canal (1980), also increased upstream diversions from the Sacramento River.

The CVP was successful in its primary goals: expelling salt water from the Delta by way of controlled releases from Shasta Reservoir and supplying fresh water to irrigators and some urban users in the San Joaquin Valley and areas west of the Delta. The project also provided benefits to power generation and navigation. However, it was less successful in providing additional flood control protection. Levee failures continued to occur in the Delta whenever the surface elevations of water channels exceeded four feet above mean sea level for more than 48 hours. Moreover, the CVP investments in water supply and salinity control were not considered adequate over the long run, given the anticipated growth in demand for water exports. Since the 1940s, a series of investigations have explored longer-term solutions to these issues. Salinity management in the Delta remains a major issue for the CVP.

The State Water Project

In 1960, California voters authorized the first phase of the State Water Project, which aimed to extend water deliveries from northern watersheds to Southern California cities and to farmers in the Tulare Basin that were beyond the reach of the CVP. Although this project ultimately adopted the same basic approach to water exports as the CVP, relying on the Delta as a transfer point, this approach was not a foregone conclusion. Options that surfaced (or resurfaced) included a saltwater barrier, a highly reengineered and simplified Delta, and a peripheral canal. Investigations into the first two options took place in the 1950s. Peripheral canal investigations continued well into the 1970s, as part of the consideration of the SWP's expansion.

The foundation of the State Water Project was laid in the 1950s, through a series of proposals, plans, and legislative actions. In 1953, the state legislature passed the Abshire-Kelly Salinity Control Barrier Act to reexamine the need for a saltwater barrier. The state Division of Water Resources hired a Dutch consultant, Cornelius Biemond, who was Director of Water Supply for Metropolitan Amsterdam. Biemond rejected the idea of a barrier, proposing instead to reduce the Delta's 1,100 miles of levees to a 450-mile system of master levees. This plan included the construction of both a siphon to take Sacramento River water under the San Joaquin River on its way south and a barrier at the confluence of these two rivers.

By 1957, the newly formed Department of Water Resources discarded the concept of a saltwater barrier in favor of a somewhat modified Biemond Plan and recommended it to the governor and legislature as part of the State Water Project (Department of Water Resources, 1957). Under this proposal, water would be transferred through both a trans-Delta system (the Biemond Plan) and an Antioch Crossing Canal, along the Delta's western edge. Three pumping plants in the south Delta near Tracy would pump supplies farther southward. The Biemond Plan would isolate many Delta channels from tidal action, allowing salinity to be controlled with one-third of the available freshwater flow. In 1959, the Water Resources Development Act was passed to pay for the first phase of the SWP; it was approved by the voters in 1960.

Perhaps reflecting the growing political savvy of Delta interests, the SWP ran into greater public acceptance obstacles than the CVP had. As a precondition to the SWP's advancement, the legislature passed the Delta Protection Act of 1959, which established the legal geographical boundaries of the Delta and stipulated that the state-run SWP, in coordination with the federally run CVP, would be required to maintain Delta water quality standards (i.e., sufficiently low salinity to permit farming and other economic uses). However, Delta interests remained concerned about water quality, and in 1961, the State Assembly Interim Committee of Water rejected the Biemond Plan, stating that it was an imposed solution rather than one worked out in consultation with local interests.

While work began on the SWP's main storage and conveyance components—Oroville Dam and the California Aqueduct—deliberations continued on the ultimate solution for moving water from north to south.

An Interagency Delta Committee was formed to examine Delta water problems. As one alternative, USBR revised the peripheral canal proposal from the 1940s.[9] The committee also examined options for keeping the entire Delta fresh, either with a physical barrier at Chipps Island on the Delta's western edge or through the continued use of controlled reservoir releases to maintain a hydraulic saltwater barrier.

In 1964, the committee released its *Proposed Report on Plan of Development, Sacramento–San Joaquin Delta*, again recommending the peripheral canal but with several refinements, including an increase in the volume of diversions from the Sacramento River to supply south-of-Delta users. The report stressed the intangible environmental benefits of the canal and proposed further work to safeguard the water supplies of western counties. In public hearings, only Contra Costa County raised objections to the canal proposal, while environmental groups remained supportive of it.

The peripheral canal was on its way to becoming a reality. By 1966, DWR had officially adopted the canal as a part of the State Water Project and had reached agreements on cost-sharing provisions with USBR. Public meetings were held to gather local input on proposed canal alignments. While waiting for congressional authorization, the new director of DWR placed the project design on hold but continued with right-of-way purchases. In 1969, USBR released its economic feasibility study and recommended that Congress approve the project. Both chambers of the California legislature issued strong endorsements of the canal. Despite its promising start, this version of the peripheral canal never came to be—other forces were at work that changed the course of the debate about the Delta.

Environmental Concerns Change the Course of Delta Policy Debates

The SWP's plans would all change over the following decade, as California, like the nation as a whole, witnessed the rise of environmental concerns. This shift in public attitudes was reflected in new legal and

[9]The proposal was launched in the committee's 1963 report, *Report of the Interagency Delta Committee for Delta Planning* (Jackson and Paterson, 1977).

regulatory frameworks for pollution control and species protection. The Delta and its tributary watersheds, home to many unique aquatic species, would become a focal point for these new concerns. One casualty would be the build-out of the State Water Project, as northern rivers slated as sources for additional upstream storage were declared "Wild and Scenic" and off limits for new reservoirs or diversions. Another casualty would be the peripheral canal, which eventually drew strong environmental opposition.

The wave of new environmental legislation began in the mid-1960s, with a succession of federal laws regarding water quality and species protection—the National Wilderness Preservation Act (1964), the Federal Endangered Species Preservation Act (1966, a precursor to the 1973 Endangered Species Act), the National Wild and Scenic Rivers Act (1968), the National Environmental Policy Act (1969), the Clean Water Act (1972), and the Safe Drinking Water Act (1974). California's legislature was equally active in the environmental arena, passing comparable bills at the state level.

As species protection became an explicit goal in the Delta, alongside the maintenance of fresh water for human uses, perceptions of the effects of water diversions and the nature of water quality problems began to change. In 1971, the State Water Resources Control Board (SWRCB) adopted Water Rights Decision 1379, establishing water quality standards for the CVP and the SWP that included new outflow requirements for the San Francisco Bay–Delta Estuary and a comprehensive monitoring program to follow changes in environmental conditions. This decision, stayed by court order in response to lawsuits filed by San Joaquin Valley irrigation districts, marked the beginning of a series of legal and regulatory battles over Delta water quality standards for the environment.[10]

[10]In 1978, the SWRCB adopted a new water quality control plan for the Delta and Suisun Marsh (the 1978 Delta Plan) and set new Delta water quality standards with Decision 1485 (D-1485), again focusing on environmental as well as human water quality needs and implying greater restrictions on water exports. Following successful legal challenges at the trial court level, the 1986 "Racanelli Decision" affirmed the SWRCB's broad authority and discretion over water rights and quality issues, including jurisdiction over the CVP. The SWRCB was ordered to prepare a new plan for Delta flows and export guidelines with a greater environmental emphasis. This new draft, put forth in 1988, was withdrawn the following year amid controversy over its legal and water rights implications.

Defeat of the Peripheral Canal

During the 1970s, the peripheral canal plan was also subject to increased environmental scrutiny. Although the canal was initially promoted as having environmental benefits in addition to the primary benefit of controlling the salinity of Delta water exports, these benefits were not spelled out in any detail in the reports of the 1960s. Subsequent reports were more mixed. Controversy around the plan began to build, generating considerable debate, including lawsuits, over several years.[11] In the end, the canal was beaten in the court of public opinion. By the time it was put to a referendum in 1982, an alliance of environmentalists and northern water interests, with backing from some Tulare Basin farmers who feared water high costs (Arax and Wartzman, 2005), successfully argued that the canal would be bad for the environment and Northern California water rights. Large majorities of Northern California voters rejected the perceived water grab by Southern California.[12]

Drought Intensifies Conflict

In 1987, California entered a multiyear drought that severely reduced available flows from the Delta's two main watersheds. As the drought wore on, it provoked conflict over the amount of water reserved for environmental flows. Initially, CVP and SWP exports were not cut, and both environmentalists and fisheries agencies raised concerns over the consequences for important fish species that depended on the Delta. In 1989, the Sacramento River winter-run Chinook salmon was listed as

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[11] In 1970, a preliminary report from the U.S. Geological Survey suggested that the southern San Francisco Bay could suffer from reduced Delta outflows. A 1973 report by the director of the California Department of Fish and Game endorsed the canal for correcting adverse conditions in the Delta for fish (notably problems caused by pumping in the southern Delta), but it also stressed the importance of maintaining adequate flows within the Delta itself and of involving fisheries agencies in the decisionmaking process (Arnett, 1973). That same year, a student uncovered an unknown, preliminary report from the federal Environmental Protection Agency (U.S. EPA) that was highly critical of the canal. The student gave the report to the Friends of the Earth and it was made public. DWR published a 600-page draft *Environmental Impact Report* in August 1974 with only minor changes from the 1969 design. In the early 1970s, environmental groups filed a series of complaints and lawsuits on a range of procedural issues relating to federal involvement and permitting of the peripheral canal (Jackson and Paterson, 1977; Hundley, 2001).

[12] In Northern California counties, the "no" vote consistently exceeded 90 percent. Strong majorities in all San Joaquin Valley counties except Kern also rejected the canal.

threatened under the federal Endangered Species Act and as endangered under its state counterpart, and DWR and USBR agreed to build salinity control gates in Suisun Marsh and make other efforts to preserve the habitat in the marsh.

With the drought still in full force, water exports to some San Joaquin Valley farmers were reduced in 1991 to maintain minimum environmental flows. The following year, water users were dealt several legal and legislative blows.[13] By 1993, a crisis was erupting. The delta smelt was listed as a threatened species, and other listings began to follow (Table 2.2). The federal EPA threatened to impose stricter water quality standards for the estuary that would severely curtail water exports. Under the threat of a regulatory hammer, water users agreed to work with environmental interests to forge a new plan for the Delta that would comprehensively address both water user and environmental concerns. In December 1994, the signing of the Bay-Delta Accord marked the beginning of the CALFED era.

The CALFED Era: Testing the Limits of Consensus

CALFED sought to involve the full array of relevant federal and state agencies, together with local and statewide stakeholders, to form a new plan for the Bay-Delta. The CALFED process continued in earnest for roughly a decade, funded primarily with state bond monies and some limited federal contributions.

One of CALFED's early efforts was to review and compare strategic alternatives for the Delta. Over 20 diverse conceptual alternatives were initially reviewed and briefly discussed, but little formal analysis was published (CALFED, 1996). The CALFED Record of Decision (ROD) was signed in mid-2000 by all agencies with authority over Delta operations, and it advocated the continuation of the through-Delta strategy for water exports. All four of CALFED's main goals (water supply

[13]The courts upheld that an irrigation district must cease pumping during peak migration times for endangered Chinook salmon and that the CVP must release flows sufficient to protect downstream fisheries. Congress then passed the Central Valley Project Improvement Act (CVPIA), a central component of which was a requirement that the CVP commit 800,000 acre-feet/year (or roughly 10 percent of total deliveries) to support fish and wildlife.

Table 2.2

Status of Fish Species in the Sacramento–San Joaquin Delta Watersheds

Species	Year	Status
Sacramento River winter-run Chinook salmon	1989	Endangered (CESA) Threatened (ESA)
Delta smelt	1993	Threatened (ESA and CESA)
Sacramento River winter-run Chinook salmon	1994	Reclassified as endangered (ESA)
Sacramento splittail	1995	Species of concern (CESA)[a]
Longfin smelt	1995	Species of concern (CESA)
Sacramento perch	1995	Species of concern (CESA)
River lamprey	1995	Species of concern (CESA)
Central Valley steelhead trout	1998	Threatened (ESA)
Central Valley spring-run Chinook salmon	1999	Threatened (ESA)
Sacramento River drainage spring-run Chinook salmon	1999	Threatened (CESA)
Central Valley fall-run and late-fall-run Chinook salmon	2004	Species of concern (ESA)
Southern green sturgeon	2006	Threatened (ESA)

SOURCE: Department of Fish and Game (2006a), available at www.dfg.ca.gov/hcpb/species/t_e_spp/tefish/tefisha.shtml.

NOTES: ESA and CESA refer to the federal and California Endangered Species Acts, respectively.

[a]The Sacramento splittail was listed as threatened under the ESA in 1999 but was removed from the list in 2003.

reliability, water quality, ecosystem restoration, levees) were based on this strategy and were not to be revisited until 2007. The maxim that "everyone would get better together" tied all fates to this single approach.

CALFED proved to be a fragile truce. As discussed in more detail in Chapter 5, by the tenth anniversary of the Bay-Delta Accord, stakeholder frustrations were widespread. Water exporters were frustrated with slow movement to augment water supplies, which in some cases meant restoring supplies that had been reduced to support the environment. In-Delta users were discouraged by the limited progress on dealing with Delta salinity and water quality. Environmental interests remained concerned that water export goals were taking precedence over ecosystem protection—a concern that turned into alarm when the news broke about precipitous drops in

the delta smelt and other pelagic fish species. And Delta landowners and farmers were frustrated over limited funds for levee improvements and maintenance, which had previously received some state funding but were not a priority for CALFED funds.

Arguably, CALFED was not designed to deal with some of the problems that have recently emerged. New research on the long-term risks associated with Delta levees, the significant levee breach on Jones Tract in the summer of 2004, and the devastating effects of levee breaches in New Orleans all made the levee issue more urgent than it had been in the years leading up to the CALFED ROD. Similarly, CALFED's initial ecosystem focus was on restoring salmon runs, in part because delta smelt and other pelagic organisms were less understood. The recent severe declines in these fish populations caught most experts by surprise.

CALFED was also founded on the implicit assumption that the Delta would not face the urbanization pressures that have become apparent over the past few years. This assumption may have been justified in the early to mid-1990s, particularly in light of the passage of the Delta Protection Act of 1992, which reserved most Delta lowlands for agricultural and environmental uses. However, since the late 1990s, a housing boom has swept the Central Valley, and today a number of large projects are slated for development in lowland areas that are exempt from the act's restrictions. In addition, recent concerns about urban flood risks behind agricultural levees, state liability for failure of project levees (following the 2003 *Paterno* decision), and the long-term environmental effects of urbanizing Delta islands have raised urbanization as a serious long-term issue for Delta management.[14]

But CALFED also suffered from some fundamental design flaws, particularly with regard to financing. CALFED parties agreed to a principle of "beneficiary pays," but in practice, the implications for user contributions were never fleshed out. The program was launched at the height of the dot-com boom, when the state enjoyed windfall surplus revenues, and it relied on unrealistic expectations of massive state and federal taxpayer funds. Serious, long-term funding proposals were never developed. This lack did not matter so much in the first years after

[14]For more on *Paterno*, see Department of Water Resources (2005a).

the signing of the ROD, because $1.5 billion in state bond funds was earmarked for the program (de Alth and Rueben, 2005). But by 2005, when most bond funds had run out, legislative frustration over the lack of a realistic plan for beneficiary contributions spelled the end of most CALFED activities.

CALFED did achieve some notable successes. Major improvements were achieved in interagency coordination. Considerable progress was made in ecosystem restoration in several watersheds upstream of the Delta. Water transfers have become largely accepted statewide, with success during the 1987–1992 drought followed by a very successful Environmental Water Account (Hanak, 2003). Improvements in water conservation efforts have continued, and funding for research has brought more data and some new thinking to Delta ecological problems. Ultimately, however, the program suffered from a failure of political processes to come to long-term agreement without continued massive taxpayer subsidies. In light of the new problems facing the Delta, it now appears that the CALFED premise that everyone can get better together may be unrealistic.

The Lessons of Delta History

The Delta's short history of European settlement has seen major changes in the form, use, and settlement of land in the Delta. Before European settlement, the Delta was a massive tidal marsh, with significant seasonal variations in flow and salinity, as well as large interannual variations caused by floods and droughts. This era was followed by a period of land reclamation for agriculture, which, for better or worse, created much of the Delta's current landscape. Marsh reclamation reduced tidal flows, but upstream diversions in the Sacramento Valley increased salinity intrusion into the central Delta during dry seasons of dry years, processes clearly understood in the 1930s.

The prospect of major water exports from the Delta made salinity intrusion a primary concern for all water users within the Delta. Various strategies, including saltwater barriers, were considered early on. By the 1930s, a hydraulic barrier, consisting of Delta outflows from upstream reservoirs, was selected as the primary means of salinity control for agricultural and urban water users. Using this approach, both in-Delta

users and water exporters could agree on a need to keep the Delta always fresh.

The notion of an always-fresh Delta supported by persistent net Delta outflows has endured for over 70 years, but it is not aging well. This management strategy retains support from in-Delta users, but water exporters have come to see increasing risks from this approach, for reasons described in Chapter 3. In Chapter 4, we will examine changes in our understanding of the Delta ecosystem, which also cause us to doubt the wisdom of continuing with this strategy. Because of the history of profound and widespread change in the Delta, we are long past the point where the Delta can be "restored" to past conditions, whether it be the pre-European Delta or the bucolic agricultural Delta. No matter what we do, the Delta of the near future will be very different from past Deltas.

Delta history provides insight into the processes by which Californians have sought solutions to collective problems in this pivotal region. And as this history suggests, these processes have rarely been simple or smooth. At several points over the last century, strenuous efforts have been made to provide solutions to the Delta's problems, and these solutions have been followed by major investments in the chosen strategy. From the 1890s to the 1910s, the Debris Commission worked on Central Valley flood control. Later, state and federal efforts developed the 1930 State Water Plan and executed the Central Valley Project; investigations in the 1950s led to the development of the State Water Project. In more recent times, as environmental concerns have become central in Delta policy considerations, the search for solutions appears more constrained. Thus, CALFED worked under the premise that the Delta's basic configuration should remain unchanged and that environmental goals could be satisfied simultaneously with those of exporters and in-Delta interests. Given the crisis now looming in the Delta, it is once again time for California to launch a serious search for solutions, both old and new.