4 Urgent and Fundamental Challenges

CALIFORNIA DEPARTMENT OF WATER RESOURCES

> The need for change bulldozed a road down the center of my mind.
>
> Maya Angelou, *I Know Why the Caged Bird Sings*

Changes, and the corresponding challenges they present, are inevitable for California's water system. The already fragile condition of the state's aquatic environment, flood control system, key parts of its water supply infrastructure, and the quality of its water sources will be further taxed by the drivers of change discussed in Chapter 3. Water management will need to change in response to these challenges. Failure to respond will lead to continued broad deterioration in the system's economic and environmental performance.

California has successfully adapted to many past water challenges, despite the unavoidable delays and controversies involving changes to the status quo. Some changes, such as the organization of groundwater users in Southern California and the improvements in agricultural and urban water use efficiency in recent decades, have occurred incrementally and have largely been initiated at the local level, in response to local pressures. Other more strategic changes have required state and federal leadership (Chapter 1). Examples include the creation of a comprehensive flood management system for the Central Valley, the widespread introduction of wastewater treatment in the 1970s and 1980s under the Clean Water Act, the shift toward addressing water management's harmful effects on native species through the Endangered Species Acts and other laws in the 1970s, and the launching of a water market to help cope with droughts in the early 1990s.

In each of these cases, state or federal intervention was needed because decentralized approaches were unable to resolve the problems on their own, for one or more reasons: (1) the scale of the problem was too large for local

Subsided cropland behind a Delta levee (Twitchell Island).

agencies to resolve (e.g., Central Valley flood control); (2) external pressure was needed to address the negative spillover effects of water management (e.g., new environmental regulations); or (3) existing state or federal laws and agency practices were getting in the way of local innovation (e.g., the water market).

Today, several major challenges facing California water will require strategic reform, with state and federal initiative: (1) resolving the Sacramento–San Joaquin Delta's water supply and environmental problems; (2) reversing the decline of native fish and aquatic ecosystems across the state; (3) preventing major increases in exposure to flood risk; (4) protecting source water quality through improved management of nonpoint source pollution and new chemicals introduced into the marketplace; and (5) effectively integrating state and regional storage and distribution systems with local water demands and supplies. In most of these cases, continuing to make incremental changes within the status quo policy framework will not only slow progress, it will make conditions worse. Success in these five strategic areas is fundamental to an economically and environmentally viable future for California's water system.

This chapter summarizes these five major challenges and how they affect the foundations of California water policy. While highlighting the need for state and federal leadership on these issues, we recognize the considerable difficulties governing bodies face in today's policymaking environment. To its credit, the state's administrative and legislative leadership passed two significant water reform packages in recent years—the first in 2007, addressing flood management in the Central Valley, and the second in 2009, addressing a range of water supply issues, including Delta governance, water use efficiency, and improvements in monitoring and reporting groundwater and surface water. However, in both cases, legislative negotiations reflected deep divides and strong resistance to change among stakeholders, preventing more significant reforms.

Our interviews with a wide range of California water experts revealed widespread concern over the capacity of state and federal agencies to address major challenges facing the state (Null et al. 2011). Problems cited include a lack of authority in particular areas, a lack of political support or will to exercise already broad existing authority, and a lack of adequate implementation capacity in many agencies. In Part III of this book, we explore options for bolstering the capacity of state and federal governments to assert the leadership needed to adapt to change.

Five Areas in Need of Strategic Reform

The Delta

The Sacramento–San Joaquin Delta—the hub of California's water supply network—provides a stark example of how incremental approaches to reform can lead to continued deterioration rather than progress. More than 20 years after the listing of Sacramento winter-run Chinook salmon in 1989, conditions for native species in this region are at all-time lows (Moyle, Katz, and Quiñones 2010). Meanwhile, the region's role as a conduit for high-quality water for cities and farms is more compromised than at any time since the Central Valley Project began pumping water from the southern Delta in the early 1950s. Risks of catastrophic levee failure are growing, and the pumps are operating under accumulating regulatory cutbacks to address native species declines. Over time, freshwater exports through Delta channels will become increasingly unreliable, and ultimately infeasible, as a result of sea level rise and island failures (Chapter 3).

Conditions in the Delta worsened during the CALFED decade (mid-1990s to mid-2000s), when policy discussions focused on making incremental improvements rather than fundamental changes in Delta management (Chapter 1). Strategic change, in this case, requires a system overhaul. Two basic options are available. Rather than continuing to route export water through the Delta, an alternative conveyance system is needed, either around or under the Delta, so that flows within the Delta itself can be managed to better support native species. Alternatively, the state needs to plan for greatly diminishing and ultimately ending Delta water exports (Lund et al. 2010; Moyle et al. 2010).

Major efforts are now under way to pursue the first option, by developing new conveyance infrastructure that would allow continued use of the Delta as a water supply hub, along with comprehensive flow and habitat investments to support the Delta ecosystem. Under the Bay Delta Conservation Planning process, export water users are working with state and federal fisheries agencies, under the auspices of the California Natural Resource Agency, to establish a new habitat conservation plan for the Delta that would accomplish these goals. Senate Bill (SB) X7-1, part of the 2009 legislative package, established several new governance components to provide broad oversight of Delta management, including a Delta Stewardship Council (which will oversee the development of a comprehensive plan for water and land use in the Delta) and a Delta watermaster

within the State Water Resources Control Board (SWRCB) (who will oversee Delta flow management).

But a high probability remains that controversy and expense will eventually eliminate the Delta as a major water source.[1] This risk is greater if senior state and federal leaders do not press for a comprehensive solution. Ending exports entirely would have some merit for the Delta ecosystem, by reducing the amount of water diverted from the system and ending the harm caused by the pumps. But it also would pose great hazards in terms of loss of political interest and funding for environmental reconciliation in the Delta. In Chapter 6, we provide new modeling insights regarding the effects on California's economy of long-term cutbacks in Delta water exports. We find that local, decentralized efforts to reduce urban water use can help reduce the overall costs of Delta cutbacks. However, losing the ability to move water from northern and eastern California to points south and west would still be very costly for the state's economy, with major implications for San Joaquin Valley agriculture. These costs will be particularly high if California's future becomes significantly drier, as predicted by some climate models.

Fish and Aquatic Ecosystems

The Delta is just one manifestation of a widespread crisis for native aquatic ecosystems in California. Statewide, harmful water and land management practices have left a legacy of severely degraded wetland, riverine, and estuarine ecosystems. As a consequence, native fish species have been on a downward spiral. Similar trends are evident for terrestrial and riparian species that depend on functioning riverine and wetland habitat.

Regrettably, conditions for native fish species have largely continued to deteriorate despite regulatory protections under state and federal environmental laws passed in the 1970s. State and federal environmental safeguards were needed because of inherent conflicts between traditional water development projects and environmental protection. Thus, providing water and cheap power for farmers in the upper Klamath River Basin in Oregon can conflict with protecting endangered salmon in the lower river in California, as well as maintaining fisheries (Box 2.4; Doremus and Tarlock 2008). Statewide, contention over releases of water from dams to protect fish and enhance fisheries is

1. Madani and Lund (2011) describe how various parties' reluctance to compromise may prevent a negotiated solution—a game of "chicken" that leads to continued decline and a worse overall outcome for both water supply and environmental values.

Fish kills are common in areas where pollution, dams, and algae create poor water quality, such as in the Klamath River. Photo by Sarah Null.

common, because these releases can come at considerable cost to urban and agricultural water users.

The effectiveness of environmental regulations has been limited by the piecemeal approaches to recovery that have become the industry standard. Water management today tends to view aquatic ecosystems as a series of incremental constraints to be handled as cheaply as possible in the short term, rather than as a sustained, coherent objective. Even in the best of projects, the goal is to reduce water development effects on ecosystems, not to halt or reverse their decline. Mitigation efforts seek only to compensate for negative effects, not to sustain native ecosystems. This "no net losses in habitat" approach has rarely worked. Piecemeal, species-by-species mitigation measures have proven to be a poor and perilous substitute for environmental management that focuses on fostering functioning ecosystems.

As discussed in Chapter 5, a new approach is needed in which natural aquatic environments are protected and managed on a systematic basis. Rather than focusing principally on individual species, management will need to focus on improving the functioning of ecosystems in which native species once thrived. Given the likelihood of even greater conflicts among water management objectives with a warmer (and possibly drier) climate, this approach also will need to balance economic and environmental objectives at a broader scale. This means, for instance, perhaps managing some whole watersheds largely

for natural values, while other watersheds primarily serve economic purposes. Many watersheds would continue to be managed for multiple purposes. This balancing will require many critical decisions, big and small, to be made every year: managing flows in regulated rivers, saving cold water for fish, preventing the introduction of new invasive species, reducing contaminant loads, changing land use practices to limit erosion and keep development away from rivers, moving back levees to allow wider riparian areas to receive floodwaters, removing dams, and so forth.

Such a strategic shift in aquatic environmental management will require strong leadership by state and federal regulatory agencies, which must become willing and able to assert their authority in a more decisive and systematic manner. For instance, the Department of Fish and Game has substantial authority to deal with many key environmental issues (e.g., requiring fish releases from most dams via § 5937 of the Fish and Game Code). But this agency generally lacks the independence, clout, and resources to do more than nibble at the edges of real protection. Likewise, the SWRCB has seldom used its power to adequately regulate flows in streams for fish and other aquatic organisms.

Flood Risk Management

Flood management is another area where incremental improvements can make matters worse (Kelley 1989). The 2007 legislative package on flood management in the Central Valley attempted to reduce problems in several areas: (1) It doubled the required level of urban flood protection (from one-in-100-year flood protection required by federal law up to one-in-200 years) (SB 5); (2) it required that cities and counties, which have local land use authority, incorporate flood risk considerations in their general plans and establish community protection goals (Assembly Bill [AB] 162); and (3) it aimed to correct some faulty incentives for building in the floodplain introduced by the 2003 *Paterno v. State of California* decision (see Chapter 1), by making these local agencies share liability with the state for flood losses on lands they approve for development in high-risk areas (AB 70). The move to encourage more integration of flood considerations in land use planning is laudable. But the doubling of the urban protection standard is likely to prolong the basic weaknesses of federal flood policy: It will promote some strengthening of existing flood defenses but ultimately encourage more development of flood-prone lands (Chapter 6). Even if these efforts reduce the *frequency* of flooding, they are likely to increase

Urbanization on Central Valley floodplains increases risk to lives and property. Photo by Rand Schaal.

overall flood *risk*—or the economic consequences of flooding—by continuing to encourage population growth and economic activity behind levees.

As described in Chapter 6, a new flood management policy is needed that supplements reductions in the frequency of flooding with reductions in the vulnerability to damage when inundation occurs. Such a policy will lead to more differentiation in levels of required protection, depending on the extent of economic losses to be avoided. As part of this strategy, flood management should also return to an approach that California used with success in the early 20th century—allowing greater flows on floodplains, with the use of bypasses and flood easements on agricultural land (Chapter 1; Kelley 1989). In addition to mitigating flood risk, such an approach also can improve aquatic and terrestrial habitats and in some cases enhance groundwater basin recharge. Although the state government can lead in effecting this shift, key federal agencies (notably the U.S. Army Corps of Engineers) will need to participate.

Any effective flood management approach also will require a major change in funding and liability frameworks. The major gap between funding needs and availability, despite roughly $5 billion in recent state bonds for flood works, implies continued structural unreliability for decades to come (Chapter 2). Moreover, despite the passage of AB 70, financial incentives for floodplain development persist in many areas, as local governments face few short-term risks from flood failures and stand to gain from increased tax revenues from new development.

Pollution from urban runoff is a major cause of beach closures. Photo by Mark Ralston/AFP/ Getty Images.

Protecting Source Water Quality

Great strides have been made since the late 1960s to reduce pollution from urban wastewater facilities and industrial plants, often known as "point" sources. However, "nonpoint" sources of pollution from urban and agricultural runoff still pose major problems. Moreover, new and more exotic water quality threats such as pharmaceuticals have emerged. These threats are likely to grow as the range of chemicals employed in the economy continues to expand. The economic value of new chemicals must be weighed against their potential for harming public health and the environment.

The presence of these contaminants raises the costs of treatment for drinking water, and treatment itself cannot remove all potentially harmful substances. Chemical treatments such as chlorination, used to protect drinking water from pathogens, can create carcinogenic "disinfectant by-products" in the water—trading an acute health risk for a chronic one. By improving and protecting source water quality, less disinfection is needed, concentrations of disinfection by-products are greatly diminished, and less expensive drinking water treatment is required (Chen et al. 2010). Moreover, treatment does not solve problems for fish, birds, and other aquatic and riparian organisms that depend on the quality of water within rivers, lakes, and estuaries; for them, source water protection is the only solution.

Source protection is another area where incremental approaches are not working. A weak regulatory framework, which puts the onus for demonstrating environmental harm from chemicals on the regulatory agency and requires little disclosure from industry, has made the federal Toxic Substances Control Act ineffective at monitoring and tracking chemicals that should be regulated. And nonpoint source pollution control efforts under the Clean Water Act have focused largely on monitoring and best management practices, not on actual effectiveness in limiting discharges. As we discuss in Chapter 6, a regulatory approach is needed that places more burden for disclosure on industry and that requires performance-based outcomes for dischargers of polluted runoff.

Water Supply Management

To make the most of increasingly tight water supplies, California also will need to pursue strategic reform in managing its statewide and regional water storage and distribution systems. As discussed in Chapter 2, the state has a highly interconnected network of surface storage and conveyance facilities. This network is linked, in many places, to groundwater basins that are major sources of water for agricultural and urban users. Many groundwater basins have unrealized potential to serve as complementary, low-cost sites for storing water for dry years (California Department of Water Resources 2009). More integrated and flexible management of the network would permit California to cope better with variable precipitation, a shrinking snowpack, and shifting water demands (Tanaka et al. 2006).

As discussed in Chapters 6 and 7, considerable progress toward integrated system management has occurred incrementally in the past few decades, with the rise of active groundwater banking systems in some parts of the state, improvements in coordination between the Central Valley Project and the State Water Project (run by the federal and state governments, respectively), and the rise in water marketing. However, two major obstacles remain to achieving more efficient and environmentally beneficial management: (1) the lack of comprehensive groundwater management in many areas and (2) the lack of transparent and workable rules for transferring water among users. In contrast to the other challenges discussed above, this is an area where incremental actions, spurred by local agencies, can make some headway in the direction needed. But progress will be slower, and the system less effective, without strategic policy shifts and state and federal actions to remove these barriers.

Monitoring and managing groundwater

Almost alone among western states, California provides for no state-level regulation of groundwater (Garner and Willis 2005; Legislative Analyst's Office 2010). Comprehensive groundwater management schemes—in the form of adjudicated basins (which apportion the rights to use basin waters) or special management districts (which charge pumping fees to help regulate water levels)—now exist in much of urban Southern California and in Silicon Valley (Figure 4.1). In these regions, serious problems of overdraft and salinity intrusion threatened urban water supplies, spurring water users to find solutions from the legislature (the case of special districts) or from the courts (the case of adjudication) (Blomquist 1992). Each local adjudication typically required more than a decade.

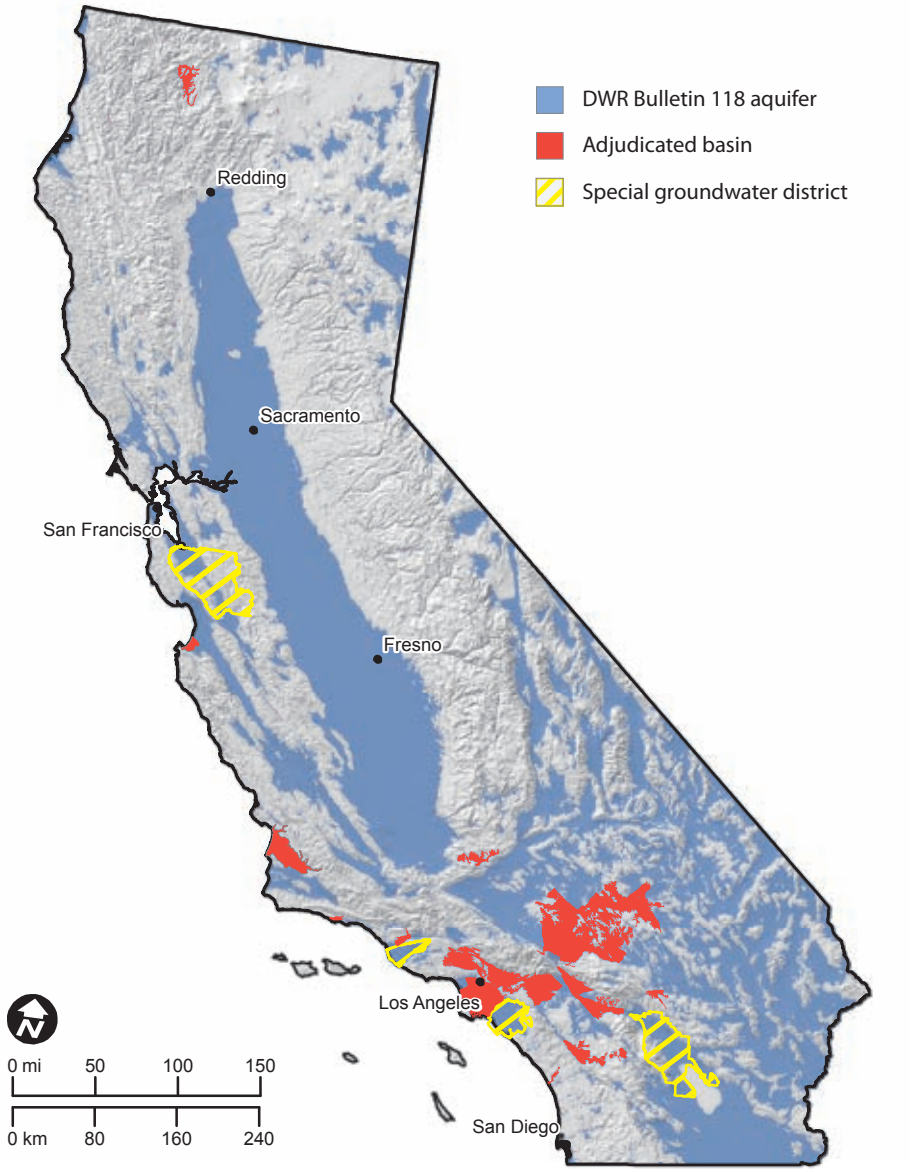
Elsewhere in California, groundwater management is much more ad hoc. In many places, groundwater is managed, often quite effectively, by setting surface water prices below the cost of local groundwater pumping. This encourages more surface water use in wet years, which allows groundwater basins to recharge; pumping can then increase in drier years when there is less surface water available (Vaux 1986; Jenkins 1992). But this type of informal integration is becoming increasingly stressed by reduced surface water availability and higher surface water costs.

Local monitoring networks have also increased in many places, in response to localized overdraft problems (e.g., the Sacramento Regional Water Authority) or the potential for groundwater banking with external parties (e.g., Kern County).[2] Since the early 1990s, the state has encouraged the formation of voluntary basin management plans and provided bond funding to support monitoring wells and basin modeling studies. However, resistance to more comprehensive groundwater management remains strong in most rural counties, as witnessed by the failure of the 2009 legislative water package to require more than minimal concessions that counties monitor groundwater levels voluntarily.

As discussed in Chapter 6, the absence of groundwater monitoring and regulation has prevented the development of groundwater banking and limited water marketing in many rural counties, while contributing to groundwater mining in several major groundwater basins, particularly in the Tulare Basin. The failure to integrate groundwater and surface water management, despite their hydrological connection, has also reduced flows in rivers and lessened groundwater support

2. On the Regional Water Authority, see Hanak (2003). On Kern County, see Thomas (2001) and Hanak (2003).

Figure 4.1
Comprehensive groundwater schemes are concentrated in urban Southern California and Silicon Valley



SOURCE: California Department of Water Resources (DWR).

NOTES: The map shows all groundwater basins (blue), all 22 adjudicated groundwater basins (red), and four special groundwater management districts (Coachella Valley Water District, Fox Canyon Groundwater Management Agency, Orange County Water District, and Santa Clara Valley Water District), all of which exercise authority to levy pump charges. (For a list of adjudicated basins, see www.water.ca.gov/groundwater/gwmanagement/court_adjudications.cfm.) In the Scott Valley (far north on the map), the adjudication included both ground and surface water rights.

for riparian and wetland habitats (Chapter 7, Box 7.2) (Howard and Merrifield 2010; Hall 2010). Climate change, sea level rise, and increased demand will exacerbate poor basin conditions in many areas (Chapter 3).

These pressures may eventually stimulate additional adjudications in some areas. However, our interviews revealed a broad consensus—including among agricultural interests—that state intervention is needed to spur more rapid reform in regions where the economic and environmental costs of delay are great (Null et al. 2011). We propose a framework of cooperative federalism, wherein the state sets enforceable deadlines for local parties to establish comprehensive basin management plans (Chapter 9).

Facilitating water markets

The past 20 years have seen the rise of water markets in California, making it possible to reallocate scarce water supplies during droughts and to accommodate longer-term shifts in water demands (Chapter 6). The state played a major role in launching the market, through enabling legislation in the early 1980s and the establishment of drought water banks during the early 1990s. Since then, the state and federal governments have been major market players, as purchasers of environmental water. They were also brokers of the most extensive package of long-term transfers, involving the transfer of more than half a million acre-feet of Colorado River water from farms to cities under the Quantification Settlement Agreement in the early 2000s.

However, market transactions appear to have leveled off since the early 2000s, despite recent drought conditions, which should have spurred increased sales. As we discuss in Chapter 6, the market's flexibility to serve as a drought response tool has been hindered by the fragmented nature of water rights and contracts, the absence of effective groundwater regulation, and the lack of clarity regarding the type and extent of environmental mitigation required. To meet the water challenges of the 21st century, the state needs to develop a more streamlined, transparent system for water marketing, with a clearinghouse to facilitate transactions between parties. In Chapter 7 we discuss options for creating such a clearinghouse, drawing on examples from the energy sector. Although many market participants in local and regional water agencies would likely support such a shift, the changes involved also are likely to meet resistance from various other—or "third"—parties that have opposed market development. Thus, the state—in partnership with the federal government as a major water rights holder—will once again need to significantly shape these

new market institutions, also encouraging broader mitigation approaches to address third-party effects.

Pathways Forward

California's highly decentralized system of water management does relatively well with incremental solutions. Broad stakeholder involvement and decentralized authority often lead to careful (if noisy) crafting of small, useful changes. However, these same conditions can prevent significant, strategic changes from being made, even when they are broadly beneficial (Madani and Lund 2011). Some fundamental, strategic changes are needed to address major economic and environmental challenges facing the state's water system. State and federal governments will need to spearhead these changes, because local incentives are not sufficiently aligned, and local authority is not sufficiently strong, for strategic changes to happen through a purely decentralized process.

The Local Role

With the right policy directions and incentives, local institutions have crucial roles in crafting and implementing on-the-ground solutions to the major water management challenges facing the state. For instance, local entities—working together—will be better able than a state agency to determine workable operating rules for groundwater basins. The same is true for meeting performance standards for nonpoint source pollution. In both cases, the state should set a policy target and time line for local entities to develop a workable plan. In addition, local entities—working together—will often be able to make the best decisions on how to manage and integrate water supply portfolios most effectively and flexibly, combining a range of tools including water use efficiency, wastewater treatment and reuse, coordinated use of ground and surface water, stormwater management, and water marketing. In such areas, state and federal actions—including effective incentives, technical support, and regulations—can help motivate, maintain, and accelerate the pace of action but are not always essential to progress.

One major weakness in the current capacity of local entities is geographic and functional fragmentation, which impedes effective coordination and integration of water management actions. To address this, we propose the creation of regional stewardship authorities. These authorities would coordinate water supply, water quality, flood management, land use, and ecosystem actions at the

scale of watersheds, providing a venue for integrating local planning to ensure that resource management actions occur at the appropriate scale. Chapters 5 through 7 discuss the role these entities could play in a variety of water management areas, and Chapter 8 describes how the entities might be structured.

Consequences of State and Federal Inaction

Of course, there is a strong possibility that state and federal governments will fail in at least some of the strategic action areas outlined here, in which case only incremental solutions will be available. Decisionmakers at all levels need to be prepared for such contingencies.

In the case of the Delta, such a failure spells missed opportunities for more effective management, greater likelihood of losing additional native species, and billions of dollars in near-term costs to deal with supply interruptions from catastrophic levee failures. But, as shown in Chapter 6, state and federal failure to resolve the Delta's problems, while very expensive, does not spell disaster for California's economy. The long-term economic losses will be concentrated regionally, as farm activity and related employment are reduced in the southern Central Valley. Urban water agencies are likely to respond with greater emphasis on local opportunities to cope with scarcity, including water conservation, wastewater reuse, desalination, and enhanced local storage. State and federal governments can facilitate useful incremental actions through legislation that strengthens the hand of local agencies, such as the new target to reduce urban water use by 20 percent by 2020 (adopted as part of the 2009 water package). Where available, financial incentives can also support local efforts, such as recent federal stimulus grants to support recycled water development.[3]

In the case of flood management, a failure to change course toward more risk-based policies and greater environmental use of floodplains is more problematic, because it implies increasing flood risk exposure for many homes and businesses. This problem will be compounded by the lack of financial resources to bring protections beyond the new 200-year minimum in urban parts of the Central Valley. As the example of the Sacramento Area Flood Control Agency, described in Chapter 6 (Box 6.6), shows, local initiative can make considerable headway on its own, but there are financial and geographic limits to the effectiveness of decentralized approaches.

3. California's local agencies were very successful in tapping federal stimulus funds for recycling, with $132 million in awards, and 26 out of a total of 27 projects funded (Environmental News Service 2009).

Perhaps the greatest problem from a failure of state and federal leadership is inadequate ecosystem protection across the state. Ecosystems are changing rapidly as a result of increased human demand for water, invasive species, harmful land management practices, and climate change. Without a strategic shift in the basic approach, California risks losing many of its remaining native aquatic and riparian species and the distinctive habitats they require. Management needs to focus on beneficial ecosystem function and prioritize conservation dollars to achieve maximum benefit. As described in Chapter 5, this shift cannot be accomplished without a major effort by state and federal governments to reorient resources and, in some cases, refocus regulatory action.

In the following chapters, we elaborate on these themes and outline policy changes, both large and small, that can help California meet the goals of more efficient and environmentally beneficial water management in the decades to come.