Chapter 3
A More Reliable Water Supply for California

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The Delta Reform Act 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.

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Chapter 3
A More Reliable Water Supply for California

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 Provide 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 Reform Act mandates many strategies that the Delta Plan must address to improve water supply reliability for California:[1]

- 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

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.

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[1] See Water Code sections 85004(b), 85020(d) and (f), 85021, 85023, 85302(d), 85303, and 85304.

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 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.

While exports from the Delta account for only a fraction of California's water supplies, the Delta is of central importance given its geographic situation 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 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, estimates that California could reduce water demand and increase water supply in the range of 5 to 10 million acre-feet (MAF) by 2050 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.
- 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.

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 Delta exports will support more natural flow patterns in the Delta, which will aid native species and reduce regulatory uncertainty and vulnerability to disruption by natural disasters that currently threaten reliability of water exports from the Delta. 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.

About this Chapter

This chapter provides an overview of California's water supply, where it comes from, and how it is used. This chapter also describes California's water policy foundations, including federal, State, and local policies, laws, and programs, and the need for continued improvements in local water planning, management, and information. The chapter also explains the special role of the 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 policies and recommendations found at the end of the chapter.

California'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 sidebar, Where California's Water Comes From.)

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).[2] 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 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

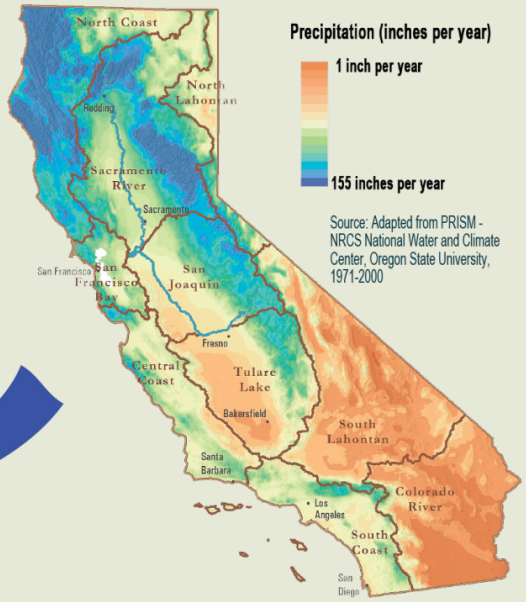
The amount of water available to meet agricultural, urban, and ecosystem water demands starts with the state's annual precipitation. On average, about half of this water evaporates; is used by surface vegetation for transpiration; or flows to deep subsurface areas, saline sinks, or the ocean (DWR 2009). The rest of this water—known as "dedicated water"[3]—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).

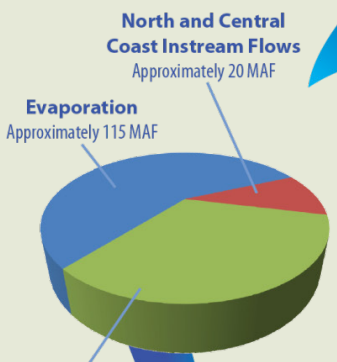
[2] Includes up to 10 MAF of precipitation that occurs in Oregon, Mexico, and the Colorado River and is imported into California.

[3] DWR uses the terms "dedicated" and "developed" interchangeably in their publications. DWR identifies California's average annual dedicated water supply as 85 million acre-feet.

WHERE CALIFORNIA'S WATER COMES FROM…

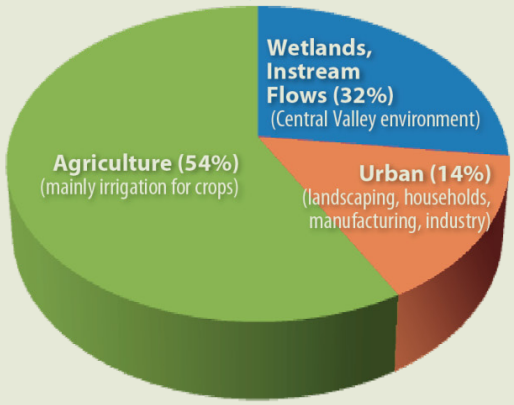
Most of California's water comes from rain and snow that falls in the northern half of the state. On average, precipitation and river inflow supplies California with approximately 200 million acre-feet (MAF) per year. More than half of this supply evaporates or is taken up by trees and vegetation (through transpiration), leaving approximately 80 to 85 MAF of water available for instream and human uses in an average year.





Only Some Is Available to Meet California's Water Demands

California's North Coast and some Central Coast areas are largely isolated from the state's developed water system of reservoirs and canals. About 20 MAF annually is reserved by law for instream flows, which run to the ocean. This means the state's remaining supply, or total water use (the amount of water brought under human control to meet agricultural, urban, and specific environmental needs), averages about 65 MAF per year.



…WHERE CALIFORNIA'S WATER GOES

The state's remaining water supply is divided among agricultural, urban, and environmental uses. On average, 9 MAF (14 percent) is used for urban purposes, 34 MAF (54 percent) is used by agriculture, and nearly 20 MAF (32 percent) is for instream flows and managed wetlands in the Central Valley. Accounting for how much water California actually uses is complicated because water can be reused several times for various purposes before it reaches the ocean or cannot be recovered.

Source: Adapted from DWR 2009, USGS 2010

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Patterns of how and when water is used in the state vary with the type of water year. In fact, while 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.[4] 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 80-85 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 discussion of SWP/CVP Water Delivery Challenges.)

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.[5,6] In an average year, irrigated agriculture uses approximately 34 MAF (54 percent) of this water, while urban areas use about 9 MAF (14 percent), and 20 MAF (32 percent) is mandated to meet instream flow requirements, including 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.[7] 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

[4] All statewide average water use values were calculated based on 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 (versions published in 2009 and 2011).

[5] Data are from 2000, which DWR categorized as an "average" rainfall year for the state.

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

[7] 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.

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.[8] 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 3-1). 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.

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) composing 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 keystone feature of the

[8] 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.

Figure 3-1

Moving and Storing California's Water

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

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.

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 percent to 40 percent (DWR 2010d). 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). 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 and also will increase risk from catastrophic levee failure and floods. 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 Climate Action Team 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 constitutional 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.[9] The State can review and modify existing water rights as well as consider approval of new permits and water rights 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

[9] Beneficial uses recognized in California include domestic, fire protection, fish and wildlife, industrial, irrigation, municipal, power production, recreation, and other uses (SWRCB 2010a).

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 consumption 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, nonconsumptive 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.

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 this coequal goal is expected 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,

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 non-use (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 the California Department of Water Resources hold appropriative water rights for the operation of the Central Valley Project and State Water Project, 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 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).

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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 P on Demonstrating Consistency with the Delta Plan Regarding 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 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 southern 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 sidebars, Reliance on the Delta Varies by Region and Who Uses Delta Water Exports?)

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 2011, Reclamation 2011a). 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.

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 groundwater 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:

- **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).
- **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).
- **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.

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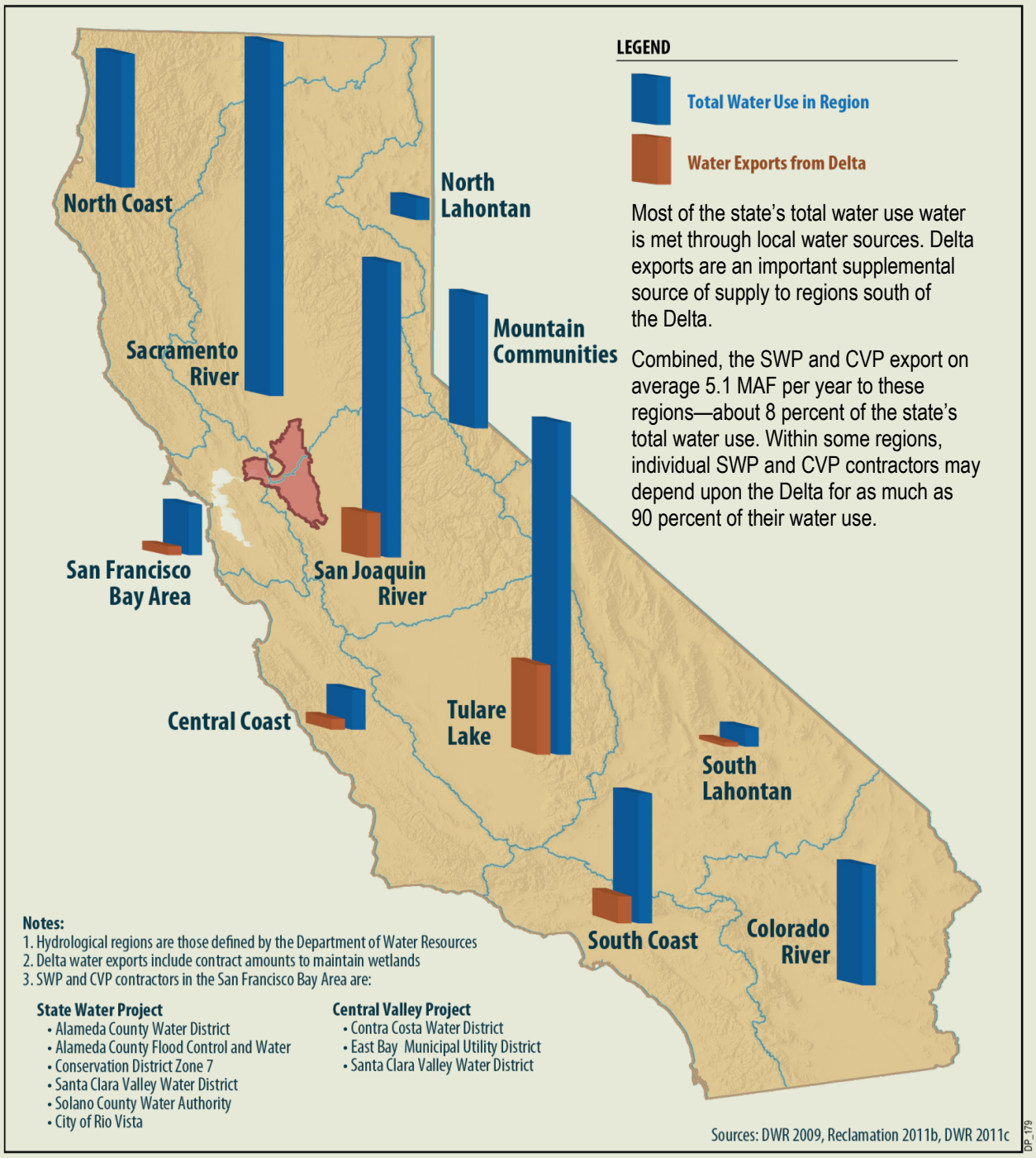
Use of Water from the Delta Watershed

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.

WHO USES DELTA WATER EXPORTS?



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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 4-4 in Chapter 4. This is 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 2011a, 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 sidebar, Where the Delta's Water Comes From and Goes.)

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 overdraft 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.

WHERE DELTA WATER COMES FROM AND GOES

The Sacramento River watershed, tributaries east of the Delta, and precipitation supply about 86 percent (18.7 MAF) of water flowing into the Delta, and the San Joaquin River provides about 14 percent (3.1 MAF). Collectively, these flows support the Delta ecosystem and contribute water to meet urban and agricultural demands in the Delta as well as in the Bay Area, Central Valley, and Southern California.

Over the past century, the combination of upstream diversions and water exports has transformed the Bay Delta ecosystem, reducing historical outflows by an average of 50 percent.

Sources: LAO 2008; Reclamation 2011b; DWR 2011

LEGEND

Sources of water into the Delta

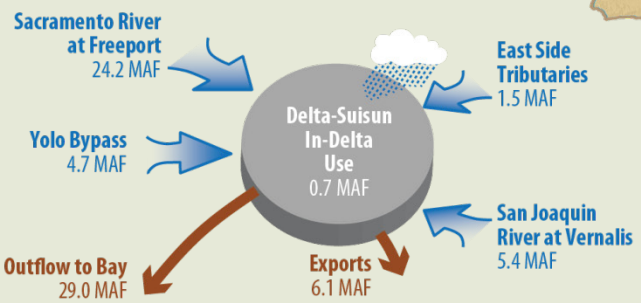
Water deliveries and flow out of the Delta

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

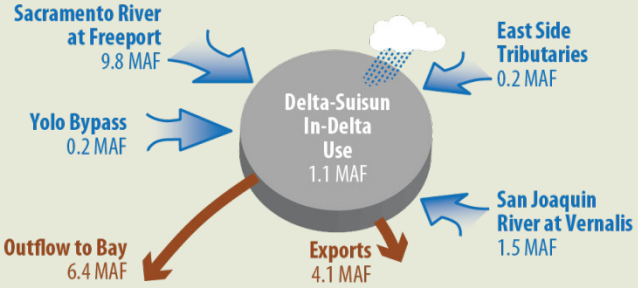
Delta-Suisun in-Delta use includes water to the Contra Costa Canal and to the Mokelumne and Hetch Hetchy aqueducts.

Source: DWR 2010b

Delta Exports Vary from Year to Year



WET YEARS. Lots of water is available to meet a wide range of demands, including Delta ecosystem flows, but less is required for exports because other supplies are available, and insufficient storage capacity is available to receive water in areas that use Delta exports.



DRY YEARS. Much less flow is available to meet demands, but water demands are higher, which increases competition for the Delta's water resources for the Delta ecosystem, in-Delta water users, and exports south of the Delta for agricultural and urban users.

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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 due to 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 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 require the California Department of Fish and Game, U.S. Fish and Wildlife Service, and National Marine Fisheries Service to regulate water project operations in the Delta. Federal biological opinions 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 alternatives under consideration by the Bay Delta Conservation Plan (BDCP) 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.

CVP and SWP Water Delivery Challenges

Overall, exports from the Delta have been rising over the past four decades (Figure 3-2). 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). 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 2011b, 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.[10] 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).

[10] 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.

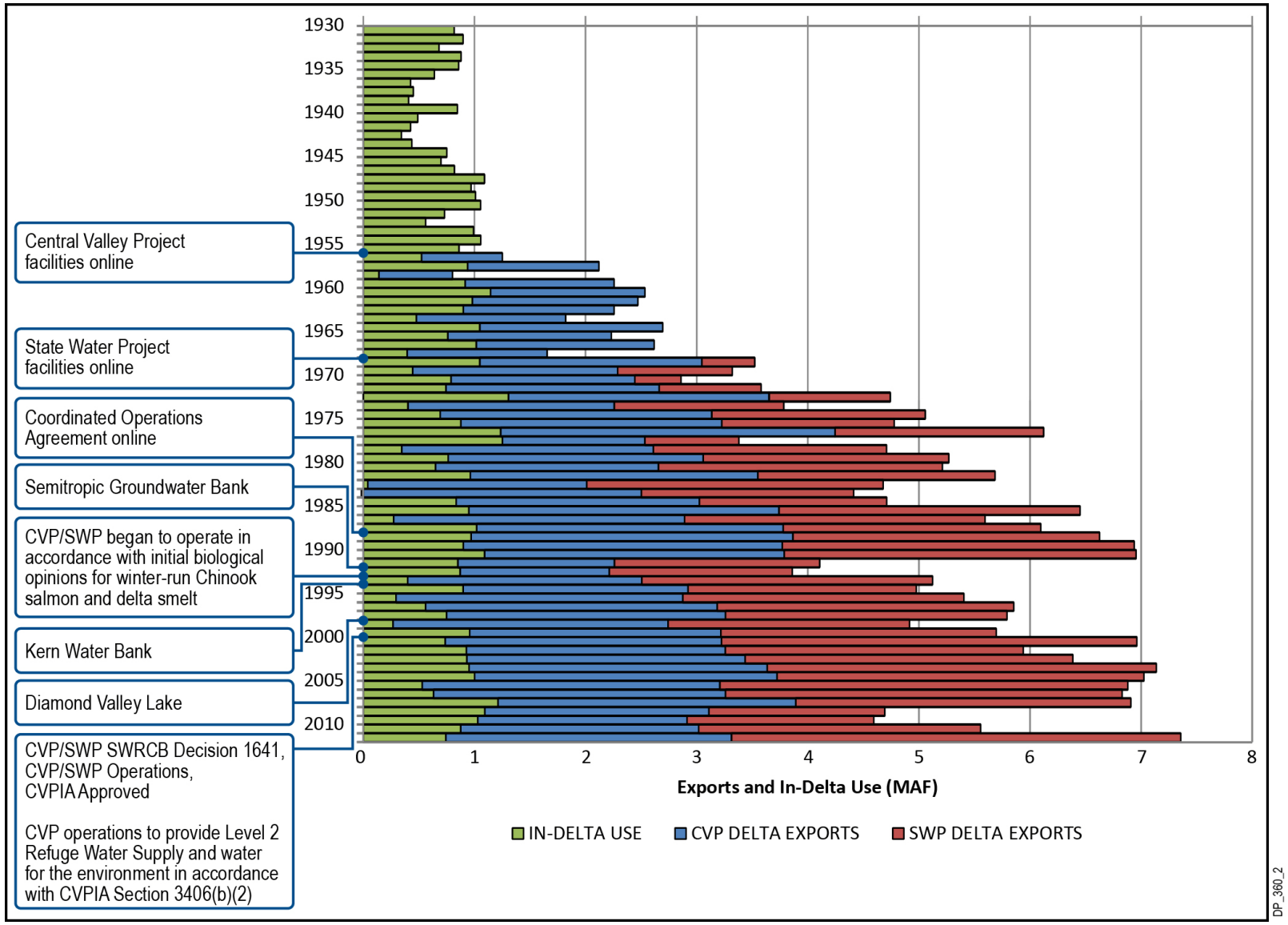

Figure 3-2
Historical Exports and In-Delta Use

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 predictability of Delta exports. 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.

A lesser-known 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 constraints, and budgetary shortages. Challenges are also attributed to having a smaller, less experienced staff than comparable utilities due to severe recruitment and retention problems, ill-suited State contracting practices, and State hiring freezes (Torgersen 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 3-3). 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.

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 the instream flow criteria could be captured and stored. This stored water could then be released later in the year or carried over into subsequent years.

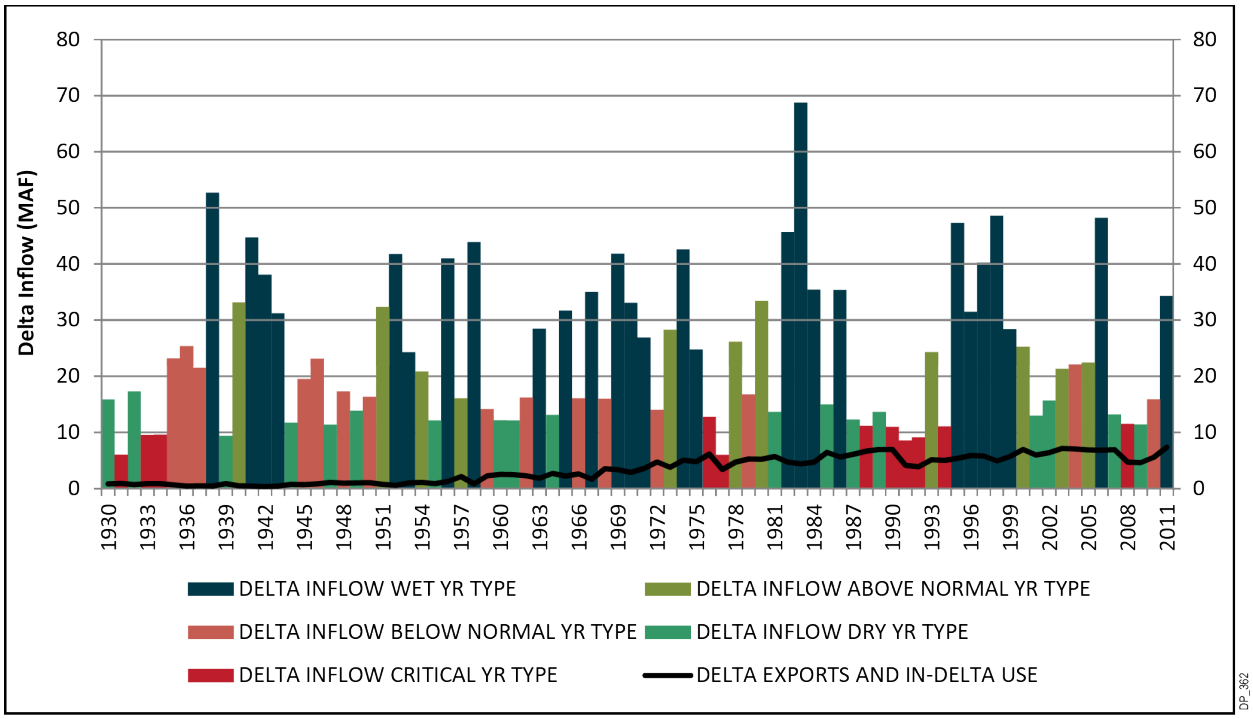

Figure 3-3
Historical Delta Inflow and Delta Exports
In many years, the amount of water flowing into the Delta (inflow from the Sacramento and San Joaquin river systems) greatly exceeds the amount of water exported from the Delta. However, in dry years, water exports have averaged as much as 36 percent of inflows. Experts say that increased Delta inflows or reduced exports–or both–during dry year and during drier months within a year are needed to protect and restore the Delta ecosystem. One way to do this is through new surface and groundwater storage and improved conveyance that will make it possible for more water to be taken during wet years—when more water is available—and less water will be taken during dry years when it is needed for in-Delta water quality and environmental protections. (Poff et al. 1997, Bunn and Arthington 2002, Carlisle et al. 2010)
Source: DWR 2012a

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 are moved or modified. Risks to a reliable source of fresh water conveyed through the Delta could be reduced through the conveyance alternatives that could provide multiple diversion locations in the Delta (as those being analyzed in the BDCP process) and through strategic levee investments.

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.

The Role of Storage in Increased Flexibility

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.

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 completing surface storage investigations 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.[11] 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.

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 section New Water for California provides 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 and associated ecosystem restoration actions are being evaluated as part of the multiagency BDCP effort. (See sidebar, Bay Delta Conservation Plan and Water Supply Reliability.) 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.

[11] 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.

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 A) could be applied to a water management decision.

Adaptive Management Step			Hypothetical Water Supply Reliability Improvement Project
Plan	1	Define/redefine the problem	Current storage and conveyance configuration is not adequate for providing a more reliable water supply to south-of-Delta users under modern operating rules.
	2	Establish goals and objectives	***Goal:*** Improve water supply reliability for south-of-Delta water users. ***Objective:*** 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.
	3	Model linkages between objectives & proposed action(s)	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 Central Valley Project 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 water 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.
	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.
Do	5	Design & implement action(s)	Design and implement the feasibility analyses and modeling.
	6	Design & 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.
Evaluate and Respond	7	Analyze, synthesize, & 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 California Department of Water Resources, Bureau of Reclamation, and SFD contractors decide on a pilot- or full-scale improvement project.

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During this time, steps must 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).

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 over the next 30 years through the use of existing strategies and technologies (see Figure 3-4).[12] 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.[13]

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 (DWR 2009).

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. For more about drinking water quality, see Chapter 6.

[12] 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).

[13] Under California law, water conservation is considered a source of supply (Water Code section 1011(a)). A 2008 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).

BAY DELTA CONSERVATION PLAN AND WATER SUPPLY RELIABILITY

The Bay Delta Conservation Plan (BDCP) is a Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP) that "proposes major physical changes to the Delta, including new diversion and conveyance facilities and their operational criteria, extensive new aquatic habitat, and other measures to help reverse the Delta's ecological decline and secure water supplies from the Delta for human use" (BDCP 2012c).

The BDCP is planned to be implemented over a 50-year timeframe using an adaptive management and monitoring program to adapt as conditions change and new information emerges. The parties seeking one of several permits pursuant to the BDCP include California Department of Water Resources, Bureau of Reclamation, Metropolitan Water District of Southern California, the Kern County Water Agency, the Santa Clara Valley Water District, Zone 7 Water Agency, Westlands Water District, and the State and Federal Water Contractors Agency (BDCP 2012a). The goal of these parties, with the exception of the Bureau of Reclamation, is to formulate a plan that could ultimately be approved by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service as an HCP under the provisions of Endangered Species Act section 10(a)(1)(B) and as an NCCP by California Department of Fish and Game (DFG) under Fish and Game Code sections 2800 et seq. and/or the California Endangered Species Act sections 2050 et seq. The Bureau of Reclamation intends to use information developed as part of the BDCP process to help inform its Endangered Species Act Section 7 consultation on the coordinated long-term operation of the Central Valley Project (CVP) and State Water Project (SWP) with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. If the BDCP is successfully completed, and DFG determines that the BDCP meets the requirements in Water Code section 85320, it must be incorporated into the Delta Plan. That determination by DFG may be appealed to the Council (Water Code section 85320 (e)).

The BDCP is being developed to contribute to improving water supply reliability by modifying Delta conveyance facilities to create a more natural flow pattern in the Delta and allow for water exports when hydrologic conditions result in the availability of sufficient water, consistent with the requirements of State and federal law and the terms and conditions of SWP and CVP water delivery contracts and other existing applicable agreements.

The BDCP process is considering a range of options for conveying water through or around the Delta:

- Through-Delta Conveyance: Continue to divert water in the southern Delta at existing or modified intakes/diversions for SWP and CVP operations.
- Isolated Conveyance: Divert water from the Sacramento River at new intakes/diversions and convey the water to the existing SWP and CVP pumping plants through a pipeline/tunnel.
- Dual Conveyance: Combine through-Delta conveyance and isolated conveyance to allow operational flexibility.

The BDCP process is ongoing. As of this publication, the public draft of the BDCP and the related environmental impact report/environmental impact statement are planned for release by late 2012, with final documents expected to be released in mid 2013 (BDCP 2012b). The Delta Stewardship Council is a Responsible Agency for California Environmental Quality Act purposes.

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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.

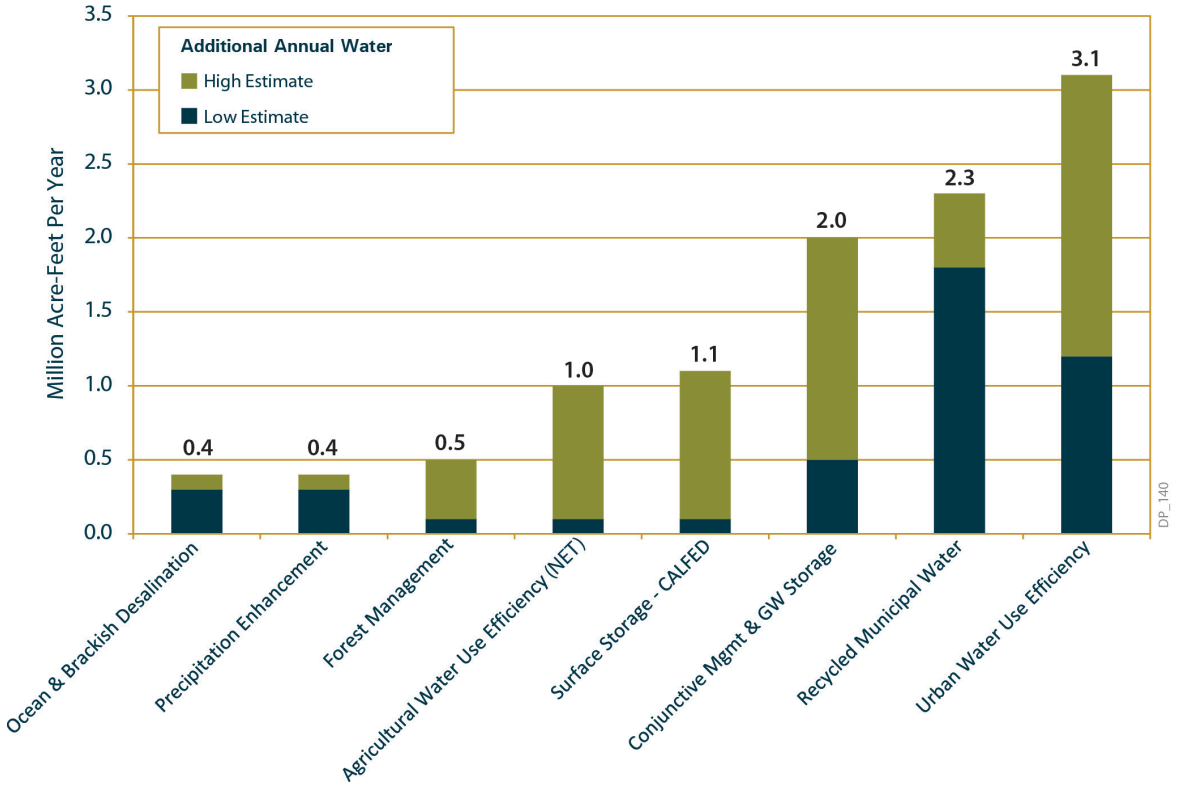

Figure 3-4
Local Strategies to Increase Water Supply and Reduce Demand
California has a wealth of additional water resources that can be developed. In 2009, DWR estimated that the state could further reduce water demand and increase water supplies in the range of 5 to 10 MAF over the next 30 years just through the use of existing technologies. Improved efficiency and development of these supplies will help reduce reliance on the Delta, improve regional self-reliance, and greatly improve water supply reliability for California.
Source: DWR 2009

- **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 (Assembly Bill [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 (ARB 2008).

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.[14]

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 significant new amounts of water supplies and increased water efficiency that is being implemented. Later in this chapter, the section Informed Decision Making Requires Information 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 E). 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 (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).

[14] 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.

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 disruption of water deliveries from the Delta from 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).

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).

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 voluntary 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 unreasonable 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 could not be used prior to January 2021 to establish a violation of the law for the purposes of state administrative or judicial proceedings (Water Code section 10608.8(a)(2)).

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 integrated regional water management plan (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, while 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 U.S. 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 0 that authorized $500 million in local bond funds 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, Central Valley Project and State Water Project) 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).

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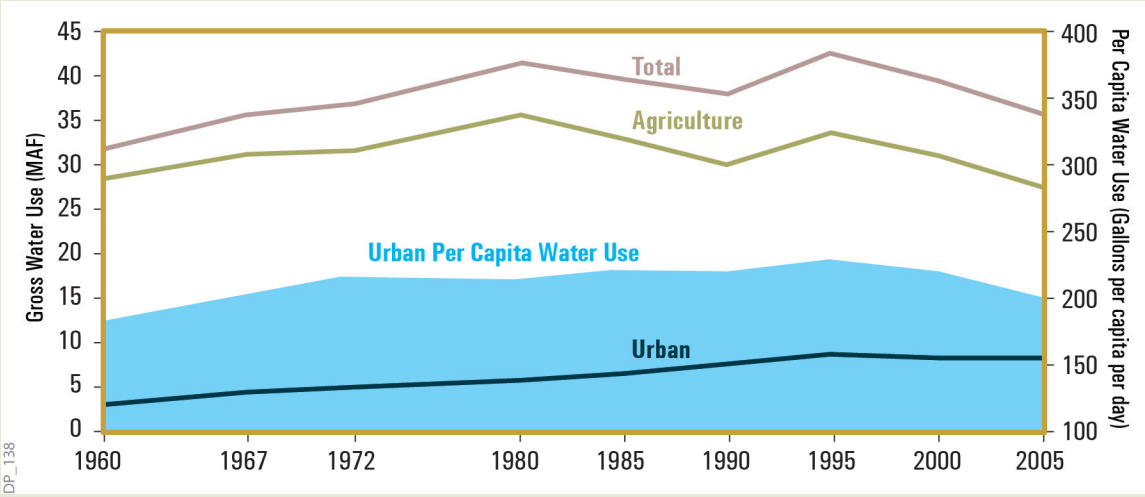
Importantly, for those who prepare them, urban water management plans and integrated regional water management plans appear to be working. As a result of these efforts and increased irrigation efficiency, the amount of water needed to meet future urban and agricultural demands has changed. Since 1980, 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 sidebar, Trends in California's Water Use.)

TRENDS IN CALIFORNIA'S WATER USE



Over the last two decades, California's total water use has been declining. Most of the reduction has occurred in the agricultural sector, where increased irrigation efficiency and some land retirements have shifted water use patterns. Urban water use is also becoming more efficient, and per capita water use has declined significantly. As a result, statewide urban water use has remained relatively flat over the last decade, despite substantial population growth. Some major cities, like Los Angeles, are using the same amount today as they did over 30 years ago, even with the addition of more than 1 million people. California's experience mirrors national trends that show declining water use patterns, particularly in the urban sector.

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

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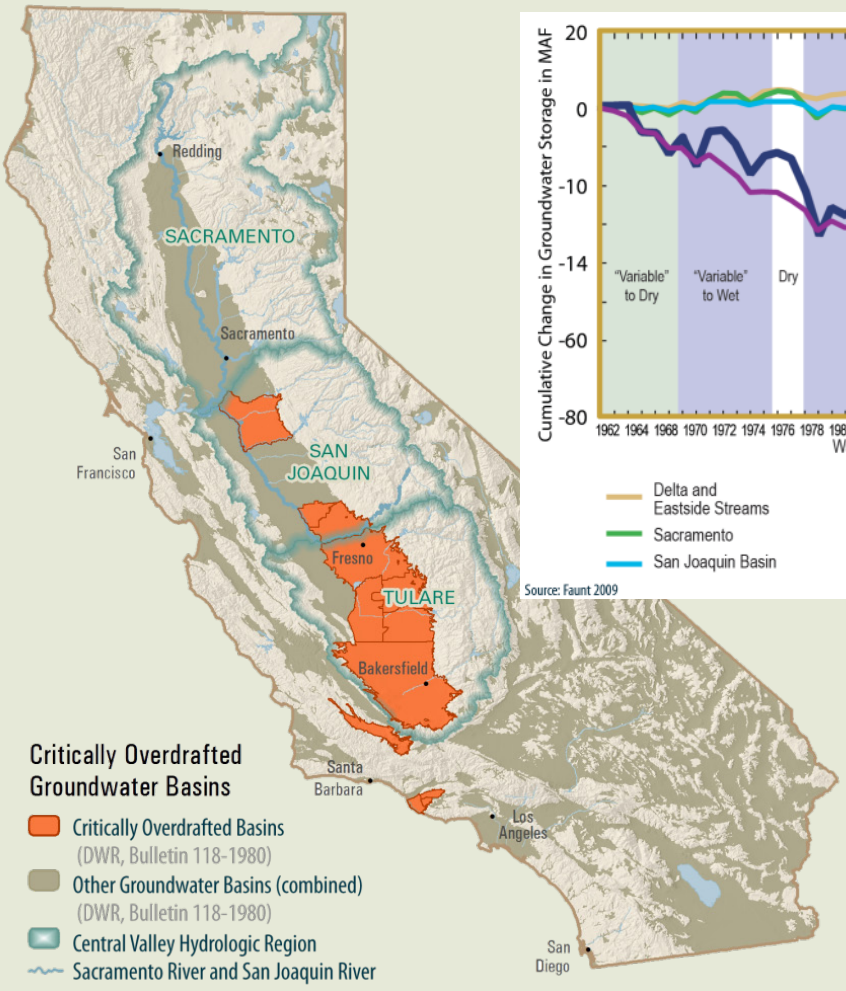
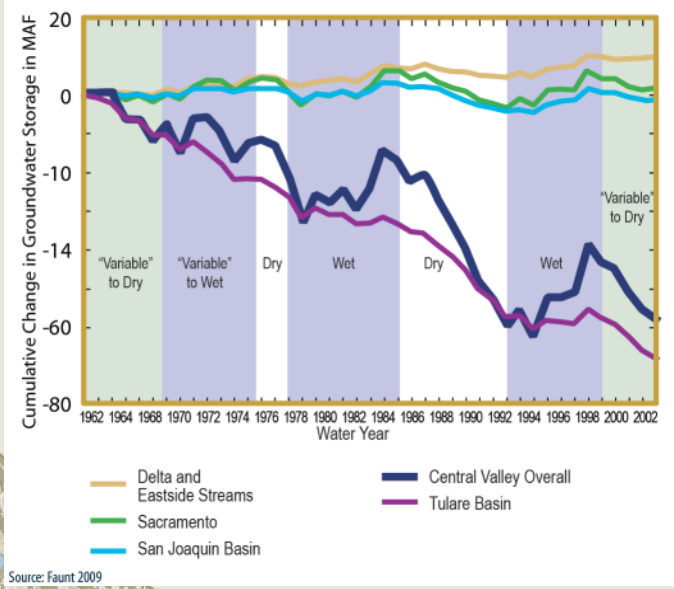
Groundwater Overdraft Is an Impediment to the Coequal Goals

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). 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 sidebar, Groundwater Overdraft Challenges.) The Tulare Lake region alone accounts for more than one-third of the state's total groundwater pumping (DWR 2009). Because of historical groundwater overdraft 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 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 groundwater storage during the period of October 2003 to March 2010 (Famiglietti et al. 2011).

GROUNDWATER OVERDRAFT CHALLENGES





Critical Overdraft by Region

Sacramento Hydrologic Region

None

San Joaquin Hydrologic Region

Eastern San Joaquin County Basin
Chowchilla Basin
Madera Basin

Tulare Hydrologic Region

Kings Basin
Kaweah Basin
Tulare Lake Basin
Tule Basin
Kern County Basin

Other Hydrologic Regions

Cuyama Valley Basin
Oxnard Basin
Las Posas Basin
Valley Basin

Groundwater is California's single largest source of water. 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.

Groundwater overdraft is a critical problem facing specific regions of California. Overdraft is a condition in which the amount of water withdrawn from a basin by pumping exceeds the amount of water that recharges a basin over the long term, resulting in permanent loss of storage capacity, water quality degradation, and environmental impacts. It is estimated that the San Joaquin Valley (Tulare Lake Basin) has lost about 60 MAF of groundwater storage in the past 50 years, and land subsidence affects more than half this region.

Sources: DWR 2003a; DWR 2009

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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).[15] 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.

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

[15] 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), 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 management groundwater resources, and has identified 14 required and recommended components for groundwater plans. Prior to 2002, there were no required elements for groundwater plans.

unknown and may be over-allocated in some locations or during dry periods (SWRCB 2008b, 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 2011).
- 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 2003). Consistent application of this policy is important (see Appendix F).
- 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 Department of Public Health have been working to develop a coordinated database to track the urban and agricultural water use data that is 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.

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).

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. See Appendix P for additional detail on demonstrating compliance with the Delta Plan regarding reduced reliance on the Delta and improved regional self-reliance.

Policies

WR P1 Reduce Reliance on the Delta and Improve Regional Self-Reliance

The policy of the State of California is to reduce reliance on the Delta in meeting future water supply needs and that each region that depends on water from the Delta watershed shall improve its regional self-reliance. Success in achieving the statewide 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.

The intent of WR P1 is to ensure that urban and agricultural water suppliers are taking appropriate actions to contribute to the achievement of reduced reliance on the Delta by complying with the statutory requirements of SB X7 7 and other water management laws, and by implementing programs and projects that are locally cost effective and technologically feasible for urban and agricultural water suppliers to increase water use efficiency and conservation and diversify local water supply portfolios.

WR P1: Water shall not be exported from, transferred through or used in the Delta if (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 the three requirements stated below; (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.

For the purpose of Water Code section 85057.5 (a)(3), this policy covers a proposed action to export water from, transfer water through, or use water in the Delta.

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 WR P1:

1) Completed a current urban or agricultural water management plan which has been reviewed by DWR for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;

2) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the management plan, of all programs and projects that are locally cost effective and technically feasible that reduce reliance on the Delta; and

3) Included in the plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance.

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 projects, and improved regional coordination of local and regional water supply efforts.

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 10601 et seq.), the 20% 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 other applicable water laws, regulations, or rules.

WR R2 Require SWP Contractors to Implement Water Efficiency and Water Management Laws

The Department of Water Resources should include a provision in all State Water Project contracts, contract amendments, contract renewals, and water transfer agreements that require 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 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 CEQA.

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 Delta water supplies up to 36 months due to catastrophic events, 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 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 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 Department of Water Resources, the State Water Resources Control Board, the 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 Caltrans 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 that 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 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 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 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 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 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 2100–2101.

Improve Conveyance and Expand Storage

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.

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 completion of the BDCP and the implementation of major new 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 G, The Delta Stewardship Council's Role Regarding Conveyance.

Recommendations

WR R12 Complete Bay Delta Conservation Plan

The relevant federal, State, and local agencies should complete the Bay Delta Conservation Plan, consistent with the provisions of the Delta Reform Act, and receive required incidental take permits by December 31, 2014.

WR R13 Complete Surface Water Storage Studies

The 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 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 DWR on priority projects and funding.

WR R15 Improve Water Transfer Procedures

The 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 July 1, 2014. 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.

Problem Statement

The lack of accurate, timely, consistent, and transparent information on the management of California water supplies and beneficial uses is a significant impediment to the achievement of the coequal goals. The State does not have 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

WR P2 Transparency in Water Contracting

The contracting process for water from the State Water Project (SWP) and/or the Central Valley Project (CVP) must be done in a publicly transparent manner consistent with applicable policies of the Department of Water Resources and the Bureau of Reclamation referenced below.

For purposes of Water Code section 85057.5(a)(3), this policy covers the following:

a. With regard to water from the SWP, a proposed action to enter into or amend a water supply or water transfer contract subject to DWR Guidelines 03-09 and/or 03-10 (each dated July 3, 2003), which are included in Part 1 of Appendix F.

b. With regard to water from the CVP, a proposed action to enter into or amend a water supply or water transfer contract subject to Section 226 of P.L. 97-293 or Section 3504(a)(2)(B) of the Central Valley Project Improvement Act, which are included in Part 2 of Appendix F.

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 Department of Water Resources, in coordination with the State Water Resources Control Board, the Department of Public Health, Public Utilities Commission, 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 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 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 department 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 3-5 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.

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 to the impacts of climate change
- Improved methods for downscaling climate change models (including dynamic downscaling) and improved models for water scenario planning that incorporates this 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

TIMELINE **CHAPTER 3: Reliable Water Supply**

	ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025
POLICIES	Reduce reliance on the Delta and improve regional self reliance (WR P1)	Water suppliers	●	●
	Transparency in water contracting (WR P2)		●	●
RECOMMENDATIONS	Implement water efficiency and water management planning laws (WR R1)	Water suppliers	●	●
	Require State Water Project contractors to implement water efficiency and water management laws (WR R2)	DWR	●	●
	Compliance with reasonable and beneficial use (WR R3)	SWRCB	●	●
	Expanded water supply reliability element (WR R4)	Water suppliers receiving Delta water	●	
	Develop water supply reliability element guidelines (WR R5)	DWR	●	
	Update water efficiency goals (WR R6)	DWR and SWRCB	●	●
	Revise State grant and loan priorities (WR R7)	DWR, SWRCB, and DPH	●	
	Demonstrate State leadership (WR R8)	State agencies	●	●
	Update Bulletin 118, California's Groundwater Plan (WR R9)	DWR	●	●
	Implement groundwater management plans in areas that receive water from the Delta watershed (WR R10)	Water suppliers receiving Delta water and uses groundwater	●	
	Recover and manage critically overdrafted groundwater basins (WR R11)	Local and regional agencies	●	●
	Complete Bay Delta Conservation Plan (WR R12)	Federal, State, and local agencies	●	●
	Complete surface water storage studies (WR R13)	DWR	●	
	Identify near-term opportunities for storage, use, and water transfer projects (WR R14)	DWR	●	
	Improve water transfer procedures (WR R15)	DWR	●	
	Supplemental water use reporting (WR R16)	SWRCB	●	
	Integrated statewide system for water use reporting (WR R17)	DWR	●	●
	California Water Plan (WR R18)	DWR	●	
	Financial needs assessment (WR R19)	DWR	●	●

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Agency Key:

Council: Delta Stewardship Council
DPH: Department of Public Health
DWR: 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

Figure 3-5
Timeline for Implementing Policies and Recommendations

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 Delta Stewardship Council will collaborate with Department of Water Resources, the State Water Resources Control Board, and stakeholders to develop a standardize 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 integrated regional water management plans; 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 Delta Stewardship 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 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 C 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 measureable reduction in reliance on the Delta and improvement in regional self-reliance. (WR R1, WR R4)
- Progress 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 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 towards 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 a least 1 MAF per year by 2030. (WR R6)

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