California **Water Plan** Highlights

INTEGRATED WATER MANAGEMENT

Update 2009 • Department of Water Resources

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Secretary's Message

It is my pleasure to introduce the 2009 California Water Plan Update (Update 2009), which sets forth a blueprint for sustainability and forges a new direction for water management in California. Our new reality is one in which we must manage a resource characterized by uncertainty and vulnerability due to climate change and changing ecosystem needs. Our past hydrology is no longer an accurate indicator of the future.

This Water Plan follows the Update 2005 roadmap of strategies for sustainable water use but with an increased sense of urgency. Update 2009 reinforces the need to follow the principles of integrated water management – statewide and regionally – and to use water efficiently, improve water quality and reliability, and integrate environmental stewardship into every aspect of how we manage our water.

Update 2009 comes on the heels of a historic water legislation package passed by the Legislature and signed into law by Governor Schwarzenegger in November 2009. The landmark legislative package positions California for 21st Century water management by establishing new urban water conservation targets, requiring statewide groundwater monitoring, and creating a new framework for improved governance in the Sacramento-San Joaquin Delta.

The Resource Management Strategies in Update 2009 build upon the new legislation and chart a path forward into a future characterized by risk and uncertainty. There is a new urgency with which we must embrace water use efficiency in the context of climate change and increased urban demand. Improved water conveyance is a strategy from past Water Plans, but is now presented with renewed significance given the context of a Delta ecosystem in continued decline and the threats of seismicity and sea level rise.

New to this Water Plan is an integration of water resource management and flood management throughout the state. This approach aims to increase resiliency in our systems while yielding multiple benefits like increased public safety, habitat protection, and water supply reliability. A critical strategy in Update 2009 is the development of a reliable revenue stream to fund necessary system improvements and to invest in the continued resilience and robustness of California's water resources and the ecosystem that supports them.

Climate change and increasing demand have greatly reduced the flexibility and resilience of the last century's infrastructure investments. Now is the time to recognize our changed conditions and reinvest in that infrastructure in a sustainable manner. In addition to statewide improvements, local resource strategies such as conservation, water recycling, groundwater storage and conjunctive use, urban runoff management, and more can converge in the context of Integrated Regional Water Management (IRWM) planning.

The strategies outlined in these pages provide the means to manage resources comprehensively; from snowmelt to estuary, from field to tap, and all of the uses within the watershed.

California water management cannot be changed overnight, but Update 2009 and the momentum behind it provide the plan, tools, and strategies to achieve momentous change beginning now. I hope you will agree that Update 2009 is the state's blueprint for sustainability and integrated water management and marks a significant new chapter in the way California manages its water resources.

Lester A. Snow
Secretary for Natural Resources
The Natural Resources Agency

California Water Today:

California is facing one of the most significant water crises in its history—one that is hitting hard because it has many aspects and consequences. Reduced water supplies and a growing population are worsening the effects of a multi-year drought. Climate change is reducing our snowpack storage and increasing the frequency and intensity of floods. Court decisions and new regulations have resulted in the reduction of water deliveries from the Delta by about 20 to 30 percent. Key fish species continue to decline. In some areas of the state, our ecosystems and quality of underground and surface waters are unhealthy. The current global financial crisis will make it even more difficult to invest in solutions. We must act now to provide integrated, reliable, sustainable, and secure water resources and management systems for our health, economy, and ecosystems.

Although the current drought appears to be comparable to that faced in 1977, conditions in California have changed dramatically:

• Population nearly 75 percent higher.

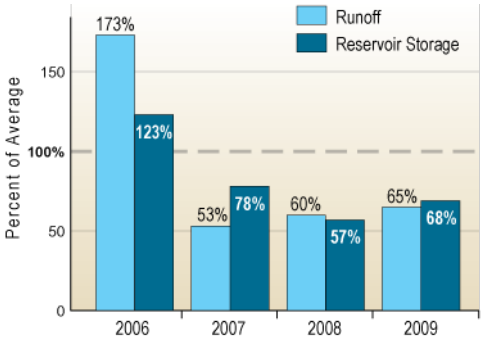
• Reduced water supplies from Colorado River, Owens River, State Water Project, and Central Valley Project.

• Court decisions restrict water exported from the Sacramento-San Joaquin River Delta.

Greater Drought Impacts

Today we are feeling the effects of a major drought. Water Year 2009 was the third consecutive dry year for the state. Because of losses caused by this drought, the U.S. Department of Agriculture in September designated all of the counties within the San Joaquin River, Tulare Lake, and Central Coast Hydrologic Regions as either Primary Natural Disaster Areas or Natural Disaster Areas (statewide total was 21 counties and 29 counties, respectively). The state entered the 2009-2010 Water Year with its key supply reservoirs at only 68 percent of average (see figure). Even if more precipitation develops during this water year, we cannot assume that statewide water supply will fully recover in 2010.

Statewide runoff and key reservoir storage for water years 2006-09



Statewide runoff totals and end-of-water-year storage, 2006 to 2009, for key reservoirs (Trinity, Shasta, Oroville, Folsom, Don Pedro, New Melones, and San Luis) as a percentage of average.

Source: DWR 2009

Increasing Flood Risk

Every region of California faces flood risks. Nearly 2 million people in California live within areas that can expect flooding on average of once in 100 years. This means that, on average, approximately 20,000 people per year can expect to be affected by floods. More people are moving into these floodplains and flood-prone areas every day. Sacramento, California's capital, has one of the lowest levels of flood protection of any major city in the nation. Hurricane Katrina provided a vivid reminder of levee vulnerability and consequences of flooding urban areas. Before Katrina, the New Orleans levees were rated as having a 200-year level of flood protection; Sacramento's levees are rated about one half that amount. The threat of catastrophic flooding, especially in the deep floodplains of the Central Valley and Delta, is a continuing concern.

Imperative to Act

Declining Ecosystems

The ecosystems in many areas of the state have declined; many species have been listed as threatened or endangered. Problems with watershed health, lack of suitable habitat, competition with invasive species, toxicity, and water operations contribute to the decline. One of the most obvious examples of an ecosystem in crisis is the Sacramento-San Joaquin Delta. Salmon, delta smelt, and other species are at their lowest levels since records were kept, about 50 years. This decline has led to court restrictions and new regulations on Delta diversions.

Impaired Water Bodies

The quality of groundwater and surface waters varies significantly throughout the state. We need improvements in drinking water treatment, cleanup of polluted groundwater, salt management, and urban runoff management. A high priority is creating healthy watersheds to keep source water free of pollutants like pathogens and chemicals that are regulated or will be regulated in the near future. Recently, unregulated chemicals and pollutants that were previously not thought to be problematic have emerged as actual or potential contaminants. They can be in pharmaceuticals and personal care products, byproducts of fires and fire suppression, or discarded elements of technology.

Aging Infrastructure

Conditions today are much different than when most of California's water system was constructed; and upgrades have not kept pace with changing conditions, especially considering growing population; changing societal values, regulations, and operational criteria; and the future challenges accompanying climate change (see pages 8 through 11). California's flood protection system, composed of aging infrastructure with major design and construction deficiencies, has been further weakened by lack of maintenance. State and regional budget shortfalls and a tightened credit market may delay new projects and programs.

Find discussions of California's water challenges in Volume 1, Chapter 4 California Water Today and regional reports of Volume 3

The entire system—water and flood management, watersheds, and ecosystems—has lost its resilience and is changing in undesirable ways.

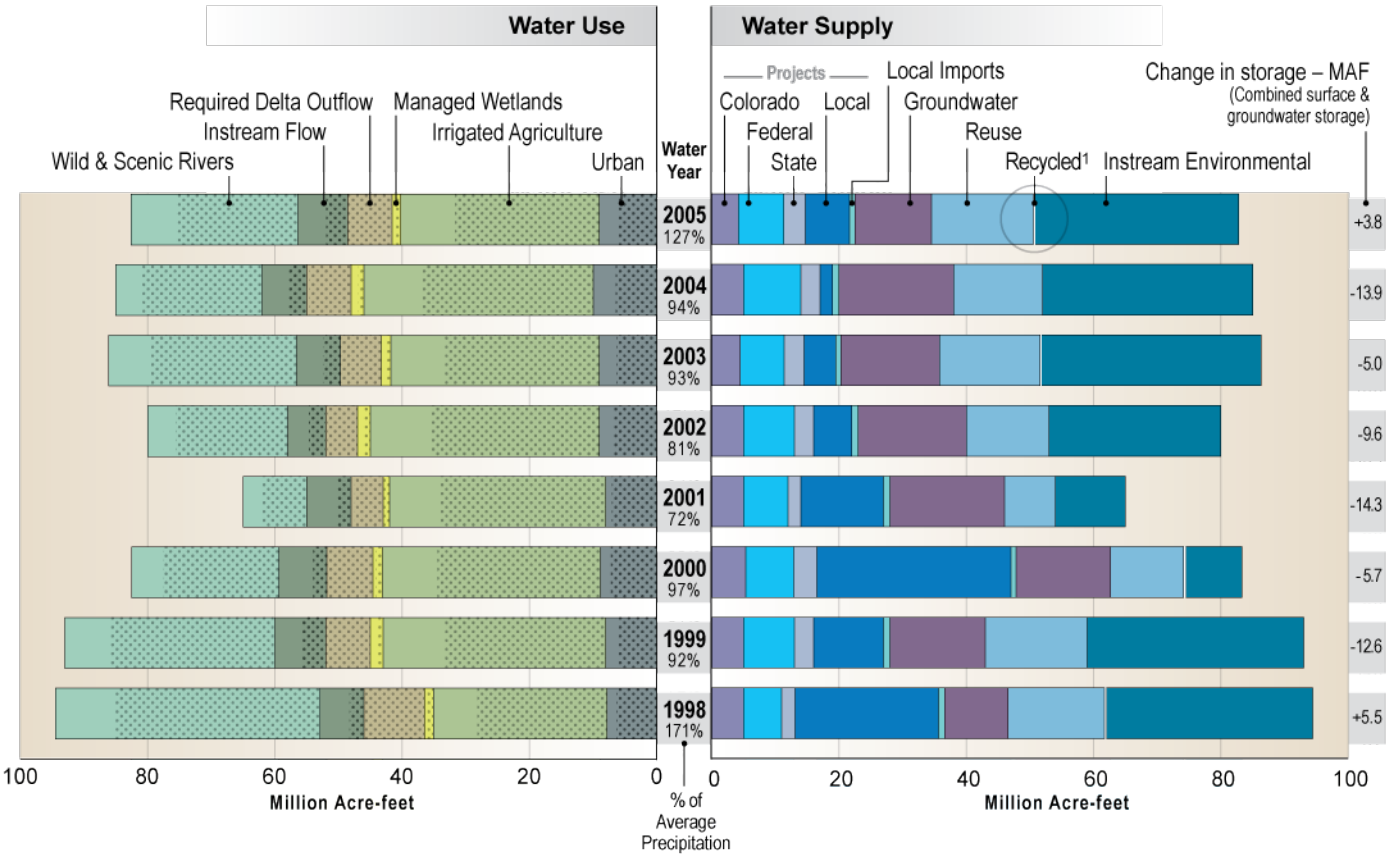
Future stresses on our water systems

- At what rate will California's population grow into the future?
- What will future urban, agricultural, and ecosystem land uses be?
- What are the limits to California's water supplies?
- How much will climate change result in rising sea level, more severe floods and droughts, and stress on the ecosystem?
- When will a major earthquake cause catastrophic failure of Delta levees and disrupt at least a portion of water supply to 25 million people and millions of acres of farmland?
- How will future regulations change the way the system is operated for water supply, flood management, water quality, and ecosystem health?
- What other unknown challenges (endangered species listings, new heath concerns for water quality, etc.) will surface?

California's Water Resources:

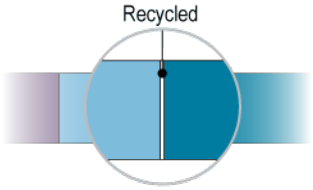
California Water Balance by Year

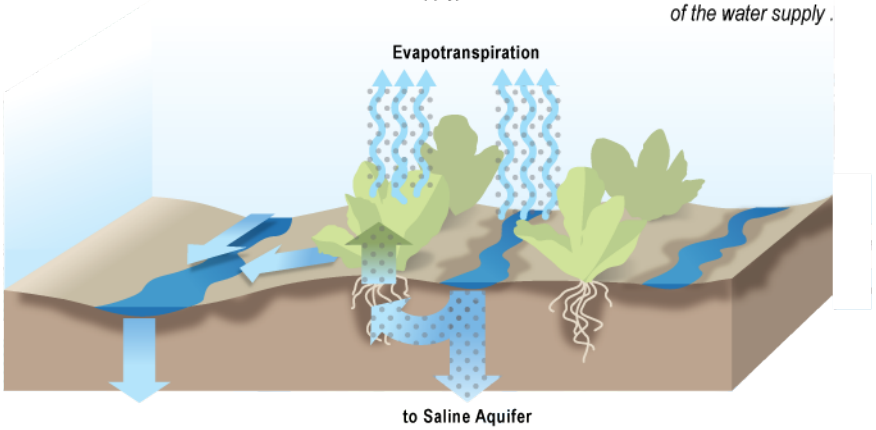
A lot of information is presented in this figure including statewide water use, source of supply, annual change in storage, and percentage of average precipitation.



Stippling in bars indicates **depleted (irrecoverable) water use** *(water consumed through evapotranspiration, flowing to salt sinks like saline aquifers, or otherwise not available as a source of supply)*

[1] **Detail of bar graph:** *For water years 1998-2005, recycled municipal water varied from 0.2 to 0.5 MAF of the water supply .*





Variable and Extreme

California is often recognized as a land of extremes—its diversity in cultures, ecosystems, geography, and water resources. However, "variable" would be a more accurate term to describe its water resources. Precipitation, which is the root of California's water supplies, varies from place to place, season to season, and year to year. Most of the state's snow and rain fall in the mountains in the north and eastern parts of the state, and most water is used in the valleys and along the coast. In addition, the state's ecosystem, agricultural, and urban water users have variable needs for the quantity, quality, timing, and place of use. The water and flood systems face both the threat of too little water to meet needs during droughts and too much water during floods.

Update 2005 began the process of developing water balances to show water used and sources of water for individual years. With Update 2009, statewide balances are available for eight water years, 1998 through 2005 (shown on the previous page). The eight-year sequence did not include any major floods and does not encompass the possible range of far wetter and far drier years in the record.

The figure demonstrates the state's variability for water use and water supply. "Water use" shows how applied water was used by urban and agricultural sectors and dedicated to the environment; and "water supply" shows where the water came from each year to meet those uses. In addition to what is shown, in an average year about 120 million acre-feet of precipitation and inflows either evaporates, is used by native vegetation, provides rainfall for agriculture and managed wetlands, or flows out of the state or to salt sinks like saline aquifers. (See next page for 2005 regional water balances and information about groundwater overdraft.)

Key Water Supply and Water Use Definitions

Applied water. The total amount of water that is diverted from any source to meet the demands of water users without adjusting for water that is depleted, returned to the developed supply or considered irrecoverable (see water balance figure).

Instream environmental. Instream flows used only for environmental purposes.

Instream flow. The use of water within its natural watercourse as specified in an agreement, water rights permit, court order, FERC license, etc.

Recycled water. Municipal water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.

Reused water. The application of previously used water to meet a beneficial use, whether treated or not prior to the subsequent use.

Urban water use. The use of water for urban purposes, including residential, commercial, industrial, recreation, energy production, military, and institutional classes. The term is applied in the sense that it is a kind of use rather than a place of use.

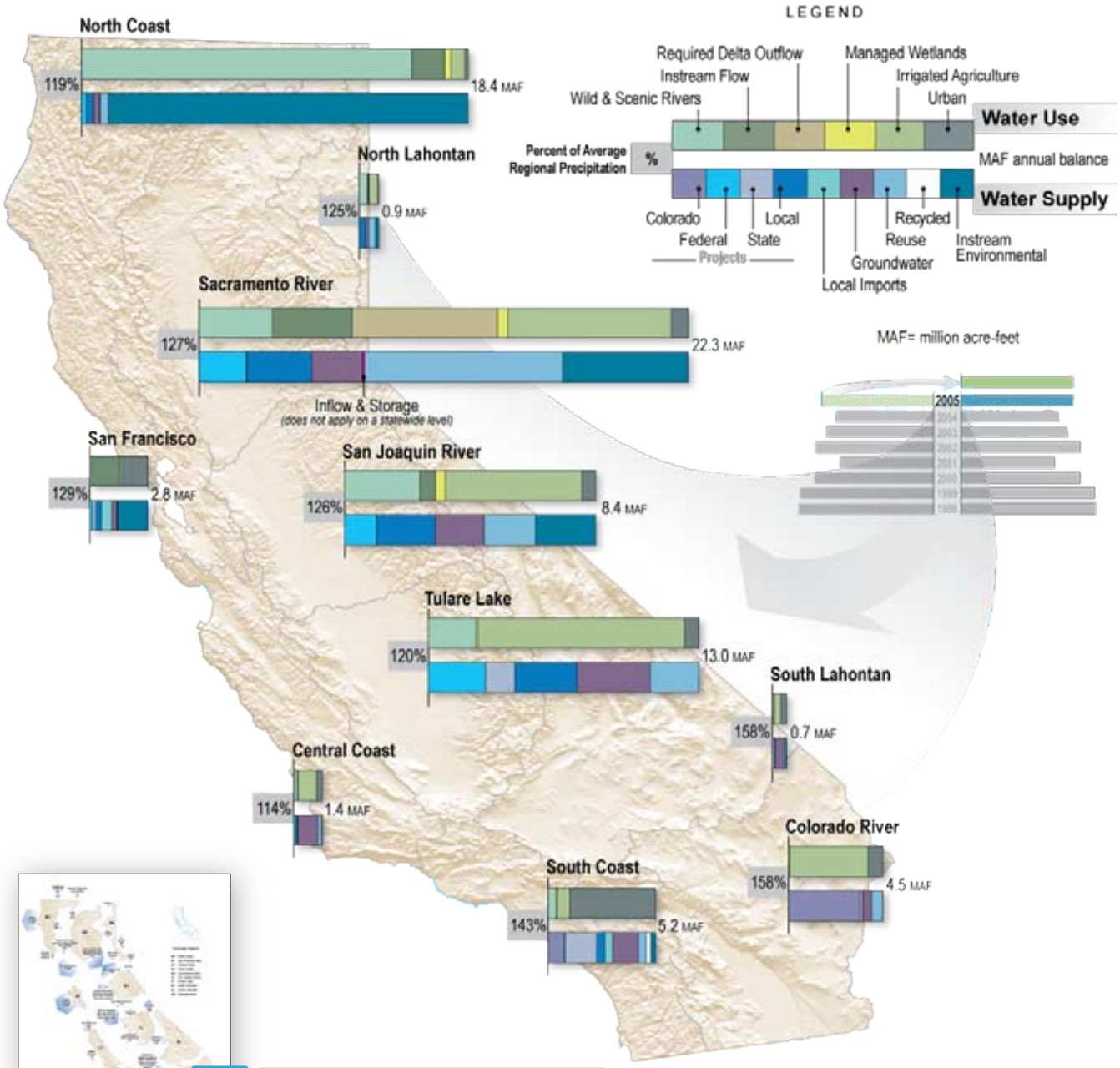
Water balance. An analysis of the total developed/dedicated supplies, uses, and operational characteristics for a region. It shows what water was applied to actual uses so that use equals supply.

For a description of California's variable and sometimes extreme conditions, read Volume 1 Chapter 4 California Water Today

California's Water Resources:

Water Balance by Region for Water Year 2005

Water balances can be used to compare how water supplies and uses can vary between wet, average, and dry hydrologic conditions through the regions and how each region's water balance can vary from year to year.



See Figure 4-9 Regional inflows and outflows, water year 2005 in Volume 1 Chapter 4 California Water Today for estimates of inter-regional flows.

Understanding Regional Diversity

California has a variety of climates and landforms. The amount and variability of precipitation can change dramatically between the northern regions of California and its southeast portions such that statewide average information does not truly depict regional conditions. It is common for the winter precipitation to be wet or above average in the northern portions of the state, while below normal to dry in the south and southeast portions for the same winter.

Agricultural, urban, and environmental water uses in a region all vary according to the wetness or dryness in a given year. In very wet water years with excessive precipitation, outdoor water demands are slightly lower due to the high amount of rainfall that directly meets the needs. During the very dry water years, demands for water are reduced as a result of urban and agriculture water conservation practices and because the available surface water supplies are at less-than-normal levels for use.

To better understand California's regional diversities and plan for future needs, the Department of Water Resources divides the state into 10 hydrologic regions. In addition two regional overlays—the Sacramento-San Joaquin River Delta region and the Mountain Counties area—combine areas of common interests.

In Update 2009, regional water portfolios provide information about annual water use and water supply balances for the 10 hydrologic regions and the Mountain Counties area for years 1998 through 2005. The figure on the facing page depicts balances for the hydrological regions for year 2005, considered a wet year statewide. Water balances can be used to compare how water supplies and uses can vary between wet, average, and dry hydrologic conditions through the regions and how each region's water balance can vary from year to year.

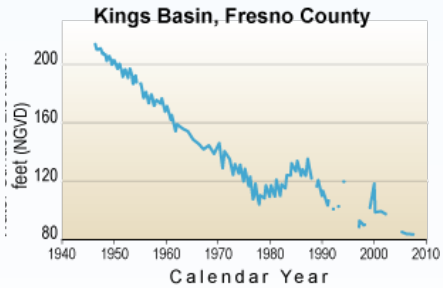
Groundwater

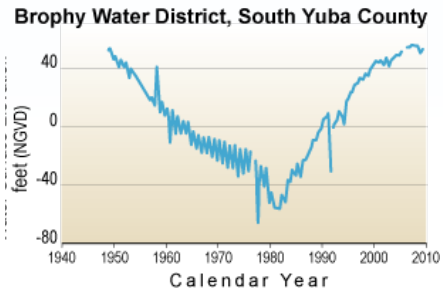
Each year on average, about 2 million acre-feet more groundwater is used than what naturally recharges – called groundwater overdraft. Overdraft is characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. Overdraft can lead to increased extraction costs, land subsidence, water quality degradation, and environmental impacts.

To better understand California's variable and sometimes extreme differences, read Volume 3 Regional Reports.

Groundwater Overdraft

The two hydrographs below show the response of groundwater levels to differing water management regimes. The first hydrograph shows groundwater levels declining in response to agricultural development in the San Joaquin Valley. Groundwater levels recover somewhat during the wet period of the early 1980s, but continue to decline through the 1980s and 1990s. The second hydrograph shows a similar groundwater level decline in response to development in southern Yuba County. However, groundwater levels begin to recover in the early 1980s when surface water imports from Yuba County Water Agency began. The hydrograph shows a decline in groundwater levels during the early 1990s drought as surface water imports were curtailed and groundwater was more heavily relied upon. Continued conjunctive water management action resulted in the refilling of the South Yuba Groundwater Subbasin, which continues up to present.





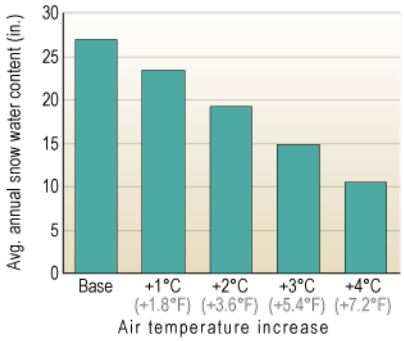
Climate Change:

By and large, California's reservoirs and water delivery systems were designed, and operating rules have been developed, using historical hydrology – an assumption that the past is a good guide to the future. With climate change, that assumption may no longer be valid.

What Has Already Happened?

Looking over the past century, the following changes are evident:

- California's temperature has risen one degree Fahrenheit, mostly at night and during the winter, with higher elevations experiencing the greatest increase.
- Average early spring snowpack in the Sierra Nevada has decreased by about 10 percent, a reduction of 1.5 million acre-feet of water in storage (one acre-foot of water is enough for one to two families for one year). Seasonal snowpack of the Sierra Nevada is California's largest surface water storage.
- Sea level along California's coast has risen 7 inches.
- Flood peaks in the state's rivers have increased.
- Climate patterns are more variable.



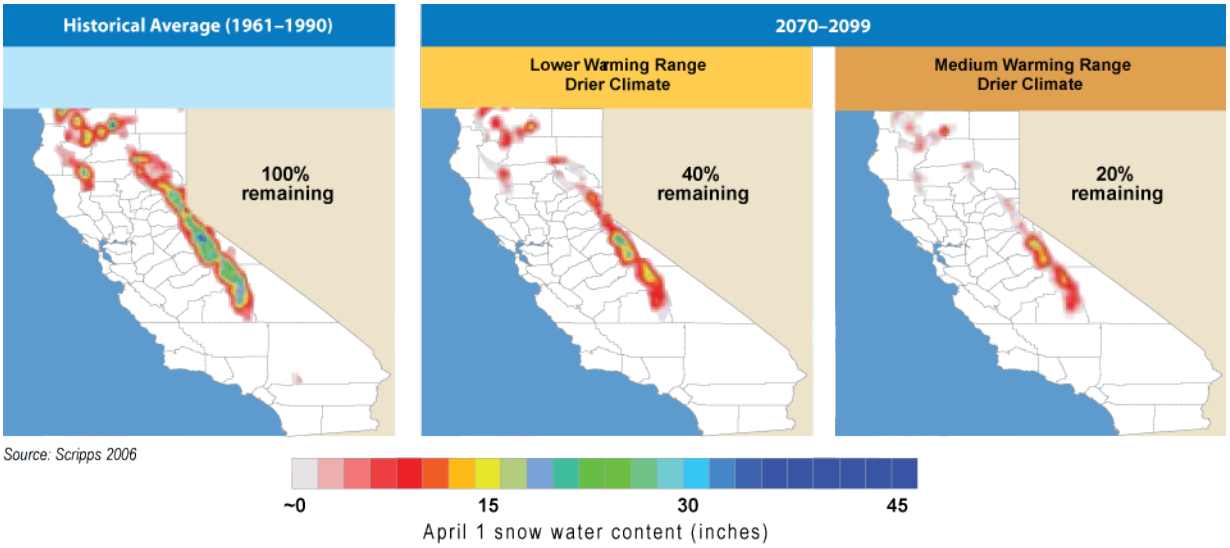
Average Annual Snowmelt for Upper Feather River Basin

Warming air temperatures may cause some of our precipitation to shift from snow to rain. This would lead to a reduction in the amount of snowpack, an important natural reservoir for storing water in the winter and later augmenting the water supply as spring snowmelt. Climate-change-induced shifts in the timing and the amount of snowmelt runoff may require revising traditional water planning practices. The Upper Feather River Basin provides water for Lake Oroville, the main water supply reservoir for the State Water Project.

Source: DWR 2009

Decreasing California Snowpack

These figures show projections of how two climate scenarios may reduce Sierra snowpacks to 40% and 20% of recent historical averages



Source: Scripps 2006

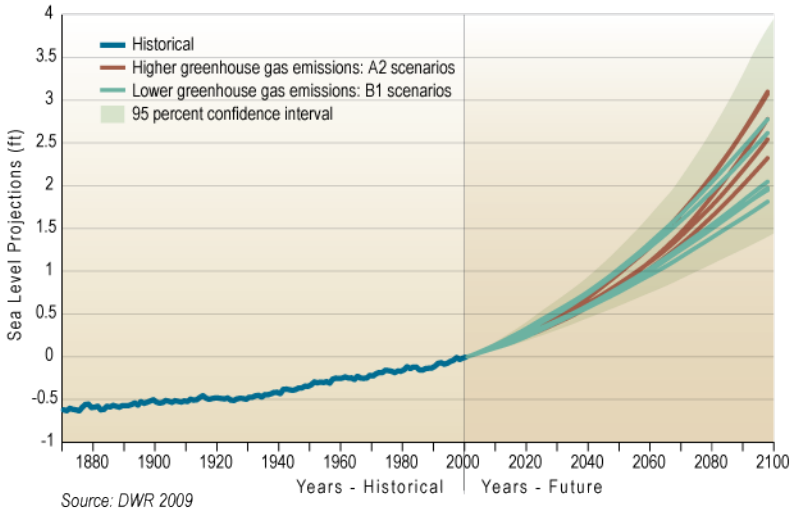
Future Hydrology Unlike the Past

What More is Expected?

Looking forward to the year 2050 and on to the end of the century, more changes can be expected:

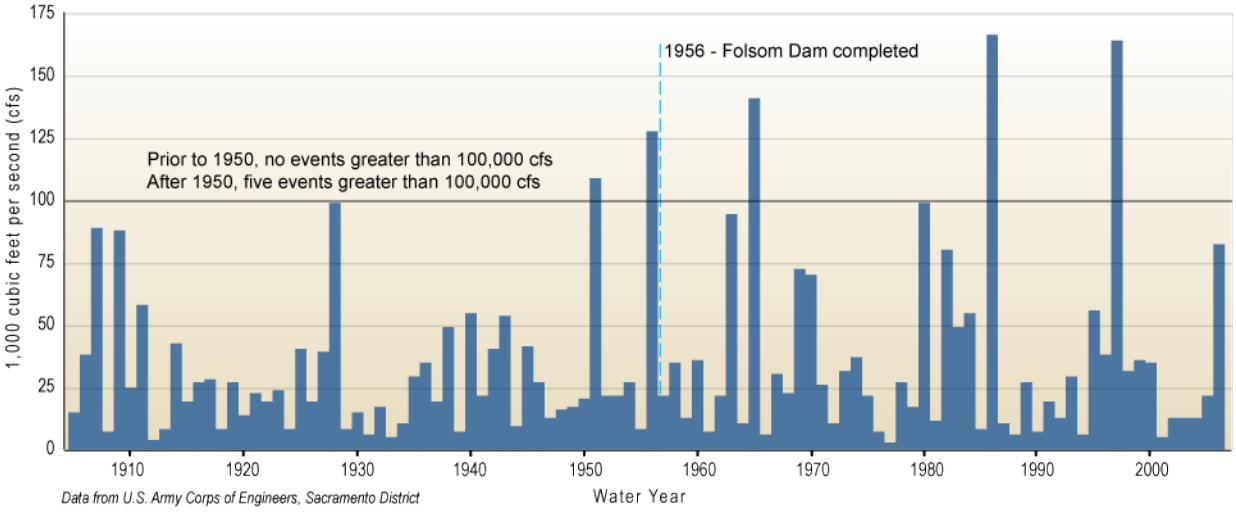
- California's mean temperature may rise 1.5 degrees to 5.0 degrees Fahrenheit by 2050 and 3.5 degrees to 11 degrees by the end of the century.
- Sierra Nevada snowpack may decrease by 25 to 40 percent by mid-century, a storage volume about 3.8 million acre-feet to 6 million acre-feet, from a little less to a little more than the capacity of California's largest constructed surface reservoir.
- Average annual precipitation may show little change, but more intense wet and dry periods can be expected – more floods and more droughts.
- Flood peaks will become higher and natural spring/summer runoff will become lower.
- Studies show a possible global sea level rise of 4 to 16 inches by mid-century and 7 to 55 inches by the end of the century.
- Higher sea levels will increase salinity in the Delta.

Historical and Projected Sea Level at Golden Gate



American River Runoff Annual Maximum 3-Day Flow

The five highest floods of record on the American River have occurred since 1950.



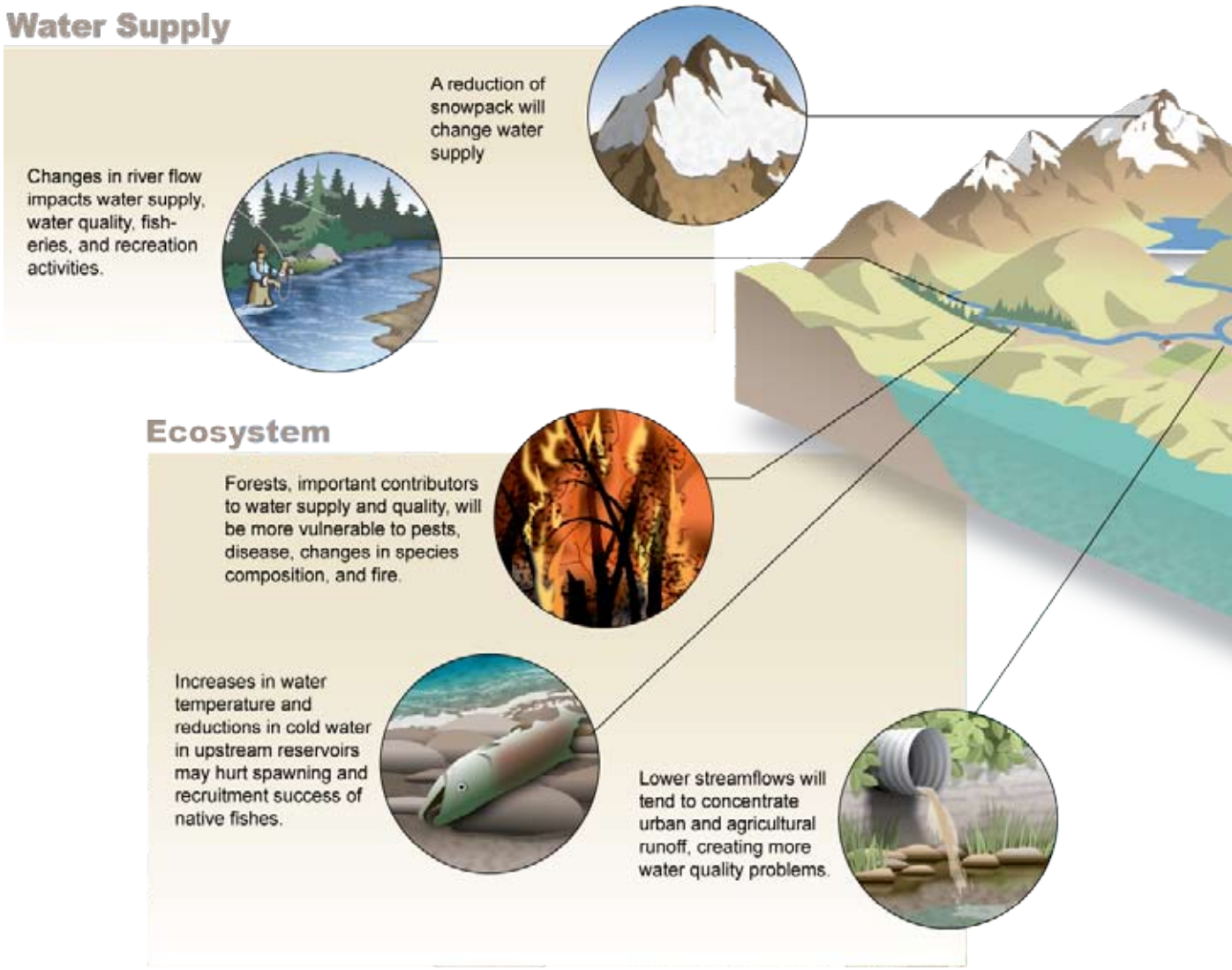
Read more on climate change in Volume 1 Chapter 5 Managing an Uncertain Future and Chapter 6 Integrated Data and Analysis. Find technical and support articles in Volume 4 Reference Guide.

Climate Change:

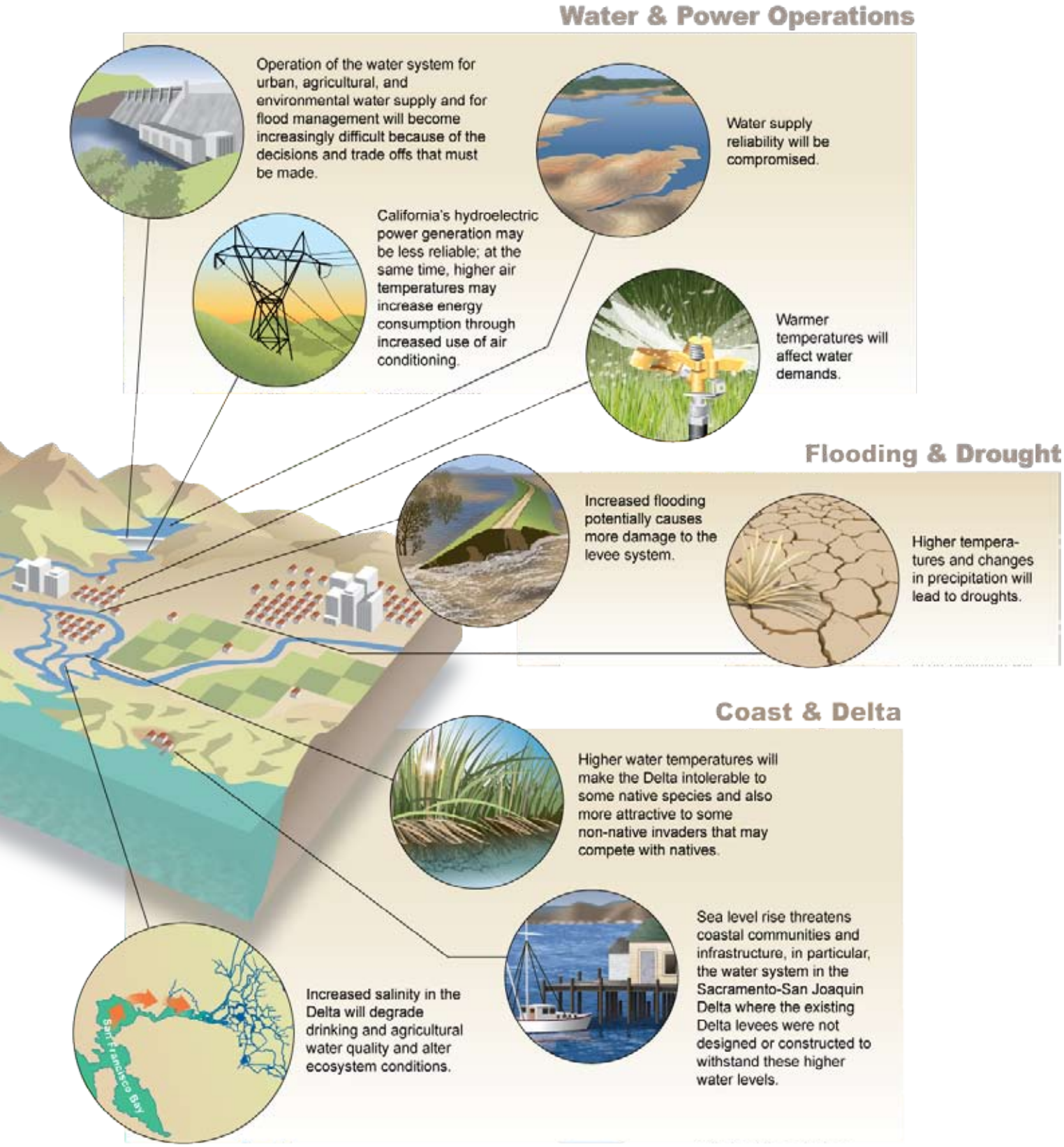
What are the Expected Impacts from These Changes?

Climate change is already having a profound effect on California's water resources as evidenced by changes in snowpack, river flows, and sea levels. Scientific studies show these changes will increase stress on the water systems in the future. Because some level of climate change is inevitable, the water systems must be adaptable to change.

The impacts of these changes will gradually increase during this century and beyond. California needs to plan for water system modifications that adapt to the following impacts of climate change:



Stressing Our Water Systems



California Water Plan Update 2009:

Integrated Water Management

The California Water Plan updates have been important sources of information for water planners since 1957. But unlike prior Water Plan updates, which were primarily products of the Department of Water Resources, Update 2009 truly can be viewed as the state's Water Plan. It has benefited from the first interagency California Water Plan steering committee representing 21 state government agencies with jurisdictions over different aspects of water resources and integrates their companion planning documents. In addition, a 45-member advisory committee, expanded regional outreach, greater involvement of California Native American Tribes, and coordination with federal agencies provided broad participation in plan preparation.

Update 2009 builds on the framework and resource management strategies outlined by California Water Plan Update 2005 promoting two major initiatives:

- **Integrated regional water management** enables regions to implement strategies appropriate for their own needs and helps them become more self-sufficient.
- **Improved statewide water and flood management systems** provides for upgrades to the large physical facilities, such as the State Water Project, and statewide management programs essential to the California economy.

To minimize the impacts of water management on California's natural environment and make sure that the state continues to have the water supplies it needs, the two initiatives are supported by three foundational actions:

- Use water efficiently to get maximum utility from existing supplies.
- Protect water quality to safeguard public and environmental health and secure the state's water supplies for their intended purposes.
- Expand environmental stewardship as part of water management responsibilities.

Unfold to read the details of
Water Plan's Strategic Plan

Building on a Framework

Update 2009 uses the same framework presented in Update 2005 and enhances it in several areas:

- Integrates information and recommendations from many state plans and initiatives, particularly those agencies on the Water Plan Steering Committee.
- Incorporates consideration of uncertainty, risks, and resource sustainability into planning for the future to reduce uncertainties, recognize risks to success, and manage for more sustainable water supply, flood management, and ecosystems.
- Includes integrated flood management and drought contingency plan.
- Advances climate change adaptation and mitigation strategies.
- Includes information from Native American Tribes and proceedings from the 2009 California Tribal Water Summit.
- Updates resource management strategies and regional reports.
- Extends regional and statewide water balances to include eight years.
- Includes a plan for improving data, analytical tools, and information management and exchange.
- Further acknowledges that the Water Plan as a living document will continue to evolve and adapt integrated water management.

Update 2009 integrates information and recommendations from key state plans and initiatives. See Volume 1, Chapter 3 Companion State Plans

Transitioning from Extraction to Sustainable Outcomes

Incorporating the concept of resource sustainability is an ongoing process or approach that will continue to be developed in future Water Plan updates. A system that is sustainable meets today's needs without compromising the ability of future generations to meet their own needs. A sustainable system generally provides for the economy, the ecosystem, and equity.

Over the past few decades, questions have been raised about how sustainable our ecosystems and water, land, and other resources are, given current management practices and expected future changes. California's water resources are finite and now require managing for sustainability—management that may be different than what has been practiced during the first 150 years of the state's history.

To achieve sustainability, resource managers and planners must transition from the past model that places value primarily on water supply yield and extraction to a model that values sustainable outcomes.

Find more about the roadmap to safe and clean water through 2050 in Volume 1 Chapter 2 Imperative to Act and Chapter 7 Implementation Plan.

Unfold to read the details of
Water Plan's Strategic Plan

California Vision 2050:

Update 2009 sets us on a strategic path to managing our water resources in a way that pro

Desired future for California water

California has healthy watersheds and integrated, reliable and secure water resources and management systems that

- Enhance public health, safety, and quality of life in all its communities;
- Sustain economic growth, business vitality, and agricultural productivity; and
- Protect and restore California's unique biological diversity, ecological values, and cultural heritage.

Desired outcomes over the planning horizon 2050

1. California has water supplies that are adequate, reliable, secure, affordable, sustainable, and of suitable quality for beneficial uses to protect, preserve, and enhance watersheds, communities, and environmental and agricultural resources.

2. State government supports integrated water resources planning and management through leadership, oversight, and public funding.

3. Regional and interregional partnerships play a pivotal role in California water resources planning, water management for sustainable water use and resources, and increasing regional self-sufficiency.

4. Water resource and land use planners make informed and collaborative decisions and implement integrated actions to increase water supply reliability, use water more efficiently, protect water quality, improve flood protection, promote environmental stewardship, and ensure environmental justice in light of drivers of change and catastrophic events.

5. California is prepared for climate uncertainty by developing adaptation strategies and investing in a diverse set of actions that reduce the risk and consequences posed by climate change, that make the system more resilient to change, and that increase the sustainability of water and flood management systems and the ecosystems they depend on.

6. Integrated flood management, as a part of integrated water management, increases flood protection, improves preparedness and emergency response, enhances floodplain ecosystems, and promotes sustainable flood management systems.

7. The benefits and consequences of water decisions and access to state government resources are equitable across all communities.

Vision & Mission
•
Goals
•
Guiding Principles
•
Objectives & Actions
•
Recommendations

The Desired Future for Water

vides reliable and clean water supplies for all beneficial uses today and for generations.

Purpose of the Water Plan

Updating the California Water Plan provides state, federal, Tribal, regional, and local governments and organizations a continuous strategic planning forum to collaboratively:

- Recommend strategic goals, objectives, and near-term and long-term actions that would conserve, manage, develop, and sustain California's watersheds, water resources, and management systems;
- Prepare response plans for floods, droughts, and catastrophic events that would threaten water resources and management systems, the environment, property, and the health, welfare, and livelihood of the people of California; and
- Evaluate current and future watershed and water conditions, challenges, and opportunities.

Core values and philosophies / How to make decisions

1. Use a broad, stakeholder-based, long-view perspective for water management.
2. Promote management for sustainable resources on a watershed basis.
3. Increase regional drought and flood preparedness.
4. Increase regional self-sufficiency.
5. Promote regional coordination and collaboration among local governments and agencies, public and private organizations, and Tribal governments and Tribal communities.
6. Determine values for economic, environmental, and social benefits, costs, and tradeoffs to base investment decisions on sustainability indicators.
7. Incorporate future variability, uncertainties, and risk in the decision-making process.
8. Apply California's water rights laws, including the longstanding constitutional principles of reasonable use and public trust, as the foundation for public policy-making, planning, and management decisions on California water resources.
9. Promote environmental justice -- the fair treatment of people of all races, cultures, and incomes.
10. Use science, best data, and local and indigenous peoples' knowledge in a transparent and documented process.

Read more about the Water Plan's strategic plan elements in Volume 1 Chapter 2 Imperative to Act

Implementation Pla

Update 2009's implementation plan has 13 objectives that will help us achieve the Water Plan will help California deal with a changing climate and other uncertainties and risks, and provide

Numbering of elements in this strategic plan is for ease of reference and does not represent priority

Statements of intent / What and when

1. **Expand Integrated Regional Water Management**
   Promote, improve, and expand Integrated Regional Water Management to create and build on partnerships that are essential for California water resources planning, sustainable watershed and floodplain management, and increasing regional self-sufficiency.

2. **Use and Reuse Water More Efficiently**
   Use water more efficiently with significantly greater water conservation, recycling, and reuse to help meet future water demands and adapt to climate change.

3. **Expand Conjunctive Management of Multiple Supplies**
   Advance and expand conjunctive management of multiple water supply sources with existing and new surface water and groundwater storage to prepare for future droughts, floods, and climate change.

4. **Protect Surface Water and Groundwater Quality**
   Protect and restore surface water and groundwater quality to safeguard public and environmental health and secure California's water supplies for their beneficial uses.

5. **Expand Environmental Stewardship**
   Practice, promote, improve, and expand environmental stewardship to protect and enhance the environment by improving watershed, floodplain, and instream functions and to sustain water and flood management systems.

6. **Practice Integrated Flood Management**
   Promote and practice integrated flood management to provide multiple benefits including better emergency preparedness and response, higher flood protection, more sustainable flood and water management systems, and enhanced floodplain ecosystems.

7. **Manage a Sustainable California Delta**
   Set as co-equal goals a healthy Delta ecosystem and a reliable water supply for California and recognize the Delta as a unique and valued community and ecosystem to promote and practice management for a sustainable California Delta.

8. **Prepare Prevention, Response, and Recovery Plans**
   Prepare prevention, response, and recovery plans for floods, droughts, and catastrophic events to help residents and communities, particularly disadvantaged communities, make decisions that reduce the consequences and recovery time of these events when they occur.

an: *An Urgent Roadmap*

goals. Meeting these objectives, and planning and investing in their 115-plus related actions,
more adaptive and resilient ecosystems and more sustainable water and flood systems.

9. **Reduce Energy Consumption of Water Systems and Uses**
   Reduce the energy consumption of water and wastewater management systems by implementing the water-related strategies in AB 32 Scoping Plan to mitigate greenhouse gas emissions.

10. **Improve Data and Analysis for Decision-making**
    Improve and expand monitoring, data management, and analysis to support decision-making, especially in light of uncertainties, that support integrated regional water management and flood and water resources management systems.

11. **Invest in New Water Technology**
    Identify and fund applied research on emerging water technology to make them attainable and more cost effective.

12. **Improve Tribal Water and Natural Resources**
    Develop Tribal consultation, collaboration, and access to funding for water programs and projects to better sustain Tribal water and natural resources.

13. **Ensure Equitable Distribution of Benefits**
    Increase the participation of small and disadvantaged communities in state processes and programs to achieve fair and equitable distribution of benefits. Consider mitigation of impacts from the implementation of state government programs and policies to provide safe drinking water and wastewater treatment to all California communities and ensure that these programs and policies address the most critical public health threats in disadvantaged communities.

Find details of the Water Plan's objectives and related actions in Volume 1 Chapter 7 Implementation Plan

Water Scenarios 2050:

What will California look like in 2050? Will the population growth keep pace with recent trends? Will the pattern of climate change continue? Will the protection of water quality and endangered species be driven mostly by lawsuits, creating a patchwork of legal requirements? We have no way of predicting the future, but we can construct some plausible scenarios. Future scenarios can be used to help us better understand the implications of future conditions on water management. Update 2009 made significant improvements to the scenarios by considering the potential effect of long-term climate change on future water demands. (See more on climate change in Highlights pages 8 through 11.)

The California Water Plan acknowledges that planning for the future is uncertain and that change will continue to occur. It is not possible to know for certain how population, water demand patterns, environmental conditions, the climate, and many other factors that affect water use and supply may change by 2050. To anticipate change, our approach to water management and planning for the future needs to incorporate consideration of uncertainty, risk, and sustainability.

Factors of Uncertainty

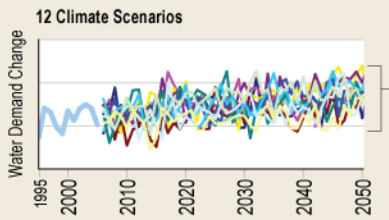
- Population
- Land Use
- Irrigated Crop Area
- Environmental Water
- Background Water Conservation

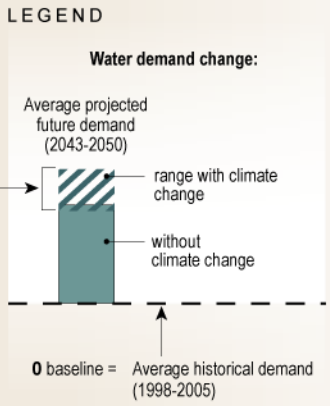
Update 2009 uses three future scenarios for year 2050 to illustrate how the water community would need to respond to a variety of future conditions. Regions respond by implementing a mix of resource management strategies. (See more about resource management strategies on Highlights pages 18 and 19 and examples of regional strategies on Highlights pages 20 and 21.) The title of each scenario—Current Trends, Slow & Strategic Growth, and Expansive Growth—tells us something about how different factors, like population, irrigated farmland, or background water conservation (plumbing code changes, natural replacement, actions water users implement on their own, etc.), are assumed to change over time. These are factors over which the water community has little control yet affect future water demand for the urban, agricultural, and environmental sectors.

Water Demand Changes and Climate Change Variability

The graph under each scenario represents future **water demand change** (the difference between the average demands for 2043-2050 and 1998-2005.) This change could be either an increase (above baseline) or a decrease (below baseline) in water use.

Climate change adds another dimension of variability to demand changes. In figure at right, historical period shows actual demand (blue line). Each colored line represents 1 of 12 climate scenarios. This variability is represented on the water demand change graph by the hatched area.





Factors That Shape Our Future

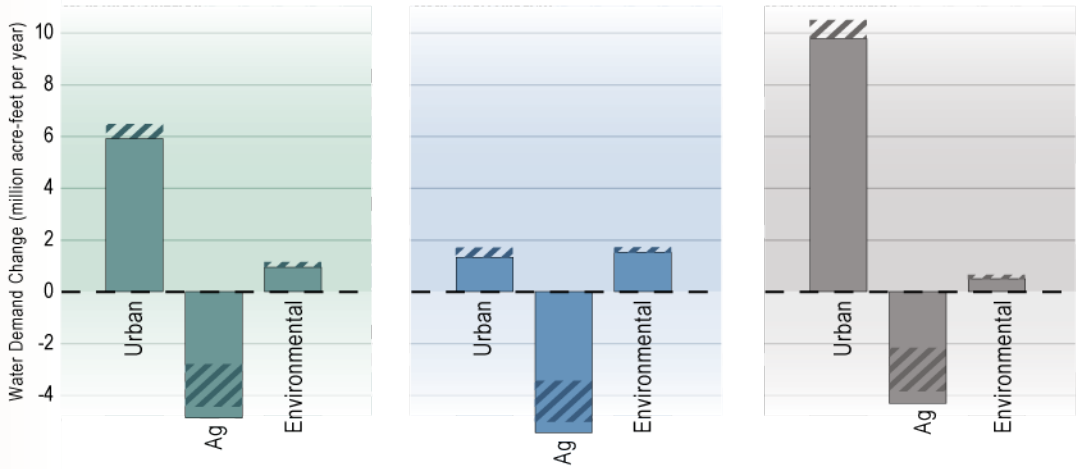
An uncertain future to which the water community will need to respond

Current Trends	Slow & Strategic Growth	Expansive Growth
Recent trends are assumed to continue into the future. Regulations are not coordinated or comprehensive, creating uncertainty for planners and managers. The state continues to face lawsuits, from flood damages to water quality and endangered species protections.	Private, public, and governmental institutions form alliances to provide for efficient planning and development that is less resources intensive than current conditions. State government implements comprehensive and coordinated regulatory programs to improve water quality, protect fish and wildlife, and protect communities from flooding.	Future conditions are more resource intensive than existing conditions. Protection of water quality and endangered species is driven mostly by lawsuits. State government has responded on a case-by-case basis, creating a patchwork of regulations and uncertainty for planners and water managers.
59.5 million* (22.8 million increase)	**44.2** million (7.5 million increase)	**69.8** million (33.1 million increase)
Continued development	Compact development	Sprawling development
8.6 million acres (0.7 mil. acre decrease)	**9.0** million acres (0.2 mil. acre decrease)	**8.2** million acres (1.0 mil. acre decrease)
1.0 additional MAF	**1.5** additional MAF	**0.6** additional MAF
10% more efficient	**15%** more efficient	**5%** more efficient

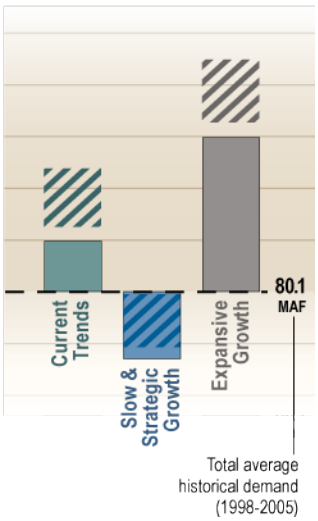
The charts at the bottom of this page show net change in statewide water demand between 2050 and 2050 for each scenario. (See pages 16 and 17 for potential water demand changes for each hydrologic region.)

* *Department of Finance population projection*

2050 Water Demand Changes by Scenario



Combined Water Demand Change by Scenario

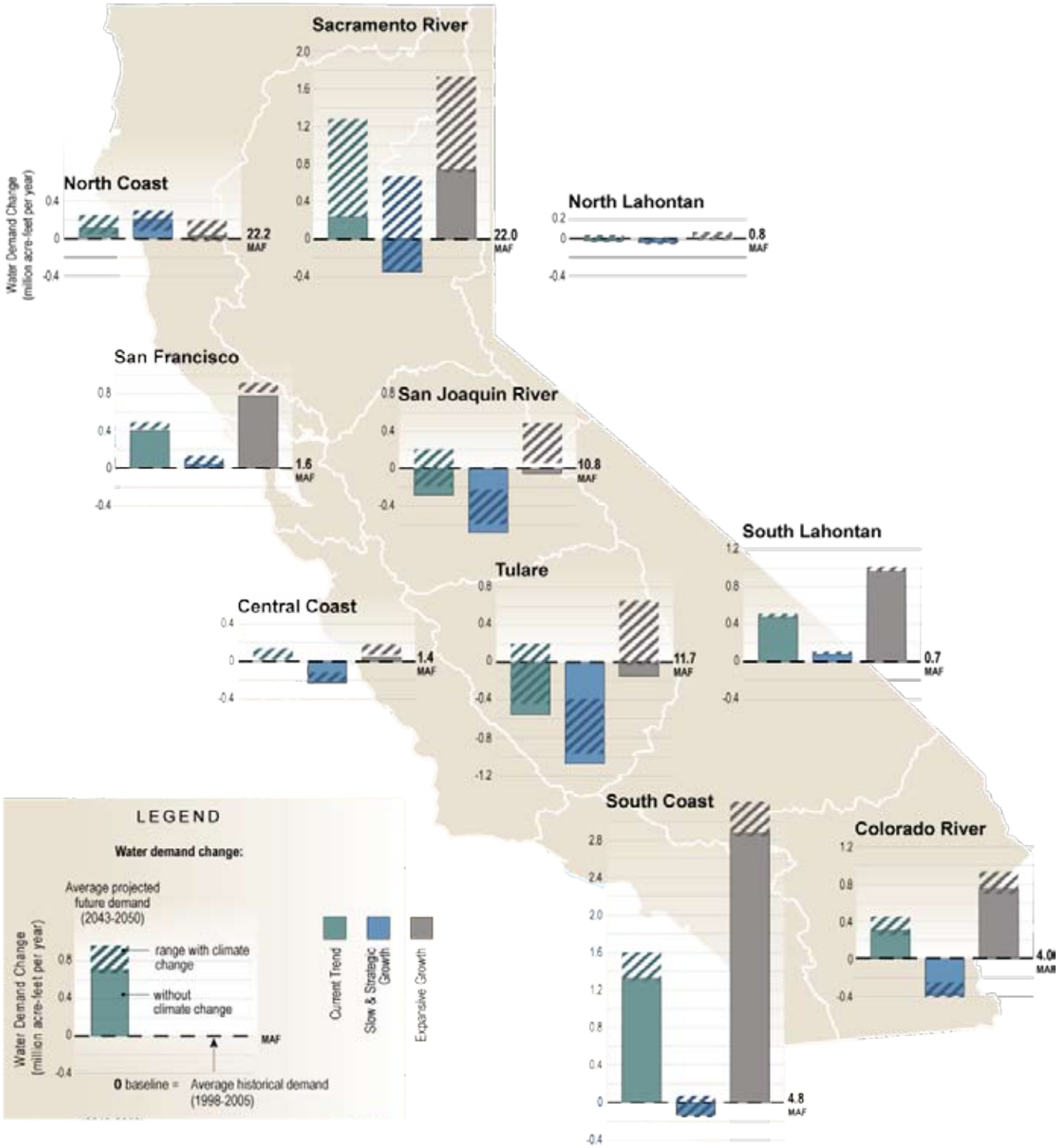


Read more on scenarios and how they were used in estimating future water demand in Volume 1, Chapter 5 Managing an Uncertain Future

Water Scenarios 2050:

Future Regional Water Demand Changes by Scenario

Hydrologic regions expecting higher population growth show higher changes in water demands. Water demand changes in Central Valley agricultural areas were most sensitive to the warmer and drier climate change scenarios.



From a Regional Perspective

The three baseline scenarios for 2050 (described on pages 14 and 15) would play out differently in various hydrologic regions. This regional variability is illustrated in the figure at left, showing the combined urban, agricultural, and environmental water demand changes for each scenario in each region.

The way scenario water demands change in each region reflects a number of things—the relative amount of water demand in the region for cities, farms, and environment; how the scenario factors (population, irrigated crop acreage, and water dedicated to the environment) increase or decrease in each area of the state; and how temperature and precipitation changed regionally in the 12 climate change scenarios examined.

Hydrologic regions expecting higher population growth under the Current Trends and Expansive Growth scenarios, like the South Coast and the Sacramento River, show higher changes in water demands. Population growth also tends to drive urbanization of agricultural lands, reducing irrigated crop acreage.

Precipitation and temperature heavily influence water demand for outdoor landscaping and irrigated agriculture. Less precipitation falling during the growing season increases the need to apply more irrigation water. Warmer temperatures increase crop evapotranspiration, which increases water demand.

Water demand stays the same or decreases in the San Joaquin River and Tulare Lake regions when climate change was not considered because of less irrigated crop area from urbanization and more background water conservation. Water demand changes in Central Valley agricultural areas were most sensitive to the warmer and drier climate change scenarios. This is particularly evident in the Sacramento River Region where the variation in potential change in water demand is quite large across the 12 climate change scenarios.

Each future scenario describes a different baseline for 2050, to which the water community would need to respond by implementing a mix of the resource management strategies shown on pages 18 and 19. No single management strategy is sufficient to meet future regional demands with so much variation possible from region to region and sector to sector. California needs to ensure that each region can tailor responses to local conditions. We can achieve this most effectively by implementing integrated regional water management supported by strong statewide water management systems.

Read how future scenarios can help us deal with uncertainty and risk and improve resource sustainability in Volume 1 Chapter 5 Managing an Uncertain Future and Chapter 6 Integrated Data and Analysis.
Find regional water demand information in Volume 3 Regional Reports.

Resource Management Strategies:

Integrated water management undertakes water and flood management at all fronts and on many levels—regionally and statewide, for multiple uses and benefits, for sustaining watersheds, water uses, and water and flood management systems, while weighing the risks of uncertain futures.

The 27 resource management strategies presented here provide a range of choices and are the building blocks for this approach. The strategies are grouped by their intended outcome, and the potential benefits and implementation cost are presented for each strategy.

Potential Strategy Benefits[1]										
Provide Water Supply Benefit	MAF/year - Applied Water	Improve Drought Preparedness	Improve Water Quality	Operational Flex & Efficient	Reduce Flood Impacts	Environmental Benefits	Energy Benefits	Recreational Opportunities	Reduce GW Overdraft	Accumulated Cost by 2030 ($ Billions)

Reduce Water Demand

Water conservation has become a viable long-term supply option because it saves considerable capital and operating cost for utilities and consumers, avoids environmental degradation, and creates multiple benefits.

Strategy	Potential Strategy Benefits[1] MAF/year[2]									Accumulated Cost by 2030 $ Billions[2]
Agricultural Water Use Efficiency	0.1 - 1.0[3]									0.3 - 5.0
Urban Water Use Efficiency	1.2 - 3.1									2.5 - 6.0

Improve Operational Efficiency & Transfers

California's water system responds to our need to move water from where it occurs to where it will be used.

Strategy	Potential Strategy Benefits[1] MAF/year[2]									Accumulated Cost by 2030 $ Billions[2]
Conveyance—Delta	N/A									1.2 - 17.2
Conveyance—Regional/Local	N/A									N/A
System Reoperation	N/A									N/A
Water Transfers	N/A									N/A

Increase Water Supply

California's communities are finding innovative ways to generate new supplies.

Strategy	Potential Strategy Benefits[1] MAF/year[2]									Accumulated Cost by 2030 $ Billions[2]
Conjunctive Management & Groundwater Storage	0.5 - 2.0									N/A
Desalination – Brackish & Seawater	0.3 - 0.4									2.0 - 3.0
Precipitation Enhancement	0.3 - 0.4									0.1 - 0.2
Recycled Municipal Water	1.8 - 2.3									6.0 - 9.0
Surface Storage—CALFED	0.1 - 1.1									0.7 - 9.2
Surface Storage—Regional/Local	N/A									N/A

1. Actual resource management strategy benefits, e.g., reducing groundwater overdraft, will depend on how strategies are implemented.
2. Additional information is found in resource management strategies and Volume 5 Technical Guide.
3. Value is Net Water to account for water reuse among agricultural water users.

N/A= Not Available

A Range of Choices

As California changes, local agencies and governments continue to use different methods for managing water resources. Growing population, changing regulations, and evolving public attitudes and values are a few conditions that are influencing water decisions. No single response package will work for all areas of California. Facing an uncertain future, regions need to invest in an appropriate mix of strategies based on integrated regional water management plans that are diversified, satisfy regional and state needs, meet multiple resource objectives, include public input, address environmental justice, mitigate impacts, protect public trust assets, and are affordable.

Improve Water Quality

Improved water quality can directly improve the health of Californians and our ecosystem.

Strategy	Potential Strategy Benefits[1] MAF/year[2]	Accumulated Cost by 2030 $ Billions[2]
Drinking Water Treatment and Distribution	N/A	1.4 / year
Groundwater/Aquifer Remediation	N/A	20.0
Matching Quality to Use	N/A	0.1
Pollution Prevention	N/A	21.0
Salt and Salinity Management	N/A	>10.0
Urban Runoff Management	N/A	N/A

Practice Resource Stewardship

We must protect other resources as we make water supplies available for other beneficial uses.

Strategy	Potential Strategy Benefits[1] MAF/year[2]	Accumulated Cost by 2030 $ Billions[2]
Agricultural Lands Stewardship	N/A	5.3
Economic Incentives (Loans, Grants, Water Pricing)	N/A	N/A
Ecosystem Restoration	N/A	N/A
Forest Management[4]	0.1 - 0.5	0.3 - 0.8
Land Use Planning and Management	N/A	N/A
Recharge Area Protection	N/A	N/A
Water-dependent Recreation		N/A
Watershed Management	N/A	0.5 - 3.6

Improve Flood Management

Strategy	Potential Strategy Benefits[1] MAF/year[2]	Accumulated Cost by 2030 $ Billions[2]
Flood Risk Management	N/A	N/A

4. Numbers are for Meadow Restoration only.

N/A= Not Available

NOTE: The water supply benefits are not additive. Additional select unit cost information is found in Box 1-2 of Volume 2. Although presented individually, the resource management strategies are alternatives that can complement each other or compete for limited system capacity, funding, water supplies, or other components necessary for implementation. Assumptions, methods, data, and local conditions vary per strategy.

Find descriptions of 27+ resource management strategies in Volume 2.

Regional Strategies:

Regional partnerships in many parts of the state are successfully employing a mix of resource management strategies. Experience is showing that these regional efforts can better resolve regional needs, especially when paired with statewide water management systems.

With Integrated Regional Water Management (IRWM), regions have been able to take advantage of opportunities that are not always available to individual water suppliers: reduce dependence on imported water and make better use of local supplies; enhance use of groundwater with greater ability to limit groundwater overdraft; increase supply reliability and security; and improve water quality. More is being done to meet water demands with water conservation, reoperation of facilities, water recycling, groundwater storage and management, transfer programs, and, in limited cases, regional or local surface storage reservoirs. Overall, this increased focus on IRWM solves water management problems more efficiently, considers other resource issues, and enjoys broader public support.

IRWM provides an effective forum and a critical framework for actions to address the uncertainties presented by climate change as well as other risks to California's water future. The extent to which regions have carried these out has been driven by considerations like economics, environment, engineering, and institutional feasibility. For more information on the IRWM Program, go to Web site: *http://www.water.ca.gov/irwm/*

See more about regional strategies in Volume 3 regional reports.

North Coast

- Araujo Dam Restoration Project
- Newell Water System Upper Mattole River Culvert Replacement
- Westport Water Tank

San Francisco Bay

- Mocho Groundwater Demineralization Plant
- Water Saving Hero Campaign

San Joaquin River

- Yosemite Spring Park Utility Company Improvements

South Coast

Los Angeles

- Calleguas Regional Salinity Management Project
- Arundo Removal
- Las Virgenes Creek Restoration
- Joint Water Pollution Control Plant Marshland Enhancement (Bixby Marshland)

Santa Ana

- Arlington Desalter
- Orange County Groundwater Replenishment System
- Solar Array at RP-5 Wastewater Treatment Plant

San Diego

- Tri-County Funding Area Coordinating Committee
- El Monte Valley Groundwater Recharge and River Restoration Project
- Carlsbad Desalination Project Local Conveyance
- Rancho California Water District Water Reclamation Project
- Santa Margarita Conjunctive Use Project

Multiple Responses and Benefits

Sacramento River

- Red Clover Valley Restoration – Upper Feather River Watershed
- The Bear River Project: Reducing Legacy Mercury Contamination

North Lahontan

- Merrill Davies Meadow Restoration Project

Central Coast

- Groundwater Recharge Enhancement
- City of Watsonville Recycled Water Facility and Pajaro Valley Water Management Agency Coastal Distribution System
- Salinas Valley Water Project
- Santa Maria Wastewater Treatment Plant Expansion
- Los Osos Wastewater Project

Tulare Lake

- Southern Sierra IRWM Effort
- Alta Irrigation District Harder Pond recharge and banking project

South Lahontan

- Inyo-Mono Integrated Regional Water Management Project
- Upper Amargosa Creek Recharge and Nature Park Project
- Antelope Valley Regional Recycled Water Project

Colorado River

- Coachella Valley Regional Water Management Group potential projects include water conservation, recycling, conjunctive use and water quality improvements.
- Salton Sea restoration partnership
- Coachella Canal Lining
- All-American Canal Project

• Regional strategies information provided by Roundtable of Regions

Conclusion

With new urgency, this Water Plan follows the Update 2005 roadmap to sustainable water uses and reliable water supplies—to use water efficiently, improve water quality, and expand environmental stewardship. Update 2009 marks a new chapter in the way California must manage her water resources. It is the state's blueprint for integrated water management and sustainability—statewide and regional.

Landmark legislation signed by the Governor in November 2009 will provide needed impetus and acceleration to achieve progress in implementing resource management strategies that are critical for regions across the state including urban and agricultural water conservation, monitoring of groundwater basins, and restructuring governance to better address the sustainability of the Delta and to improve water supply reliability.

We must adapt and evolve California's water systems more quickly and effectively to keep pace with ever changing conditions now and in the future. Population is growing while available water supplies are static and even decreasing. Climate change, as evidenced by changes in snowpack, river flows, and sea levels, is profoundly impacting our water resources. The Delta and other watersheds and ecosystems continue to decline. The state's current water and flood management systems are increasingly challenged by legal remedies and regulatory protections, with economic and societal consequences. The entire system—water and flood management, watersheds, and ecosystems—has lost its resilience and is changing in undesirable ways.

So where do we start? — From all directions! — It is imperative that decisions about California water account for and reduce uncertainty and risk, and that investments make our water management systems, flood protection systems, and ecosystems more sustainable. New to this Water Plan is an integration of water resource and flood management. This approach will be challenging, but it can yield significant public safety benefits, protect water supplies, and improve the environment.

Update 2009 may truly be called California's Water Plan because it embodies countless deliberations between and among the brightest minds in government and private agencies, Tribes, cities, farms, industry, and environmental organizations. As a result, Update 2009:

- Provides an investment guide for state, federal, Tribal, and regional strategies to reduce water demand, improve operation efficiency, increase water supply, improve water quality, advance environmental stewardship, and improve flood management;
- Integrates objectives and strategies from numerous state agencies and initiatives and offers more than 115 near- and longer-term actions to achieve them;
- Describes 27 resource management strategies that each region can select from to develop a unique and diverse water portfolio suitable for managing an uncertain future; and
- Outlines new analytical methods and tools to help plan for future effects of climate change, population growth and development patterns, economic change, and other factors outside the water community's control.

We must invest—significantly and uninterrupted—in California's aging and increasingly inadequate water and flood systems. Californians have recognized the need to invest in our water and flood systems through passage of a series of past bonds. Ultimately, California needs more stable and continuous sources of revenue to invest in statewide and regional integrated water management and to build resilience back into the state's water and flood management systems, as well as into the watersheds, groundwater basins, and ecosystems that support them.

Recommendations

California Water Plan Update 2009 identifies the most pressing water management issues and challenges faced statewide and by regions and the available opportunities and assets. Through the Water Plan process, we have developed recommendations in the form of policies, strategies, and approaches that will help reduce and remove impediments, and leverage resources and opportunities to help implement the Water Plan actions and achieve its goals and objectives through 2050.

These recommendations are summarized here and described in Volume 1 Chapter 2 Imperative to Act. They are directed at decision-makers and water users throughout California (referred to as ***California***) and at the executive and legislative branches of state government, the Department of Water Resources and other state agencies (referred to as ***state government***).

1. California should implement and invest in the Water Plan's actions as the key to achieving its goals and objectives.
2. California needs a water finance plan with stable and continuous funding from an array of revenue sources for integrated water management on a statewide and regional basis. The finance plan should recognize the critical role of public-private partnerships and the principle of beneficiary pays; include alternative revenue sources; and guide investment decisions based on sustainability indicators.
3. California should manage its water resources with ecosystem health and water supply reliability and quality as equal goals, with full consideration of public trust uses whenever feasible.
4. State government should effectively lead, assist, and oversee California's water resources and flood planning and management activities that regions cannot accomplish on their own.
5. State and federal government should lead and support planning, monitoring, and scientific research to help California adapt and mitigate for climate change impacts.
6. California should improve the coordination of land use policies and practices; economic development decisions; and water, flood, and natural resource planning and management.
7. California should renovate and improve its aging water, wastewater, and flood infrastructure.
8. California should articulate and update as needed the roles, authorities, rights, and responsibilities of federal, Tribal, State, and local governments and agencies responsible for water resource and flood planning and management.
9. California should increase public understanding and awareness of where our water comes from as well as the value and importance of water, water quality, and water conservation to people, ecosystems, and California's economy.

The recommendations are as varied as the constraints they are intended to change—institutional, legal, knowledge, information, skills/capacity, resources, funding, schedule, and public awareness.

California needs to act on these recommendations to improve drought contingency planning, make flood management improvements, and adapt to climate change. We need to invest the water and flood bond funds that the public has approved to implement these recommendations and realize this Water Plan.

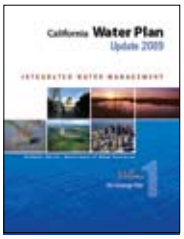
Read more about these policy recommendations in Volume 1 Chapter 2 Imperative to Act. More detailed recommendations for each of the resource management strategies are in Volume 2.

Navigating Through Water Plan Volumes

California Water Plan Update 2009 presents the latest statewide strategic plan for water management – a roadmap to year 2050. Use this reader's guide to navigate the many volumes that describe California's diverse water conditions and statewide and regional integrated water management.

The Roadmap

Where are we and how should California proceed?



Volume 1 The Strategic Plan

California Resources
Variable and Extreme
Critical Challenges
- *Climate change, population growth, dry years, floods, vulnerable ecosystems and Delta, water quality, aging infrastructure (levees), catastrophic events, data gathering, funding, disadvantaged communities*

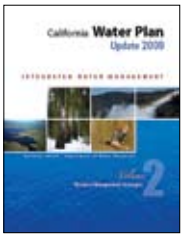
Managing our Resources
Sustainability
- *Water use efficiency, water quality, stewardship*

Reliability
- *IRWM, water/flood systems*

Reduction of Risk and Uncertainty
Companion State Plans
Integrated Data and Analysis
Statewide Objectives and Actions

Options/decision-making

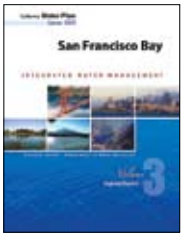
What can we do?



Volume 2 Resource Management Strategies

A Range of Choices
27+ management strategies to
- *Reduce water demand*
- *Increase Water Supply*
- *Improve Water Quality*
- *Practice Resource Stewardship*
- *Improve Flood Management*

How does it look and work at the regional level?



Volume 3 Regional Reports

10 regions and 2 areas of interest
- *Setting*
- *Water Conditions*
- *Relations with Other Regions*
- *Water and Flood Management*
- *Water Balances*
- *Looking to the Future*
- *Scenario Results*

Digging deeper

Want more on what we know and what we want to know?

Volume 4 Reference Guide

An encyclopedic look
- *Background on California Water Resources*
- *Water Resources Analysis*
- *Emerging Issues*

What's the metadata on the data?

Volume 5 Technical Guide

Documentation
- *Assumptions*
- *Data*
- *Analytical Tools and Methods*

The California Water Plan provides a framework for resource managers, legislators, Tribes, other decision-makers, and the public to consider options and make decisions regarding California's water future. Our goal is that this document meet Water Code requirements, receive broad support among those participating in California's water planning, and be a useful document. With its partners, DWR completed the final Update 2009 volumes and *Highlights* in December 2009.

The first four volumes of the update and the *Highlights* booklet are contained on the CD attached below. All five volumes of the update and related materials are also available online at *www.waterplan.water.ca.gov*.

Volume 1: The Strategic Plan
Volume 2: Resource Management Strategies
Volume 3: Regional Reports
Volume 4: Reference Guide
Volume 5: Technical Guide

For printed copies of the Highlights, Volume 1, 2, or 3, call 1-916-653-1097.
If you need this publication in alternate form, contact the Public Affairs Office at 1-800-272-8869.

The accompanying CD holds proceedings and other materials from the 2009 California Tribal Water Summit, "Protect Our Sacred Water."

Insert holder for CD inside of back cover