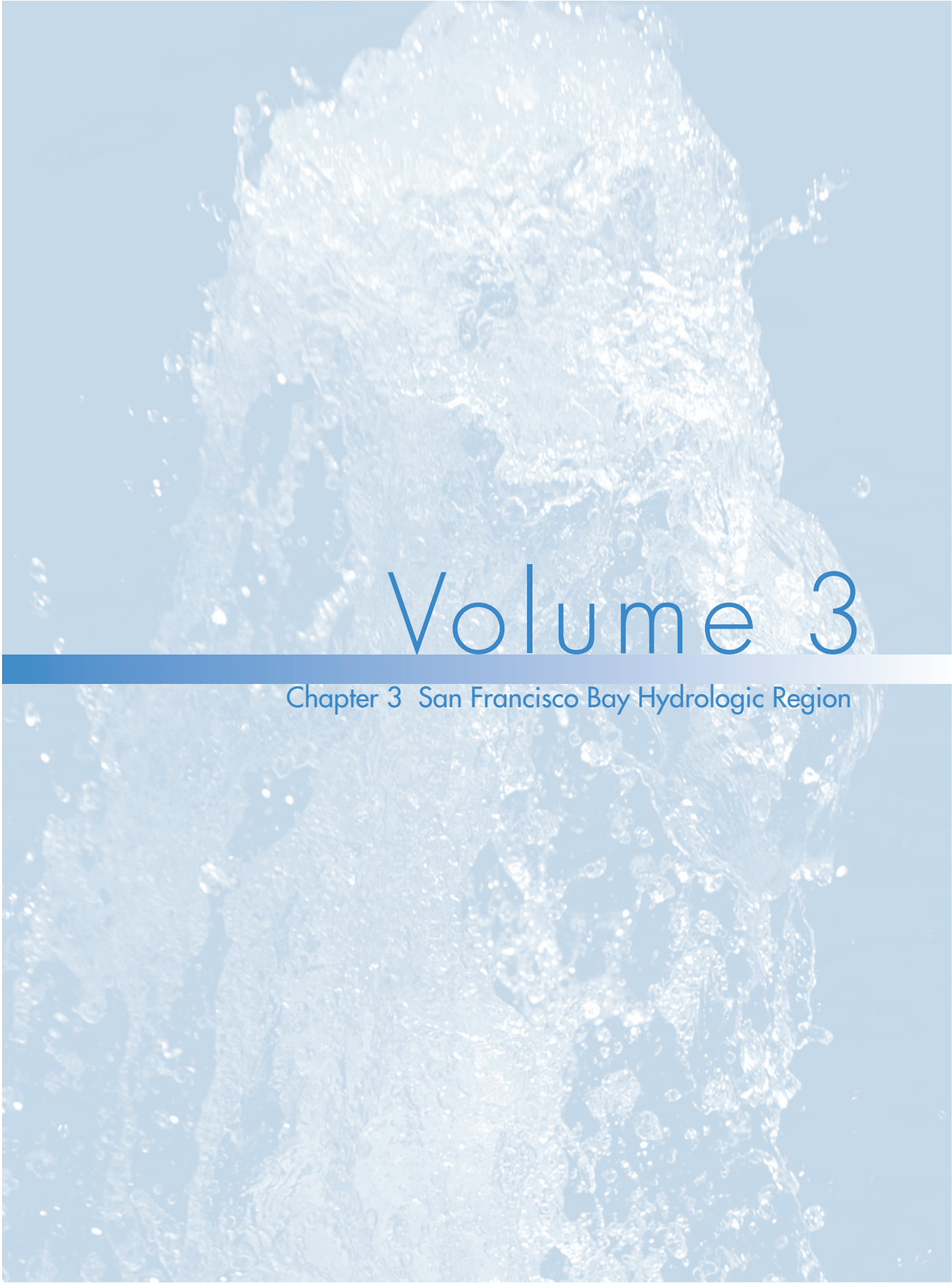

Volume 3

Chapter 3 San Francisco Bay Hydrologic Region

Chapter 3 San Francisco Bay Hydrologic Region

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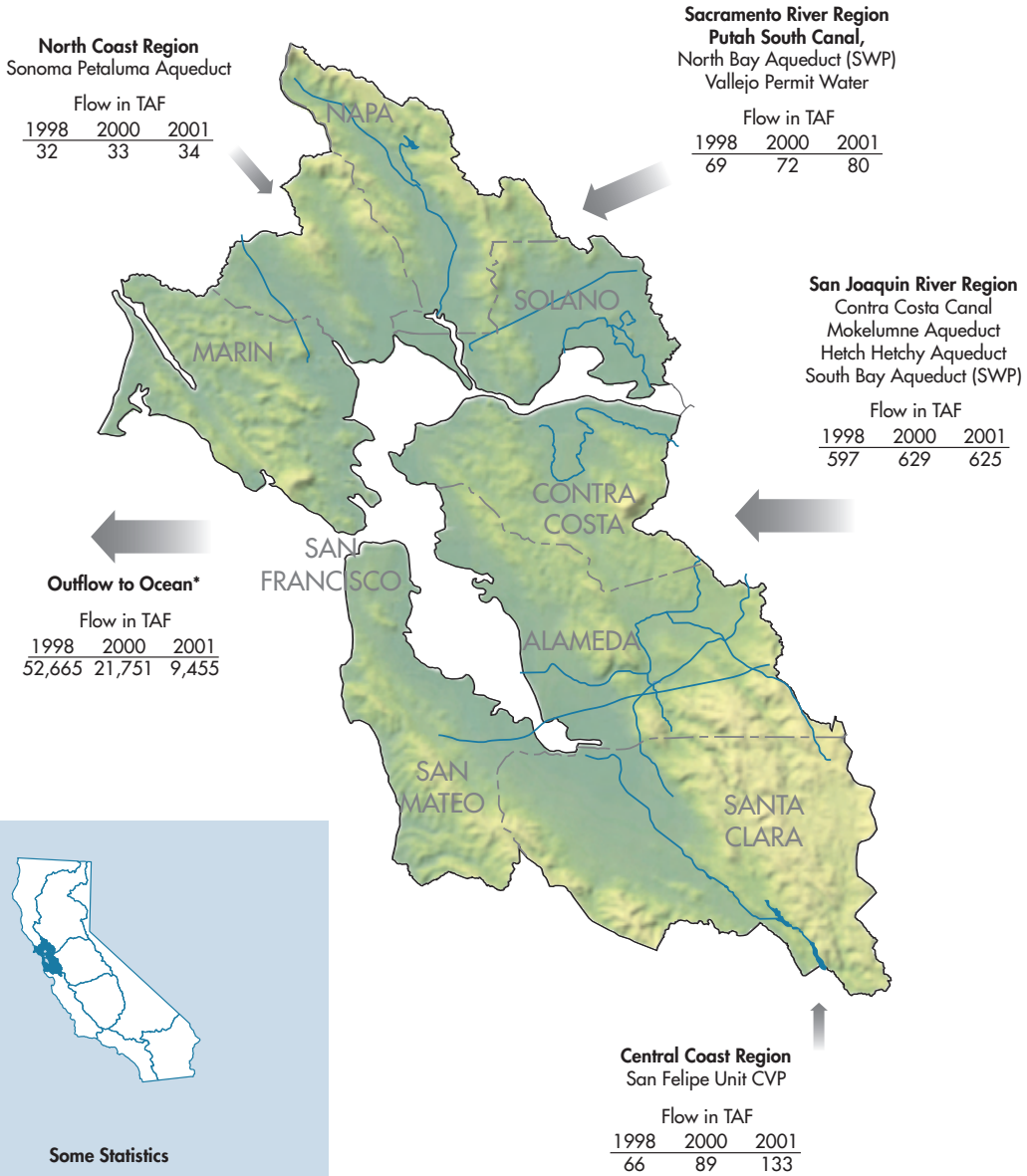


Some Statistics

- Area - 4,506 square miles (2.8% of State)
- Average annual precipitation - 25.4 inches
- Year 2000 population - 6,105,650
- 2030 population projection - 7,857,360
- Total reservoir storage capacity - 746 TAF
- 2000 irrigated crop area - 70,300 acres

The San Francisco Bay Hydrologic Region includes the San Francisco and Suisun bays and Suisun Marsh and their drainage areas. Arrows indicate annual flows entering and leaving the region for water years 1998, 2000, and 2001.

**Outflow to Ocean includes Wild and Scenic Rivers, regulated flows, and estimated wastewater outflows.*

Chapter 3 San Francisco Bay Hydrologic Region

Setting

The San Francisco Bay Hydrologic Region, which occupies parts of nine counties, extends from southern Santa Clara County north to Tomales Bay in Marin County, and inland to the confluence of the Sacramento and San Joaquin rivers near Collinsville (Figure 3-1). The eastern boundary follows the crest of the Coast Range, the highest peaks of which are more than 3,000 feet above sea level. Streams in the region flow into the bay-estuary or to the Pacific Ocean. The climate within the region varies significantly from west to east. Coastal areas are typically cool and often foggy, and inland valleys are warmer with a Mediterranean-like climate. Rainfall amounts vary among subregions and can be highly influenced by vegetative cover and marine influences. Although there are several small reservoirs and groundwater basins throughout this region, the primary water supplies are imported from other regions of the state.

The bay region boasts significant Pacific Coast marshes such as Pescadero marsh and Tomales Bay marshes as well as San Francisco Bay itself. San Francisco Bay is an estuary with a deep central channel, broad mudflats, and fringing marsh. The bay is commonly divided in to the South, Central, and North Bay. The North Bay is more brackish while the South and Central bays are more marine dominated. Suisun Marsh in between the North Bay and the Delta is the largest contiguous brackish water marsh remaining on the west coast of North America, providing more than 10 percent of California's remaining wetlands.

The combined flows of the Sacramento and San Joaquin watersheds flow through the Delta and into the San Francisco Bay. Delta outflow interacts with tides to determine how far salt water intrudes from the ocean into the San Francisco Bay Estuary. The resulting salinity gradients influence the distribution of many estuarine fishes and invertebrates as well as plants, birds, and animals in wetlands areas. Delta outflow varies with hydrology, reservoir releases, and diversions upstream.

Land Use

Portions of the region are highly urbanized and include the San Francisco, Oakland, and San Jose metropolitan areas. Agricultural acreage occurs mostly in the north and northeast in Napa, Marin, Sonoma, and Solano counties. Santa Clara and Alameda counties also have significant agricultural acreage at the edge of the urban development. The predominant crops are grapes along with fruit and nut trees, hay production, and dairy and livestock operations. In the area along the ocean coastline south of the Golden Gate, more than half of the irrigated acres are in high-value specialty crops, such as artichokes, strawberries, or flowers.

Population and Water Use

The bay region is a heavily urbanized region. From California Department of Finance figures, the total population of this hydrologic region in year 2000 was 6,106,000, with approximately half of the people residing in Alameda and Santa Clara counties. The Association of Bay Area Governments projects that even with the implementation of "Smart Growth" policies by local government, the nine counties that include the bay region will add 2 million people, 750,000 households and create 1.5 million jobs by year 2030. Figure 3-2 provides a graphical depiction of the San Francisco Bay hydrologic region's total population from year 1960 through year 2000, with current projections to year 2030. Water use in the bay region is predominantly urban with more than 50 percent of the use residential. There are also numerous industrial users around the bay. Agricultural water use is a much smaller percentage of total water use in this region compared to other inland regions, such as the Sacramento River region, San Joaquin River region, and the Tulare Lake region. For example, in the San Francisco Bay region part of the Santa Clara Valley Water District service area, agricultural use is less than one percent of total water use of 383,000 acre-feet per year. However SCVWD does deliver about 29,000 acre-feet of agricultural water to customers in the Central Coast Hydrologic Region.

Portions of the San Francisco Bay Region are highly urbanized and include the San Francisco (skyline in photo above), Oakland, and San Jose metropolitan areas. Agricultural acreage occurs mostly in Napa, Marin, Sonoma, and Solano counties and also in Santa Clara and Alameda counties. (DWR Photo)

Figure 3-1; provides a graphical presentation of all of the water supply sources that are used to meet the developed water uses within this hydrologic region for years 1998, 2000, and 2001.

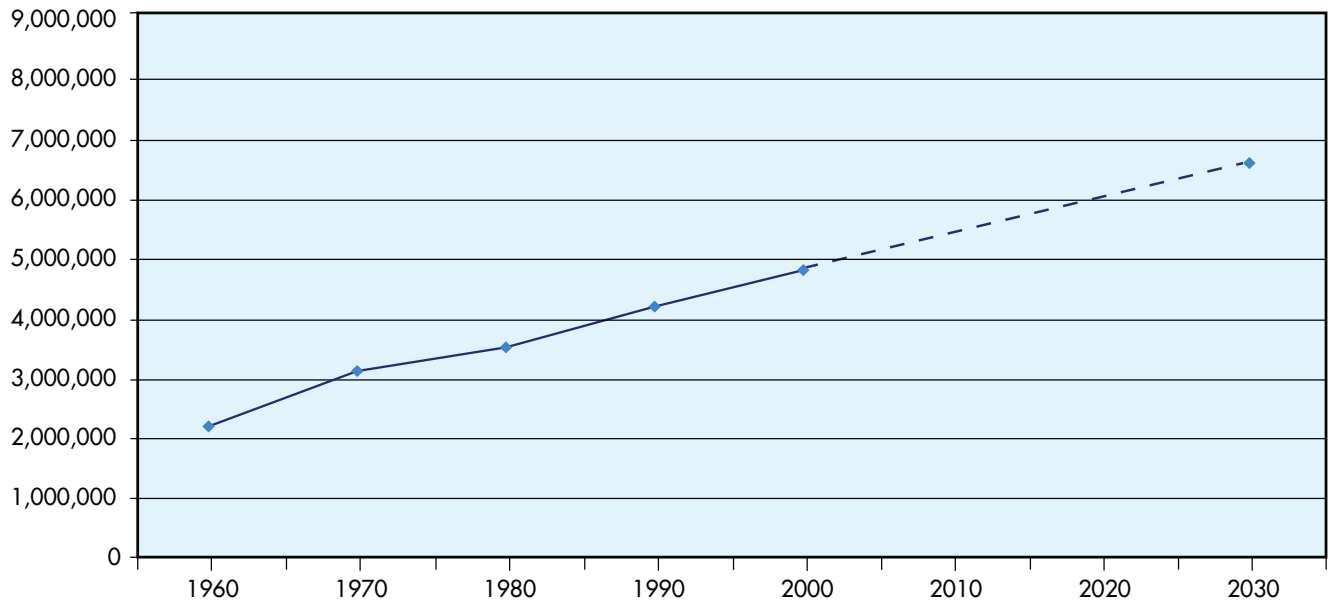
Water Supplies

In the early 1900s, local water agencies developed significant imported water supplies from the Mokelumne and Tuolumne rivers to meet the anticipated demands. At the same time, local reservoirs and watersheds were being developed to capture surface supplies, to recharge the groundwater basins, and to act as terminal reservoirs for the larger projects. Later, State and federal water projects brought water to the northern, eastern, and southern parts of the region through a number of canals. Table 3-1 shows the sources of surface water imported. As additional information, Figure 3-3 presents bar charts that summarize all of the dedicated and developed urban, agricultural and environmental water uses and supplies within this hydrologic region for years 1998, 2000 and 2001.

Groundwater

Local groundwater accounts for only about 5 percent of the region's average water year supply. The more heavily used basins include the Santa Clara Valley, Livermore Valley, Westside, Niles Cone, Napa-Sonoma Valley, and Petaluma Valley groundwater basins. For agencies like SCVWD, Alameda County Water District (ACWD), and Alameda County Flood Control and Water Conservation District-Zone 7 (Zone 7), groundwater is a critically important local supply that helps offset dependence on imported water supplies. (See Box 3-1 for list of acronyms used in this chapter.) Conjunctive use programs have also been implemented by these agencies to optimize the use of groundwater and surface water resources, and water quality programs are in place to monitor and protect groundwater quality. Throughout the region additional groundwater resources continue to be investigated and developed to expand the role of conjunctive use programs.

Figure 3-2 San Francisco Bay Hydrologic Region population



Data from the California Department of Finance provide decadal population from 1960 to 2000 and population projection for 2030 for the San Francisco region.

Recycled Water

Recycled water in the bay region is used in a full spectrum of applications, including landscape irrigation, industrial cooling, agricultural needs and as a supply to the areas many wetlands. Currently, nearly 50-million gallons per day of recycled water is produced in the bay region, and future planned projects have the potential to increase this amount to 100 mgd by the year 2020.

Role of Conservation

Urban water districts in the bay region generally are signatories to the Memorandum of Understanding Regarding Urban Water Conservation in California (MOU) that commits them to make a good faith effort to implement Best Management Practices (BMPs). In 2001, the California Urban Water Agencies issued a report that projected net water savings for the bay region based on implementation of the MOU at about 105,000 acre-feet. These numbers are being updated and revised by the CALFED Bay-Delta Water Use Efficiency Program as part of its planning process.

The seven agencies that participate in the Bay Area Water Agencies Coalition—SCVWD, ACWD, Zone 7, San Francisco Public Utilities Commission (SFPUC), Contra Costa Water District (CCWD), East Bay Municipal Utilities District (EBMUD), and Bay Area Water Supply and Conservation Agency (BAWSCA)—recently completed a study on conservation advancement that showed that as a whole, their members had reduced the per capita water use by 16 percent since 1986 and decreased total water use by 1.4 percent despite a 17 percent increase in population served during the same period. Individual agency results varied around these numbers.

Water Quality

The San Francisco Bay Hydrologic Region is centered on the San Francisco Estuary and its water quality. The estuary's immediate watershed is highly urbanized, resulting in contaminant loads from both point and nonpoint sources, as well as pollutants from the Napa, Petaluma, and Guadalupe rivers, the Sacramento-San Joaquin Delta, and the Central Valley. Bay Area residents generally receive good quality drinking water that varies by source and treatment. Sources range from high quality Hetch Hetchy and Mokelumne River supplies, local surface and groundwater, and variable-quality Delta water. Utilities that depend on the Delta for all or part of their domestic water supplies do meet the current drinking water standards, although they remain concerned about issues such as microbial contamination, salinity, and organic carbon.

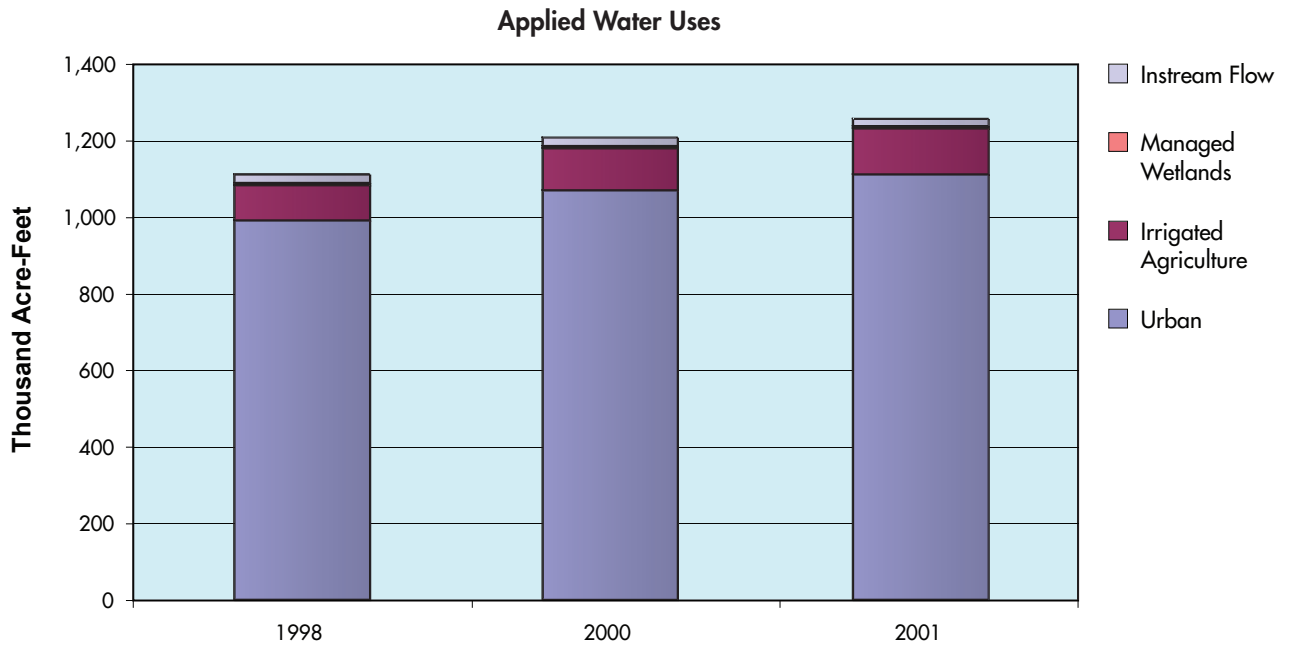
Table 3-1 Sources of surface water imported

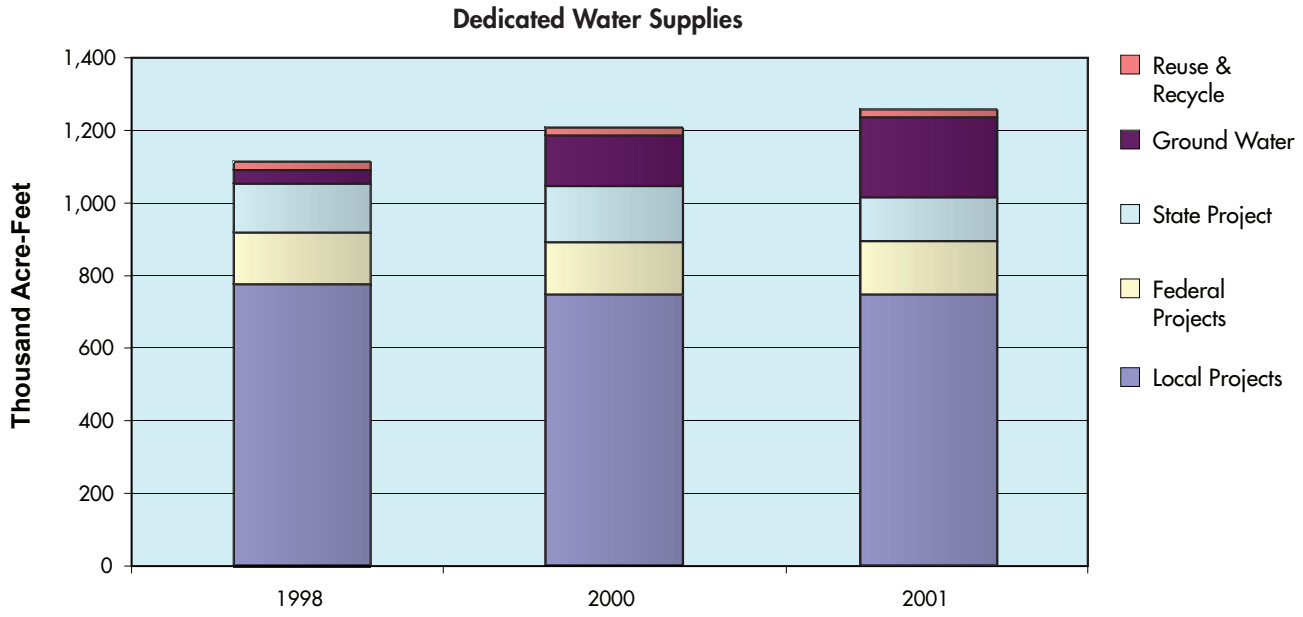
Water Conveyance Facility	Water source	Operator	Counties Served	Water supplied to the Bay Region via facility in 2000
Hetch Hetchy Aqueduct	Tuolumne River	SFPUC	San Francisco, San Mateo, Alameda, and Santa Clara counties	259 TAF (29%)
Mokelumne Aqueduct	Mokelumne River	EBMUD	Alameda, Contra Costa counties	206 TAF (23%)
South Bay Aqueduct	Delta	DWR (SWP)	Alameda, Santa Clara counties	119 TAF (13%)
Contra Costa Canal	Western Delta	CCWD/ CVP	Contra Costa County	117 TAF (13%)
San Felipe Unit	Delta via San Luis Reservoir	USBR (CVP)	Santa Clara County	89 TAF (10%)
North Bay Aqueduct	Northern Delta	DWR (SWP)	Solano, Napa counties	36 TAF (4%)
Putah South Canal	Lake Berryessa	USBR	Solano County	35 TAF (4%)
Sonoma Petaluma Aqueduct	Russian River	SCWA	Sonoma County	33 TAF (4%)

Box 3-1 Acronyms Used in the San Francisco Bay Regional Report

ACWD	Alameda County Water District
BAWSCA	Bay Area Water Supply and Conservation Agency
BACWA	Bay Area Clean Water Agencies
bay region	San Francisco Bay Region
BMPs	Best Management Practices
CALFED	State and Federal Bay- Delta Authority
CCMP	Comprehensive Conservation and Management Plan
CCWD	Contra Costa Water District
CVP	Central Valley Project
EBMUD	East Bay Municipal Utility District
mgd	million gallons per day
MMWD	Marin Municipal Water District
MOU	Memorandum of Understanding Regarding Urban Water Conservation in California
SCVWD	Santa Clara Valley Water District
SCWA	Sonoma County Water Agency
SFPUC	San Francisco Public Utilities Commission
SIP	Seismic Improvement Program
SMPA	Suisun Marsh Preservation Agreement
SLLPIP	San Luis Low Point Improvement Project
SWP	State Water Project
Zone 7	Alameda County Flood Control and Water Conservation District-Zone 7

Figure 3-3 San Francisco Bay region water balance for water years 1998, 2000, 2001





Three years show a marked change in amount and relative proportions of water delivered to San Francisco region's urban and agricultural sectors and water dedicated to the environment (applied water, top chart), where the water came from, and how much water was reused among sectors (dedicated water supplies, bottom chart).

Delta water constitutes about one-third of the domestic water in the bay region.

Wetlands and Watershed Management

The San Francisco Bay is one of the most modified estuaries in the United States. The topography, ebb and flow of the tides, patterns of freshwater inflows locally and from the Delta, and the availability and types of sediment have all been altered. Many new species of plants and animals have been introduced. These exotic and invasive species, such as the Chinese mitten crab and Asian clam, threaten to undermine the estuary's food web and alter its ecosystem.

Water quality has also changed over time. The character of the wetlands around the bay has changed dramatically. Over 75 percent of the bay's historical wetlands have been lost or altered through a variety of land use changes around the bay including filling for urban and industrial uses and the construction of dikes for agricultural uses. There used to be 190,000 acres of tidal marsh; now there are 40,000 acres with only 16,000 of these having been tidal marsh historically. Tidal flats have been reduced from 50,000 acres to 29,000 acres due to bay fill, erosion, tidal marsh evolution, and other factors. The total area covered by the bay at high tide was historically about 516,000 acres. Now the bay covers about 327,000 acres at high tide. There are about 500 species of fish and wildlife associated with the bay lands, 20 of which are now threatened or endangered. In recent decades, filling of the bay has slowed significantly due to regulatory changes and the creation of the Bay Conservation and Development Commission, a State agency charged with permitting activities along the shore of the bay.

State of the Region

Some of the major water related challenges facing the San Francisco Bay region include improving water supply reliability to sustain water supplies in drought periods and other emergency outages, maintaining and improving drinking water quality across the region by continuing to meet and exceed current and anticipated drinking water quality standards and protecting drinking water sources, and improving the ecosystem health of San Francisco Bay. Other challenges include linking local land use planning with water system planning and improving water management planning on a regional level.

Many projects and programs are already under way to address these needs. However, the various parties concerned with water-related issues in the bay region are increasingly recognizing that there is also a need to develop solutions on a more collaborative regional or subregional basis (Box 3-2 Bay Area Water Agency Forums). Some of the longstanding regional planning efforts within the bay region are described in this section, including projects under way to improve water supply reliability, water quality and ecosystem restoration through regional partnerships. In addition, some of the newer water management and drinking water quality regional planning initiatives are described in the next section, "Looking to the Future."

Box 3-2 Bay Area Water Agency Forums

ABAG-CALFED Task Force. Regional body of elected officials from local government and water districts, staff, and nongovernmental organizations that was formed to link planning for water supply and water supply reliability, water quality, and environmental protection for the Bay; support the objectives of the CALFED Record of Decision; and explore opportunities to improve regional cooperation.

Bay Area Water Agencies Forum (formerly known as the Six Agencies Group). First convened in 2000 to provide a regular opportunity for water agency policymakers to discuss regional water policy issues and explore cooperative approaches to improving the quality and reliability of Bay Area water supplies.

Bay Area Water Agencies Coalition. Established in 2002 to provide a forum and a framework for water agency general managers to discuss water management planning issues and coordinate projects and programs to improve water supply reliability and water quality.

Northern California Salinity Coalition. Created in 2003 to advance the interests of the eight member water agencies in the development of local and regional efforts that will use desalination or salinity management technologies, practices, and approaches to improve water supply reliability for coalition members and to reduce salinity-related problems affecting the water supplies of the member agencies.

Water Supply Reliability

Generally, water districts in the San Francisco Bay region have sufficient supplies to meet the needs of their customers in normal water years now and for some time into the future. The major water supply reliability challenges occur during droughts and other emergencies. Currently, during drought periods, locally developed water supplies are very limited, and imported water supplies can be short of water users needs. This problem is expected to worsen over time as the region's urban use grows and because these imported supplies may be more at risk due to various other factors. For example, area of origin communities outside the San Francisco Bay region will also need more water as they grow. Water could be reallocated for environmental needs or Delta outflow and operational requirements could change, affecting the San Francisco Bay regions' imported water supply.

Some examples of future shortfall estimates are:

- Using year 2020 demand projections, SCVWD estimates a shortfall of approximately 66,000 acre-feet in a very dry year (a repeat of 1977 drought conditions), or approximately 15 percent of the projected demand.
- EBMUD, without the Freeport Project, could face projected dry period customer rationing of 68 percent based on 2020 projected demand. With the proposed intake from the Sacramento River at Freeport, rationing would be reduced to 28 percent during dry periods.

The exact magnitude of drought year shortfalls and the best water management tools to be used to address them are controversial. Each district has different assumptions and policies that guide their planning. Different systems rely on water from different watersheds, so even the definition of a drought for planning purposes varies somewhat. However, drought supply reliability will continue to be a major challenge for water supply planning in the bay region.

The region is also prone to major earthquakes and other natural disasters that could damage and interrupt water delivery. Critical seismic reliability upgrades are required for some facilities that cross or are located on any of the three active earthquake fault systems (that is, San Andreas, Hayward, and Calaveras faults). According to SFPUC, a major earthquake could disrupt water supplies for up to 60 days in its system, which serves 2.4 million people in the bay region. In other areas, significant progress has already been made on seismic vulnerability but challenges remain.

Each water district has plans under way to address these drought shortfalls and to ensure that their systems will provide a certain level of water service in the event of an earthquake or natural disaster. Details such as future projected water demands, supplies, and planned capital expenditures can be found in each district's plans. However, there are no statistics that summarize the current and future expenditures planned region-wide or the amount of water expected to be developed for droughts or the expected performance region-wide in the event of a seismic event. This is the type of information that may become available through integrated resources planning.

Some examples of projects under way to address future reliability needs are described in the following sections. In addition to the example projects listed here, there are numerous other efforts under way.

Seismic Vulnerability and Drought Supply Planning

- SFPUC is implementing a $4.3 billion capital improvement program to replace or repair aging facilities, provide seismic upgrades and improve water supply reliability.
- EBMUD is nearing completion of a 10-year seismic improvement program. The program is a $189 million program to improve post-earthquake firefighting capability and water service within the EBMUD service area.
- Zone 7 is updating its Well Master Plan so that it can more readily rely on groundwater to meet its normal demands if a seismic event disrupts the imported water delivery system.
- SCVWD is implementing and updating its integrated water resources plan to address water supply shortfalls and preparing a comprehensive water utility infrastructure management program to address seismic and security hazards.
- CCWD recently completed the major components of its $120 million Seismic Reliability Improvements program, including a 21-mile Multi-purpose Pipeline, a new pumping plant at its Mallard Slough Intake, interties, and seismic valves. These facilities improve reliability and fire-fighting flows after a major earthquake.

Groundwater

- ACWD, SCVWD, and Zone 7 have implemented conjunctive use programs within their service areas to optimize the combined use of groundwater and surface water resources. Objectives of these programs include the prevention of groundwater overdraft and subsidence, the prevention of salt water intrusion, and the development of an emergency groundwater storage supply.

- To ensure that the quality of local groundwater supplies is not degraded, bay region water agencies actively monitor water quality and have implemented several groundwater protection measures.
- To date, the CALFED Bay-Delta Program has invested $2.4 million in eight local groundwater projects in areas like Santa Clara County.
- Solano County Water Agency, ACWD, SCVWD, and Zone 7 have entered into agreements with groundwater banks outside the region. Currently 425,000 acre-feet of water is stored under these programs, as an additional water supply for droughts. Other Bay Area agencies are studying the potential of out-of-region groundwater banking options, as well as new conjunctive use programs.

Conveyance and Interconnections

- EBMUD, in conjunction with the Sacramento County Water Agency, is preparing preliminary design documents to divert water from the Sacramento River to reduce customer rationing during multi-year droughts (Freeport Project).
- A 40-mgd intertie between the SCVWD system and the SFPUC system was completed recently in the City of Milpitas. EBMUD and SFPUC are also constructing another 30-mgd treated water intertie between their systems.
- Studies are under way on the San Luis Low Point Improvement Project to address water quality and conveyance issues for South Bay water users and to improve the reliability of water supplies from San Luis Reservoir for the customers of the San Felipe Unit of the Central Valley Project including SCVWD. Additional details on the SLLPIP including schedule and budget can be found in the CALFED Bay-Delta Program Plan for the Conveyance Program.

Water Conservation and Recycling

Many different wastewater reclamation/recycling projects are under way in the Bay Region, and others are in the planning and environmental documentation stages. The Bay Area Regional Water Recycling Program (BARWRP) Water Recycling Project Master Plan, prepared in 1999, analyzed recycling for the counties of San Francisco, San Mateo, Santa Clara, Alameda and Contra Costa and developed a plan to achieve 125,000 acre-feet/year of water recycling over the next 10 years.

BARWRP also had a number of recommendations to make regional reclamation and recycling projects more implementable including increasing public acceptance and dealing with environmental impacts regionally. Many of the near-term recycling projects identified in the plan are now being developed, some through the use of $43 million in Bay-Delta program funding. BARWRP members are reviewing progress and updating program objectives and recommendations. A similar coordinated water recycling program is under way in the northern portion of the San Francisco Bay region.

Water conservation is generally included as a component of each water agency's planning programs. Agencies are actively involved in implementing water conservation measures and raising public awareness about the need to conserve water supplies through more efficient practices. Water conservation efforts are helping to reduce water demands and conserve the bay region's water supplies. To date, the CALFED Bay-Delta Program has invested over $15 million in 35 local water conservation programs.

Surface Storage

Water agencies are also studying several surface storage projects within the region and in other regions to help with drought relief, emergency storage, and water quality management. Some of the surface water storage projects under consideration in the region include expansion of Calaveras, Pacheco, and Los Vaqueros reservoirs. Calaveras Reservoir expansion is being studied as part of the CALFED Bay Area Water Quality and Supply Reliability Program to provide water supply reliability to SFPUC customers and potential regional partners in the Bay Area. Los Vaqueros expansion is being evaluated as part of the CALFED Program. This project is being studied both as a way to improve drought supply reliability and water quality for the Bay Region, and to provide environmental benefits to the Bay-Delta. Studies of the potential for expansion of Los Vaqueros are under way. Additional details on the schedule and budget for this project can be found in the CALFED Bay-Delta Program Plan for Storage. Expansion of Pacheco Reservoir is being considered by CALFED as an alternative under the SLLPIP. Additional information on this project can be found in the CALFED Bay-Delta Program Plan for Conveyance.

Desalination

With recent advances in technology, several water agencies in the Bay Region are investigating desalinization as a source to improve water supply reliability. Marin Municipal Water District is proposing a major new desalination project for Marin County using water from San Rafael Bay. EBMUD, CCWD, SCVWD and SFPUC are conducting a joint feasibility study for a desalinization plant to serve the Bay Region as an emergency

or dry-year supply. ACWD has built a brackish water desalination plant to produce potable water from brackish water taken from local aquifers.

Environmental Water Quality

The San Francisco Bay/Delta Estuary is the main focus of water quality issues in this region. Water and sediment in the estuary meet quality guidelines for most contaminants, with constituents in water meeting toxicity and chemical guidelines about 87 percent of the time. Sediment concentrations, though, are more problematic, due to legacy pollutants, with only about 60 percent of the sediment samples meeting chemical guidelines and passing toxicity tests. Over time, estuary water quality has significantly improved, for instance, with fewer toxic episodes and decreased silver concentrations in the south bay. Implementation of secondary treatment of domestic wastewater has dramatically improved the quality, especially the oxygen content, of the San Francisco Estuary, as has the reduction in the use of organophosphate pesticides.

Major water quality issues include control of storm water, urban, and construction site runoff, as well as runoff and discharges from the vast Central Valley and Delta watershed. Legacy pollutants, such as polychlorinated biphenyls (PCBs) and mercury, contaminate fish in the estuary. Other water quality concerns include copper and nickel in the South Bay, selenium from Contra Costa refineries, erosion from vineyards in Napa and Sonoma valleys, pesticides in urban creeks generally, and toxicity of water and especially sediment. Habitat in the Suisun Marsh is threatened by increasing sedimentation. Exotic and invasive species, such as the Chinese mitten crab and Asian clam, threaten to undermine the estuary's food web and alter its ecosystem. Because San Francisco Bay has several active seaports, discharge of ballast water and vessel wastes and maintenance dredging and disposal of contaminated sediments are water quality concerns. New contaminants are emerging that may be causing impacts to the aquatic ecosystem, including PBDEs (polybrominated diphenyl ethers), pyrethroid insecticides, and compounds from pharmaceuticals and personal care products.

The bay acts as a sediment repository, so persistent, sediment-bound contaminants, such as mercury, dioxins, PCBs, and organochlorine pesticides have accumulated over time. These compounds also bioaccumulate in the food chain, causing contamination of bay fish and endangering their consumers, including humans and wildlife. Happily, new inputs of the persistent sediment contaminants in the estuary are controlled as the use of most organochlorine pesticides and PCBs are banned, and the concentrations in the sediments and in organisms appear to be declining. The San Francisco Regional Water Quality Control Board is developing new regulatory requirements to address the mercury sources to the estuary, most significantly, the New Almaden mine, as well as the thousands of abandoned mercury and gold mine tailings in the Central Valley watershed. Mercury contamination in rstuary fish, such as the striped bass, has remained high for more than 30 years. Wetland restoration could increase mercury methylation processes and cause higher contamination in fish. State and federal agencies, working through the CALFED Bay Delta Program and other organizations, have funded a number of studies to determine potential effects of restoration and explore management actions that would decrease methyl mercury production and bioaccumulation.

Since 1993, the San Francisco Regional Monitoring Program has been providing monitoring, and evaluation of the monitoring results, on water, sediment, and fish contamination issues in the bay. The annual conference and publication "Pulse of the Estuary" is produced by the San Francisco Estuary Institute and summarizes what is known about the estuary's water quality issues. In addition to the mercury research mentioned previously, the CALFED Bay Delta Program has funded $10 million in projects related to water quality in the bay, including watershed management, pesticide use reduction, and toxicity studies.

Outside of the San Francisco Estuary, Tomales Bay is one of only four commercial shellfish growing areas on the entire west coast. Some of the coastal watersheds of Marin and San Mateo counties provide important habitat for listed species of coho salmon and steelhead. Sediment threatens water quality and habitat in Bolinas Lagoon, the only wetland on the West Coast designated as a Wetland of International Significance by the U.S. Fish and Wildlife Service.

Drinking Water Quality

The quality of domestic water supplies in the San Francisco Bay Region is generally excellent, but does vary by source of supply and method of water treatment. For instance, the source water quality of SFPUC's Tuolumne River supply, EBMUD's Mokelumne River supply, and local surface and groundwater supplies is generally better than that of water diverted from the Sacramento-San Joaquin Delta. However, even with a high quality water source, San Francisco recently implemented chloramine disinfection of drinking water, in order to reduce disinfection byproducts. In the CCWD service area, the storage of higher quality Delta water in Los Vaqueros Reservoir, as well as the implementation of advanced water treatment systems, has significantly improved water quality in that area.

Utilities that divert and deliver water from the Sacramento–San Joaquin Delta are pursuing a range of projects to protect and improve the quality of the water, including storing Delta water when it has relatively good quality, managing the watersheds, blending water from different sources, and applying advanced water treatment technology. For example, CCWD is continuing to work with local and regional agencies and CALFED to improve its source water quality. Projects include using CALFED funding to relocate agricultural drains and to line portions of the Contra Costa Canal that may be impacted by poor quality local groundwater. Utilities in Solano County use water blending methods to combine high quality local surface water with Delta water of variable quality from the North Bay Aqueduct. SCVWD, ACWD, and Zone 7 utilize a diversified portfolio of water sources, including Delta water, Hetch Hetchy supplies, local surface water, and groundwater. Starting in 2002, the SVCWD initiated major renovations to each of its three regional water treatment plants in order to provide higher quality drinking water to the residents of Santa Clara County. When these projects are completed in year 2010, the systems will switch from the current method of disinfection by chlorination to the use of ozone technology for water disinfection.

The CALFED Bay-Delta Program has funded several efforts to improve water quality in the region, including the feasibility of expanding Los Vaqueros Reservoir and the San Luis Low Point Improvement Project (previously discussed under "Surface Storage" and "Water Supply Reliability/Conveyance," respectively). The Bay Area Water Quality and Supply Reliability project is evaluating a broad array of cooperative regional projects to benefit ACWD, Zone 7, SFPUC, CCWD, SCVWD, EBMUD, and the Bay Area Water Supply and Conservation Agency (BAWSCA - representing the 28 wholesale water customers of the SFPUC). Some of the regional project concepts being considered in this study include the expansion of storage in Calaveras and Los Vaqueros reservoirs, additional recycling, additional conservation beyond existing urban BMPs, and desalination.

In general, groundwater quality throughout most of the region is suitable for most urban and agricultural uses with only local impairments, such as leaking underground storage tanks. Groundwater in the Livermore Valley and Niles Cone (southern Alameda County) basins has high levels of total dissolved solids, chloride, boron, and hardness; such that both Zone 7 and ACWD are implementing wellhead demineralization projects to improve the quality of this groundwater supply. In the Santa Clara Valley region, some of the underlying groundwater supplies are threatened by pollutants from various industrial activities and historical agriculture. SCVWD works to protect the quality of these supplies by aggressively responding to pollution threats such as MTBE, PCE, TCE, and prechlorate. These pollution threats are individually identified and evaluated in order to prevent or mitigate groundwater contamination. Elsewhere, groundwater in Petaluma Valley and the Gilroy-Hollister Valley has high levels of nitrate, which adversely impacts the ability to use domestic wells for drinking water purposes. Groundwater recharge projects and the use of imported water have effectively halted land subsidence in most areas, and have successfully stopped or reversed seawater intrusion into aquifers around the bay.

Wetlands and Watershed Management

Although there are serious problems facing San Francisco Bay, its wetlands, and watershed, there has been a concerted effort over the last 20 years to restore the Bay. Some of the major planning and implementation efforts are described here. Expenditures to date on ecosystem restoration include $32 million in Bay-Delta Program funding, along with significant local, state and federal funding.

The Comprehensive Conservation and Management Plan, completed by the San Francisco Estuary Project in 1993, presents a blueprint of 145 specific actions to restore and maintain the chemical, physical, and biological integrity of the bay and Delta. The CCMP has been implemented over time by a wide variety of local, state and federal partners including the CALFED Bay-Delta Program. The Estuary Project regularly updates the priorities for CCMP implementation and prepares a report on the state of the estuary. In addition, the Estuary Project prepares Bay-Delta Report card that identifies many of the restoration projects under way to track progress implementing the CCMP. The most recent list of priorities identified by Estuary Project is:

- Reduce the impact of invasive species on the estuary through prevention, control, eradication, and education.
- Expand, restore, and protect bay and Delta wetlands and contiguous habitats. (These two items were both identified as top priorities.)
- Protect and restore watersheds, including promoting creek restoration, throughout the estuary.
- Create "incentives" that motivate governments, landowners, businesses and communities to protect and restore the estuary.
- Minimize or eliminate pollution of the estuary from all sources.

- Increase public interaction with the estuary's natural resources, encourage stewardship, and promote the values ecological processes provide to human activities and the effects of human activities on them.
- Continue, sustain, and expand the regional monitoring program to address all key CCMP issues including pollution;, wetlands including mitigation measures, watersheds, dredging, and sediment transport, biological resources, land use and flows and integrate scientific monitoring results into management and regulatory actions.
- Promulgate baseline inflow standards for San Francisco, San Pablo, and Suisun bays to protect and restore the estuary.

The Baylands Ecosystem Habitat Goals Report, prepared by the Habitat Goals Project in 1999, is a guide for restoring and improving the bay lands and adjacent habitats of the San Francisco Estuary. It provides recommendations for the kinds, amounts, and distribution of wetlands and related habitats that are needed to sustain diverse and healthy communities of fish and wildlife resource in the Bay. The CCMP originally identified the need for these types of habitat goals. The recommendations are being implemented over time through voluntary restoration efforts that include many local, state and federal partners.

The Implementation Strategy for The San Francisco Bay Joint Venture, prepared in 2001, identifies actions in the Habitat Goals Report that are consistent with the Joint Venture's objectives. The State and federal partners in the Joint Venture are implementing these actions.

State, federal, and local governments, landowners, and nonprofit agencies have been working cooperatively to restore the San Francisco Bay estuary for a number of years in conjunction with these and other planning processes. Because the restoration and watershed management projects around the bay are so numerous, each one is not listed individually. Additional information can be found on websites for groups active in restoration such as the San Francisco Bay Joint Venture (www.sfbayjv.org/), the Wetlands Regional Monitoring Program's Wetlands Tracker (www.wrmp.org) or the Estuary Project's Report Card (www.abag.ca.gov/bayarea/sfep.org). A few of the largest efforts are described here.

The Napa Sonoma Marsh Project is joint State, federal, and local project to restore 10,000 acres of wetlands and associated habitats within the former Cargill salt pond complex in the North Bay. It includes habitat restoration, beneficial use of recycled water, and improved water quality in the Napa River and the bay. The Bel Marin Keys and Hamilton Airfield projects will collectively restore over 2,400 acres of diked historical wetlands in the North Bay along the Marin County shoreline. These three projects, along with many smaller North Bay projects, will provide significant restoration of wetlands and associated uplands. In 2003, the State of California and the federal government approved the purchase and restoration of 15,100 acres of Cargill's salt ponds in the South San Francisco Bay.

Acquisition of the South Bay salt ponds provides an opportunity for landscape-level wetlands restoration, improving the physical, chemical, and biological health of the San Francisco Bay. The South Bay Salt Pond Restoration Project will integrate restoration with flood management, while also providing for public access, wildlife-oriented recreation, and education opportunities. The project will restore and enhance a mosaic of wetlands, creating a vibrant ecosystem. Restored tidal marshes will provide critical habitat for the endangered California clapper rail and the salt marsh harvest mouse. Large marsh areas with extensive channel systems will also provide habitat for fish and other aquatic life and haul out areas for harbor seals. In addition, the restored tidal marshes will help filter out and eliminate pollutants. Many of the ponds will remain as managed ponds and be enhanced to maximize their use as feeding and resting habitat for migratory shorebirds and waterfowl traveling on the Pacific Flyway.

Flood management will be integrated with restoration planning, to ensure flood protection for local communities. Where feasible, flood capacities of local creeks, flood control channels, and rivers will be increased by widening the mouths of the waterways and reestablishing connections to historical floodplains. As ponds are opened to the tide, levees between the newly created tidal marsh and local communities will need to be built or enhanced to provide flood protection.

The acquisition of such a large area of open space in the South Bay will allow for the provision of public access, wildlife-oriented recreation, and education opportunities, to be planned concurrently with restoration and flood management. Public uses could include creation of Bay Trail segments for biking and hiking, and provision of hunting and angling opportunities, bird watching, environmental education, and other recreational opportunities.

In the Suisun Marsh, the Suisun Marsh Charter Group was formed in 2001 to resolve issues including recovery of endangered species, amendment of the Suisun Marsh Pres-

ervation Agreement (SMPA), issuance of a U.S. Army Corps of Engineers Regional General Permit, and implementation of a Suisun Marsh Levee Program. The Charter Group was charged with developing and analyzing a plan for the Suisun Marsh that would outline the actions necessary to preserve and enhance managed seasonal wetlands, restore tidal marsh habitat, implement a comprehensive levee protection/improvement program, and protect ecosystem and drinking water quality, consistent with the CALFED Bay-Delta Program's goals and objectives. The proposed Suisun Marsh Plan would balance the goals and objectives of the Bay-Delta Program, SMPA, federal and State Endangered Species Acts, and other management and restoration programs within the Suisun Marsh in a manner that is responsive to the concerns of all stakeholders and is based upon voluntary participation by private landowners. The proposed Suisun Marsh Plan also would provide for simultaneous protections and enhancement of: (1) The Pacific Flyway and existing wildlife values in managed wetlands, (2) endangered species, (3) tidal marshes and other ecosystems, and (4) water quality, including, but not limited to the maintenance and improvement of levees.

Restoration efforts focused on the upper watershed lands above the baylands are also under way. A wide variety of local groups and agencies have watershed management initiatives under way. These are aimed at controlling pollution at the source, identifying contaminants of concern, and protecting watershed habitat. These are usually multi-objective efforts to address needs such as flood control, storm water management, habitat restoration, recreation, and open space. Local government agency and region-wide efforts are under way to control storm water runoff to Bay Region waterways, to initiate innovative land use development and agricultural practices and to improve wastewater discharges—leading to higher water quality for human and livestock consumption.

The Santa Clara Basin Watershed Management Initiative (SCBWMI) is one example of a collaborative, stakeholder driven effort among representatives from regional and local public agencies; civic, environmental, resource conservation and agricultural groups; professional and trade organizations; business and industrial sectors; and the general public, to protect and enhance the Santa Clara Basin watershed, creating a sustainable future for the community and the environment. The State Watershed Task Force recognized the SCBWMI as one of the top 10 watershed partnerships in California through Assembly Bill 2117. Its successes include the adoption of achievable and protective numeric standards for copper and nickel for lower South San Francisco Bay, adoption of wastewater discharge permits and multi-year stream maintenance permits, watershed education and outreach programs and collaborative efforts to address linkages between watershed management, flood protection and other land use and development activities.

Box 3-3 Ongoing Planning Organizations

- The Association of Bay Area Governments (ABAG) CALFED Task Force
- Bay Area Water Agencies Coalition (BAWAC)
- Bay Area Wetlands Restoration Program
- Bay Area Regional Water Recycling Program (BARWRP)
- Fish Passage Improvement Program
- San Francisco Estuary Institute
- Audubon Society – S.F. Bay Restoration Program
- S.F. Bay Area Pollution Prevention Group (BAPPG)
- Bay Area Stormwater Management Agencies Association (BASMAA)
- Bay Area Clean Water Agencies (BACWA)
- San Francisco Bay Conservation and Development Commission (BCDC)
- San Francisco Estuary Project (SFEP)
- SF Bay Area Regional Water Quality Control Board (RWQCB) – SF Bay Basin Plan
- Northern California Salinity Coalition (NCSC)

Looking to the Future

The San Francisco Bay Hydrologic Region is home to a multitude of planning organizations that seek to identify future trends and the challenges that accompany them (Box 3-3 Ongoing Planning Organizations). These groups are working on issues of land use, housing, environmental quality, and economic development, wetlands, water reliability, watershed management, groundwater management, water quality, fisheries, and ecosystem restoration.

Most, if not all, of the water supply agencies in the bay region have undergone integrated water resource planning processes involving stakeholders in their regions including local land use planners and are implementing the adopted strategies to improve water supply reliability. These strategies call for the implementation of a diverse portfolio of water management actions including: conservation, recycling, desalination, conjunctive use, dry year transfers, banking, and storage development.

Many local governments are now routinely evaluating or considering water supply plans as they conduct their land use planning through cooperative efforts with the agencies responsible for water supply. However, until recently, integrated water management planning has not been coordinated among the various subregions of the bay region and has not systematically combined water supply reliability, water quality, storm water and wastewater management, and environmental restoration planning together. A number of regional associations, including BAWAC, North Bay water districts, and BACWA are working under a Letter of Mutual Understandings that sets up a planning framework to develop such an integrated regional water management plan for the entire nine-county Bay Area. Parties involved in developing the report sections focusing on water supply and drinking water quality expect it to be completed by winter 2006 while efforts to compile other sections of the report will continue.

This effort to develop a broad based multi-regional integrated water management plan for the nine-county bay region is very broad in its vision and scope. Although some of the regional agencies and organizations responsible for various aspects of water management have not been able to participate, others have joined BAWAC in this effort.

These efforts at integrating regional water management and planning can benefit the bay region in many ways by facilitating implementation of innovative, cost-effective and efficient multi-objectives water management solutions. For instance, by demonstrating how recycling and water use efficiency are being incorporated, they can increase public support for the plan as a whole. Through an integrated plan, the Bay Region may also better compete for funding from broader sources such as state bond funds or federal appropriations. Some of the largest projects in the region will likely require multiple agencies to agree to participate and finance the effort. These types of regional agreements may be more easily reached with regional planning.

Efforts to develop a regional approach to water management can also benefit the state. As regional water management planning moves forward, regional information on current conditions and future planning is expected to become more readily available. This regional information will complement the information being developed for future California water plans and will be an important part of measuring the performance of the CALFED Bay-Delta Program at meeting water quality and supply reliability goals. It will also help the State and federal governments target expenditures at the highest priority regional needs.

Future bay region regional profiles are expected to incorporate information from integrated regional water management plans (IRWMP). The focus of the integrated regional water management plan within the San Francisco Bay Hydrologic Region covers the nine Bay Area counties. Areas outside the hydrologic boundary are developing separate plans. Proposition 50, Chapter 8 provides funds to assist agencies in developing the IRWMPs. Implementation proposals were submitted in July 2005 for projects that are part of the water supply–water quality section of the draft IRWMP.

Water Quality

Bay region water agencies have made significant investments in programs and projects to actively protect municipal water quality including facility upgrades, advanced treatment methods, watershed monitoring, groundwater monitoring and protection, demineralization projects, and nonpoint water source evaluations. More monitoring and studies are needed to determine the effects of contaminants, including the emerging contaminants, on the aquatic ecosystem of the San Francisco Bay. As the population continues to grow in the Bay Area, the control of storm water runoff, particularly from urban areas, will need to be improved in order to reduce contaminant loads to the estuary. Stricter regulatory requirements are being developed to address the major bay contaminants such as PCBs and mercury. However, even if all the sources of these contaminants were abated, it would take a very long time before sediment contaminants were reduced by degradation, transport to the

Table 3-2 San Francisco Bay Hydrologic Region Water Balance Summary - TAF

Water Entering the Region – Water Leaving the Region = Storage Changes in Region

	Water Year (Percent of Normal Precipitation)		
	1998 (188%)	2000 (109%)	2001 (81%)
Water Entering the Region			
Precipitation	11,438	6,644	4,908
Inflow from Oregon/Mexico	0	0	0
Inflow from Colorado River	0	0	0
Imports from Other Regions ***	764	823	872
Total	**12,202**	**7,467**	**5,780**
Water Leaving the Region			
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	363	394	415
Outflow to Oregon/Nevada/Mexico	0	0	0
Exports to Other Regions	0	0	0
Required Outflow to Salt Sink	23	22	20
Additional Outflow to Salt Sink	664	727	759
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	11,146	6,234	4,795
Total	**12,196**	**7,377**	**5,989**
Storage Changes in the Region			
[+] Water added to storage			
[–] Water removed from storage			
Change in Surface Reservoir Storage	76	-25	-56
Change in Groundwater Storage **	-70	115	-153
Total	**6**	**90**	**-209**
Applied Water * (compare with Consumptive Use)	1,060	1,158	1,214

***Footnote for applied water**

Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.

****Footnote for change in Groundwater Storage**

Change in Groundwater Storage is based upon best available information. Basins in the north part of the state (North Coast, San Francisco, Sacramento River and North Lahontan regions and parts of Central Coast and San Joaquin River regions) have been modeled – spring 1997 to spring 1998 for the 1998 water year and spring 1999 to spring 2000 for the 2000 water year. All other regions and year 2001 were calculated using the following equation:

GW change in storage =
intentional recharge + deep percolation of applied water + conveyance deep percolation - withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow.

ocean or atmosphere, or burial under new sediment deposits. Continued monitoring is needed to evaluate the effectiveness of management actions, detect long-term trends and investigate emerging issues from new contaminants.

Wetlands and Watershed

With the large scale wetlands restoration under way around the bay, there will need to be ongoing monitoring and adaptive management to ensure that projects are meeting environmental objectives and integrating well with other water management objectives.

Water Portfolios for Water Years 1998, 2000, and 2001

The following tables present actual information about the water supplies and uses for the San Francisco Bay Hydrologic Region. Water year 1998 was a wet year for this region, with annual precipitation at 188 percent of average, while the statewide annual precipitation was 171 percent of average. Year 2000 represents nearly normal hydrologic conditions with annual precipitation at 109 percent of average for the San Francisco Bay region, and year 2001 reflected drier water year conditions with annual precipitation at 81 percent of average. For comparison, statewide average precipitation in year 2001 was 72 percent of normal. Table 3-3 provides more detailed information about the total water supplies available to this region for these three specific years from precipitation, imports and groundwater, and also summarizes the uses of all of the water supplies. The three-year Water Portfolio table, Table 3-4, and companion Water Portfolio flow diagrams, Figures 3-4 and 3-5, provide more detailed information about how the available water supplies are distributed and used throughout this region.

Table 3-3 presents the portion of the total available water that is dedicated to urban, agricultural and environmental purposes. Because most of the San Francisco Bay region is largely urbanized, more than 85 percent of the developed water is supplied for urban use. By comparison, agricultural use consumes roughly 10 percent of the developed water supply and instream flows and managed wetlands use only 2 to 3 percent of the total dedicated water supply in this region. Table 3-3 also provides detailed information about the sources of the developed water supplies, which are primarily from surface water systems. For the years 1998, 2000 and 2001, this table shows that more than 65 percent of the region's developed water supplies were imported from other hydrologic regions of the state.

Selected References

Water Quality Control Plan, Regional Water Quality Control Board

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2002 California 305(b) Report on Water Quality, State Water Resources Control Board

Bulletin 118, California's Groundwater, Update 2003, Department of Water Resources

Nonpoint Source Program Strategy and Implementation Plan, 1998-2013, State Water Resources Control Board, California Coastal Commission, January 2000

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"2003 Pulse of the Estuary," San Francisco Estuary Institute

Table 3-3 San Francisco Bay Region Water Use and Distribution of Dedicated Supplies- TAF

	1998			2000			2001		
	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion
WATER USE									
Urban									
Large Landscape	83.7			90.8			94.6		
Commercial	206.4			223.2			233.0		
Industrial	59.4			63.5			66.1		
Energy Production	0.0			0.0			0.0		
Residential - Interior	291.6			315.4			329.4		
Residential - Exterior	322.8			350.6			365.4		
Evapotranspiration of Applied Water	290.7	290.7		306.9	306.9		320.0	320.0	
E&ET and Deep Perc to Salt Sink	0.0	0.0		0.0	0.0		0.0	0.0	
Outflow	632.8	632.8		692.7	692.7		722.6	722.6	
Conveyance Applied Water	12.4			12.2			11.2		
Conveyance Evaporation & ETAW	6.2	6.2		6.1	6.1		5.6	5.6	
Conveyance Deep Perc to Salt Sink	0.0	0.0		0.0	0.0		0.0	0.0	
Conveyance Outflow	6.2	6.2		6.1	6.1		5.6	5.6	
GW Recharge Applied Water	14.4			13.6			10.4		
GW Recharge Evap + Evapotranspiration	0.0	0.0		0.0	0.0		0.0	0.0	
Total Urban Use	**990.7**	**935.9**	**935.9**	**1,069.3**	**1,011.8**	**1,011.8**	**1,110.1**	**1,053.8**	**1,053.8**
Agriculture									
On-Farm Applied Water	90.1			108.3			119.2		
Evapotranspiration of Applied Water	69.4	69.4		83.7	83.7		91.8	91.8	
E&ET and Deep Perc to Salt Sink	0.0	0.0		0.0	0.0		0.0	0.0	
Outflow	20.7	20.7		24.6	24.6		27.4	27.4	
Conveyance Applied Water	1.4			1.4			1.2		
Conveyance Evaporation & ETAW	0.7	0.7		0.7	0.7		0.6	0.6	
Conveyance Deep Perc to Salt Sink	0.0	0.0		0.0	0.0		0.0	0.0	
Conveyance Outflow	0.7	0.7		0.7	0.7		0.6	0.6	
GW Recharge Applied Water	0.0			0.0			0.0		
GW Recharge Evap + Evapotranspiration	0.0	0.0		0.0	0.0		0.0	0.0	
Total Agricultural Use	**91.5**	**91.5**	**91.5**	**109.7**	**109.7**	**109.7**	**120.4**	**120.4**	**120.4**
Environmental									
Instream									
Applied Water	23.1			21.5			20.0		
Outflow	23.1	23.1		21.5	21.5		20.0	20.0	
Wild & Scenic									
Applied Water	0.0			0.0			0.0		
Outflow	0.0	0.0		0.0	0.0		0.0	0.0	
Required Delta Outflow									
Applied Water	0.0			0.0			0.0		
Outflow	0.0	0.0		0.0	0.0		0.0	0.0	
Managed Wetlands									
Habitat Applied Water	6.2			6.2			6.2		
Evapotranspiration of Applied Water	3.1	3.1		3.1	3.1		3.1	3.1	
E&ET and Deep Perc to Salt Sink	0.0	0.0		0.0	0.0		0.0	0.0	
Outflow	3.1	3.1		3.1	3.1		3.1	3.1	
Conveyance Applied Water	0.0			0.0			0.0		
Conveyance Evaporation & ETAW	0.0	0.0		0.0	0.0		0.0	0.0	
Conveyance Deep Perc to Salt Sink	0.0	0.0		0.0	0.0		0.0	0.0	
Conveyance Outflow	0.0	0.0		0.0	0.0		0.0	0.0	
Total Managed Wetlands Use	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**
Total Environmental Use	**29.3**	**29.3**	**29.3**	**27.7**	**27.7**	**27.7**	**26.2**	**26.2**	**26.2**
TOTAL USE AND OUTFLOW	**1,111.5**	**1,056.7**	**1,056.7**	**1,206.7**	**1,149.2**	**1,149.2**	**1,256.7**	**1,200.4**	**1,200.4**
DEDICATED WATER SUPPLIES									
Surface Water									
Local Deliveries	273.7	273.7	273.7	244.0	244.0	244.0	216.4	216.4	216.4
Local Imported Deliveries	501.2	501.2	501.2	502.9	502.9	502.9	529.8	529.8	529.8
Colorado River Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CVP Base and Project Deliveries	104.7	104.7	104.7	108.6	108.6	108.6	109.4	109.4	109.4
Other Federal Deliveries	37.7	37.7	37.7	34.5	34.5	34.5	37.5	37.5	37.5
SWP Deliveries	134.2	134.2	134.2	155.0	155.0	155.0	121.3	121.3	121.3
Required Environmental Instream Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater									
Net Withdrawal	-17.2	-17.2	-17.2	81.8	81.8	81.8	163.6	163.6	163.6
Deep Percolation of Surface and GW	54.8			57.5			56.3		
Reuse/Recycle									
Reuse Surface Water	0.0			0.0			0.0		
Recycled Water	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
TOTAL SUPPLIES	**1,111.5**	**1,056.7**	**1,056.7**	**1,206.7**	**1,149.2**	**1,149.2**	**1,256.7**	**1,200.4**	**1,200.4**
Balance = Use - Supplies	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*