State of California
Regional Water Quality Control Board
San Diego Region

EXECUTIVE OFFICER SUMMARY REPORT
March 12, 2008

ITEM: 10

SUBJECT: Report: California Water Plan Update 2009—a major element in the plan update will be the protection of water quality. The California Department of Water Resources, in developing this plan this year, will provide the Regional Board an overview of the process to integrate water quality information in the plan update. Additional information on the 2009 Update can be accessed at the website www.waterplan.water.ca.gov/ (Michael McCann)

PURPOSE: To provide the Regional Board an overview of the process of obtaining water quality information from the Regional Boards, other governmental agencies, and the public.

PUBLIC NOTICE: This is an information item. There are no legal noticing requirements.

DISCUSSION: A representative from the Department of Water Resources (DWR) will be giving a presentation on the integration of water quality protection information in the update currently in development. DWR continues to convene workshops and meetings for the purpose of obtaining information on water quality. The State Water Resources Control Board has encouraged the Regional Boards to participate as fully as possible with DWR in the development of the updated plan.

The principal goals of the Water Plan Update is to receive broad support among those participating in California's water planning and to be a useful document for the public, water planners, legislators and other decision makers.

The California Water Plan is a framework for water managers, legislators, and the public to consider options and make decisions regarding California's water future. The plan provides extensive information on the state's water resources. A major element in the information in the next update will be the protection of water quality.

The 2005 Update stated the following concerning protection of water quality:

To ensure that our water uses are sustainable, water management at all levels—State, federal, regional, and local—must be based on three foundational actions: 1) Use water efficiently, 2) Protect water quality, and 3) Support environmental stewardship.

The update further stated that water supply and water quality are inseparable in water management. While implementing projects to reduce water demand or to augment supply, water managers must employ methods and strategies that protect and improve water quality:

- Protect surface waters and aquifers from contamination
- Explore new treatment technologies for drinking water and groundwater remediation
- Match water quality to its intended uses
- Improve management of urban and agricultural runoff
- Improve watershed management

The attached supporting document, a reference guide on the status of Water Quality in 2004, contains useful information on water quality. It is a consolidation of the water quality sections from the various volumes of the Plan Update.

SUPPORTING DOCUMENT: (1) Water Plan Update 2005--Reference Guide: California Water Quality in 2004

RECOMMENDATION(S): The Executive Officer may provide a recommendation following discussion of this item.

Water Quality, California, 2004

written and edited by
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In this paper, DWR has consolidated in one place the major water quality sections from the various volumes of this California Water Plan Update. To start, it presents an overview of the legal and regulatory framework for protecting water quality, then discusses statewide water quality issues of concern, and concludes with regional profiles of water quality issues around California. It also includes a section describing the Water Boards and their role in water quality, which is not found elsewhere in Bulletin 160-05. Most of the other information, though, is excerpted from this California Water Plan Update, with editing only for context and clarity.

Legal and Regulatory Framework for Protecting Water Quality

(excerpted from "Water Allocation, Use, and Regulation in California," Volume 4)

Clean Water Act-National Pollutant Discharge Elimination System

Section 402 of the Clean Water Act established a permit system, the National Pollutant Discharge Elimination System (NPDES), to regulate point sources of discharges in navigable waters of the United States. USEPA was given the authority to implement the NPDES, although the Act also authorizes states to implement the NPDES program in lieu of the USEPA, provided the state has sufficient authority.

After the Clean Water Act was enacted in 1972, USEPA and the states focused primarily on implementing technology-based controls for "point" sources (for example, discharges from pipes from factories and municipal sewage treatment plants). Today, those controls are largely in place, and the focus is beginning to shift to "non-point source" pollution, such as runoff from cities and farms.

Porter-Cologne Water Quality Control Act

This Act is California's comprehensive water quality control law and is a complete regulatory program designed to protect water quality and beneficial uses of the State's water. It requires the adoption of water quality control plans (basin plans) by the State's nine Regional Water Quality Control Boards (Regional Water Boards) for watersheds within their regions. The basin plans are reviewed triennially and amended as necessary by the Regional Water Boards, subject to the approval of the California Office of Administrative Law, the State Water Board and ultimately the federal USEPA. Moreover, pursuant to Porter-Cologne, these basin plans shall become part of the California Water Plan, when such plans have been reported to the Legislature (Section 13141, California Water Code).

In 1972, the Legislature amended the Porter-Cologne Act to give California the authority and ability to operate the federal NPDES permits program. Before a permit may be issued, Section 401 of the Clean Water Act requires that the RWQCB certify that the discharge will comply with applicable water quality standards. In addition, under Porter-Cologne, the RWQCB may also issue waste discharge requirements, that set conditions on the discharge of a waste. These requirements must be consistent with the water

[1] The author recognizes and thanks Loren Bottorff for his thoughtful comments and edits on these various water quality sections.

quality control plan for the body of water that receives the waste discharge, as well as protect the beneficial uses of those receiving waters.

The Regional Water Boards also implement Section 402 of the federal Clean Water Act, which allows the State to issue a single discharge permit for stormwater runoff for the purposes of both State and federal law.

Federal Safe Drinking Water Act

The Safe Drinking Water Act (SDWA), enacted in 1974 and significantly amended in 1986 and 1996, directed the USEPA to set national standards for drinking water quality. It required the USEPA to set maximum contaminant levels for a wide variety of constituents. Local water suppliers are required to monitor their water supplies to assure that regulatory standards are not exceeded.

A Maximum Contaminant Level (MCL) is the maximum concentration of a contaminant that is allowed in public drinking water systems. The 1986 amendments set a timetable for the USEPA to establish standards for specific contaminants and increased the range of contaminants local water suppliers were required to monitor to include contaminants that did not yet have an MCL established. The 1986 Safe Drinking Water Act Amendments also led to the USEPA's adoption of the Surface Water Treatment Rule, which addresses filtration and disinfection of surface waters. The amendments included a wellhead protection program, a grant program for designating sole-source aquifers for special protection, and grant programs and technical and financial assistance to small systems and states.

The 1996 amendments included stronger regulation of microbial contaminants (i.e. Cryptosporidium) while managing levels of disinfection byproducts, source water assessment programs, and establishment of a drinking water state revolving fund. The source water assessment and protection programs offer tools and opportunities to build a prevention barrier to drinking water contamination. Under the Safe Drinking Water Act, the state is required to develop comprehensive Source Water Assessment Programs that will identify the areas that supply public tap water, inventory contaminants and assess water system susceptibility to contamination, and inform the public of the results.

For every new standard, USEPA conducts an analysis to determine if the benefits of the standard justify the costs. If not, USEPA may adjust the MCL to a level that "maximizes the health risk reduction benefits at a cost that is justified by the benefits."

California Safe Drinking Water Act

In 1976, California enacted its own Safe Drinking Water Act, requiring the Department of Health Services (DHS) to regulate drinking water, including: setting and enforcing federal and State drinking water standards; administering water quality testing programs; and administering permits for public water system operations. In 1989, significant amendments to the California act incorporated the new federal safe drinking water act requirements into California law, gave DHS discretion to set more stringent MCLs, and recommended public health levels for contaminants.

California Government

Beyond DWR, many State departments and agencies oversee California's water quality. For example, the State Water Board integrates water rights and water quality decision-making authority. The State Water

Board and the nine Regional Water Boards are responsible for protecting California's water resources. Other State agencies and their roles in water quality management follow:

- California Bay-Delta Authority—Oversees the 23 State and federal agencies working cooperatively through the CALFED Bay-Delta Program to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem.
- California Environmental Protection Agency—Restores, protects, and enhances the environment to ensure public health, environmental quality, and economic vitality.
- California Integrated Waste Management Board—Manages the estimated 76 million tons of waste generated each year by reducing waste whenever possible, promoting the management of all materials to their highest and best use, and protecting public health and safety and the environment.
- Department of Fish and Game—Regulates and conserves the state's wildlife.
- Department of Food and Agriculture—Supports California's agricultural economy.
- Department of Health Services—Oversees programs to protect and improve the health of all Californians, regulates and permits drinking water.
- Department of Pesticide Regulation—Regulates pesticide sales and use and plays a significant role in monitoring for the presence of pesticides and in preventing further contamination of the water resource.
- Department of Toxic Substances Control—Provides technical oversight for the characterization and remediation of soil and water contamination.

Federal Government

The federal government also has an important role in protecting the state's water quality, particularly the USEPA, which protects human health and the natural environment. Other federal agencies with water quality roles include:

- US Army Corps of Engineers—Plans, designs, builds, operates, and regulates water resources projects (e.g., navigation, flood control, environmental protection, disaster response). The Corps is also responsible for 404 dredge and fill permits that will then result in a need for Regional Water Board water quality certification.
- US Bureau of Reclamation—Constructs federal water supply projects and is the nation's largest wholesaler of water and the second largest producer of hydroelectric power.
- US Department of Agriculture (USDA)—Manages forests, watersheds, and other natural resources.
- Natural Resource Conservation Service (within USDA)—Provides technical and financial assistance to conserve, maintain and improve natural resources on private lands.
- U.S. Fish and Wildlife Service—Conserves, protects, and enhances fish, wildlife, and plants and their habitats.
- U.S. Geological Survey—Provides water measurement and water quality research.

Public Agencies, Districts, and Local Governments

Local city and county governments and special districts have ultimate responsibility for providing safe and reliable water to their customers. Cities and counties, which may also provide domestic water, are also the land and resource management agencies and planning entities that most influence the location and amount of population growth within the state.

Private Entities

In addition to public agencies, private entities may also supply water. Mutual water companies, for example, are private corporations that perform water supply and distribution functions similar to public water districts. Sometimes investor-owned utilities are also involved in water supply activities as an adjunct of hydroelectric power development. These investor-owned water companies are regulated by the California Public Utilities Commission.

Individual Water Users

Collectively, the millions of urban businesses, individual households, and farms fund the operation and maintenance of California's water systems through payment of taxes and water bills. Each makes decisions on water use and conservation for its own circumstances. Individual water users must dispose of used water, usually through a sewer or gutter, which in turn can create water pollution. This return flow can provide water to downstream water users. During drought periods, many households modify outdoor watering to conserve water. Each year, farmers make decisions on planting and water application based on weather conditions, forecasted water supply, and individual tolerance for market risk. Taken together, these individual decisions about water use have an enormous impact on both water demand and water quality and present many opportunities for individuals to play positive roles in better managing California's water quantity and quality.

Water Quality and the Water Boards[2]

Water is California's most precious resource, providing an essential lifeline between agriculture, industry, the environment and urban and rural interests throughout the state. With a growing population of more than 30 million and a limited supply of fresh water, the protection of water for beneficial uses is of paramount concern for all Californians. The State Water Board and the Regional Water Boards, under the umbrella of the California Environmental Protection Agency, are responsible for protecting California's water resources.

Created by the Dickey Water Pollution Act, the Regional Water Boards have been responsible for protecting the surface, ground and coastal waters of their regions since 1949. In 1967, the State Water Rights Board and the State Water Quality Control Board were merged to create the State Water Resources Control Board, integrating water rights and water quality decision-making authority. The nine Regional Water Boards are semi-autonomous and comprised of up to nine part-time Board members appointed by the Governor. Regional boundaries are based on watersheds. Together, the Regional Water Boards have about 875 staff members in 12 regional locations. Each Regional Water Board makes critical water quality decisions for its region. These decisions include setting standards, issuing waste discharge requirements, determining compliance with those requirements, and taking appropriate enforcement actions.

The State Board's role in protecting water quality includes setting statewide policy, coordinating and supporting the Regional Water Board efforts, and reviewing petitions contesting Regional Water Board actions. The State Water Board is also solely responsible for allocating surface water rights. Today, the State Water Board, with roughly 600 staff members, is organized into four divisions that address water

[2] This section was prepared by State and Regional Board staff.

quality, water rights, financial assistance, and administrative functions. These functions not only support the State Water Board, but also the nine Regional Water Boards. Five full-time Board members, appointed by the Governor, are responsible for setting statewide water policy.

The Boards completed a strategic plan in 1995 and revised it in 1997 and again in 2001. The 2001 Strategic Plan updates the mission, vision, values, operating principles, goals, objectives, performance measures and key strategic projects of the California Water Boards. The Water Boards' overall mission is to preserve, enhance and restore the quality of California's water resources, and ensure their proper allocation and efficient use for the benefit of present and future generations. The Strategic Plan highlights critical water resource issues to be addressed over the next five years, while considering our progress to date.

Since the passage of the federal Clean Water Act in 1972, California has made great strides in cleaning up its rivers, lakes, groundwater aquifers, and coastal waters. The primary focus of that effort, both in California and nationally, has been on wastewater discharged from "point sources" – sewer outfalls and other easily identifiable sources such as pipes. Much of that progress resulted from a regulatory effort that required a permit for each distinct point of discharge, combined with a sizable loan and grant program to help fund the facilities needed to clean up discharges to permit levels.

Despite this progress, significant challenges remain. For example, the permitting of point sources is becoming more complex and contentious as new state and federal mandates affect standards and enforcement. The 1999 Compliance Assurance and Enforcement Initiative established the goal of achieving measurable and continuing increases in compliance rates and identified a wide variety of challenges and proposed solutions. Improved data management is essential for improved compliance assurance and enforcement. Regulators, policy makers, and the public need better access to violation and enforcement information.

An even greater challenge is pollution resulting from "nonpoint sources" – runoff from urban areas, agriculture, timber operations, mine drainage and other sources for which there is no single point of discharge. Nonpoint source (NPS) pollution is the most significant California water quality challenge today, and requires flexible and creative responses. The challenge of NPS pollution lies in its very nature: diffuse, sporadic and difficult to trace to its sources, and thus more difficult to regulate through a permitting process. Because treatment to remove NPS pollutants is an expensive and potentially endless task, it is essential to keep these pollutants from reaching the water. Effective water quality protection requires a comprehensive approach to managing nonpoint sources. Prevention needs to be emphasized, and the cumulative effects of NPS pollution on entire watersheds must be considered.

More than 20 state agencies, in addition to the California Water Boards, have authorities, programs, or responsibilities relating to the control of NPS pollution. Coordinating and focusing such a large number of entities to produce an effective NPS program in a state as large and geomorphologically diverse as California poses unique and difficult challenges. A NPS Program Plan, developed in coordination with the California Coastal Commission and other responsible State agencies, was approved in 2000. The NPS Program Plan includes a program strategy, implementation plan, and management measures to control NPS pollution. A NPS Implementation and Enforcement Policy, adopted in 2004, explains how the NPS Program Plan will be implemented and enforced. In addition, the California Water Boards have implemented a broad program of outreach, education, technical assistance and financial incentives. This

program is supplemented by collaborative efforts with other agencies and non-governmental organizations. The goal is to provide an integrated statewide approach to controlling NPS pollution.

Total Maximum Daily Loads (TMDLs) is a tool used by the California Water Boards to address both point source and nonpoint source pollution. Federal law requires states to identify all water bodies that do not meet water quality standards. For those "impaired" water bodies failing to meet standards, the states must establish TMDLs. TMDLs define how much of a specific pollutant a water body can tolerate and still meet relevant water quality standards. The establishment of TMDLs in California is one of the most significant and controversial efforts undertaken by the California Water Boards. Not only do the TMDLs have to be established, but they must also be implemented by allocating responsibility for corrective measures among a variety of dischargers.

The 2002 303(d) list identifies 1883 water body-pollutant combinations requiring TMDL development. The California Water Boards have developed guidance for this new and complex program, and are working with stakeholders to adopt and implement TMDLs. Many TMDLs are already well under way. In the long-term, additional resources will be required to accurately monitor and assess water bodies and subsequently determine the success of the TMDLs in restoring the state's water to meet relevant standards.

Adequate and accurate monitoring and assessment is the cornerstone to preserving, enhancing, and restoring water quality. The information gathered from these monitoring activities is critical for: determining the effects of point and nonpoint source pollution; protection of drinking water supplies; conducting federal Clean Water Act assessments; determining trends in water and habitat quality; and developing water quality standards and then determining if they are being met. In November 2000, in response to Assembly Bill (AB) 982, the State Board submitted to the Legislature a comprehensive plan for the Surface Water Ambient Monitoring Program (SWAMP) and Groundwater Ambient Monitoring and Assessment (GAMA). The California Water Boards are now implementing these programs to the extent funding is available.

Finally, it is essential to recognize that pollution occurs without respect to jurisdictional or organizational boundaries and it is vital to create strategies to address cross-media/cross-organizational issues. After years of focusing on single point source pollution control, the California Water Boards are now looking at the bigger picture when developing methods of dealing with water pollution.

A key component of the Strategic Plan is to utilize a watershed management approach for water resources protection. To protect water resources within a watershed context, a mix of point and nonpoint source discharges, ground and surface water interactions, and water quality and water quantity relationships must be considered. These complex relationships present considerable challenges to water resource protection programs. The California Water Boards are responding to these challenges within the context of the organization's Watershed Management Initiative (WMI). The WMI was developed to help the California Water Boards in meeting the goal of providing water resource protection, enhancement, and restoration while balancing economic and environmental impacts. The WMI provides a framework that overlies numerous separate and competing program priorities established by federal and state mandates.

The California Water Boards have been implementing the WMI since 1997 to better coordinate and focus limited public and private resources to address both point and nonpoint source water quality problems,

especially in high priority targeted watersheds. By looking at entire watersheds rather than focusing on specific pollutants or polluters, the California Water Boards can develop unique solutions that consider all local conditions and pollution sources for each watershed. These solutions rely on the input and involvement of local stakeholders.

The Regional Water Boards have developed WMI Chapters that describe the Regional Water Board strategies for addressing water quality concerns on a watershed basis. These strategies rely on close coordination with other state, federal and local agencies in using limited fiscal and technical resources. The WMI Chapters identify priorities, describe the Regional Board watersheds and watershed-related activities, as well as program activities. Even though the chapters are meant to be long-term strategies, priorities can change quickly. Hence, the WMI Chapters are meant to be living documents so that relevant sections can be updated when new information on changing priorities is received. The WMI Chapters identify priority tasks and projects to be funded by existing resources, as well as those that are currently unfunded, including potential projects for grant applications. The California Water Boards can utilize the chapters in making informed decisions on which activities will be funded by specific workplans. The WMI Chapters are dynamic and represent the best information and strategies at the time they are written.

Statewide Concerns for Water Quality

(excerpted from Chapters 2 "California Water Today" and 3 "Planning for an Uncertain Future", Volume 1)

California faces water quality challenges at the statewide, regional, and local levels. Significant statewide water quality issues are summarized here, while a discussion of specific regional and local challenges follows.

Water Supply and Water Quality

Water supply and use are inherently linked to water quality. Various water management actions such as transfers, water use efficiency, water recycling, conjunctive use of aquifers, storage and conveyance, Delta operations, land fallowing, and hydroelectric power potentially have water quality impacts. Alternatively, degraded water quality can limit, or make very expensive, some water supply uses or options because the water must be pretreated. Furthermore, water managers increasingly recognize that the water quality of various water supplies needs to be matched with its eventual use and potential treatment.

Contamination of Surface Water and Groundwater

Nonpoint-source pollution, including urban and agricultural runoff, is the largest contributor of human-induced contamination of surface water and groundwater in the state. Regarding surface water, about 13 percent of the total miles of California's rivers and streams and about 15 percent of its lake acreage are listed as impaired. With respect to groundwater, samples analyzed from all 10 hydrologic regions showed that between 5 and 42 percent of public water supply wells exceeded one or more drinking water standards, depending on the region. Exceedances were usually for inorganic chemicals or radioactivity and, in particular, nitrate, which presents a known health risk. Largely agricultural or industrial regions had high percentage of exceedances for pesticides and volatile organic chemicals, respectively. Seawater

intrusion in the Delta and in coastal aquifers, agricultural drainage, and imported Colorado River water can increase salinity in all types of water supplies, adversely affecting many beneficial uses.

Since December 31, 2002, discharges for irrigated agriculture and timber harvesting must be monitored, placing much uncertainty over the future of runoff from these activities. Along with urban runoff, the USEPA has identified agricultural runoff as the most serious threat to water quality in the country. Municipal and industrial wastewater and even some urban runoff are already formally managed. However, agricultural runoff, application of biosolids to farms, and agricultural drainage, especially in the Central Valley, will remain significant and potentially expensive challenges, with no obvious or simple solutions.

Population Growth

More population growth means more domestic wastewater discharges and urban runoff, which may in turn contaminate natural water bodies used as drinking water sources. Combined with demographic change, population growth can result in wastewater discharges that pollute California's waters with emerging contaminants such as endocrine disrupters as well as higher concentrations of traditional contaminants.

Emerging Contaminants

The nature and impact of contaminants themselves may be changing in the future. Future population growth and demographic changes may further impair the quality of water bodies with both known and emerging contaminants, increasing the risk of drinking water. Demographic change may create larger groups of people, including the very old and the very young, which are vulnerable to risks from drinking water contaminants. While most of water contaminants are unregulated, that does not mean that they do not present a threat. Information on pollutant sources and their impacts is insufficient to adequately respond to existing problems. As new health risk information is obtained, water quality standards may need to become more stringent to protect health and safety. Re-evaluation of health effects research often leads to re-regulation of known contaminants. Moreover, there is a growing demand from consumers, expressed in opinion surveys as well as in the marketplace, for higher quality water.

Legacy Contaminants

In rural areas, the main pollution sources can come directly from land use practices, both present and past. As an example, the Sierra Nevada Ecosystem Project notes the adverse impact that hydraulic mining, which ceased during the 19th century, is still having on numerous Central Valley rivers. In addition, logging and related road cuts are a major cause of high sediment loads to North Coast streams. Roads result in significant erosion into watersheds throughout the coastal and inland areas. Grazing impacts, such as increased erosion, loss of streamside vegetation, loss of groundwater recharge ability in mountain meadows, and nutrient inputs, have contributed to the overall water quality degradation. Other legacies of California's economy and lifestyles include mercury, nitrate, PCBs, MTBE and other fuel components, perchlorate, and a variety of industrial and agricultural chemicals.

People Without Clean and Safe Drinking Water

Census figures from 1990 indicate that in California, the sixth largest economy in the world, almost 32,000 housing units obtained water from shallow wells and another 49,000 housing units obtained their water from some source other than dug wells, drilled wells, or public or private water systems. The

Census counted about 68,000 housing units (less than one percent of the state's population) that disposed their sewage by means other than a public sewer, septic tank, or cesspool.

Californians lacking access to safe drinking water are vulnerable to a higher incidence of disease than the general population. Untreated water can contain bacterial, parasitic, and viral contaminants. People at risk most often get their water from untreated surface water such as rivers, lakes, or springs. They may also have shallow unsealed wells or use irrigation ditch water. Surface water and shallow wells can become contaminated from rain runoff or flooding. A further concern is sewage disposal. Many rural communities have problems associated with failing septic drainfields and sewage surfacing in yards. This lack of wastewater infrastructure may contaminate potable water and domestic water sources.

Environmental Justice

Californians from disadvantaged and under-represented communities continue to face economic and environmental inequities with respect to water supply, participation in water policy and management decisions, and access to State funding for water projects. All Californians do not have equal opportunity or equal access to State planning processes, programs, and funding for water allocation, improving water quality, and determining how to mitigate potential adverse impacts to communities associated with proposed water programs and projects.

Groundwater Overdraft

Overdraft is the condition of a groundwater basin in which the amount of water withdrawn by pumping over the long term exceeds the amount of water that recharges the basin. 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. A comprehensive assessment of overdraft in California's groundwater basins has not been conducted since 1980 (DWR 1980), but it is estimated that overdraft is between 1 million and 2 million acre-feet annually (DWR 2003).

Deferred Maintenance and Aging Infrastructure

Some facilities of the SWP and the federal CVP have surpassed their design life and require significant rehabilitation or replacement. In recent years infrastructure failures have disrupted water deliveries. Current infrastructure disrepair, outages, and failures and the degradation of local water delivery systems are in part the result of years of underinvestment in preventive maintenance, repair, and rehabilitation. The California Performance Review (2004) cited a report by the Public Policy Institute of California estimating the state's "water supply and wastewater treatment systems maintenance backlog" to be about $40 billion. (Dowall and Whittington 2003).

Global Climate Change

California's water systems have been designed and operated based on data from a relatively short hydrologic record. Mounting scientific evidence suggests that forecasted climate changes could significantly change California's precipitation pattern and amount from that shown by the record. Less snowpack would mean less natural water storage. More variability in rainfall, wetter at times and drier at times, would place more stress on the reliability of existing flood management and water systems.

Different precipitation and runoff patterns resulting from climate change could have impacts on water quality as well. For instance, seasonal increases in water volumes could dilute the concentrations of existing contaminants, while increased flows erode and wash more non-point source pollution into water bodies. Moreover, some water quality research suggests that water borne disease outbreaks may be associated with high runoff events. Individual water quality parameters such as turbidity, temperature, and toxicity could also be affected by the hydrologic impacts of climate change.

Regional Water Quality[3]

(excerpted from Volume 3)

In preparing these regional water quality profiles, DWR relied upon the following documents from the California Water Boards, primarily in an effort to conform to the intent of Porter-Cologne (i.e. that regional basin plans are a part of the California Water Plan).

- Water Quality Control Plan, Regional Water Quality Control Boards
- Watershed Management Initiative Chapter, Regional Water Quality Control Boards
- 2002 California 305(b) Report on Water Quality, State Water Resources Control Board
- Nonpoint Source Program Strategy and Implementation Plan, 1998-2013, State Water Resources Control Board, California Coastal Commission, January 2000
- Strategic Plan, State Water Resources Control Board, Regional Water Quality Control Boards, November 15, 2001

In addition, the Department also extensively utilized DWR's Bulletin 118, *California's Groundwater, Update 2003* to prepare these reports.

North Coast

The North Coast Region generally has the most abundant water resources of any region of the State. The high volumes of precipitation and natural river runoff are a key component for most of the beneficial uses of its water bodies, including commercial and recreational fishing, shellfish harvesting, urban and agricultural use, and recreation. Many of the region's forests and watersheds support threatened and endangered species of plants and animals, and the major rivers and streams contain significant anadromous fishery resources. This region also features important coastal resources, including Bodega Harbor and Humboldt Bay, as well as many small estuaries.

The region nonetheless is confronted by many water quality and water supply challenges. The North Coast Water Board's water quality priorities highlight the need for control of nonpoint source runoff from logging, rural roads, agriculture (including grazing), and urban areas. In fact, sediment, temperature, and nutrients are the primary focus of the North Coast Water Board's 303(d) list of impaired water bodies. Along the coast, nonpoint source pollution can cause microbial contamination of shellfish (and in particular, oyster) growing areas. Much of the region is characterized generally by rugged, steep, forested lands, with highly erodable, loosely consolidated soils; taken together with wildfires, extensive timber

[3] DWR appreciates the contributions to and review of these regional water quality profiles by California Water Board staff. The author also wishes to acknowledge the input of the DWR District Office staff to these reports as well. Last, the staff of the California Bay-Delta Authority contributed to the Sacramento Valley, San Francisco Bay, and South Coast narratives; in particular, Authority staff primarily wrote the Sacramento-San Joaquin Delta section.

harvesting, and heavy precipitation primarily in the form of rainfall, the watershed is highly susceptible to erosion and landslides. Such heavy runoff in turn causes stream sedimentation that impacts habitat for spawning and rearing of anadromous fish. Channel modifications and water diversions have radically changed water quality conditions in many water bodies in the region, reducing natural flows that dilute contaminant concentrations and lessen their impacts. In the southern portion of this region, the development of new hillside vineyards is an increasing source of erosion, as well as pesticides.

The cold water fisheries in the region has been adversely affected by a number of water quality factors. The Eel, Mad, Mattole, Trinity, and Russian Rivers, as well as many other streams, are listed on the Clean Water Act 303(d) list as impacted by excessive sedimentation. One of the largest impacts from sediment is caused when salmonid spawning gravels are smothered. Timber harvesting can also decrease the canopy shading rivers and streams, thereby increasing water temperatures to levels that are harmful to cold water fisheries. The North Coast Region's basin plan sets turbidity restrictions to control erosion impacts from logging and related activities, such as road building. The basin plan also specifically establishes temperature objectives for the Trinity River, in which reduced flows have disrupted temperature and physical cues for anadromous fish runs. Because of water diversions, summer temperatures in the Trinity as well as the Klamath can be lethal to salmonids. Fisheries can be further adversely affected by the lack of woody debris for pool habitat and sediment metering. The North Coast region is in the process of considering revisions to the basin plan temperature objectives and sediment prohibitions to address these issues.

The North Coast Water Board's basin plan requires tertiary treatment of wastewater discharges to the Russian River, a major source of domestic water, and establishes limits on bacteriological contamination of shellfish growing areas along the coast. The plan also prohibits or strictly limits waste discharges to the Klamath, Trinity, Smith, Mad, and Eel Rivers, as well as estuaries and other coastal waters. Nonpoint source runoff, especially after heavy precipitation, has resulted in contamination and closure of shellfish harvesting beds in Humboldt Bay. In the lower Russian River watershed stormwater runoff may also be contributing to high ammonia and low dissolved oxygen levels in Laguna de Santa Rosa, which is threatening aquatic life. Mercury in fish tissue is a water quality concern in Lakes Pillsbury, Mendocino, and Sonoma; a health advisory for mercury has been issued for Lake Pillsbury.

Groundwater quality problems in the North Coast region include contamination from seawater intrusion and nitrates in shallow coastal groundwater aquifers; high total dissolved solids (TDS) and alkalinity in groundwater associated with the lake sediments of the Modoc Plateau basins; and iron, boron, and manganese in the inland groundwater basins of Mendocino and Sonoma counties. Septic tank failures in western Sonoma County, at Monte Rio and Camp Meeker, and along the Trinity below Lewiston Dam, are a concern due to potential impacts to groundwater wells and recreational water quality.

Abandoned mines, forest herbicide application and historical discharge of wood treatment chemicals at lumber mills, including the Sierra Pacific Industries site near Arcata and Trinity River Lumber Company in Weaverville, are also regional issues of concern. Of note, according to the 305(b) report, only the Russian River basin has a long-term water quality data set in this region, which is necessary to evaluate quality changes over time. Current SWAMP sampling will contribute to this data set.

The drinking water for many of the communities on the North Coast, such as Klamath, Smith River, Crescent City, and most of the Humboldt Bay area, is supplied by Ranney collectors (horizontal wells

adjacent to or under the bed of a stream). Erosion is undercutting some of these collectors, such as those in the Mad River supplying the Humboldt Bay Municipal Water District (which serves Eureka, Arcata, and McKinleyville). As such, these "wells" may actually be under the direct influence of surface water, which would require their filtration. The Russian River provides domestic water, in part with flows diverted from the Eel, to over a half million people, stretching from the cities of Santa Rosa and Ukiah, to southern Sonoma County and portions of Marin County. The City of Willits has had chronic problems in the past with turbidity, and taste and odor with water from Morris Reservoir, and high arsenic, iron, and manganese levels in its well supply. Organic chemical contamination has closed municipal wells in the cities of Sebastopol and Santa Rosa.

Central Coast

Unique coastal resources, such as Morro Bay and Monterey Bay, as well as the Salinas Valley, are the focus of water quality issues in this region. Sedimentation poses the greatest water quality threat to Morro Bay, one of 28 estuaries in the National Estuary Program. The Bay is also contaminated by pathogens (from agriculture, boats, and urban runoff), nutrients (due to fertilizers, animal wastes, and urban runoff), and heavy metals contaminating sediments (from abandoned mines in the upper watershed, as well as boat yards offshore). Elevated levels of bacteria have closed many of the shellfish growing beds in Morro Bay, and also have occasionally closed beaches in Santa Cruz County and southern Santa Barbara County. To protect special areas of biological significance, waste discharges are prohibited or limited in portions of Monterey Bay, a National Marine Sanctuary, and other specific coastal and ocean waters of the region. In its triennial review, the Central Coast Water Board also identified the need to incorporate new microbiological standards for water contact recreation.

The Salinas River watershed has significant nitrate contamination related to agriculture, the valley's main land use. Groundwater overdraft is also a problem in the area, and seawater has now intruded six miles inland into the shallow groundwater aquifer around Castroville. The nearby Pajaro River watershed faces a variety of water quality threats, such as erosion (primarily from agricultural practices), urban runoff, sand and gravel mining, flood control projects, off-road vehicles, and historical mercury mining in the Hernandez Lake area. Coastal wetlands in Elkhorn Slough, a tributary to Monterey Bay located between the Salinas and Pajaro Rivers, suffers from erosion from strawberry and other cropped lands in its watershed. Elevated bacterial levels in the Slough may be associated with a large dairy and waste operation in the watershed as well as septic tank systems. In addition, over 600 year-round vessels use the Moss Landing Harbor, and increasing the waste load to the Slough. The accumulated effects of these water quality problems, along with the re-suspension of pesticides in sediments, have restricted shellfish growing in Elkhorn Slough.

Beyond the Salinas Valley, other regional water quality concerns include one of the nation's worst oil spills at Unocal's Guadalupe Oil Field in the Santa Maria River watershed. Nutrients and pathogens impact the San Lorenzo River basin, from septic systems, horse corrals, and urban runoff, as well as erosion from logging, urban development, and road maintenance. Groundwater basins that are impacted by salinity include the Hollister, the Carrizo Plain, the Santa Maria and Cuyama Valleys, San Antonio Creek Valley, portions of the Santa Ynez Valley, and Goleta and Santa Barbara.

Sacramento Valley

Surface water quality in the watershed is generally good, making the Sacramento River one of the most desirable water sources in the state. Nonetheless, turbidity, rice pesticides, and organophosphate

pesticides such as diazinon can affect fisheries and drinking water supplies. For instance, the decline of fisheries in the Sacramento River is in part related to water quality problems on the River's main stem: unsuitable water temperature, toxic heavy metals (such as mercury, copper, zinc, and cadmium) from acid mine drainage, pesticides and fertilizer in agricultural runoff, and degraded spawning gravels. Holding of rice field drainage, allowing for degradation or rice herbicides, has effectively addressed this water quality concern among downstream water users, in particular, the City of Sacramento. In the Cache Creek watershed, Clear Lake suffers from large mercury, sediment, and nutrient loadings, the latter leading to nuisance algae blooms. Along with a few select other water bodies, the basin plan specifically prohibits direct discharges of wastes into Folsom Lake and the Lower American River downstream to its confluence with the Sacramento; waste discharges from houseboats on Shasta, Clear Lake, and in the Delta are also banned. High density recreation use of Whiskeytown and Shasta Lakes may be contributing to high bacteria levels in these two reservoirs.

In its triennial review, the Central Valley Water Board identified mercury loads, a legacy of California's gold mining heritage, as one of the most significant water quality problems in the region. In particular, the Cache Creek watershed is the major source of mercury to the Delta; to a lesser extent, mercury is also a concern in Lake Berryessa and Marsh Creek Reservoir. An organic form of mercury, methylmercury, is a neurotoxin that is especially dangerous to fetuses and infants, attacking the central nervous system and causing an array of developmental and other problems. Because of methylmercury's bioaccumulative properties, several water bodies in the Sacramento R. region have fish consumption advisories. In addition, the Central Valley Water Board has amended its basin plan to include a control program for mercury in Clear Lake and will be considering further amendments to address mercury in Cache Creek and its tributaries and the Delta waterways. Pesticide management and agricultural water discharges have recently received new attention due to the legislative requirement that the Regional Water Boards review their waivers associated with these activities. Coalitions within the region are forming partnerships to address this issue through a watershed approach as provided for by the Central Valley Water Board and affirmed by the State Water Board in their review of the Irrigated Lands Conditional Waiver. Stakeholders within the region are working to find a solution that encompasses the protection of beneficial uses, meets current and future water quality regulations, and allows for a sustainable agricultural economy.

Groundwater quality in the Sacramento River Region is excellent, though there are local groundwater problems. Naturally occurring salinity impairs wells at the north end of the Sacramento Valley. Groundwater in the vicinity of the Sutter Buttes is impaired due to the local volcanic geology, and hydrogen sulfide is a problem in wells in the geothermal areas in the western part of the region. Human-induced impairments, like nitrate, are generally associated with agriculture and septic tanks; the latter is especially an issue in Butte County, where 150,000 of its 200,000 residents rely upon individual septic systems. Septic tanks are often inappropriately sited in shallow, unconfined or fractured hard rock aquifers, where insufficient soil depth is available for necessary leaching. Heavy metals from historic burn dumps also contaminate groundwater locally. In the Sierra foothills there is potential for encountering uranium and radon-bearing rock or sulfide mineral deposits containing heavy metals. Perchlorate, used as an oxidizer or booster for solid rocket fuel and now a human health concern in domestic water, has contaminated wells in the Rancho Cordova region near Sacramento.

San Joaquin River

The major water quality problems of San Joaquin River basin are a result of depleted freshwater flows, municipal and industrial wastewater discharges, salt loads in agricultural drainage and runoff, and other pollutants associated with agricultural irrigation and production, including nutrients, selenium, boron, organophosphate pesticides (such as diazinon and chlorpyrifos), and toxicity of unknown origin. The Central Valley--which covers San Joaquin River, as well as the Sacramento River and Tulare Lake basins--has 40 water bodies impaired due to agriculture, including 800 miles of waterways, and 40,000 acres in the Delta. In its most recent triennial review of its basin plan, the Central Valley Water Board identified as high priorities salinity and boron discharges to the San Joaquin River, low dissolved oxygen problems in the lower San Joaquin, organophosphorous pesticide control generally, and a policy for protecting Delta drinking water quality.

High salinity is a problem in the San Joaquin basin, because of the greatly altered flow regime of the River; most of the San Joaquin is diverted from its natural course at Friant Dam. Moreover, irrigation water from State and federal projects annually import over a half million tons of salt to the Westside of the San Joaquin River basin. Water released from New Melones Reservoir on the Stanislaus River is currently used to help meet the salinity and dissolved oxygen requirements at Vernalis on the San Joaquin. Agricultural drainage and discharges from managed wetlands are already formally managed under permit in the 370,000 acre Grasslands watershed, which contributes high levels of salts, selenium, boron, and nutrients to Mud and Salt Sloughs, which in turn are the primary contributors of selenium to the San Joaquin River. Dairies, stockyards, and poultry ranches are also a concern in the region for their loadings of pathogens, nutrients, salts, and emerging contaminants (such as antibiotics) to water bodies. Some dairies and other agricultural operations are already subject to regulatory review. Water releases from managed wetlands, part of State and federal wildlife refuge system, also discharge salts and nutrients. Erosion of Westside streams is the primary source of organochlorine pesticides in the San Joaquin River.

Migrating and spawning salmonids can face high temperatures in the Stanislaus, Tuolumne, and Merced rivers downstream from dams during certain times of the years, depending upon hydrologic and water supply conditions. Contamination of fish are also a concern in these three rivers as well as the main stem of the San Joaquin River. For example, the Central Valley Regional Water Quality Control Board cites one study of the 43-mile reach of the San Joaquin, between its confluences with the Merced and the Stanislaus, to be toxic to fish about half the time. In the Lower San Joaquin River, low dissolved oxygen, or DO, in the Stockton Deepwater Ship Channel is attributable to warm temperatures, low flows, nutrients, and channel configuration; this low DO area is potentially a barrier to fall run Chinook salmon migrating to the Merced, Tuolumne, and Stanislaus rivers to spawn. The Central Valley Water Board is considering a basin plan amendment to improve the dissolved oxygen conditions at this location.

Groundwater quality throughout the region is generally suitable for most urban and agricultural uses. There are, though, some 1000 square miles of groundwater contaminated with salinity, mostly along the western edge of the Valley floor, where the high-saline marine sediments of the Coast Range exist. The salinity of groundwater in the region increases when the evapotranspiration of crops and wetlands leaves behind the majority of the salt contained in the imported water. In addition, high water table conditions underlying marginal lands along the Westside of the San Joaquin River Basin contribute to subsurface drainage problems. In order to maintain a salt balance in the root zone, much of this salt is leached into

the groundwater. For aesthetic purposes (i.e. taste), DHS regulations recommend that drinking water contain less than 500 mg/L of salinity as measured by total dissolved solids (TDS); for agricultural uses, water with a salinity of less than 450 mg/L TDS is generally acceptable. While the DHS recommendation is adopted by reference into the basin plan to protect domestic use of groundwater, the basin plan contains no numerical salinity objectives for protection of agricultural beneficial uses.

Nitrates, from the disposal of human and animal waste products or the inefficient application of fertilizer or irrigation water, have contaminated 200 square miles of groundwater, presenting a threat to domestic water supplies. Pesticides have contaminated 500 square miles of groundwater, primarily in agricultural areas on the east side of the San Joaquin Valley, where soil permeability is higher and depth to groundwater shallower. The entire Central Valley is home to approximately 500,000 household septic systems, which are more susceptible to failure than community wastewater systems, and can contaminate groundwater with nitrates and microbes. The most notable agricultural contaminant detected in groundwater samples from the region is dibromochloropropane (DBCP), a now-banned nematocide, found mostly along the State Route 99 corridor. There are 200 square miles of groundwater contaminated by naturally occurring selenium.

As of January 1, 2003, SB 390 ended previous conditional waivers of waste discharge requirements (WDRs) for 23 types of waste discharges, including irrigated agriculture and logging. Previously, a petition from three environmental groups requested the rescinding of these waivers, because of concerns about pesticides in discharges. Unlike the federal Clean Water Act—which specifically exempts agricultural discharges from regulation—the State's Porter-Cologne Water Quality Control Act allows a waiver from regulation only if it is not against the public interest. The Central Valley Water Board granted such a waiver to irrigated lands in 1982, exempting their discharges from WDRs. That waiver did have conditions, but because of a lack of staff resources, the Central Valley Water Board did not review compliance with them. SB 390 allows for the continuation of waivers, but only if specifically renewed by the Regional Water Board, subject to a five-year review.

Relative to other regions, discharges from irrigated lands--which include managed wetlands and nurseries--have their greatest impact in the Central Valley, which covers 40% of California's land area, and contains seven million irrigated acres and at least 25,000 individual agricultural dischargers. As an interim measure, the Central Valley Water Board adopted in July 2003 a pair of conditional waivers for such discharges to surface water, one for "coalition groups" and the other for individuals, covering surface runoff (tailwater), "operational spills" (excess water diverted but not used), subsurface drainage (to lower the water table for growing), and stormwater runoff. Commodity-specific and low-threat waivers and general permits may also be possible. Waiver conditions this time include water quality monitoring and implementation of BMPs (or "management measures") to control pollution. This new waiver program, which focuses on capacity building and data collection (including monitoring for toxicity and drinking water constituents of concern), expires on December 31, 2005. Subsequently, a 10-year implementation program is envisioned to fully protect the State's waters for their beneficial uses from discharges from irrigated lands, in order to meet water quality objectives.

While agricultural land use currently impacts water quality, rapid urbanization of the Central Valley, converting undeveloped or agricultural lands to residential and commercial use, may present different or new water quality problems in the future. The Central Valley Water Board has recently begun requiring many municipal dischargers to implement costly tertiary treatment of wastewater.

Mountain Counties

By virtue of their location, domestic water users in the Mountain Counties generally benefit from higher quality water than most other Californians. Many water supplies are from pristine foothill or mountain sources, which are largely unaffected by agricultural or urban pollution. Unfortunately, all too often this higher quality water is degraded while in transit through the numerous open ditch delivery systems. Drainage from abandoned mines, including Penn Mine in the Mokelumne River watershed, contributes metals and other water quality problems downstream. Mercury was imported the region as part of the gold mining process and remains as a legacy of that era. Erosion from natural flooding, logging and land development, and areas devastated from forest fires, introduces sedimentation and nutrients to waterways, as well as causing elevated temperatures due to the loss of riparian shade canopy. This is a concern to both domestic water treatment operations and migration and spawning of salmonids, particularly below the major dams on the Stanislaus, Tuolumne, and Merced Rivers. The conversion of agricultural land to residential use, and undeveloped land to both agricultural and residential use, could present different or new water quality impacts in the near future.

Many small water systems in the foothills and mountains of California have historically tapped surface water or springs with minimal or no treatment; other small systems rely upon water from open ditch systems, sometimes in use for over 100 years, used primarily for agriculture or hydropower and only incidentally for domestic water. However, with a greater recognition of the health risk posed by pathogens in drinking water sources, these systems must now maintain reliable filtration and disinfection facilities. In addition, low housing densities in this region result in a large number of isolated, small water systems, which individually do not have the technical or financial capacity to upgrade their treatment facilities and infrastructure, and cannot consolidate to take advantage of a larger rate base. When such treatment upgrades are infeasible, water purveyors are instead requiring customers receive bottled water. Also common to the ditch delivery systems within the Mountain Counties region is the tendency to have large conveyance losses and sanitary hazards. Repairs on some systems have been opposed by various groups and landowners who argue the loss of the aesthetics of the flowing canal, loss of vegetation and wildlife created by leakage and percolation and who see the water saved as growth inducing. Many other water users in this region are on private wells, which are unregulated and, thus, may never have been assessed for contamination.

The Mountain Counties areas are concerned with forest fires and the damage they cause to the watersheds and the wooden infrastructure associated with the ditch systems. Every year, numerous forest fires occur in the Sierra Nevada and expose the watershed to erosion and change runoff timing. Sediment can obstruct water flow in open ditches, reduce reservoir capacity, add nutrient loading, diminish water quality and cause excessive algae growth. Fires have damaged components to the ditch systems including diversion structures and flume sections. As a result communities have been left without water for extended periods of time.

Like surface water, groundwater in this region is generally of good quality, but it may be contaminated by naturally occurring radon, uranium, and sulfide mineral deposits containing heavy metals. In particular, radon contamination is associated with granite, such as the granite batholith of the Sierra Nevada. Meeting state secondary standards for both iron and magnesium can also be difficult. Also, because of the lack of community wastewater systems, individual septic tanks are prevalent in this region, potentially adversely affecting groundwater quality.

San Francisco Bay

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 non-point 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, though they remain concerned about issues such as microbial contamination, salinity, and organic carbon. [budget studies consistently show that costs to meet future water quality standards are relatively low]. Delta water constitutes about one-third of the domestic water in the Bay region.

The San Francisco 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. Currently major water quality issues include control of stormwater, 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 flame retardant PBDEs (polybrominated diphenyl ethers), pyrethroid insecticides, and compounds from pharmaceuticals and personal care products. Already verboten in many European countries, California will ban two types of PBDEs because of their impact to mothers and nursing babies, beginning in 2008.

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 contaminating 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 Water 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 Estuary 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.

Since 1993, the San Francisco Regional Monitoring Program has been providing monitoring and synthesis of findings 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 the state of what is known about the Estuary's water quality issues. 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 USFWS.

The quality of domestic water supplies in the San Francisco Bay Region is generally excellent, but does vary due to source and treatment. For instance, the source water quality of San Francisco Public Utilities Commission's Hetch Hetchy supply, East Bay Municipal Utility District'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 chloramination disinfection of drinking water, in order to reduce disinfection byproducts. Alternatively, the storage of higher quality Delta water in Los Vaqueros Reservoir, as well as implementation of advanced water treatment, has significantly improved the water quality in the service area of the Contra Costa Water District.

Most utilities that deliver water from the Delta are pursuing a range of projects to protect and improve the quality of the water that they serve, including the ability to store Delta water when it is relatively good, watershed management, source blending, and advanced treatment. Examples include CALFED funded projects to relocate agricultural drains and line portions of the Contra Costa Canal that may be impacted by poor quality local groundwater. Utilities in Solano County utilize a blend of local surface water and Delta water of variable quality delivered via the North Bay Aqueduct. Santa Clara Valley Water District, Alameda County Water District, and Zone 7 Water Agency employ a diversified portfolio of water sources, including Delta water, Hetch Hetchy, local surface water, and groundwater. The Bay Area Water Quality and Supply Reliability project is evaluating a broad array of cooperative regional projects to benefit ACWD, Zone 7, SFPUC, BAWSCA (representing the 28 wholesale water customers of the SFPUC), CCWD, SCVWD, and EBMUD. 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 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; both Zone 7 and ACWD are implementing wellhead demineralization projects to improve groundwater basin and delivered water quality. Meanwhile, parts of the basin underlying the Santa Clara Valley are threatened by pollutants from various industrial activities and historic agriculture. Elsewhere, groundwater in Petaluma Valley and the Gilroy-Hollister Valley has high levels of nitrate impacting domestic use of wells. Recharge projects and use of imported water has successfully stopped or reversed seawater intrusion into aquifers around the Bay.

More monitoring and studies are needed to determine the effects of contaminants, including the emerging contaminants, on the aquatic ecosystem of the bay. As the population continues to grow in the Bay Area, stormwater runoff, particularly from urban areas will need to continue to improve 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 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.

Tulare Lake

Salinity is the primary contaminant affecting water quality and habitat in the Tulare Lake Region, a consequence of agricultural operations compounded by groundwater overdraft. Agricultural runoff and drainage are also the main sources of nitrate, pesticides, and naturally occurring selenium that endanger groundwater and surface water beneficial uses. The basin also has a relatively large concentration of dairies that contribute microbes, salinity, and nutrients to both surface and groundwaters. Nitrate has contaminated over 400 square miles of groundwater in the Tulare Lake Basin. In addition, over 800 oilfields discharge a wide variety of contaminants to the waters of the region.

On the region's Westside, though, salinity, sulfate, boron, and selenium limit the uses of groundwater. Where groundwater quality is marginal to unusable for agriculture, farmers use good quality surface water to irrigate crops, or blend higher quality surface water with poor quality groundwater to create a larger supply. Irrigation with saline imported water, as well as the inefficiency of some crop irrigation systems, results in percolation of applied water into the shallow unconfined aquifers, causing drainage problems and degrading groundwater quality. This marginal to poor quality groundwater has reached crop root zones in this area and is threatening the viability of agriculture there.

Naturally occurring arsenic and man-made organic chemicals—pesticides and industrial chemicals—have contaminated groundwater used as domestic water supplies in this region. For example, the lone well that provides water for City of Alpaugh's 760 residents—40% of which live in poverty—contains unsafe levels of naturally occurring arsenic. By 2006, new federal and State rules will force more than 50 central San Joaquin Valley communities, including Hanford, Pixley, and Tranquility, to cut arsenic levels to one-fifth the current allowable levels. The closing of 40 wells in Fresno due to high levels of dibromochloropropane (DBCP), trichloroethylene (TCE), and other organic compounds required the installation of activated charcoal filtration systems to remove these contaminants.

The quality of local surface water from the Kings River and the San Joaquin River (diverted south through the Friant-Kern Canal) is excellent for irrigation, and municipal and industrial uses. The Central Valley Water Board did, though, specifically identify salinity in the lower Kings River as a priority in its 2002 Triennial Review. On the Westside, DWR has sought solutions to the flooding on the Arroyo Pasajero, which threatens the California Aqueduct. The Aqueduct, which forms a barrier to Arroyo floodwaters and sediment flow, is at risk of failure during major rainstorms in the watershed. Further, the asbestos in the Arroyo sediment load that enters the aqueduct during floods has raised questions of possible health risks. Both Panoche and Silver Creeks contribute large sediment loads to the Aqueduct and the Valley floor; Panoche Creek also has elevated levels of selenium.

In addition, the drainage water is sometimes contaminated with naturally occurring, but elevated, levels of selenium, boron and other toxic trace elements that threaten the water quality, environment, and fish and wildlife. Water planners had originally envisioned a master surface water drain to remove this poor quality water, but that proposal was never implemented. The U.S. Bureau of Reclamation has an obligation to provide agricultural drainage service to CVP westside acreage. To convey this sometimes contaminated drainwater more directly to the San Joaquin River and away from the sensitive San Luis National Wildlife Refuge Complex, a portion of the San Luis Drain was reopened in September 1996 as part of the Grassland Bypass Project. The San Luis Drain was modified to allow drainage through six miles of Mud Slough, a natural waterway that passes through the San Luis National Wildlife Refuge Complex and a section of the North Grassland Wildlife Area.

The monitoring of San Joaquin Valley agricultural drainage water began in 1959 as a cooperative agreement between the California Department of Water Resources and the University of California. In 1984 the San Joaquin Valley Drainage Program was established as a joint federal and State effort to investigate drainage and drainage-related problems and identify possible solutions. In September 1990 the San Joaquin Valley Drainage Program summarized its findings and presented a plan to manage drainage problems in a report entitled "A Management Plan For Agricultural Subsurface Drainage and Related Problems in the Westside San Joaquin Valley ". In December 1991, several federal and State agencies signed a memorandum of understanding, and released an implementation strategy entitled "The San Joaquin Valley Drainage Implementation Program." The purpose of the 1991 MOU and its strategy document was to coordinate various programs in implementing the 1990 recommendations.

In 1997 an Activity Plan was initiated by the member agencies of the San Joaquin Valley Drainage Implementation Program and the University of California to review and evaluate the 1990 Plan and update its recommendations. Eventually, the San Joaquin Valley Drainage Authority which includes districts in the Grassland, Westlands, and Tulare subareas was formed to develop a long-term solution for drainage problems in the Valley, which could include out-of-valley disposal. Studies continue in pursuit of cost effective ways to dispose of the drainage water.

In 2002, the U.S. Bureau of Reclamation released the San Luis report, which declared that an "in-Valley" solution to the drainage problem on the Valley's Westside should be implemented. The proposed alternative includes the following features: a drainwater collection system, regional drainwater reuse facilities, selenium treatment, reverse osmosis treatment for the Northerly Area, and evaporation ponds for salts disposal.

Also in 2002, the Westlands Water District, and the United States reached a settlement agreement regarding drainage that the U.S. was legally bound to provide to Westside farmers. As a result of this agreement, the number of acres requiring drainage service in the San Luis Unit will initially be reduced by retiring approximately 33,000 acres, part of a proposal to retire up to a total of 200,000 acres.

North Lahontan

Water quality in the North Lahontan region is generally excellent but many communities face specific water quality problems. These include groundwater contamination from septic tank discharges in urban subdivisions in the vicinity of Susanville and Eagle Lake, and MTBE contamination in South Lake Tahoe. Drinking water quality has also become a greater issue for many surface water systems around Lake Tahoe, forcing many of the smaller private systems to consolidate or change ownership because

they are unable to afford the new monitoring and treatment regulatory requirements. South Tahoe Public Utility District, the largest water purveyor in the Tahoe basin, is also experiencing some difficulty in meeting these water quality requirements. The abandoned Leviathan Mine, a Superfund site in the upper reaches of the Carson River watershed, impacts local creeks with acid mine drainage water. The top water quality issues emerging from the Lahontan Water Board's 2003 Triennial Review included proposals to revise the waste discharge prohibition for piers in Lake Tahoe, and sodium standards for the Carson and Walker Rivers and their tributaries.

Lake Tahoe is the subject of its own chapter in the region's basin plan, and receives many specific and extraordinary water quality protections. The Porter-Cologne Water Quality Control Act bans the discharge of domestic wastewater from California in the Lake Tahoe basin; the same ban is in effect in Nevada by executive order, resulting in the export of all domestic wastewater from the basin. Discharges of industrial wastewater, wastes from boats and marinas, food wastes, and solid waste are also prohibited in the Tahoe basin. Lake Tahoe's clarity has declined as development has increased around the shoreline, increasing the sediment load and nutrients reaching the lake and its tributaries. In the late 1960s, the clarity of the lake—as measured by the depth to which a "Secchi disk" (a small white disk of specific size) is visible-- was about 100 feet; but in recent years, the average Secchi disk visibility has been closer to 70 feet. Nutrients, such as nitrogen and phosphorous used in landscaping fertilizers, can enter the lake via storm water runoff, promoting growth of algae and thereby reducing clarity. Nitrogen pollution in the basin is primarily due to vehicles, while phosphorous is mostly derived from erosion and dust (phosphate-based detergents are banned).

Roads and road maintenance activities, including snow removal and de-icing, are the focus of new restrictions that are intended to reduce erosion and other water quality impacts into the streams that enter Lake Tahoe. The traditional use of salt for road de-icing had resulted in adverse impacts to the trees and plants which help prevent erosion and sediment from flowing into the lake. Forest fires, grazing, and logging also present a threat to the lake's water clarity due to related and subsequent erosion into the stream systems. The use of agricultural pesticides in the Lake Tahoe basin is prohibited, and the Tahoe Regional Planning Agency has more recently banned the use of two-stroke engines in all boats on Lake Tahoe, to prevent contamination from gasoline components such as benzene and MTBE. Other restrictions on land development and soil disturbances are employed in the continuing efforts to maintain or improve the lake's water quality, and programs that purchase and preserve sensitive lands are being implemented. Lake Tahoe is now extensively monitored by many federal, State and special purpose agencies, such as the UC Davis Tahoe Research Group, and the University of Nevada's Desert Research Institute.

South Lahontan

The quality of limited surface water is excellent in the region, greatly influenced by snowmelt from the eastern Sierra Nevadas. At lower elevations, though, groundwater and surface water quality can be degraded, both naturally (from geothermal activity) and through human activities (e.g. recreation, grazing). Nutrients entering Crowley Reservoir, on Owens River south of Mono Lake, have contributed to low dissolved oxygen levels in reservoir releases that can adversely affect fish downstream. Water quality and quantity are inherently related in the Owens River watershed due to the large exports of surface and groundwater to the City of Los Angeles. Arsenic, a known human carcinogen, is a health concern in the basin, and therefore, in Los Angeles as well, especially with the impending lower drinking water standard. The vast majority of public water supply wells meet drinking water standards. When these

standards are exceeded, it is most often for TDS, fluoride, or boron. Several domestic water supply wells in the Barstow area have been closed due to historical contamination from industrial and domestic wastewater. Three military installations in the southwestern part of the region are on the federal Superfund National Priorities List because of volatile organic compounds and other hazardous contaminants, and the infamous PG&E chromium groundwater contamination site in Hinkley is also in this region. In its triennial review, the Lahontan Water Board identified the need for site-specific ammonia objectives for Paiute Ponds and Amargosa Creek in Los Angeles County. Also, monitoring and cleanup of chromium in groundwater and cleanup of sites contaminated by mining wastes continue to be needed in the region.

South Coast

Like many regions in the state, water quality and water supply challenges are intertwined. The South Coast region must manage for uncertainties caused by population and economic growth. Growth will not only affect demand, but it will add contamination challenges from increases in wastewater discharges and urban runoff, as well as increased demand for water-based recreation. Outside the region, environmental and water quality needs in the Delta, Colorado River, and Owens River/Mono Basin systems affect imported water supply reliability and quality. The region must also assess and plan for impacts of climate variations and global climate change, as well as the cost of replacing aging infrastructure.

Given the size of the region and the diverse sources of water supply, the challenges to the region's water quality are varied. Surface water quality issues in the South Coast are dominated by stormwater and urban runoff, which contribute contaminants—including trash—to local creeks and rivers. These pollutant sources, as well as sanitary sewer overflows, overwatering, ocean outfalls, tidal input, and even wildlife, can degrade coastal water quality, closing beaches and increasing the health risks from swimming. These sources also specifically affect water quality in the major bays—Santa Monica, Newport, and San Diego—along the South Coast. Newport Bay, for instance, suffers from excess algae blooms (due to nutrients), toxicity to aquatic life, high bacterial counts, and sedimentation. Shipping can also influence water quality, especially at the US Naval Port in San Diego Bay and the Long Beach and Los Angeles Harbors, where there are toxic sediment hot spots. Harbors and marinas and recreational boating threaten water quality through ballast water discharges (which can introduce invasive species), petroleum and sewage discharges and spills, biocides from boat hulls, boat cleaning and fish wastes, trash, and reduced water circulation. The South Coast Wetlands Recovery Project works to restore wetland habitat and eradicate exotic species in many watersheds of the region. Several dedicated wildlife and ecological reserves are located along the South Coast as well.

Constructed wetland projects in Hemet/San Jacinto, San Diego Creek, and Prado Basin, remove large loads of nitrogen from wastewater and urban runoff. Salinity, nitrogen, and microbes are the major contaminants in the Santa Ana River, affecting downstream beneficial uses such as swimming and groundwater recharge for domestic use. Because of upstream irrigation diversions, flows in the middle and lower Santa Ana are composed mostly of reclaimed wastewater, creating a year-round flow that is high in salinity. The Santa Ana suffers as well from an invasive exotic species, the giant reed Arundo donax. Other non-native, invasive species of concern in this region include the marine alga Caulerpa taxifolia along the San Diego coast, and salt cedar (Tamarix sp.) in various streams and rivers; both, like Arundo donax, have the potential to wreak havoc with native ecosystems. Lake Elsinore, the largest natural freshwater lake in southern California, experiences nuisance algae blooms from excess nutrients, impairing its ecological and recreational beneficial uses. Local groups have implemented many wetland

and river restoration projects to improve water quality, for example, at Bolsa Chica and in Ballona Creek, as well as along the Los Angeles and San Gabriel Rivers. The US and Mexico jointly built the South Bay International Wastewater Treatment Plant to treat a portion of the sewage from Tijuana, which flows across the international boundary into the San Diego basin, fouling Imperial Beach and the ocean.

The Chino Basin hosts the highest concentration of dairy animals in the United States. In a 40 square mile area, well over 300,000 animals are maintained on approximately 300 dairies. Because of a lack of sufficient land to dispose of manure, as well as flooding from expanding suburban development, dairy runoff contributes nitrate, salts, and microorganisms to groundwater as well as surface water. Since 1972, the Santa Ana Water Board has issued waste discharge requirements to the dairies in this basin; in addition, pilot projects for sewering dairies and treating dairy washwater have also been recently completed. From brackish aquifers such as the Chino Basin, water utilities can use desalters to recover groundwater, but only if they have access to the regional brine line (the Santa Ana River Interceptor). Groundwater quality in this basin is integrally related to the surface water quality downstream in the Santa Ana River, which in turn serves as a source for groundwater recharge in Orange County. Orange County Water District and, to the north, West Basin Municipal Water District, operate groundwater injection programs to form hydraulic barriers, to protect aquifers from seawater intrusion.

Public health, environmental and economic concerns about the TDS content of wastewater, and the presence in treated wastewater of pharmaceuticals, household products, and other emerging contaminants, have grown with the expansion of water recycling programs in the South Coast region. The high salinity of imported Colorado River water limits the number of times water can be reused before the salt content becomes too high and wastewater can only be discharged to the ocean. Increased use of recycled water and marginal quality groundwater supplies during droughts can result in water quality problems for some local supplies that endanger future water management projects. For instance, groundwater recharge potential may be restricted because the Regional Water Board has established TDS requirements for recharge water in some groundwater basins to protect existing basin water quality.

The average TDS concentration of MWD's Colorado River Aqueduct (CRA) water is about 900 mg/L while the average TDS content of SWP supplies is about 300 mg/L. The of Los Angeles Aqueduct supply has a significantly lower TDS concentration, typically about 160 mg/L. TDS levels in local groundwater supplies in the region vary considerably, ranging from 200 mg/L (Cucamonga Basin near Upland) to more than 1,000 mg/L (Arlington Basin near Corona). Local water uses also contribute significantly to overall salinity levels. For example, municipal and industrial use of water adds between 250 and 500 mg/L of TDS to wastewater. Key sources of local salts include water softeners (typically contributing from 5 to 10 percent of the salt load) and industrial processes.

The long-term salt balance of the region's groundwater basins is an increasingly critical management issue. Smaller basins like the Arlington and Mission groundwater basins were abandoned as municipal supplies because of high salinity levels. These basins have only recently been restored through brackish water desalting projects. Blending SWP and CRA supplies, or using the SWP's relatively low TDS supplies for groundwater replenishment, is a strategy in some areas. However, some inland water districts that reuse wastewater have salt accumulation problems in their groundwater basins because they lack an ocean outfall or stream discharge. Other districts have established access to a brine line for exporting salt and concentrated wastes to a coastal treatment plant and ocean outfall, while others have not found construction of a brine line to be economical.

Beyond salinity, several established and emerging contaminants of concern to the region's drinking water supplies include disinfection by-products (DBPs), perchlorate, arsenic, nitrosodimethylamine (NDMA), hexavalent chromium and methyl tertiary butyl ether (MTBE). Historically, industrial solvents have extensively impacted the groundwater underlying the San Gabriel Valley. Imported water from the Owens Valley is of excellent water quality, and imported Delta water quality is generally good. Nonetheless, arsenic is a concern in the Owens Valley supply, and Delta water can contain precursors—such as organic carbon and bromide—of potentially carcinogenic disinfection by-products, if treated with certain beneficial disinfection processes necessary to inactivate pathogens in drinking water. Perchlorate, a component of rocket fuel that can disrupt thyroid gland function, has particularly impacted the groundwater in Pasadena and the Rialto-Colton-Fontana region. Perchlorate is also a concern in Colorado River water, largely due to contamination from inactive ammonium perchlorate manufacturing facilities in Nevada. Perchlorate contamination of wells in the San Gabriel Valley, which resulted in the deactivation of many of these wells, has led to testing of ion exchange technologies for the removal of this constituent.

Naturally occurring arsenic, a known human carcinogen, is another contaminant of concern, present in the LAA supply as well as local aquifers. The City of Los Angeles currently manages arsenic concentrations in LAA water through treatment and exchanges with MWD. In southern California, local water sources with high arsenic levels are found in Los Angeles, San Bernardino, and Riverside counties.

NDMA, a probable human carcinogen, is associated with the production of rocket fuel, and the manufacture of explosives, paints, and other industrial goods. Contamination of surface and groundwater by NDMA at missile and rocket fuel manufacturing and storage sites is a significant concern, particularly for groundwater supplies. NDMA can also be formed during the treatment of wastewater, which is a threat to aquifers that are recharged with reclaimed wastewater and later used for drinking water.

Groundwater contamination by hexavalent chromium, a suspect carcinogen better known as chromium 6, in the Los Angeles basin and elsewhere, has resulted from its use in various industries including aerospace and plating. In Los Angeles County, Los Angeles Water Board staff is overseeing assessment and cleanup of sites impacted by hexavalent chromium at defense-related businesses and manufacturing and other industrial sites.

MTBE and other oxygenates have been added to gasoline in areas with severe air pollution to help gasoline burn more cleanly and comply with federal law. MTBE can contaminate groundwater when pipelines, fuel tanks, and other containers or equipment leak, when fuel is spilled, and when unburned fuel is discharged from watercraft. The high mobility and low biodegradability of MTBE presents a significant risk to aquifer supplies. MTBE has been widely detected in South Coast groundwater, surface water, and imported water supplies. In particular, MTBE has limited the use of most of Santa Monica's wells, making the city more dependent upon imported water and treatment systems.

Groundwater quality issues are being addressed in the region. In the San Gabriel Valley, the Main San Gabriel Basin Watermaster, San Gabriel Basin Water Quality Authority, Upper San Gabriel Valley Municipal Water District, and a number of water suppliers have actively pursued technical remedies for the groundwater quality problems described earlier. Several treatment facilities for the VOCs were first constructed in the 1990s. As of June 2002, 18 treatment facilities are operational. Groundwater supplies

with high nitrate levels are either blended with other supplies or not used at all. Similar cleanup efforts are being pursued in the San Fernando Basin by LADWP and the Upper Los Angeles River Basin Watermaster. Several groundwater desalting plants are currently operated by the Santa Ana Water Project Authority (SAWPA), Chino Basin Desalting Authority, City of Corona, Eastern Municipal Water District's, Irvine Ranch Water District, the City of Oceanside, West Basin MWD, and the Sweetwater Authority. Brackish groundwater desalting delivers about 100,000 acre-feet of water today and will increase to approximately 250,000 acre-feet during the next decade. Proposition 13 water bond funding is being utilized to expand desalting capacity in the region.

The SAWPA is a joint powers authority located in the eastern portion of the region. It represents five agencies in the counties of Orange, Riverside, and San Bernardino and covers a watershed area of 2,650 square miles. It provides effective and concerted watershed planning on a regional basis. In addition, SAWPA operates a brine disposal line, which facilitates disposal of waste brine from regional desalting plants and operates the Arlington Desalter. SAWPA has been particularly successful in recent years in assisting its member agencies in implementing several new water resources projects that enhance groundwater recovery, groundwater storage, water quality improvement and water recycling through the use of Proposition 13 Water Bond funding. Approximately 20 potential groundwater recovery projects were evaluated with a net yield of 95,000 acre-feet per year.

The Port Hueneme Water Agency was formed to develop and operate a brackish water desalting demonstration facility for its member agencies in western Ventura County. Its goals are to improve the quality and reliability of local groundwater supplies and decrease seawater intrusion in the Oxnard Plain. The facility will provide a full-scale demonstration of side-by-side operation of three brackish water desalting technologies: reverse osmosis, nanofiltration, and electrodialysis reversal.

Colorado River

The Salton Sea, with its increasing salinity, selenium, and eutrophication, is the primary focus of water quality issues in the Colorado River region. The largest sources of the Sea's inflow are the New and Alamo Rivers and the Imperial Valley agriculture drains, which contribute pesticides, nutrients, selenium, and silt. The New River, the most polluted river in the US, actually originates in Mexicali, Mexico, flows across the International Boundary, through the City of Calexico, and then northward, emptying into the Salton Sea. It conveys urban runoff, untreated and partially treated municipal and industrial wastes, and agricultural runoff from the Mexicali and Imperial Valleys. These pollution sources contribute pesticides, pathogens, silt, nutrients, trash, and VOCs (the latter, primarily from Mexican industry) to the Sea. Both the Alamo River, which originates just two miles south of the border and also flows northward to the Salton Sea, and the Coachella Valley Stormwater Channel, which flows southward to the Sea, consist mainly of agricultural return flows from the Imperial and Coachella Valleys, respectively. Both the Coachella Valley Stormwater Channel and the Palo Verde Outfall Drain, which also drains to the Sea, are heavily contaminated with pathogens.

Contamination in the Salton Sea presents threats to migrating birds on the Pacific Flyway. At some times of the year, nutrient loading to the Sea supports large algal blooms that contribute to odors, as well as low dissolved oxygen levels that adversely affect fisheries. Selenium is a more recent constituent of interest, potentially affecting fish and wildlife.

The relatively saline Colorado River provides irrigation and domestic water to much of southern California. Of recent human health concern, though, are the presence of low levels of perchlorate in the Colorado River (from a Kerr-McGee chemical facility in the Las Vegas Wash, the nation's largest perchlorate contamination site), and high levels of hexavalent chromium in wells near Needles, from a PG&E Topock natural gas compressor station. Septic systems at recreational areas along the Colorado are also a concern for domestic and recreational water uses. Other important water quality issues in this region include increasing levels of salinity, nitrates and other substances in groundwater associated with animal feeding and dairy operations and septic tank systems, especially in the Desert Hot Springs area and in the Cathedral City Cove area. In the Coachella Valley, nitrates have restricted the use of several domestic water supply wells.

Sacramento-San Joaquin Delta[4]

The Delta is a source of drinking water for over 23 million Californians, which underscores the importance of carefully managing a wide range of water quality issues in the region.

Water Standards

Requirements of the State Water Board govern release of upstream flows and curtailment of export pumping to maintain Delta water quality and outflow requirements for the San Francisco Bay. The first water quality standards for the Delta were adopted in May 1967, when the State Water Rights Board (predecessor to the State Water Board) released Water Right Decision 1275, approving water rights for the State Water Project while setting agricultural salinity standards as terms and conditions. These requirements were altered in 1971 under Decision 1379 (D-1379), which added standards the CVP and SWP are to meet for non-consumptive uses (water dedicated to fish and wildlife), along with agricultural, municipal, and industrial consumptive use standards. In 1978, the State Water Board issued D-1485 and the 1978 Delta Plan, which together revised flow and salinity standards and required the US Bureau of Reclamation (USBR) and Department of Water Resources (DWR) to reduce pumping, release stored water upstream, or both to meet the standards.

In 1986, Congress passed the CVP-SWP Coordinated Operation Agreement (Title I of PL 99-546), requiring that the CVP be operated in coordination with the SWP to meet state water quality standards. Also in 1986, the Supreme Court upheld the Racanelli Decision, which recognized State Water Board authority and discretion over water rights and water quality issues, including authority over CVP operations. As a result of increasing use of Delta waters combined with escalating environmental and fishery problems, the State Water Board adopted a new Bay-Delta Plan in 1991, which included objectives for salinity, dissolved oxygen, and temperature. The USEPA followed with federal standards for the Estuary through USEPA regulations in 1994. In December of 1999, the State Water Board issued a new Decision 1641 as a part of the1995 Bay-Delta Water Quality Control Plan, which replaced earlier Delta standards and conditioned the water rights permits of the SWP and CVP to implement the new objectives. The requirements set in D-1641 covered Phases 1 – 7 of the Bay-Delta Water Rights Hearings. In April of 2001, the State Water Board went on to adopt Water Rights Order 2001-05, which facilitates negotiations to settle the responsibilities for implementing and maintaining the 1995 WQCP.

[4] This section was prepared primarily by the staff of the California Bay-Delta Authority.

Currently the SWP and the CVP coordinate project operations to maintain the standards established by D-1641, by releasing water from upstream reservoirs for Delta outflow requirements, and by curtailing export pumping at the SWP Banks and CVP Tracy Pumping Plants during the specified time periods. This combination of Delta outflow requirements and export pumping limitations impose the most difficult challenges to the process of transporting water from upstream reservoirs to meet water needs in the San Joaquin Valley, San Francisco Bay Area, and Southern California.

Salinity

The impact of salinity on water quality in the Delta is important and directly related to water supply reliability. The balance of ocean tides, river outflows, salinity input from agricultural and urban drainage, export pumping rates, and other factors directly impacts aquatic health in the Delta and the public health of those who use Delta drinking water. South Delta agricultural diverters are often faced with high levels of salinity, which can damage crops and reduce productivity. DWR's South Delta Temporary Barriers Project helps limit saltwater intrusion into areas of agricultural diversions, while also raising water levels.

Mercury

Mercury can be found throughout the Delta as a result of the mining activities that were widespread throughout the Central Valley, such that the entire Delta is presently on the State Water Board's 303(d) list[5] for sources of mercury. Miners extracted mercury in the Coastal Range, and then used the mercury to separate gold from rock in the Sierras. Abandoned gold and mercury mines continue to leach mercury today. While mercury in its natural form is usually not easily transmitted into living organisms, some natural processes encourage conversion to methyl mercury, a powerful neurotoxin harmful to animals and humans that accumulates in fish tissue. Restoration of wetlands have faced increasing scrutiny because the conversion of mercury to methylmercury (i.e. methylation) may be encouraged by certain natural wetland processes.

Dissolved Oxygen (DO)

Current water quality standards call for at least five milligrams per liter of dissolved oxygen to protect aquatic organisms (including fish), allow for successful fish reproduction and juvenile rearing, and prevent odor problems. Discharges into the San Joaquin River and the Delta sometimes contain material with a high biochemical oxygen demand or a high nutrient level, which can encourage algae growth and cause subsequent oxygen depletion. These discharges, along with depleted freshwater flows, channel configuration, and water temperatures, have resulted in isolated areas in the Delta with DO levels below the current standard. On the San Joaquin River and the Stockton Deep Water Channel (the dredged portion of the lower San Joaquin its mouth near Antioch upstream to the Port of Stockton), low DO levels may pose a barrier to fall-run salmon migrating upstream to spawn.

Organic Carbon (TOC)

Organic carbon is itself not a harmful constituent – in fact it's essential for aquatic life. Problems occur when water of high organic carbon content is treated in drinking water treatment plants, which must use chemicals to inactivate harmful pathogens. Some forms of organic carbon react with some of these

[5] The Clean Water Act requires that states and territories identify impaired and threatened water bodies that are not expected to meet water quality standards, as outlined in Section 303(d) of the Act. Placement on these lists require the development of Total Maximum Daily Loads (TMDLs), which establish the maximum amount of pollutants the water body can receive while still meeting water quality standards.

beneficial disinfection agents, such as chlorine, producing potentially carcinogenic disinfection byproducts (e.g. trihalomethanes). Since wetland restoration efforts could potentially increase the level of vegetation and organic carbon in Delta water supplies, there may be conflicting objectives between ecosystem and water quality initiatives, as is also the case with mercury. Because some organic carbon processes are still poorly understood, much of the current work is focused on investigating how carbon is used in the aquatic food web and how natural and anthropogenic factors affect the type and amount of organic carbon released into the system.

Selenium

Selenium enters the Delta region from multiple sources, including natural groundwater discharges from selenium-containing soils, agricultural runoff, and refinery inputs from the San Francisco Bay. Selenium, like mercury, bioaccumulates in aquatic life and has been shown to have negative affects on fish and waterfowl. High selenium concentrations could cause disruptions in drinking water and agricultural water deliveries, and are often correlated with high salinity levels as well. Both the Central Valley and San Francisco Water Boards have developed TMDLs for the San Joaquin River and San Francisco Bay, respectively.

Pesticides

Pesticides are insecticides, herbicides, fungicides, and other substances used to prevent, destroy, repel, or prevent pests. In the Delta, several types of chemical pesticides are widespread, including organophosphates, organochlorines, and pyrethroids. Each of these materials has certain risks for humans and aquatic organisms because they are, by design, meant to disrupt biological processes[6].

Organophosphates (also called organophosphorous pesticides) affect the nervous system, and were used in World War II as nerve agents in addition to being used as insecticides (such as chlorpyrifos and diazinon). While usually not persistent in the environment, organophosphates have been found in the Bay-Delta watershed, and could impact the distribution and abundance of aquatic species. Organochlorines, which include DDT and chlordane, were used extensively in the past but now are much less widely used because of their toxicity and persistence. Like mercury, organochlorines bioaccumulate in fish, and could contaminate humans and animals who consume them. Pyrethroids are synthetic versions of a naturally occurring pesticide in chrysanthemums, and some forms can be extremely toxic to the nervous systems of fish and invertebrates. Pyrethroids are becoming more widely used, but current monitoring equipment is unable to measure concentrations in the environment. The Central Valley Water Board is developing TMDLs for the Delta and the San Joaquin River to address organophosphates.

Toxicity of Unknown Origin

Besides those constituents known to impact organisms in the Delta, there are likely other substances that have not yet been identified that are contributing to toxicity problems. There are also many other constituents and issues related to water quality that are important in the Delta region. Like some forms of organic carbon, bromide, which is a component of salinity, can produce disinfection byproducts when treated with certain, necessary disinfection processes used in domestic water treatment plants. Various pathogens are also present in Delta waterways.

[6] Much of the pesticide information is taken from U.S. EPA Pesticide Program website (www.epa.gov/pesticides).

Appendix 1: Basin Plan Adoption Dates

Region	Latest Basin Plan	Amendments	Triennial Review
1. North Coast	1993	1994, 1995, 1996, 1998; 2001; 2003; 2004 (2)	2004
2. San Francisco Bay	1995	1997; 2000; 2001; 2002; 2004	2004
3. Central Coast	1994	1995; 2000; 2002 (2); 2003	2001
4. Los Angeles	1994	1998; 1999 (2); 2001 (3); 2002 (4); 2003 (7); 2004 (5)	2001
5. Sacramento-San Joaquin	2004	2003[7]; 2004 (2)	2002
5. Tulare Lake	2004	none	2002
6. Lahontan	1994	2000 (2); 2001; 2002; 2003	2003
7. Colorado	1993	2001 (2); 2002 (2); 2004	2002
8. Santa Ana	1994	1997; 1998 (2); 1999; 2000; 2003; 2004	2002
9. San Diego	1994	1994; 1995; 1996; 1997; 2002 (2)	2003

[7]These amendments were not included in the 2004 basin plan because they had not yet been fully approved by the various approving agencies and were therefore not effective.