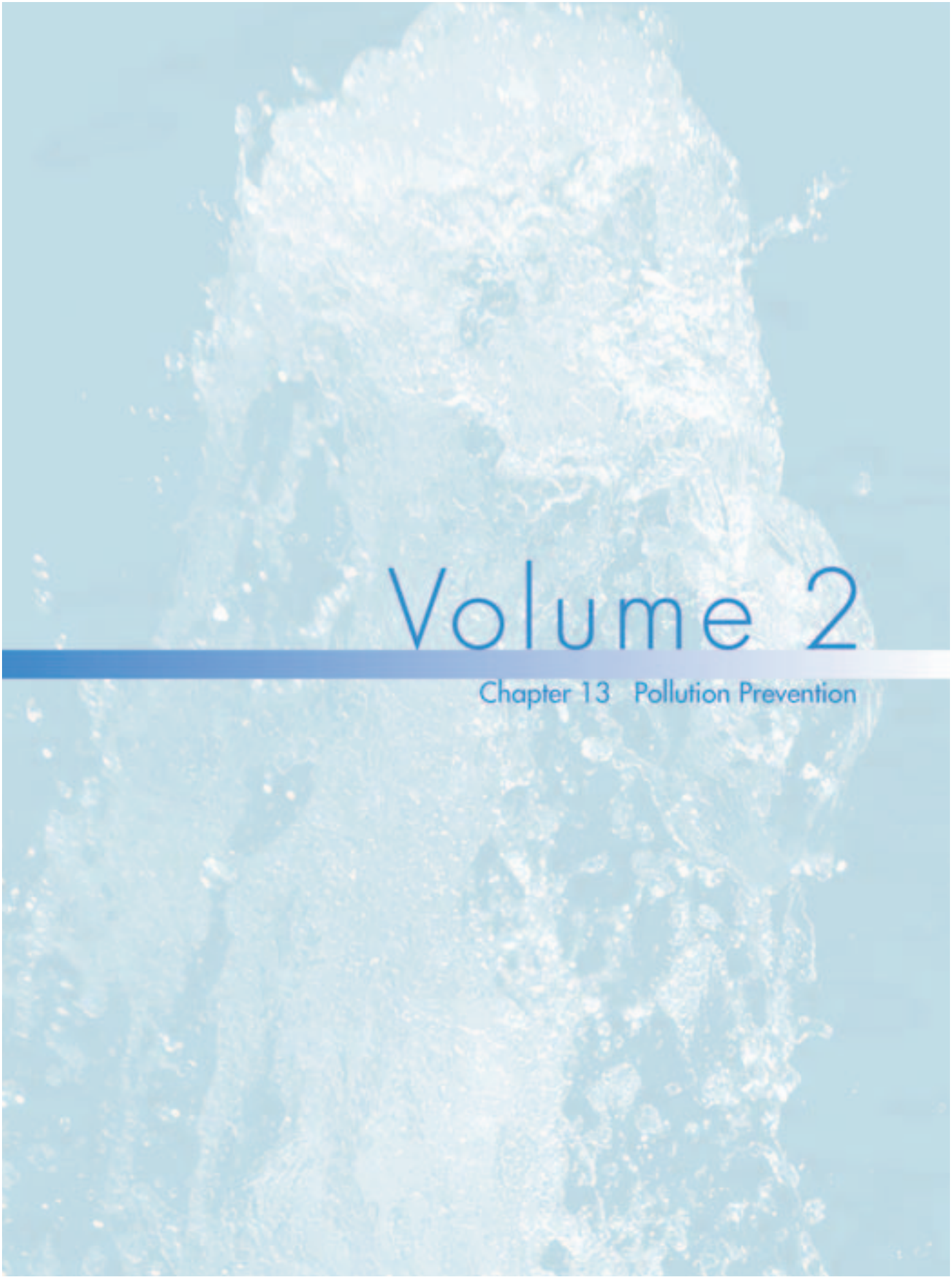

Volume 2

Chapter 13 Pollution Prevention

Federal and State permits, enforcement, remediation, monitoring, and watershed-based programs are some of the tools used to prevent pollution. The National Water Quality Inventory in 2000 found urban and agricultural runoff is the primary source of water pollution in the United States. (DWR photo)

Chapter 13 *Pollution Prevention*

Pollution prevention can improve water quality for all beneficial uses by protecting water at its source, reducing the need and cost for other water management and treatment options. By preventing pollution throughout a watershed, water supplies can be used, and re-used, for a broader number and types of downstream water uses. Improving water quality by protecting source water is consistent with a watershed management approach to water resources problems. In addition, the legal doctrine of "public trust" demands that the State protect certain natural resources for the benefit of the public, including uses such as fishing, protection of fish and wildlife, and commerce, all of which are affected by pollution.

Status of Pollution Prevention in California

There are many tools — regulatory, voluntary, or incentive-based — currently available for preventing pollution. The U.S. Environmental Protection Agency, State Water Resources Control Board, and Regional Water Quality Control Boards have permitting, enforcement, remediation, monitoring, and watershed-based programs to prevent pollution. Pollution can enter a water body from point sources like pipes and from nonpoint sources over a broad area like sedimentation along a long river reach. Preventing pollution from most point sources relies on a combination of source control and treatment, while preventing nonpoint source pollution generally involves the use of best management practices (BMPs) and efficient water management practices (EWMPs). The SWRCB and RWQCBs are adopting total maximum daily loads (or TMDLs), to control both point and nonpoint source pollution, in those water bodies that are not attaining their water quality standards. Nonpoint source (NPS) pollution is responsible for 76 percent of the impairments in California's waters. The SWRCB and RWQCBs are also focusing on water quality issues related to abandoned mines, the U.S.-Mexico border, and beach closures. USEPA and the Department of Heath Services (DHS) have sanitary survey and source water assessment programs specifically for drinking water sources. Beyond these State and federal efforts, many local agencies, businesses, farmers, non-governmental organizations, and watershed-based groups are preventing pollution directly, on their own or through partnerships.[1]

Surface Water Quality

As approved by USEPA, the State's official evaluation of its surface water quality is the SWRCB's biennial water quality assessment and the Clean Water Act 303(d) List of Water Quality Limited Segments. In 2002, California listed 685 water bodies on the 303(d) list, which exceed established water quality objectives. In some cases, a water body is listed for more than one pollutant, and in total, there are currently 1,883 pollutant water-body listings. About 13 percent of the total miles of California's rivers and streams, and about 15 percent of its lake acreage, are now listed as limited under the 303(d). Water bodies are most often listed as impaired for pathogens, nutrients, pesticides, metals, and organic chemicals. The potential sources most often noted as the cause of impairments are unspecified nonpoint sources, source unknown, agriculture, urban runoff, and natural sources. As of 2002, advisories warning against fish consumption, an indirect indicator of surface water quality, were posted for 18 percent of California's lakes, while less than 1 percent of the state's rivers were similarly posted.

[1] Please refer to Volume 1, Chapter 3, for a more detailed discussion of the legal and regulatory framework for protecting ambient water quality.

Groundwater Quality

Although standards or objectives do not cover all water quality contaminants, for example, perchlorate, 62 percent of wells reviewed by DWR's Bulletin 118 (California's Groundwater), using data provided by DHS, met Title 22 of the California Code of Regulations maximum contaminant levels (MCLs) for the period 1994-2000. However, in each of the state's hydrological regions, a 24 percent to 49 percent of public water supply wells exceeded one or more MCLs, usually for inorganic chemicals or radioactivity.[2] As a result of man-made contamination from agricultural practices and septic tanks, nitrate, which presents a known, short-term health risk, has closed more public water wells statewide than any other contaminant. Other groundwater contaminants of concern, including arsenic and hexavalent chromium (or chromium-6), are chronic (i.e. long-term health risks, such as cancer or reproductive and endocrine system dysfunction. Another common groundwater contaminant, salinity—while not a health risk—is a concern for water palatability as well as water facility longevity. A different indicator of groundwater quality, leaking underground fuel tanks, has steadily declined after peaking in 1995, due primarily to the success of regulatory action. In addition to underground storage tanks, older landfills and hazardous waste disposal sites are also common sources of groundwater contamination, and abandoned wells can provide a ready conduit for aquifer contamination.

Environmental Water Quality

Throughout California, water quality impairments threaten riparian and aquatic habitats, and in some cases are major impediments to ecosystem restoration. Urban, military, industrial, hydropower, mining, logging, agricultural, grazing, and recreational activities can degrade water quality. Depleted freshwater flows as a result of upstream dams, diversions, and interbasin transfers, also affect the quality of water downstream, and have public trust doctrine implications. Other water management actions and projects, such as conjunctive use, conveyance, transfers, and conservation, can also affect water quality, both positively and negatively. Many significant pollution problems today are the result of persistent "legacy" pollutants, such as mercury, extracted from the Coast Range and used to process gold in the Sierra mines in the 19th century, and industrial chemicals such as polychlorinated biphenyls (PCBs), used in electrical transformers. These pollutants also contaminate sediments, making ecosystem restoration efforts more difficult. Hydraulic mining during the 1900s still has an adverse impact on numerous Central Valley rivers as well as San Francisco Bay. Some environmental contaminants of concern, such as mercury and selenium, are persistent or bioaccumulative — that is, their concentration and toxicity magnifies in the food chain — and can be toxic to key food chain links, such as aquatic invertebrates, and negatively impact communities and tribes dependent upon subsistence fisheries.

Drinking Water Sources

Public water systems in California have about 15,000 groundwater and 1,000 surface water sources of drinking water. About 4,000, or a quarter, of these sources have at least one detection of a regulated contaminant, usually from man-made sources, at a level greater than its MCL. The data specifically show a steady increase in the number of wells that exceed MCLs for nitrate and arsenic; moreover, the MCL for arsenic, a naturally-occurring contaminant, will drop further in 2006, affecting another 900 drinking water sources. Uranium, a naturally occurring radionuclide, and the organic chemicals trichloroethylene (TCE, an industrial solvent), 1,2-dibromo-3-chloropropane (DBCP, a now-banned nematocide) and methyl tertiary-butyl ether (MTBE, a gasoline additive), also frequently pollute drinking water sources. In addition to the one for arsenic, California will soon adopt new MCLs for perchlorate and hexavalent chromium.

DHS, with the assistance of 34 counties and 500 water systems, recently completed source water assessments for 15,000 public drinking water sources in California. Initial evaluation of the assessment results indicates that groundwater sources (about 14,000 wells) are most vulnerable to septic tanks and sewage collection systems. Surface water sources are most vulnerable to surface water recreation and septic tanks. These assessments, combined with water quality monitoring, suggest that California is not doing enough to prevent nitrate pollution, an acute health hazard to infants and developing fetuses, the MCL for which has the lowest margin of safety of all regulated drinking water contaminants.

One particular water source, the Hetch Hetchy water supply (Tuolumne River) which serves more than 2 million people in the San Francisco Bay Area, does not require filtration because of pollution prevention measures in its protected, Sierra watershed. Generally, forested watersheds play an important role in protecting water quality.

[2] The DHS database, though, only covered wells in about half of the groundwater basins in the state. And even for those basins that have wells in the database, the water quality in those wells is not necessarily representative of the water quality throughout the basin.

Another drinking water source, the Sacramento-San Joaquin Delta, provides some portion of the water supply for more than 22 million Californians. A unique aspect of this water source is that seawater introduces relatively high levels of bromide that, upon disinfection in a domestic water treatment plant, can contribute to the formation of disinfection by-products, such as trihalomethanes and bromate, which are potential carcinogens. Those water systems near the Delta that use it as a source of drinking water are also challenged by algal blooms as well as fluctuating levels of pH, turbidity, and alkalinity.

Potential Benefits

For the vast majority of contaminants, it is generally accepted that a pollution prevention approach to water quality is more cost-effective than end-of-the-pipe treatment of wastes, or advanced domestic water treatment for drinking water. Pollution prevention measures are usually more cost-effective because they have lower initial capital costs, as well as less ongoing operations and maintenance costs, than traditional engineered treatment systems. However, because of the nature and sources of some contaminants, like bromide (introduced by seawater) and organic carbon (natural runoff from the watershed), a pollution prevention approach may not be possible, cost-effective, or even desirable in some instances. Small water systems, which generally lack technical and financial capacities, may be more reliant upon pollution prevention measures than other options available to larger systems, such as advanced treatment. High-quality near-shore coastal waters provide multiple benefits or uses by providing recreational opportunities, as well as serving as a water source for desalination plants, and habitat for wildlife.

Potential Costs

According to the 2000 USEPA Clean Water Needs Survey, California has more than $14 billion of needs to prevent both point source and nonpoint source pollution.[3] This survey, though, emphasized point source discharges, which represented more than $13 billion of the needs, and likely underestimated the cost of measures to adequately prevent nonpoint source pollution. In terms of drinking water quality, investments in pollution prevention measures may entail more risk and uncertainty in improving water quality relative to advanced domestic water treatment options.

Major Issues

Urban Impacts

USEPA's most recent National Water Quality Inventory in 2000 found that pollution from urban and agricultural runoff are the primary sources of water pollution in the U.S. Urban runoff and stormwater wash pollutants, such as nutrients (lawn fertilizers and pet wastes), pesticides, oil and grease, metals, organic chemicals, microorganisms, and debris, from city streets and other hard surfaces, that impair surface waters (including beaches) and negatively impact existing and future groundwater replenishment projects that use stormwater for recharge (see Urban Runoff Management, and Recharge Area Protection strategies).

Agricultural Impacts

Agricultural drainage can impair water supplies with relatively high levels of salinity, nutrients, pesticides, sediment, and other contaminants, as can wastes from dairies and feedlots, which are high in nitrates and microbes. In the Central Valley, the Regional Water Quality Control Board has endorsed the use of farm-based watershed groups to monitor water quality and implement best management practices (BMPs) and efficient water management practices (EWMPs) to control nonpoint source pollution from 7 million acres of irrigated lands (i.e., crops, nurseries, and managed wetlands).

Natural Impacts

Arsenic, asbestos, radon, minerals, and sometimes microbes and sediment are examples of naturally occurring contaminants for which a pollution prevention approach is obviously infeasible. Furthermore, some contaminants that are concerns specifically for drinking water, such as organic carbon from watershed runoff and bromide — a component of ocean salinity, are a result of natural processes for which a pollution prevention approach may not be possible, effective, or even appropriate. As an example of the latter, organic carbon, while problematic for drinking water treatment, is a necessary and beneficial component of the ecosystem. While of course not ignoring pollution prevention opportunities, the use and integration of other water quality management tools, such as matching water quality to water use and drinking water treatment and distribution, may be more effective and appropriate for these latter two drinking water contaminants.

[3] Cost estimate adjusted to $15 billion in 2004 dollars.

Emerging Contaminants

Traditionally, water agencies focus on pathogens (disease –causing microorganisms), chemicals, and disinfectant by-products (potential cancer-causing contaminants), that are regulated or will be regulated in near future. Recently, though, unregulated chemicals found in pharmaceuticals and personal care products are emerging as water contaminants. For instance, as the state's population ages, there may be increasing levels of pharmaceutical discharges in domestic wastewater and to the environment. Such contaminants might not be removed by traditional treatment processes, and can negatively impact water recycling and groundwater recharge projects.

Population Growth Demands and Impacts

Future population growth and land-use changes may unpredictably affect water quality. As population and water demand increase, the volume of wastewater will also increase, which may then be discharged in proportions to the receiving water flow that could prevent some current domestic water sources to continue serving that beneficial use. Moreover, as demand for water grows, there may be demand as well to use some supplies—such as those originating from groundwater remediation sites—that would previously not have been approved for domestic use. For such supplies, drinking water standards alone may not be enough to determine quality, because such standards assume a basic purity of the water supply (see groundwater remediation/aquifer remediation). In addition, population growth may lead to increased demand for water-based recreation, which can degrade fisheries and wildlife habitat as well as drinking water supplies.

Monitoring and Assessment

Only a small percentage of California water bodies are regularly monitored and assessed for water quality or for the appropriate contaminants of concern. Once data is collected, it is too often not assessed or evaluated, and therefore not readily available for analysis. Much water quality data is collected on a project, rather than comprehensive, basis, and sampling program objectives, designs, methods, and quality assurance can vary greatly between projects. Even the SWRCB's biennial water quality assessment is limited by data availability, and notes as well another data problem: "healthy environments are less likely than troubled ones to be targeted for monitoring."

Fragmented Delivery and Regulation of Water Quality

Management and regulation of water quality in California is fragmented among at least eight State and federal agencies, with no one agency looking after water quality from source to tap. For example, the State and regional boards regulate ambient water quality, while DHS primarily regulates treatment and distribution of potable water. Further, surface water in California is mostly managed by DWR and the U.S. Bureau of Reclamation, while groundwater is usually not managed at all. Moreover, actually serving drinking water to Californians is an obligation of cities, water districts, and private water companies that were generally not formed in any comprehensive pattern.

Legacy Pollutants

Although abandoned mines, clear-cut forests, and many former industrial and commercial sites leave behind pollution problems (e.g. leaking underground storage tanks), what is often not left behind is a legally responsible or financially viable party to pay for cleanup. The State and federal governments and potentially responsible parties often wind up in extensive regulatory and legal proceedings determining legal and financial responsibility while hazardous waste sites remain.

Pollutant-by-Pollutant Water Quality Management

Federal law requires that the State regulate water quality on a programmatic, pollutant-by-pollutant basis, even though our rivers, lakes, and bays — and the aquatic organisms in them — are actually exposed to a mix of pollutants. Much has yet to be understood about the combined effects of chemicals, temperature, pH, transport, sunlight, and other factors. From the standpoint of ecosystem integrity, it is important to recognize that major threats may not be observed in obvious fish kills, but instead may arise subtly through sub-lethal changes in reproductive rates, gene structure, nervous system functions, or immune response. Such changes can over time affect species survival, and population and ecosystem structure.

Recommendations to Improve Pollution Prevention

1. In addition to regulating water quality on a pollutant-by-pollutant basis, water quality problems should be best managed using a watershed-based "source-to-tap"

approach. The State should adopt a strategy that integrates improvements in pollution prevention, water quality matching, and, for drinking water, treatment and distribution. For pollution prevention, such a strategy would build on urban and agricultural pollution prevention programs of SWRCB and RWQCBs, as well as DHS's Source Water Assessment Program.[4] The strategy would focus in particular on the prevention of nitrate pollution statewide.

2. In order to help implement the previous recommendation, the State should adequately fund basin plan triennial review and updates, for incorporation into the California Water Plan Update (pursuant to Section 13141 of the California Water Code). Per the CALFED Record of Decision, the State should complete the drinking water policy for the Delta and its tributaries, which as an amendment to the basin plan for the basins of the Sacramento and San Joaquin rivers, will be an additional tool for drinking water source protection.

3. State agencies with a regulatory, management, or scientific role in the California's water quality should take the lead in establishing an Interagency Water Quality Program to coordinate and integrate all federal, State, and local water quality monitoring and assessment programs, for surface water and groundwater. This program would include a focus on emerging, unregulated contaminants in order to provide an early warning system of future water quality problems, as well as identify trends in water quality. Such a program would also seek to standardize methods, especially for monitoring of emerging, unregulated contaminants, regularly monitor the quality of all waters of the state, and provide compatible data management that is accessible to a wide range of users. For drinking water supplies, this monitoring program should include a focus on outcomes-based monitoring, such as biomonitoring and waterborne disease outbreak surveillance.[5]

4. Regional, tribal, and local governments and agencies should establish drinking water source and wellhead protection programs to shield drinking water sources and groundwater recharge areas from contamination. These source protection programs should then be incorporated into local land use plans and policies. Such programs would encourage or regulate land-use activities that are protective of water quality, or, alternatively, discourage or restrict land uses or activities that threaten surface and groundwater quality. (See recharge area protection strategy.)

5. The State should prioritize grant funding for source water protection activities, including building institutional capacity for watershed planning.

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USEPA National Water Quality Inventory

DHS data Web site: www.dhs.ca.gov/ps/ddwem/chemicals/chemindex.htm

Interagency Coordinating Committee (for NPS Pollution Control)

Environmental Protection Indicators for California (EPIC)

[4] Such a strategy would be much like the "Equivalent Level of Public Health Protection (ELPH)" process of the CALFED Drinking Water Quality Program, and similar efforts recently established by the Massachusetts Water Resources Authority (for Boston), New York City, and the national governments of Canada and Australia. This strategy would also conform to the recommendations of the 2000 International Conference on Freshwater, held in Bonn, Germany.

[5] The proposed Interagency Water Quality Program would be modeled after the existing Interagency Ecological Program. The groundwater portion of this effort should be consistent with the recommendations of AB 599 (the Groundwater Quality Monitoring Act of 2001) and DWR's Bulletin 118 (California's Groundwater), while the surface water aspects should be coordinated with SWRCB's Surface Water Ambient Monitoring Program (SWAMP, AB 982).