State Water Resources Control Board

PLAN FOR IMPLEMENTING A COMPREHENSIVE PROGRAM FOR MONITORING AMBIENT SURFACE AND GROUNDWATER QUALITY

January 2000

SUPPLEMENTAL REPORT OF THE 1999 BUDGET ACT

The State Water Resources Control Board (SWRCB) is required by the Supplemental Language for the Fiscal Year (FY) 1999-00 Budget Act to report on the baseline ambient surface water and ground water monitoring programs as follows:

"Baseline Ambient Surface and Groundwater Quality Monitoring.

"(a) By January 10, 2000, the SWRCB shall report to the Chairs of the Joint Legislative Budget Committee and Senate and Assembly fiscal committees on:

"The specific watersheds and coastal resources where ambient surface water quality monitoring has been conducted or contracted for during the three-year period beginning July 1, 1997. The report shall include the dates the sites were monitored, the type of monitoring, the pollutants monitored for, the results of the monitoring, and expenditures.

"The specific groundwater basins where ambient water quality monitoring has been conducted or contracted for during the three-year period beginning July 1, 1997. The report shall include the dates the sites were monitored, the type of monitoring, the pollutants monitored for, the results of the monitoring, and expenditures.

"A plan for implementing a comprehensive program for monitoring ambient surface water quality and groundwater quality, and how the Governor's 2000-01 budget proposal fits within this plan.

"(b) The Legislative Analyst shall review and critique the report required in paragraph (a), and comment on its review at hearings on the 2000-01 budget. The Legislative Analyst's commentary shall include a report on the board's plan for implementing a comprehensive program for monitoring ambient surface water quality and groundwater quality."

SWRCB RESPONSE TO THE SUPPLEMENTAL REPORT

This report presents the SWRCB's response to the three mandates in the Supplemental Report. The surface water and groundwater monitoring plan is presented in this report and the groundwater and surface water monitoring information is presented in a separate, companion report.

This report provides the SWRCB's comprehensive monitoring plan, and includes (1) a description of how ambient monitoring fits into the existing water quality regulatory process, (2) the elements of a comprehensive ambient monitoring program, (3) a plan that will lead to the implementation of the statewide surface water ambient monitoring program, (4) a plan that will lead to the implementation of the statewide groundwater ambient monitoring program, and (5) linkage of the proposed plans to the FY 2000-01 budget proposal for monitoring.

The proposed comprehensive plan is the initial step in developing and implementing long-term ambient monitoring programs. A central feature of the surface water plan is the implementation of Assembly Bill (AB) 982 (Ducheny; Chapter 495; 1999) which is discussed in the report.

The SWRCB has detailed information on the specific watersheds and coastal resources where ambient surface water quality monitoring have been conducted beginning July 1, 1997. Although it was not collected on Statewide basis, it is lengthy and therefore is included as an appendix.

Prior to FY 1999-00, the SWRCB had no ongoing Statewide ambient groundwater programs and therefore, no data can be provided similar to surface water data noted above. The SWRCB and the Regional Water Quality Control Boards (RWQCBs) do have groundwater efforts at specific locations such as underground storage sites, U.S. Department of Defense facilities, and solid waste disposal sites. The SWRCB's budget was augmented by $500,000 for FY 1999-00 to monitor priority groundwater basins on a rotational basis under contract with the U.S. Geological Survey (USGS). A workplan for FY 1999-00 groundwater monitoring with sampling locations and schedule is in preparation.

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EXECUTIVE SUMMARY

AB 982 (Statutes of 1999) requires the State Water Resources Control Board (SWRCB) to convene an advisory group or groups to assist in the evaluation of program structure and effectiveness as it relates to the implementation of the requirements of Section 303(d) of the federal Clean Water Act (CWA), applicable federal regulations, and monitoring and assessment programs. The bill also requires the SWRCB to report, on or before November 30, 2000, and annually thereafter until November 30, 2002, to the Legislature on the structure and effectiveness of its water quality program as it relates to Section 303(d). The bill, in addition, requires the SWRCB, on or before November 30, 2000, to assess and report to the Legislature on the SWRCB's and the Regional Water Quality Control Boards' (RWQCB) current surface water quality monitoring programs for the purpose of designing a proposal for a comprehensive surface water quality monitoring program for the State. AB 982 was enacted subsequent to the Supplemental Report Language and, therefore, this report is intended to form the basis for meeting both directives.

This report provides the starting point for implementing comprehensive surface and groundwater ambient monitoring programs. It presents background information on the definition of ambient monitoring and where it fits into the water quality regulatory programs. Also presented are the steps for implementing the ambient monitoring programs including the starting point for the policy questions that should direct the monitoring programs, approaches available for collecting the needed information, and the concepts to manage data, quality assurance, and reporting.

Ambient Monitoring

Protecting and restoring environmental resources requires an understanding of where you are and deciding where you want to be in the future. Monitoring is a key component in determining if we are making adequate progress toward our environmental goals. It is impossible to directly assess progress without a tool to do so. Monitoring is the tool that helps measure the success of environmental programs.

Ambient monitoring refers to any activity in which information about the status of the physical, chemical, and biological characteristics of the environment is collected to answer specific questions about the status and trends in those characteristics.

Water Quality Framework

Water quality regulatory programs are implemented to protect water quality and to protect beneficial uses in order to restore and maintain the chemical, physical, and biological integrity of the State's waters. Ambient monitoring is a separate,

but necessary component of the water quality program. It serves as a measure of the overall effectiveness of remedial actions and the need to modify actions to improve program effectiveness.

What Constitutes a Comprehensive Ambient Monitoring Program?

Virtually every comprehensive assessment of environmental protection has acknowledged the need for a more coherent and comprehensive understanding of the state of the environment. To do this, monitoring programs should be built around several key attributes.

The key attributes are:

- Adaptability
- Clear objectives
- Scientifically sound monitoring design
- Meaningful indicators of impact
- Comparable sampling and analytical methods
- Results evaluation
- Continual refinement and
- Regular reporting

Because of the character and associated problems of surface water and groundwater are extremely different, this document presents two separate plans for ambient monitoring of these resources. These two plans are summarized below.

Surface Water Ambient Monitoring Plan

The Surface Water Ambient Monitoring Program (SWAMP) will assess impacts on beneficial uses, the locations of polluted sites, the areal extent of pollution, and trends in water quality. This document presents a comprehensive plan for monitoring ambient surface water quality with the following objectives:

1. Establish advisory groups to review the design of SWAMP (AB 982).

2. Strengthen relationships and data sharing capabilities with Department of Fish and Game (DFG); Department of Health Services (DHS); Office of Environmental Health Hazard Assessment (OEHHA); Department of Pesticide Regulation (DPR); and other federal, State, and local agencies.

3. Specify the expectations of the monitoring and specify the management objectives for ambient monitoring.

4. Define monitoring strategies and indicators that address specific monitoring objectives.

5. Develop sampling designs.

6. Develop costs and schedules.

7. Develop proposal for a comprehensive monitoring program, including a mechanism to fund the program.

8. Develop report on the structure and effectiveness of water quality programs.

Once the comprehensive surface water monitoring proposal is completed, the following tasks will be completed:

1. Implement the monitoring program.

2. Report the information collected.

3. Disseminate the information and reports.

Groundwater Ambient Monitoring Plan

The SWRCB, pursuant to a provision in the 1999 Budget Act, proposes to develop and implement a comprehensive Groundwater Ambient Monitoring and Assessment Program (GAMA) using the collaborative efforts of agencies with groundwater monitoring responsibilities. Although groundwater quality data have been collected over the last several decades by various federal, state and local entities, no agency has developed and implemented a comprehensive program to compile and evaluate the data. The goal of the GAMA program is to provide information about the quality of California's groundwater and make relevant assessments and recommendations.

The GAMA program will collect and synthesize information generated by existing groundwater monitoring programs. SWRCB will coordinate the database compilation through formation of a team of agencies, such as DWR, DHS, and USGS, including groundwater purveyors, with existing groundwater monitoring programs (Groundwater Resource Information Sharing Team — GRIST).

Data will be evaluated for acceptable quality and analyzed using the SWRCB's relational database as a tool for trend and pattern recognition. Information gaps identified during GAMA implementation that are critical to making assessments will be filled by modifying/augmenting existing programs or, if necessary,

proposing additional monitoring programs. The Legislature has provided funding for FY 1999-00 to contract with the USGS for this purpose.

Assessments are intended to provide status and trend information in priority basins and draw working conclusions to provide decision-makers with recommendations for monitoring and regulatory program implementation. Reporting will be based on the completion of assessments and recommendations during different phases of the program.

The initial phase of the GAMA program, the first three years, will assess effects of potentially contaminating activities on a limited number of the most hydrogeologically vulnerable drinking water aquifers. Data and assessments will be internet-accessible with a mapping capability (GIS), and available to appropriate agencies to reduce the risk of public exposure to pollutants.

Funding Needed For Ambient Monitoring

At this point it is impossible to accurately assess the complete costs for a comprehensive ambient monitoring program. As these monitoring efforts are further developed and refined, additional funding requests may be made. Note that the FY 2000-01 budget change proposal (BCP) is the first step in meeting the need for comprehensive monitoring. The BCP proposes (1) 15.0 Personnel Years (PYs) and (2) $5.4 million in contracts for enhanced surface water and groundwater monitoring.

SECTION I. BACKGROUND

Why monitor?

Protection and restoration of environmental resources requires an understanding of where you are and determining where you want to be in the future. Monitoring is a key component of environmental protection programs to see if we are making adequate progress toward our environmental goals. It is impossible to directly evaluate progress toward resource protection and restoration without a tool to assess that progress. Monitoring is the tool that helps measure the success of environmental programs.

At every stage of environmental management, good monitoring programs provide the feedback needed to ensure that the programs implemented to improve the environment are effective and that progress is being made to meeting the established goals (Figure 1).

How does monitoring differ from research?

Monitoring is periodic or continuous collection of environmental information to assess the current status or changes in the environment over time. Monitoring can be short- or long-term in duration and is typically driven by statutory, policy, or other regulatory requirements. Research differs from monitoring in that it usually involves short-term studies focused on cause-and-effect relationships, understanding causative mechanisms, open-ended questions, methods development, special studies focused on questions generated by monitoring, etc. Both monitoring and research can influence the water quality regulatory process (Figure 1).

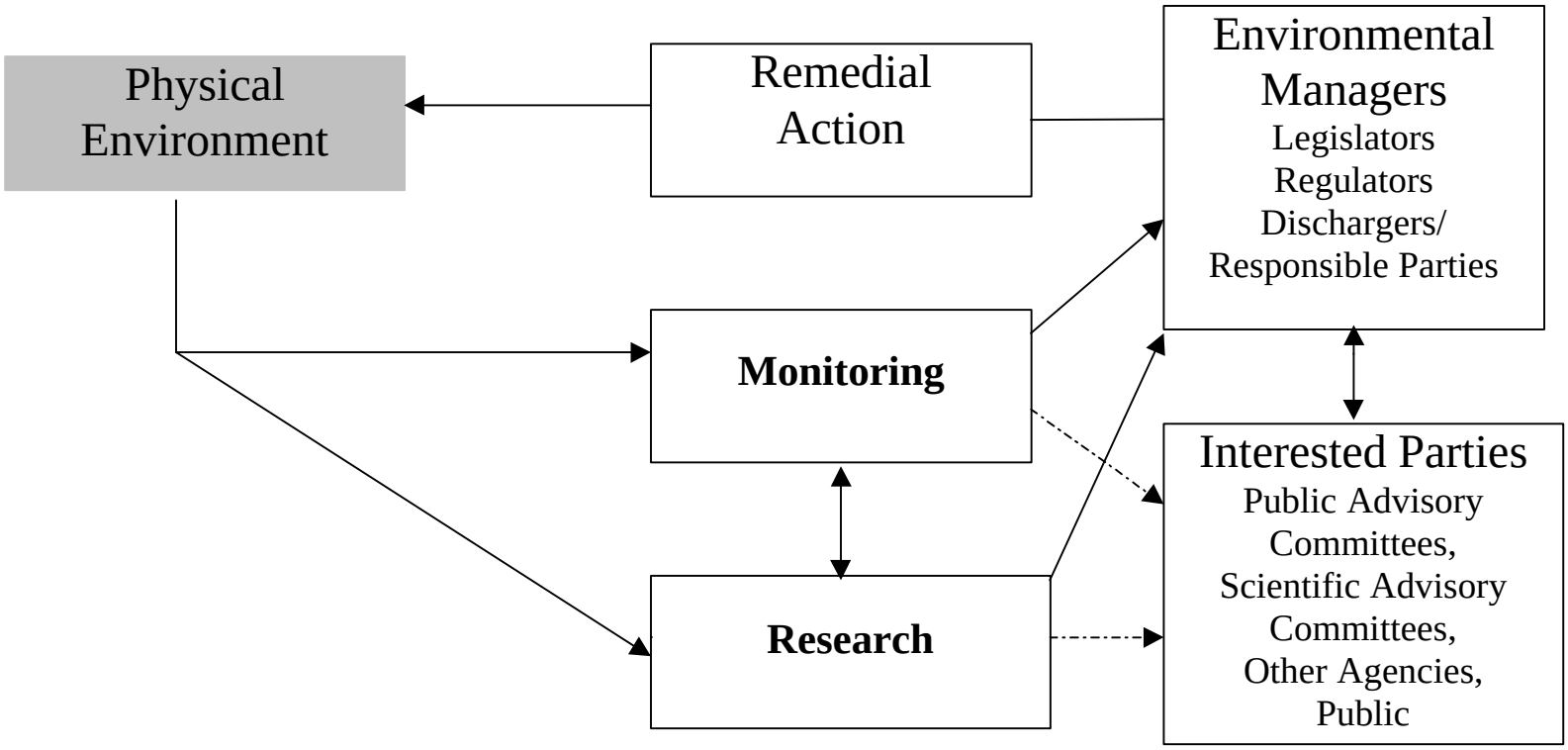
Is all monitoring the same?

Monitoring can take many different forms depending on the purpose. In this report, two major types of monitoring are described: ambient and compliance. Ambient monitoring is focused on assessing the overall quality of environmental resources including locations that are impacted. Compliance monitoring has a more narrow focus on the impacts and the influence of individual dischargers or activities and tends to be site-specific.

What is ambient monitoring?

Generally defined, ambient monitoring refers to any activity in which information about the status of the physical, chemical, and biological characteristics of the environment is collected to answer specific questions about the status and trends in the characteristics.

FIGURE 1: THE ROLE OF MONITORING IN DECISION MAKING



What is compliance monitoring?

Compliance monitoring is useful in determining if a specific discharger is meeting the requirements established in Waste Discharge Requirements (WDRs) and permits. With respect to nonpoint sources, compliance monitoring includes identification of sources of pollutants or contaminants and assessment of the effectiveness of specific best management practices (BMPs). Examples of compliance monitoring include: monitoring programs associated with WDRs or permits for surface water discharges, monitoring needed to establish Total Daily Maximum Loads (TMDLs), and monitoring required by the Underground Storage Tank Program (UST).

Why is ambient monitoring needed?

Ambient monitoring activities are needed to find out the present condition of an environmental resource (i.e., if the beneficial uses of water are protected) and if it is getting better or worse. Ambient monitoring can point to the status of individual resources, trends of improvement or deterioration in water quality parameters and can focus attention on problem areas where water quality protection efforts need to be improved.

What are the uses of ambient monitoring information?

Monitoring also provides the feedback to determine if actions to improve the environment are working. Ambient monitoring results can provide environmental managers (and the public) with the information needed to evaluate whether implemented actions have made a difference in protecting or improving the environment. In the absence of ambient monitoring, it is impossible to determine environmental conditions and if the actions of the environmental regulatory process are effective. In other words, without monitoring to guide us, we will never know if the remedial actions taken will lead us or have led us to our goal.

Ambient monitoring provides information that allows the SWRCB and RWQCBs to:

1. Identify water quality problems
2. Assign priorities
3. Implement water quality management programs
4. Evaluate the effectiveness of management actions
5. Modify actions to improve program effectiveness

SECTION II. FRAMEWORK FOR AMBIENT MONITORING AND WATER QUALITY PROTECTION

Water quality regulatory programs are implemented to protect water quality and to protect beneficial uses in order to restore and maintain the chemical, physical, and biological integrity of the State's waters. The relationship of ambient monitoring activities to SWRCB and RWQCBs regulatory programs is presented in Figure 2. The Porter-Cologne Water Quality Control Act and the federal Clean Water Act (CWA) direct the water quality programs to implement efforts intended to protect and restore the integrity of waters of the State. Ambient monitoring is independent of the water quality programs and serves as a measure of the overall effectiveness of remedial actions. This chapter presents a brief overview of the SWRCB and RWQCB programs and the types of monitoring needed and used in these programs. This chapter shows where ambient monitoring fits into the water quality regulatory programs.

Planning

The RWQCBs have Water Quality Control Plans for their Regions (Basin Plans). The Basin Plans contain inventories of and specifically designate beneficial uses of the waters in the Regions, as well as water quality objectives to ensure reasonable protection of the beneficial uses (Figure 3). The Basin Plans also contain an implementation program to achieve the water quality objectives. This program can include actions necessary to achieve water quality objectives, a time schedule for the actions, and descriptions of the monitoring necessary to determine compliance with objectives.

The SWRCB has adopted Policies or statewide water quality control plans (Figure 3). The Policies contain water quality principles and guidelines for long range resource planning, including surface water management. The Policies may also contain water quality objectives. RWQCB Basin Plans must conform to all SWRCB Policies.

Plans and Policies are implemented through the issuance of WDRs, National Pollutant Discharge Elimination System (NPDES) permits, water quality certification, cleanup and abatement orders (CAO), and other enforcement actions such as cease and desist orders (CDO) and administrative civil liability (ACL) orders.

If ambient monitoring finds that beneficial uses are not protected, then these Plans and Policies are not having the intended effect. They should be changed to better preserve and enhance the quality of the State's water resources.

FIGURE 2: AMBIENT MONITORING AND THE WATER QUALITY REGULATORY PROCESS

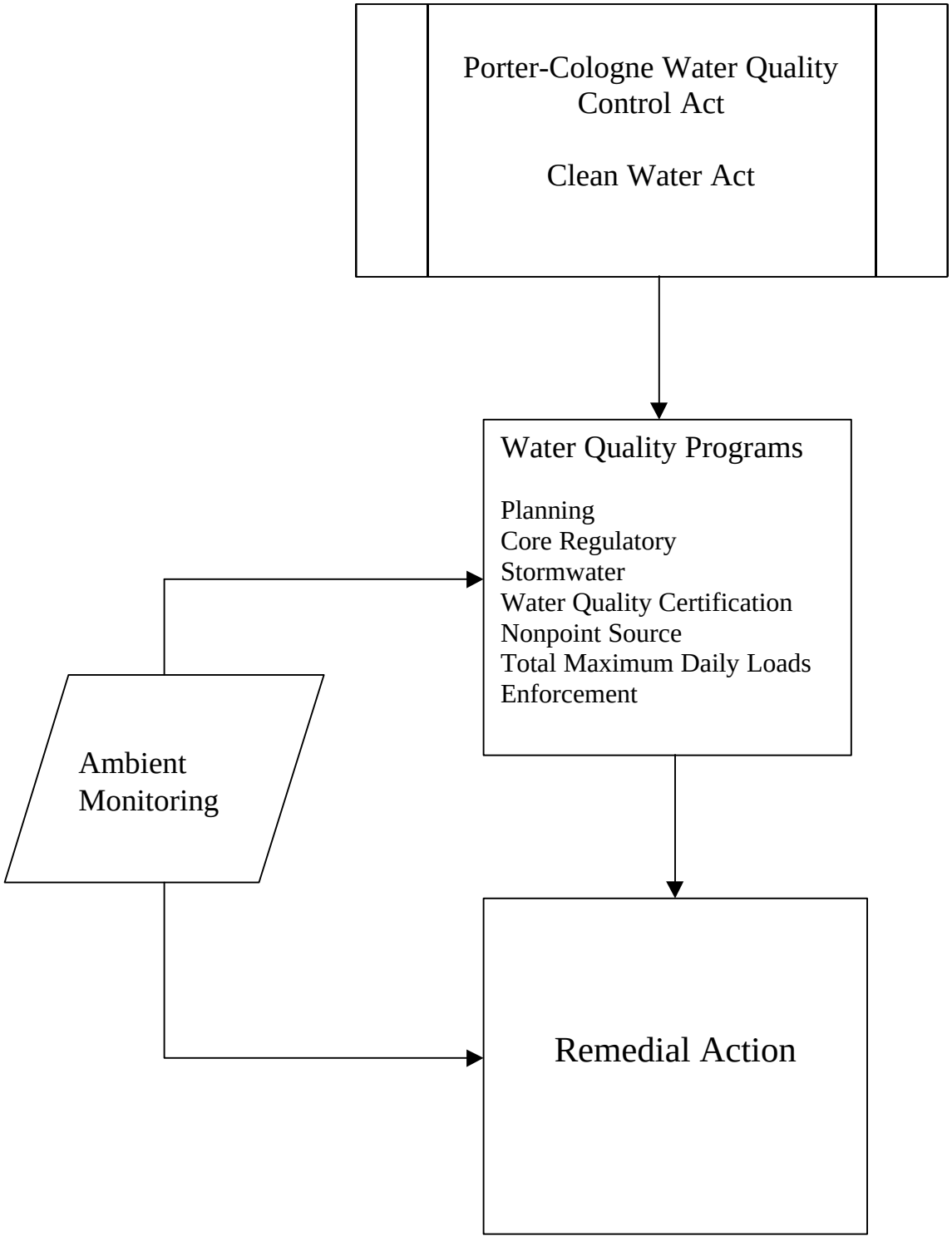
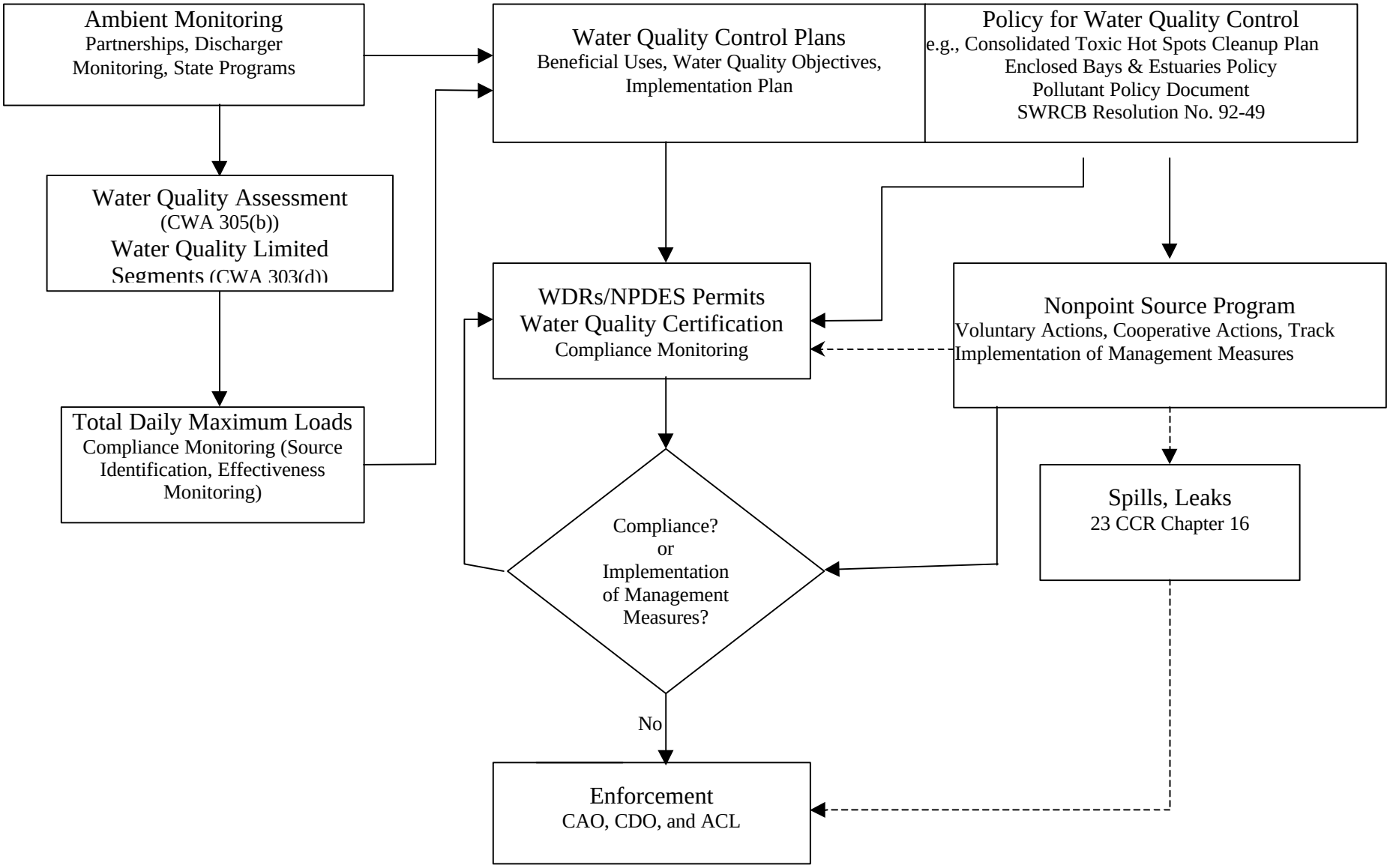


FIGURE 3: WATER QUALITY PROGRAMS AND MONITORING



WDRs and NPDES Permits and Water Quality Certification

All dischargers of waste to the waters of the State must apply for and receive from a RWQCB a WDR (Figure 3). WDRs list what can and cannot be discharged to the waters of the State. WDRs implement water quality control plans and are intended to protect the beneficial uses of receiving water. WDRs are adopted by RWQCBs after interested parties and the discharger have had an opportunity to comment on the provisions of the WDR.

Similarly, under Section 401 of the CWA, applicants for any Federal license or permit for an activity which may discharge to waters of the United States must apply for certification of compliance with State water quality standards. The RWQCBs may choose to issue WDRs or recommend that the SWRCB issue a conditional certification or deny the certification. No applicable Federal license or permit may be granted until State certification has been issued or waived, or if certification is denied.

The issuance of WDRs satisfies the requirements of both State and Federal law. Consequently, for a point source discharger to surface water, WDRs are considered to be an NPDES permit. Currently, projects receiving either WDRs or NPDES permits do not require additional water quality certification. Under the Water Code (Chapter 5.5) the RWQCBs have the authority to issue NPDES permits for a fixed term not to exceed five years. Other authorities include inspection and monitoring, notice to the public, notice to the U.S. Environmental Protection Agency (USEPA), notice to any other affected state, protection of navigation, enforcement, a pretreatment program, and necessary enforcement authorities.

A monitoring program is included in WDRs, certifications (when necessary), and NPDES permits to determine compliance. The monitoring tends to be focused on the potential impacts of the discharge and whether the locations near the discharge are impacted.

The RWQCBs regulate nonpoint source discharges of pollutants to surface waters primarily through application of the SWRCB's Nonpoint Source Management Plan (NPS Plan). The NPS Plan provides a policy for addressing all types of nonpoint source discharges (such as agricultural return flows). The NPS Plan gives the RWQCBs the discretion to determine which of three options, individually or in combination, should be used to address a nonpoint source pollution problem. The options are: (1) voluntary or self-directed implementation by dischargers of best management practices (BMPs); (2) regulatory actions by RWQCBs to encourage dischargers to implement BMPs; and (3) RWQCB issuance of effluent limitations in WDRs (Figure 3). Monitoring is an essential component of the NPS Program to evaluate the effectiveness of BMPs in protecting and improving water quality.

Enforcement

RWQCBs have a variety of enforcement actions that they can use to ensure that WDRs and NPDES permits are met. The actions can be administrative (actions taken by the RWQCB) or judicial (considered in the courts after referral to the State Attorney General). The enforcement actions listed below are at the discretion of each RWQCB; and, as a result, there may not be strict uniformity as to method or level of enforcement from Region to Region.

Administrative Civil Liability

The process of imposing ACL orders begins when the RWQCB staff issues a complaint to an alleged violator for discharging waste, for failure to furnish or furnishing false technical or monitoring reports, for various cleanup and abatement violations, and other issues. These orders are based on the violation of a WDR, an NPDES permit, or a prohibition in a water quality control plan.

Cease and Desist Orders

CDOs are based on the violation of a WDR, an NPDES permit, or a prohibition in a water quality control plan. The violation can be actual or threatened. The CDO itself must be adopted by the RWQCB.

Cleanup and Abatement Orders

This type of order directs a discharger to do or not do something. CAOs can be based upon a violation of existing RWQCB orders (e.g., WDRs) or where someone has discharged waste or threatens to discharge waste. The effect of the CAO is to clean up the waste discharged or abate the effects of the waste, or in the case of threatened pollution or nuisance, to take other remedial action.

Statutory References for Ambient Monitoring

Even though ambient monitoring is an important tool used to assess the quality of the State's water resources, ambient monitoring is discussed only briefly in the Water Code. For example, Water Code Section 13177 discusses the need for the California Mussel Watch Program and expresses the importance of the Program in the SWRCB's comprehensive monitoring strategy and how the program should guide the SWRCB and RWQCBs in protecting water quality. Section 13392.5 requires the RWQCBs to develop an ongoing monitoring and surveillance program to identify toxic hot spots.

Recently signed Legislation (AB 982) requires the SWRCB to convene an advisory group or groups to assist in the evaluation of program structure and effectiveness as it relates to the implementation of the requirements of Section 303(d) of the CWA, applicable federal regulations, and monitoring and assessment programs (Water Code Section 13191). The bill also requires the SWRCB to report, on or before November 30, 2000, and annually thereafter until November 30, 2002, to the Legislature on the structure and effectiveness of its water quality program as it relates to that provision of the CWA. In addition, the bill requires the SWRCB, on or before November 30, 2000, to assess and report to

the Legislature on the SWRCB's and the RWQCB's current surface water quality monitoring programs for the purpose of designing a proposal for a comprehensive surface water quality monitoring program for the State (Water Code Section 13192).

The CWA requires the use and collection of ambient water quality information. Section 305(b) of the CWA requires that states and other jurisdictions receiving CWA grant funding submit a water quality report to USEPA every two years. The 305(b) report contains summary information about water quality conditions in rivers, lakes, estuaries, bays, harbors, wetlands, and coastal waters. States must also identify and prepare a list [Section 303(d) list] of waters that do not or are not expected to meet water quality standards after applying existing required controls (e.g., minimum sewage treatment technology). States are required to prioritize waters/watersheds and target high priority waters/watersheds for TMDL development.

SECTION III. FEATURES OF A COMPREHENSIVE AMBIENT MONITORING PROGRAM

Virtually every comprehensive assessment of environmental protection has acknowledged the need for a more coherent and comprehensive understanding of the state of the environment (USEPA et al., 1999). To do this, monitoring programs should be built around several key attributes. The surface water and groundwater monitoring plans presented in the next sections embody the key attributes presented below.

Adaptability

California has a huge diversity of natural resources with a variety of water resources. The State's water resources include groundwater, streams, rivers, lakes, estuaries, coastal lagoons, enclosed bays, and coastal waters. The optimal monitoring approach will allow adaptation to each of these systems because the scale, dimension, and environmental resources vary so greatly.

For example, the characteristics of surface water and groundwater are so different that separate monitoring approaches must be used (Table 1). Sampling of surface water involves capturing sometimes transient conditions of a vulnerable and highly visible resource. The location of sampling points can be flexible. In contrast, sampling of groundwater involves determining conditions of an invisible resource that changes slowly. Sampling locations are fixed and few relative to aquifer size; therefore, data gaps are a significant problem. In ambient monitoring of both surface and groundwater, there are inherent problems with data adequacy and accuracy. It is necessary to extrapolate over great distances in order to depict the resources as reliably as possible.

Because of these large differences, this report presents separate plans for monitoring ambient surface water (Section IV) and groundwater (Section V).

Cooperative efforts

Monitoring can be expensive due to the scale of the monitoring and the costs of analysis. The most cost-effective efforts are those that bring together all stakeholders to jointly design and implement the ambient monitoring program. The SWRCB and RWQCB watershed management initiative and SWRCB Strategic Plan emphasize full participation of affected parties. This type of cooperative planning initially helps identify redundant efforts and areas in need of monitoring activity and ultimately reduces costs.

Clear Objectives

Because environmental monitoring can be costly, it is important to clearly define the information most useful to resource agencies to better protect water quality and safeguard resources. Clear monitoring objectives are essential if the ambient monitoring program is to produce meaningful and useful information.

TABLE 1: SURFACE WATER AND GROUNDWATER CHARACTERISTICS

FACTOR	SURFACE WATER	GROUNDWATER
Sampling Locations	Generally flexible.	Generally fixed (wells and springs).
Flow	High or low flow velocity; pollutants dispersed in water body.	Very low flow velocity; pollutants tend to persist.
Temporal Variation	Can be very great; pollutants mobilized during high flow conditions, during storms, or during periods of high discharge (e.g. agricultural irrigation return flow).	Temporal variations in flow and transport conditions tend to be long-term and muted.
Spatial Extent (Lateral)	Generally small except for ocean, San Francisco Bay and large lakes.	Major aquifers are very large (10s to 100s of square miles).
Temperature	Diurnal and seasonal variations.	Constant except in geothermal areas.
Biological resources	Aquatic life impacts generally measurable. Variety of indicators available to measure potential impact.	No direct ecological considerations unless groundwater "daylights" as surface water.
Human Impacts on Water Quality	Many reaches of rivers and streams, locations in enclosed bays and estuaries, and some coastal areas degraded by human activities.	Some basinwide or aquiferwide degradation from human activities, for example nitrate pollution, pumping-induced salt-water intrusion, and large solvent plumes. Some localized degradation from landfills, underground storage tanks, and spills and leaks. Potentially significant other sources, such as sewer lines and septic tanks have not been adequately investigated.
Remediation	Engineering approaches available for reducing pollutant loads from point sources. Cleanup of nonpoint source pollution often difficult because it occurs due to diffuse sources over large areas.	Cleanup difficult due to pollutant adsorption onto the matrix. Also, technical difficulties associated with containing and treating plumes. Removal of certain point sources (landfills) not feasible.
Public Awareness	Public can sometimes observe degradation of surface waters, but the public may often drink or swim in surface waters without realizing it is degraded.	Public may drill wells and drink water without realizing it is degraded.
Vulnerability	Extremely vulnerable; short-term surface pollution usually immediately affects surface water.	May be extremely vulnerable under certain geological conditions (e.g., fractured bedrock). Vadose zone may retain some pollutants and act as reservoir for constituents that are not biodegradable.

Scientifically sound monitoring design

All monitoring programs should be based on solid, defensible scientific design. Solid scientific information provides a sound basis for changes in water quality programs, policies, and standards set to protect the environment. This will assist in comparing results among programs.

Meaningful indicators

The ambient monitoring program should use the best available condition and response indicators of the environmental system. These indicators should be scientifically valid and practical, and they should address the needs of the water quality programs.

Comparable methods of sampling and analysis

In order for monitoring information to be comparable between monitoring locations and programs, there must be a measure of consistency in the approaches and analytical methods used, as well as stated minimum detection limits and strict quality assurance requirements. The data produced should be of definable or equivalent quality so both within and between water body comparisons can be made. To the extent possible, all methods should be described, validated, performed competently, compared to a reference, and, to the extent possible, performance-based.

Results evaluation

Monitoring data must be evaluated in order to make meaningful assessments of the status of the environment. Such evaluations are integral in evaluating the effectiveness of and modifying water quality programs. Results evaluation is especially important for implementation of CWA Sections 305(b) and 303(d).

Continual refinement

Monitoring efforts that are driven by clear objectives generate useful information that resource managers need to evaluate the success of their water quality protection efforts. Such information is vital in indicating where resources should be directed to address specific problems, and which policies and programs should be fine tuned. Such refinement of programs and policies makes the monitoring process dynamic and meaningful.

Regular reporting

Although monitoring news may not always be good, assessments of water quality and the changes over time provide needed information for decision makers and the public. Monitoring information is useful in setting priorities. The worst problems can be addressed first. Also, monitoring identifies issues that are not a problem. Such information is useful for long-term planning, enabling us to evaluate changing conditions and in gauging future stresses on environmental resources such as CWA Section 303(d). Additionally, monitoring results are useful for the public to increase public awareness and education on the impacts of their activities on the aquatic environment.

SECTION IV. PLAN FOR IMPLEMENTING A COMPREHENSIVE SURFACE WATER AMBIENT MONITORING PROGRAM

Introduction

This Plan presents the goals and tasks necessary to implement a comprehensive Surface Water Ambient Monitoring Program (SWAMP). SWAMP is proposed as a multi-year program to assess the effectiveness of the SWRCB and RWQCB programs in protecting water quality, and to provide timely and useful information that will be used to improve water quality program effectiveness. This Plan presents the assumptions used, the goals of the plan, the objectives to be completed, the starting point for many of the tasks that will be completed, and the tasks necessary to develop and implement SWAMP. Much of the approach presented is adapted from a National Research Council (NRC) report on marine monitoring (NRC, 1990).

Ambient Monitoring and the SWRCB Strategic Plan

Monitoring is a key component of the SWRCB's Strategic Plan (1997). One of the goals of the Strategic Plan is to preserve, enhance, and restore water resources while balancing economic and environmental impacts. To accomplish the goal, the SWRCB has committed to employing sound scientific methods, data, and tools to: (1) characterize our natural resources and the communities that depend upon them; (2) specify the appropriate water-related environmental objectives for specific water bodies given resource availability and economic impact; and (3) identify and prioritize all issues and problems preventing the SWRCB from realizing the environmental objectives.

The SWRCB also committed to develop and implement action plans, monitor and evaluate the effectiveness of our actions, and make appropriate modifications to continually improve our water resources. One of the SWRCB's strategies is to evaluate, propose, and establish new long-term monitoring and assessment mechanisms to appraise SWRCB and RWQCB progress in meeting environmental objectives.

Assumptions

The following assumptions were made in the development of the Plan as follows:

1. SWAMP will begin the process required in the Water Code and the Budget Act for implementing comprehensive monitoring (e.g., AB 982).

2. SWAMP will not address the need for or requirements of compliance monitoring.

3. The design of SWAMP will address the process for listing "water quality limited segments" under CWA Section 303(d).

4. SWAMP will be adaptable (i.e., changeable with changing circumstances and resources).

5. The data produced by SWAMP will be comparable to the data produced by other programs operating in the State, and the data will be made available through the World Wide Web.

6. To the extent possible, SWAMP will produce information that is representative of changes in the environment.

7. SWAMP will be built on a foundation of the best available scientific information that is currently available and feasible.

8. SWAMP will be developed and implemented in a public process.

Plan Goals

1. Evaluate the effectiveness of water quality regulatory programs in protecting beneficial uses of waters of the State.

2. Identify specific water problems preventing the SWRCB and RWQCBs from realizing beneficial uses in targeted watersheds.

3. Document receiving water conditions.

Plan Objectives

Each of the following objectives will be implemented in order to fully develop and implement SWAMP. The objectives to be accomplished by November 30, 2000 are:

1. Establish advisory groups to review the design of SWAMP.

2. Strengthen relationships and data sharing capabilities with Department of Fish and Game (DFG); Department of Health Services (DHS); Office of Environmental Health Hazard Assessment (OEHHA); Department of Pesticide Regulation (DPR); and federal, State and local agencies.

3. Specify the expectations of the monitoring and specify the management objectives for ambient monitoring.

4. Define monitoring strategies and indicators that address specific monitoring objectives.

5. Develop sampling designs.

6. Develop costs and schedules.

7. Develop proposal for a comprehensive monitoring program, including a mechanism to fund the program.

8. Develop report on the structure and effectiveness of water quality programs.

Once the comprehensive surface water monitoring proposal is completed, the following tasks will be initiated:

1. Implement monitoring program.

2. Report the information collected.

3. Disseminate the information and reports.

Tasks to Implement SWAMP

The tasks associated with each of the plan goals are presented below.

Establish advisory groups to review SWAMP design

Public and scientific review of the ambient monitoring program is both necessary and desirable. This review ensures that the program that is developed and implemented reflects the needs and expectations of the public affected by the program while including the scientific aspects in the development process. Two committees will be established to support the development of the SWAMP. Members will be appointed to these groups by the SWRCB.

Public Advisory Group

Water Code Section 13191 (AB 982, Ducheny) requires that the SWRCB establish an advisory group or groups to assist in the evaluation of program structure and effectiveness in matters related to the implementation of CWA Section 303(d) requirements and other applicable regulations, as well as other monitoring and assessment programs.

The SWRCB will establish the Public Advisory Group (PAG) to assist in the development of SWAMP. An important function of this advisory group will be the integration of public concerns and expectations with the legal and regulatory framework of a monitoring program to help identify relevant, specific, and refined questions to be addressed.

The PAG will probably be composed of representatives from point source dischargers; nonpoint source dischargers; citizen monitoring groups; environmental groups; and public health, wildlife conservation, and public interest organizations. The SWRCB will make available all pertinent information regarding any meeting scheduled by the PAG and will ensure that all meetings will be held in a manner that facilitates the effective participation of the public and stakeholder participants.

Scientific Advisory Group

A second advisory group will be established to review the technical and scientific aspects of SWAMP. It will be the responsibility of this Scientific Advisory Group (SAG) to provide comments on the conversion of the general monitoring objectives into specific monitoring objectives that can be measured with available scientific approaches. The

group will also review the program's monitoring approach and provide suggestions for monitoring improvements. The SAG will be comprised of independent scientific and technical experts including but not limited to the fields of toxicology, ecology, bacteriology, organic and inorganic chemistry, experimental design, statistics, bioaccumulation, public health, pesticide management, monitoring program implementation, and quality assurance. The SAG should not have members from the staff of agencies implementing SWAMP.

The SAG will be established after the monitoring objectives are clearly defined.

Strengthen relationships and data sharing capabilities with DFG, DHS, OEHHA, DPR, and other agencies

Ambient monitoring is performed by and supported by a number of Federal, State, and local agencies. In order for SWAMP to be comprehensive and to not overlap existing efforts it is necessary to involve Federal, other State, and local agencies as full partners on the development and implementation of SWAMP. Agency involvement in the implementation of SWAMP could include: (1) Performing the monitoring (e.g., DFG performs the monitoring activities of the State Mussel Watch Program and the BPTCP), (2) Coordinating the studies (e.g., OEHHA might oversee performance of studies on fish contamination), and (3) Improving data sharing capabilities.

Summary of Monitoring Planning Efforts

Many efforts are underway to plan and encourage ambient monitoring programs. In 1998, the SWRCB and the RWQCBs staff convened a team to evaluate the State's water quality monitoring and assessment approaches, efforts, and needs. These discussions led to the Coastal Monitoring Strategy (California Environmental Protection Agency, 1998) and the FY 2000-01 budget proposal.

The SWRCB and RWQCBs have begun implementation of the Watershed Management Initiative (WMI) (SWRCB and RWQCBs, 1998). The WMI is attempting to achieve the water quality goals in all of California's watersheds by supporting the development of local solutions to local problems with the full participation of all affected parties. Some commitments have already been made by RWQCBs to work collaboratively with local stakeholders to meet specific watershed goals.

The WMI is focused on integrating the water quality activities of the SWRCB, RWQCBs and the USEPA. These include regulatory, monitoring, assessment, planning, standard setting, and nonpoint source activities. The related efforts at other State, local, and federal agencies will also be addressed, as will the need to coordinate with local stakeholders and non-agency initiatives and interests.

Another effort is the California Aquatic Bioassessment Workgroup (CABW) that is focused on coordinating scientific and policy-making efforts toward implementing aquatic bioassessment in California (CABW, 1999).

For the San Francisco Bay and Delta, agencies are developing the Comprehensive Monitoring, Assessment, and Research Program (CMARP) for the San Francisco Bay-Delta system. CMARP is directed at providing new facts and scientific interpretations necessary for CALFED program implementation (CALFED, 1999).

Types of Ambient Monitoring Programs and Approaches

A number of ambient monitoring programs are underway that are already collecting information that may influence SWAMP or contribute to the information available to the SWRCB and RWQCBs (Table 2). There are no programs focused on assessing the suitability of water quality for agricultural or industrial use.

Most of these monitoring programs are focused on local monitoring, but some programs are directed towards broader questions related to estimating polluted area in some State waters. The majority of monitoring programs are aimed at assessing exposure to chemical and bacterial pollutants.

Some of the programs have made significant strides in assessing biological impacts using measures of effects. A survey of enclosed bay, estuary, and coastal monitoring programs was completed in 1998 (http://www.sfei.org/camp).

Specify the expectations of the monitoring and specify the management objectives

From the SWRCB and RWQCBs perspective, the ultimate goal of monitoring is to produce information that will be useful in making management decisions. Useful information depends on clear monitoring objectives.

Ambient Monitoring Objectives

Ambient monitoring information can only be useful if it provides the information to make appropriate management decisions. To be useful in evaluating the effectiveness of the regulatory program, ambient monitoring programs should be driven by the information needs of the decision makers. This section presents the starting point for the overall objectives of SWAMP. These general objectives should be refined and made specific when SWAMP is designed and implemented.

The Overall Objective

The Porter-Cologne Water Quality Control Act is a broad-based water quality regulatory program designed to protect water quality and to protect the beneficial uses of the State's waters. Beneficial uses include: domestic, municipal, agricultural and industrial water supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or reserves.

To measure the overall effectiveness of the SWRCB and RWQCB regulatory programs, the SWAMP should focus on the status and trends in beneficial uses. In other words, the overall objective of the SWAMP is to answer the question:

Are beneficial uses protected?

TABLE 2: TYPES OF SURFACE WATER AMBIENT MONITORING PROGRAMS

Program (Agency)	Local Monitoring	Regional Monitoring	Effects	Exposure	Reference
State Mussel Watch Program (SWRCB)	●			●	1
Toxic Substances Monitoring Program (SWRCB)	●			●	2
Bay Protection and Toxic Cleanup Program (SWRCB)	●	●	●	●	3
Southern California Bight Projects (SCCWRP)		●	●	●	4
San Francisco Regional Monitoring Program (SFEI)	●		●	●	5
Interagency Ecological Program (IEP)	●		●	●	6
USEPA Environmental Monitoring and Assessment Program (USEPA)		●	●	●	7
Rapid bioassessments (DFG and RWQCBs)	●		●	●	8
Toxicity studies (SWRCB and others)	●		●		9
Fish Contamination Study (SWRCB)	●			●	10
Citizen monitoring programs (various groups)	●			●	11
Surveys of swimming area water quality (Counties)	●			●	12

1 e.g., Rasmussen, 1996
2 e.g., Rasmussen, 1997
3 e.g., SWRCB, 1998; SWRCB, 1999; Hunt et al., 1998a; Hunt et al., 1998b; Anderson et al., 1998; Fairey et al., 1996
4 e.g., SCCWRP, 1998a; SCCWRP, 1998b; Schiff and Gossett, 1998; Bergen et al., 1998; Allen et al., 1998; Bay et al., 1998
5 e.g., San Francisco Estuary Institute (SFEI), 1999
6 e.g., IEP, 1999
7 e.g., Western EMAP study, in progress; Anderson et al., 1997
8 e.g., Davis et al., 1996; Harrington, personal communication, November 1999
9 deVlaming et al., in press
10 Contract with DFG (#9-035-250); contract with OEHHA (#9-038-250)
11 http://www.epa.gov/owow/monitor/dir2.html#california
12 Data from Counties provided to SWRCB

The Specific Questions

The overall objective (stated above) is too general to be converted into a quantifiable monitoring program. It is, therefore, necessary to make the question more specific. Figure 4 presents eight questions that begin to focus on specific beneficial use protection. With increasing specificity of the objectives, it is more likely that the design of the ambient monitoring program will meet the specific needs of decision makers. Also, the monitoring program can be focused on specific strategies, indicators, and amounts of change necessary to answer environmental management questions. The following sections present some strategies that can be used to answer these management questions.

The advisory groups (mandated by Water Code Section 13191) will be helpful in establishing a three-way communication between the scientists responsible for designing and carrying through the monitoring program, interested parties, and the users of the monitoring information. Such interactions should prove useful in identifying the limitations of monitoring, as well as help the scientists who design the monitoring program with an understanding of the questions that should be answered.

Define monitoring strategies that address specific monitoring objectives

A monitoring program design should incorporate a strategy to narrow the focus of monitoring from a large number of questions and parameters that could be measured to those that will produce the specific information needed. Without clearly stated testable questions, monitoring can result in a collection of data largely unusable for decision making. This analysis ensures that the monitoring is relevant to the natural processes and the environmental quality and human health objectives established early in the technical design.

Ambient monitoring can occur on many spatial and temporal scales. Spatially, monitoring can focus on a site, a stratum (e.g., shipyards within an enclosed bay), a water body, a watershed, a population of water bodies, a Region, or Statewide. Likewise, temporal scales can vary greatly — one time, multiple measurements within a season, between seasons, and between years. These factors must be addressed before selecting the sampling program or indicators.

For each monitoring objective it is necessary to use a specific monitoring strategy tailored to the monitoring objective. Some examples of monitoring strategies follow.

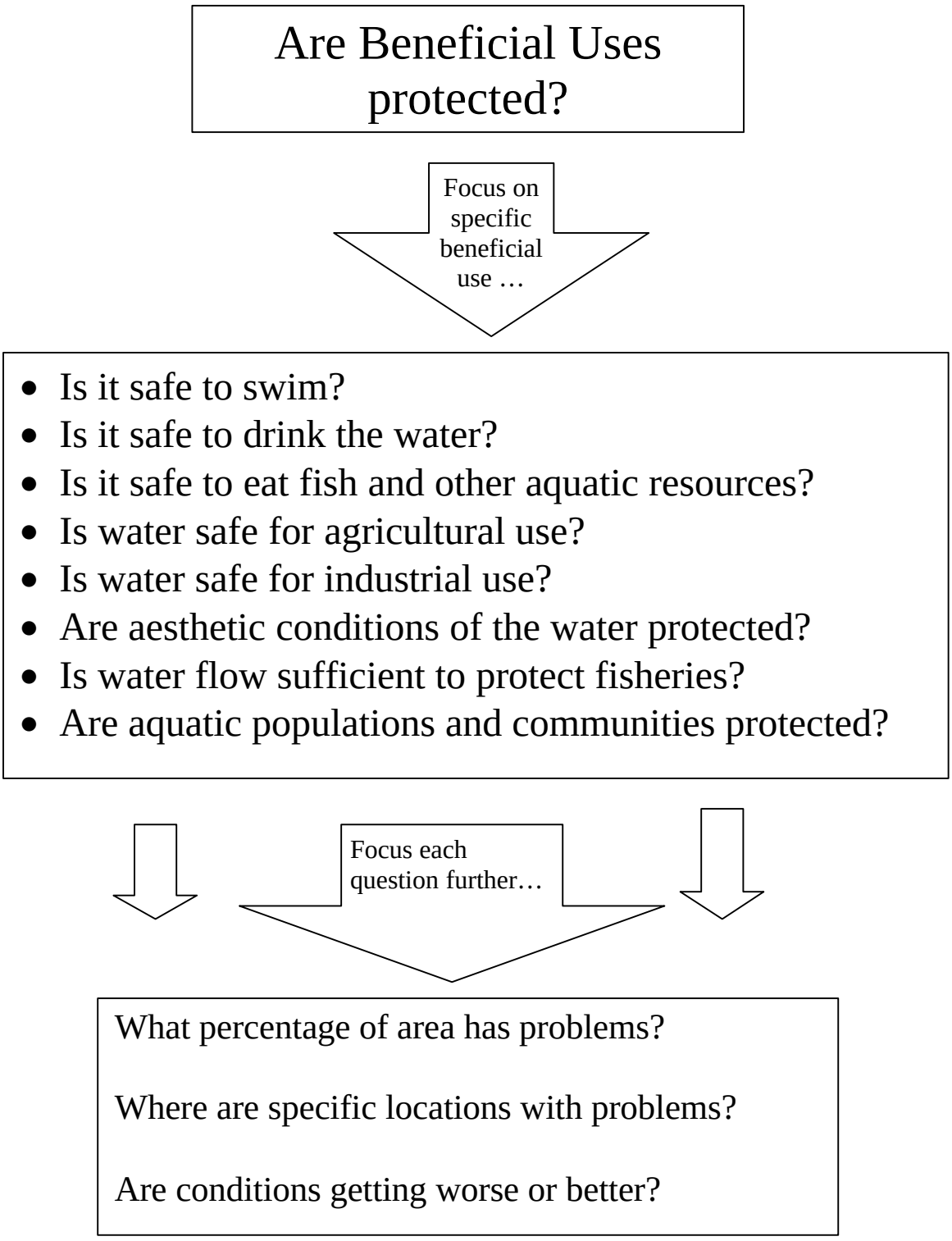
Safety of Waters for Swimming

Three sets of information could be developed:

1. Measurement of levels of indicators of disease in recreational areas;

2. Measurement of levels of indicators of disease in storm drains that empty into recreational areas; and

FIGURE 4: AMBIENT SURFACE WATER MONITORING QUESTIONS



3. Identification of areas where concentrations of pathogens render water unsafe for swimming.

This design would enable resource managers to determine how many miles of lake, river, or coastal shoreline exceed water quality objectives; how often they exceed the objectives; and whether the problems are more prevalent in specific areas. These answers would allow an assessment of the overall quality of swimming areas in the region, identify the most vulnerable areas, and help communicate this to the public through such means as detailed maps.

Sampling would take place at swimming beaches, diving areas, and the mouths of storm drains.

Safety of Fish for Human Consumption

Three sets of information could be developed:

1. Estimates of the concentration of chemical contaminants in edible fish tissue from rivers, lakes and important fishing areas along the coast;

2. Identification of fish species and chemicals for which concentrations are unsafe in each fishing area; and

3. Determination of whether concentrations of pollutants are increasing or decreasing.

This design would enable resource managers to target areas or species for fishing restrictions, determine the size of the contamination problem, and find out whether management actions have been effective at reducing contamination. Focused studies on what fish people eat, identifying high risk groups, and determining how contaminants are working their way up the food chain (i.e., are becoming bioavailable) can aid public health outreach and remediation efforts.

Safety of Shellfish for Human Consumption

Four sets of information could be developed:

1. Estimates of the concentrations of indicators of disease (such as coliform bacteria) in bivalve shellfish and in water in major sport and commercial harvesting areas;

2. Estimates of the concentrations of chemical contaminants, including algal toxins, in edible shellfish in major sport and commercial harvesting areas;

3. Identification of areas where concentrations of contaminants or bacteria render shellfish unsafe for human consumption; and

4. Determination of whether concentrations of pollutants are increasing or decreasing.

This design would enable resource managers to target areas or species for shellfishing restrictions, determine the size of contamination problems, and ascertain the effectiveness of management actions.

Sufficient Flow to Protect Fisheries

Five sets of information could be developed:

1. Identify the number and adequacy of existing surface flow monitoring sites in coastal watersheds;

2. Reestablish surface flow monitoring sites;

3. Collect information about annual surface flow variation;

4. Collect information on gauge location, water availability, drainage area, period of record, type of gauge, extremes for period of record, extremes for the current record, total annual runoff, daily discharge, monthly summaries; and

5. Measure water quality parameters (e.g., temperature and suspended materials).

This design would enable resource managers to determine the number and adequacy of surface monitoring sites; determine annual surface flow variation; and better understand the significance of flow data such as daily discharge and total annual runoff. This would allow an assessment of the overall surface flow monitoring in coastal watersheds and locations where information gaps exist.

The goal is to reestablish or expand the number of surface flow monitoring sites in coastal watersheds. During the 1990s the decline of Federal, State, and local funding has resulted in the discontinuation of more than 20 surface monitoring sites in California coastal streams.

One of the most significant factors affecting coastal coho salmon and steelhead trout is surface water flow. Surface flows define the shape and contour of the stream channel; move gravel, sediment, and woody material into and through the system; and create the habitat diversity that is necessary for the health of the ecosystem. This habitat diversity is critical for the perpetuation of healthy salmon and trout populations.

Accurate information about the annual surface flow variation is necessary for understanding the processes that are contributing to changes in the abundance of aquatic life, water quality, and pollutant loads in a stream. This information is also very important for estimating loads for the development of TMDLs.

Effects of Pollution on Aquatic Life

This objective could be approached in two complementary ways — one that identifies conditions in local areas and the other that could provide an overall status report for the

State's rivers, lakes, estuaries, enclosed bays and coast, or large parts of the coast;. The first approach, referred to here as local monitoring, assesses the ecological health or habitat condition of specific places. It identifies the location of the most and least impaired areas in terms of their biological communities. The second, referred to here as regional monitoring, determines the percentage of the whole resource area (rivers, lakes, estuaries, enclosed bays, or the coastline) that is impaired or unimpaired.

These findings are useful because they enable resource managers to map ecological health and the quality of habitat, identify the areas that need the most protection, and determine the most significant contaminants responsible for alterations of the aquatic ecosystem. In both local and regional monitoring, three sets of information would be developed: (a) measures of contaminant exposure; (b) measures of biological response; and (c) measures of habitat condition.

Local Monitoring

The choice of sampling points differs considerably between local and regional monitoring. In local monitoring, sampling would focus on areas known or suspected to be polluted and areas that may serve as sources of pollution. Thus, sampling could focus on urbanized shorelines, waterways near agricultural fields, bay and estuary sediments, marinas, shipyards, or boatyards.

Sampling points could also include places where fresh water meets salt water, the mouths of streams and storm drains, the confluence of rivers and streams, and coastal lagoons. This sampling design assumes that some sources of pollution are upstream in the watershed.

Some locations would be chosen to represent least polluted conditions to serve as a reference. Rivers, streams, lakes, enclosed bays, estuaries, lagoons, tidal wetlands, freshwater wetlands (e.g., vernal pools and marshes), and other waters of the United States would be included in local monitoring programs.

Regional Monitoring

Regional monitoring defines the larger-scale condition of aquatic life, determines if known local impacts can be observed at large distances, and assesses the natural variability inherent in the environment. This allows the results from local monitoring to be put in perspective regarding other locations in the Region or in the State. Also, regional monitoring can assess dramatic episodes that have wide impacts (e.g., El Niño) that may overwhelm local monitoring but have a large influence on the overall condition of aquatic life.

In general, sampling locations are chosen without regard for the presence or absence of known or suspected areas of pollution or other impairments. This assures that each sampling point represents conditions in its section of a water body in an unbiased manner.

Some areas (e.g., urbanized bays) may contain more sampling points than others to reflect the greater degree of interest in those areas. However, the points within those areas are still chosen randomly without regard for the location of polluted areas.

Identify available indicators that can be used to represent impacts

One of the most important steps in the development of an ambient monitoring program is the selection and use of indicators of water quality (ITFM, 1995). Indicators are the tools used to assess and measure water quality.

What is an indicator?

An indicator is a "... measurable feature or features that provide managerially and scientifically useful evidence of environmental and ecosystem quality or reliable evidence of trends in quality" (ITFM, 1995). Indicators must be measurable with available technology, scientifically valid for assessing or documenting ecosystem quality, and useful for providing information for management decision making. Environmental indicators include tools for assessment of chemical, physical, and biological conditions and processes.

Selection of Appropriate Indicators

One of the hardest tasks for development of an ambient monitoring program is the selection of meaningful indicators of water quality. General criteria are needed to help shape the monitoring efforts so that the results are useful in the decision making process. The use of criteria streamlines the indicator selection process, potentially reduces costs, prevents use of indicators that will not allow program effectiveness to be assessed, and provides consistency.

Scientific validity is the foundation for determining whether data can be compared with reference conditions or other sites. An indicator must not only be scientifically valid, but its application must be practical (i.e., not too costly or too technically complex) when placed within the constraints of a monitoring program. Of primary importance is that the indicator must be able to address the questions posed by the ambient monitoring program.

Develop sampling designs

The information developed in the previous three activities determines the sampling design. The design states what variables will be measured and where and when the measurement will be taken. A number of steps must be followed to ensure that the sampling and measurement design will be appropriate to the questions upon which the monitoring is based (NRC, 1990). These include: (1) determining meaningful change in indicators, (2) assessing and incorporating sources of natural variability, (3) selecting variables to measure, (4) developing sampling design and its statistical basis, and (5) incorporating quality assurance into SWAMP sampling design.

Develop proposal for a comprehensive monitoring program

The SWRCB is required, in part, by Water Code Section 13192 to prepare a report to the Legislature on the SWRCB's and RWQCB's current surface water quality monitoring programs for the purpose of designing a proposal for a comprehensive surface water

quality monitoring program for the State. This step will require the combination of monitoring objectives, sampling design, indicators, and other factors developed for the SWAMP design. Additional information will be included: estimates of costs, fee structure, and other factors.

The report is required to include a proposal for the program, including steps and costs associated with developing the full program, cost of implementation of the program after development, and appropriate funding mechanisms, including any fee structure. The SWRCB is allowed to include information required to be submitted to the USEPA pursuant to CWA Section 305(b), information required to be submitted under Water Code Section 13181(c)(1), and any information required to be submitted to the Legislature by the Supplemental Report of the Budget Act of 1999 (this report).

In considering and designing the proposal, the SWRCB is required to address factors that include, but need not be limited to, all of the following:

1. Physical, chemical, biological, and other parameters about which the program shall collect and evaluate data and other information and the reasonable means to ensure that the data is accurate in determining ambient water quality.

2. The use of models and other forms of information not directly measuring water quality.

3. Reasonable quality assurance and quality control protocols sufficient to allow sound management while allowing and encouraging, where appropriate, data collection by entities, including citizens and other stakeholders, such as dischargers.

4. A strategy to expeditiously develop information about waters which the State presently possesses little or no information.

5. A strategy for assuring that data collected as part of monitoring programs and any associated quality assurance elements associated with the data collection will be made readily available to the public.

6. A strategy for assessing and characterizing discharges from nonpoint sources of pollution and natural background sources.

7. A strategy to prioritize and allocate resources in order to effectively meet water quality monitoring goals.

Develop report on the structure and effectiveness of water quality programs

By November 30, 2000 and annually thereafter until November 30, 2002, the SWRCB shall also report to the Legislature on the structure and effectiveness of its water quality programs as related to CWA Section 303(d). The report may include information required for submittal to the USEPA pursuant to CWA Section 305(b), as well as any other information required for submittal pursuant to the Budget Act of 1999. The

SWRCB will assess pathways for introducing ambient monitoring information into decision-making (e.g., planning, core regulatory, nonpoint source, enforcement, cleanup planning, and TMDLs).

Timeline for completion of the reports required by AB 982

Developing the proposal for a comprehensive surface water monitoring program will be completed by November 30, 2000. The timeline with estimate on the time it will take to complete each task is presented in Figure 5. As indicated in the figure, all activities will be completed within one year.

SWAMP Implementation

After the monitoring proposal required by AB 982 is completed, the SWRCB and RWQCBs will begin implementing the program. These activities will be completed using funding proposed for FY 2000-01.

Implement the monitoring program

During this phase of the program the monitoring data are collected and analyzed. The SWRCB will develop contracts and interagency agreements to implement SWAMP.

Report the information collected

The raw data in a monitoring program frequently do not directly address public concerns or the information needs of decision makers. Data are individual facts; and information is data that has been processed, synthesized, and organized for a specific purpose. A well designed monitoring program provides knowledge or a mechanism to ensure that knowledge is used to convert data collected into information.

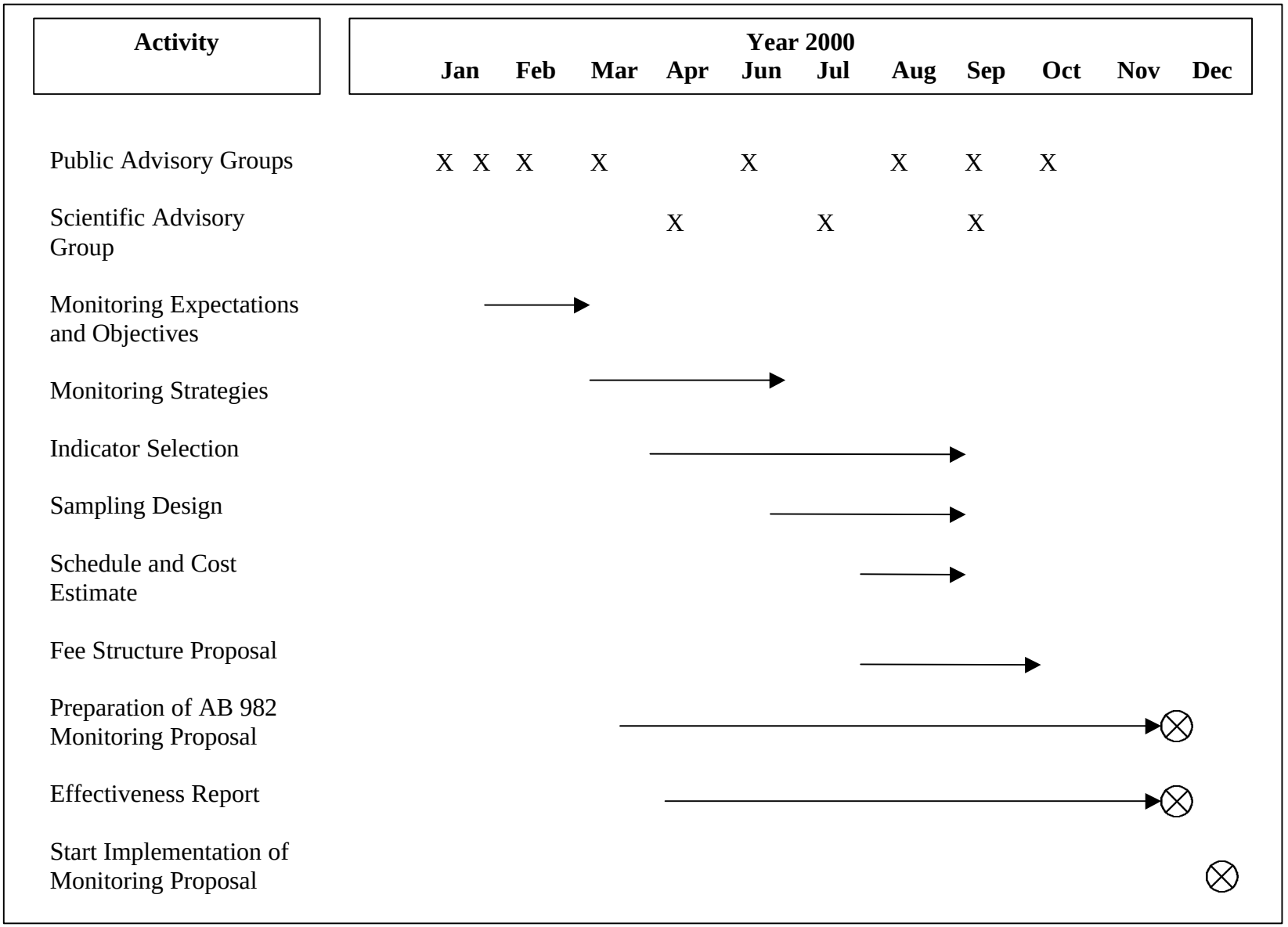
Distributed databases and evaluation tools

With the advent of the World Wide Web, it is now possible to share information easily among interested scientists, regulators, dischargers, and the public. It is not necessary to centralize data; but rather, it is now possible to establish links to databases available on the Internet. For example, the California Environmental Resources Evaluation System (CERES) is an information system developed by the California Resources Agency to facilitate access to a variety of electronic data describing California's rich and diverse environments (Internet address: http://www.ceres.ca.gov).

Disseminate the information and reports

An important aspect of any ambient monitoring program is the availability of the data. For the monitoring program to be effective, the data must be made available so that the fullest use can be made by the SWRCB, RWQCBs, scientists, dischargers, and the public. Monitoring information will most likely be disseminated through the SWRCB web site, written reports, and publication in scientific journals.

FIGURE 5: TIMELINE FOR IMPLEMENTATION OF SWAMP



SECTION V. PLAN FOR IMPLEMENTING A COMPREHENSIVE GROUNDWATER AMBIENT MONITORING AND ASSESSMENT PROGRAM

Summary

The SWRCB, pursuant to a provision in the 1999 Budget Act, proposes to develop and implement a comprehensive Groundwater Ambient Monitoring and Assessment Program (GAMA) using the collaborative efforts of agencies with groundwater monitoring responsibilities. Although groundwater quality data have been collected over the last several decades by various federal, state and local entities, no agency has developed and implemented a comprehensive program to compile and evaluate the data. The goal of the GAMA program is to provide information about the quality of California's groundwater and make relevant assessments and recommendations.

The GAMA program will collect and synthesize information generated by existing groundwater monitoring programs. SWRCB will coordinate the database compilation through formation of a team of agencies, such as DWR, DHS, and USGS, including groundwater purveyors, with existing groundwater monitoring programs (Groundwater Resource Information Sharing Team — GRIST).

Data will be evaluated for acceptable quality and analyzed using the SWRCB's relational database as a tool for trend and pattern recognition. Information gaps identified during GAMA implementation that are critical to making assessments will be filled by modifying/augmenting existing programs or, if necessary, proposing additional monitoring programs. The Legislature has provided funding for FY 1999-00 to contract with the USGS for this purpose.

Assessments are intended to provide status and trend information in priority basins and draw working conclusions to provide decision-makers with recommendations for monitoring and regulatory program implementation. Reporting will be based on the completion of assessments and recommendations during different phases of the program.

The initial phase of the GAMA program, the first three years, will assess effects of potentially contaminating activities on a limited number of the most hydrogeologically vulnerable drinking water aquifers. Data and assessments will be internet-accessible with a mapping capability (GIS), and available to appropriate agencies to reduce the risk of public exposure to pollutants.

Background

The SWRCB proposes to develop and implement a comprehensive GAMA pursuant to a provision in the 1999 Budget Act requiring the SWRCB to provide a plan for this program. The GAMA program will mesh well with actions that the

SWRCB is now taking in response to the discovery of MTBE, a gasoline additive, in public supply wells in a number of cities including Santa Monica, Los Angeles, and South Lake Tahoe. These discoveries have eroded public confidence in the quality of drinking water supplies and focused increased attention on the issue of groundwater quality.

A December 1998 audit by the California State Auditor, "California's Drinking Water…", concluded that the State is lacking:

- An effective mechanism for the interagency coordination necessary for the early recognition and prevention of contamination of groundwater resources.

- Ability to easily identify the sources of groundwater contamination closest to drinking water wells and, therefore, prioritize the investigation or remediation based on this threat.

- Ability to provide drinking water regulators and water purveyors sufficient notification or details about contamination moving toward drinking water sources.

- A standardized database with a GIS interface that could streamline the integration of data from multiple agencies (i.e., it could integrate data for contaminant sites and drinking water sources) and give all stakeholders the information necessary to protect the beneficial uses of the State's groundwater.

Governor's Executive Order D-5-99 to phase out MTBE requires the SWRCB, in consultation with DHS and Department of Water Resources (DWR), to identify the more vulnerable groundwater areas to help prioritize remedial actions related to MTBE releases.

The SWRCB actions taken in response to the discovery of MTBE provide an existing framework for the GAMA program. The SWRCB has overseen the development of a powerful database (and GIS interface) for groundwater, hydrogeologic, drinking water well, and contaminant release data. In addition, the SWRCB has developed working maps based on published literature identifying groundwater areas, which are hydrogeologically most vulnerable to potentially contaminating activities. The SWRCB has been, and will continue to, work with DHS's Source Water Protection Program and DWR in a number of programs including the Bulletin 118 Update.

GAMA Program Goal and Objectives

The goal of the GAMA program is to provide information about the quality of California's groundwater and to make relevant assessments and recommendations. The GAMA program will develop and implement a comprehensive program to compile, evaluate, disseminate, and assess

groundwater data that have been collected over the last several decades by various federal, state and local entities, and to support filling information gaps, as feasible. The goal will be attained by accomplishing the following objectives:

1. **Outreach.** Formation of a team of agencies, including groundwater purveyors, with existing groundwater monitoring programs. The Groundwater Resource Information Sharing Team (GRIST) would facilitate effective exchange of information and maximize efficiency;

2. **Collection of Existing Data.** Collection and synthesis of data from agencies with existing monitoring programs;

3. **Data Management.** Import of existing data into the SWRCB's relational database, such that it is internet-accessible with a mapping capability (GIS) and available to appropriate agencies to reduce the risk of public exposure to pollutants;

4. **Data Analysis.** Evaluation of usability of existing data and identification of information gaps critical for making assessments;

5. **Fill Information Gaps.** Filling of critical information gaps by modifying/augmenting existing programs or, if necessary, propose additional monitoring programs. The Legislature has provided funding for FY 1999-00 to contract with the USGS for this purpose;

6. **Assessment, Report of Findings, and Recommendations.** Assessment of groundwater quality, such as status, spatial and temporal trends, and causal relationships. Assessment will provide additional information for Basin Plan spatial variation (i.e., depth), effectiveness of regulatory programs to protect beneficial uses, and prioritization of RWQCB regulatory oversight activities. Assessment will result in reports of findings and recommendations to decision-makers for both monitoring and regulatory program improvement.

The SWRCB will achieve the goals and objectives outlined above by instituting a statewide comprehensive program (GAMA). The conceptual framework, implementation of program objectives, and the initial phase of the GAMA program are more fully described in the subsequent sections.

Conceptual Monitoring Framework

A number of related efforts have been made by various agencies to develop frameworks and protocols for comprehensive water quality monitoring programs. One framework in particular encompasses the needs of the GAMA program. This framework is contained in *Conceptual Frameworks for Ground-Water-Quality Monitoring* (1997) developed by the Intergovernmental Task Force on Monitoring Water Quality (ITFM) under the leadership of the USGS and the USEPA. This framework incorporates the knowledge gained through the development and

implementation of the USGS's ambient water quality program, National Water Quality Assessment Program (NAQWA). The basic approach for building a comprehensive monitoring system outlined in the ITFM framework is consistent with the SWRCB overall approach. In addition the SWRCB will customize the conceptual monitoring framework based on consultation with others regarding their experience, including other states and other State agencies.

Implementation of Objectives

Outreach

The GAMA program will require extensive coordination and collaboration with State, federal, and local agencies, as well as water districts and purveyors. To maximize the applicability of the program and to facilitate resource sharing, the SWRCB will solicit input from these stakeholders and incorporate the input into the program, as feasible and consistent with the overall goals. With their help, the GAMA program will provide a robust tool for assessing the state of California's groundwater and its future, and provide the basis for making essential and effective regulatory improvements. The mechanism for achieving effective resource sharing will be the Groundwater Resource Information Sharing Team (GRIST), which will be composed of representatives from the various agencies. GRIST will be the vehicle for expedient transfer of water quality data in the most usable format.

Collection of Existing Data

A hydrogeologic framework will be used to organize and prioritize the collection and assessment of groundwater data. The hydrogeologic framework will be based on groundwater basins as delineated in DWR Bulletin 118, or as revised in the RWQCB's Water Quality Control Plans. In response to the Governor's Order on MTBE to identify the more vulnerable groundwater areas, the SWRCB is establishing the groundwork for the development of the hydrogeologic framework. The hydrogeologic framework will aid in prioritizing areas for the ambient monitoring effort. Table 3, modified from ITFM (1997), provides a comprehensive list of information that may be used to develop the conceptual model. At a minimum, necessary information for a subject groundwater basin includes:

1. Spatial distribution (vertical and horizontal) of aquifers;

2. Type of aquifer, alluvial, fractured rock, etc.

3. Groundwater conditions (confined/unconfined, depth to water, and gradient)

4. Source of influx (areas of recharge, inflow) and discharges (wells)

5. Monitoring well location and construction details

6. Water quality at discrete intervals

The SWRCB will inventory, evaluate, and compile existing data. Groundwater monitoring data have been collected by federal, state, and regional agencies, and water districts. Table 4, modified from CALFED, 1999, is a compilation of some of the data sources that could be used in the GAMA program. Additional programs and sources of data may be identified and incorporated into the GAMA program during the data collection task. However, at a minimum, the SWRCB will include data from:

- DHS for 14,000 public water supply wells;
- DWR monitoring data;
- USGS monitoring data;
- DPR for pesticide groundwater monitoring program;
- Water supply agencies' monitoring data;
- SWRCB/RWQCBs – Remediation monitoring data from UST, SLIC and DoD sites;
- SWRCB/RWQCBs –Compliance monitoring data from Chapter 15, non-Chapter 15, and SWAT programs.

The SWRCB will evaluate the data adequacy and usefulness of indicator parameters that have been selected based on the ITFM framework (ITFM, 1997) and through input from the various stakeholders.

SWRCB expects three groups of parameters of interest:

Primary parameters will consist of the following general water quality indicators, based on the recommended short list from ITFM (1997):

- field parameters for basic water chemistry information,
- major ions and dissolved solids to determine general suitability for beneficial uses,
- nutrients as a general measure of human impacts.

Secondary parameters will consist of potential groundwater contaminants such as petroleum-related constituents (including MTBE), chlorinated solvents, pesticides, herbicides, and metals. These constituents will be assessed at locations

TABLE 3: INFORMATION NEEDED TO DESCRIBE THE GEOLOGIC FRAMEWORK, HYDROLOGY, AND NATURAL ENVIRONMENTAL SETTING OF A HYDROGEOLOGIC UNIT

Information for Surficial or Confined Hydrogeologic Units, or Both	
FEATURE	**COMMENTS**
Areal extent map	If a hydrogeologic unit has a surficial part (unconfined) and a confined part, the boundary between the two parts is delineated.
Geologic map showing areal extent	A geologic map depicts structural features of the rocks and unconsolidated deposits, such as folds and faults, that may have a substantial effect on patterns and rates of groundwater flow.
Types or combinations of lithology	Lithologies include clastic and carbonate rocks, igneous and metamorphic basement rocks, granite and related rocks, basalt flows, and so on.
Types of sedimentary deposits	Sedimentary deposits include alluvial fans, flood-plain deposits, glacial outwash, till, loess, evaporites, and so on.
Detailed description of lithology	This description includes particle size and mineral composition of rocks and sedimentary particles; presence or absence of secondary minerals, such as pyrite, calcite or other carbonates, gypsum, quartz, and feldspar; presence of iron oxide or other types of mineral coatings on sedimentary grains or fracture surfaces; and organic-matter content in sedimentary deposits.
Structure-contour map of top of unit	This map may correspond, in part, to a topographic map of the land surface for surficial hydrogeologic units.
Structure—contour map of bottom of unit	The combination of this map and the structure-contour map of top of unit define the location of the hydrogeologic unit in three-dimensional space. With these maps and basic information on a well, the sampled interval in a well can be assigned to a specific hydrogeologic unit.
Isopach (thickness) map of unit	A thickness map defines the spatial geometry of the unit. Thickness of a unit at a point is one factor in the transmissivity of the unit at that point (see next entry).
Transmissivity map of unit	Transmissivity is a direct measure of the water-transmitting capability of the unit.

Information for Surficial or Confined Hydrogeologic Units, or Both	
FEATURE	**COMMENTS**
Potentiometric-surface map	Because horizontal groundwater flow generally is approximately perpendicular to contours of equal hydraulic head, general directions of groundwater flow can be inferred from these maps.
Selected vertical hydrogeologic sections	Hydrogeologic sections include not only the distribution of hydrogeologic units in a vertical section, but the distribution of hydraulic head. A combination of hydrogeologic sections can provide an initial appreciation for directions of three-dimensional flow in the hydrogeologic units.
Approximate water budget of unit	Water budgets of hydrogeologic units are most useful when they are associated with a map of areal extent or a schematic diagram, or both, showing locations and rates of recharge and discharge, approximate flow patterns, and soon. Groundwater flow models are a powerful extension of preliminary water budgets because they permit refinement of water budgets, definition of groundwater flow patterns in and between hydrogeologic units, and estimates of age of groundwater by particle tracking, which can be compared with estimates of age by chemical means (see estimate of age entry).
Estimates of age of ground water at selected points in the groundwater flow system	Estimates of age can be obtained by analysis of selected radioactive isotopes, such as tritium, or ratios of isotopes and by analysis of some synthetic organic compounds, such as the chlorofluorocarbons. Age dating places a water sample in the historical time frame of human activity and establishes a time marker in the groundwater flow system. In addition, age dating is a valuable tool in calibrating groundwater flow models by permitting a comparison of groundwater ages determined by chemical means and by particle tracking (see water budget entry).
Information for Surficial Hydrogeologic Units	
Map showing the water table and related surface water bodies	General directions of shallow groundwater flow obtained from water table Maps permit approximate delineation of groundwater contributing areas for surface water bodies that receive groundwater discharge.
Estimates of groundwater contributions to streamflow	Estimates can be obtained by stream hydrograph separation, by various types of modeling, and by applying methods that use environmental isotopes. A closely related issue is the effect of groundwater on surface water quality.

Information for Surficial or Confined Hydrogeologic Units, or Both	
FEATURE	**COMMENTS**
Map showing depth to the water table, and maps and logs depicting lithologic characteristics of the unsaturated	A map of depth to the water table represents the approximate thickness of the unsaturated zone, assuming that no perched groundwater is present; however, the capillary fringe may extend the saturated part of the hydrogeologic unit above the water table. The thickness and lithologic character of the unsaturated zone may greatly affect the quantity and quality of recharge water percolating from the land surface that reaches the water table. Like the saturated zone, primary data on the unsaturated zone is obtained from borehole drilling logs, borehole samples and cores, and borehole geophysical logs. Relevant properties include rock type, mineralogy, and grain size of earth materials; vertical permeability; and organic-matter content.
Soils and soil-properties maps	Soils maps have been compiled for much of the Nation at a scale of 1:250,000 and can he obtained in either map or digital format. County maps of soils generally are prepared at scales between 1:10,000 and 1:25,000. Compiled properties of soils, such as drainage characteristics, vertical permeability, and content of organic matter, may he of interest in a particular study.

Obtained From U.S. Department of Agriculture National Resources Conservation Service (formerly the Soil Conservation Service) in Source: ITFM, 1997.

TABLE 4: MAJOR GROUNDWATER QUALITY MONITORING COMPONENTS OF GAMA

Program Department	General	Metals	Nutrients	Organics	Pesticides	Pathogens
Federal						
National Water Quality Assessment Program (NAWQA), USGS	●	●	●	●	●	
Environmental Monitoring and Assessment Program, USEPA	●	●	●	●	●	
Toxic Substances Hydrology Project, USGS					●	
State						
Municipal Water Quality Investigations Program, DWR	●	●	●	●	●	●
State Water Project Water Quality Monitoring Program, DWR	●		●	●		●
Compliance Monitoring, DWR	●		●			
Department of Pesticide Regulation	●				●	
Interagency/ Regional						
Various compliance and ambient monitoring programs, RWQCBs	●	●	●	●	●	●
Various local monitoring programs by water districts/purveyors	●	●	●	●	●	

Modified from Proposal for Comprehensive Monitoring, Assessment and Research Program, CALFED March 1999 (www.calfed.water.ca.gov/programs/cmarp/contents.html)

where they are of concern based on aquifer vulnerability or land use. In addition, they will be examined on a statewide to establish baseline conditions.

Focus Area/Regional parameters will be based on localized conditions and input from regional entities. Some constituents not included in the lists of primary and secondary parameters may be of local concern based on specific land uses or known problems. These parameters would be assessed at a frequency and locations based on focus areas or regional conditions.

Data Management

An effective data management system is a pivotal component of any comprehensive water quality program. A relational database with a GIS interface is necessary for the storage, retrieval, and evaluation of the large qualities of complex data needed for the GAMA program. A relational database structure allows individual agencies to manage their own data locally, while providing a centralized means of uploading the data into a larger database.

The SWRCB will use Geographical Environmental Information Management System (GEIMS), the standard relational database structure that has been developed under the direction of SWRCB. GEIMS was designed to serve as a central database tracking system and as a data "warehouse" to integrate information from multiple, possibly disparate databases. GEIMS has the capability to store and manage extensive data sets associated with other contaminant sources, water quality data, water well, and infrastructure data needed for a comprehensive ambient groundwater quality monitoring program. Currently, GEIMS contains data sets for USTs sites, leaking underground fuel tanks (LUFTs), petroleum pipelines, and public drinking water wells. This centralized database can be used for comprehensive analysis and reporting by agencies and stakeholder scientists providers (e.g., USGS, State and local agencies).

GeoTracker, an Internet GIS software package, allows data users to analyze data relationships, create reports, and generate maps of environmental data from the GEIMS database via the internet. The existing GEIMS database, with GeoTracker serving as the internet interface, will be used for the storage and management of the groundwater quality and hydrogeologic data collected for this program.

Data Analysis

Determination of the usability of data for program purposes will also be based on appropriate level of quality assurance/quality control (QA/QC). The general requirements of an effective QA/QC program are contained ITFM framework (ITFM, 1997). The GEIMS database currently contains a QA/QC component. This QA/QC component will be modified as necessary to address program-specific needs. In the case of some older data sets, limited or no QA/QC may be

available. If these data are critical for the goals of program, they may be included with appropriate qualifiers.

The SWRCB will analyze the data in the GEIMS database to:

- Determine the character of groundwater quality under existing conditions;
- Identify any of the following water quality trends:
  - Temporal
  - Spatial, lateral and vertical;
- Relate water quality trends to potentially impacting factors (i.e., regulated units, land use, water management);
- Identify data gaps where additional monitoring is critical for making assessments

The two general approaches to data analysis are statistical and physical/deterministic. Statistical methods are commonly used to describe and compare data sets, and to evaluate the sensitivity of groundwater quality to specific variables. The physical approach is useful in testing causal relationships. Both of these methods will be applied to data evaluation, as appropriate. Further discussion of these methods is contained in ITFM (1997).

Fill Information Gaps

The SWRCB will provide for field monitoring of ambient groundwater quality in priority basins based on information needs identified for the GAMA program.

Data gaps are likely in two areas:

- Additional sampling and analysis at existing monitoring locations (e.g., general minerals, tritium, perchlorate to assess effects of potentially contaminating activities on drinking water aquifers); and
- Additional monitoring locations, either drilled or not yet drilled, such as collecting deep-aquifer data.

Whenever possible, the SWRCB will fill these data gaps through adjustments to or expansions of existing programs of other agencies. However, should new monitoring programs need development, the SWRCB will provide for development of a workplan that will generally follow the guidelines contained in the ITFM (1997) section on *Designing and Implementing Specific Monitoring Projects.* The Legislature has provided funding for a contract with the USGS for FY 1999-00, which will be a first step in filling information gaps.

Assessment, Report of Findings, and Recommendations

Under the GAMA program, the SWRCB will assess groundwater information, report findings, and make recommendations. Assessment and reporting will be conducted on an ongoing basis to describe current status of groundwater conditions, changes over time, and changes in scope of the program. The assessments would draw working conclusions to decision-makers for both monitoring and regulatory program improvement, and provide decision-makers with recommendations for implementation.

Assessments will focus on groundwater quality, such as status, spatial and temporal trends, and causal relationships. Where sufficient data exist, SWRCB would identify past or current conditions and trends. Otherwise, the SWRCB would identify information gaps and recommend approaches to fill them. Assessment will provide information about vertical variations in water quality that can be used in conjunction with Basin Plans. This information will be used to evaluate the effectiveness of regulatory programs in protecting beneficial uses and to prioritize RWQCB regulatory oversight activities.

The SWRCB will develop the focus and format of program reports in collaboration with the stakeholders. The structure of the reports must be capable of accommodating changing needs and concerns of the State. In general, program reporting will include:

- Summarized data in tabulated and graphical format;
- Graphical presentation of data in the form of maps at scales appropriate for the various study areas and which can include such information as water supply wells and the more vulnerable aquifers;
- Written analysis of the program results and discussion of proposed modifications to the program; and
- Supporting documentation.

The transfer of program findings may take the form of verbal presentations to stakeholders and the general public, community outreach, newsletters, published data and interpretative reports. To provide maximum accessibility and use of the program, all information products will be available in electronic format through the Internet.

Initial Phase of GAMA Program

The development and implementation of the GAMA program will require a significant effort involving collaboration, planning, framework development, data management and assessment. Because of the level of effort required for this program, the SWRCB proposes that the initial phase consist of a focused three-year effort.

The initial phase will attempt to: address early recognition and prevention of contamination of groundwater resources, in response to the 1998 Auditor General Report; assess the condition of shallow, deep, and intermediate aquifers and their relationship to potentially contaminating activities; and test a basic premise used in the identification of the more vulnerable groundwater areas, which the SWRCB is delineating in response to the Governor's Order on MTBE.

The premise of the effort to identify the more vulnerable groundwater areas is that aquifers that are overlain by low-permeability clay layers ("confined" aquifers) are generally less vulnerable to potentially contaminating activities than are aquifers that are overlain by more permeable sediments ("unconfined" aquifers).

The initial phase will involve a limited number of the more vulnerable groundwater areas, which supply a significant volume of water to a public drinking water supply. Data will be collected statewide with emphasis on these focus areas. Both historic and recent data will be collected, and will include lithologic data, well construction data, location and water quality data from both water supply well and compliance monitoring locations.

Recommendations from the initial phase will address the results of the assessment, additional assessments that may be warranted, and will also discuss GAMA program implementation in additional focus areas, ultimately resulting in statewide coverage.

SECTION VI. LINKAGE OF AMBIENT MONITORING PLAN TO THE FY 2000-01 BUDGET PROPOSAL

This Plan proposes that monitoring be funded for ambient surface water and groundwater. This section of the report presents how the SWRCB's budget change proposal (BCP) for the Water Quality Initiative in FY 2000-01 fits within the Plans.

Current monitoring and assessment capability at the SWRCB is limited and tends to be focused on specific program needs. This has led to a fragmentation of monitoring efforts resulting in gaps in needed information and a lack of integrated analyses. For FY 2000-01 the Governor's budget includes the SWRCB's Water Quality Initiative BCP to support and expand the implementation of ambient monitoring. The BCP is consistent with the approach proposed in the preceding plan. As monitoring efforts are further developed and refined through the process outlined in the plan, additional funding requests may be made.

The budget augmentation received in FY 1999-00 partially funded monitoring for the purposes of developing TMDLs. However, a gap exists for the first step of the process — ambient water quality monitoring.

The baseline budget in FY 1998-99 for monitoring activities was $1.8 million, focused primarily on coastal monitoring. In FY 1999-00, the SWRCB received a $1 million augmentation for fish and shellfish tissue monitoring programs, toxicity testing in all priority watersheds, and groundwater monitoring. The proposed ambient monitoring and assessment activities for FY 2000-01 will be focused on implementing the surface water and groundwater monitoring plans.

The Water Quality Initiative BCP would provide 15 PYs and $5.4 million in contracts to evaluate the water quality in watersheds or ecoregions as listed in the WMI Chapters. For surface waters the monitoring will be implemented in accordance with the comprehensive surface water monitoring plan developed pursuant to AB 982. These efforts will help fill in many critical data gaps that currently exist in the assessment of many water bodies of the State. The number of watersheds or ecoregions may be increased if additional funding becomes available through regional programs or other sources.

LIST OF ABBREVIATIONS

AB	Assembly Bill
ACL	Administrative Civil Liability
BCP	Budget change proposal
BMP	Best Management Practice
BPTCP	Bay Protection and Toxic Cleanup Program
Cal/EPA	California Environmental Protection Agency
CAO	Cleanup and Abatement Order
CDO	Cease and Desist Order
CERES	California Environmental Resources Evaluation System
CMARP	Comprehensive Monitoring, Assessment and Research Program
CWA	Clean Water Act
DDT	Dichlorodiphenyltrichloroethane
DFG	Department of Fish and Game
DHS	Department of Health Services
DPR	Department of Pesticide Regulation
DWR	Department of Water Resources
EMAP	Environmental Monitoring and Assessment Program
FY	Fiscal year
GAMA	Groundwater Ambient Monitoring and Assessment Program
GEIMS	Geographic Environmental Information Management System
GIS	Geographic information system
GRIST	Groundwater Resource Information Sharing Team
IEP	Interagency Ecological Program
ITFM	Intergovernmental Task Force on Monitoring
LLNL	Lawrence Livermore National Laboratory
LUFT	Leaking Underground Fuel Tanks
MTBE	Methyl tertiary-butyl ether
NAWQA	National Water Quality Assessment Program
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRC	National Research Council
OEHHA	Office of Environmental Health Hazard Assessment
PAG	Public Advisory Group
PY	Personnel year
QA/QC	Quality Assurance/Quality Control
RWQCB	Regional Water Quality Control Board
SAG	Scientific Advisory Group
SCCWRP	Southern California Coastal Water Research Project
SFEI	San Francisco Estuary Institute
SWAMP	Surface Water Ambient Monitoring Program

SWIM	System for Water Information Management
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UST	Underground Storage Sites
WDR	Waste discharge requirements
WMA	Watershed Management Area
WMI	Watershed Management Initiative

GLOSSARY

Ambient Monitoring	Any activity in which information about the status of the physical, chemical, and biological characteristics of the environment is collected to answer specific questions about the status and trends in the characteristics.
Beneficial Use	Regulatory definitions of the resources, services, and qualities of specific water bodies that are the ultimate goals of protecting and achieving high water quality. These include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.
Bioassessment	A tool for evaluating the biological integrity of a water body and its watershed, using surveys of the organisms living in the water body.
Compliance Monitoring	Monitoring to determine if a specific discharger is meeting the requirements established in Waste Discharge Requirements WDRs, NPDES permits, or water quality certifications.
Contamination	An impairment of the quality of the waters of the state by waste to a degree which creates a hazard to the public health through poisoning or through the spread of disease. It includes any equivalent effect resulting from the disposal of waste, whether or not waters of the State are affected.
Habitat	The environment occupied by individuals of a particular species, population, or community.
Indicator	The tools used to assess and measure water quality. Indicators must be measurable with available technology, scientifically valid, and useful for providing information for management decision making. Environmental indicators include tools for assessment of chemical, physical, and biological conditions and processes.
Local Monitoring	Monitoring that is focused on areas known or suspected to be polluted and areas that may serve as sources of pollution.
Monitoring	Periodic or continuous collection of environmental information to assess the current status or changes in the environment over time. It can be short or long term in duration and is typically driven by statutory, policy or other regulatory requirements.

Pollution	An alteration of the quality of the waters of the State by waste to a degree which unreasonably affects either the waters for beneficial uses or the facilities which serve these beneficial uses.
Regional Monitoring	Monitoring that defines the larger scale condition of aquatic life, determines if known local impacts can be observed at large distances, and assesses the natural variability inherent in the environment. Sampling locations are chosen randomly without regard for the presence or absence of known or suspected areas of pollution or other impairments.
Research	Scientific investigation that involves short-term studies focused on cause-and-effect relationships, understanding causative mechanisms, open-ended questions, methods development, and special studies focused on questions generated by monitoring.
Watershed	Lands that drain to a common place. As physical systems, watersheds consist of hillslopes, valleys, and drainage networks.

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