

A Framework for Monitoring and Assessment in the San Diego Region

California Regional Water Quality Control Board, San Diego Region

Staff Report

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I. Executive Summary

The mission of the San Diego Water Board is to protect and restore the chemical, physical, and biological integrity of waters in the San Diego Region. To enable the Water Board to carry out its mission more strategically and more effectively, this framework outlines an approach to monitoring and assessment that focuses on producing important and useful information. This approach is conceptually simple, logical, systematic, question-driven, and water body-oriented, and it has been successfully used elsewhere in California.

Current monitoring required by the San Diego Water Board is focused on discharges, and whether discharges and cleanups necessitated by discharges are in compliance with regulatory requirements. The most fundamental shortcoming of such a discharge-oriented approach to monitoring and assessment is that important basic information about conditions in water bodies is not produced.

Monitoring and assessment programs should always be designed to answer specific questions. The water body-oriented approach outlined in this framework and shown on the following page starts with monitoring and assessment to answer questions about conditions in water bodies as they relate to beneficial uses, such as:

- Is water safe to drink?
- Are fish and shellfish safe to eat?
- Is water quality safe for swimming?
- Are habitats and ecosystems healthy?

If unsatisfactory conditions are found, the question to be answered by the next phase of monitoring and assessment is:

- What are the primary stressors causing the unsatisfactory conditions?

Once the primary stressors have been identified, the question to be answered by the next phase of monitoring and assessment is:

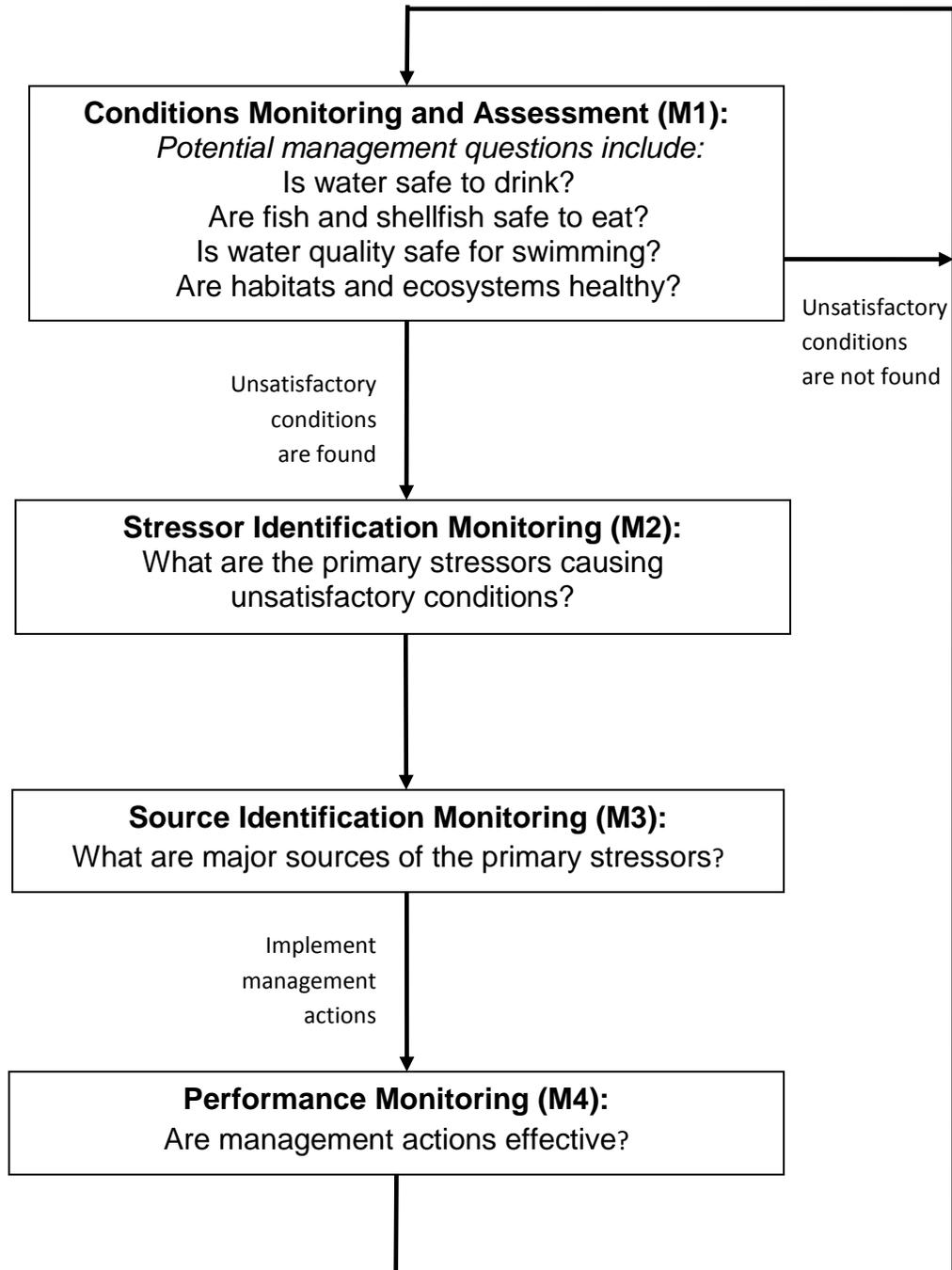
- What are the major sources of the primary stressors?

Once the major sources have been identified and management actions have been taken to address the primary stressors and major sources, the question to be answered by the next phase of monitoring and assessment is:

- Are management actions effective?

Monitoring and assessment to answer questions about the effectiveness of management actions includes and, therefore, connects back to monitoring and assessment to answer questions about conditions in water bodies.

This framework also outlines a collaborative process for implementation of this approach. A detailed plan will be developed to implement this framework.



Water Body-Oriented Monitoring and Assessment

II. Introduction

The framework set forth in this document outlines a new approach to monitoring and assessment with the intent of enabling the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) to carry out its mission more strategically and more effectively. This framework also outlines a collaborative ten-step process for implementation of this new approach.

This framework:

- Is consistent with the one established by the National Water Quality Monitoring Council (NWQMC 2011);
- Follows the 2010 strategy of the Surface Water Ambient Monitoring Program (SWAMP) of the State and Regional Water Boards (SWAMP 2010); and
- Is consistent with the goals of the 2008 Water Boards Strategic Plan (SWRCB 2008); and
- Is consistent with ongoing efforts of the San Diego Water Board to focus on environmental outcomes.

The ideas and concepts on which this framework is based are widely used in California and other parts of the United States. This framework refines, adapts, and applies these ideas and concepts for the San Diego Region.

This framework is applicable to ground and surface waters, fresh and salt waters, and inland and coastal waters. It outlines an approach to monitoring and assessment and a process for implementing that approach that can be applied to any type of water body with any suite of beneficial uses. This document does not and is not intended to specify details of any particular monitoring and assessment program.

III. Vision, Goals, and Guiding Principles

Vision:

The vision of the San Diego Water Board is that monitoring and assessment programs will produce information that:

- (a) Enables the work of protecting and restoring San Diego Region waters to be strategic and effective; and
- (b) Provides for meaningful evaluation of the success of that work.

Goals:

The goals are for monitoring and assessment programs to:

1. Determine the status and trends of conditions in San Diego Region waters;
2. Identify the causes of unsatisfactory conditions and their sources;
3. Determine the effectiveness of management actions; and
4. Effectively communicate key findings to the public, stakeholders, and decision-makers.

Guiding Principles:

The principles that will guide development, implementation, and management of monitoring and assessment programs include the following.

1. Monitoring and assessment programs will be:
 - a. Pertinent to concerns about beneficial uses of water bodies;
 - b. Especially focused on areas of special importance, interest, and/or concern;
 - c. Question-driven, scientifically and statistically sound, and cost-effective;
 - d. Coordinated, comparable, and consistent across jurisdictions, within water bodies, from water body to water body, and from watershed to watershed;
 - e. Developed and implemented collaboratively with regulated entities and other interested parties;
 - f. Periodically reviewed by independent outside experts;
 - g. Updated and refined over time, as appropriate; and
 - h. Funded, to the extent possible, by entities whose activities or facilities have already or could potentially adversely affect conditions in water bodies.
2. The San Diego Water Board will maintain active participation in, leadership of, and oversight of development, implementation, and management of monitoring and assessment programs.

IV. Background – Need for a New Approach to Monitoring and Assessment

A. Mission of the San Diego Water Board

The state Porter-Cologne Act (PCA) and the federal Clean Water Act (CWA) are the primary water quality statutes in California and the nation, respectively. The desired outcome of these statutes can be expressed in various ways, such as:

- Waters with chemical, physical and biological integrity;
- Waters that are free of degradation and impairment;
- Waters that are healthy; or
- Waters that fully support beneficial uses.

Regardless of how it is expressed, this desired outcome is about conditions in water bodies.

The mission of the San Diego Water Board is to achieve the desired outcome of the PCA and CWA in the San Diego Region. Work to achieve this mission involves both protecting and restoring water bodies.

B. Role of Monitoring and Assessment

Since the desired outcome of the PCA and CWA is about conditions in water bodies (e.g., chemical, physical, and biological integrity), information about conditions in water bodies is essential to help guide the work of protection and restoration. Where conditions are unsatisfactory, information about the causes of those conditions and their sources is needed so that appropriate management actions can be taken. Where management actions are taken, information about the effectiveness of those actions is needed. None of this information can be produced without appropriate monitoring and assessment.

Monitoring should be inseparable from assessment. Monitoring is the collection of data, while assessment is the conversion of monitoring data into useful information. If monitoring is designed and carried out incorrectly, assessment is of little use. On the other hand, if monitoring is designed and carried out properly, but assessment is not done or not done correctly, then monitoring is useless. Therefore, it is essential for monitoring to be designed and carried out correctly and for assessment to be done correctly. Unless the results of monitoring and assessment are effectively communicated to appropriate audiences, neither monitoring nor assessment is of any value.

C. Past Approach: Discharge-Oriented Monitoring and Assessment

The San Diego Water Board has not previously set forth a monitoring and assessment strategy, other than what is in the, now at least somewhat outdated, “Surveillance, Monitoring and Assessment” chapter of the Water Quality Control Plan for the San Diego Basin (Basin Plan). In the past, however, the San Diego Water Board’s approach to monitoring and assessment focused largely on discharges. With this approach, much of the monitoring done by or required by the San Diego Water Board was devoted to determining whether discharges and cleanups necessitated by discharges were in compliance with regulatory requirements. Such monitoring and assessment consisted largely of measuring individual constituents in regulated discharges and in water bodies in close proximity to those discharges and then comparing those measurements with numeric limits to evaluate compliance with regulatory requirements. To some degree, this made sense, because (a) discharges have the potential to adversely affect the health of water bodies, (b) it is relatively easy to measure individual constituents and compare those measurements with numeric limits, and (c) most regulated discharges in the past were conventional point-source discharges. This discharge-oriented approach used in the past has largely continued to the present.

Currently a number of different monitoring and assessment programs are conducted by and for a number of different entities in San Diego Region waters. A few of these programs are conducted by the San Diego Water Board; many are conducted by others as required by the San Diego Water Board; and some are conducted by others independent of the San Diego Water Board. The level of effort devoted to monitoring and assessment required by the San Diego Water Board far exceeds the level of effort devoted to monitoring and assessment conducted by the San Diego Water Board. Although monitoring and assessment programs required by the San Diego Water Board generate substantial amounts of data, those programs are mostly discharge-oriented. Relatively little of the monitoring and assessment required by the San Diego Water Board is devoted to evaluating conditions in water bodies, other than in close proximity to regulated discharges or cleanup sites.

D. Shortcomings of Discharge-Oriented Monitoring and Assessment

The most fundamental shortcoming of a discharge-oriented approach to monitoring and assessment is that important basic information is not produced, including information about:

- Conditions in water bodies;
- The stressors causing unsatisfactory conditions and the sources of those stressors; and
- The effectiveness of management actions.

The lack of such information severely limits the ability of the San Diego Water Board to carry out its mission strategically and effectively.

There are also other shortcomings of a discharge-oriented approach. Since discharges can be highly variable in space and time, noncompliance might not be detected. Also, compliance of discharges with numeric regulatory limits does not ensure the chemical, biological or physical integrity of water bodies, because numeric regulatory limits might not be sufficiently protective, because significant effects might be caused by stressors for which limits have not been established, because significant effects might be caused by stressors from sources that are not regulated or not adequately regulated, and/or because significant effects might be caused by stressors from past sources that are no longer active.

V. New Approach: Water Body-Oriented Monitoring and Assessment

A. Overview

The San Diego Water Board has recognized that, in order to carry out its mission more strategically and more effectively, it needs to take a new approach to monitoring and assessment. Therefore, this document outlines a new systematic, logical, problem-solving approach that is water body-oriented rather than discharge-oriented. Since, as indicated above, the desired outcome of the PCA and CWA is about conditions in water bodies (e.g., the support of beneficial uses), meaningful and reliable information about conditions in water bodies is essential.

Monitoring and assessment programs should always be designed to answer specific questions (Figure 1). With a water body-oriented approach, the first and most basic questions have to do with the conditions in water bodies, such as questions reflecting fundamental concerns about beneficial uses, e.g.,

- Is water safe to drink?
- Are fish and shellfish safe to eat?
- Is water quality safe for swimming?
- Are habitats and ecosystems healthy?

Monitoring and assessment to answer these kinds of questions can be referred to as “conditions monitoring,” or “M1.” M1 needs to be conducted on an ongoing basis to determine whether and how conditions have changed, even in waters where unsatisfactory conditions have not previously been found.

If M1 indicates that conditions are unsatisfactory, the next question is:

- What are the primary stressors causing unsatisfactory conditions?

Monitoring and assessment to answer this question can be referred to as “stressor identification monitoring” or “M2.”

Once the primary stressors have been identified, the next question is:

- What are the major sources of the primary stressors?

Monitoring and assessment to answer this question can be referred to as “source identification monitoring” or “M3.”

Once the major sources have been identified, and management actions have been taken to address the primary stressors and the major sources, the next question is:

- Are management actions effective?

Monitoring and assessment to answer this question can be referred to as “performance monitoring” or “M4.”

These four phases of water body-oriented monitoring and assessment are shown in Figure 1 and described in more detail below.

B. Phases of Water Body-Oriented Monitoring and Assessment

1. Conditions Monitoring and Assessment (M1)

Conditions monitoring and assessment may consist of several different elements: (1) reference site monitoring and assessment, (2) probabilistic monitoring and assessment, and (3) targeted monitoring and assessment.

Monitoring and assessment of a network of reference sites (“minimally disturbed sites”) is necessary in order to provide information about conditions in the absence of or with a minimum of anthropogenic influence. Reference conditions provide a widely accepted mechanism for defining appropriate expectations and accounting for natural variability (Ode & Schiff 2009). Also, changes at reference sites can help distinguish between effects associated with climate change and those associated with other stressors.

In order to determine the conditions throughout a water body or watershed or across different water bodies of the same type, probabilistic monitoring and assessment is needed. In probabilistic monitoring and assessment, sampling locations are randomly selected and represent a proportion of the entire water body (or other defined area(s) of interest) with statistical confidence (Ode et al., 2011). With a probabilistic approach, conditions at sites that are not sampled can be estimated.

Since sampling locations for probabilistic monitoring and assessment are randomly selected, such monitoring and assessment does not generally provide adequate information about particular locations of special interest. Targeted monitoring and assessment may be needed to evaluate conditions at such locations.

The results of reference site monitoring and assessment, probabilistic monitoring and assessment, and targeted monitoring and assessment can and should be combined in an integrated assessment of conditions in water bodies (Stein & Bernstein 2008).

2. Stressor Identification Monitoring and Assessment (M2)

Stressor identification monitoring and assessment can be conducted simultaneously with M1 or after M1. Stressor identification monitoring and assessment diagnoses the causes of or the reasons for unsatisfactory conditions. There are several ways to approach stressor identification monitoring. For probabilistic conditions monitoring and assessment, several potential stressors (physical, chemical and/or biological) can be monitored simultaneously and then stressor-response models, stressor gradients, and/or risk analysis can evaluate causative stressors. Special studies may be needed in order to understand the direct, indirect, and/or cumulative effects of stressors and/or to obtain a better understanding of the relationships between stressors and responses. Where conditions monitoring and assessment is conducted at targeted sites, stressors causing toxicity can be identified through Toxicity Identification Evaluations and stressors causing impaired biological communities can be identified using Causal Analysis/Diagnosis Decision Information System (CADDIS).

3. Source Identification Monitoring and Assessment (M3)

Source identification monitoring and assessment can be conducted after M1 and M2 or simultaneously with M1 and M2. Source identification monitoring and assessment determines the major sources of the stressors found through stressor identification monitoring and assessment. Source identification monitoring and assessment can be conducted based on a probabilistic or a targeted monitoring design. Probabilistic monitoring and assessment can identify likely sources through Geographic Information System (GIS) modeling of land use, hydrologic modeling, and the modeling of the transport of stressors. At targeted sites, sources can be identified using techniques such as effluent monitoring or microbial source tracking.

4. Performance Monitoring and Assessment (M4)

After management actions are taken to address the primary stressors and the major sources, performance monitoring and assessment needs to be conducted to determine if the management actions taken are successful. Performance monitoring and assessment is usually conducted after M1, M2, and M3. Performance monitoring and assessment consists of two major components. The first component focuses on individual management actions (e.g. numeric effluent limits or improved management practices). Monitoring and assessment of individual management actions, which is intended to confirm that such actions are in fact being implemented, might include monitoring of discharges and evaluation of compliance. This component is relatively straightforward and can be started as soon as individual management actions have been taken.

The second component focuses on conditions in water bodies after management actions have been implemented. Changes in conditions in water bodies can take years or decades to occur, so this monitoring and assessment will likely need to be long-term; it is complicated by the variety of influences that can affect conditions in water bodies. This kind of performance monitoring and assessment is essentially the same as conditions monitoring and assessment. In other words, performance monitoring (M4) connects back to conditions monitoring (M1) (Figure 1).

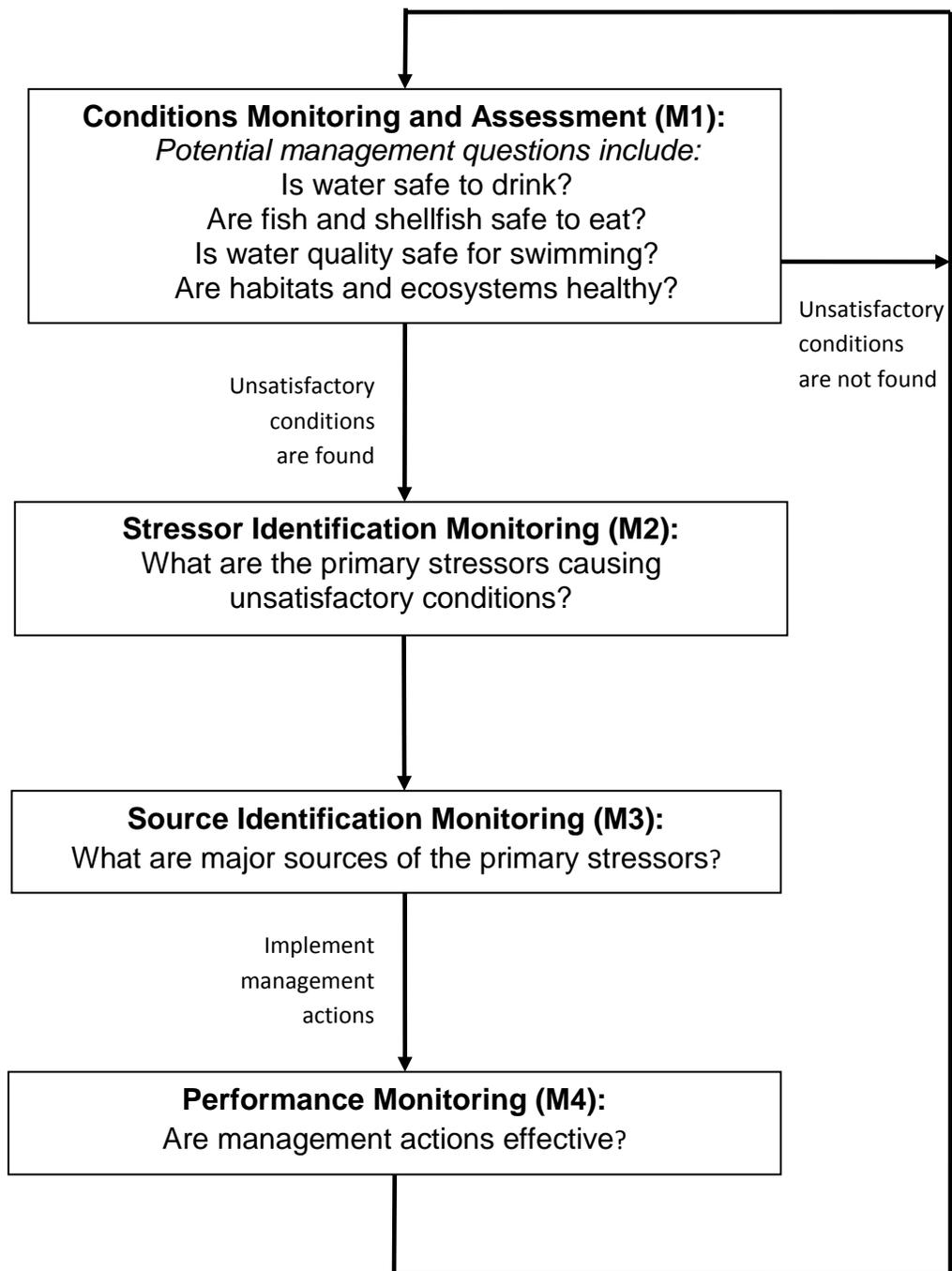


Figure 1: Water Body-Oriented Monitoring and Assessment

VI. Implementation of Water Body-Oriented Monitoring and Assessment

A. Overview

All monitoring and assessment conducted by the San Diego Water Board – as well as all monitoring and assessment required by the San Diego Water Board – should be water body-oriented. The San Diego Water Board is planning to use its staff and funding resources to support development, implementation, management, and oversight of water body-oriented monitoring and assessment programs. Nevertheless, additional resources will be needed. Entities whose activities or facilities could adversely affect conditions in water bodies should be primarily responsible for providing the resources needed for water body-oriented monitoring and assessment programs.

Water body-oriented monitoring and assessment is already being implemented to some degree in the San Diego Region, especially in monitoring and assessment programs conducted by the San Diego Water Board. As discussed previously, however, the level of effort devoted to monitoring and assessment conducted by the San Diego Water Board is far less than that devoted to monitoring and assessment required by the San Diego Water Board. Therefore, converting monitoring and assessment required by the San Diego Water Board from discharge-oriented to water body-oriented will be critical to implementing the new approach to monitoring and assessment.

The collaborative ten-step process outlined below, or portions of it, has been used to develop, and, in several cases, implement a number of exemplary monitoring and assessment programs in California, some of which include the San Diego Region and involve the San Diego Water Board. Successful programs in California include the San Francisco Bay Regional Monitoring Program (SFBRMP), the Southern California Bight Regional Monitoring Program, the San Gabriel River Watershed Regional Monitoring Program, the Los Angeles River Watershed Regional Monitoring Program, and the Stormwater Monitoring Coalition Regional Bioassessment Monitoring Program (SMC 2007). These programs and the process used in their development and implementation provide useful models for the San Diego Water Board and stakeholders to use in their efforts to improve monitoring and assessment in the San Diego Region. The SFBRMP, which was developed and implemented in response to a PCA section 13267 directive issued by the San Francisco Bay Regional Water Quality Control Board in 1992 (see Appendix), is particularly notable because of its origins, funding, institutional arrangements, organizational structure, and communication of results, among other features.

A climate of cooperation and a commitment to participation has been instrumental to the success of these exemplary programs. It will also be essential in order for this collaborative ten-step process to be successful in improving monitoring and assessment in the San Diego Region.

B. Collaborative Ten-Step Process

1. Collaboration

Collaboration is necessary to ensure that development and implementation of monitoring and assessment programs is informed by a broad range of experience, expertise, and perspectives. Collaboration also helps to build support and buy-in for the monitoring and assessment programs that are ultimately developed and implemented.

The San Diego Water Board is committed to providing leadership and working actively and collaboratively with other parties to develop and implement water body-oriented monitoring and assessment programs, as outlined in the ten-step process described below. At the same time, by virtue of its statutory responsibilities, the San Diego Water Board will maintain active oversight of development, implementation, and management of monitoring and assessment programs.

The San Diego Water Board has been part of several successful collaborative efforts in the past, including the Southern California *Caulerpa* Action Team (eradication of the invasive non-native alga *Caulerpa taxifolia* in Agua Hedionda Lagoon) and the Tijuana River Valley Recovery Team (development of a recovery plan for the Tijuana River Valley). The San Diego Water Board also initiated the San Diego River watershed monitoring coordination project, an ongoing collaborative effort to better coordinate and improve monitoring in the San Diego River watershed (Bernstein et al. 2012).

2. The Ten-Step Process

In order to successfully make the transition from discharge-oriented monitoring and assessment to water body-oriented monitoring and assessment, a ten-step process for developing and implementing monitoring and assessment programs should be followed (Figure 2). The purpose of this process is to collaboratively develop and implement useful water body-oriented monitoring and assessment programs that are question-driven and scientifically and statistically sound. Several different monitoring and assessment programs will need to be developed and implemented, e.g. for different types of water bodies and/or for different categories of beneficial uses.

These ten steps are described in more detail below.

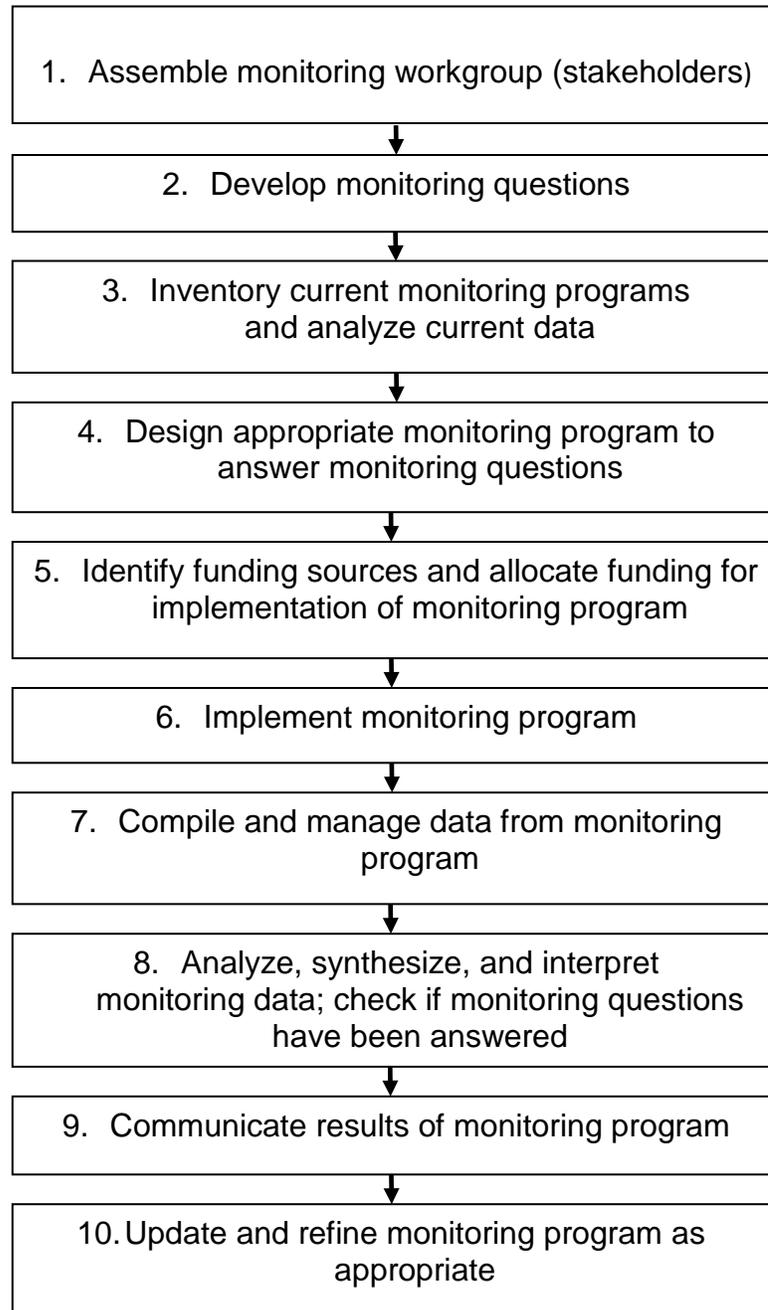


Figure 2: The Ten-Step Process

Step 1: Assemble monitoring workgroup (stakeholders)

To develop and implement technically sound monitoring and assessment programs that are widely accepted and supported, a workgroup of stakeholders should be convened for each monitoring and assessment program. Each workgroup should collectively share the responsibility of developing and implementing a water body-oriented monitoring and assessment program for the type of water body and beneficial use category(ies) of interest. Each workgroup should determine the direction of its monitoring and assessment program and decide how data should be analyzed, synthesized, and interpreted.

Each workgroup should include representatives of entities whose activities or facilities could adversely affect conditions in water bodies. Many of these entities are subject to regulation, including “major” National Pollutant Discharge Elimination System (NPDES) dischargers, Municipal Separate Storm Sewer System (MS4) dischargers, and agricultural dischargers, among others. Each workgroup should also include other parties that beneficially use or have interests in and/or responsibilities for beneficial uses of waters in the San Diego Region, such as water supply agencies, public health agencies, fish and wildlife agencies, non-governmental organizations, citizen monitoring groups, and others. Other groups and individuals with expertise in monitoring and assessment would also be very helpful additions to workgroups. San Diego Water Board staff should be part of each workgroup.

Step 2: Develop monitoring questions

As indicated in the SWAMP Assessment Framework of the SWAMP strategy (SWAMP 2010), clearly stated monitoring and assessment questions are essential prerequisites for effective monitoring and assessment programs. There are several different levels of questions, and each workgroup will need to decide which level of questions needs to be developed. The monitoring and assessment questions should be based on the management questions that are most important for purposes of making management decisions.

Since resources for monitoring and assessment are always limited, it will be important for the workgroups to consider the relative importance and usefulness of different information so that monitoring and assessment programs can be designed to produce the information that is most important and most useful (see Step 4) and so that resources can be allocated to monitoring and assessment that produces the information that is most important and most useful (see Step 5).

Step 3: Inventory current monitoring programs and analyze current data

Before designing a program to answer the questions identified in Step 2, an inventory of current monitoring and assessment programs should be conducted and data from these monitoring programs should be analyzed. Analysis of these data could show whether some of the questions identified in Step 2 have already been answered, and if so, whether the answers led to successful management actions. If the previous programs did not state monitoring and assessment questions and/or were unable to answer questions, then the lessons learned may help in the design of a new monitoring and assessment program. The inventory of programs and analysis of data will be facilitated by the use of new tools like the California Environmental Data Exchange Network (CEDEN), the My Water Quality Portal of the State Water Resources Control Board, and the San Diego Regional Water Quality Data Portal.

Step 4: Design appropriate monitoring program to answer monitoring questions

Once the questions have been developed and the inventory of current programs and analysis of existing data has been completed, the next step is to design a program to answer the monitoring questions. Monitoring and assessment program designs must ensure that sufficient data is produced to answer the monitoring questions with an adequate degree of statistical certainty. The monitoring design must be technically sound and appropriate indicators will need to be chosen. Over the past few years, several field and lab methods and indicators have been developed for California; these will help facilitate the design of the monitoring and assessment programs.

An important element of monitoring program design is quality assurance, i.e., an integrated system of management activities that focuses on providing confidence in monitoring and assessment data and products by ensuring that they are of the type and quality needed and expected. Quality assurance guidance and assistance is available from SWAMP.

Step 5: Identify funding sources and allocate funding for implementation of monitoring program

Once an appropriate monitoring and assessment program is designed to answer the monitoring questions, the next step is to identify funding sources and allocate funding for implementation of the program. Stable funding will be one of the key factors for development, implementation, management, and oversight of water body-oriented monitoring and assessment programs.

As indicated previously, the San Diego Water Board is planning to use its staff and funding resources to support development, implementation, management, and oversight of water body-oriented monitoring and assessment programs, but additional resources will be needed. Entities whose activities or facilities could adversely affect conditions in water bodies should be primarily responsible for providing the resources needed for water body-oriented monitoring and assessment programs.

To facilitate implementation of water body-oriented monitoring and assessment programs, the San Diego Water Board plans to discontinue, reduce, or modify existing monitoring requirements so that the corresponding level of effort can be redirected to the new programs. Stakeholders will be asked to provide recommendations for such changes.

As indicated under Step 2, resources for monitoring and assessment are always limited. As a practical matter, this means that decisions will need to be made in order to match the level of monitoring and assessment effort to the resources available. Nevertheless, the question of what monitoring and assessment is worthwhile should precede the question of what monitoring and assessment can be done with the resources available. Each workgroup will need to develop criteria and a process for deciding what to do if available resources are not sufficient to do all the monitoring and assessment that is deemed worthwhile.

Step 6: Implement monitoring program

Once funding is allocated, the program can be implemented as planned.

Step 7: Compile and manage data from monitoring program

As sampling is done, the data produced will need to be compiled and managed in a way that provides easy access to data by all stakeholders and the public. Several tools (CEDEN, San Diego Water Quality Data Portal, and GeoTracker GAMA [Groundwater Ambient Monitoring and Assessment Program]) have already been developed to simplify compilation and management of the data.

Step 8: Analyze, synthesize, and interpret monitoring data; check if monitoring questions have been answered

The purpose of this step is to assess the monitoring data. Once all the data from any given phase or cycle of a monitoring and assessment program are collected, the data will need to be analyzed, synthesized, and interpreted by the monitoring workgroup in a manner that is scientifically and statistically sound. Once this is done, it will be important to check if the stated questions have been answered.

Step 9: Communicate results of monitoring program

As indicated previously, monitoring and assessment programs are useless if the results are not communicated effectively to appropriate audiences. There are a number of ways to communicate results to the public, stakeholders, and decision-makers; different ways may be appropriate for different audiences. It is important for summaries of results to be both technically sound and easily understood. In some cases it may be important to provide contextual and other supplemental information to help facilitate understanding.

As a step towards producing easily understood summaries of monitoring and assessment results, development of a watershed report card has been initiated as part of the San Diego River watershed monitoring coordination project (Bernstein et al., 2012).

Step 10: Update and refine monitoring program as appropriate

In some cases, if questions have been adequately answered, one phase or cycle of a monitoring and assessment program or the entire program can be concluded. In some cases, new questions will need to be answered and a new program will need to be developed to answer those questions. In many cases, water body-oriented monitoring and assessment programs will need to be conducted on an ongoing basis. For example, there will be an ongoing need for monitoring and assessment programs to answer basic questions about conditions in water bodies (conditions monitoring and assessment, M1). That does not mean, however, that such programs must or should continue without changes. For example, if it is found that the questions were not answered (see Step 8), then the monitoring and assessment program will need to be refined so that the questions can be answered. Also, as new and improved monitoring and assessment tools are developed, it is important that they be folded into monitoring and assessment programs. In some cases these newer tools will augment older ones; in some cases they may replace them.

Periodic review by independent outside experts should be part of this step, especially for ongoing, long term monitoring and assessment programs.

C. Available Tools, Infrastructure and Resources for Implementation

1. Available Tools and Infrastructure for Implementation

As suggested in the preceding section, at least some of the tools and infrastructure needed for implementation of water body-oriented monitoring and assessment in the San Diego Region are already in place. Some of the tools and infrastructure were not available until fairly recently.

Several new standard operating procedures (SOPs) for field and laboratory methods have been developed over the past few years. In addition, several indicators to measure biological integrity (based on benthic macroinvertebrates and algae) and physical habitat integrity have been developed. Also, functional assessments like the California Rapid Assessment Method (CRAM) have been advanced. Strong quality assurance and quality control tools such as those established by the SWAMP Quality Assurance Team can now be applied to monitoring and assessment programs. Also, existing infrastructure is available for database management (CEDEN, GeoTracker GAMA, and San Diego Regional Water Quality Data Portal) and the dissemination of data (My Water Quality Portal and GeoTracker GAMA).

2. Resources for Implementation

The San Diego Water Board has the ability to control or influence how various financial resources are used for monitoring and assessment. These can be categorized as:

- Financial resources of the San Diego Water Board;
- Financial resources of regulated entities; and
- Financial resources of other entities.

These categories are briefly discussed below.

Financial Resources of the San Diego Water Board

The only allocation in the San Diego Water Board budget specifically designated for staff work on monitoring and assessment is approximately 80 percent of a full time staff position per year. The San Diego Water Board also uses contract funding to conduct and support monitoring and assessment. The primary source of such funding is SWAMP of the State and Regional Water Boards. This funding comes from the State Water Board budget and is paid for with Waste Discharge Permit Fees. Each Regional Water Board has received an annual allocation from SWAMP since 2000. The San Diego Water Board allocation has been between \$200,000/year and \$300,000/year. The San Diego Water Board uses SWAMP funding to support monitoring and assessment of conditions in San Diego Region water bodies. The San Diego Water Board also has used funds from the U.S.EPA to perform and contract monitoring and assessment activities. These funds are used to support assessment of surface waters and development of total maximum daily loads or other approaches to addressing impaired water bodies.

The San Diego Water Board also has financial resources for a laboratory contract that is used to conduct and support monitoring and assessment. Generally staff will collect data and contract for laboratory analysis of the samples. Over the last several years, the funding provided for the laboratory contract has varied substantially. The current contract has funding of \$25,000 per year. The San Diego Water Board uses this contract funding for small projects for compliance evaluation, emergency monitoring during spills, and/or water body condition assessments.

Finally, the San Diego Water Board has influence over how certain funds of the State Water Board are spent, including financial assistance (grants and loans), supplemental environmental projects in civil liability cases, and use of the State Water Pollution Cleanup and Abatement Account.

Financial Resources of Regulated Entities

The San Diego Water Board requires a number of entities to conduct or participate in monitoring and assessment. The San Diego Water Board generally specifies the monitoring and assessment to be done, but not the amount to be spent on monitoring and assessment. The total amount spent on monitoring and assessment required by the San Diego Water Board is estimated to be several million dollars per year. The level of effort devoted to monitoring and assessment required by the San Diego Water Board far exceeds the level of effort devoted to monitoring and assessment conducted by the San Diego Water Board.

Financial Resources of Other Entities

Other entities, such as governmental organizations with responsibilities for public health or natural resources, academic and other research institutions, and non-governmental organizations, also devote financial resources to monitoring and assessment of water bodies in the San Diego Region. Such organizations are among the stakeholders included in the collaborative ten-step process shown in Figure 2. The San Diego Water Board does not regulate these organizations, so it cannot control how these financial resources are used, but it may be able to influence how they are used. In any case, monitoring and assessment conducted and funded by these organizations may be useful to the San Diego Water Board.

Although their financial resources are usually quite limited, citizen monitoring groups can make significant contributions to water body-oriented monitoring and assessment with the help of community volunteers. The State Water Board's Clean Water Team provides assistance to such groups.

Future Allocations of Financial Resources

The monitoring and assessment that the San Diego Water Board requires other entities to conduct or participate in is critical to making the transition to water-body oriented monitoring and assessment. There are two reasons for this. First, the financial resources devoted to such monitoring and assessment is much greater than the financial resources the San Diego Water Board has available for monitoring and assessment. Second, much of the monitoring and assessment the San Diego Water Board requires other entities to conduct is not currently water body-oriented. Consequently, in many cases there is considerable room for improvement in such monitoring and assessment.

The level of effort (i.e., financial resources) needed to conduct or participate in monitoring and assessment required by the San Diego Water Board differs substantially from entity to entity. The level of effort may be appropriate and equitable in some cases, but not in others. Monitoring and assessment required by the San Diego Water Board may be "too much," "too little," or "just right" for different entities. Although it is reasonable to expect the San Diego Water Board to establish monitoring and assessment requirements that are appropriate and equitable (i.e., "just right") for all entities, there is currently no formula for determining what is appropriate and equitable.

Where the required monitoring and assessment is “just right,” it should be possible to transition to water body-oriented monitoring and assessment simply by reallocating resources from monitoring and assessment that is less important and less useful to that which is more important and more useful. Where required monitoring and assessment is “too much,” both reallocation of resources and an overall reduction in required monitoring and assessment should occur. Where required monitoring and assessment is “too little,” both reallocation of resources and an overall increase in required monitoring and assessment should occur. Although such adjustments and reallocations are straightforward in concept, they are likely to be difficult to implement in practice.

To improve the way that the financial resources of regulated entities are used for monitoring and assessment, the San Diego Water Board will need to commit more of its own staff resources to monitoring and assessment than it has in the past. It is planned that seven staff positions of the San Diego Water Board will be devoted primarily to monitoring and assessment work. These include five staff positions in the Monitoring, Assessment, and Research Unit (MARU) and two senior specialist positions. Only one position, currently partly funded by SWAMP, is budgeted specifically for monitoring and assessment. Funding for the other positions is drawn from a broad swath of programs administered by the San Diego Water Board. Monitoring and assessment work is implicitly part of or related to much of the San Diego Water Board’s work to carry out its mission, so staff resources that can reasonably be used for monitoring and assessment work are not limited to those that the budget specifically designates for such work. Programs of the San Diego Water Board that could reasonably contribute to funding the seven positions may include but are not limited to the following:

- National Pollution Discharge Elimination System (NPDES)
- Waste Discharge Requirements (WDR)
- Clean Water Act section 401 Water Quality Certification
- Total Maximum Daily Load (TMDL)
- Cleanup and Remediation
- Nonpoint Source
- Water Quality Assessment (Clean Water Act sections 303d and 305b).

VII. Short-Term and Long-Term Milestones for Implementation of Water Body-Oriented Monitoring and Assessment

A. Short-Term Implementation Milestones: One to Five Years

Implementation milestones over the short term, the next one to five years, are to:

- a) Start the collaborative ten-step process to develop water body-oriented monitoring and assessment programs for selected types of water bodies and selected categories of beneficial uses;
- b) Begin implementation of newly developed programs;
- c) Communicate the preliminary results of those programs as they are produced; and
- d) Develop and implement performance monitoring and assessment programs (M4) as management actions are implemented.

B. Long-Term Implementation Milestones: Five to Twenty Years

Implementation milestones over a longer five to twenty year timeframe are to:

- a) Complete development and implementation of water body-oriented monitoring and assessment programs;
- b) Regularly and frequently communicate the results from all such programs on an ongoing basis, including the results of performance monitoring and assessment (M4);
- c) Have the programs reviewed periodically by independent outside experts;
- d) Periodically update and refine the programs, as appropriate; and
- e) Periodically review and refine the approach to monitoring and assessment, as appropriate.

As indicated previously, changes in conditions in water bodies can take years or decades to occur, so ongoing, long-term monitoring and assessment will be needed to evaluate changes and trends.

VIII. References

Publications and Technical Reports

Bernstein et al. 2012: San Diego River Watershed Monitoring Program. SWAMP draft report.

Ode, P. and Schiff, K. 2009: Recommendations for the development and maintenance of a reference condition management program (RCMP) to support biological assessment of California's wadeable streams. SWAMP Technical Report.

Ode, P.R., Kincaid, T.M., Fleming, T., and Rehn, A.C. 2011: Ecological Condition Assessments of California's Perennial Wadeable Streams: Highlights from the Surface Water Ambient Monitoring Program's Perennial Streams Assessment (PSA) (2000-2007). SWAMP Technical Report.

NWQMC (National Water Quality Monitoring Council) 2011: A Framework for Water Quality Monitoring.

SWRCB (State Water Resources Control Board) 2008: Strategic Plan Update, 2008-2002.

SMC (Stormwater Monitoring Coalition Bioassessment Working Group) 2007: Regional Monitoring of southern California's coastal watersheds. Southern California Coastal Water Research Project, Technical Report 539.

Stein & Bernstein 2008: Integrating probabilistic and targeted compliance monitoring for comprehensive watershed assessment. Environ. Monit. Assess. 144, 117-129.

SWAMP (Surface Water Ambient Monitoring Program) 2010: 2010 Update of the Comprehensive Monitoring and Assessment Strategy to Protect and Restore California's Water Quality. SWAMP Planning Document.

Important Websites:

Frameworks:

- National Water Quality Monitoring Council:
<http://acwi.gov/monitoring/>
- Surface Water Ambient Monitoring Program (SWAMP) Planning Documents:
http://waterboards.ca.gov/water_issues/programs/swamp/reports.shtml#plan_docs

Monitoring Programs:

- San Gabriel River Watershed Regional Monitoring Program and Los Angeles River Watershed Regional Monitoring Program:
<http://watershedhealth.org/programsandprojects/watershedmonitoring.aspx>
- Southern California Bight Regional Monitoring Program:
<http://www.sccwrp.org/ResearchAreas/RegionalMonitoring/BightRegionalMonitoring.aspx>
- San Francisco Bay Regional Monitoring Program:
<http://sfei.org/rmp>
- Groundwater Ambient Monitoring and Assessment Program (GAMA):
http://www.waterboards.ca.gov/water_issues/programs/gama/

Tools:

- Causal Analysis/Diagnosis Decision Information System (CADDIS):
<http://www.epa.gov/caddis/>
- Surface Water Ambient Monitoring Program (SWAMP) Standard Operating Procedures (SOPs):
<http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/standard-operating-procedures>
- Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance (QA) information:
<http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/quality-assurance>
- California Environmental Data Exchange Network (CEDEN):
<http://ceden.org/>
- My Water Quality Portal:
<http://waterboards.ca.gov/mywaterquality>
- San Diego Regional Water Quality Data Portal:
<http://www.ca-watersheds.org/reg9-public/>
- California Rapid Assessment Method (CRAM): <http://www.cramwetlands.org>
- GeoTracker GAMA:
http://www.waterboards.ca.gov/water_issues/programs/gama/geotracker_gama.shtml
- Clean Water Team (citizen monitoring assistance):
http://www.waterboards.ca.gov/water_issues/programs/swamp/cwt_volunteer.shtml

IX. Glossary

- **Assessment:** The conversion of monitoring data into information relevant to identified management issues.
- **Conditions:** Chemical, physical, biological, and/or microbiological characteristics of water, sediment, organisms, populations, biological communities, ecosystems, and/or habitats as they relate to beneficial uses of water bodies.
- **Monitoring:** Periodic collection of data.
- **Monitoring Questions:** Management issues formulated as questions that can be answered by analysis of data derived from measurement of environmental variables.
- **Reference Site:** A specific locality on a water body that is undisturbed or minimally disturbed, and is representative of the expected undisturbed or minimally disturbed conditions at other localities on the same water body or similar nearby water bodies.
- **Special Studies:** Data collection and analysis undertaken for a narrowly defined purpose. Special studies are often intended to produce information to enable better understanding and interpretation of monitoring data.
- **Stressor:** Pollutants and other influences with the capacity to have adverse effects on beneficial uses. Stressors can be of natural origin (e.g., nutrients) or of anthropogenic origin (e.g., DDT). The concentrations, levels or magnitudes of stressors of natural origin (e.g., nutrients) are sometimes modified as a result of anthropogenic actions (e.g., runoff from fertilized land might cause an estuary to have unnaturally elevated levels of nutrients). Stressors are not limited to chemical substances; they may also be biological (e.g., invasive non-native species) or physical (e.g. Modified hydrological regimes or changes in physical habitat).
- **SWAMP:** Surface Water Ambient Monitoring Program of the State and Regional Water Boards
- **Unsatisfactory conditions:** Conditions that are impaired, degraded, impacted, detrimental, adverse, or otherwise poor, unfavorable, undesirable, unacceptable, or unhealthy, and/or that do not meet water quality standards.

X. Appendix

San Francisco Bay Water Board PCA section 13267 letter, 1992

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
2101 WEBSTER STREET, SUITE 300
OAKLAND, CA 94612
(510) 464-1233



12 June 1992

TO: Attached Mailing List

SUBJECT: Implementation of a Regional Monitoring Program for the San Francisco Estuary.

On April 15, 1992, the San Francisco Bay Regional Board adopted Resolution 92-043 directing the Executive Officer to implement the Regional Monitoring Plan for San Francisco Bay. The Regional Monitoring Plan is designed to collect information on the concentrations of pollutants in water, sediment and biota from throughout the estuary. The RMP will allow the Regional Board to evaluate the effectiveness of its water quality control program.

This letter is a formal request under Section 13267 of the California Water Code that your agency participate in the implementation of the baseline portion of the RMP. It is imperative that the implementation be as a collective rather than individual monitoring. A reply by July 7, 1992 on your intention to implement the RMP is requested. Failure to comply could result in an enforcement action under Section 13268 of the California Water Code. I intend to inform the Regional Board at the July 15, 1992 monthly meeting on the progress of implementing the RMP.

There are several operating principles I will be following in implementing the RMP. First, portions of the RMP will be phased in over time and thus costs may increased in future years. Second, there will be linkage to existing or proposed programs by other agencies to eliminate duplication and thereby keep costs reasonable. Third, the RMP in future years will be examining cause and effect relationship which dictates that a certain portion of future efforts be categorized as research. Finally, the program must be accountable and credible to the regulatory agencies, sponsoring agencies and the public. Therefore, we will continue to provide a strong leadership and technical role in the implementation of the RMP.

In addition, Resolution 92-043 provides that certain routine monitoring of effluents and ambient waters contained in NPDES permits could be reduced or suspended. Examples of effluent monitoring reductions are daily BOD or total suspended solids

ammonia, and oil/grease. Examples of ambient monitoring parameters that could be suspended are dissolved oxygen, ammonia, pH, conductivity (or salinity), temperature, and coliforms. All reductions or suspensions will be considered on a case-by case basis. There will be no reduction or suspension in toxicity monitoring. There will be consideration in reducing the frequency of toxic pollutant monitoring based on past monitoring results. Proposals for reductions or suspensions should be made directly to your contact in the Surface Water Management Division subsequent to the July 7 response deadline.

Regional Board staff and I have had numerous meetings with 28 dischargers (13 POTWs, 12 Industrial, Santa Clara and Alameda urban runoff programs, and the U.S. Army Corps of Engineers) regarding this action. I believe that all POTWs should be included at this time, at least at a minimal level. Exact cost participation will be decided soon for the 1992-1993 fiscal year. In the 1993-1994 fiscal year, additional urban runoff and small industrial dischargers will be included.

If you have any questions regarding this request please contact me at (510)464-0516 or Michael P. Carlin at (510)464-1325 of my staff.

Sincerely,



STEVEN R. RITCHIE
Executive Officer

Attachments: Resolution 92-043
Mailing List