

**Maximizing the
Efficiency and Effectiveness of
Water Quality Data
Collection and Dissemination
and Ensuring that Collected Data are Maintained
and Available for Use by Decision-makers and the Public**

Recommendations of the
**California Water Quality
Monitoring Council**

submitted to

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and

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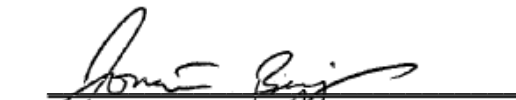
State of California

December 1, 2008

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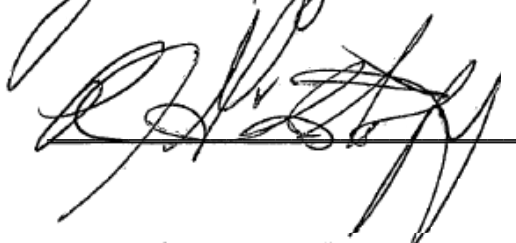
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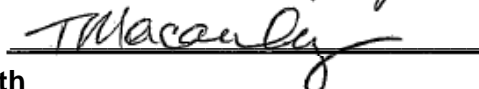
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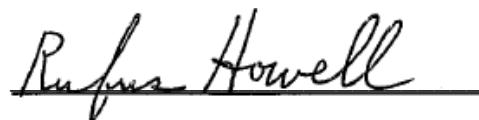
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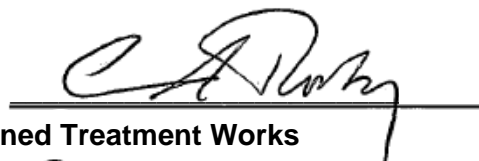
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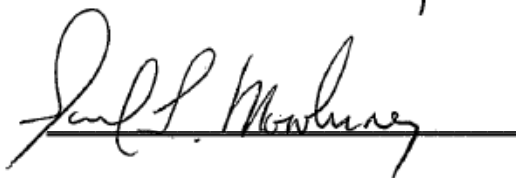
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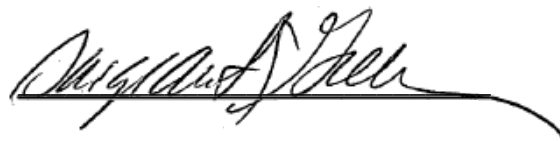


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Executive Summary

The California Water Quality Monitoring Council (Monitoring Council) urges the Secretaries of the California Environmental Protection Agency (Cal/EPA) and the Resources Agency to accept the recommendations contained in this report. The Monitoring Council's vision to maximize the efficiency and effectiveness of water quality and related ecosystem monitoring, assessment, and reporting includes the following key components:

1. A system of web-based, user-oriented, data access portals to California's water quality monitoring and assessment information developed and implemented by a series of decentralized, issue-specific workgroups operating under the Monitoring Council's overall guidance and approval
2. Web portals organized around themes that are framed as easily understood questions that deliver data to those people who need it in ways that directly meet their highest-priority needs
3. A website created to provide a single, coordinated, global point of entry to water quality data, assessment results, and supporting information and that provides a design template for the theme-based web portals
4. Monitoring and assessment information managed through distributed, but federated, systems of databases and data centers linked through data exchange networks to centralized web portal access points
5. Theme-based workgroups to develop and enhance the portals and their underlying monitoring and assessment programs according to performance measures identified by the Monitoring Council
6. Monitoring, assessment, and data management methods standardized to increase comparability within and between data types, and tools developed to improve data integration, in ways that achieve an appropriate balance between statewide consistency and regional flexibility
7. Cooperative relationships between the Monitoring Council, the theme-based workgroups, and regional and local monitoring programs through the exchange of training, support and tools in return for enhanced development and access to monitoring data that can be used for baseline and broad-scale assessments
8. Long-term-sustainable funding to support the above ongoing efforts

The Monitoring Council also respectfully requests that the Secretaries of Cal/EPA and the Resources Agency

- Endorse the Monitoring Council's vision and empower the Monitoring Council to guide its development and the comprehensive integrated water quality monitoring program strategy outlined in Senate Bill 1070 (Kehoe, 2006)
- Direct the boards, conservancies, commissions, departments, and offices within Cal/EPA and the Resources Agency to support and participate in the efforts of the Monitoring Council and the theme-based workgroups to implement the above vision
- Seek sufficient resources to ensure this effort's long-term sustainability, beyond the existing funding provided by the State Water Resources Control Board

Recommendations of the Water Quality Monitoring Council

On an annual basis, beginning in December 2009, the Monitoring Council will report back to the agency secretaries on progress made in implementing the Council's vision, and in a manner that supports Cal/EPA's conduct of a triennial audit of the effectiveness of the comprehensive monitoring program strategy, as called for in the legislation. The first of these annual reports will contain the Monitoring Council's recommendations for the development of the comprehensive monitoring program strategy.

Foreword

Senate Bill 1070 (Kehoe, 2006) amended Water Code Section 13181(b) to require that the California Environmental Protection Agency (Cal/EPA) and the Resources Agency enter into a Memorandum of Understanding establishing the California Water Quality Monitoring Council (Monitoring Council), to be administered by the State Water Resources Control Board. The MOU was signed November 26, 2007. SB 1070 requires that “the monitoring council shall review existing water quality monitoring, assessment, and reporting efforts, and shall recommend specific actions and funding needs necessary to coordinate and enhance those efforts.” The legislation goes on to say, “[t]he recommendations shall be prepared for the ultimate development of a cost-effective, coordinated, integrated, and comprehensive statewide network for collecting and disseminating water quality information and ongoing assessments of the health of the state’s waters and the effectiveness of programs to protect and improve the quality of those waters.” The first Monitoring Council task, as outlined in the legislation, is to report by December 1, 2008 to Cal/EPA and the Resources Agency its recommendations for maximizing the efficiency and effectiveness of existing water quality data collection and dissemination, and for ensuring that collected data are maintained and available for use by decision-makers and the public. This report fulfills this initial Monitoring Council responsibility.

Past improvement efforts have focused mainly on methods consistency, standardizing data formats, developing large databases, and other technical issues. While a focus on such technical details is necessary, the Monitoring Council believes that the best way to coordinate and enhance California’s monitoring, assessment and reporting efforts is first to provide a platform for simplified, streamlined access to water quality information that directly addresses users’ questions. This will require that data be gathered and organized in ways that can best answer these questions. The Monitoring Council recommends that issue-specific workgroups, under the overarching guidance of the Monitoring Council, evaluate existing monitoring, assessment and reporting efforts and work to enhance those efforts to improve the delivery of water quality information to the user. This will provide the structure and incentive to coordinate disparate monitoring programs, improve the technical infrastructure needed to support that coordination, and will act to reduce conflicts and incompatibilities within the technical infrastructure as it continues to develop. The appendices of this report provide a preliminary survey of existing water quality monitoring, assessment and reporting efforts, evaluate the success of those efforts to deliver water quality information in ways that directly support users’ needs, and provide a preliminary roadmap toward improvement.

Chapter 1: California's Water Quality Information Problem

Water is California's most precious resource. It provides an essential lifeline that links agriculture, industry, the environment, and urban and rural interests throughout the state. With a growing population of more than 38 million, a limited supply of fresh water, and a range of impacts on both terrestrial and marine habitats and resources, the protection of water for beneficial uses is of paramount concern for all Californians. This concern is reflected in the numerous monitoring and assessment programs that track the condition of waters and related aquatic resources throughout the state. Conducted by a wide array of local, regional, state, and federal entities, these programs produce a wealth of data and information products that are vital to the public, managers, and scientists involved in water quality issues.

1.1 Water quality data are hard to find and use

Despite the volumes of data produced, the efforts of technical staff in many agencies, and the large amount of funds expended on monitoring, the state's system for providing ready access to these data is defective. Managers, scientists, and the public experience a common set of problems when trying to find, access, and use monitoring data and assessment results, including:

- The lack of user-friendly means of finding, accessing, viewing, obtaining, and working with monitoring data and assessment information
- Inconsistency in monitoring objectives and in the methods used to collect and assess data
- Inability to integrate data from different studies due to inconsistencies in the way they are formatted and stored in database systems
- Data gaps resulting from a mismatch between the data collected and the management questions that must be answered

As a result of these problems, the state cannot answer many of the most fundamental water quality questions, such as "Is the quality of the state's waters getting better?" Data from different studies cannot be integrated to produce more comprehensive assessments of condition or to create maps across wider areas. Users cannot search, select, and download subsets of data for more targeted studies. Relatively simple questions regarding the health of California's waters can be difficult to answer. In many cases, the large number of programs, databases, and datasets makes finding specific data types or reports a daunting task. As one example of the limitations the current system creates, Figure 1 presents a statewide picture of impaired water bodies, based on combining 303(d) listing assessment results from each of the nine Regional Water Quality Control Boards. Differences in methodology between Regional Water Boards result in dramatically different estimates of the extent of impairment, even when the underlying data are relatively similar. Such differences in assessment methods are often poorly documented, complicating the task of intelligently combining data from different studies, not just at the statewide scale, but at local and regional scales as well.

The problems outlined above are not unique either to California or to water quality data in particular. They are inevitable wherever data from multiple sources, collected for different purposes and with a variety of methods, must be found, accessed, and integrated to create broader assessments or to address complex problems.

1.2 Don't get lost in the details

Solutions to data access and integration problems often focus on technical issues such as consistency of methods, standardization of data formats, and development of large databases. These bottom-up approaches are more successful where the number of data types and/or participants is limited, a foundation of relevant technical standards already exists, or the consequences of failed integration are severe. Without these prerequisites, a primary emphasis on technical standardization can become a quagmire, undermined by a concentration on lower-level details that are not necessarily directly connected with users' needs. Such efforts thus run the risk of creating yet another layer of incompatibility (e.g., among competing database systems) without necessarily improving access to data and information products. While a focus on the technical details is necessary, it is insufficient alone to solve data access and integration problems.

1.3 The Monitoring Council's solution

The Monitoring Council believes that, while important, a primary focus on technical tools does not directly address the source of the access problem because it is not driven by end users' perspectives. The Monitoring Council's solution to the data access problem therefore is centered on delivering data to those people who need it in ways that directly address their key questions about water quality. The essential components of this concept include a template for web-driven, user-oriented data access portals that are developed and implemented by a series of issue-specific workgroups operating under the Monitoring Council's overall guidance and approval.

This process will promote efficiency by highlighting where (and only where) improved standardization of monitoring methods and data management approaches is necessary for meeting users' needs. Developing these standardized methods and approaches will be the responsibility of the issue-specific workgroups, working within general guidelines set by the Monitoring Council.

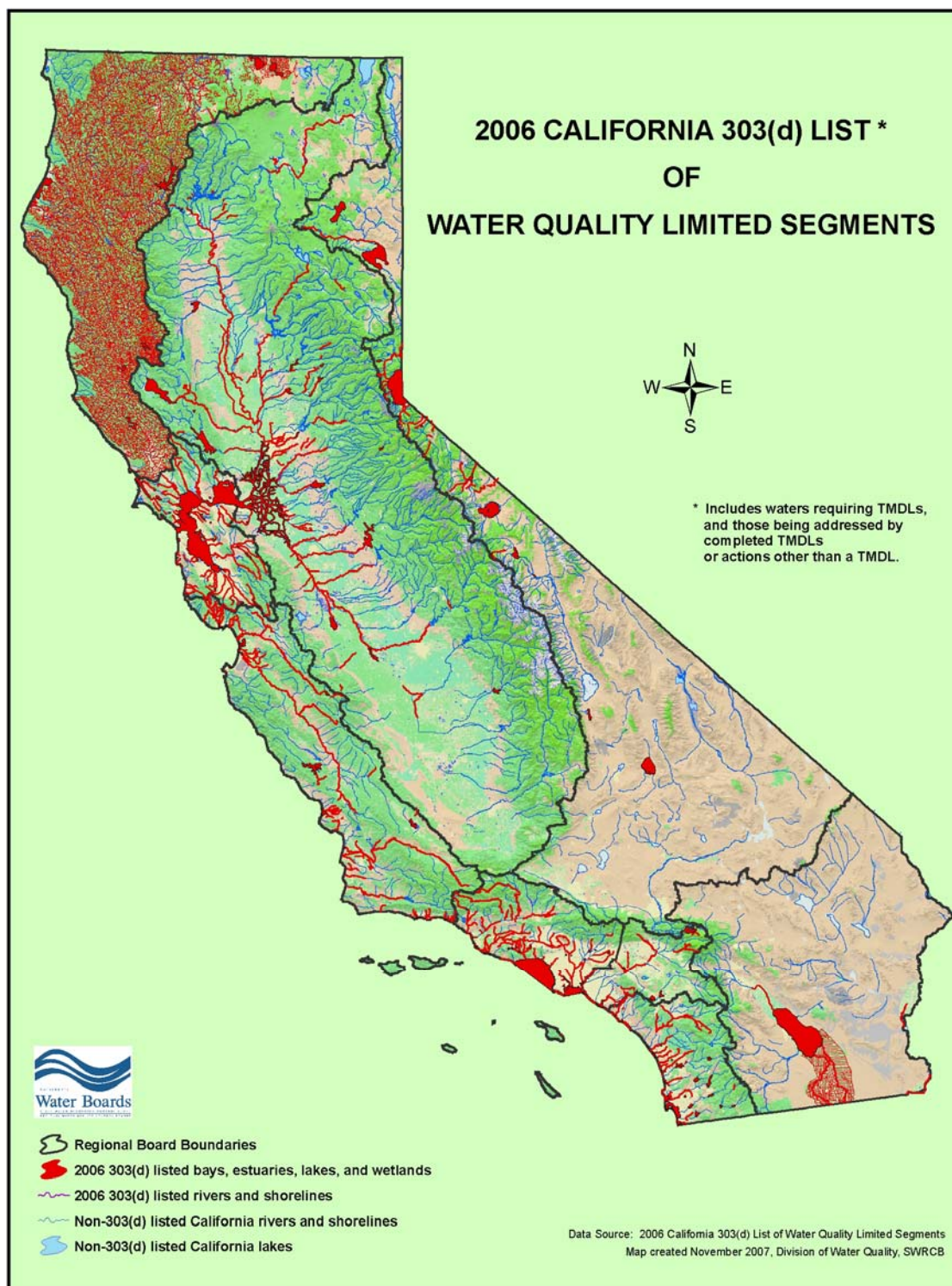


Figure 1. The existing picture of overall water quality in California, based on the set of 2006 303(d)-listed impaired water bodies identified by each Regional Water Quality Control Board. Because of differences in assessment methods, the implication is that the northwest portion of the state has the worst water quality in the state. However, this stems from the fact that the North Coast Region lists entire watersheds as impaired, while other Regional Water Quality Control Boards list smaller, individual water body segments.

Chapter 2: The Water Quality Data Access Solution

The Monitoring Council proposes a vision that is centered on a coordinated set of entry points to web portals that would provide ready access to a variety of water quality-related data and assessment information. These portals are organized around themes (Appendix 1) that are framed as easily understood questions (e.g., “Is it safe to swim in our waters?”) that enable all users to readily find and then access the specific information in which they are interested. Users are more concerned with having access to data that can answer their questions about water quality than they are about which program(s) (e.g., Appendix 2) created that data. For this reason, the Monitoring Council believes that a system of theme-based web portals that simplifies and streamlines access will provide the structure and incentive to coordinate disparate monitoring programs and improve the technical infrastructure needed to support that coordination (e.g., databases, standardized methods). In addition, the existence of a set of web portals, all based on consistent design principles, will act to reduce conflicts and incompatibilities within the technical infrastructure as it continues to develop.

2.1 A five-part solution

The Monitoring Council has identified five key elements that are necessary to realize its vision of broader data access through theme-based web portals:

- An organizational structure built on decentralized, issue-specific workgroups that operate within common policies and guidelines defined by the Monitoring Council
- A set of performance measures which each theme-based workgroup will use to evaluate, coordinate and enhance monitoring, assessment, and reporting efforts
- A single, global point of entry to water quality data, and a design template for the complete set of theme-based web portals
- Standardization of monitoring and assessment methods that achieves an appropriate balance between statewide consistency and regional flexibility
- Database and data management standards necessary for more efficient data access and integration

These five elements are described further in the following sections.

2.1.1 A flexible organizational structure

The Monitoring Council proposes establishing an organizational structure based on theme-specific workgroups operating within common policies and guidelines established by the Monitoring Council. These workgroups should be staffed by issue experts representing key stakeholders and report periodically to the Monitoring Council, with the Monitoring Council acting as a clearinghouse for standards, guidelines, and collaboration. Workgroups would develop both the web portal devoted to their theme or sub-theme as well as underlying monitoring and assessment methods and data management procedures. Workgroups would also be responsible for coordinating existing monitoring programs and achieving the standardization necessary to meet users’ needs (see Section 2.1.4).

The California Wetlands Monitoring Workgroup has become the first such workgroup, formalizing its relationship with the Monitoring Council and bringing its monitoring design and web portal development efforts under the Council’s overall review and guidance (see Section 2.2 for more detail). The Monitoring Council anticipates similar arrangements will be made with

the additional high-priority themes described in Section 2.2. This organizational approach provides complementary benefits for all involved. For the Monitoring Council, workgroups provide increased leverage, specific scientific, management, and user expertise, established networks of relationships, and access to funding that it would be difficult for the Monitoring Council itself to duplicate. For workgroups, association with the Monitoring Council provides broader visibility, easier access to statewide information management infrastructure, assistance in developing technical monitoring and assessment tools, compliance with broader statewide guidelines for data access, and assistance in achieving compliance with new monitoring and data management standards (see Sections 2.1.4 and 2.1.5 below).

For the workgroups to be effective in fostering and maintaining the integration of local and regional monitoring and assessment efforts, the entities responsible for those efforts must feel that they receive something of value in return. Given the limitations and instability in the budgets for state and federal monitoring programs, local and regional monitoring programs must be relied upon to provide additional baseline and broad-based monitoring data and to adhere to the standards necessary for the integration of those data and assessments. In return, the workgroup provides support and expertise to local monitoring and assessment efforts, including training, data management, and other tools. In this way, regional and statewide assessments of the health of our water resources will be made possible.

The Monitoring Council's role is thus not redundant with those of existing monitoring programs and data integration efforts. Rather, the Monitoring Council, because of its unique and overarching perspective, is the place where issues of data access, program coordination, and standardization should be dealt with at the broadest level.

2.1.2 Performance measures

The Monitoring Council's vision is that each theme or sub-theme (see Appendix 1) would have its own web-based portal providing a single, coordinated access point for data, assessment results, and supporting information. In order for such theme-based web portals to provide simple and straightforward access to water quality monitoring and assessment information, both the portals and the coordinated monitoring programs on which they are based require certain attributes which can be defined with performance measures. The following six performance measures are adapted from USEPA's 2003 report *Elements of a State Water Monitoring and Assessment Program* (USEPA 2003):

- **Program strategy, objectives, and designs**

The portal must describe monitoring strategies, objectives, and designs in enough detail that users can make informed decisions about how and for what purposes the data can be used. Assessment questions must reflect the concerns of key audiences and the way data will be used to make decisions. Objectives must be specific enough to connect assessment questions to the operational details of monitoring designs. Program objectives and designs must be evaluated to ensure that monitoring data effectively answer the underlying strategic questions.

- **Indicators and methods**

The portal must describe indicators and methods in detail sufficient to inform users about the extent of standardization and any constraints on combining data from different programs. Indicators, sampling and analysis methods, and quality assurance benchmarks must be standardized and maintained at a scale (at least regional and preferably statewide) that is extensive enough to allow data from multiple studies to be combined to produce meaningful broader-based assessments.

- **Data management**

The portal must be based on distributed database systems that support extensive data integration and access, and all data must be processed according to clearly specified and broadly applied data management procedures. National and/or statewide data formatting standards should take clear precedence over new/developing, regional or local standards. Coordination with water supply and use information, as envisioned in the Water Data Institute,¹ should occur as practical.

- **Consistency of assessment endpoints**

The portal must describe the assessment methods used to convert raw monitoring data into information on the condition of California's water resources and their beneficial uses. Assessment methods must be standardized to the greatest extent possible in order to support consistent statewide assessments. Where multiple assessment approaches are called for, the portal should explain the need for multiple methods and provide a means of integrating the separate results to create broader assessments.

- **Reporting**

The portal must support timely and consistent reporting of monitoring data and assessment results, along with the metadata needed to demonstrate adherence to standards and to ensure data are used wisely. Reports must be produced at a range of time scales appropriate to the concerns of managers, the public, and other audiences. In addition to formal reports prepared by monitoring and assessment programs, users have also come to expect the ability to prepare customized, or ad hoc, reports using interactive tools to query online databases.

- **Program sustainability**

Portals, and the programs they serve, must have the resources to actively participate in efforts such as methods development workgroups, laboratory intercalibration studies, and research and development into improved assessment methods. In addition, effective portals require investment in information technology infrastructure that improves users' capabilities to access, obtain, subset and/or combine, and work with a variety of monitoring data. This in turn depends on the allocation of staff and funding on a more permanent basis than is typical for many monitoring and assessment programs and the agencies and organizations that manage them.

Each theme-based workgroup will use these performance measures to evaluate existing water quality monitoring, assessment, and reporting efforts and to develop specific actions and funding needs necessary to coordinate and enhance those efforts. The Monitoring Council used these performance measures for a preliminary assessment of existing web portals (Appendix 3) and will use them in future to gauge the success of these workgroup efforts.

2.1.3 A single, global point of entry

This system of theme-based web portals will be accessed through a single, global point of entry to all water quality monitoring and assessment information. A working test version of this website has been developed (Figure 2), designed around intuitively clear questions that are readily understood by managers, the public, and scientists:

- Is our water safe to drink?

¹ The Water Data Institute is part of the Water Boards' strategic plan and Cal/EPA's agency information management strategy. The Institute is envisioned to be a long-term entity that integrates water quality with water supply and water use information.

Recommendations of the Water Quality Monitoring Council

- Is it safe to swim in our waters?
- Is it safe to eat fish and shellfish from our waters?
- Are our aquatic ecosystems healthy?
- What stressors and processes affect our water quality?

Each question will lead to a series of web pages for each theme (see Figure 3 for the draft page for swimming safety) that provide map-based access to summary assessment products and more detailed monitoring data, as well as tools for downloading data and conducting ad hoc queries and analyses. Links along the left-hand side of each page will enable users to access management, regulatory, and technical information specific to each theme. In the draft swimming safety portal (Figure 3), additional pages addressing more detailed questions link to

The screenshot shows the draft home page of the California Water Quality Monitoring Council. At the top, there is a header with the 'CA.GOV' logo, the text 'State of California ENVIRONMENTAL PROTECTION AGENCY RESOURCES AGENCY', and the title 'CALIFORNIA WATER QUALITY MONITORING COUNCIL'. A search bar is located on the right, with radio buttons for 'California' and 'This Site'. Below the header is a navigation menu with buttons for 'Home', 'Safe to Drink', 'Safe to Swim', 'Safe to Eat Fish', 'Ecologic Health', and 'Stressors & Processes'. A green banner below the menu reads 'My Water Quality - hosted by the Surface Water Ambient Monitoring Program (SWAMP) |'. The main content area features a 'Welcome to My Water Quality' section with a sub-header and a paragraph of text. To the left is a sidebar with a profile of Governor Schwarzenegger and a list of navigation links. Below the welcome section are six topic-based cards, each with an image and a 'More >>' link: 'IS OUR WATER SAFE TO DRINK?', 'IS IT SAFE TO SWIM IN OUR WATERS?', 'IS IT SAFE TO EAT FISH AND SHELLFISH FROM OUR WATERS?', 'ARE OUR AQUATIC ECOSYSTEMS HEALTHY?', and 'WHAT STRESSORS AND PROCESSES AFFECT OUR WATER QUALITY?'. The SWAMP logo is also present in the sidebar. At the bottom, a green footer contains the text 'Back to Top | Help | Contact Us | Site Map'.

Figure 2. Draft Monitoring Council home page, designed as a global entry point to monitoring and assessment information for all theme and sub-theme web portals.

websites maintained by a variety of entities, including the State Water Board, USEPA, and Heal the Bay. Being connected together through a single portal will provide both incentive and a mechanism for achieving greater standardization among related programs (as described below, Section 2.1.4).

2.1.4 Standardization of core program elements

Lack of standardization is clearly one of the primary causes of many of the problems users experience with data access and integration. An important role for the Monitoring Council is therefore to help develop, promote, and implement statewide standardization of monitoring methods, assessment approaches, quality assurance protocols, and data formats. However, not every aspect of every monitoring program requires statewide standardization, and attempting to achieve such universal standardization would be inefficient and lead to resistance and rigidity.

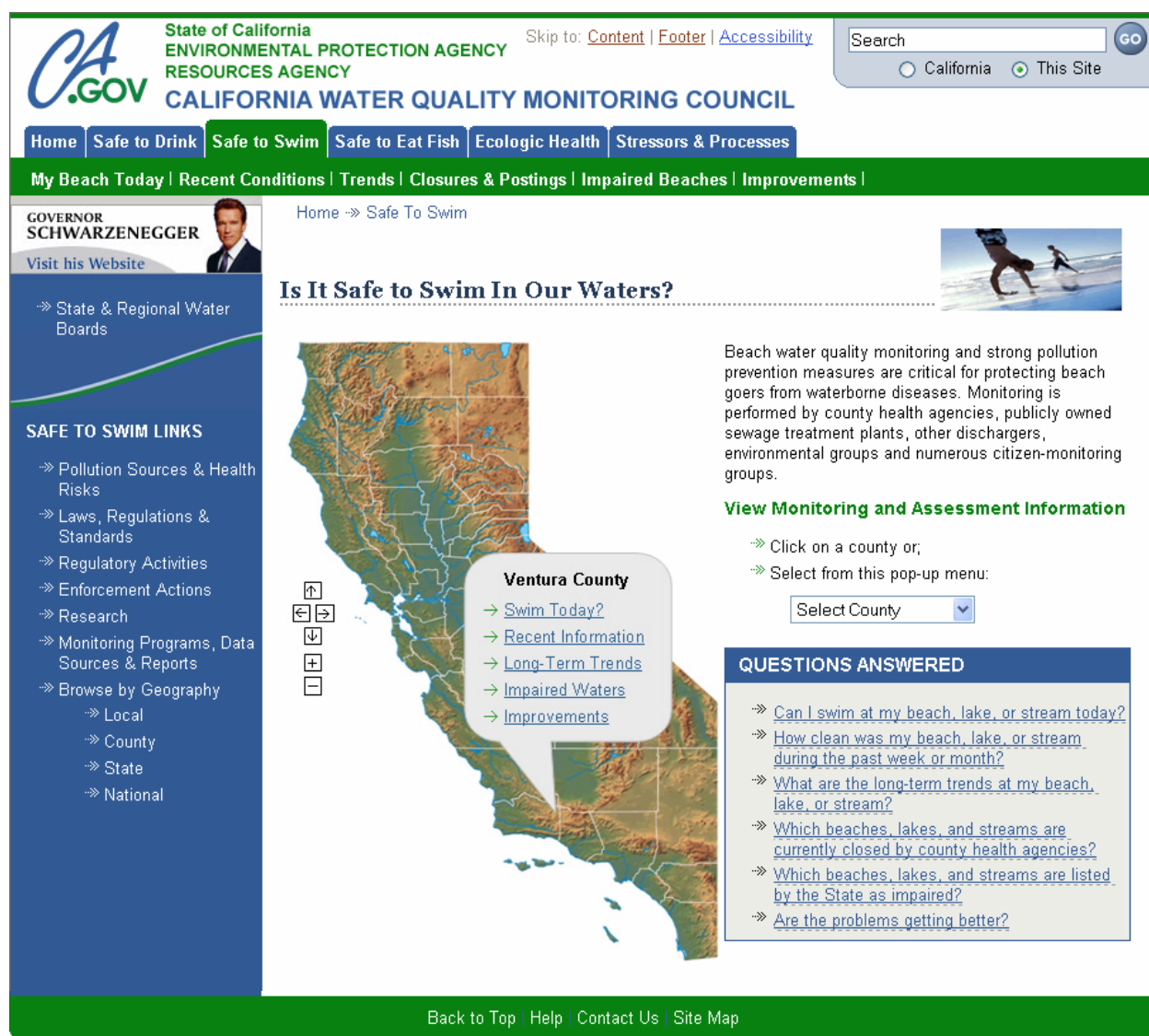


Figure 3. Draft Monitoring Council web page for the theme “Is it safe to swim in our waters?”

The Monitoring Council will therefore work with each individual workgroup to identify those core program elements that require statewide standardization in order to support comprehensive assessments, and those that can vary regionally based on local needs. Standards, particularly those related to quality assurance, may need to include multiple tiers to accommodate different levels of quality appropriate to different assessment needs. A tiered quality assurance approach has been proposed by the statewide Surface Water Ambient Monitoring Program (SWAMP) to allow standardization across a broad range of water quality projects.

The Monitoring Council will pursue three complementary approaches to ensure that standards are adopted and applied as envisioned: voluntary adoption, permit/grant/contract requirements, and legislation. Voluntary adoption can be achieved in some instances either in return for technical and programmatic assistance, or because the proposed standards provide clear benefits compared to current practice. In other cases, the Monitoring Council would recommend that the Secretaries of the Cal/EPA, Resources, and other agencies direct individual boards and departments to adopt appropriate standards and to include requirements to implement those standards in the monitoring programs associated with NPDES and other permits, grant agreements and contracts over which it has authority. Where such approaches are not available, or are not effective, the Monitoring Council would pursue a legislative solution.

2.1.5 Improved data management

The Monitoring Council's goal is to foster centralized access to data (through theme-based web portals), increased comparability within and between data types, and the development of tools to improve data integration. This will require formal data management standards and protocols, combined with appropriate databases and other information technology infrastructure, all coordinated to reflect a common philosophy and purpose. The Monitoring Council is aware of the substantial challenges that stem from the large number of data sources, data types, and users, all with valid, and sometimes wide, differences in needs related to accuracy, precision, timeliness, and levels of quality assurance.

While theme based web portals allow for a single global point of entry to water quality data, the Monitoring Council is aware that centralizing all data in one or a few locations is infeasible and that attempting to do so would be a recipe for failure. The Monitoring Council therefore proposes identifying *centralized access points* through regional data centers and distributed networks such as the California Environmental Data Exchange Network (CEDEN) and cataloging monitoring metadata using systems such as the California Environmental Resources Evaluation System (CERES). The pieces for a statewide data access and integration infrastructure are available, primarily in systems established by Cal/EPA, the Resources Agency, and USEPA (see Appendix 4 for additional detail), but they must be knit into a coordinated whole, rather than serving separate constituencies as they now do. This is consistent with the envisioned Water Data Institute that integrates water quality with water supply and water use information.

Data centers have an important role to play in promulgating formatting, quality assurance, and metadata standards, and there are a number of existing data standards that provide a useful starting point for this effort. In applying such standards in any particular instance, the Monitoring Council believes that data management protocols and data formats should be standardized at the highest level possible, with first priority given to federal data standards, the next to statewide standards, and the third priority to regional or single agency standards.

2.2 First steps

In order to assess the scope of the data access problem, and to determine a logical starting point for its efforts, staff surveyed existing monitoring and assessment efforts (Appendix 2) and the Monitoring Council assessed the current state of data access and integration across the state for each of the themes and sub-themes listed in Appendix 1. Using the six performance measures in Section 2.1.2 as performance criteria, the Monitoring Council developed an overall rating of the current status for each theme, supported by detailed fact sheets (see Appendix 3 for summary ratings and fact sheets). This review showed that, while only one theme (the surface water sub-theme in the “Is Our Water Safe To Drink?” theme) rated High on all six criteria, there are a number of sub-themes that rated at least Medium on all criteria. This provides support for the Monitoring Council’s optimism that there is a productive starting point for undertaking the efforts needed to achieve SB 1070’s goals. However, some themes rated Low on most or all criteria. This, combined with the sheer volume of programs, monitoring designs, and data, emphasizes the amount of sustained and coordinated effort needed to improve access to useful data and information products across all themes and sub-themes.

The Monitoring Council prioritized the themes for immediate action, using as criteria the level of concern to the public and managers, the results of the evaluation in Appendix 3, and the presence of attractive opportunities (i.e., low-hanging fruit) that would demonstrate the feasibility and utility of the theme-based web portal approach and the institutional structure the Monitoring Council proposes to support such efforts. The results of this prioritization exercise (see Appendix 5) identified four specific opportunities the Monitoring Council will focus in the immediate future:

- The groundwater sub-theme in the “Is our water safe to drink?” theme
- The sportfish sub-theme in the “Is it safe to eat fish and shellfish from our waters?” theme
- The coastal beaches, bays, and estuaries in the “Is it safe to swim in our waters?” theme
- The wetlands sub-theme in the “Are our aquatic ecosystems healthy?” theme

In addition, the State Water Board’s Surface Water Ambient Monitoring Program (SWAMP) has been defining comparability standards for water quality monitoring since 2003, including:

- A statewide status and trends assessment framework
- Leveraged partnerships with regional monitoring programs
- Sets of assessment thresholds, indicators, quality assurance and data management tools that foster data comparability

For this reason, SWAMP projects, products and tools will also be accessible via the Monitoring Council’s global entry website.

In each of the above cases, substantial progress toward achieving statewide standardization of monitoring and assessment methods, combined with the presence of existing workgroups and active interest in the web portal concept, make these the most promising near-term opportunities.

For each theme or sub-theme, the Monitoring Council will follow the same general approach:

1. Establish or foster the continued efforts of a collaborative workgroup of involved stakeholders, both in and out of state government agencies

2. Evaluate current systems and programs in terms of the portal and underlying monitoring and assessment program performance measures established by the Monitoring Council
3. Define elements to be standardized at statewide vs. regional scales
4. Define a common data infrastructure that permits examination of data across a variety of space and time scales
5. Develop detailed workplan to address shortcomings in each of the six performance measures

Detailed theme-by-theme actions are presented in Appendix 7. While each targeted sub-theme will require a somewhat different approach, depending on the technical and management issues involved, the proposal recently submitted to the State Water Board by the wetlands workgroup (see Appendix 6) is illustrative of the type of detail that would need to be developed. As one example of the way the Monitoring Council's role would promote statewide consistency, the Monitoring Council recommends that the regional homepages described in the wetlands proposal be replaced by, embedded within, or accessed through the sort of single, global entry point represented in the draft website shown in Figures 2 and 3.

An additional workgroup will also need to be formed to carry out the day to day management of the global entry web site and underlying data management infrastructure. A users group already exists for the SWAMP data centers and CEDEN. This group can be expanded to include additional partners. Once formed, the workgroup can assist the Monitoring Council and its recommendations can be promoted and standardized through the Monitoring Council.

2.3 A ten-year plan

This report represents the initial recommendations of the Monitoring Council, pursuant to California Water Code Section 13181(b). However, this is just the beginning. Water Code Section 13181(e) requires the State Water Board to develop, in coordination with the Monitoring Council, "a comprehensive monitoring program strategy that utilizes and expands upon the state's existing statewide, regional, and other monitoring capabilities and describes how the state will develop an integrated monitoring program that will serve all of the state's water quality monitoring needs and address all of the state's waters over time." The strategy is to be completed within a 10 year timeframe and must be comprehensive in scope and must identify specific technical, integration, and resource needs. Included in this strategy are a number of additional requirements:

- Water quality protection indicators that provide a basic minimum understanding of the health of the state's waters
- Quality management plans and quality assurance plans that ensure the validity and utility of the data collected
- Methodology for compiling, analyzing, and integrating readily available information acquired from regulated discharges, volunteer monitoring groups, local, state, and federal agencies, and recipients of state or federal funding for water quality improvement or restoration projects
- An accessible and user-friendly electronic data system with timely data entry and ready public access via the Internet, including geographic location information

- Production of timely and complete water quality reports and lists required under the Clean Water Act and the Beaches Environmental Assessment and Coastal Health Act of 2000
- An update of the State Water Board's SWAMP needs assessment that acknowledges the benefits of increased coordination and integration of information from other agencies and information sources

2.3.1 Resources

Funding will be needed to implement the Monitoring Council's vision and for ensuring the sustainability of a comprehensive integrated water quality monitoring program for California. Acquisition of funding should be approached in a phased manner. Funds may be redirected or leveraged from existing monitoring efforts by eliminating redundancy or creating tradeoffs (e.g., reduce project or discharge monitoring to enhance regional assessments, as was done in the Southern California Bight program). Funding may be available through federal agencies, foundations and other sources. The Monitoring Council will develop specific recommendations for funding, based on costs to achieve early theme development efforts.

Baseline funding will be needed for the development and maintenance of data centers, exchange networks, and other components of the data management systems. Initial funding for this effort has come from the State Water Board's SWAMP program, including \$500,000 annually for the establishment of four data centers and CEDEN. On December 2nd, the State Water Board will consider whether to provide up to \$4 million over three years to fund the four data centers and CEDEN. During this three year period, the data centers will determine a use fee that will allow the centers to be sustainable.

The user-driven theme-based water quality web portal concept, backed by the data centers and exchange networks such as CEDEN, involves establishing web services that allow a variety of databases and users to "talk" to each other seamlessly, a difficult and time consuming operation. Developing and maintaining these systems over time will take significant resources (time, money, and expertise). Effectively integrating systems will require a significant commitment from the state.

Chapter 3: Recommendations and Next Steps

In summary, the California Water Quality Monitoring Council recommends the following actions to maximize the efficiency and effectiveness of existing water quality data collection and dissemination and to ensure that collected data are maintained and available for use by decision-makers and the public:

1. Create a system of web-based, user-oriented, data access portals to California's water quality monitoring and assessment information, developed and implemented by a series of decentralized, issue-specific workgroups operating under the Monitoring Council's overall guidance and approval
2. Organize portals around themes that are framed as easily understood questions that deliver data to those people who need it in ways that directly meet their highest-priority needs, including
 - a. A map-based interface
 - b. Data and assessment information at a variety of space and time scales
 - c. Ad hoc data query and analysis tools
 - d. Ability to download raw data
3. Create a website that provides a single, coordinated, global point of entry to water quality data, assessment results, and supporting information and that provides a design template for the complete set of theme-based web portals; this will provide both incentive and a mechanism for achieving greater standardization among related programs
4. Manage monitoring and assessment information through distributed, but federated, systems of databases and data centers linked through data exchange networks to centralized web portal access points
5. Empower the theme-based workgroups to develop and enhance the portals and their underlying monitoring and assessment programs so as to achieve high scores in all of the following six attributes:
 - a. Program strategy, objectives, and designs that support informed decisions
 - b. Consistent and fully described indicators and methods
 - c. Integrated but distributed data management
 - d. Consistent assessment endpoints
 - e. Timely and complete reporting with multiple levels of access
 - f. Program sustainability with resources that support sharing of data and assessments beyond the scope of individual projects and programs
6. Standardize monitoring and assessment and data management methods to increase comparability within and between data types and the development of tools to improve data integration that achieve an appropriate balance between statewide consistency and regional flexibility
7. Foster cooperative relationships between the Monitoring Council, theme-based workgroups, and regional and local monitoring programs through the exchange of

training, support and tools in return for enhanced development and access to monitoring data that can be used for baseline and broad-scale assessments

8. Develop recommendations for long-term-sustainable funding mechanisms to support the above efforts, the ongoing work of the Monitoring Council, and the theme-based workgroups

In these ways, the Monitoring Council intends to provide the structure and incentives to coordinate disparate monitoring programs and to improve the technical infrastructure needed to support that coordination. The Monitoring Council is the place where issues of data access, program coordination, and methods standardization should be dealt with at the broadest levels. Detailed coordination, standardization and implementation will be provided by each theme-based workgroup.

For these goals to be achieved, the Monitoring Council must continue its efforts. Near term Monitoring Council actions include:

1. Working with initially identified workgroups, including the Wetlands Monitoring Workgroup, to implement the measures identified above
2. Conducting outreach to additional local, regional, state and federal agencies, non-government organizations, and other entities that are responsible for existing monitoring and assessment efforts
3. Coordinating the formation of stakeholder-based workgroups to support each theme or sub-theme

In the longer term, the Monitoring Council will develop recommendations for the full-range of issues necessary for California to achieve a comprehensive water quality monitoring program strategy from which the state is able to develop an overall picture of the health of the state's waters, establish priorities, evaluate the effectiveness of programs and activities to protect and improve water quality, report on its accomplishments, and to provided all of this information to its citizens.

It is clear that the work of the Monitoring Council is not over. There is much yet to be done. And the recommendations of this report provide a foundation on which these future efforts can be built.

For this reason, the Monitoring Council urges that Cal/EPA and the Resources Agency accepts its initial recommendations and that the Monitoring Council continue in operation to oversee the implementation of the recommendations contained in this report and the development of the comprehensive integrated water quality monitoring program strategy outlined in the legislation. Developing the technical, organizational, and financial infrastructure needed to ensure the long-term sustainability of the Monitoring Council's standardization and data access efforts will be a considerable task, requiring dedicated resources for planning, staffing, development, and maintenance.