

San Francisco Estuary Project

**Comprehensive Conservation
and Management Plan**

San Francisco Estuary Project
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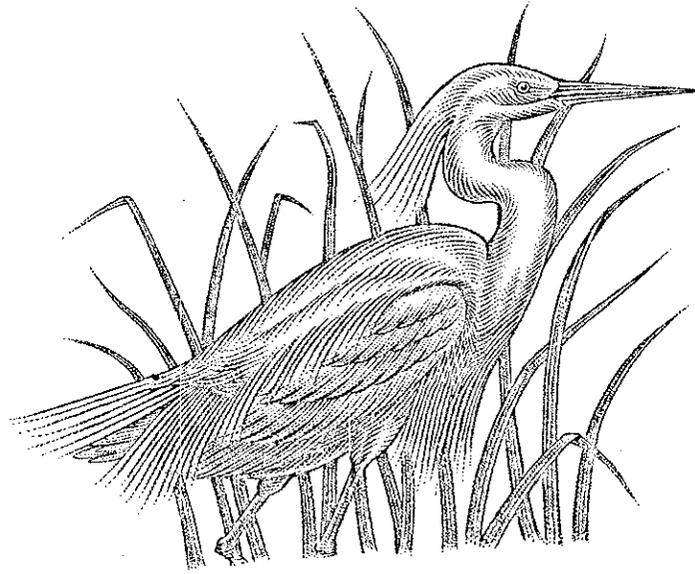
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Oakland, California

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Comprehensive Conservation and Management Plan



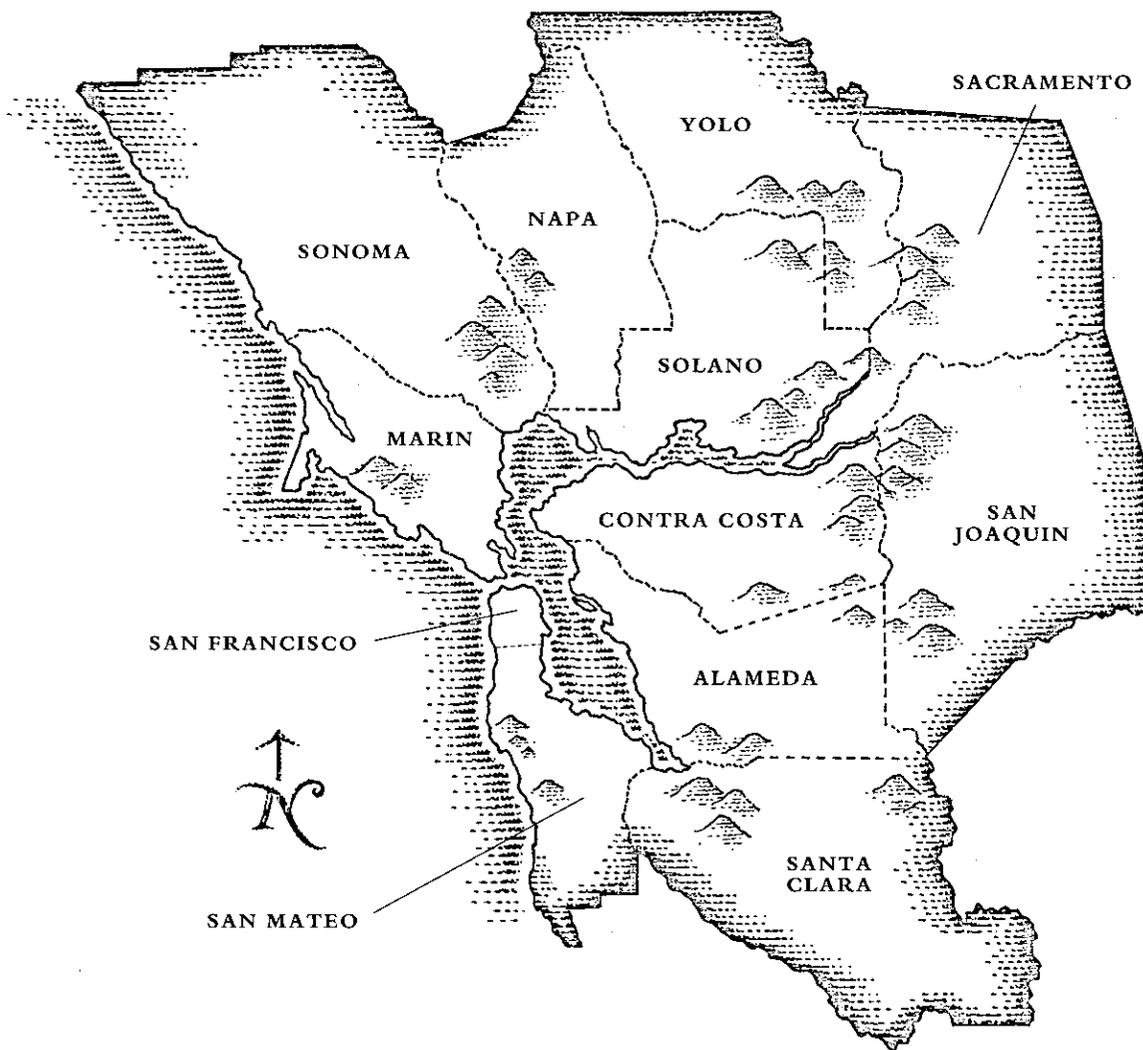
“WE, THE PEOPLE of California and the San Francisco Bay-Delta region, believe the San Francisco Estuary is an international treasure and that our ongoing stewardship is critical to its preservation, restoration, and enhancement. Acknowledging the importance of the Estuary to our environmental and economic well-being, we pledge to achieve and maintain an ecologically diverse and productive natural estuarine system.”

**San Francisco Estuary Project
Management Committee 1992**

The Twelve Bay-Delta Counties of the San Francisco Estuary

A Significant Natural Resource

San Francisco Bay and the Delta combine to form the West Coast's largest estuary. The Estuary conveys the waters of the Sacramento and San Joaquin Rivers to the Pacific Ocean. It encompasses roughly 1,600 square miles, drains over 40 percent of the state (60,000 square miles), and contains about 5 million acre-feet of water at mean tide. The Estuary watershed provides drinking water to 20 million Californians and irrigates 4.5 million acres of farmland. The Estuary also hosts a rich diversity of aquatic life. Each year, two-thirds of the state's salmon pass through the Bay and Delta, as do nearly half of the waterfowl and shorebirds migrating along the Pacific Flyway. In addition, Estuary waters enable the nation's fourth-largest metropolitan region to pursue diverse activities, including shipping, fishing, recreation, and commerce.





GOVERNOR PETE WILSON

November 17, 1993

Ms. Carol Browner
Administrator
USEPA
401 M Street, S.W., W-1200
Washington, D.C. 20460

Dear Ms. Browner:

I have a long history of involvement and support for the San Francisco Estuary Project. As a United States Senator, I was pleased to help assure that the San Francisco Bay was included in the amendment to the Clean Water Act that authorized and funded the development of the proposed Comprehensive Conservation Management Plan (CCMP). I have reviewed the proposed plan in context of my original reasons for supporting this program's establishment, reflected in my correspondence to the Senate conferees on the Clean Water Act in 1985:

"At a time when Congress is apparently willing to make a further commitment to the preservation of environmentally sensitive estuaries, I think it highly appropriate that the San Francisco Bay be part of this program

What is needed is a central repository for this information with a mandate to produce a Bay-area management plan Implementation by the state of this management plan is intended to be funded in part by an EPA grant. [emphasis added]

As Governor, I have been pleased to help ensure a constructive state role in development of the

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CCMP. California has committed substantial resources to assist in its development and is contributing the lion's share of money to fund many of the current and planned actions it recommends.

As noted in the supplemental material prepared by the San Francisco Estuary Project on the financial implications of its plan, the state is presently funding 83 actions endorsed by the CCMP. California is currently committed to expend more than twice as much as the federal government over the twenty-year implementation period. This reflects the state's existing and continuing commitment to provide the lead in restoring and protecting the environmental values of this great Estuary.

Additionally, my administration has initiated a number of water resource management policies that both support and complement the trust of the CCMP. Indeed, a central part of my comprehensive, long-term water policy focuses on the Estuary.

I am pleased that a substantial part of the CCMP is consistent with my overall water resource policy. However, changed circumstances have made several specific actions recommended in the CCMP either moot or inconsistent with our own comprehensive state policy. Consequently, I must condition my concurrence.

Despite my conditional acceptance of its conclusions and recommendations, it should be clear that I view the development of the CCMP by the San Francisco Estuary Project as a monumental and beneficial undertaking, involving many individuals and public agencies. The participants have made a major contribution to the debate concerning problems facing the San Francisco Bay-Delta Estuary. Their five plus years of effort will represent a significant milestone only if we both pursue its implementation in the most cost-effective manner and build upon this state-federal cooperative planning effort by conducting the recommended state-led EIS/EIR to document how to best address the underlying causes of the major problems in the Estuary.

As Governor, I must ensure we use a balanced approach to managing and "fixing" the Bay-Delta: one that reconciles the nationally significant economic

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and environmental values that are each dependent on the Estuary. The conditions I am placing on implementation of the CCMP will assure this necessary balance.

I hereby concur with the Comprehensive Conservation Management Plan of the San Francisco Estuary Project with the following conditions:

Aquatic Resources

1. I concur with this Plan with the understanding that it will not increase the existing authority of any federal entity in regards to management or regulation of California's water resources. The state will remain the sole authority in allocation of water rights within California.

2. This Plan cannot be implemented in isolation from the other critical, beneficial uses and values dependent upon the Estuary; most notably water supply for domestic, industrial and agricultural use. These are equally required to be protected under both State and Federal law. Consequently, I must specifically condition the implementation of this Plan with minimizing to the degree feasible the impact upon other legally recognized and protected beneficial uses.

3. I am concurring with this Plan with the explicit understanding that it neither requires nor recommends the use of a two (2) parts per thousand (PPT) salinity measurement as a water quality standard. Rather, the Plan only recommends monitoring the 2 ppt isohaline as one of the variables to be measured in order to better understand the dynamics of the Estuary, and specifically the salience and effectiveness of a salinity standard. This field test of the relationship between salinity and the health of aquatic resources should be valuable in determining the degree to which salinity can serve as a useful barometer of the biological conditions in the Estuary.

4. Although I accept the general goal of Objective AR-3 ("Implement recovery actions for all listed and candidate threatened and endangered species."), I have serious reservations about some of the specific actions it calls for. It is my belief

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that an ecosystem focus and better coordination among state and federal agencies should be the emphasis of any strategy to resolve these issues. Continuing the old methodology of producing recovery and habitat plans and consultations on individual species is likely to only move us further down the tracks toward an environmental and economic "train wreck," instead of solving current problems and preventing new ones from arising in the future.

5. Action AR-4.1(a) is now outdated and moot. In light of the federal government's imposition of standards under its pre-eminent Endangered Species Act authority, as well as the expressed intention of the federal Environmental Protection Agency to promulgate its own water quality standards for the Estuary, I requested in April of this year that the State Water Resources Control Board not contribute to further regulatory overload by promulgating its own interim State water quality standards. Therefore, the portion of this Action item calling for issuance of immediate interim state water quality standards is outdated and irrelevant and should be removed.

The original basis for the "interim standards" was to sufficiently stabilize the Estuary's public trust resources to afford the time necessary for a long-term solution to be documented and implemented. I remain committed both to taking actions now that can stabilize the health of the Estuary and to proceeding expeditiously with a thorough and objective solution-finding process.

I have directed State entities to work with their federal counterparts to achieve the requirements of the law. The State will constructively contribute to the current federal process, with the goal of establishing scientifically-sound interim water quality standards in a manner least costly to the millions of Californians dependent on the Estuary for their drinking, industrial agricultural and water supply.

6. I want to particularly highlight and comment on Objective AR-5 ("Develop a comprehensive plan to optimize the management of estuarine aquatic resources that addresses the needs of all users and

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promotes an equitable balance; protects indigenous species; and, consistent with the state and federal mandates, doubles the natural production of anadromous fishes.") This Objective and implementing Actions are essential if we are to achieve the needed restoration of the Estuary. We must conduct the recommended solution-finding process to address the underlying causes of the Estuary's problems. Until this is done, the current "management by crisis" will be perpetuated.

It is critical in achieving this goal that the interests of all three water segments; urban, agriculture and the environment are met. Included in this we need to be mindful of future facility needs that may be required to meet these objectives. It would be inappropriate to unduly place the burden of meeting water needs on one segment.

This Objective and implementing Actions appropriately call for a state lead in the conduct of a solution-finding process within the rigorous requirements of public involvement and objectivity of the National Environmental Policy Act and the California Environmental Quality Act. I have launched this effort through an Executive Order establishing the Bay-Delta Oversight Council, and I have charged the Council to oversee many of the specific actions recommended in AR-5. I am seriously troubled, however, as this effort continues to suffer from the lack of meaningful and essential federal involvement, as called for in the CCMP. This central Objective can only be achieved when the Federal Administration commits itself to the solution-finding process.

Wetlands

Since July, when the San Francisco Estuary Project CCMP was forwarded to me, both I and President Clinton have announced comprehensive wetlands policies. The two policies appear consistent and should foster an improvement in wetlands programs in California.

On August 23, 1993, I announced my Wetlands Conservation Policy. It is founded on three basic

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principles: (1) achieving a net increase in wetlands acreage and values, (2) reducing the complexity of the regulatory process, and (3) encouraging partnerships to make landowner incentives and planning the primary focus of wetlands conservation. The policy calls for the state to undertake many diverse actions to accomplish its goals and gives directions to state agencies to undertake the actions necessary for its implementation.

The major components of my wetlands policy include: a comprehensive statewide wetlands inventory, establishment of regional and statewide goals to increase wetland acreage and quality, promotion of landowner programs, adoption of a single regulatory definition for wetlands, delegation of wetlands permitting authority in the Federal Clean Water Act Section 404 program from the U.S. Army Corps of Engineers to the State, initially in the San Francisco Bay Area, support for \$70 million for wetlands protection in a natural resources bond measure, active support for wetlands mitigation banks, establishment of an inter-agency task force responsible for coordinating the implementation of the wetlands policy, and identification of regional strategies in the Central Valley, San Francisco Bay Area, and Southern California to begin implementation of the policy.

Because of the critically important environmental and economic benefits that wetlands in the San Francisco Bay estuary provide -- including fish, wildlife and water fowl habitat, water purification and filtration, flood control, and scenic and recreational enjoyment -- these are among the state's and nation's most important wetlands.

Consequently, my wetlands policy identifies the San Francisco Bay Area as one of three regions in which a variety of actions be taken to increase wetlands acreage and values, while streamlining the wetlands regulatory process.

I find the overall goals of the CCMP wetlands section to be generally consistent with my policy. The goal of increasing and improving Bay Area wetlands corresponds exactly with my policy of identifying specific numerical goals to increase and improve wetlands. I also support the development of a

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regional wetlands management plan, and suggest that the Estuary Project's efforts be closely coordinated with development of the State plan.

Because my wetlands policy is just now being implemented, it would be unwise to concur in the most specific actions of the CCMP. Some CCMP actions prejudice issues which ought to be further developed through the public processes my policy anticipates. For example, my policy requests the State Water Resources Control Board develop a balanced approach to the Army Corps of Engineers Nationwide Permits (NWP); the CCMP, on the other hand, prescribes a specific solution prior to the completion of the State Board's deliberations.

As the State moves forward with implementation of my policy, we anticipate working closely with the federal government in implementing the President's new wetlands policy. Due to the coincidences of timing and content, a close state/federal partnership can be developed. I am particularly pleased that the President's policy anticipates an increased role for states in the Clean Water Act, Section 404 program.

Therefore, I concur with the actions of this section which are consistent with my policy. Additional decisions concerning the compatibility of my policy with the specific actions in the CCMP will be made as the need arises, and will be guided by the principles of my wetlands policy.

Costs and Priorities

I further condition my concurrence of the CCMP with a frank recognition of the fiscal realities confronting California. Revenues in the state budget have been declining and base programs are being cut.

While the actions called for in the CCMP are already being pursued at a state funding level twice that of the federal government, the ability for the State to take on any new fiscal responsibilities is severely limited. Therefore, my concurrence with the CCMP is not, and should not be interpreted as, a commitment to a specific funding level by the state. Rather, to the degree that funds are available or can be gained from other sources, the state will

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pursue those CCMP recommendations that are determined to be most cost-effective. Additionally, I specifically do not concur with the recommendations on new revenue sources recommended by the Planning Subcommittee (pp. 157-158).

Second, it is incumbent upon the Executive Council to establish priorities within the CCMP. It is imperative that the Executive Council refine the multitude of recommendations within the CCMP to determine a priority sequencing based upon cost-effectiveness and available funding from the state, federal and private sector.

Implementation

As Governor, I believe it is essential that implementation of the CCMP be structured in a manner that recognizes and reflects the state's primary role in managing and protecting its water resources. Consequently, I am pleased by the goals established for the implementation structure:

"The Executive Council will have primary responsibility for implementing the CCMP. The Implementation Committee will coordinate implementation activities under the broad policy direction of the Executive Council."

To assure that these goals can be fulfilled, my concurrence is conditioned on the following understandings of this section:

- 1) Except as specifically called for in the CCMP, the members of the Implementation Committee, and other committees, will be appointed by the Executive Council;
- 2) The Implementation Committee serves as advisor to the Executive Council on matters regarding workplan, budgets, priorities and policy; and,
- 3) Most importantly, my concurrence is specific to the Executive Council composition as described in the CCMP. A federally dominated Executive Council, as outlined in current implementing legislation in

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Congress, is completely unacceptable to the State and would receive neither state support nor participation. In fairness, it is my understanding that the author of that legislation sought to codify the composition recommended by the CCMP, but was informed that to do so would violate the separation of power provisions of the U.S. Constitution. I urge Congressional supporters of the CCMP not to legislate on this point, but rather to embrace the implementation structure as recommended by the CCMP and hereby concurred with by the Governor of California.

In closing, I am pleased to generally concur with the fundamental findings and recommendations of the CCMP. With these actions, we will do what is now most cost-effective to stabilize the Estuary. Yet, we must not lose sight of the fact that substantial restoration of the Bay-Delta's natural resources will be prohibitively costly, in both dollars and water, unless and until we effectively address the underlying causes of the problems now manifest in the Bay-Delta.

We can only achieve the goals of the CCMP and our shared responsibility to reconcile California's economic and environmental water dependencies through conducting a joint federal and state EIS/EIR as recommended in both my water policy and in this CCMP. Until we jointly identify and implement feasible solutions, the "broken" Bay-Delta will continue to tragically pit the natural resources of one of the nation's most important estuaries against the needs of the humans, including the water supply for twenty million Californians and the most productive state economy in the country.

Just as California is committing itself to do its fair and necessary part to implement both the Central Valley Project Improvement Act (CVPIA) and the CCMP, it is time for the federal government to join with California in conducting a solution-finding process to investigate and resolve the underlying cause(s) of the problems in the Bay-Delta.

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I pledge my Administration's continued support
in working with all parties for an effective and
equitable implementation of the CCMP, as conditioned
herein by my concurrence.

Sincerely,

A handwritten signature in cursive script, appearing to read "Pete Wilson".

PETE WILSON



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC -9 1993

THE ADMINISTRATOR

Honorable Pete Wilson
Governor of California
Sacramento, California 95814

Dear Governor Wilson:

Thank you for your letter of November 17, 1993, concurring with the Comprehensive Conservation and Management Plan (CCMP) for the San Francisco Bay-Delta. I am pleased to add my approval of the CCMP and look forward to our working together in its implementation. The CCMP is an impressive culmination of a public-private process to identify the problems afflicting the Bay and their solutions. Through its 144 specific action items, the CCMP provides a detailed strategy for protection and restoration of a nationally significant natural resource, the San Francisco Bay-Delta. Sections 319 and Titles II and VI of the Clean water Act are available to the State of California to assist in implementing the CCMP as provided for in the Act.

I appreciate your stated desire to work closely with the Federal Government in the implementation of the CCMP. This is essential if we, together with our partners in the private sector, are to achieve the important goals and actions it reflects. We support your commitment to ensure a "constructive state role" in the implementation of the CCMP. Further, your substantial commitment of resources on behalf of the State of California, more than twice that of the Federal government over the next 20 years, is a clear reflection of your leadership in restoring and protecting the Bay-Delta. As you state in your letter, this does indeed "reflect the State's existing and continuing commitment to provide the lead in restoring and protecting the environmental values of this great Estuary." You had included several conditions and concerns in your concurrence which I have responded to in the enclosed document.

I fully agree with the Management Conference's decision to place the responsibility for managing the Conference and overseeing the implementation of the CCMP in the San Francisco Bay Regional Water Quality Control Board, and the integration of actions into the water resource agency's programs. The Environmental Protection Agency (EPA) and the other Federal Agencies which have supported the development of the CCMP will continue to work together, under the Executive Council's leadership, to ensure the CCMP is successfully implemented.

I want to close by stressing EPA's commitment to work with you to protect this critical resource. We can build upon the cooperative relationship we have begun through the San Francisco Estuary Project. In addition, I want to thank the Estuary Project participants who worked so diligently to prepare the Plan.

If you have any questions or concerns regarding this approval, please contact me or call Robert Perciasepe, Assistant Administrator for Water, at (202)260-5700.

Sincerely,



Carol M. Browner

Enclosure

EPA's Comments on Governor Wilson's Concurrence

The conditions raised in Governor Wilson's November 17, 1993, letter relates to the purpose of the CCMP and clarify the State's interpretation of several provisions of the Plan. Given the unique nature of the CCMP and the numerous challenges facing the Bay-Delta estuary, it is important that State and Federal roles in implementing the Plan are clearly stated. In this way, both can direct their efforts towards implementation of actions that achieve improved environmental conditions.

The CCMP represents a commitment on behalf of the participants in the Management Conference to coordinate their efforts "to achieve and maintain an ecologically diverse and productive natural estuarine system." As such, the CCMP establishes a framework for an expanded partnership among all parties concerned with the environmental and economic well-being of the Bay-Delta region. The Plan does not provide the Federal government with new authority to regulate activities in the Bay-Delta estuary.

Implementation relies primarily on the support that the Plan has among the parties responsible for carrying out the actions. Clearly, some CCMP actions can be implemented by existing agencies under current authorities, and several actions are already underway. Other actions, however, will require additional resources; and a few call for changes in Federal or State legislation. Therefore, key decision-makers will need to develop understandings and agreements among themselves to ensure successful implementation.

To facilitate CCMP implementation, the Plan envisions establishing an interagency oversight entity. Specifically, the entity would set priorities, identify lead-agencies, seek needed resources, develop strategies based on cross-cutting CCMP actions, ensure follow-through on commitments, and provide for direct public participation. EPA recognizes State support for the membership of the Executive Council as described in the CCMP and the concern that proposed legislation may establish different representation. EPA and the State can work together to ensure that the Executive Council membership would be consistent with the CCMP.

It is understood that funds for implementing the CCMP may be limited. Since completion of the CCMP, lead responsibility for San Francisco Estuary Project (SFEP) administration and CCMP oversight has been transferred to the State at the San Francisco Bay Regional Water Quality Control Board. Most recently, EPA has provided nearly \$300,000 to the Board and other parties to assist with these activities. However, additional funds may be required to support implementation more fully.

The CCMP can be used to help target existing funding and to justify the need for additional funding to ensure that environmental results are achieved in an effective and efficient manner. For example, existing sources of funding available to the State could be used to implement CCMP actions. Section 320 of the Clean Water Act (CWA), which authorizes the National Estuary Program, states that funds for CCMP implementation may be provided for eligible activities under Section 319 and under Titles II and VI of the CWA.

The CCMP Aquatic Resources and Wetlands Program Areas were among the most controversial considered by the SFEP Management Committee and were adopted by majority votes, rather than unanimous agreement. Nevertheless, both reflect a high level of agreement and make an important contribution to improving conditions throughout the Bay-Delta estuary. Implementation of some of these actions will take further consideration by key decision-makers based on related State and Federal mandates.

The Aquatic Resources Program Area will require especially close coordination between State and Federal agencies. Four of the Federal agencies that participated in the development of the CCMP (Fish and Wildlife Service, National Marine Fisheries Service, Bureau of Reclamation, and EPA) are preparing to announce on December 15, 1993, an integrated set of proposed strategies including water quality standards designed to restore and protect the estuary's declining fish populations and critical habitats. EPA is encouraged by California's commitment to contribute to a cooperative process and to take actions now to stabilize the health of the estuary.

The commitment to develop an implementation plan for the December 15 proposal will be essential to ensure that all users share responsibility for protecting the estuary. The development of an effective implementation plan should include all stakeholders concerned with the environmental and economic well being of the Bay-Delta and its watershed. Industries, municipalities and fisheries in the Bay-Delta area, as well as users in the watershed that depend on freshwater diversions from the Delta, should all have an active role in implementation.

EPA and the Federal agencies also share your desire to proceed expeditiously to find a long-term solution. With a State commitment to pursue joint implementation of the Federally proposed strategies, the Federal agencies stand ready to participate in a joint process on long-term solutions. This approach would provide a workable framework for a true state-federal partnership on these issues.

It is correct that EPA regards the CCMP as "neither requiring nor recommending the use of a two (2) parts per thousand (ppt) salinity measurement as a water quality standard."

However, based on the strong endorsement of the scientific community, EPA has stated its intent to propose 2 ppt salinity criteria for comment on December 15. However, EPA would approve alternative criteria adopted by the State, provided that they are sufficient to protect the designated uses of the estuary.

In terms of the CCMP Wetlands Program Area, EPA agrees that some of the recommendations may require further consideration by the appropriate State and Federal agencies to ensure consistency with their respective mandates and policies, including the recently announced State Wetlands Conservation Policy and President Clinton's Wetlands Plan. In that regard, my approval of the final CCMP is based upon an understanding that the appropriate entities will consider the CCMP recommendations in light of other significant efforts to effectively protect and restore wetlands. Since 1991, EPA has provided over \$1 million to the State for development of its wetlands program. EPA looks forward to continued support of State efforts to improve the quality of wetlands within the State and to working with California to ensure that these activities are coordinated with implementation of the CCMP.

CCMP implementation will complement and enhance the many efforts currently underway to improve environmental conditions throughout the Bay-Delta estuary. Implementation will provide a means for the key stakeholders to work together, to maintain in the long-run a sustainable ecosystem that provides economic, social, and environmental benefits. EPA's resolve to promote such ongoing stewardship can demonstrate that environmental protection and economic prosperity can be successfully linked. Furthermore, EPA and the State together can demonstrate that growth can take place in a manner that not only enhances the estuary, but also ensures that our neighborhoods, communities, and regions continue to be great places to live.

*San Francisco Estuary Project
Management Committee
Resolution: Adoption of CCMP*

Whereas:

- 1) The San Francisco Estuary Project (SFEP) is a five-year cooperative effort that has involved the active participation of diverse environmental, social, and economic interests, to promote effective management of the San Francisco Bay-Delta Estuary and to restore and maintain its water quality and natural resources.
- 2) The Management Committee (MC), as SFEP's primary decision-making body, represents a unique partnership of organizations that have overseen the preparation of a series of "Status and Trends Reports" to characterize the Estuary's problems and have worked together to prepare a Public Draft and Interim Draft Comprehensive Conservation & Management Plan (CCMP).
- 3) The purpose of the CCMP, as specified by Section 320 of the Clean Water Act, is to "restore and monitor the... integrity of shellfish, fish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected." The Act further states that the "plan shall be implemented."
- 4) The members of the Management Committee have striven to reach consensus on the CCMP goals, objectives, and actions in each program area. In those areas where consensus was not feasible, the MC made a decision by a majority vote.
- 5) Extensive public review and comment were solicited on the Public Draft CCMP through an active public outreach effort. Subsequently, the MC reviewed public comments and made revisions to the CCMP.
- 6) Costs [and benefits] of the actions to the public and private sectors have not been fully quantified and evaluated, and clear priorities have not been established to guide choices between actions competing for limited funds and related resources. Consensus March 31, 1993
- 7) Recognizing that the San Francisco Bay-Delta Estuary is one of the nation's greatest resources, the MC adopted the following vision statement for the CCMP:

"We, the people of California and the San Francisco Bay-Delta region, believe the San Francisco Estuary is an international treasure and that our ongoing stewardship is critical to its preservation, restoration, and enhancement. Acknowledging the importance of the Estuary to our environmental and economic well-being, we pledge to achieve and maintain an ecologically diverse and productive natural estuarine system."

Therefore, be it resolved that:

We, as members of the San Francisco Estuary Project Management Committee, agree to:

- 1) Adopt the Interim Draft CCMP (March, 1993) to guide development of a refined strategy on actions for implementation;
- 2) Approve the revised Regional Monitoring Strategy and include it in the CCMP package;
- 3) Direct staff to make revisions to the CCMP, as per our discussion today;
- 4) Direct staff and the Implementation Committee to revise cost estimates and to include costs to public and private sectors for CCMP actions. They will work with implementors in both government and the private sector to determine costs and benefits and potential revenue sources, establish clear priorities, and refine implementation schedules. Priorities shall be determined by the Executive Council and the Implementation Committee and take into consideration environmental as well as other costs and benefits, both direct and indirect. Consensus March 31, 1993
- 5) Forward the CCMP package to the Sponsoring Agency Committee for review, Governor Wilson for concurrence, and Administrator Browner for approval;
- 6) Work together to develop effective and efficient mechanisms to implement the Plan; and
- 7) Attach this resolution to the front of the CCMP.

This resolution was approved by the Management Committee on March 31, 1993.



Harry Seraydarian, Chair
SFEP Management Committee

Adopted by *consensus*: March 31, 1993

SAN FRANCISCO ESTUARY PROJECT
RESOLUTION ADOPTING THE
COMPREHENSIVE CONSERVATION AND MANAGEMENT PLAN

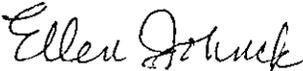
March 31, 1993



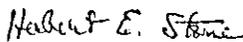
Greg Karras
Citizens for a Better Environment



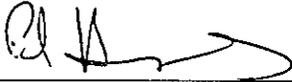
Pete Williams
Bay Area Council



Ellen Johnck
Bay Planning Coalition



Herbert E. Stone
Bay Area League of Industrial Associations



Pal Hegedus
Sacramento Metropolitan Chamber of Commerce



Harry Seraydarian
U.S. Environmental Protection Agency, Region IX
Management Committee Chair



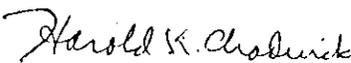
Kassandra R. Fletcher
Building Industry Association of Northern California



Leonard E. Cardoza
U.S. Army Corps of Engineers



Steven R. Ritchie
San Francisco Bay Regional Water Quality Control Board



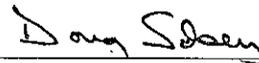
Harold M. Chadwick
California Department of Fish and Game



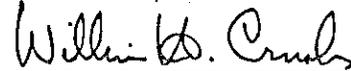
John P. Fraser
Association of California Water Agencies



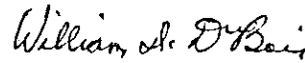
Kenneth M. Lentz
U.S. Bureau of Reclamation



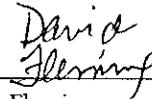
Doug Sobey
Marin Audubon Society



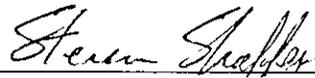
William H. Crooks
Central Valley Regional Water
Quality Control Board



William I. DuBois
California Farm Bureau Federation



David Fleming
Association of Bay Area Governments



Steven Shaffer
California Department of Food and Agriculture



Bill Gaines
California Waterfowl Association



Ronald W. Kukulka
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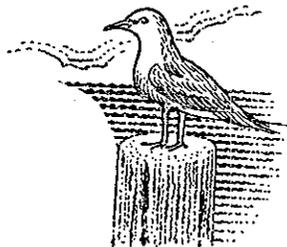
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Executive Summary

The Estuary

A Significant Natural Resource

San Francisco Bay and the Delta combine to form the West Coast's largest estuary. The Estuary conveys the waters of the Sacramento and San Joaquin Rivers to the Pacific Ocean. It encompasses roughly 1,600 square miles, drains over 40 percent of the state (60,000 square miles), and contains about five million acre-feet of water at mean tide.

The Estuary watershed provides drinking water to twenty million Californians and irrigates 4.5 million acres of farmland. The Estuary also hosts a rich diversity of aquatic life. Each year, two-thirds of the state's salmon pass through the Bay and Delta, as do nearly half of the waterfowl and shorebirds migrating along the Pacific Flyway. In addition, Estuary waters enable the nation's fourth-largest metropolitan region to pursue many activities, including shipping, fishing, recreation, and commerce.

The San Francisco Estuary Project

A Cooperative Approach to Environmentally Sound Management

Growing public concern for the health of the Bay and Delta led the U.S. Environmental Protection Agency (U.S. EPA) to establish the San Francisco Estuary Project (SFEP or Project) in 1987. The Project, part of the U.S. EPA's National Estuary Program, is a five-year cooperative effort to promote more effective management of the San Francisco Bay-Delta Estuary and to restore and maintain the Estuary's water quality and natural resources. The Project is jointly sponsored by the U.S. EPA and the State of California. It is financed by federal appropriations under the Clean Water Act and matching funds from the state and local entities.

Managing a resource as important and complex as the Estuary is a challenging task. The compelling need for environmental protection must be weighed against competing uses of Estuary waters and resources. To address this challenge, the Project brought together over one hundred representatives from the private and public sectors, including government, industry, business, and environmental interests, as well as elected officials from all twelve Bay-Delta counties. After five years, the Project's cooperative public-private partnership has reached its goal of developing a Comprehensive Conservation and Management Plan (CCMP) for the Estuary.

The Plan

A Blueprint for Estuary Conservation and Restoration

The CCMP presents a blueprint to restore and maintain the chemical, physical, and biological integrity of the Bay and Delta. It seeks to achieve high standards of water quality; to maintain an appropriate indigenous population of fish, shellfish, and wildlife; to support recreational activities; and to protect the beneficial uses of the Estuary.

For the purposes of the CCMP, restoration implies improving the health of the Estuary. Rather than attempting to completely restore the Estuary to its historical state, the CCMP strives to maintain, protect, and enhance the ecological integrity of the Estuary within the given urban context. The CCMP attempts to regain as much of the altered or destroyed wetlands as possible, to establish the highest restoration or target goals, to ensure continuance of beneficial uses, and to generally provide a sustainable ecosystem.

To develop the CCMP, the Project's Management Conference identified five critical program areas of environmental concern: 1) decline of biological resources; 2) pollutants; 3) freshwater diversions and altered flow regime; 4) dredging and waterway modification; and 5) intensified land use. Subcommittees then produced status and trends reports that summarized

the current state of the Estuary's resources. Next, the subcommittees prepared recommendations that became the basis for a CCMP Action Plan. The Management Committee reviewed a working draft of the Plan in November, 1991. The Management Committee then met frequently during the first seven months of 1992. Through facilitated, consensus-building discussions, the Management Committee developed a Draft CCMP, which was released for public comment in August of 1992. Finally, the Management Committee incorporated public comments on the Draft CCMP and finalized the CCMP. The Management Committee unanimously adopted the final CCMP at its March 31, 1993, meeting.

The CCMP sets forth this vision for the Estuary:

"We, the people of California and the San Francisco Bay-Delta region, believe the San Francisco Bay-Delta Estuary is an international treasure and that our ongoing stewardship is critical to its preservation, restoration, and enhancement. Acknowledging the importance of the Estuary to our environmental and economic well-being, we pledge to achieve and maintain an ecologically diverse and productive natural estuarine system."

The mission statements that guided the development of the CCMP are to:

- Restore and protect a diverse, balanced, and healthy population of fish, invertebrates, wildlife, plants, and their habitats, focusing on indigenous species.
- Assure that the beneficial uses of the Bay and Delta are protected.
- Improve water quality, where possible, by eliminating and preventing pollution at its source, while minimizing the discharge of pollutants from point and nonpoint sources and remediating existing pollution.
- Manage dredging and waterway modifications to minimize adverse environmental impacts.
- Effectively manage and coordinate land and water use to achieve the goals of the Estuary Project.
- Increase public knowledge about the Estuary ecosystem and public involvement in the restoration and protection of the health of the Estuary.
- Increase our scientific understanding of the Estuary and use that knowledge to better manage the Estuary.
- Develop and expand non-regulatory programs, such as public-private partnerships and market incentives, in conjunction with regulatory programs, to achieve the goals of the Project.
- Preserve and restore wetlands to provide habitat for wildlife, improve water quality, and protect against flooding.
- Assure an adequate freshwater flow as one of the essential components to restore and maintain a clean, healthy, and diverse Estuary.

Adoption of the Plan

Governor and Administrator Approval

After the Management Committee approved the CCMP, it was sent to the Project's Sponsoring Agency Committee (SAC) for review. The SAC forwarded the Plan to the Governor of California and the Administrator of the U.S. Environmental Protection Agency. Governor Wilson concurred on the CCMP on November 17, 1993. Administrator Browner approved the CCMP on December 9, 1993. Formal implementation of the Plan may now commence.

CCMP Program Areas

In the sections that follow this Executive Summary, you will find program areas on Aquatic Resources, Wildlife, Wetlands Management, Water Use, Pollution Prevention and Reduction, Dredging and Waterway Modification, Land Use, Public Involvement and Education, and Research and Monitoring. Each program area includes the following elements:

- A problem statement;
- Discussion of the existing management structure;
- Program area goals;

- A recommended approach to the problem; and
- The stated objectives and actions.

For purposes of this Executive Summary, the discussion of the existing management structure has been eliminated, and the list of actions abbreviated. Therefore, not all recommended actions for a particular program area will appear in this Summary.

Aquatic Resources

The Problem

Native flora and fauna in Estuary waters have declined precipitously in recent years. This is largely the result of human activities that modify waterways, impair water quality, alter freshwater flows, and introduce non-native species. For example, water development projects reduce Delta outflows and contribute to an increase in salinity levels in the lower reaches of the Estuary. The projects thereby eliminate low-salinity habitat necessary for certain estuarine-dependent species. Water diversion facilities can also trap and displace migrating fish.

As a result of these habitat modifications, the number of Chinook salmon returning to spawn in the Estuary's tributaries has declined by 70 percent from historical levels. Populations of striped bass, Delta smelt, longfin smelt, Sacramento split-tail, and California bay shrimp—all of which depend on the Estuary for reproduction and survival—are also in decline.

During the past century, at least one hundred species of non-native aquatic invertebrates have been introduced into the Estuary. This has also taken its toll on native species. For example, the Asian clam, *Potamocorbula amurensis*, has reached populations of up to 30,000 clams per square meter in some places. The clam is rapidly replacing native bottom-dwelling organisms and interfering with the aquatic food supply.

Recommended Approach:

The Aquatic Resources section of the CCMP Action Plan seeks to build on cooperative efforts already underway among government agencies, non-governmental organizations, academic institutions, and water consumers to improve the management of aquatic resources in the Estuary. This section recommends development of a comprehensive plan to manage estuarine aquatic resources, development of species-specific management plans to control or eliminate undesirable non-indigenous species, and adoption of standards for salinity and flow that will increase the probability of successful reproduction and survival of important living resources.

Goals

- Stem and reverse the decline in the health and abundance of estuarine biota (indigenous and desirable non-indigenous), with an emphasis on natural production.
- Restore healthy estuarine habitat conditions to the Bay-Delta, taking into consideration all beneficial uses of Bay-Delta resources.
- Ensure the survival and recovery of listed and candidate threatened and endangered species, as well as other species in decline.
- Optimally manage the fish and wildlife resources of the Estuary to achieve the purpose of these goals.

Actions

Actions to achieve water quality, flows, and management goals include such measures as:

- Designing, installing, and effectively operating fish screens or other protective devices at diversions associated with fish mortality;
- Protecting and restoring shaded riverine aquatic habitats;
- Identifying alternative water quality and flow standards, water management measures, operational changes, habitat improvements, and facilities to improve protection of estuarine resources;
- Adopting and implementing measures to control discharges of ship ballast water within the Estuary or adjacent waters;
- Prohibiting the intentional introduction of exotic species into the Estuary and its watershed;
- Providing necessary instream flows and temperatures in tributaries to the Delta to benefit anadromous fish;
- Identifying and protecting remnant stream habitats containing indigenous and endemic fishes by establishing Aquatic Diversity Management Areas;
- Implementing the Upper Sacramento River Management Plan; and
- Developing and implementing a San Joaquin River management plan.

Wildlife

The Problem

Many of the Estuary's wildlife species are in long-term decline, succumbing to urban growth, pollution, water development, disease, predation, loss of habitat, and other factors. In particular, development over the past 140 years has drastically reduced and fragmented the Estuary's native wildlife habitats, forcing wildlife to concentrate in small, isolated areas. Primarily as a result of habitat loss, at least seven insect species, one reptile species, three bird species, and five mammal species have become extinct in the Estuary region.

The environmental changes associated with human activities and regional population growth continue to have an enormous impact on the Estuary's wildlife. Total waterfowl numbers in the Estuary dropped from a record high of 1.3 million in 1977 to a low of 109,000 in 1982. Populations of dabbling ducks and geese are at all-time lows. Meanwhile, growing numbers of red fox (a non-native species) continue to prey on many shorebird populations, including the endangered California clapper rail. Unlike the fox, however, many small native mammals and carnivores can now find little food and habitat in the Estuary's fast-developing counties.

As a result of these declines, federal and state governments have designated over 130 species of fish, insects, amphibians, reptiles, birds, mammals, and plants in the Estuary as deserving of special protection or monitoring.

Recommended Approach:

Many of the problems associated with the decline in abundance and diversity of the Estuary's wildlife are interrelated. This section of the CCMP Action Plan can only be effective when coupled with other actions identified throughout the CCMP. Recommended actions in other sections, such as increasing and protecting critical habitat, increasing biodiversity, decreasing harmful pollutants, and managing freshwater flows through the Estuary, will collectively help restore populations of Bay-Delta wildlife.

Goals

- Stem and reverse the decline of estuarine plants and animals and the habitats on which they depend.
- Ensure the survival and recovery of listed and candidate threatened and endangered species, as well as special status species.
- Optimally manage and monitor the wildlife resources of the Estuary.

Actions

Actions designed to achieve wildlife protection goals include:

- ❑ Preserving, creating, restoring, and managing large and contiguous expanses of tidal salt marsh and necessary adjacent uplands;
- ❑ Completing the expansion of the San Francisco Bay National Wildlife Refuge and its satellite refuges;
- ❑ Restoring tidal marshes in San Francisco Bay;
- ❑ Identifying and converting/restoring non-wetland areas to wetland- or riparian-oriented wildlife habitat;
- ❑ Enhancing the biodiversity within all publicly owned or managed wetlands and other wildlife habitats as appropriate;
- ❑ Completing and implementing a wildlife habitat restoration and management plan for the Estuary;
- ❑ Implementing predator control programs;
- ❑ Updating and, where necessary, preparing recovery plans for all listed wildlife species; and
- ❑ Monitoring the status of all candidate species and listing them if warranted.

Wetlands

The Problem

In 1850, the Estuary's tidal marshes covered 545,371 acres. By 1985, they had dwindled to approximately 45,000 acres, due largely to urban and agricultural development. These losses have reduced the Estuary's capacity to support sustainable populations of fish and wildlife and to provide the other benefits associated with wetlands. Of the thirty-two wildlife species whose populations are currently declining, twenty-three are associated primarily with wetlands. Although wetlands degradation and conversion have slowed substantially since the 1970s, wetland losses continue. Unless substantial efforts are made to avoid future losses and increase wetland acreage and values, the health of the Estuary will continue to deteriorate.

Recommended Approach:

The Wetlands Management Program seeks to improve wetlands regulation and management for all ecological wetlands, consistent with the general welfare of the state and with respect to private property rights, by identifying ways for state, federal, and local agencies to work together more effectively. This section intends to expand efforts to acquire, enhance, restore, and create wetlands, as well as improve existing regulatory mechanisms.

The actions recommended here establish clear, non-duplicative goals and policies for wetlands protection and restoration and encourage private initiatives to protect wetlands. This section also recommends that the state government develop a comprehensive wetlands protection program that recognizes the Bay-Delta Estuary as a resource of statewide significance and relies on local wetlands protection programs.

Goals

- ❑ Protect and manage existing wetlands.
- ❑ Restore and enhance the ecological productivity and habitat values of wetlands.
- ❑ Expedite a significant increase in the quantity and quality of wetlands.
- ❑ Educate the public about the values of wetlands resources.

Actions

Actions within the Wetlands Management area include:

- Preparing a Regional Wetlands Management Plan;
- Encouraging geographically focused cooperative efforts to protect wetlands;
- Establishing a comprehensive state wetlands program for the Estuary;
- Increasing enforcement efforts to curtail illegal wetlands alteration and ensure compliance with permit conditions;
- Developing and adopting uniform compensatory mitigation policies;
- Expanding wetlands acquisition programs; and
- Identifying and converting/restoring non-wetlands areas to wetlands- or riparian-oriented wildlife habitat.

Water Use

The Problem

Northern California rivers and streams carry two-thirds of the state's available fresh water. However, water diversions at more than seven thousand locations for purposes such as agriculture, flood control, and drinking water storage reduce the annual volume of fresh water entering San Francisco Bay by more than one-half in some years. The resulting changes in the Estuary's natural flow patterns (often referred to as altered flow regime) affect the Estuary's circulation and water quality, as well as habitat conditions for wildlife, production of phytoplankton and zooplankton, and the survival of eggs and young of many fish species. Construction of currently planned local water development projects and completion of the State Water Project will likely increase annual diversions from the Estuary's water supply by at least 1.1 million acre-feet. With demand for the Estuary's limited freshwater supply increasing on all sides, California is now struggling to manage competing demands and protect the health of the estuarine ecosystem.

Recommended Approach:

This section of the CCMP strongly encourages conservation of existing water supplies. Agricultural, urban, and industrial water users should develop and implement aggressive water conservation measures statewide. By providing funding for research and pilot projects, government can foster further conservation of water used for agriculture. This section encourages more efficient use of existing water supplies, combined with development of new supplies, by promoting use of reclaimed water to reduce: 1) existing diversions of fresh water; 2) demand for increased diversions; and 3) existing discharge of wastewater directly into the Estuary. Legal and regulatory methods to achieve such reductions could include pricing incentives and water-marketing arrangements.

The development of new storage and conveyance facilities, coupled with more efficient use of existing supplies, can help reduce the problems associated with water diversion in the Estuary watershed. Methods of augmenting water supplies include, but are not limited to, reclamation, conservation, water transfers, water-marketing agreements, and conjunctive use of groundwater. (Conjunctive use refers to the coordinated management of groundwater and surface water supplies that results in more efficient use of both water sources.)

Goal

- Develop and implement aggressive water management measures to increase freshwater availability to the Estuary.

Actions

Water Use actions include:

- Encouraging publicly owned treatment works, municipalities, and water districts to complete water reclamation and reuse feasibility studies;
- Ensuring that state water quality standards and Basin Plans encourage water reclamation and reuse;
- Working to develop a mechanism to ensure implementation of efficient agricultural water management practices;

- ❑ Researching new methods of agricultural water conservation;
- ❑ Evaluating and adopting mechanisms to manage groundwater to protect the long-term integrity of groundwater basins;
- ❑ Creating the legal and regulatory framework for voluntary water-marketing agreements among agricultural, urban, and environmental interests; and
- ❑ Encouraging the state to continue to negotiate with the federal government regarding the possible transfer of ownership or operational control of the Central Valley Project to a non-federal entity.

Pollution Prevention and Reduction

The Problem

The marked reduction in conventional pollutants entering the Estuary over the past forty years has largely eliminated the most obvious symptoms of water pollution, such as odors, algal blooms, and low oxygen levels. But other pollutants, such as trace elements, organochlorines and other synthetic pesticides, and petrochemical hydrocarbons, continue to be of major concern.

Each year, an estimated five to forty thousand tons of at least sixty-five pollutants enter the Estuary from urban and agricultural runoff, municipal wastewater treatment plants, industrial facilities, dredging, chemical spills, and atmospheric deposition. The pollutants reach highest concentrations in harbors, marinas, and industrial waterways and at effluent discharge sites. High pollutant levels have produced toxic effects in the Estuary's fish, shellfish, bird, and mammal species. Studies indicate that certain pollutants are reducing reproductive success in the starry flounder and causing decreased embryo size and eggshell thickness in black-crowned night heron eggs.

These effects indicate that much of the Estuary is threatened or impaired by combinations of different toxic pollutants. With urban land uses expected to expand, pollutant loading from all sources will increase substantially.

Recommended Approach:

Protection of estuarine species and human health requires that the pollutant problem be addressed in a comprehensive manner that includes: 1) pollution prevention; 2) control and reduction of pollutants that cannot be avoided; and 3) remediation of existing contamination. This program proposes both the full implementation of existing regulations and, where necessary, the development of new initiatives to reduce pollution at its source. The pollution actions identify methods to integrate existing regulatory programs and enforce existing statutes more effectively. This area also recommends policy initiatives for pollution prevention.

Goals

- ❑ Promote mechanisms to prevent pollution at its source.
- ❑ Where pollution prevention is not possible, control and reduce pollutants entering the Estuary.
- ❑ Clean up toxic pollution throughout the Estuary.
- ❑ Protect against toxic effects, including bioaccumulation and toxic sediment accumulation.

Actions

Actions designed to reduce, prevent, control, and alleviate pollution include:

- ❑ Establishing specific goals for reducing the discharge of toxic pollution over time and discouraging reliance on toxic materials;
- ❑ Developing environmental audit procedures for all significant users and producers of toxic substances;
- ❑ Reinforcing existing programs and developing new incentives to reduce selenium levels in agricultural drainage;

- Developing a comprehensive strategy to reduce pesticides in the Estuary;
- Pursuing a mass emissions strategy to both reduce pollutant discharges into the Estuary from point and nonpoint sources and to address the accumulation of pollutants in estuarine organisms and sediments;
- Adopting water quality objectives that effectively protect estuarine species and human health;
- Improving the management and control of urban runoff from public and private sources;
- Developing control measures to reduce pollutant loadings from energy and transportation systems;
- Establishing a model environmental compliance program at federal facilities;
- Cleaning up contaminants presently affecting fish, wildlife, and their habitats; and
- Expediting the clean up of toxic hot spots in estuarine sediments.

Dredging and Waterway Modification

The Problem

To maintain the navigability of the region's harbors, marinas, and shipping channels, dredgers remove over eight million cubic yards of sediment from the Estuary floor each year. Although critical to the Estuary's economic well-being, such extensive dredging and waterway modification activities have had significant environmental impacts. In the Bay and Delta, waterway channelization, shoreline riprapping, urban development, and flood control projects have eliminated or degraded wetlands and riparian wildlife habitats, increased seasonal storm flows, and changed sediment movement and distribution in the estuarine ecosystem.

Environmental impacts associated with dredging and disposal of dredged material in the Bay include redistribution of toxic pollutants, burial of bottom-dwelling organisms, and resuspension of sediment particles, which causes turbidity and reduces fishing success in and around disposal sites. In the late 1980s, these kinds of environmental concerns and the accumulation of dredged sediments at the Alcatraz disposal site—a navigational hazard—brought disposal practices into question. State and federal agencies and concerned citizens then called for the development of more environmentally sound dredging and disposal methods for the future.

Recommended Approach:

Much of the approach described here derives from the Long-Term Management Strategy (LTMS) for dredging and disposal, a regional effort begun in 1989 by thirty different government agencies, environmental organizations, development interests, ports, and fishing organizations. The LTMS seeks to develop technically feasible, economically prudent, and environmentally acceptable long-range ways to meet the region's dredging and disposal needs over the next fifty years. The effort sprang directly from SFEP's cooperative discussions and research on dredging and waterway modification in 1988 and 1989.

The LTMS will evaluate all potential disposal options, including ocean sites, in-Bay sites, and upland alternatives, such as reuse of dredged material for wetlands creation or other projects. By supporting this broad-based effort, this section of the CCMP seeks to provide the framework for developing connections among many issues facing the Estuary, including improvement of waterway modification practices, sediment management, and ecosystem protection and enhancement.

Goals

- Adopt a sediment management strategy for dredging and waterway modification.
- Manage modification of waterways to avoid or offset the adverse impacts of dredging, flood control, channelization, and shoreline development and protection projects.
- Eliminate unnecessary dredging activities.
- Maximize the use of dredged material as a resource.
- Conduct dredging activities in an environmentally sound fashion.

Actions

Actions to achieve the goals in this area include:

- ❑ Conducting studies on sediment dynamics aimed at defining accretion (the addition of soil to land by gradual, natural deposits) and erosion processes in marsh and mudflat areas;
- ❑ Developing and setting sediment quality objectives;
- ❑ Identifying dredged material reuse/nonaquatic disposal opportunities and constraints;
- ❑ Developing regulatory land use procedures to promote reuse of dredged material for wetlands restoration/creation and other beneficial uses; and
- ❑ Implementing waterway modification policies that protect shoreline areas from detrimental flooding and erosion while maintaining natural resource values.

Land Use

The Problem

With over one million new inhabitants expected during the next two decades, population growth and land use change in the twelve-county Estuary area will continue to increase pollutants, alter wetland and stream habitats, and otherwise adversely affect the Estuary's health. Because state planning laws do not require Estuary protection, local government land use decisions rarely consider impacts on this regional resource.

Recommended Approach:

This section of the CCMP seeks to enhance the Estuary, while ensuring economic development to meet vital housing, transportation, and other needs. It focuses on using existing local land use decision-making mechanisms to protect wetlands and stream environments and reduce pollutants and runoff.

Goals

- ❑ Establish and implement land use and transportation patterns and practices that protect, enhance, and restore the Estuary's open waters, adjacent wetlands, adjacent essential uplands habitat, and tributary waterways.
- ❑ Coordinate and improve planning, regulatory, and development programs of local, regional, state, and federal agencies to improve the health of the Estuary.
- ❑ Adopt and utilize land use policies that provide incentives for more active participation by the private sector in cooperative efforts that protect and improve the Estuary.

Actions

Actions to achieve land use goals include:

- ❑ Integrating protection of the Estuary with other state land use-related initiatives;
- ❑ Adopting policies and plans to promote compact, contiguous development;
- ❑ Developing and implementing guidelines for site planning and best management practices;
- ❑ Educating the public about how human actions impact the Estuary;
- ❑ Creating economic incentives that encourage local governments to implement measures to protect and enhance the Estuary; and
- ❑ Investigating and creating market-based incentives that promote more active private sector participation in cooperative efforts to protect and restore the Estuary.

Public Involvement and Education

The Problem

Public involvement will be essential for effective implementation of the CCMP. Public involvement will make the difference between general concern and informed action, and between complacency and directed public will. Without a united and organized public constituency able to monitor the ongoing management of the Estuary, achievement of the CCMP's goals, objectives, and individual actions cannot be assured. Only when it comes to understand and embrace the CCMP will the public be able to promote, support, use, enforce, and watchdog the Plan through the critical years of its implementation.

Recommended Approach:

This section of the CCMP provides for a strong public involvement program enabling educated and motivated volunteers to invest in sustaining and restoring the Estuary. In a time of severe budget constraints in both government and the private sector, the public's skills, energy, and enthusiasm can serve as low-cost alternative resources to solve many of the Estuary's problems. Through actions recommended in this section, the public can also provide informed activism, trained and vigilant monitoring, and other support vital to the CCMP.

Goals

- Build public understanding of the value of the Estuary's natural resources and the need to restore, protect, and maintain a healthy Estuary for future generations.
- Increase public involvement in the ongoing stewardship of the Estuary.

Actions

Actions designed to encourage CCMP education, advocacy, and citizen involvement include:

- Building awareness, interest, and support of the CCMP's goals and action plans by the general public and decision-makers;
- Providing and encouraging opportunities for direct citizen involvement in CCMP implementation;
- Seeking, encouraging, and actively supporting environmental projects and programs that are consistent with CCMP goals and objectives;
- Developing, promoting, and supporting multicultural understanding of and involvement in Estuary issues;
- Developing and promoting necessary public education tools;
- Holding a State of the Estuary Conference at least every other year; and
- Providing opportunities for hands-on citizen action in Estuary restoration activities.

Research and Monitoring

The Problem

Environmental decision-makers and managers need continuous access to timely scientific research to refine existing strategies and formulate new methods for protecting the Estuary's resources. Effective use of research results requires strong alliances among managers, scientists, educators, and the public. In addition, new institutional arrangements are necessary to broaden existing environmental research and monitoring programs for the Estuary.

Recommended Approach:

A new institutional arrangement is necessary to implement a coordinated research and monitoring program concerned with the broadest range of issues facing the Estuary. The central recommendation of this section is the establishment of a San Francisco Estuarine Institute* to assist in gathering, analyzing, and disseminating information on all environmental

*According to its by-laws adopted in May, 1994, the San Francisco Estuarine Institute has changed its name to the San Francisco Estuary Institute.

issues of concern to the Estuary. This specifically includes oversight of a Research Enhancement Program and the Regional Monitoring Strategy, which are currently under development.

Goal

- ❑ Improve the scientific basis for managing natural resources within the Estuary through an effective monitoring and research program.

Actions

Recommended Research and Monitoring actions include:

- ❑ Establishing a San Francisco Estuarine Institute for coordination of research and monitoring;
- ❑ Providing a long-term administrative home for the Research Enhancement Program; and
- ❑ Developing and implementing the Regional Monitoring Strategy, which will integrate and expand upon existing efforts and will eventually be part of the comprehensive Regional Monitoring Program.

Implementation of the CCMP

The development of this Comprehensive Conservation and Management Plan is only the first step towards achieving and maintaining an ecologically diverse and productive estuarine system. In order to achieve the goals and the vision described in the CCMP, its recommended actions must be implemented. Further, implementation of the recommended actions will require strong public support, adequate funding, and the cooperation of multiple parties.

Effective implementation will require close coordination among the variety of public, local, state, and federal organizations that have responsibility for managing the Estuary. Therefore, the Management Committee has proposed an implementation structure under which an Executive Council will have primary responsibility for implementing the CCMP. An Implementation Committee will coordinate implementation activities under the broad policy direction of the Executive Council. The Implementation Committee will convene subcommittees and working groups as necessary.

The Science/Technical Review Committee, through the San Francisco Estuarine Institute, will ensure that the CCMP's Research and Monitoring Program is carried out and will provide technical support for implementation activities.

Friends of the San Francisco Estuary will implement the CCMP's Public Involvement and Education Program and will provide a public review and involvement function for CCMP implementation.



*San Francisco Estuary Project Management Conference
Members & Active Alternates*

Sponsoring Agency Committee

CHAIR—Dan McGovern, U.S. Environmental Protection Agency, Region IX
W. Don Maughan, State Water Resources Control Board
Pamela Lloyd, San Francisco Bay Regional Water Quality Control Board
Clifford C. Wisdom, Central Valley Regional Water Quality Control Board

Management Committee

CHAIR - Harry Seraydarian, U.S. Environmental Protection Agency, Region IX ³

Business/Water/Discharger

Chuck Batts, Bay Area Dischargers Association ^{5, 8}
William DuBois, California Farm Bureau Federation ^{3, 4}
John Fraser, Association of California Water Agencies ³
Kassandra Fletcher, Building Industry of Northern California ^{2, 6, 8}
Alternate: Dan Boatwright, Jr., The Hoffnan Company
Roger James, Santa Clara Valley Water District (BASMAA)
Ellen Johnck, Bay Planning Coalition ^{5, 6, 8}
Herbert Stone, Bay Area League of Industrial Associations ⁵
Pete Williams, Bay Area Council

Alternate: Ken Guziak

Pal Hegedus, Sacramento Metropolitan Chamber of Commerce

Environment/Conservation

Greg Karras, Citizens for a Better Environment ^{4, 5}
Richard Oba, United Anglers of California
Arthur Feinstein, Citizens Committee to Complete the Refuge ^{1, 2, 8}
Barbara Salzman, Marin Audubon Society ^{1, 2, 6, 8}
Neil Havlik, Solano County Farmlands and Open Space Foundation
Jay R. Sorensen, California Striped Bass Association
Alternate: Ralph Dradson
Zeke Grader, Pacific Coast Federation of Fishermen's Associations
Herbert W. Von Colditz, Pacific Interclub Yachting Association/Recreational Boaters of California
Alternate: Leonard Long ⁴
Totton Heffelfinger, Sierra Club/San Francisco Bay Chapter ²
Alternate: Jackie McCort
Barry Nelson, Save San Francisco Bay Association ^{1, 3, 4, 8}
Alternate: Marc Holmes ²
Bill Gaines, California Waterfowl Association

Number notations following members' names indicate membership on subcommittees. Numbers correspond to subcommittees on ¹Biological Resources, ²Wetlands, ³Flows, ⁴Dredging/Waterway Modification, ⁵Pollutants and Quality Assurance/Quality Control, ⁶Land Use, ⁷Research Enhancement Program, and ⁸Planning. Unless otherwise designated, all alternates are from the same organization or agency as the committee member.

Local Government/Civic

Supervisor Albert Aramburu, County of Marin

Mayor David Fleming, City of Vacaville (ABAG Representative) ^{3,6}

Arliss Ungar, League of Women Voters of the Bay Area ^{2,3}

Alternate: Elva Edger

Councilmember Bobbie Landers, City of Orinda (Contra Costa Cities)

Alternate: Councilmember Terri Williamson, City of Pleasant Hill

Supervisor Kevin Shelley, City and County of San Francisco

Alternate: Michele Pla', San Francisco Clean Water Program ^{3,8}

Supervisor Sunne Wright McPeak, Committee for Water Policy Consensus ⁸

Alternate: Lori Griggs

Mayor Anne Rudin, City of Sacramento

Alternate: Jim Sequeira, City of Sacramento Water Division

State Agencies

A.J. Yates, California Department of Food and Agriculture

H.K. Chadwick, California Department of Fish and Game ³

William Crooks, Central Valley Regional Water Quality Control Board

Alternate: Paul Jepperson

Ed Anton, State Water Resources Control Board

Alternate: Jerry Johns ³

Peter Grenell, California Coastal Conservancy

Steven Ritchie, San Francisco Bay Regional Water Quality Control Board ⁸

Alternate: Loretta Barsamian

Steve McAdam, San Francisco Bay Conservation and Development Commission ^{1,2,3,8}

Alternate: Jeffrey Blanchfield ⁶

Robert Potter, California Department of Water Resources ³

Alternate: Dr. Randall Brown

Dr. Wolfgang Fuhs, California Department of Health Services ⁵

Federal Agencies

James Bybee, National Marine Fisheries Service

Alternate: Chris Mobley ^{2,3,4,8}

Lt. Colonel Larry Jinkins, U.S. Army Corps of Engineers

Commander Lee Michlin, Naval Facilities Engineering Command

Kenneth Lentz, U.S. Bureau of Reclamation

James J. McKeivitt, U.S. Fish and Wildlife Service ⁸

Ex-Officio

Public Advisory Committee Chair--James Haussener, California Marine Parks and Harbors Association

Technical Advisory Committee Chair--Tom Wakeman, U.S. Army Corps of Engineers

Public Advisory Committee

CHAIR--James Haussener, California Marine Parks and Harbors Association ⁸

Agriculture

George Dupray, California State Grange

Philip Bowles, Bowles Farming

Kathy Mannion, Western Growers Association

Business/Water-Related Industry

Judith Moorad, Western Oil and Gas Association

Citizens-at-Large

Betty Croly ⁶

Emily Renzel ⁶

Ted Smith

Civic Organizations

Robert Rabb, San Francisco Planning & Urban Research Association (SPUR)

Jane Rogers, San Francisco Foundation

Education/Research

Steve Cochrane, Hayward Shoreline Interpretive Center

Rita Schmidt-Sudman, Water Education Foundation

Environmental Organizations

Richard Izmirian, Federation of Fly Fishers

Ernie Goitein, Peninsula Conservation Center Foundation

Labor

Art Santos, Plumbers and Steamfitters Union Local 467

Recreation

Jeremy West, Dolphin Swim and Boating Club

M'K Veloz, Northern California Marine Association

Shipping

Robert Langner, California Marine Affairs and Navigation Conference

Alternate: William Boland ⁴

Patrick Ryan, Port of Oakland

Diane Kelly, California Association of Port Authorities

Wetlands

Trish Mulvey, Citizens Committee to Complete the Refuge ^{1, 4, 5, 6, 8}

A.L. Riley, Golden State Wildlife Federation

Elected Officials—Counties

Supervisor Jan Stewart, Solano County

Supervisor Edward Campbell, Alameda County

Supervisor Ernest Carpenter, Sonoma County

Supervisor Illa Collin, Sacramento County

Alternate: Douglas Fraleigh, Sacramento County Public Works

Supervisor George Demars, Yolo County

Supervisor Anna Eshoo, San Mateo County

Alternate: Mem Levin ⁶

Supervisor Nancy Fahden, Contra Costa County

Elected Officials--Cities

Vice Mayor Robert Glaze, City of San Leandro
Gene Roh, City of West Sacramento

Public Institutions

Charles Warren, State Lands Commission
Alternate: Elizabeth Patterson
Betty Harris, California Association of Resource Conservation Districts
Henry Holmes, Urban Habitat Program
Robert Manning, State Reclamation Board
Doug Nadeau, Golden Gate National Recreation Area
David Schuster, State Water Contractors
Alternate: Thomas Rinn³
Martin Vitz, East Bay Regional Park District
Alternate: Ken Burger
Rodney Kilcoyne, Council of Bay Area Resource Conservation Districts
Luana Kiger, U.S. Soil Conservation Service
John Steiner, San Francisco Bay National Wildlife Refuge

Technical Advisory Committee

CO-CHAIRS--Tom Mumley, San Francisco Bay Regional Water Quality Control Board^{5, 6, 7}
Tom Wakeman, U.S. Army Corps of Engineers^{4, 7, 8}

Academic

Donald Crosby, Department of Environmental Toxicology, U.C. Davis
Terrence Gosliner, California Academy of Sciences
John Harte, Energy and Resources Group, U.C. Berkeley
Michael Herz, The BayKeeper³
James Hollibaugh, Romberg Tiburon Center, San Francisco State University
Joe O'Connor, Aquatic Habitat Institute^{4, 5, 7}
Gary Page, Point Reyes Bird Observatory
Robert Riseborough, Marine Science Studies, U.C. Santa Cruz
Steve Monismith, Department of Civil Engineering, Stanford University⁷
Robert Spies, Lawrence Livermore National Laboratory⁵
John Cashman, UCSF School of Pharmacy⁵
Jeff Koseff, Department of Civil Engineering, Stanford University
Tom Powell, Department of Environmental Studies, U.C. Davis⁷

State

Michael Carlin, San Francisco Bay Regional Water Quality Control Board^{4, 7}
Randall Brown, Department of Water Resources^{1, 5, 7}
Alternate: Ed Winkler
Wolfgang Fuhs, California Department of Health Services⁵
Marshall Lee, California Department of Food and Agriculture
Gerald Pollock, California Environmental Protection Agency, Pesticide and Environmental Toxicology Section
Michael Rugg, California Department of Fish and Game
Alternate: Perry Herrgesell^{1, 7}
Leo Winternitz, State Water Resources Control Board^{5, 7}
Alternate: Tom Tamblyn
Greg Gartrell, Contra Costa Water District
Alternate: Richard Denton

Federal

James Arthur, U.S. Bureau of Reclamation ¹
 David Young, U.S. Environmental Protection Agency ⁵
 Brian Melzian, U.S. Environmental Protection Agency
 Frederic Nichols, U.S. Geological Survey ^{1,7}
 Roger Hothem, U.S. Fish and Wildlife Service ¹
 David Peterson, U.S. Geological Survey
 Larry Schemel, U.S. Geological Survey ⁵
 Larry Smith, U.S. Geological Survey
 Jeannette Whipple, National Marine Fisheries Service

Subcommittee Members

Dennis Barry, Contra Costa County ⁶
 Bob Batha, San Francisco Bay Conservation and Development Commission ¹
 Mike Cheney, California Marine Affairs and Navigation Conference ⁴
 Shelley Clarke, U.S. Environmental Protection Agency ⁴
 Jim Cloern, U.S. Geological Survey ⁷
 Pat Foster-Turley, Marine World Foundation ⁷
 Steve Goldbeck, San Francisco Bay Conservation and Development Commission ⁴
 Archie Greenberg, East Bay Municipal Utility District ⁵
 Tom Harvey, U.S. Fish and Wildlife Service ^{1,2}
 Bruce Herbold, U.S. Environmental Protection Agency ^{1,7}
 Alan Jassby, Department of Environmental Studies, U.C. Davis ^{1,7}
 Margaret Johnston, Aquatic Habitat Institute ⁷
 Michael Josselyn, Romberg Tiburon Center, San Francisco State University ⁷
 Joan Jurancich, State Water Resources Control Board ¹
 Kent Kitchingman, U.S. Environmental Protection Agency ⁵
 Stanley Klemetson, Building Industry Association ⁵
 John Krautkraemer, Environmental Defense Fund ³
 Robb Leidy, U.S. Environmental Protection Agency ²
 John Malamut, Bay Planning Coalition ⁶
 Tom Maurer, U.S. Fish and Wildlife Service ⁵
 Jim McDaniel, Department of Water Resources ³
 Barry Montoya, Central Valley Regional Water Quality Control Board ⁵
 Richard Morat, U.S. Fish and Wildlife Service ³
 Peter Morse, Sacramento County Planning Department ⁶
 Peter Moyle, Department of Wildlife and Fisheries Biology, U.C. Davis ^{1,7}
 Denis Nickel, U.S. Soil Conservation Service ¹
 Phil Oshida, U.S. Environmental Protection Agency ⁴
 Maria Rea, U.S. Environmental Protection Agency ⁵
 John Renning, U.S. Bureau of Reclamation ³
 Emily Renzel, City of Palo Alto ⁶
 Liza Riddle, California Coastal Conservancy ²
 Carol Schemmerling, Urban Creeks Council ⁴
 Fred Seto, Hazardous Materials Laboratory, California Department of Health ⁵
 Doris Sloan, Department of Geology, U.C. Berkeley ⁷
 Bob Tasto, California Department of Fish and Game ⁴
 Mike Vasey, Department of Biology, San Francisco State University ⁷



I

INTRODUCTION

*"A thing is right when it tends to preserve the integrity,
stability, and beauty of the biotic community.
It is wrong when it tends otherwise."*

Aldo Leopold,

A Sand County Almanac, 1949

The San Francisco Bay-Delta Estuary is a rich and treasured resource. The Bay-Delta region, which provided a home for the early Native Americans and sparked the imagination of Jack London, is today the center of one of the world's strongest economic areas. The biological diversity of the area is matched only by its economic diversity, which supports a thriving tourist trade alongside major shipping and industrial facilities. The rich ecology and enduring economy ensure the San Francisco Estuary's national and international importance.

The Importance of the San Francisco Bay-Delta Estuary

An Ecological Treasure

The San Francisco Bay-Delta Estuary is the largest estuarine system on the West Coast of the United States. It drains over 40 percent of California's land and includes the waters of San Francisco Bay, San Pablo Bay, Suisun Bay, and the Sacramento-San Joaquin Delta.

The Estuary is an immensely productive ecosystem that supports a diverse community of plant, animal, and aquatic life. Half of the birds migrating along the Pacific Flyway use the Estuary's wetlands for wintering. Pintails, canvasbacks, widgeons, and other waterfowl breed here. In certain seasons, the Estuary's mudflats and saltflats support more than one million shorebirds.

In addition to providing fisheries and wildlife habitat, wetlands improve water quality by filtering pollutants. They also protect urban and agricultural areas from flooding. However, today only 44,371 acres of historical tidal wetlands remain in the Estuary. Approximately 92 percent of the Estuary's historical tidal wetlands have been filled, diked, or developed.

Over 130 fish species live in the Estuary. Hundreds of thousands of native and hatchery-bred salmon, including four separate runs of Chinook salmon, migrate through Bay-Delta waters. Historically, more than half a million Chinook salmon returned each year from the ocean to spawn in the Estuary. Today, the number is drastically lower, and the winter-run salmon is listed as endangered under the federal Endangered Species Act.

The number of striped bass, a highly prized sport fish, has decreased from between three and four million in the 1960s to just over half a million today. Its population is maintained primarily from hatchery stocks.

Economic Importance

Northern California's economy is one of the strongest in the United States. In 1990, the gross regional product for the nine Bay Area counties alone was estimated at \$168 billion. Over three million people were employed in this region.

The Estuary region's economy is based on a variety of industries ranging from petroleum production and refining in the East Bay to nationally important high-tech computer development in the South Bay. Many of these industries rely directly or indirectly on the Estuary's natural resources.

Manufacturing provides 600,000 jobs in the twelve-county Bay-Delta region. Manufacturing depends on a plentiful, high-quality water supply, available wastewater facilities, and adjacent transportation systems, such as railways, highways,

and ports. An important contributor to the area's economic position is the construction industry, which supplies homes for millions of the Estuary's inhabitants and jobs for 209,000 people.

Over 3,500 commercial vessels enter the San Francisco Bay each year, making the shipping industry one of the largest on the West Coast. In 1989, the six major Estuary ports handled over twenty-three million tons of cargo (excluding liquid bulk). Industry sources indicate that, in 1985, over 45,000 jobs were supported by shipping, generating \$3 billion in gross sales transactions.

Agriculture is one of the most resource-dependent of all the businesses operating within the Estuary region. It employs over 51,000 people. Agriculture requires land for production and water for crop irrigation. California agriculture generates an estimated \$18 billion a year and an estimated \$3.5 billion in the twelve Bay-Delta counties. It is also responsible for 11 percent of the total U.S. agricultural production annually and over 50 percent of the total U.S. vegetable production annually.

The Estuary's natural resources and scenic beauty contribute to the region's significant tourist industry. In 1990, visitors to San Francisco spent \$3.9 billion on tourist-related activities, supporting 66,000 jobs.

Commercial and sport fishing depend directly on the Estuary's natural resource base. The commercial salmon fishery generated almost \$42 million in landings prices in 1988. Sport fishing, including both charter and individual angler activities, generates hundreds of millions of dollars in revenues annually.

The Estuary provides opportunities for swimming, water skiing, fishing, sailing, and boating at over 290 shoreline recreational areas and three hundred marinas. Recreational boating contributes to the economy of the region through berth rents, fees, and equipment sales.

The abundance of migratory waterfowl and corresponding recreational hunting activities make another contribution to the region's economy. The Estuary is responsible for approximately one-fourth of California's waterfowl harvest. Over two hundred private hunting clubs operate in Suisun Marsh and the Delta. According to the U.S. Fish and Wildlife Service, duck hunters spent \$127 million in the state, while federal duck stamp sales in California generated over \$800,000 for land acquisition in 1989.

The Economic-Environmental Link

Although economic development and environmental protection are sometimes seen as conflicting goals, activities can be managed to benefit both.

Salmon, striped bass, and other important Estuary fish need cool, clean water and habitat for spawning and good flows during the spring for out-migration. Agriculture requires an abundant supply of water to plant spring crops. Millions of out-migrating fish are entrained in the powerful water project pumps that divert water to farmlands. If water exports were decreased from March through mid-June and pumping and storage increased in other months, sufficient water would be available to protect young salmon and striped bass and still provide for irrigation and urban needs.

Water conservation by agricultural and urban users benefits everyone. Basic water conservation can decrease the cost of water to consumers, defray the cost of expensive water projects, and provide needed instream flows for fish and wildlife. Thus, resource-dependent businesses, such as commercial and sport fishing and waterfowl hunting, can benefit economically. Through water-transfer systems, farmers can benefit from water conservation measures they implement by selling their conserved water to other water users.

Industrial processing produces pollutant by-products that can be hazardous to biological resources and human health. Economic incentives can encourage industry to undertake voluntary source reduction measures to decrease the use of hazardous

materials. This often results in the added benefit of reducing industry's cost of doing business. These measures also can reduce the level and cost of regulatory monitoring and free revenue to address other pollutant threats to the Estuary.

To maintain shipping lanes and marinas within the Estuary, dredging is essential. However, disposal of contaminated sediments can pose health hazards to aquatic life. Clean dredged materials, if used to stabilize levees and create new wetland areas, can provide benefits to both economic and environmental interests.

The adoption of actions that protect and restore the ecological resources of the Estuary, while providing the needed incentives and assurances of economic benefits, is fundamental to long-term effective change in the Estuary. The San Francisco Estuary Project attempts to link environmental protection and economic viability in developing effective management goals and actions. A healthy Estuary supports a healthy economy.

Addressing the Estuary's Importance

The National Estuary Program

In 1987, the United States Congress created the National Estuary Program in response to growing public concern over the decline of the nation's estuaries. The program's purpose is to protect and improve the water quality and natural resources of estuaries throughout the country by addressing the environmental problems specific to each.

As directed by Section 320 of the Clean Water Act, representatives of each estuary in the National Estuary Program must develop a Comprehensive Conservation and Management Plan (CCMP). The Plan must contain recommended actions to restore and maintain water quality; maintain a balanced indigenous population of shellfish, fish, and wildlife; allow recreational activities in the estuary; and protect the beneficial uses of the estuary.

The National Estuary Program also recognizes the need for coordinated and comprehensive planning to address the problems facing estuaries. Estuaries and their surrounding regions often encompass many diverse political, governmental, and economic entities that use the resources. Each estuary has environmental and socioeconomic concerns that call for the development of unique, locally focused CCMPs. Through the National Estuary Program, local users, regulators, and public interest groups develop an estuary-specific CCMP, thus at the same time developing the political will needed to implement the plan.

The San Francisco Estuary Project

In 1987, the U.S. EPA established the San Francisco Estuary Project (SFEP) as part of the National Estuary Program. SFEP has received federal appropriations under the Clean Water Act and matching funds from the State of California. The Project is jointly sponsored by the U.S. EPA and the State of California, which is represented by the State Water Resources Control Board, the San Francisco Bay Regional Water Quality Control Board, and the Central Valley Regional Water Quality Control Board.

SFEP is a cooperative program designed to promote effective management of the San Francisco Estuary and to restore and maintain its water quality and natural resources. For the first time, the Project brought together various Estuary user groups from the public and private sectors and all levels of government, including elected officials from the twelve Bay-Delta counties, to address the Estuary's critical environmental problems. This working partnership worked to develop a CCMP to address these problems, following specific schedules, actions, and commitments determined by Project members.

Geographic Scope

SFEP defines the Estuary as the waters of San Francisco Bay, San Pablo Bay, Suisun Bay, and the Sacramento-San Joaquin Delta. The Project boundaries include these waters, their watersheds, and lands in the Delta as delineated by Section

12220 of the State Water Code. In this CCMP, the term "Estuary" denotes the land and water within the watershed of the three bays and the Delta.

Under Section 320 (CWA), SFEP has authority to assess problems and develop corrective recommendations for activities occurring within the "estuary zone," which is defined as extending to the upstream reach of tidal influence or the historical limit of anadromous fish runs, whichever is greater. The Estuary zone extends well into the upper reaches of streams in Northern California and the Central Valley, where fish such as salmon and steelhead trout have historically spawned. The Estuary Project has developed recommendations and corrective actions for the entire Estuary watershed.

SFEP Management Conference Structure and Participants

The structure of the Management Conference, including the purpose, membership, time frame, approval of implementation plans, and authorization of appropriations, is defined in Section 320 of the Clean Water Act. Over one hundred participants representing diverse environmental, social, and economic interests and all levels of government serve on one or more of the Project's committees.

The Sponsoring Agency Committee directed the Project's overall policy. The Management Committee served as the primary decision-making body for SFEP. It approved Project activities and budgets and oversaw development of the CCMP. Serving under the Management Committee were the Technical and Public Advisory Committees. Both committees evaluated Project products and made recommendations to the Management Committee.

Subcommittees, comprised of members of the Management Committee, Public Advisory Committee, Technical Advisory Committee, and members of the public, assisted in the development of Status and Trends Reports for each program area, including Dredging and Waterway Modification, Pollutants, Wetlands, Wildlife, Aquatic Resources, Land Use and Population, Land Use Effects, and Regulatory Management. These technical documents form the foundation for the actions recommended in the CCMP. Technical reports and public education materials produced by SFEP are listed on the inside back cover.

San Francisco Estuary Project Goals

In 1987, the Management Committee developed the following goals to provide direction and purpose for the Project:

1. Develop a comprehensive understanding of environmental and public health values attributable to the Bay and Delta and how these values interact with social and economic factors.
2. Achieve effective, united, and ongoing management of the Bay and Delta.
3. Develop a Comprehensive Conservation and Management Plan to restore and maintain the chemical, physical, and biological integrity of the Bay and Delta, including restoration and maintenance of water quality; a balanced indigenous population of shellfish, fish, and wildlife; and recreation activities in the Bay and Delta; and assure that the beneficial uses of the Bay and Delta are protected.
4. Recommend priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution. These recommendations will include short- and long-term components based on the scientific information available.

Project participants also identified five primary management issues that require attention in the CCMP because of their impacts on the Bay and Delta. These issues, which became the basis for the program areas of the CCMP, are:

- ☐ Intensified Land Use
- ☐ Decline of Biological Resources

- Freshwater Diversion and Altered Flow Regime
- Increased Pollutants
- Dredging and Waterway Modification

Status and Trends Reports for each of these management issues summarize the current level of understanding. The *State of the Estuary Report*, written for SFEP and published in 1992, summarizes data in the technical reports and other documents and presents the information in a comprehensible format for the general public.

Development of the Comprehensive Conservation and Management Plan

CCMP development was based on technical data, subcommittee discussions, and consensus-building negotiations among the entire Management Committee. When the Management Committee could not reach consensus on a particular goal or action, voting was used. However, most CCMP actions were reached by consensus.

Five-Stage Development of the CCMP

The Management Committee developed the CCMP in five stages:

1. Subcommittees developed Status and Trends Reports, which detailed the current state of the resource and presented management recommendations.
2. Writing teams, comprised of subcommittee members and staff, refined the management recommendations and produced a working CCMP, which was presented to the Management Committee in November, 1991.
3. The Management Committee met frequently during the first seven months of 1992 for facilitated, consensus-building discussions to refine and adopt the management recommendations presented in the working CCMP. A Draft CCMP was released for public comment in August, 1992.
4. The Management Committee incorporated public comments on the Draft CCMP and finalized unfinished sections of the CCMP (the Aquatic Resources Program, implementation, and costing).
5. The Management Committee adopted the final CCMP at its March 31, 1993, meeting.

Throughout this process, the Management Committee worked to develop actions that link the ecological health of the Estuary to economic benefits. These recommendations are reflected in the strategies suggested to implement the CCMP.

Governor and Administrator Approval

As part of the review process, the San Francisco Bay Conservation and Development Commission (BCDC) analyzed the CCMP and found that it was consistent with applicable provisions of the Coastal Zone Management Act.

Following the Management Committee's approval of the CCMP, it was sent to the Project's Sponsoring Agency Committee for review, then on to the Governor of California for concurrence and the Administrator of the U.S. Environmental Protection Agency for approval. Governor Wilson concurred on the CCMP on November 17, 1993. Administrator Browner approved the Plan on December 9, 1993. Implementation may now commence.



II

STATE OF THE ESTUARY

*"The river once entered the salt marshes clean and rich,
blending fresh water with the tides, sustaining the pickleweed
and uncountable numbers of other living things in the mud
and shallows of the estuaries. Now the river bears messages
which the chemistry of life itself cannot read."*

David Cavagnaro,
"Living Water"

Land Use—Human Development and Uses of the Estuary

Findings:

- Before 1848, human impacts on the Estuary's water quality and its ability to sustain biological resources were minimal.
- Hydraulic gold mining caused the first major human-induced alteration of the Estuary. By the early 1900s, more than one billion cubic yards of mining debris had silted in hundreds of miles of streams and the bottom of parts of San Francisco Bay by as much as three feet. Although the debris exacerbated flooding and impeded navigation, some of the deposited sediment enabled the spread of tidal marshes in the Bay.
- By the turn of this century, levee construction in the Delta and along the shore of the Bay had enabled the conversion of more than half of the Estuary's tidal wetlands to farmland and urban uses.
- The human population in the twelve Estuary counties has increased from about one million in 1920 to more than seven-and-a-half million today. Currently, the Bay Area is the fourth-most-populous metropolitan area in the United States. By the year 2005, nearly nine million people will reside in the twelve Estuary counties, and almost three million more will inhabit the Central Valley watershed.
- Urban expansion has converted thousands of acres of farms, rangeland, and forests to towns and cities. This has increased the Estuary's pollutant loads and has lowered the region's ability to support wildlife.
- The Estuary provides thousands of water-dependent jobs in commercial shipping, fishing, and other industries. Jobs in agriculture and in other sectors throughout the state depend on supplies of high-quality fresh water from the Estuary watershed.

Until the mid-1800s, the Estuary's waters and biological resources were essentially undisturbed by human development. Following the influx of gold seekers in the 1850s, human activities began to change the Estuary in major ways. Hydraulic mining carried more than one billion cubic yards of silt and gravel from the Sierra Nevada into the Delta and San Francisco Bay. Land reclamation in the Delta and along the edge of the Bay converted more than 750 square miles of tidal marsh into agriculture and other uses. Farming and ranching altered large expanses of upland vegetation.

In this century, especially during the past four decades, urbanization has been the major influence on the lands around the Estuary. Large-scale residential and commercial development replaced small farms and pasture on the flatlands adjacent to San Francisco Bay. The construction of highways and freeways and associated leapfrog suburban development have become major features of the landscape. Much of this development converted or degraded important habitats, particularly tidal wetlands, and increased the loading of pollutants in urban runoff. Today, more than 30 percent of the land in the nine counties surrounding San Francisco Bay has been urbanized, as has more than 10 percent of the land in the three Delta counties.

“By the year 2005, nearly nine million people will reside in the twelve Estuary counties, and almost three million more will inhabit the Central Valley watershed.”

The increase in urban land around the Estuary reflects the growth of the human population. More than 7,500,000 individuals now live in the twelve Estuary counties, making the region the fourth-most-populous metropolitan area in the United States. With more than two million additional people in the Central Valley, about one-third of California's population now lives on land that drains into the Delta and Bay. The number of people living within the Estuary's entire watershed is projected to increase to twelve million by 2005. Population growth is expected to be greatest in San Joaquin, Solano, and Sacramento counties.

Population growth is expected to result in the loss of productive agricultural land and, to a lesser extent, rangeland and forest land. Between 1990 and 2005, approximately 275 square miles of land will be urbanized in the twelve Estuary counties. In the Central Valley watershed, urban land is projected to increase by 454 square miles during the same time period. These changes will reduce the acreage of valuable farmland, wetlands, and riparian areas (the land immediately adjacent to rivers and streams) and will increase the amount of human-produced pollutants entering the Estuary.

Decline of Biological Resources

Findings:

- The Estuary's habitats—its open water, wetlands, and uplands—sustain the estuarine ecosystem.
- During the past 140 years, most of the wetland habitats—mudflats, tidal and seasonal marshes, and riparian woodland—have been drastically diminished, while the Bay's open water has been reduced by one-third. More than one-half of the native upland habitat has been converted to urban land.
- Since the mid-1970s, the abundance of phytoplankton has declined in the Estuary's northern reach (San Pablo and Suisun Bays), due in part to decreased freshwater flows, increased water transparency, and the establishment of the voracious, non-native clam *Potamocorbula* in Suisun Bay. With this decrease in phytoplankton, zooplankton production has been low, thus reducing the availability of food for several species of young fish.
- The number of Chinook salmon returning to spawn in the Estuary's tributaries has declined by 70 percent from historical levels. In the San Joaquin River, there has been a 90 percent reduction. The Sacramento River winter-run salmon has been designated a federal threatened and state endangered species. Water development is the major cause of the decline of this valuable resource.
- The striped bass population is at its lowest level since the species was introduced into the Estuary more than one hundred years ago. The population of adult striped bass has dropped to one-half million, less than 20 percent of the number in the 1960s. Several factors, including water diversions, pollutants, and habitat alteration, are suspected causes of the decline.
- The U.S. Fish and Wildlife Service listed the Delta smelt as threatened under the federal Endangered Species Act. This once-abundant native species resides in the Delta and Suisun Bay and feeds solely on the diminishing supplies of plankton.
- Many species of bottom-dwelling animals recently introduced to the Bay and Delta have altered the community composition. Unintentional introductions seem to occur at a rate of about one per year.
- The Estuary is one of the most important staging and wintering areas for migratory waterfowl and shorebird populations on the west coasts of North and South America. Nearly one million waterfowl and one million shorebirds use the Estuary's open water and wetland habitats at certain times of the year. As waterfowl habitat has dwindled in other parts of the state, the Estuary has become increasingly important for maintaining bird populations.
- Major factors affecting wildlife in the Estuary basin are habitat loss, disease, introduced predators, and pollution.
- Between 1985 and 2005, some four hundred square miles of range, forest, and agricultural lands in the Estuary basin are expected to be converted to urban uses. This, and additional losses of wetlands, will further compromise the region's ability to support a thriving community of wildlife.

- Wetlands, one of the Estuary's most valuable resources, are critical for maintaining many of its fish and wildlife species. Of the thirty-two species of wildlife whose populations are declining in the Estuary, twenty-three are associated primarily with wetlands.
- In addition to their value as fish and wildlife habitat, wetlands provide many other important benefits, including flood control, groundwater recharge, shoreline stabilization, open space and recreation, and water quality maintenance.
- Of the 545,375 acres of historical tidal wetlands, only 44,371 acres (8 percent) remain. In the Delta, 92 percent of the original wetlands have been converted to farmland. In San Francisco Bay, 82 percent of the tidal wetlands have been filled or diked.
- More than 100,000 acres of the Estuary's wetlands (about one-sixth of the existing wetland acreage) have been protected in the form of parks, refuges, and preserves. Although wetland degradation and conversion have slowed substantially since the early 1970s, loss of valuable habitat still continues.
- Projected urban expansion in the Estuary basin could adversely affect at least 10,000 acres of stream corridor and 3,500 acres of non-riparian wetlands. Mitigation could offset some of the losses.
- Based on expected patterns of urban expansion, seasonal and riparian wetlands are the most threatened wetland types.

The Estuary's biological resources—its habitats, aquatic organisms, and wildlife—have undergone major changes since the Gold Rush. These changes include habitat degradation and conversion, population declines and the extirpation of many native species, and the introduction of hundreds of plant and animal species. Although the estuarine ecosystem remains diverse and productive, it is highly modified.

In the past 150 years, shoaling caused by hydraulic mining debris and the diking and filling of tidal marshes have decreased the surface area of San Francisco Bay by 37 percent to its present area of 478 square miles. More than half a million acres of the Estuary's historical tidal wetlands have been converted to farms, salt ponds, and urban uses, a reduction of 92 percent. Fewer than 45,000 acres of the Estuary's historical tidal marshes remain intact. Non-tidal wetlands have been converted to farms and other uses, and many of the riparian forests have been removed by flood control projects and urban development. More than half the natural upland habitats in the Estuary's basin have been converted to urban uses.

Whole communities of aquatic resources—phytoplankton, zooplankton, bottom-dwellers, and fish—have undergone extensive change. More than one hundred exotic species of aquatic invertebrates, including clams, oysters, and worms, have been introduced in the past century. Today, most of the large invertebrates of the Bay shallows are introduced species, and the majority of the more than fifty fish species found in the Delta are non-natives.

Much of the Estuary's productivity is dependent upon the growth of phytoplankton, small floating plants that transform sunlight into food. Since the early 1970s, and especially since the 1976-1977 drought, phytoplankton abundance generally has declined in the Estuary's northern reach. Populations of zooplankton, which feed on phytoplankton, also have declined and are now at levels much lower than in the 1970s. The causes of these changes are not well understood, but are thought to include, at a minimum, reduced freshwater flows and the introduced Asian clam.

“Of the 545,375 acres of historical tidal wetlands, only 44,371 acres (8%) remain.”

The recent arrival of the Asian clam has made it difficult for scientists to understand the causes for alterations of the phytoplankton and zooplankton communities. Unintentionally introduced into the Estuary in cargo ship ballast water, the clam was first discovered in the Carquinez Strait area in 1986, following a winter of unusually high river flow. Since then, during five years of low flows, the Asian clam has spread throughout Suisun and San Pablo

Bays and, to a lesser extent, into portions of San Francisco Bay. Growing at densities as high as 25,000 individuals per square meter, the clam population is able to consume vast quantities of phytoplankton. By greatly reducing the availability of phytoplankton to other organisms, this clam may be causing a major shift in the makeup of the aquatic ecosystem in the northern portion of the Estuary.

Several of the Estuary's fish species have undergone changes in population levels in recent years. Although some species have increased in numbers, including the commercially important Pacific herring and many of the native non-game fish that inhabit the South Bay, others have declined. Species with declining populations that are receiving the greatest attention are Chinook salmon, striped bass, and Delta smelt.

“The Estuary’s salmon stocks have dropped markedly since the turn of the century, when an annual average of some 900,000 fish returned to Central Valley streams to spawn.”

The Estuary's salmon stocks have dropped markedly since the turn of the century, when an annual average of some 900,000 fish returned to Central Valley streams to spawn. By the early 1950s, following construction of Shasta Dam on the Sacramento River and Friant Dam on the San Joaquin River, Chinook salmon runs had dropped to about 400,000 fish annually. The construction of Friant Dam completely destroyed the upper San Joaquin River stock of mostly spring-run salmon. Numerous smaller dams are also responsible for the declining salmon populations. Today, an annual average of about 275,000 salmon spawn in the Estuary watershed; most of these are fall-run fish which spawn in the Sacramento River drainage.

Other factors responsible for the decline in salmon populations include reduced spawning habitat, inadequate stream spawning flows, intermittent poor water quality, spawning gravel of unsuitable size, high stream temperatures, and losses of young fish to water diversions. The upper Sacramento River winter-run salmon has declined to such an extent that it has been listed as a federal and a state endangered species. The annual commercial ocean catch of about 400,000 salmon has remained fairly stable, maintained in part by five hatcheries that produce a total of more than thirty million fingerlings and yearlings each year. The natural production of salmon in streams is now inadequate to sustain commercial and sport fisheries.

Striped bass, introduced into the Estuary in the 1880s, supported a large commercial fishery until the 1930s. Today the striped bass is prized as a sport fish. However, at approximately 500,000 fish, the current number of adult striped bass is at the lowest level of this century. Potential causes of the decline include Delta water diversions, reduced Delta outflows, reverse flows, low San Joaquin River flows, pollutants, and wetland filling. Losses to Delta water diversions appear to be a very important factor in the decline. Between 1976 and 1986, tens of millions of young bass and an inestimable number of eggs and larvae were lost to state and federal water project pumps in the southern Delta. Additional losses occurred in the 1,800 unscreened siphons and pumps of Delta farms.

Although the Delta smelt has no commercial or sport value, it is one of the few remaining native species found in the upper reaches of the Estuary. Once common, its numbers have dropped precipitously since the early 1980s. Because this species feeds entirely on plankton, it is not surprising that the changes in the smelt population have occurred at the same time as the decline in plankton production in the Estuary's northern reach. Invasions of exotic invertebrates and phytoplankton, losses to water diversions, and habitat modification have all contributed to its deterioration. The California Fish and Game Commission and the U.S. Fish and Wildlife Service both recently listed the Delta smelt as endangered under their respective Endangered Species Acts. These listings could affect water project operations in the Delta and upstream.

The Estuary supports more than 380 species of wildlife. About one-third of these species, including most of those with high commercial or recreational value, are associated with open water, wetlands, and adjacent uplands.

Development of the Estuary has drastically altered wildlife habitats, and, as a result, populations of most wildlife species are smaller than in the past. Some ninety species and subspecies, whose populations are dwindling or monitored, are designated

by federal or state agencies as being in need of special attention. Of these, sixty-one are affected by the loss of wetlands and riparian areas.

The Bay and Delta comprise one of the most important wintering areas for migratory waterfowl on the west coasts of North and South America. Nearly one million waterfowl use the Estuary's open water and wetland habitats. Suisun Marsh and farmed wetlands in the Delta provide valuable habitat for ducks, geese, pelicans, and swans. As wetlands in other parts of California continue to diminish, the Estuary's remaining wetlands are becoming ever more important to waterfowl.

More than thirty-four species of shorebirds occur regularly within the Estuary. Most of these species frequent the Bay and Delta during the spring, en route to northern breeding grounds in Canada and Alaska, and in the fall upon their return. Census figures indicate that shorebird populations peak in the spring months to more than one million birds. In San Francisco Bay, about 60 percent of shorebird use occurs in the South Bay and 20 percent occurs in San Pablo Bay. In the Delta, marshes, mudflats, oxidation ponds, and farm fields provide important habitat. Extensive fall and spring flooding of plowed Delta fields can result in large concentrations of shorebirds. In 1990, the San Francisco-San Pablo Bay system was recognized as a site of hemispheric importance by the Western Hemisphere Shorebird Reserve Network. Only three other areas on the west coasts of North and South America have received such high recognition.

Populations of several of the Estuary's wildlife species have recently increased. In the past five years, the breeding population of the double-crested cormorant, a bird that nests on bridges and other constructed structures, increased to more than

“The Bay and Delta comprise one of the most important wintering areas for migratory waterfowl on the west coasts of North and South America.”

1,110 pairs. The breeding population of the western gull has also grown. In 1981, California gulls established a nesting population that still flourishes in the Bay. Through immigration from other areas and human assistance, the American peregrine falcon, an endangered species, has increased ten-fold in the Bay Area during the past twenty years. However, none of the locally nesting pairs has successfully reproduced recently.

Since the 1980s, there has been a substantial increase in the red fox population, especially on the eastern shoreline of the South Bay. The fox, introduced to California from the Midwest in the early 1900s, is an efficient predator that has adapted to urbanized areas and now poses a severe threat to ground-nesting birds, waterfowl, and shorebirds in the Estuary. The U.S. Fish and Wildlife Service recently proposed a plan to reduce the threat of fox predation to nesting birds of the San Francisco Bay National Wildlife Refuge.

Although populations of some species have increased in recent years, populations of other species have declined. The endangered California clapper rail, estimated at 1,500 individuals in the mid-1980s, has dropped to below three hundred. The South Bay nesting population of the Caspian tern also has declined from more than one thousand in 1971 to only about two hundred in 1990. Predation by the red fox and other introduced predators, as well as habitat changes, are noted causes of these declines. The nest of the least tern, also an endangered species, is subject to predation and human disturbance as well.

Habitat availability for the salt marsh harvest mouse, a state and federal endangered species, has declined markedly in the past twenty years. While about 6,000 acres of habitat remain available to the northern subspecies in Suisun Bay, the southern subspecies inhabits only about 760 acres of South Bay marshes, where diking of tidal marshes, land sinkage, and shoreline erosion have reduced tidal marsh acreage, especially at high tide.

Future land development in the Estuary region is expected to reduce the most valuable habitats and adversely affect populations of many fish and wildlife. Although some species may flourish, many will not. Unless efforts are made to minimize losses of valuable habitat and to improve the way in which the Estuary's land and water are managed, conditions for many of the region's biological resources will continue to deteriorate.

Freshwater Diversions and Altered Flow Regime

Findings:

- The Estuary's freshwater supply strongly influences environmental conditions in the Estuary. It also supports many other beneficial uses, including water for agriculture, municipalities, and industry. Some twenty million Californians, or two-thirds of the state's population, rely on the Estuary's freshwater supply for drinking water.
- Ninety percent of the Estuary's fresh water originates in the Central Valley watershed. The Sacramento River provides about 80 percent of this flow, and the San Joaquin River and other streams contribute the remainder.
- The total annual volume of fresh water reaching the Estuary is highly variable, primarily as a result of rain, or the lack of it. During the past twenty years, annual inflow has ranged from more than fifty million acre-feet to less than eight million acre-feet and has averaged about twenty-four million acre-feet.
- More than seven thousand diversions for a variety of purposes, such as flood control, storage, and agricultural use, reduce the annual volume of water entering San Francisco Bay by more than one-half in some years. At the current level of development, more than sixteen million acre-feet of fresh water are diverted from the Estuary's supply. Of this volume, more than nine million acre-feet are diverted upstream of the Delta for local use and export, and about seven million acre-feet are diverted from the Delta for local use and export. Reservoirs in the Central Valley are capable of storing about twenty-seven million acre-feet of fresh water, roughly three million acre-feet more than the Estuary's average annual inflow since the 1920s.
- The federal Central Valley Project and the State Water Project are by far the two largest diverters, together removing nearly ten million acre-feet of water from within the Estuary watershed. Eighty-five percent of this water is used by agriculture and 15 percent goes to municipal, industrial, and other uses.
- Storage and diversions affect the seasonal volume of fresh water entering the Bay. Natural Estuary freshwater flow is reduced significantly during late fall, winter, spring, and early summer and is slightly increased during the late summer and early fall. The effects of diversions and storage on seasonal flow are greatest in the spring.
- Diversions and altered flow affect the Estuary's circulation and water quality, habitat conditions for wildlife, production of phytoplankton and zooplankton, and the survival of eggs and young of many fish species, including salmon, striped bass, and others. The effect on these species is magnified during dry and critically dry years.
- Construction of currently planned local water development projects and the completion of the State Water Project are expected to increase annual diversions from the Estuary's water supply by at least 1.1 million acre-feet.

Freshwater flows are among the most important factors influencing physical, chemical, and biological conditions in the Estuary. Many of its biological resources are directly affected by the quantity and timing of these flows, and by the way in which water is diverted for non-estuarine uses. Considering this, and the fact that two-thirds of California's population depend upon the Estuary's fresh water as a supply for drinking and other uses, it is not surprising that the "flows" issue is being discussed avidly by Estuary Project participants and others throughout the state.

The Estuary's freshwater flows originate as precipitation in the Central Valley and in the watershed surrounding the Bay. About 90 percent of the flows are from the Central Valley watershed. The remainder come from the Bay watershed. Because the amount of precipitation varies each year, so does the volume of fresh water that reaches the Estuary.

Development of major flood control and water storage reservoirs began in the latter half of the last century. Today, there are more than one hundred reservoirs in the Central Valley watershed, each with a storage capacity of at least 50,000 acre-feet. Combined, they can store about twenty-seven million acre-feet of water, which exceeds the average annual flow from the Delta into the Bay.

“Currently, development, upstream diversions, in-Delta uses, and Delta exports reduce flows to San Francisco Bay by more than fifteen million acre-feet, a reduction of more than 50% of the average annual flow.”

Diversions from the Estuary’s tributaries began in the mining regions of the northern Sierra in the mid-1850s as miners diverted water for hydraulic mining operations. At about the same time, farmers began to divert water from streams on the Valley floor. The volume of water diverted upstream of the Delta has grown steadily ever since. As of 1990, upstream diversions reduced the volume of water reaching the Estuary by more than nine million acre-feet. This water is used for agricultural, municipal, and industrial uses in the Central Valley and in the Bay Area. Within the Delta, about one million acre-feet of water are consumed each year to irrigate crops in the rich Delta soils.

Since the 1940s, when the federal Central Valley Project began diverting water into the Contra Costa Canal, the export of fresh water from the Delta has steadily increased. In 1951, the federal Delta-Mendota Canal began to export Delta water southward into the San Joaquin Valley, mostly to farms. In 1968, the State Water Project Delta pumping facility began exporting Delta water into the California Aqueduct, a system that conveys water southward into the San Joaquin Valley and to Southern California.

Currently, development, upstream diversions, in-Delta uses, and Delta exports reduce flows to San Francisco Bay by more than fifteen million acre-feet, a reduction of more than 50 percent of the average annual flow. About 85 percent of the fresh water exported from the Delta goes to farms; the remainder is used by municipalities and industries in the Bay Area, the Central Valley, and Southern California.

Water development has changed the patterns of freshwater flow into the Estuary. Water is stored during winter and spring for release later in the year. This greatly reduces flows during April, May, and June, and may increase them slightly during the late summer and early fall. In 1990, Delta outflow during spring and early summer was about one-third of what it would be without water storage and diversions.

Water resources development and associated changes in the timing and volume of freshwater flows have had an enormous impact on the Estuary’s biological resources. This impact has been particularly severe on several fish species and results primarily from habitat loss and degradation, altered water temperature regimes, increased mortality of eggs and young from diversions and predators, transport of species into new areas, and alteration or confusion of migration patterns of spawning adults or out-migrating young. The impacts have been most obvious on certain fish species, such as salmon, striped bass, and some resident fishes. The number of naturally reproducing salmon and striped bass has plummeted from historical levels, and populations of other species have declined as well.

Water development is far from complete in the Estuary watershed and in other parts of California. State Water Project planners are currently evaluating ways to increase average annual Delta exports by more than one million acre-feet and, at the same time, reduce some of the existing problems associated with Delta diversions. In addition to increasing the export rate at the state’s Delta pumping facility, planners are considering modifying Delta channels and constructing water storage facilities elsewhere. The federal government is planning to increase its water deliveries from Estuary tributaries and is currently evaluating the environmental impact of various development alternatives.

Given the expected increase in water demand from California’s growing population in the coming decades, it is clear that water supplies must be used more efficiently. It is equally clear that the Estuary’s freshwater supply must be managed in a scientifically and ecologically sound manner. It is likely that Californians will meet future water needs through a combination of conservation measures, changes in water policy, and new physical facilities.

Increased Pollutants

Findings:

- Each year, an estimated five to forty thousand tons of at least sixty-five pollutants enter the Estuary. Many of the pollutants are carcinogenic, teratogenic, or mutagenic in one type of organism or another.
- The major sources of pollutants to the Estuary are urban runoff, non-urban runoff, municipal wastewater treatment plants, industrial facilities, rivers, dredging, spills, and atmospheric deposition.
- Since the 1950s, improved treatment has lowered the quantity of biodegradable pollutants entering the Estuary from wastewater treatment plants. As a result, effects associated with low oxygen concentrations and high bacteria levels are now rare in the Estuary.
- Improved treatment at municipal wastewater treatment plants and industrial facilities has reduced the discharge of some toxic trace elements, but these substances continue to enter the Estuary in large quantities, especially from uncontrolled sources.
- Pollutants are widespread in the Estuary and reach highest concentrations in harbors, marinas, industrial waterways, and at effluent discharge sites.
- Pollutants that enter the Estuary can concentrate at high levels in animal tissues, even though they may occur at low concentrations in the water and sediments.
- Bioassays of Estuary water, sediments, municipal and industrial effluent, and urban and non-urban runoff have elicited toxic effects in some test organisms.
- Concentrations of silver, copper, and cadmium in South Bay clams vary in response to annual water circulation processes that dilute and transport trace elements.
- Persistent pollutants appear to cause sublethal effects in some species. For example, polychlorinated biphenyls (PCBs) appear to reduce reproductive success in starry flounder in the eastern portion of the Central Bay. PCBs and DDE in black-crowned night heron eggs have been correlated with decreased embryo size and eggshell thickness.
- Concentrations of several pollutants in Estuary waters exceed state water quality objectives. Concentrations of some pollutants in animal tissues exceed international standards and guidelines for the protection of aquatic life.
- While pollutant effects can be demonstrated in laboratory bioassays, effects on animal behavior, population dynamics, or community structure in the Estuary are poorly understood.
- Discontinuing the use of a particular chemical may be more effective in reducing its presence in the Estuary than treating it. After being banned by law, DDT and PCB levels in biota fell dramatically.
- More than twelve million humans will live in the Estuary watershed within the next two decades. Urban runoff and the associated pollutant loading are sure to increase.

Pollutants are substances that adversely affect the physical, chemical, and biological properties of the environment. Some occur naturally and have been components of ecosystems for millions of years. Others are human-produced and introduced only recently.

“Each year, an estimated five to forty thousand tons of at least sixty-five pollutants enter the Estuary.”

There are four kinds of pollutants in the Estuary: inorganic chemicals, organic chemicals, biological pollutants, and suspended sediments and other particles. The most important inorganic chemicals are the compounds of phosphorus and nitrogen, and heavy metals, also known as trace elements. Phosphorus and nitrogen, primarily in the form of phosphates and nitrates, are necessary for plant growth. However, in high concentrations, they may cause excessive growth of aquatic vegetation. The trace elements in the Estuary that cause the most concern are arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, tin, and zinc.

Organic chemicals of greatest concern are synthetic substances, including plastics, pesticides, fertilizers, solvents, and pharmaceuticals. PCBs and pesticides, such as DDT and Malathion, are organics that may adversely affect Estuary organisms. Most biological pollutants (bacteria and viruses) that are harmful to human health enter the Estuary in untreated sewage, recreational boat discharge, and runoff from farms, feedlots, and urban areas. Eroding soil and decomposing plant and animal wastes are sources of sediment and other particles that may also degrade water quality.

The kinds of pollutants considered to adversely affect the Estuary have changed markedly over the years. Until the 1940s, the most obvious pollution problems were caused by untreated industrial and sewage wastes. After World War II, increased use of synthetic organic compounds began to pose new, often more subtle, threats.

Pollutants enter the Estuary from many sources, each of which contributes a unique mixture of chemicals. At present, these sources include more than fifty municipal wastewater treatment plants, more than sixty-five industrial facilities, urban runoff, rural runoff, rivers, and dredging and dredged material disposal.

Beginning in the 1950s, some municipal wastewater treatment plants began primary treatment to screen and remove sediment and to digest and disinfect sludge. In the mid-1960s, secondary treatment began to further remove sediment and chemicals. The expenditure of more than \$3 billion on enhanced treatment in the 1960s and 1970s led to major improvements of municipal and industrial effluent and of Estuary water quality. For example, between 1955 and 1985, even as the volume of municipal discharges increased from 250 to 550 million gallons per day, improved treatment reduced biochemical oxygen demand by about 80 percent and loadings of suspended solids by about 75 percent.

In the late 1970s, advances in pretreatment programs also reduced the load of toxic pollutants entering the Estuary from municipal wastewater treatment plants. Pretreatment programs aim to remove toxic pollutants at their sources rather than at municipal treatment plants. This reduces the volume of pollutants destined for treatment plants, thus helping them operate more effectively.

The treatment of wastewater discharged directly from industrial facilities into the Estuary has also improved. Loading of pollutants from oil refineries, the biggest class of industrial dischargers, has declined dramatically since the early 1960s. For example, in 1961, refineries discharged about two tons of chromium and zinc into the Bay each day. By 1984, daily discharge was about twenty-five pounds. Additional reductions in industrial loadings have been made through pollution prevention and source reduction.

The quantity of conventional pollutants entering the Estuary from municipal and industrial sources has declined markedly during the past forty years. As a result, the most obvious symptoms of poor water quality—odors, algal blooms, and low oxygen levels—have been eliminated throughout most of the Estuary. Pollutants that continue to be of major concern are the trace elements, organochlorines and other synthetic pesticides, and petrochemical hydrocarbons.

Preliminary estimates indicate that rural and urban runoff contribute the greatest quantities of most trace elements to the Estuary. Urban runoff is the major source of oil and grease. Municipal and industrial effluent contribute sizable proportions of cadmium, mercury, and silver. Agricultural lands contribute large quantities of pesticides.

Pollutants have been detected in the Estuary's water, sediments, and organisms. Although the concentrations of most pollutants surveyed in water are low, copper, lead, mercury, and nickel have exceeded state water quality objectives established to protect beneficial uses of the Estuary's water.

Compared to background levels attributable to natural sources, pollutant concentrations in sediments are slightly elevated in nearly all parts of the Estuary. Concentrations are highest in harbors, harbor entrances, industrial waterways, and marinas. Trace elements with the highest concentrations in sediments are copper, lead, chromium, and zinc. Areas with particularly high concentrations of these pollutants include Islais Creek, Alameda Naval Air Station, Channel Creek, Mare Island Strait, and Hunters Point Naval Shipyard. Currently no standards exist for pollutant concentrations in sediments.

“Even though pollutant levels for many trace elements from municipal and industrial effluent sources have decreased in recent decades, concentrations of most pollutants in the Estuary's sediments and animals do not indicate a similar trend.”

Pollutants in the Estuary's water and sediments may ultimately find their way into its animals. Filter feeders, such as clams and oysters, ingest pollutants in the water as they feed on plankton and other microorganisms, snails and worms take in pollutants as they graze on the organic matter in sediments, and so on up the food chain. Eventually, these pollutants can end up in human food. As organisms consume contaminated prey, pollutant concentrations in their tissues may increase. Concentrations of ten trace elements, DDT, and PCB sampled in the Estuary's mussels, clams, fish, and birds are either significantly elevated, compared to samples collected elsewhere in the state, or exceed the State Maximum Allowable Residue Level or the Median International Standard. Concentrations of pollutants in aquatic animals are greatest in organisms inhabiting harbors, harbor entrances, marinas, and industrial waterways.

Even though pollutant loads for many trace elements from municipal and industrial effluent sources have decreased in recent decades, concentrations of most pollutants in the Estuary's sediments and animals do not indicate a similar trend. Based upon available data from repeated analyses of sediments, sediment cores, mussels, and other animals, few reductions in pollutant concentrations have been demonstrated.

While it is fairly easy to measure concentrations of pollutants in water, sediments, and animal tissue, it often is extremely difficult to determine the overall effect of a pollutant on individual animals. Even more difficult to determine are pollutant effects on populations of a single species or on the entire aquatic community. During the past five years, laboratory bioassays (some of which must be considered as preliminary) have indicated that, at times, the Bay's ambient water, some municipal and industrial effluent, and some urban and rural runoff are toxic to test organisms.

The future loading of pollutants to the Estuary will be determined by the number of people living in the watershed, land use patterns, the use and disposal of pollutant-containing products, industrial processes, and treatment technologies. In the absence of additional control measures or more widespread and effective pollution prevention, loads from municipal effluent will rise as the population discharging to municipal treatment plants increases. With some 725 square miles of urban land projected to be developed in the watershed by 2005, pollutant loading from urban runoff is expected to increase substantially. Also, unless there are significant changes in farming practices, agriculture will continue to contribute heavily to rural runoff.

Dredging and Waterway Modification

Findings:

- Each year, some six million cubic yards of sediments enter the Estuary, primarily from the Sacramento and San Joaquin River systems. Most of this material is deposited in waterways of the Bay and Delta, where dredging is required to ensure adequate water depths for commercial and recreational vessels.
- Dredging is conducted by the U.S. Army Corps of Engineers, the U.S. Navy, ports, commercial marina operators, local flood control and reclamation districts, and others.
- During 1986-1987, the U.S. Army Corps of Engineers and the U.S. Navy dredged an annual average of 7.3 million cubic yards of material in the Estuary. In combination with other projects, some eight million cubic yards were dredged and disposed of each year.
- Since 1975, there have been only three main aquatic disposal sites for dredged materials in the Bay. Of the dredged material disposed of in 1986-1987, 65 percent went to the Alcatraz disposal site. The remainder was disposed of at sites in San Pablo Bay and Carquinez Strait or at upland sites in the region.
- Modeling and field studies indicate that much of the dredged material disposed of at aquatic sites remains in the Bay, with some redepositing in dredged areas.
- Dredging and disposal of dredged material temporarily increases turbidity, influences bottom-feeding communities at and near disposal sites, and may affect the behavior and physiology of fish and other organisms. It also may redistribute toxic pollutants and increase their availability to aquatic organisms.
- The two most hotly debated dredging issues during the past few years have been the effect of dredged material disposal on Central Bay angler success and the redistribution and release of toxic contaminants in dredged sediment.
- In response to dredging-related environmental problems, state, federal, and other interests are developing a Long-Term Management Strategy (LTMS) for dredging and dredged material disposal. This LTMS group seeks to eliminate unnecessary dredging activities, maximize the use of dredged material as a resource, and ensure that dredging activities are conducted in the most environmentally sound fashion possible.
- Between 1995 and 2045, an annual average of about eight million cubic yards of sediments is expected to be dredged in the Estuary. Given the goals of the LTMS, it is likely that the majority of this material will not be dumped in San Francisco Bay. A significant portion will be put to beneficial use, and much of it will be disposed of in the ocean.

Dredging in the Estuary has been an issue of concern for many decades. Although nearly everyone agrees that dredging is necessary to enable safe navigation of commercial, military, and recreational vessels, there are conflicting views regarding the environmental impacts of dredging and how it should be managed.

Dredging is the systematic excavation of bottom sediments. Dredging is conducted to ensure that water depths in navigation channels, turning basins, docking slips, and marinas are deep enough for vessels to maneuver safely. Because rivers carry an average of more than six million cubic yards of sediment into the Estuary each year, and almost fifty times that amount is resuspended in the shallows by currents and waves, dredged areas require periodic maintenance.

Most of the dredging in the Estuary is undertaken by the U.S. Army Corps of Engineers, which is responsible for

nineteen projects in the Bay and Delta. The U.S. Navy dredges to maintain design depths at eight facilities in the Estuary. The fifteen major ports and refineries are also dredged periodically. Flood control districts dredge to maintain channel capacities where tributaries enter the Bay, and reclamation districts dredge periodically as part of levee maintenance. Additional dredging occurs at many of the 223 commercial marinas in the Bay and Delta and at commercial sand mining sites in the Bay. Between 1975 and 1985, the Corps and Navy together dredged an annual average of about 4.9 million cubic yards of material. In 1986 and 1987, these agencies dredged an annual average of 7.3 million cubic yards. An unspecified but smaller quantity of materials was dredged by other entities.

“Current projections indicate that between 1995 and 2045, about eight million cubic yards of materials will be dredged annually in the Estuary.”

Prior to 1972, dredged material was disposed of at more than two dozen sites in the Estuary. In the early 1970s, environmental considerations led the Corps to designate six sites in the Bay as acceptable for dredged material disposal. Since 1975, the Corps has limited nearly all aquatic disposal of dredged materials to just three sites—adjacent to Alcatraz Island, in San Pablo Bay, and in Carquinez Strait.

Alcatraz is the major disposal site in the Bay. In recent years, the proportion of dredged material disposed of there has increased considerably. From 1975 to 1984, an average annual volume of less than two million cubic yards of material was disposed of there. From 1985 to 1987, the average annual volume increased to five million cubic yards. In 1986 and 1987, about 65 percent of all dredged material disposed of in the Bay was at the Alcatraz Island site.

When the Corps designated in-Bay disposal sites in the early 1970s, it did so with the belief that currents would disperse dredged material deposited at these sites. By 1982, however, it was discovered that the Alcatraz Island site had accumulated enough material to pose a hazard to navigation. By 1986, the Corps had removed 183,000 cubic yards from the Alcatraz “mound.” This event stimulated discussion and re-evaluation regarding disposal practices and the fate of dredged material.

The main impacts of dredging and dredged material disposal include the loss of bottom-dwelling organisms and temporary increases in turbidity. Since dredging disposal occurs with relatively high frequency at the in-Bay sites, bottom-dwellers are prevented from re-colonizing disposal sites. The major effects of increased suspended sediment concentrations at disposal sites probably are on fish behavior, feeding patterns, foraging efficiency, modified prey response, and choice of habitat.

Disposal in the central Bay has been shown to alter the movement of fish schools. In a recent study of striped bass prey species near the Alcatraz Island disposal site, fish schools moved away from the disposal site immediately following disposal, but returned within an hour or two. Considering that materials were disposed of at the site more than ten times each day on nearly two-thirds of the days in 1986 and 1987, it is possible that disposal activities kept fish away from the area and reduced angler success.

Current projections indicate that between 1995 and 2045, about eight million cubic yards of materials will be dredged annually in the Estuary. This includes new projects, maintenance of existing projects, and permitted projects. Additional dredging will occur in the Delta to maintain channels, ports, and levees.

In response to the mounding problem at the Alcatraz disposal site and other concerns about dredging impacts on the Bay's water quality and biological resources, a joint effort is underway to prepare a better long-term plan to manage dredging activities. Active participants in this effort include the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the San Francisco Bay Conservation and Development Commission, the San Francisco Bay Regional Water Quality Control Board, and other dredging and environmental interests. The plan is scheduled to be completed by 1995 and will specify where dredged material may be disposed of in the ocean, in the Bay, and at upland sites.

Management of the Estuary

Findings:

- The existing management system has successfully addressed several major problems associated with controlling point source discharges, upgrading publicly owned treatment works, controlling Bay fill, and acquiring and enhancing wetlands and other sensitive ecosystems.
- The McAteer-Petris Act of 1965, the Porter-Cologne Act of 1969, and the Federal Water Pollution Control Act of 1972 (and subsequent amendments in 1977 and 1987) are responsible for many improvements in water quality.
- The success of acquisition activities is largely associated with U.S. Fish and Wildlife Service efforts to establish national wildlife refuges, the establishment of the California Coastal Conservancy, and private funding efforts of groups such as the Nature Conservancy.
- Current environmental laws promote species- and issue-specific resource protection rather than protecting whole ecosystems and biodiversity.
- The number and variety of agencies and entities involved in Estuary management are sometimes confusing to the general public, as well as to other resource managers and decision-makers.
- In some cases, legislation has created overlapping and conflicting agency mandates, making implementation difficult. Additionally, many agencies are operating under outdated missions and mandates.
- In certain instances, agency jurisdiction is ill-defined and does not relate to the resources that are supposed to be protected.
- Goals and strategies for regional coordination of resource management are lacking in a number of areas, such as habitat acquisition, mitigation priorities, growth management, land use, and dredged material disposal.
- There is no legal requirement that local governments coordinate general plans with one another or provide protection to vital natural resources in the Bay-Delta area.
- Lack of sound scientific information hinders effective decision making related to natural resource protection. Often valuable information exists, but is not in a format accessible to those involved.
- Agencies lack adequate financial and human resources to comply fully with mandates to implement programs. The permit review process has become slow and cumbersome due to budget cuts, redirection of resources, and lack of experienced staff to handle the increase in permits.

“Current environmental laws promote species- and issue-specific resource protection rather than protecting whole ecosystems and biodiversity.”

Managing a natural resource as complex as the San Francisco Estuary is a challenging task. Responsible government bodies, and the private and public interests that influence them, are as diverse as the Estuary itself. While the enactment of significant state and federal laws protecting the nation's waters has led to major improvements in Estuary water quality over the past thirty years, much remains to be done by citizens and government to preserve and restore the Estuary's health and productivity.

Today, a complex array of agencies, plans, regulations, and laws govern activities in the Estuary region. A one-mile stretch of shoreline may be affected by the decisions of up to 412 government bodies with differing mandates and jurisdictions. Some administer municipal responsibilities of a city or county, ranging from social services and infrastructure maintenance to land use and sewage treatment. Some regulate specific activities such as dredging, filling, and wastewater discharge on a state, regional, or nationwide basis. Some manage water, fish, or wildlife resources on state or federal levels. Areas of control often overlap, necessitating inter-governmental communication and coordination.

For example, while existing laws and agencies provide a relatively intricate regulatory framework for wetlands, numerous shortcomings exist. Under the Section 404 program of the Clean Water Act, not all activities that may have detrimental impacts on wetlands are regulated. Also, certain ecologically significant wetland areas are not currently included within Section 404 jurisdiction. Since no single agency has complete or final authority over wetland use, there is a great need for a coordinated framework to protect and manage these valuable areas.

Activities of Estuary resource agencies often overlap. For example, the California Department of Fish and Game manages fish in state waters, while the National Marine Fisheries Service and the U.S. Fish and Wildlife Service oversee the management of fish in state and federal waters. Their overall goals to protect and maintain natural resources are duplicative, although their specific mandates and directions may differ somewhat. The U.S. Army Corps of Engineers has conflicting missions in regard to flood control responsibilities and efforts to protect wetlands. The California Department of Water Resources has a conflicting mandate in terms of planning water resources while also contracting and selling water. Other agencies within the Estuary have similar conflicting or overlapping missions and mandates.

Research is being conducted on a variety of topics related to estuarine systems, but its value to policy development is often limited. Detailed maps of critical natural resources are not available to local governments or the development community to assist in the decision-making process. Information regarding sensitive resource areas, such as wetlands, vernal pools, and riparian habitats, is not available to private developers or landowners. There is no single place or entity where complex regional issues can be considered, decisions made, and policies carried out. There is also a need for information sharing and informal consultation among agency staffs and the private sector.

In many instances, improved coordination may overcome institutional barriers that currently hinder the implementation of essential actions. Such coordination can improve the flow of information, identify possible problems, and minimize delay, cost, and uncertainty for the entity being regulated. Furthermore, establishing common goals may help ensure that all agencies take the appropriate actions to protect and enhance the Estuary's resources.

Some problems facing the Estuary may require a totally new approach. For instance, a new or revised entity may be required to improve research and monitoring. Effective watershed management may require new institutional arrangements to implement best management practices through existing mechanisms. To promote water conservation, specific legal reforms may be necessary to remove barriers to effective water transfers and water marketing. Renewed interest in California concerning growth management and regional planning may lead to new institutions that foster coordination among local governments. In 1992, legislation introduced by Senator Pat Johnston was adopted that created a Delta Planning authority to protect important Estuary resources and improve local government coordination.

There are other encouraging signs that public and private interests are undertaking initiatives to improve resource management throughout the Estuary. The California Resources Agency, in coordination with the U.S. EPA, is preparing a State Wetlands Conservation Plan and is working with the State Wetlands Consensus Project. Several agencies concerned with dredging are helping to develop the Long-Term Management Strategy to manage dredging activities. Also, many citizen groups and other private entities are becoming directly involved in habitat restoration projects, monitoring, and pollution prevention.

Comprehensive Approach to Addressing the Issues

Several conclusions emerge from the preceding sections. First, the Estuary Project's five management issues comprise a wide range of environmental problems threatening the Estuary. Although some of these problems are more systemic and serious than others, they all ultimately affect the Estuary's biological resources and water quality.

Second, while management of some of these problems has improved in recent decades, some continue to be untenable. The most notable improvements include a declining rate of wetland loss, reduced pollutant loads of municipal and industrial sources, and improved regulation of dredging. However, urban expansion continues to deplete the stock of valuable upland wildlife habitats, wetlands, and riparian areas and increases the discharge of many point and nonpoint pollutants. Population growth fuels the increasing demand for fresh water. Water projects continue to influence the Estuary's primary productivity and habitat quality and adversely affect populations of valuable commercial and sport fish and other species.

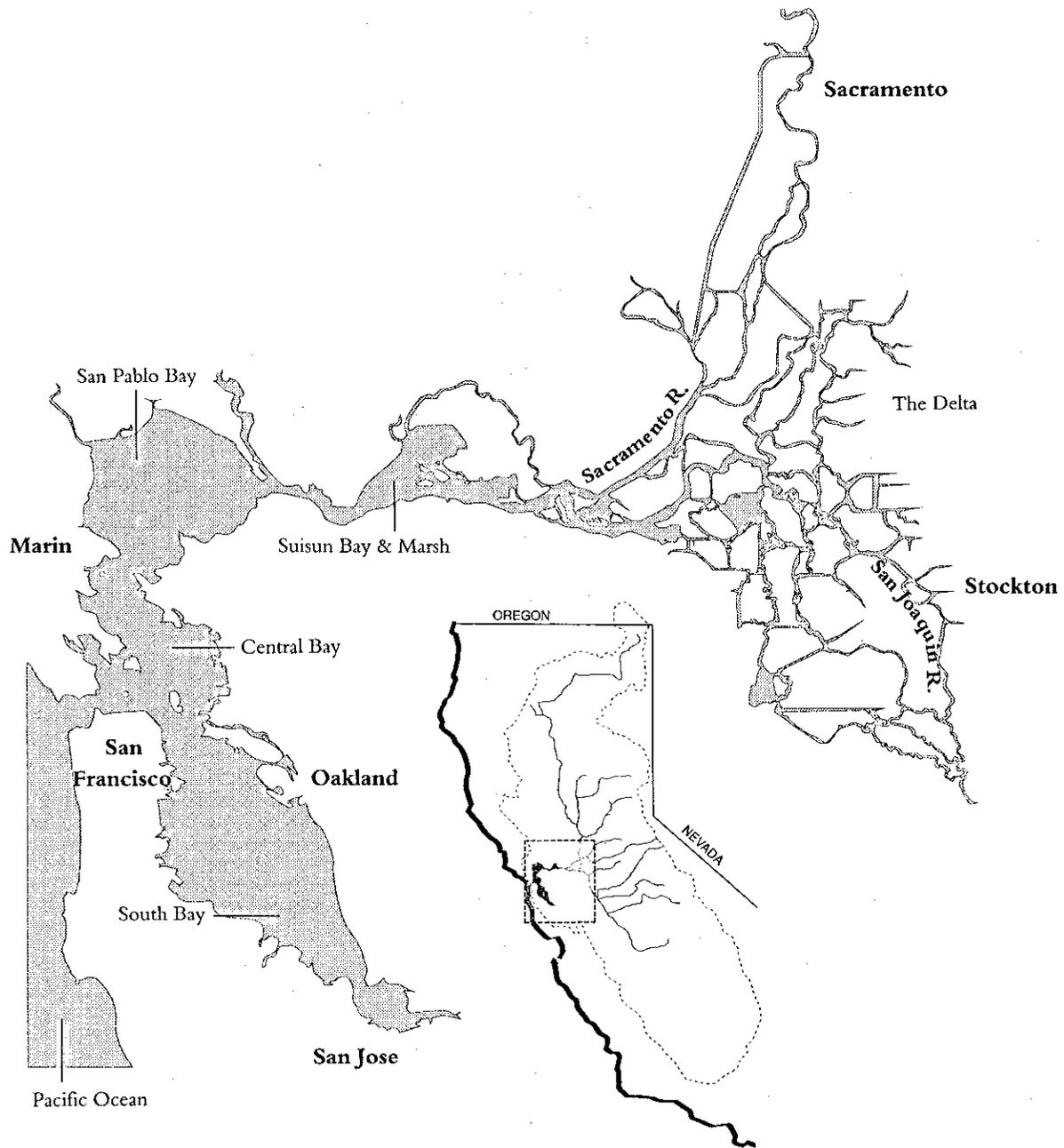
Finally, it is apparent that the problems facing the Estuary are interrelated, linked in a web of interacting chemical, physical, and biological processes. Acknowledging these interactions is critical to developing effective actions to address the issues. It makes little sense, for example, to try to lower the pollutant-related impacts of dredging without also reducing the quantities of pollutants that find their way into sediments in effluent and runoff. Similarly, it would be unwise for public entities to spend large sums of money to protect particular wetlands and then to allow incompatible land uses on adjacent uplands.

Given the interrelated nature of the issues confronting the Estuary, a coordinated approach is needed among the groups addressing them. Developing this coordination will be one of the main challenges to the public and private entities that will implement the Comprehensive Conservation and Management Plan.



The Estuary

A Significant Natural Resource



III

ACTION PLAN

THE PURPOSE of the Comprehensive Conservation and Management Plan (CCMP) is to develop, adopt, and oversee the implementation of a coordinated and comprehensive strategy to protect the San Francisco Estuary. The actions contained in this chapter under their respective program areas provide the foundation for this comprehensive approach.

The members of the Management Committee are committed to developing a plan to restore the ecological health of the Estuary, while maintaining the economic diversity of the region. The following mission statements, developed by the Committee from the findings of Status and Trends Reports, were used to facilitate and guide the consensus process.

The following programs were developed to organize the actions and correspond to the various levels of the Estuary diagram:



Aquatic Resources



Water Use



Land Use



Wildlife



Pollution Prevention and Reduction



Public Involvement and Education



Wetlands



Dredging and Waterway Modification



Research and Monitoring

CCMP Mission Statements

- Restore and protect a diverse, balanced, and healthy population of fish, invertebrates, wildlife, plants, and their habitats, focusing on indigenous species.
- Assure that the beneficial uses of the Bay and Delta are protected.
- Improve water quality, where possible, by eliminating and preventing pollution at its source, while minimizing the discharge of pollutants from point and nonpoint sources and remediating existing pollution.
- Manage dredging and waterway modifications to minimize adverse environmental impacts.
- Effectively manage and coordinate land and water use to achieve the goals of the Estuary Project.
- Increase public knowledge about the Estuary ecosystem and public involvement in the restoration and protection of the health of the Estuary.
- Increase our scientific understanding of the Estuary and use that knowledge to better manage the Estuary.
- Develop and expand non-regulatory programs, such as public-private partnerships and market incentives, in conjunction with regulatory programs, to achieve the goals of the Project.
- Preserve and restore wetlands to provide habitat for wildlife, improve water quality, and protect against flooding.
- Assure an adequate freshwater flow as one of the essential components to restore and maintain a clean, healthy, and diverse Estuary.

CCMP Program Area Development

The CCMP mission statements acknowledge the need to reduce the level of adverse physical, chemical, and biological impacts occurring today, rather than pay the higher costs of addressing them in the future. Further, these statements emphasize the need to develop a framework for alliances among various levels of government and the public and private sectors to effect positive change in the Estuary.

In November of 1991, the Management Committee received a Working Draft of the CCMP. The Working Draft contained a combination of staff and subcommittee recommendations for managing the Estuary. The Management Committee then met over a period of seven months (January through July of 1992) to evaluate the proposed actions and develop a Public Draft CCMP, which was released in August, 1992.

The Public Draft was widely circulated to all interested parties. During September, nine public hearings were held to solicit comments at various locations throughout the Bay-Delta region. The hearings attracted over one hundred individuals, and over 250 written and verbal comments were received. Estuary Project staff compiled the public comments and presented the summarized data to the Management Committee for its review and consideration in finalizing the CCMP.

The Management Committee made final revisions to all program areas in October and November of 1992, excluding the Aquatic Resources Program, which was still under development. A revised, detailed draft Aquatic Resources Program was released for public comment in February of 1993. The Management Committee adopted the complete CCMP at its March 31, 1993, meeting.

The Management Committee reached consensus on all programs except the Aquatic Resources and Wetlands Management Programs, which were approved by vote. Those members whose opinions are not reflected in the majority opinion submitted one-page minority reports, which are found immediately following the Aquatic Resources and Wetlands Management Programs. In the Wetlands Management Program, a majority report is included with the minority report to describe the intent of the approved program area.

Action Plan Format

The Action Plan format was developed to be easily understood while complying with requirements set out in the U.S. Environmental Protection Agency manual, *Content Requirements and Approval Process For National Estuary Program Comprehensive Conservation and Management Plans*.

The format consists of:

- I. Goals
- II. Problem Statement
- III. Management Structure
- IV. Recommended Approach
- V. Objectives and Actions

Actions include components that identify **who**: the responsible entity(ies); **what**: description of the activity; **when**: proposed time frame; and **cost** estimates.

Costs

To derive costs for CCMP actions, two methods were employed: 1) SFEP staff surveyed state and federal agencies to determine their respective costs for each action; and 2) SFEP subcommittees, with the help of local, state, and federal agency personnel, estimated the costs of actions in the Aquatic Resources, Dredging and Waterway Modification, and Public Involvement and Education Programs.

Only those costs associated with state and federal agency costs are listed in the CCMP. Costs to local agencies, local governments, and private entities were not determined. Costs to state and federal agencies were derived by totaling contract dollar costs and staff time. In cases where the state is acting as a contractor for the federal government or where one state agency is contracting with another agency, only the original allocation of resources is counted to avoid double counting.

All costs represent twenty-year totals. Therefore, for annual programs, the yearly cost was multiplied by twenty to determine a total cost figure. For programs that will last for fewer than twenty years, the cost shown represents the full cost of carrying out the program.

The total estimated state and federal cost for each of the program areas is as follows:

Wildlife:	\$ 442,995,000
Wetlands Management:	\$ 407,021,000
Water Use:	\$ 86,211,000
Pollution Prevention and Reduction:	\$ 224,112,000
Dredging and Waterway Modification:	\$ 24,172,000
Land Use:	\$ 38,378,000
Public Involvement and Education:	\$ 59,450,000
Research and Monitoring:	\$ 306,470,000
 Total (excluding Aquatic Resources):	 \$1,588,809,000

For additional costing details, please refer to the separate SFEP document, *Preliminary Implementation Strategy*.

Program Format

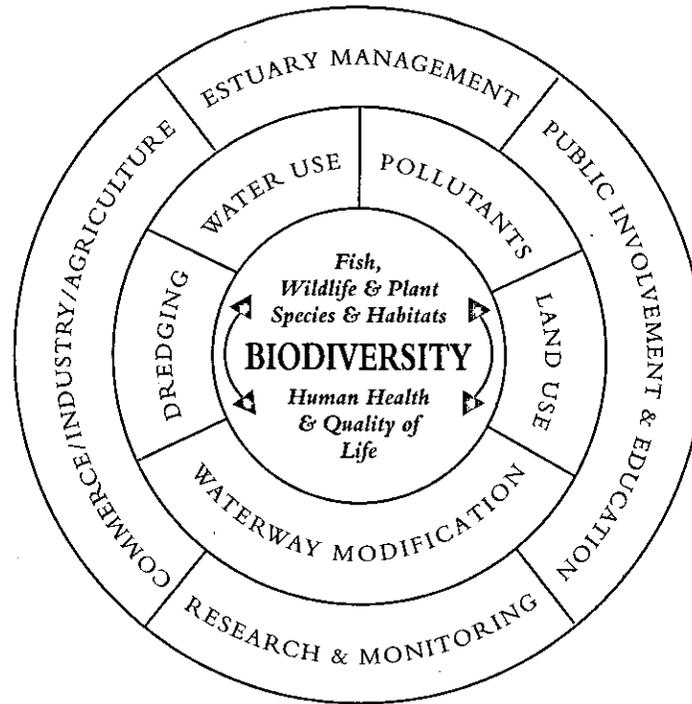
Actions have been organized into components that differ slightly from the five management issues originally identified by the Management Conference. The nine program areas better accommodate the number and variety of actions suggested and eliminate overlap within the management issues.

The concept for the new categories was derived from the diagram in Figure 1, which shows the interrelationship among estuarine resources, impacts on these resources, and the decision-making entities. At the center of the diagram are the aquatic and wildlife resources and their adjoining habitats. The important aquatic and wildlife habitats include wetlands, riparian habitats, rivers, and streams.

The second level of the diagram identifies the physical, chemical, and biological elements that affect aquatic and wildlife resources and their habitats. Activities affecting fish and wildlife are human-induced water use, pollution, dredging and waterway modification, and land use.

The third level (the outer ring) illustrates social and regulatory structures that influence the physical, chemical, and biological systems in the Estuary. Governmental regulations and management, the public's involvement and basic knowledge, scientific and technical knowledge, and the methods by which private businesses, groups, and individuals perform their activities are factors that influence how water is used, how much pollution is produced and managed, where dredging should be conducted, and how land will be developed.



FIGURE 1: *The Estuary and its Management*

The following Programs were developed to organize the actions and correspond to the various levels of the Estuary diagram:

Center of the Circle:

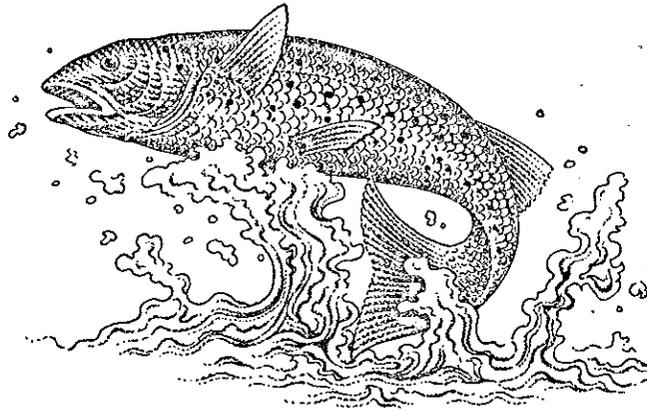
Aquatic Resources
Wildlife Resources
Wetland Habitats

Second Circle:

Water Use Program
Pollution Prevention and Reduction Program
Dredging and Waterway Modification
Land Use

Third Circle:

Public Involvement and Education
Research and Monitoring Program



.....

Aquatic Resources

Goals:

- ❑ Stem and reverse the decline in the health and abundance of estuarine biota (indigenous and desirable non-indigenous), with an emphasis on natural production.
- ❑ Restore healthy estuarine habitat conditions to the Bay-Delta, taking into consideration all beneficial uses of Bay-Delta resources.
- ❑ Ensure the survival and recovery of listed and candidate threatened and endangered species, as well as other species in decline.
- ❑ Optimally manage the fish and wildlife resources of the Estuary to achieve the purpose of the goals stated above.

Problem Statement

From 1967 to 1988, annual studies of the six most abundant estuarine species (striped bass, threadfin shad, white catfish, Delta smelt, American shad, and longfin smelt) have indicated downward trends in the abundances of most species. Declines in the abundance and survival of indigenous flora and fauna of the San Francisco Bay-Delta Estuary can be traced to the alteration of the system's hydrology and habitats. These alterations include the diversion of fresh water, entrainment, changes in salinity conditions, the loss of shaded riverine aquatic habitat, the spread of alien species, pollutant discharges, and poaching.

The total annual volume of fresh water reaching the Estuary is highly variable, primarily as a result of California's variable precipitation patterns. Between 1921 and 1990, the annual flow of fresh water into the Delta ranged from about six million acre-feet (MAF) to more than fifty MAF, with an average of about twenty-four MAF. At the current level of development, more than sixteen MAF of fresh water are diverted annually from the Estuary (about seven MAF from the Delta and more than nine MAF upstream). This amounts to a loss of more than 50 percent of the annual average Delta inflow. If future water development proceeds as planned, diversions from the Estuary will increase by at least another 1.1 MAF.

The pumping plants for the Central Valley Project (CVP) and the State Water Project (SWP) are located in the southern part of the Delta near Byron. These pumps divert water from the Sacramento-San Joaquin river system for conveyance south to farms and urban centers. During periods of high pumping or low outflow, water in the Delta channels and the San Joaquin River flows upstream, resulting in the disorientation and mortality of anadromous and estuarine-dependent fish. This phenomenon is known as "reverse flows."

The CVP and SWP facilities entrain and destroy millions of fish eggs, larvae, juveniles, and some adults, as well as other food web components, such as nutrients, phytoplankton, and zooplankton. Existing fish screens and salvage facilities at the pumping plants have not effectively curbed entrainment losses. The California Department of Water Resources (DWR) and the California Department of Fish and Game (DFG) have entered into an agreement to help mitigate entrainment losses. Mitigation activities include stocking striped bass and supporting hatcheries for salmon and steelhead. Also, DFG "salvages" fish by gathering those organisms collected on the screens and transporting them by trucks downstream for placement in the Delta. On the average, 20 to 60 percent of the organisms that survive entrainment die during the process of handling and trucking.

In addition to water sent south by the CVP and SWP, water is also diverted directly from the Delta for local use and export. In the Delta alone, there are approximately 1,800 agricultural diversions that divert flows ranging from several cubic feet per second (cfs) to several hundred cfs; only a few are screened. At industrial facilities where estuarine waters are used for cooling, aquatic organisms are entrained in the intake systems or impinged on the surface of fish screens.

Existing Management Structure

Under the federal Clean Water Act Amendments of 1972 and the implementing regulations of the U.S. Environmental Protection Agency (U.S. EPA), states are to establish designated uses (known in California as "beneficial uses") for water bodies and must adopt water quality criteria (known in California as "objectives") sufficient to protect the most sensitive beneficial uses. These beneficial uses include the protection and propagation of fish, shellfish, and wildlife; recreation; and water consumption by municipal, industrial, and agricultural communities.

U.S. EPA is to review and approve or disapprove of all state-adopted water quality objectives. The State Water Resources Control Board (SWRCB) first proposed water quality objectives for the Delta in 1965. Since then, objectives for the Delta and Suisun Marsh have been established or modified several times. SWRCB shares the authority for implementation of the federal Clean Water Act and the state Porter-Cologne Act with the nine Regional Water Quality Control Boards (RWQCBs). On a triennial basis, each RWQCB prepares a Basin Plan for its regional watershed that identifies relevant beneficial uses, establishes water quality objectives to protect these uses, and sets forth strategies and schedules for achieving the objectives.

SWRCB allocates water rights by: 1) accepting applications to divert or store water, 2) holding hearings on the effects of the proposed diversions, and 3) issuing permits (with conditions) as appropriate. Entities may divert water directly from the Delta or its tributaries, depending on their geographical locations and available facilities. The federal Central Valley Project (CVP) and the State Water Project (SWP) divert the most water from the Estuary through operations managed by the U.S. Bureau of Reclamation (U.S. BOR) and DWR, respectively.

There are a variety of agencies with responsibility for managing the fish and wildlife resources of the Estuary. The U.S. Fish and Wildlife Service (U.S. FWS) manages federal wildlife refuges, evaluates the biological effects of federally funded or federally permitted land and water development projects (especially concerning rare, threatened, or endangered flora and fauna), and provides recommendations for avoiding or minimizing adverse impacts. The National Marine Fisheries Service (NMFS) has primary federal responsibility for the conservation and management of living marine resources, such as marine mammals and anadromous fish (e.g., the winter-run Chinook salmon).

The California Department of Fish and Game (DFG) is responsible for the stewardship of California's flora and fauna. This includes the protection of sensitive habitats and the management of the commercial and sport harvest of fish, shellfish, and wildlife. DFG has dedicated an entire unit for the collection and analysis of data on the abundance and survival of aquatic organisms in the Bay-Delta Estuary. In part, this information is used to judge the potential biological effects related to proposed federal and state projects or changes in the operations of existing projects.

In 1971, the Interagency Ecological Studies Program (IESP) was established to evaluate the effects of the CVP and SWP on environmental resources of the Estuary and to identify ways to mitigate adverse impacts. IESP members include SWRCB, U.S. BOR, DWR, DFG, U.S. FWS, U.S. Geological Survey, the U.S. Army Corps of Engineers, and U.S. EPA. IESP representatives have contributed greatly to the San Francisco Estuary Project by assisting with status and trends reports, participating in technical workshops, and directing research and monitoring efforts.

The U.S. Coast Guard's general mission is to protect the marine environment and life and property at sea. It is responsible for managing the discharge of ballast water from ships, which historically has been a source of the non-native species introduced into the Estuary.

Recommended Approach

For more than a century, humans have modified the habitats of the Bay-Delta Estuary and extracted resources without a complete understanding of the long-term consequences. Huge water projects were constructed for the primary purpose of water conveyance and distribution; adverse effects on ecological systems were not adequately measured or mitigated. The result has been a poor understanding of diminished ecosystem functions and the imperilment of estuarine habitats and biodiversity.

Today, government agencies, academic institutions, and water consumers are beginning to work together to improve the scientific basis for managing the Estuary. New research and a regional monitoring program are being tailored to address uncertainties regarding the recovery and protection of the Estuary's biota and ecosystem functions.

In SWRCB's formal Bay-Delta hearings, the Board considered an extensive amount of technical testimony for the purpose of establishing scientifically based water quality standards for the Estuary. In conjunction with SWRCB's hearings, the San Francisco Estuary Project sponsored a series of technical workshops involving approximately thirty scientists and managers. The workshops were designed to evaluate the responses of estuarine biota and habitats to various conditions of salinity and flow and to identify areas of scientific agreement about these responses. In the end, participants recommended the development of seasonally based salinity standards for the Estuary that could augment existing flow standards. These findings are detailed in a report entitled *Managing Freshwater Discharge to the San Francisco Bay/Sacramento-San Joaquin Delta: The Scientific Basis for an Estuarine Standard*.

The cost estimates contained in this Aquatic Resources Program were provided by members of the ad hoc Aquatic Resources workgroup. While the estimates represent potentially significant expenditures, the Central Valley Project Improvement Act (Title XXXIV of PL 102-575) establishes a trust fund that could be directed toward CCMP implementation.

The following chart is designed to provide a "map" of the Aquatic Resources Program:

- Objective AR-1 Monitoring, ecosystem characterization, and predictive models
- Objective AR-2 Actions affecting "critters," e.g., pollutants, exotic species, and poaching
- Objective AR-3 Protection of threatened and endangered species

- Objective AR-4 Actions affecting "habitats," i.e., short-term standards that are implemented in phases, gates and screens to curb entrainment, and ecological restoration
- Objective AR-5 A process for setting long-term standards needed to reach resource recovery targets
- Objective AR-6 Restoration of watersheds upstream of the Delta

Aquatic Resources Actions

Objective AR-1

Improve the effectiveness of the techniques and programs used to evaluate and monitor the responses of the estuarine ecosystem to water management actions.

ACTION AR-1.1

Refine and coordinate existing monitoring programs to: (i) better evaluate ecosystem responses to immediate, phased, and long-term water quality and flow standards; (ii) more fully characterize ecosystem processes and properties; and (iii) enhance predictive capabilities of ecosystem models.

Who: Member agencies of the Interagency Ecological Studies Program (IESP) for the Bay-Delta Estuary, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, and the proposed San Francisco Estuarine Institute

What: Refine and coordinate existing monitoring programs to monitor better the physical, chemical, and biological changes in the Estuary and relate observed changes to water management actions and other changes occurring in estuarine management. Coordinate these monitoring activities with monitoring recommendations contained in the Regional Monitoring Strategy of the CCMP to evaluate the performance of CCMP actions.

Also, design and conduct new studies that increase the understanding of how physical, chemical, and biological processes are being affected by human activities and improve the scientific basis for managing the Estuary. Researchers should review and consider available data and ongoing studies, including evidence submitted to the State Water Resources Control Board in the Bay-Delta hearings and the SFEP-sponsored report entitled *Managing Freshwater Discharge to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: The Scientific Basis for an Estuarine Standard*. This action would be implemented in three parts:

A. Monitoring Physical and Chemical Components of the Estuary

Continue and modify, as appropriate, ongoing monitoring of temperature, flow, nutrients, salinity, and other physical and chemical components. Also, establish a series of at least six stations for continuous monitoring of salinity spaced approximately five kilometers apart along the estuarine channel between Emmaton (Western Delta) and the Carquinez Bridge. Measurements should include surface and near-bottom sampling. The data should be telemetered to a convenient location for timely analysis and interpretation. These data should be supplemented with detailed surveys to map the distribution of salinity in three dimensions. The data should also be made available in a timely way to all interested parties.

B. Monitoring Biological Components of the Estuary

The ongoing biological monitoring should also be evaluated and modified as appropriate to track biological changes occurring in response to physical and chemical changes, including changes in the position of the 2 ppt isohaline. Based on preliminary assessments, the following indicators should be considered for inclusion in the biological monitoring program (this list should be expanded as appropriate, and priorities set to identify the most appropriate indicators):

- ☐ phytoplankton: particulate organic carbon (POC) loading from rivers
- ☐ phytoplankton: primary production within the Estuary
- ☐ bacterial abundance and activity
- ☐ *Neomysis mercedis*
- ☐ *Crangon franciscorum*
- ☐ annual abundances of mollusks
- ☐ striped bass (*Morone saxatilis*)
- ☐ starry flounder (*Platichthys stellatus*)
- ☐ longfin smelt (*Spirinchus thaleichthys*)
- ☐ invasion of introduced species (e.g., cordgrass and invertebrates)
- ☐ tule (*Scirpus sp.*) growth (annual change in culm diameter)
- ☐ changes in plant composition in tidal and non-tidal marshes (the replacement of vegetation associated with freshwater conditions with vegetation associated with saltwater conditions)
- ☐ rates of survival for migrating anadromous fishes
- ☐ seagrass

C. Evaluating the Monitoring Program

The information developed in Parts A and B above should be used to target the most appropriate indicators and to refine the predictive capability of ecosystem models. Analytical techniques could include the salinity and flow response matrices proposed in *Managing Freshwater Discharge to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: The Scientific Basis for an Estuarine Standard*.

When: Incorporate into existing monitoring programs of the IESP

Cost: The *existing* annual IESP budget totals approximately \$11.9 million. Approximate interagency contributions are as follows: DWR (\$6 million), U.S. BOR (\$3.7 million), DFG (\$1.2 million), U.S. Geological Survey (\$800,000), SWRCB (\$225,000), and U.S. FWS (\$167,000).

Objective AR-2

Develop and implement species-specific management actions for the Estuary to assist in the recovery and maintenance of sustainable fish populations and to control or eliminate undesirable non-indigenous species.

ACTION AR-2.1

Develop, implement, and enforce stringent regulations to control discharges of ship ballast water within the Estuary or adjacent waters.

Who: California Department of Fish and Game, California Department of Health Services, U.S. Coast Guard, and Bay-Delta Port Authorities

What: As provided for in the newly adopted Sections 6430 to 6439 of the Fish and Game Code, the State of California should develop a ballast water control report form to monitor compliance with the *Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges*, adopted by the International Maritime Organization on July 4, 1991. If that monitoring indicates continued substantial exchange of ballast in the Estuary, the state should ask the federal government to strengthen the regulations.

When: Immediately develop the control report for filing to prepare for implementation starting in January, 1994.

Cost: Unknown

ACTION AR-2.2

Prohibit the intentional introduction of aquatic exotic species into the Estuary and its watershed.

Who: California Fish and Game Commission

What: To be prudent, the Fish and Game Commission should deny all requests for the introduction of new species into the watershed of the Estuary unless strong evidence is produced to demonstrate that an introduction will not have deleterious effects on indigenous species. Many of the exotic (non-indigenous) aquatic species introduced into the Estuary have damaged ecosystem functions. Nevertheless, there are still proposals to introduce even more exotic species into the system (e.g., grass carp). With regard to mosquito abatement, explore the feasibility of using indigenous minnows in appropriate aquatic sites to control mosquito populations.

When: Immediately

Cost: No significant cost would be incurred beyond the existing budget for the Commission.

ACTION AR-2.3

Control problem exotic species already in the Estuary.

Who: California Department of Fish and Game, California Department of Agriculture, and California Department of Boating and Waterways

What: Appropriate agencies should examine the life cycles and environmental requirements of undesirable exotic species and develop and implement feasible measures to control or eliminate these organisms.

When: Studies should begin as soon as funding can be obtained.

Cost: The cost for a single investigation program could be up to \$750,000-\$1,000,000 annually. Implementing the plan could cost much more.

ACTION AR-2.4

Develop programs to educate the public about the problems with exotic species and their incidental transport or introduction.

Who: Friends of the San Francisco Estuary, California Department of Fish and Game, California Department of Agriculture, and California Department of Boating and Waterways

What: Consistent with Action PI-3.1 of the Public Involvement and Education Program, develop a long-term educational program for user groups (e.g., anglers, sports clubs, commercial interests, schools, and environmental organizations) to curb the introduction of exotic species into the Estuary.

When: Begin in 1994

Cost: The cost is addressed in Action PI-3.1.

ACTION AR-2.5***Strengthen programs to reduce the poaching of species within the Estuary.***

Who: California Department of Fish and Game and California Department of Water Resources

What: Increase funding for the existing CAL-TIP anti-poaching program. Also, provide long-term funding for the special enforcement unit that has been established by DFG and funded for three years by DWR to deal with “illegal take” and poaching of estuarine aquatic species. This special enforcement unit is equipped with state-of-the-art equipment (e.g., night-vision scopes, shallow-water jet boats, and deep water patrol boats) and would augment existing night and overtime patrols. Consider adding a component to Action PI-3.1 of the Public Involvement and Education Program to curb poaching of aquatic resources.

When: Immediately

Cost: Funding for CAL-TIP should be increased by \$100,000 annually. DWR is currently providing \$600,000 annually for three years from its Delta pumps mitigation fund to get the special enforcement effort started.

ACTION AR-2.6***Review and modify, if necessary, harvest regulations for aquatic species of concern.***

Who: California Department of Fish and Game, the Fish and Game Commission, and Pacific Fisheries Management Council

What: Review harvest regulations and determine if they are adequately protecting aquatic species. If not, prepare alternative regulations and adopt modifications.

When: The Council should perform this task annually, and the Commission should do so bi-annually.

Cost: No additional cost

ACTION AR-2.7***Identify and control sources and sinks of contaminants that may affect fish populations or ecosystem health.***

Who: State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, California Department of Transportation, California Environmental Protection Agency, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, industrial dischargers, and agricultural dischargers

What: Consistent with Action PO-2.3 of the Pollution Prevention and Reduction Program, identify sources and sinks of contaminants (e.g., mercury, selenium, and acid mine drainage) suspected of affecting populations and implement control programs to eliminate potential hazards to the ecosystem and public health.

In addition, when managing pulses of Delta outflows, give consideration to the impacts of altered circulation and transport and bioavailability of pollutants on estuarine aquatic resources.

When: Reduce toxic effects as quickly as feasible and, by the year 2030, reduce all toxicants to levels that cause no adverse effects.

Cost: The majority of costs appear to be addressed in Action PO-2.3.

ACTION AR-2.8

Research and develop methods to reduce the incidental take of non-target species in commercial activities.

Who: California Department of Fish and Game, National Marine Fisheries Service, the commercial fishing industry, and Sea Grant

What: Currently, the trawling methods used by the commercial shrimp industry result in the incidental take of striped bass and other fish species. Resources agencies should work with the industry to develop methods that would reduce the incidental take of non-target species.

When: Implement when funding is obtained

Cost: \$125,000 for a one-year program

Objective AR-3

Implement recovery actions for all listed and candidate threatened and endangered species.

ACTION AR-3.1

Prepare/update recovery plans for all listed species. This includes designation of critical habitat.

Who: California Department of Fish and Game, U.S. Fish and Wildlife Service, and National Marine Fisheries Service

What: Review all existing data on listed species and determine their adequacy for developing recovery plans. Conduct additional studies as necessary to address critical uncertainties. When sufficient data are obtained, develop recovery plans and monitoring objectives designed to improve reproduction and survival of the species. Critical habitat should be identified to the extent practicable and desirable. All plans, whether new or existing, should be periodically reviewed and updated.

When: Develop recovery plans within one year of listing

Cost: Approximately \$300,000-\$500,000 per recovery plan

ACTION AR-3.2

Monitor status of all candidate species and list them if warranted.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Game

What: Develop and implement programs to monitor the status of all Class I and Class II candidate species, as well as state-identified species of special concern. Agencies should take steps to list any species that warrant it to afford them the full protection of the law. Any listing package should include designation of critical habitat to the extent practicable and desirable. Consider listing groups of species inhabiting common habitat areas in lieu of individual listings.

When: Implement when funding is obtained

Cost: \$120,000 per year

ACTION AR-3.3

Initiate consultations with all federal agencies that propose or are continuing actions that may affect listed species.

Who: National Marine Fisheries Service, U.S. Fish and Wildlife Service, and federal action agencies

What: All federal action agencies whose programs may affect listed aquatic species should consult with the responsible fish and wildlife agency to ensure their actions do not jeopardize the continued existence of the species or adversely affect designated "critical" habitat. These consultations will also serve to identify actions that these same federal agencies might take to improve conditions for listed species.

When: Immediately

Cost: No additional costs

ACTION AR-3.4

Review all non-federal proposals and continuing actions that may result in take of listed species and take appropriate actions.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Game

What: This action directs resource agencies to provide up-front technical assistance to non-federal agencies to enable them to avoid violations of the "take" provisions of the federal Endangered Species Act. While non-federal agencies are not obligated to consult with the U.S. Fish and Wildlife Service or the National Marine Fisheries Service regarding potential impacts on listed threatened or endangered species, they are prohibited from "taking" a listed species. Compliance with the recommendations from the resource agencies is discretionary, but prohibitions against "taking" are not.

When: Implement when funding is obtained

Cost: Estimated at \$120,000 per year for each agency

ACTION AR-3.5

Investigate the feasibility of developing a Habitat Conservation Plan (or Plans) for the Bay and Delta that promotes the recovery of the species and addresses incidental take associated with non-federal actions.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, non-federal action agencies, State Lands Commission, and local mosquito abatement districts

What: Individuals should be encouraged to enter into Habitat Conservation Plans (HCPs) or agreements per the state's Natural Communities Conservation Program (NCCP) when it would meet their needs and contribute to the protection of listed species. Permits can be granted for the "incidental" take of listed species in conjunction with an otherwise lawful activity on the part of a non-federal entity if that entity implements measures for habitat maintenance, enhancement, and protection coincident with its proposed action. These measures should be detailed in a HCP.

HCPs can be developed to address multiple development actions covering large areas and involving numerous listed species. The ideal HCP is one that improves and safeguards habitat for listed species, while allowing development to proceed concurrently.

When: Implement when funding is obtained

Cost: Estimated at \$240,000 per year

ACTION AR-3.6

Adopt listed species recovery as a policy for all public agencies whose actions affect them.

Who: All federal and non-federal action agencies and local mosquito abatement districts

What: Under this action, all public agencies would be urged to promote recovery of listed species. If recovery was assured, perhaps barriers to development could be removed. The federal Endangered Species Act precludes federal agencies from taking actions that might jeopardize listed species or adversely affect designated critical habitat. It also states that federal agencies use their authorities to promote recovery of listed species. Non-federal agencies are only precluded from "taking" listed species.

When: Immediately

Cost: In some cases, this action could be accomplished by redirecting existing funds toward an "ecosystem approach" to resource management. In other cases, new facilities may be needed that require new appropriations, or a shift in the operations of the water projects could be costly (e.g., foregone revenues from the generation of electric power), or new management practices may be required of mosquito abatement districts. Many of these costs for new facilities and modified operations are addressed by the actions under Objectives AR-4 and AR-6.

Objective AR-4

While awaiting completion of the comprehensive plan called for in Objective AR-5, and in order to create habitat conditions that contribute to the attainment of that Objective, immediately implement a phased approach to provide needed: (i) water quality, flows, and other operational measures; (ii) water management facilities; and (iii) other habitat components; so long as the phased approach significantly reduces impacts on aquatic estuarine resources and meets all environmental requirements.

ACTION AR-4.1

Adopt water quality and flow standards and operational requirements designed to halt and reverse the decline of indigenous and desirable non-indigenous estuarine biota and to contribute to the attainment of Objective AR-5. Implement these standards and requirements in at least three phases: (a) immediate, interim standards and requirements consistent with current legal requirements that would be in place with the Delta in its existing configuration; (b) standards and requirements linked to South Delta Water Management facilities; and (c) standards and requirements, as may be necessary, linked to off-stream storage south of the Delta to facilitate water banking and water-transfer activities, so long as the last two phases significantly reduce impacts on aquatic estuarine resources and meet all environmental requirements.

Who: State Water Resources Control Board, California Department of Water Resources, U.S. Bureau of Reclamation, and the U.S. Environmental Protection Agency, with input from all affected parties

What: The following are elements of the phased approach:

A. Immediate, interim standards...

- SWRCB adopts and implements interim standards to protect the public trust resources of the Estuary;
- U.S. EPA reviews the standards adopted by SWRCB and takes appropriate actions; and
- Holders of water rights comply with the adopted standards.

B. South Delta Water Management facilities...

- U.S. BOR and DWR complete environmental documentation for the construction and operation of the proposed interim South Delta water management facilities (including information necessary to develop alternative standards relating to the implementation of these facilities) and meet necessary legal and statutory requirements;
- Based on this environmental documentation, SWRCB adopts standards, as necessary, pertaining to selected alternatives; and
- U.S. BOR and DWR implement the selected alternative.

C. Off-stream storage south of the Delta...

- DWR completes environmental documentation for the construction and operation of the proposed off-stream storage facilities south of the Delta (including information necessary to develop alternative standards relating to the implementation of these facilities) and meets necessary legal and statutory requirements;
- Based on this environmental documentation, SWRCB adopts standards, as necessary, pertaining to selected alternatives; and
- DWR implements the selected alternative.

When: Begin phased implementation immediately

Cost: PART A: Costs might be reflected by foregone revenues from electrical power generation and from commodities produced from agricultural and urban sectors

PART B: Approximately \$60 million needed from new appropriations

PART C: Unknown but significant; a numerical estimate of cost would depend on the facilities selected

ACTION AR-4.2

Establish conditions on industrial facilities to control entrainment of eggs, larvae, and juvenile fish.

Who: Industrial facilities in conjunction with the State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, California Department of Fish and Game, and U.S. Fish and Wildlife Service

What: Based on seasonal abundances of eggs, larvae, and juvenile fish, modify the pumping facilities and/or their operations at industrial plants (e.g., change the location of the intake) to reduce the entrainment of aquatic organisms.

When: RWQCBs are reviewing actions triennially

Cost: Variable; depends on selected regulatory actions

ACTION AR-4.3***Design and install gates or other facilities at channel openings known to be associated with the loss of fishes.***

Who: California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and National Marine Fisheries Service

What:

- Evaluate the benefits to salmon of installing a "gated" barrier at the head of Old River. U.S. BOR cost estimates: \$5-10 million
- Evaluate the feasibility and benefits of installing a "gated" barrier at Georgiana Slough. U.S. BOR cost estimates: \$7.6-15.9 million
- Consider other areas where the control of channel openings may be desirable.
- Consider evaluating other devices, such as barriers or deflectors.
- Construct and operate feasible facilities that decrease the loss of fishes.
- In designing the facilities, consider the potential impacts on recreational boating.

When: Ongoing

Cost: If found feasible, the facilities could cost in excess of \$100 million. The Central Valley Project Improvement Act (Title XXXIV of PL 102-575) provides a federal/state cost-sharing formula to help fund these mitigation projects.

ACTION AR-4.4***Design, install, and effectively operate fish screens or other protective devices at diversions associated with fish mortality.***

Who: California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and diverters of water

What: State and federal agencies should assist diverters with developing and implementing measures to avoid the losses of juvenile anadromous fish that result from unscreened or inadequately screened diversions in the Sacramento-San Joaquin Delta and Suisun Marsh. Measures include the construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing non-functioning screens, and relocation of diversions to sites less harmful to fishery resources.

When: Accelerate ongoing efforts

Cost: Approximately 1,800 unscreened diversions exist in the Delta and Suisun Marsh. DFG estimates that the capital costs for installing screens will average about \$5,000/cfs diverted. U.S. BOR estimates that the total cost could range between \$9 million and \$60 million.



ACTION AR-4.5

Improve screen efficiencies at state and federal water project pumping and fish salvage facilities.

Who: California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, and U.S. Fish and Wildlife Service

What: Evaluate the effectiveness of SWP and CVP salvage and screening facilities and identify and correct deficiencies. Consider both reconstructing the primary and secondary channels at the Tracy Fish Collection Facility and covering the secondary channels to eliminate light to reduce predation.

When: Ongoing

Cost: Approximately \$30 million needs to be appropriated

ACTION AR-4.6

Develop and implement a management plan to reduce predation in Clifton Court Forebay and near the John E. Skinner Delta Fish Protection Facility.

Who: California Department of Water Resources and California Department of Fish and Game

What: Develop feasible measures to reduce predator populations. Implement those measures and evaluate the results.

When: Ongoing

Cost: \$300,000 per year

ACTION AR-4.7

Protect existing shaded riverine aquatic habitats to ensure no net loss of acreage, lineal coverage, and habitat value within the Estuary. Activities within the "legal Delta" should be conducted consistent with California's Delta Levees Flood Protection Act of 1988.

Who: Government agencies at all levels, private landowners, local mosquito abatement districts, and non-governmental organizations

What: Government agencies, non-governmental organizations, and landowners should forge public/private partnerships to preserve the remnants of shaded riverine aquatic habitat. In the "legal Delta," partnerships should be designed to complement ongoing levee maintenance and habitat protection activities undertaken pursuant to California's Delta Levees Flood Control Protection Act of 1988 to ensure no net long-term loss of habitat. Where possible, flood control agencies should emphasize set-back levees rather than stream alteration (refer to Action DW-5.2 regarding levee protection).

Shaded riverine aquatic habitat consists of the dense vegetation that occurs along undisturbed, partially disturbed, or restored rivers and creeks. This riparian forest stabilizes stream banks, supports diverse terrestrial habitats, provides a shady streamside canopy, and creates sub-surface habitats with branches and roots that protrude into the water. Because of these functions, it ranks among the most important habitat types along the Sacramento River and in the Delta, and therefore deserves special mention in this Aquatic Resources Program. More than 98 percent of this habitat has been lost to development, flood control activities, and the effects of wave action generated mostly by boating.

When: Implement when funding is obtained

Cost: Unknown, but potentially significant

ACTION AR-4.8

Increase the quantity of shaded riverine aquatic habitat by 1,000 percent.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Army Corps of Engineers, California Department of Water Resources, State Lands Commission, California Reclamation Board, reclamation districts, San Francisco Bay Conservation and Development Commission, county mosquito abatement districts, landowners, and non-governmental organizations

What: Only 100 acres of shaded riverine habitat remain scattered in fragments within the "legal Delta." Over the next twenty years, public and private entities should achieve a 1,000 percent increase in this acreage resulting in approximately 1,000 acres of additional habitat. Restoration of this habitat is difficult along riprapped shorelines, but should occur along natural banks and where set-back levees exist (refer to Action DW-5.2 regarding levee protection). Initial restoration efforts should focus on sites contiguous with remnant parcels. Restoration could be accomplished in conjunction with environmental mitigation. When designing restoration sites, federal and state agencies should consult with mosquito abatement districts to prevent the breeding of mosquito species that are prone to carry diseases.

When: Implement when funding is obtained

Cost: Unknown, but potentially significant.

ACTION AR-4.9

Promote the maintenance and development of tule islands, tidal wetlands, and offshore berms to protect against erosion and to provide detrital input and juvenile fish nursery habitat.

Who: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, California Department of Fish and Game, State Lands Commission, San Francisco Bay Conservation and Development Commission, and California Reclamation Board

What: Consistent with Action DW-5.2, agencies should encourage the protection and creation of these habitats to serve ecological and erosion control needs. These habitats perform important ecological functions and help control erosion in the Estuary. Unfortunately, these habitats are often destroyed through the construction of structural erosion control projects.

When: Immediately

Cost: Minimal; potentially more cost-effective than conventional erosion control techniques

ACTION AR-4.10

Work with the dredging and flood control interests to reduce or eliminate practices that adversely affect fish habitat.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, California Department of Fish and Game, State Lands Commission, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, and Central Valley Regional Water Quality Control Board

What: Consistent with both the Dredging and Waterway Modification Program of this CCMP and the Long-Term Management Strategy, agencies should work more closely with dredging and flood control interests to reduce or eliminate adverse practices. In addition, pilot projects of environmentally preferable techniques should be devised and implemented.



When: Immediately

Cost: Initially, this action may require greater effort than currently expended by resource agencies and construction and regulatory agencies (perhaps an additional staff-year per agency). However, as conflicts are reduced, it should cost no more (and perhaps less) than at present.

ACTION AR-4.11

Identify and protect remnant stream habitats containing indigenous and endemic fishes and other native aquatic species.

Who: University of California, California Resources Agency, California Department of Fish and Game, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, State Lands Commission, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, California Department of Water Resources, San Francisco Bay Conservation and Development Commission, U.S. Soil Conservation Service, Urban Creeks Council, local Resource Conservation Districts, water districts, local governments, land trusts, landowners, and citizen monitors

What: The report entitled *Status and Trends Report on Aquatic Resources in the San Francisco Estuary* noted that small-stream tributaries to the Bay and Delta (i.e., the numerous creeks and small rivers besides the Sacramento and San Joaquin Rivers) support remnant wild populations of steelhead, Chinook salmon, and coho salmon, in addition to a variety of endemic and rare species. Human activities have damaged the functional integrity of these streams through habitat fragmentation, the introduction of exotic plants and animals, and the discharge of pollutants. Furthermore, the importance of these streams to the Estuary's biodiversity has been overlooked while scientists and regulators focus their efforts on managing the large rivers and bays.

In 1992, the San Francisco Estuary Project organized and funded a network of demonstration projects for watershed protection within the Bay-Delta region. Two projects involve the inventory of streams to determine: (a) the status of riparian and aquatic habitat conditions; and (b) the diversity and abundance of native aquatic organisms (e.g., fishes, amphibians, reptiles, and invertebrates).

These projects should be implemented to complement the statewide River Assessment being conducted by the California Resources Agency. Data from the inventories should be entered into computer systems to allow investigators to identify, evaluate, and rank priority sites for inclusion into a system of Aquatic Diversity Management Areas (ADMAs) to maintain local biodiversity. The concept of ADMA designation is detailed in the report entitled *Fishes, Aquatic Diversity Management Areas, and Endangered Species: A Plan to Protect California's Native Aquatic Biota*. Top priority should be given to the most pristine systems to prevent their degradation. However, degraded streams (or segments) with restoration potential should also be considered.

For each designated ADMA, management plans should be developed and implemented to protect and restore habitat conditions. Management measures could include the provision of instream flows, erosion control, pollution prevention, and the elimination of exotic flora and fauna. Public/private partnerships should be pursued to obtain landowner participation and, where appropriate, acquisition. GIS should be employed as a monitoring tool to measure the response of stream systems to improved management practices. Inventories are underway or proposed for the following streams:

- BAY AREA:
- Mt. Diablo Creek (Contra Costa)
 - Upper Wildcat Creek (Alameda)
 - Upper San Leandro Creek (Alameda/Contra Costa)
 - Redwood, Moraga, and Indian Creeks
 - Alameda Creek Drainage (Alameda/Santa Clara)
 - Coyote Creek Drainage (Santa Clara)
 - Upper Guadalupe River Drainage (Santa Clara)
 - Los Gatos Creek
 - Saratoga Creek Drainage (Santa Clara)
 - McElroy and Bonjetti Creeks
 - Upper Stevens Creek Drainage (Santa Clara)
 - San Francisquito Creek Drainage (Santa Clara/San Mateo)
 - Upper San Mateo Creek Drainage (San Mateo)
 - Novato Creek Drainage (Marin)
 - Miller Creek (Marin)
 - Corte Madera Creek Drainage (Marin)
 - Sonoma Creek Drainage (Sonoma)
 - Huichica Creek (Napa)
 - Petaluma River Drainage (Sonoma)
 - Napa River Drainage (Napa)
 - Suisun Creek Drainage (Solano)
 - Pinole
 - San Pablo
 - Walnut Creek Drainage (including Grayson)

- DELTA:
- Cosumnes Drainage
 - Mokelumne Drainage
 - Putah Creek
 - Marsh Creek

When: Begin field inventories immediately. Within two years, propose a list of streams for priority protection. At that time, begin negotiations with local governments and private landowners on proposed ADMA boundaries, land-use agreements, and management plans. Complete the designation of an Estuary-wide network of ADMAs within ten years.

Cost: The cost of inventorying the streams on the list above would be approximately \$500,000, assuming substantial participation by the academic community. Costs for developing management plans, achieving land-use agreements through public/private partnerships, and for restoration of degraded parcels are unknown, but expected to be substantial. Cost estimates for developing a regional GIS based on the inventories may be calculated as the SFEP-sponsored demonstration projects for watershed protection are implemented.

ACTION AR-4.12

Protect and maintain marshes, wetlands, shallow water areas, and tidal sloughs to protect fisheries values.

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, California Department of Fish and Game, State Lands Commission, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, and San Francisco Bay Conservation and Development Commission



What: This action should be performed while awaiting completion and implementation of the comprehensive plan identified in Objective AR-5 and in conjunction with the Wetlands Management Program. When reviewing proposed projects and appropriate regulatory actions that might affect the aquatic sites mentioned above, agencies should recommend ways to protect and enhance the fisheries habitat values associated with wetlands, shallow water areas, and tidal sloughs and should use existing regulatory authorities to ensure "no net loss" of wetland habitats.

When: Immediately

Cost: Minimal regulatory costs; unknown project costs

Objective AR-5

Develop a comprehensive plan to optimize the management of estuarine aquatic resources that addresses the needs of all users and promotes an equitable balance; protects indigenous species; and, consistent with state and federal mandates, doubles the natural production of anadromous fishes.

ACTION AR-5.1

Based on information developed in Action AR-1.1, identify alternative long-term water quality and flow standards, water management measures, operational changes, habitat improvements, and facilities as needed to manage the estuarine aquatic resources (including water) for optimum benefit.

Who: California Resources Agency, California Environmental Protection Agency, State Water Resources Control Board, California Department of Water Resources, and California Department of Fish and Game, with input from cooperating federal agencies and the governor's Bay-Delta Oversight Council, which is comprised of: (a) members drawn from the urban, agricultural, and environmental sectors; and (b) a separate technical advisory panel.

What: Define the objectives to be accomplished for all beneficial uses dependent on the Estuary, including the recovery and maintenance of aquatic resources as prescribed in Objective AR-5. Develop and evaluate alternative sets of water quality and flow standards, water management measures, operational changes, habitat improvements, and facilities to accomplish the objectives.

When: During 1993 and 1994

Cost: Potentially covered by ongoing agency expenditures

ACTION AR-5.2

Develop an EIS/EIR to display the alternatives and trade-offs identified in Action AR-5.1 and to initiate the selection of a preferred alternative.

Who: California Resources Agency, California Department of Water Resources, and California Department of Fish and Game, with input from the governor's Bay-Delta Oversight Council and appropriate federal regulatory agencies

What: The EIS/EIR would comprehensively evaluate physical and biological processes of the Estuary and identify the changes in water management, operations, habitat improvements, and facilities required to meet the needs of the ecosystem, while recognizing the demands of urban and agricultural communities. The state would take the lead in preparing the EIS/EIR in conjunction with the lead federal agency. Concurrent with preparing the EIS/EIR, steps would be taken to comply with federal and state Endangered Species Acts, the federal Clean Water Act, and other applicable laws.

When: Within three years

Cost: Potentially covered by ongoing agency expenditures

ACTION AR-5.3

Implement the alternative from Action AR-5.2 (including the adoption of long-term water quality and flow standards and operational requirements) that best optimizes conditions for aquatic resources, efficiently conserves scarce water resources, and restores an equitable balance to the estuarine ecosystem.

Who: State Water Resources Control Board, California Department of Water Resources, U.S. Bureau of Reclamation, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and other water project operators and diverters as appropriate

What: Improve habitat of the Estuary, modify operations involving diversion and storage of water, construct the necessary facilities, and take other appropriate measures to meet the objectives identified in Action AR-5.1 and to implement the selected alternative.

When: Start upon completion of Action AR-5.2, and adoption by state and federal entities of preferred alternatives

Cost: Approximately \$500 million needed through appropriations and cost sharing

Objective AR-6

Develop and implement programs in the watershed above the Estuary necessary to complement Objective AR-5.

ACTION AR-6.1

Provide necessary instream flows and temperatures to benefit salmon and steelhead in the Central Valley to support the implementation of the state and federal mandates to double the natural production of anadromous fishes.

Who: State Water Resources Control Board, Central Valley Regional Water Quality Control Board, California Department of Water Resources, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, Federal Energy Regulatory Commission, U.S. Environmental Protection Agency, and private water project operators

What: In order to provide adequate habitat for the various life stages of anadromous salmonids and to provide for the restoration of salmonid populations, projects (existing and proposed) must store adequate supplies of cool water, reduce flow fluctuations, and provide adequate minimum instream flows.

Salmon and steelhead production throughout the Central Valley has been severely limited by the construction and operation of water resource projects. Dams have blocked access to upstream spawning areas, and hydrologic changes below impoundments have altered remaining habitats.

Spawning still occurs in the mainstem Sacramento River and in most major tributaries in the Sacramento Basin, but the lack of adequate instream flows and suitable water temperature is limiting production. In the San Joaquin River Basin, all salmon production has been limited to the major tributaries since the construction of Friant Dam on the mainstem San Joaquin River. It appears that adequate spawning gravels exist on the Stanislaus, Tuolumne, and Merced Rivers to support the restoration and maintenance of fall-run Chinook salmon below existing impoundments. However, existing minimum instream flow release requirements are inadequate, especially with regard to springtime releases, when flows are needed to move juvenile salmon out from the tributaries, down the mainstem of the San Joaquin, and safely past the Delta export pumps.

Instream flow studies are needed to identify the releases needed from project reservoirs to support restoration of salmon populations. Flow studies have already been completed on several basin streams and rivers and are underway on others. These flow studies are conducted using the Instream Flow Incremental Methodology (IFIM) developed by the U.S. Fish and Wildlife Service (U.S. FWS). The results of the studies, along with recommendations from the resource agencies regarding minimum instream release schedules and appropriate changes in operation, should be transmitted to project operators and/or regulators for action. Authority to make decisions on changes in operation and/or releases may rest with SWRCB, FERC, or the project operators.

The following information has been submitted by fisheries agencies to the appropriate decision-making authorities for consideration in water rights adjudication. In certain cases, flow studies have not yet been completed. Final decisions will take into account other factors, including water supply availability.

Mainstem Sacramento River (below Keswick Dam)

- ❑ Flow study underway. Existing minimum instream flow requirements and temperature conditions are inadequate. The California Department of Fish and Game (DFG) has initiated a flow study. Until the study has been completed and evaluated, the U.S. Bureau of Reclamation (U.S. BOR) should continue to coordinate releases with resource agencies. U.S. FWS and DFG believe that minimum beneficial flows of 3,500-6,000 cfs may be warranted during the spawning season, with attraction and outmigration flows of up to 14,000 cfs. Also, project operations need to be modified to reduce fluctuations and to provide adequate carryover storage to meet flow and temperature needs.

Clear Creek (below Whiskeytown Dam)

- ❑ Existing minimum release requirements for a normal water year total 48,000 acre-feet per year. DFG and DWR completed a flow study that identified a need of 175,000 acre-feet/year for fishery purposes, with releases ranging from 150 to 250 cfs. The Central Valley Project Improvement Act (Title XXXIV of PL 102-575) requires the increased releases to aid in restoration of the fishery.

Feather River (below Thermalito Dam)

- ❑ A flow study needs to be conducted. Current releases are per agreement between DFG and the California Department of Water Resources (DWR). Fishery needs are being re-evaluated, with investigations scheduled for completion in 1994.

Yuba River (below Englebright Dam)

- ❑ Existing releases range from 70 to 400 cfs (172,800 acre-feet per year). Based on results of a completed flow study, U.S. FWS and DFG have recommended releases ranging from 450-2,000 cfs (603,000 acre-feet per year). This matter is under consideration by SWRCB.

Bear River (below Camp Far West)

- ❑ A flow study may be conducted as part of an application to FERC for a license. Existing release requirements total 9,000 acre-feet per year. Pending completion of a flow study, U.S. FWS believes that releases on the order of 50,000 acre-feet per year are needed.

American River (below Nimbus Dam)

- Existing minimum release requirements are 250 cfs, increased to 500 cfs during the spawning season. Temperature is a major problem due to reservoir draw-down. Several studies have been conducted. Based on a 1986 flow study, DFG believes that flows ranging from 1,500 to 6,000 cfs and totalling about 2 million acre-feet per year are needed. These preliminary estimates are expected to be refined as studies currently underway are completed. Congress or the courts may ultimately decide flow requirements.

Mokelumne River (below Camanche Dam)

- A flow study has been completed. Existing requirements are 20 cfs year-round (13,000 acre-feet per year) for a hatchery supply. Based on the completed flow study results, U.S. FWS and DFG have recommended releases ranging from 100-450 cfs and totalling 207,000 acre-feet per year. The matter is under consideration by SWRCB.

Stanislaus River (below New Melones Reservoir)

- A flow evaluation is underway, but the current drought has hampered the efforts to study higher flows. Existing minimum release requirements for fish are 98,000 acre-feet per year, but pending completion of the ongoing flow study, U.S. BOR and DFG have signed an agreement for release of 302,000 acre-feet per year, with cutbacks in dry years. This allocation will be continued until all flow evaluations are completed and until SWRCB has made a final release determination.

Tuolumne River (below New Don Pedro Reservoir)

- Existing normal year release requirements are 123,210 acre-feet per year (range: 3-385 cfs with a 1-day flush of 2,500 cfs). Flow studies are underway and scheduled for completion by 1996. There is an agreement with DFG for higher interim releases, which are to prevail until the completion of the current study.

Merced River (below New Exchequer Dam)

- U.S. FWS and DFG believe existing flow requirements are inadequate. A flow study has been proposed. Flow releases should be revised upon completion of the study by FERC.

Mainstem San Joaquin River (below Friant Dam)

- Minimum release requirements are inadequate to support aquatic life. A flow study is needed to quantify fishery needs and to determine the feasibility of restoring runs to the mainstem San Joaquin River. The Central Valley Project Improvement Act (Title XXXIV of PL 102-575) requires completion of an evaluation and plan by September, 1996, for consideration by Congress.

Mainstem San Joaquin River (at Vernalis)

- No flow study has been conducted, but data have been collected showing a high positive correlation between springtime outflow and increased abundance of adult salmon returning 2.5 years later. Increasing releases from basin impoundments, especially during the months of April, May, and June, would promote the survival of juveniles and the recovery of the basin's population of wild, fall-run Chinook salmon. U.S. FWS and DFG recommended to SWRCB an interim level of protection consisting of minimum flows during these months ranging from 2,000 to 10,000 cfs for water-year types ranging from critical to wet, in conjunction with export limits. Further evaluation and development of a basin-wide flow release plan are needed. That will be accomplished as part of Action AR-6.3.

When: Ongoing

Cost: Costs depend on the flow requirements that are established

ACTION AR-6.2

Implement the Upper Sacramento River Management Plan.

Who: State Water Resources Control Board, California Department of Water Resources, California Department of Fish and Game, State Lands Commission, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and non-governmental organizations

What: The Upper Sacramento River Management Plan was developed through consensus of a diverse group of people interested in improved management of the river's biological resources. Improved habitat conditions on the Sacramento River will directly benefit the Bay-Delta ecosystem. At minimum, the following high priority measures should be implemented:

- Installation of structural temperature control devices on Shasta and Trinity dams (U.S. BOR estimate of funds potentially available from other sources: \$55,000,000);
- Rehabilitation and expansion of the Coleman National Fish Hatchery (SB 1086 estimate of cost: \$24,450,000);
- Implementation of a spawning gravel replenishment program (SB 1086 estimate of cost: \$12,000,000);
- Delivery of dependable water supplies to the Central Valley wildlife refuges;
- Re-operation of Central Valley reservoirs to minimize fisheries impacts from flow fluctuations (SB 1086 estimate of cost: \$1,100,000);
- Modification of Red Bluff Diversion Dam to minimize fish passage problems (U.S. BOR estimate of funds potentially available from other sources: \$60,000,000 minus SB 1086 estimate of cost: \$23,000,000 = \$37 million net); and
- Continued acquisition of remnant habitats along the river as well as degraded areas with restoration potential (SB 1086 funds appropriated: \$33,000,000).

When: The aforementioned activities are either planned or underway; necessary facilities are scheduled for completion within ten years

Cost: Total SB 1086 outlays	\$243,530,000
Other funds needed	\$ 93,000,000
TOTAL COST:	\$336,530,000

ACTION AR-6.3

Develop and implement the San Joaquin River Management Plan to identify reservoir operational changes, habitat improvement measures, and other action items to improve habitat and health of the aquatic ecosystem in the San Joaquin River watershed.

Who: State Water Resources Control Board, California Department of Water Resources, California Department of Fish and Game, State Lands Commission, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and non-governmental organizations

What: A consensus effort is underway to identify the environmental problems of the San Joaquin River watershed and to develop alternatives for addressing these problems. This needs to be coordinated with the efforts authorized by the Central Valley Project Improvement Act (Title XXXIV of PL 102-575) and U.S. BOR's San Joaquin River Basin Management Initiative. Implementors of the CCMP should coordinate efforts with those entities working for the improved management of the San Joaquin River watershed.

When: The planning effort is scheduled for completion by 1995.

Cost: Approximately \$1.2 million per year for the planning effort; funding sources for implementation have not yet been identified

ACTION AR-6.4

Screen upstream diversions that individually or cumulatively result in significant mortality to fishes that utilize the Estuary.

Who: California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and diverters of water

What: State and federal agencies should assist diverters with developing and implementing measures to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions in the Sacramento and San Joaquin Rivers and their tributaries. Measures include the construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing non-functioning screens, and relocation of diversions to less fishery-sensitive areas.

When: Accelerate ongoing efforts

Cost: Approximately three hundred unscreened diversions exist in the Sacramento River and tributaries and in the San Joaquin River and tributaries. DFG estimates that the capital costs for installing screens will average about \$5,000 per cfs diverted. U.S. BOR estimates that the total cost of the action will reach \$20 million. The Central Valley Project Improvement Act (Title XXXIV of PL 102-575) provides a federal/state cost-sharing formula to help fund these mitigation projects; please refer to Section 3406(b)(17, 20, and 21) of the Act.

ACTION AR-6.5

Seek damages for all impacts to trust resources from spills and discharges affecting them and use the funds to improve the resource base.

Who: State Water Resources Control Board, California Department of Fish and Game, State Lands Commission, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, and National Marine Fisheries Service

What: Whenever aquatic resources and beneficial uses are adversely impacted by spills and discharges of pollutants, monetary damages should be sought. Those funds, once obtained, should be dedicated to improving the natural resource base consistent with legal authorities.

When: Immediately

Cost: Variable, but borne by the responsible parties



Aquatic Resources Minority Report

Bob Potter—California Department of Water Resources

Steve Shaffer—California Department of Food and Agriculture

John Fraser—Association of California Water Agencies

Roger James—Santa Clara Valley Water District

Seven governmental agencies are currently involved in water allocation and management in the Estuary: the State Water Resources Control Board, the Department of Fish and Game, the Environmental Protection Agency, the National Marine Fisheries Service, the Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the Federal Energy Regulatory Commission. The SFEP's Aquatic Resources Program now recommends that one more be added. At best, the addition of the Aquatic Resources Program is simply redundant. At worst, it represents one more layer of overlapping federal jurisdiction that already has paralyzed the state's ability to control its water and environmental resources for the benefit of all Californians. For instance, what purpose is served by directives and actions to protect endangered species, except to duplicate and complicate regulatory schemes that already exist at both the state and federal level? And like the federal Endangered Species Act, the Aquatic Resources Program does not represent a balance of all needs and uses of the San Francisco Bay-Delta Estuary. As an important example, the Aquatic Resources Program does not address one of the most important beneficial water uses of the Estuary—the municipal drinking water supply for over 20 million people in Northern and Southern California. The Aquatic Resources Program's focus on water management measures to increase freshwater availability to the Estuary does not address the primary threats to drinking water supplies. The EPA, through the Regulatory-Negotiation process, will be establishing new and more stringent disinfectant/disinfection by-products (D/DBP) standards that will place a major financial burden on municipal water agencies that obtain water from the Delta through increased costs for treatment, operation, and monitoring. The high levels of total organic carbon in Delta waters combined with elevated levels of chlorides and bromides from seawater intrusion serve as precursors to the DBP's that will be regulated. Until the quality and reliability of the drinking water supply for 20 million Californians is included in a resource management plan for the Bay-Delta Estuary, it cannot be considered adequate or comprehensive.

When the SFEP was authorized in 1987, it was agreed that flow and water supply issues would not be included: the SWRCB already has plenary authority to regulate in this area; there is a long-established federal deference to state authority over water allocation; and non-water quality issues are not within the purview of the Clean Water Act (CWA § 101(g)). Nonetheless, the MC authorized flow studies, which, even then, were only supposed to be used as recommendations to the SWRCB's Bay-Delta process. The "2 ppt" surrogate which resulted (Action AR-1.1) seems to be a transparent attempt to convert non-water quality phenomena into a water quality parameter in order to bootstrap federal EPA/Clean Water Act jurisdiction over California water allocation decision making. The 2 ppt figure in Action AR-1.1 is neither scientifically proven or an accurate measure of biological health and productivity for the Estuary.

Although productive changes have been made (the mission statement and statement of goals and objectives are particularly useful), we have dissented from the Aquatic Resources Program because it remains an inappropriate conduit for intrusion into state water supply and allocation issues. The implementation aspects of the CCMP and the "Implementation Committee" only furthers that apprehension. Additionally, the costs associated with implementing this Program are speculative, at best.

The SFEP's purpose will be accomplished when its report has been delivered to the Governor, and its express mission completed. How the management of aquatic resources is implemented is a matter for the State of California, which has more than adequate authority to make a balanced use of the SFEP's reports and recommendations in a truly comprehensive way.

Aquatic Resources Minority Report

Submitted by California Farm Bureau Federation,
William I. DuBois, Consultant

Not being realistic about the probability that a goal can be achieved creates a dangerous and inefficient situation. The third goal of the Aquatic Resources Program, "Ensure the survival and recovery of listed.....," would set the stage for expensive futile efforts. It is essential to inject realism into this goal by providing for its abandonment in those instances where it is clearly so expensive that it is not sensible to continue an effort. Evolution is the nature of nature, but this goal, as is, would deny that. The real problem is population increase. The CCMP ignores the real problem and treats only the symptoms. In doing so, it also ignores that the population requires most of its water not strictly for municipal uses, but also for the growing of its food, which requires from three to five times as much water as municipal purposes. Absolutely no provisions are made in the CCMP that indicate its authors recognized the impending increases in water demand.

The "Problem Statement" does not recognize that the upstream diversion, from the Delta tributaries, of water that is removed *entirely* from the Delta system by San Francisco's Hetch Hetchy and East Bay Municipal Utilities District robs hundreds of miles of fish habitat of the use of much of its natural water supply. This water would be more productive if it were left in the stream until closer to the point of use. Failure to recognize the Hetch Hetchy problem encourages the CVP and SWP to go to the source for their supplies, and thus they, too, would avoid the fish problems of the Delta pumps and the reverse flows and salinity. Of course, the rivers would then carry much less water. "Existing Management Structure" exhibits the same narrow perception of the problem and consequently fails to ask that a study be made of the relative damage caused by Hetch Hetchy and EBMUD's projects.

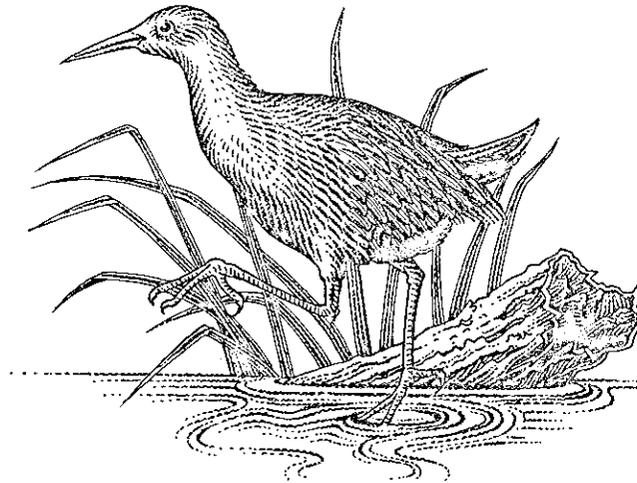
AR 2.2 states, "Prohibit the intentional introduction of exotic species into the estuary and its watershed." This, if in effect a hundred years ago, would have precluded striped bass, yet somewhat hypocritically, the CCMP protests the decline of striped bass. However, the real problem with this policy is that much of quality of life depends on the successful quest in foreign lands for predators and parasites that control the unintentionally and intentionally introduced species, such as the puncture vine, white fly, hydrilla, water hyacinth, etc. This policy is absolutely unacceptable. Our inability to control the introduction of harmful exotic species makes it incumbent upon us to search constantly for other species by which the harmful ones may be controlled, thus decreasing pesticide needs.

AR 2.4 expresses the intent to educate the public about the problems with exotic species, but not to do the same with regard to the benefits of many exotic species. It is far more important to teach a balanced comprehensive understanding of ecology than a narrow view of only certain species.

AR 4 et. seq. call for the adoption of flow standards. This means that the CCMP would in effect confuse the functions of the State Water Resources Control Board (SWRCB), which under existing law regulates water rights in California. The SWRCB has the advantage of hearing and being required to consider all competing interests in a water rights dispute to ensure that the broad public interest is served as well as is humanly possible under the existing circumstances. The EPA is a tunnel vision agency. Pursuant to Section 101(g) of the Clean Water Act, EPA must not interfere with California water rights.

The AR 4.1 "What" asks for standards to protect the public trust resources of the Estuary, but ignores the other beneficial uses of water, such as food production. This burgeoning society must be fed. The centuries-old public trust does not recognize all the social demands for water that exist today. Standards are equally important to protect beneficial uses not included under the public trust.

The Implementation Chapter calls for water diversion taxes, discharge taxes, and real estate transaction taxes. We are opposed to those taxes to pay for correcting the symptoms of a problem destined to worsen much faster as the result of rules advocated by the CCMP. The CCMP at the time of its endorsement made no effort to quantify or even estimate the private costs and the local government costs of the programs it proposes, or to question whether its actions have a favorable cost-benefit ratio.



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Wildlife

Goals:

- ❑ Stem and reverse the decline of estuarine plants and animals and the habitats on which they depend.
- ❑ Ensure the survival and recovery of listed and candidate threatened and endangered species as well as special status species.
- ❑ Optimally manage and monitor the wildlife resources of the Estuary.

Problem Statement

Following the turn of the century, destruction or conversion of terrestrial habitats both within and outside the Estuary began to accelerate. Expanding use of land for agriculture and, ultimately, urban development enveloped the permanent and seasonal wetlands, riparian forest, vernal pools, native grasslands, coastal scrub, and oak savannah of the region. Other causes of past and present declines in wildlife populations include overharvesting, competition with the livestock industry, expansion of natural or introduced competitors, use of organochlorines, and human disturbance.

Today, habitat fragments remaining within the Estuary continue to deteriorate steadily under an increasing array of negative human effects. Intensifying agricultural use and urban encroachment continue to destroy and fragment the various wildlife habitats of the Estuary.

Declines in habitat quantity and quality are most apparent in the tidal salt and brackish marsh habitats of San Francisco, San Pablo, and Suisun Bays. The current threats to inhabitants of these marshes portray a wildlife community under siege. In particular, predation by the introduced red fox has nearly eliminated the California clapper rail from major portions of its range. In addition, other factors make extinction of the California clapper rail a real possibility. These include an inconsistent success rate in designing and implementing restoration projects, a shortage of available sites, and the fact that many years are required for newly restored tidal marshes to support clapper rails.

At least seven insect species, one reptile species, three bird species, and five mammal species have been completely extirpated from the Estuary, primarily due to habitat loss. Because of their population declines, a total of ninety taxa of

insects, amphibians, reptiles, birds, and mammals within the Estuary are currently designated by federal and state governments as deserving special protection or monitoring. Included in this total are about 15 percent of the bird species and 16 percent of the mammal species occurring within the Estuary. Of these ninety taxa, sixty-one (or 68 percent) have been depleted through loss of wetland and riparian habitats. Thirty-six special status taxa have been identified as declining at the greatest rate within the Estuary.

Throughout California, most bird species are at lower population levels than existed historically. However, within the Estuary, use by some waterbirds may have increased in response to the creation of artificial habitats, such as salt evaporation ponds.

San Francisco Bay remains a major coastal wintering and migrational area for a variety of Pacific Flyway diving ducks. Suisun Marsh and the Delta provide valuable habitat for significant numbers of dabbling and diving ducks, geese, swans, and cranes. Except for some recent signs of recovery, statewide waterfowl populations for many species of dabbling ducks and geese have generally declined to the lowest levels since monitoring began in the 1950s. This has been attributed primarily to the combined effects of drought, habitat loss, and predation within wintering and nesting grounds. The ability of these populations to recover is uncertain and hinges on the extent of habitat recovery in the Canadian prairies and California and on long-term weather trends. Contaminants, in the form of trace elements, also occur in Bay diving ducks at levels known to impair reproduction.

Little information exists that compares current populations of locally breeding waterbirds to historical levels. Data on present population trends are also inadequate. Some species with an ability to exploit artificial features, such as towers and bridges, have shown population increases. However, predation by introduced red foxes has caused major nesting failures among California least terns, Caspian terns, and species of herons and egrets. The combined effects of introduced predators, human disturbance, intensive land uses, and contaminants are probably reducing breeding heron and egret populations.

In general, raptor populations in the Estuary continue to decline. At best, they show limited recovery from past depletions. For example, more peregrine falcons are attempting to nest within the Estuary. However, they have experienced nesting failures, which are likely due to contaminant effects.

Intensified agricultural practices and increasing urban expansion have also had negative effects on numerous species of songbirds dependent on grasslands, oak savannah, riparian forests, and wetlands. Because they are also vulnerable to introduced predators and competitors, many of these species face extirpation or extinction.

Intensifying agricultural conversion, urban encroachment, ongoing habitat degradation, and human disturbance have also caused a decline in the populations of certain species of carnivores, rodents, rabbits, and bats. However, many introduced mammals, including several rodents, the red fox, and the Virginia opossum, are generally increasing their populations. These non-native species readily adapt to urban settings. As their numbers increase, it is often to the detriment of native species.

California sea lions, evidently still recovering from past exploitation, are increasing their use of San Francisco Bay. Baywide censuses of harbor seals indicate a stable seal population existed from the mid 1970s through 1990. (By comparison, the seal population on Point Reyes Peninsula more than doubled during this same period.) Since 1991, there is evidence of both a shift from South to Central Bays and a general decline in the resident seal population.

Loss of vernal pools, freshwater marshes, riparian woodlands, and grasslands has led to the dramatic depletion of several species of amphibians and reptiles within the Estuary. Some, such as the California tiger salamander, red-legged frog, giant garter snake, and western pond turtle, are facing possible extirpation.



Populations of some wildlife groups within the Estuary, such as certain colonial nesting species, may currently be increasing. However, future trends for most wildlife populations are likely to be downward. Some endangered species might become extinct. Many of the current causes of wildlife problems are projected to continue into the future. These include continued threats to seasonal wetlands and upland habitats from urban encroachment and agricultural conversion, greater effects from pollutants entering the ecosystem, and increased disturbance by both humans and introduced predators.

Other factors require further monitoring and might result in dramatic losses or alteration of habitat. These include increased erosion in tidal marshes, expansion of the introduced Asian clam and cordgrass species, and salt marsh conversion due to the discharge of sewage effluent. The long-term effects of global warming and the resulting sea-level rise could cause dramatic losses and alterations of tidal mudflats and marshes, salt ponds, and farmed wetlands. This could lead to a loss of critical habitat for many species, with some possible long-term benefits for wintering waterfowl.

Existing Regulatory and Management Structure

The U.S. Fish and Wildlife Service, the U.S. National Marine Fisheries Service, the U.S. Navy, the California Department of Fish and Game, the California Department of Parks and Recreation, and the East Bay Regional Park District have significant management and conservation responsibilities for wildlife populations within the Estuary. These agencies manage a significant amount of land within national wildlife refuges, wildlife areas, preserves, parks, and installations.

If adequately implemented, several recent planning and land acquisition efforts by state and federal agencies may help to offset many of the projected losses, primarily for wetlands. These include State Senate Resolution 28, the Central Valley Habitat Joint Venture of the North American Waterfowl Management Plan, the Central Valley and San Francisco Bay Concept Plans for Waterfowl Habitat Protection, and the habitat acquisition program for the San Francisco Bay National Wildlife Refuge.

The primary agencies responsible for wildlife management are authorized under numerous laws to carry out the protection, conservation, and improvement of these resources. Nevertheless, ongoing declines in the quantity and quality of habitats and the wildlife they support clearly demonstrate the critical shortage of funding, economic incentives, and public resolve necessary to adequately implement these needed protections and restorations.

Recommended Approach

Many of the problems associated with the decline in abundance and diversity of wildlife in the Estuary are complex and interrelated. The subject areas chosen to describe these problems are useful for the study and management of the Estuary's resources. However, it is important to recognize that these categories are merely tools to understand better the many effects that human activities and natural events have on plant and animal populations. The combined goal of all the actions is to restore and protect a diverse, balanced, and healthy community of wildlife and plants, with a focus on indigenous species.

The Wildlife Program can only be effective when combined with actions identified or categorized in the other programs of the CCMP. As a whole, these recommendations should work to restore the region's wildlife. A partial or piecemeal implementation will lead only to maintenance of the status quo, which will exacerbate the dramatic changes the ecosystem is undergoing.

Many of the recommended actions described in the other sections of the CCMP will also benefit wildlife. These actions should result in increases in critical habitat, decreases in the most harmful pollutants, and beneficial changes in freshwater flow through the Estuary. Therefore, the list of actions in this program area is not intended to be the universal catalog of recommendations regarding the Estuary's wildlife, but should be viewed in the context of the entire package of actions embodied in the CCMP.

Wildlife Recommended Actions

Objective WL-1

Create and restore habitats critical to the survival of plant and animal populations and enhance the biodiversity of the Estuary.

ACTION WL-1.1

Preserve, create, restore, and manage large, contiguous expanses of tidal salt marsh and necessary adjacent uplands for the California clapper rail and the salt marsh harvest mouse.

Who: U.S. Fish and Wildlife Service, Department of Fish and Game, public land management agencies, in coordination with special districts, such as mosquito abatement districts, California Coastal Conservancy, and California Conservation Corps (as appropriate)

What: Habitats for these rapidly dwindling species are extremely fragmented, particularly in the South Bay. Recovery will require the creation of large, contiguous tracts of salt marsh interlaced with tidal sloughs and suitable refuge from high tides. At least 15,000 acres are needed (in addition to the acreage listed in the Wetlands Management Program and the planned acreage for the San Francisco National Wildlife Refuge listed under WL-1.2 below). Acquisition should be pursued with willing sellers.

When: Immediately

Cost: \$170 million estimated total (\$90 million federal and \$80 million state)

ACTION WL-1.2

Complete the expansion of the San Francisco Bay National Wildlife Refuge and its satellite refuges and acquire the proposed Stone Lakes National Wildlife Refuge.

Who: U.S. Fish and Wildlife Service

What: Congressional budget augmentation should be provided to acquire the additional 22,000 acres authorized in the legislation for the expansion of the San Francisco Bay National Wildlife Refuge. In addition, the U.S. Fish and Wildlife Service should continue to pursue acquisition of appropriate North Bay parcels for addition to the refuge as part of the normal planning process. Particular emphasis should be placed on the Napa River Marshes. The U.S. Fish and Wildlife Service should continue to pursue the acquisition of the proposed Stone Lakes National Wildlife Refuge at no less than 18,200 acres, on a willing seller basis, to be the keystone of a much larger (75,000-100,000 acres) North Delta wetland package that could include Yolo Basin wetlands, the Putah Creek and Cache Creek riparian areas, Natomas wetlands, and the Cosumnes River Preserve. All acquisition strategies, including eminent domain, easements, and other methods addressed in the preceding action, should be employed as needed. Sovereign and public trust land should be managed consistent with the refuge purposes.

When: To be determined

Cost: \$237,520,000 estimated total (\$230 million federal and \$7,520,000 state)

ACTION WL-1.3

Implement concerted efforts to acquire wetlands already degraded or destroyed and restore them so that wetlands in the Estuary are increased by 50 percent by 2000.

(See the Wetlands Management Action WT-4.1 for details.)

ACTION WL-1.4

Restore tidal marshes in San Francisco Bay.

(See the Wetlands Management Action WT-3.1 for details.)

ACTION WL-1.5

Identify and convert or restore non-wetland areas to wetland or riparian-oriented wildlife habitat.

(See the Wetlands Management Action WT-4.1 for details.)

Objective WL-2

Develop a comprehensive wildlife management plan for the Estuary.

ACTION WL-2.1

Prepare a comprehensive management plan for the San Francisco Bay National Wildlife Refuge.

Who: U.S. Fish and Wildlife Service, in coordination with special districts, such as mosquito abatement districts

What: In anticipation of the San Francisco Bay National Wildlife Refuge assuming full land management responsibility over significant salt pond acreage, the U.S. Fish and Wildlife Service should prepare a refuge habitat management plan. A goal of the plan is the maintenance of sufficient acreage of managed and tidal wetlands to support the unique assemblage of wildlife relying on those habitats. Appropriate emphasis should be placed on non-game species, such as shorebirds, colonial waterbirds, seabirds, and raptors. This plan will include the following:

1. Identification of an appropriate combination of tidal and managed wetlands to maintain greatest species diversity and population stability;
2. Identification of the most suitable tidal marsh restoration areas;
3. Identification of the optimal and most economically feasible wetland management techniques;
4. Environmental assessment of various management approaches; and
5. Coordination with ongoing monitoring and research efforts of the Point Reyes Bird Observatory, San Francisco Bay Bird Observatory, etc.

When: Within three years

Cost: \$270,000 estimated total (\$270,000 federal)

ACTION WL-2.2***Enhance the biodiversity within all publicly owned or managed wetlands and other wildlife habitats as appropriate.***

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, National Park Service, Department of Defense, California Department of Transportation, East Bay Regional Park District, San Francisco Bay Conservation and Development Commission, other public land management agencies (in consultation with the Executive Council on Biological Diversity, National Audubon Society, Point Reyes Bird Observatory, Marine Mammal Center, California Academy of Sciences, and the general public), mosquito abatement districts, California Coastal Conservancy, and California Conservation Corps (as appropriate)

What: Resource agencies will plan and implement enhancement measures that promote biodiversity for the wildlife habitats they own or manage. This could involve the establishment of a Habitat Task Force. The resource agencies will also provide technical assistance to other land management agencies in the planning and implementation of similar measures on those lands to the extent it is consistent with their missions. Cooperative agreements between the resource agencies and other public landowners to improve biodiversity and wildlife habitat values on those lands, consistent with the primary mission of the landowner, should be explored and implemented whenever practicable. Comparable agreements with private landowners should also be explored. All such agreements should be periodically reviewed and re-negotiated to improve them whenever the opportunity exists. The technical results of these enhancement measures will be used by the agencies to implement the actions, and summary material will be incorporated into the Public Involvement and Education Program. The measures will address some of the following issues:

1. Identification of wildlife groups of concern, with particular emphasis on native species;
2. Mosquito abatement districts should provide private and public wetland managers with guidelines for enhancing seasonal wetlands, while addressing vector control;
3. To the extent that it is not inconsistent with their primary missions and budgets, flood control and mosquito abatement districts should be encouraged to manage their operations to maximize wildlife and wetland values. Bank erosion control projects should be designed to maximize riparian values; and
4. Using the efforts of the Executive Council on Biodiversity, establish bioregions within the Estuary and ensure that these regions are incorporated in the land use and wetlands plans. Educate the public, the agricultural community, landowners, developers, local government officials, and agencies on the value of this concept and how to incorporate it into agency missions, management goals, land use planning, etc.

When: To be determined

Cost: \$4,260,000 estimated total (\$1,260,000 federal and \$3 million state)

ACTION WL-2.3***Complete and implement a wildlife habitat restoration and management plan for the Estuary.***

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, and landowners, in coordination with special districts, such as mosquito abatement districts, California Coastal Conservancy, and California Conservation Corps (as appropriate)



What: The resource agencies should lead a coordinated effort to develop and implement a wildlife habitat restoration and management plan for the entire Estuary. This plan would then be appended to the CCMP and should be reviewed and updated as necessary or at least once every ten years. The plan should include extensive outreach by the resource agencies to ensure full participation by affected landowners and the public. The plan would include the following elements:

1. Identification of wildlife groups of concern, with particular emphasis on native species and overwintering and migrating shorebirds and waterfowl;
2. Analysis of management alternatives to maintain and restore wetland and riparian communities and biodiversity;
3. Assessment of impacts of various management alternatives;
4. Implementation and habitat acquisition strategies that incorporate biodiversity and wildlife corridors where possible;
5. Coordination of research activities with the Regional Monitoring Program, the Public Involvement and Education Program, and ongoing efforts by Point Reyes Bird Observatory, San Francisco Bay Bird Observatory, etc.; and
6. Identification of possible funding sources and lead agencies.

The plan will also need to address private property rights.

When: Complete within three years

Cost: \$2,060,000 estimated total (\$1,560,000 federal and \$500,000 state)

Objective WL-3

Develop predator control programs to decrease the impact of introduced species on listed and candidate species, as well as special status species.

ACTION WL-3.1

Implement predator control programs in areas where introduced predators are a constraint to maintenance and restoration of native populations.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, public land management agencies, Society for the Prevention of Cruelty to Animals, and local governments

What: Implement predator control whenever the effects of predation are determined to be a constraint to the maintenance and restoration of populations of native species. Control on public lands will be implemented by the landowner/manager under a plan approved by the resource agencies. Control on private lands will be implemented by the resource agencies, with permission of the landowner, or by the landowner under a plan developed by the resource agencies. Red foxes, feral and domestic cats, and rats are some of the target species that are known to have significant impacts on native species.

When: Immediately

Cost: \$6.1 million estimated total (\$6 million federal and \$100,000 state)

Objective WL-4

Implement management measures necessary to ensure survival and recovery of listed and candidate species as well as special status species.

ACTION WL-4.1

Update, and, where necessary, prepare recovery plans for all listed wildlife species.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and San Francisco Bay Conservation and Development Commission

What: Detailed recovery plans for all listed species will be prepared or updated as necessary. Critical habitat will be identified, unless the identification of that habitat could hamper species recovery. Increased funding to prepare and implement recovery plans should be sought.

Implement recovery actions, including protection and enhancement of critical habitats targeted for acquisition or protection through regulatory processes. U.S. Fish and Wildlife Service and the California Department of Fish and Game will be the lead agencies for their respective listings. Created and restored marshes acquired for this purpose should be sufficiently large (over 1,000 acres) to support extensive tidal channel systems. Priority sites are outlined in the Joint Clapper Rail and Salt Marsh Harvest Mouse Recovery Plan. Special attention shall be given to invasive species in clapper rail and salt marsh harvest mouse habitat.

When: Within three years for listed species

Cost: \$2,125,000 estimated total (\$2,025,000 federal and \$100,000 state)

ACTION WL-4.2

Provide secure colony sites, allow for population recovery, control predators, and protect adjacent foraging areas for the California least tern.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, Department of the Navy, U.S. Army Corps of Engineers, San Francisco Bay Conservation and Development Commission, Port of Oakland, and Pacific Gas and Electric Company

What: Habitat management efforts for all California least tern nesting colonies need to be adequately funded and staffed, as needed. Management efforts must also focus on expansion of existing colonies, exploration of alternate nesting sites, predator control, and protection of foraging areas adjacent to colonies (e.g., eel grass beds, low salinity salt ponds) from threats such as dredging, boat traffic, pollution, salt pond maintenance, and development. Any acquisition or expansions pursued under this action will also need to address property rights.

When: Immediately

Cost: \$6,050,000 estimated total (\$6,050,000 federal)

ACTION WL-4.3***Monitor status of all candidate species and list them if warranted.***

Who: U.S. Fish and Wildlife Service and California Department of Fish and Game

What: Develop and implement programs to monitor the status of all Class I and Class II candidate species. Agencies should take steps to list any species that warrant such listing to afford them the full protection of the law. Any listing package should include designation of critical habitat, unless the identification of that habitat could hamper species recovery.

When: Within five years

Cost: \$25,200,000 estimated total (\$7.2 million federal and \$18 million state)

ACTION WL-4.4***Continue hunting closures to protect the Aleutian Canada goose. Investigate the need for hunting closures for other waterfowl species as necessary.***

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, and Pacific Flyway Technical Committee

What: Hunting closures to protect wintering populations of the Aleutian Canada goose in the Central Valley must be continued by the resource agencies until the subspecies is delisted.

Strengthen programs to educate hunters on proper identification of waterfowl species and male versus female (to minimize unlawful take).

Use educational programs to encourage anglers, hunters, and recreational boaters to avoid using critical areas where ducks such as canvasbacks, white-winged scoters, and greater scaup congregate. Use these same programs to encourage the public to purchase federal duck stamps at the post office.

When: Immediately

Cost: No direct costs

ACTION WL-4.5***Implement a captive breeding program for the clapper rail.***

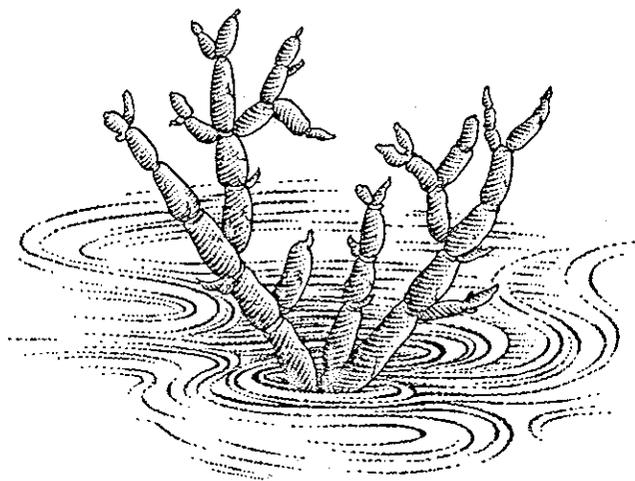
Who: U.S. Fish and Wildlife Service and California Department of Fish and Game

What: In addition to the implementation of the tidal marsh restoration actions, the resource agencies must develop a combined captive propagation program for the California and light-footed clapper rails. This is justified due to the uncertain success and extended time required for marsh restorations to provide suitable habitat for these subspecies.

When: Immediately

Cost: \$13,500,000 estimated total (\$7 million federal and \$6.5 million state)

The total estimated cost for the Wildlife Program is \$442,995,000.



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Wetlands

The Minority and Majority Reports for Wetlands follow this program.

Goals:

- Protect and manage existing wetlands.
- Restore and enhance the ecological productivity and habitat values of wetlands.
- Expedite a significant increase in the quantity and quality of wetlands.
- Educate the public about the values of wetland resources.

The intent of these goals is to guide the development and implementation of programs that, in the short-term, preserve the remaining wetlands of the Estuary and, in the long-term, increase the quantity and quality of wetlands through enhancement, restoration, and creation. Such actions should: (a) protect and restore fish, wildlife, and other natural resources of the Estuary; (b) manage land use to maintain and enhance the natural and economic benefits provided by wetlands, consistent with the general welfare of the state; and (c) respect private property rights.

Problem Statement

Wetlands and related habitats comprise some of the Estuary's most valuable natural resources. Wetlands not only provide critical habitats for hundreds of species of fish, birds, and other wildlife, but they also improve the overall water quality in the Estuary, help control flooding, offer open space, provide recreational opportunities, and contribute many other benefits to people in the region. Wetlands are vital to a healthy Estuary. Their protection is essential.

The Estuary's tidal marshes have been reduced from 545,371 acres in 1850 to approximately 45,000 acres in 1985. These losses have reduced the Estuary's capacity to support sustainable populations of fish and wildlife and to provide other benefits. Of the thirty-two species of wildlife whose populations are currently known to be declining, twenty-three are associated primarily with wetlands.

Although wetland degradation and conversion have slowed substantially since the 1970s, they are still occurring. Activities expected to continue to impact wetlands negatively include construction of ports, highways, and wastewater treatment facilities; conversion of agricultural land to urban uses; and development of residential and industrial projects. Unless substantial efforts are made to avoid future losses and increase wetlands acreages and values, the health of the Estuary will continue to deteriorate.

The Existing Management Structure

Under Section 404 of the Clean Water Act, the federal government oversees the most comprehensive wetlands regulatory program within the Estuary. Federal agencies with primary roles are the U.S. Army Corps of Engineers (the Corps), the U.S. Environmental Protection Agency (U.S. EPA), the U.S. Fish and Wildlife Service (U.S. FWS), the Soil Conservation Service (SCS), and the National Marine Fisheries Service (NMFS). The federal trustee agencies for fish and wildlife resources review and comment on all projects that may affect wetlands through authority of the U.S. Fish and Wildlife Coordination Act. The U.S. FWS also pursues non-regulatory habitat acquisition in the Estuary through several programs, including the National Wildlife Refuge system. Other federal agencies that indirectly manage wetlands include the U.S. Bureau of Reclamation, the U.S. Coast Guard, and the Federal Emergency Management Agency.

State agencies with regulatory responsibilities that affect wetlands within the Estuary include the State Water Resources Control Board (SWRCB), the Regional Water Quality Control Boards (RWQCBs), and the San Francisco Bay Conservation and Development Commission (BCDC). The California Environmental Protection Agency (Cal EPA), established in 1991, provides coordination for various agencies, including the SWRCB and the RWQCBs. Cal EPA's Secretary serves as a primary advisor to the governor for environmental issues.

BCDC is charged with preventing unnecessary filling of the Bay and protecting Suisun Marsh. The Department of Fish and Game (DFG), as the designated state trustee agency for fish and wildlife, provides recommendations on federal, state, and local actions affecting fish and wildlife. DFG also enters into streambed alteration agreements and undertakes acquisition activities.

The California Coastal Conservancy (Conservancy) is a non-regulatory agency that, along with other state agencies, oversees an active program of wetland acquisition, restoration, and enhancement. The California Resources Agency helps set major resource policy for its departments, such as DFG, and functions as an umbrella agency coordinating the work of independent departments, such as BCDC and the Conservancy.

Municipalities, county governments, and special districts, such as flood control districts and mosquito abatement districts, are responsible for a variety of policies that affect wetlands. However, no uniform requirements exist that prescribe local wetland protection standards.

Finally, non-profit entities, such as the local chapters of the Audubon Society and the Nature Conservancy, undertake projects to protect and preserve wetlands. Other conservation groups, such as Save San Francisco Bay Association and the Sierra Club, often review and comment on project proposals, permit decisions, and policy documents.

In summary, wetlands management involves an intricate combination of private land ownership issues and a body of environmental law that relies primarily on federal authority. Implementation of this authority has proven inadequate to protect valuable wetland resources. While the present regulatory framework affords a level of protection to wetlands that did not exist twenty years ago, this protection remains disjointed and incomplete. In spite of the existing management structure, wetland resources continue to decline.

Recommended Program

This Wetlands Management Program seeks to improve regulation and management for all ecological wetlands by

integrating more effectively the activities of state, federal, and local agencies and by filling gaps in existing wetland protection programs. Wetlands of concern include approximately 630,000 acres in the Estuary (170,661 acres in San Francisco Bay, 72,652 acres in Suisun Bay, and 385,236 acres in the Delta) as identified by the National Wetlands Inventory Database (*Status and Trends Report on Wetlands and Related Habitats in the San Francisco Estuary*, 1991). This includes tidal mudflats, tidal marshes, seasonal wetlands, riparian forests, and salt ponds.

The recommended program is intended to expand efforts to acquire, enhance, restore, and create wetlands, as well as improve existing regulatory mechanisms. As much as possible, all entities whose activities affect wetlands should establish goals and policies to maximize protection and restoration of wetlands and wetland resources that are clear, necessary, and nonduplicative, and that minimize delay, cost, and uncertainty. Among other things, the actions recommended in this program are intended to facilitate private initiatives that protect wetlands. The objective is to build public and private partnerships to improve all levels of wetlands management.

A comprehensive state wetlands protection and restoration program should be developed. The California Resources Agency is currently preparing a State Wetlands Conservation Plan (SWCP) through a cooperative, multi-organizational planning process. The SWCP will: 1) inventory wetlands; 2) identify crucial wetlands; 3) develop a state strategy for planning for wetlands protection and restoration; and 4) take a crucial role in overall wetlands regulation. In order to improve efficiency and effectiveness, the state program should maintain necessary roles for federal agencies while providing for local government implementation. The state government should provide increased leadership by designating the Bay-Delta Estuary as a resource of statewide significance and by ensuring ongoing stewardship of its natural resources.

Wetlands Actions

Objective WT-1

Create a comprehensive, Estuarywide wetlands management plan. [Each of the subsequent objectives would be components of the plan.]

ACTION WT-1.1

Prepare Regional Wetlands Management Plan(s).

Who: California Resources Agency (lead agency), California Environmental Protection Agency, Department of Fish and Game, Department of Water Resources, State Water Resources Control Board, Central Valley and San Francisco Bay Regional Water Quality Control Boards, California Coastal Conservancy, State Lands Commission, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, Soil Conservation Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, National Marine Fisheries Service, and local governments and special districts in coordination with the interested public

What: Prepare a Regional Wetlands Management Plan (the Plan) for San Francisco Bay and the Delta to protect, enhance, restore, and create wetlands in the Estuary. For the purposes of developing the Plan, establish geographical subregional components (e.g., the Plan may consider San Pablo Bay, the Delta, Suisun Marsh, South Bay, and others as planning units). The Plan should utilize to the fullest extent possible existing documents, such as the Concept Plans for Waterfowl Habitat Protection (San Francisco Bay and Delta), Central Valley Habitat Joint Venture, Suisun Marsh Protection Plan, and the San Francisco Bay Refuge Expansion Plan. Whenever possible, the enhancement of wildlife habitat should be a priority. Restoration and other wetland values and functions should also be considered, consistent with wildlife protection goals. In order to allow sufficient public input and review, development of the Plan should employ a public process similar

to that used by the SWRCB in development of the RWQCBs' Basin Plans or by BCDC in development of its Bay Plan. The policies and programs of the Plan should be incorporated into appropriate documents, such as the RWQCBs' Basin Plans, BCDC's Bay Plan, local general plans, etc.

[NOTE: In recognition of the fact that the regulation of jurisdictional wetlands directly affects the implementation of the Regional Wetlands Management Plan, recommendations regarding improvements to and modifications of the existing wetland regulatory system are offered in Objective WT-2 of this document. Those recommendations are intended to complement and augment the effectiveness of the Regional Wetlands Management Plan and indeed be an integral component of it. Together, the Plan and the improved regulatory system will enhance the effectiveness and efficiency of federal, state, and local efforts to protect wetlands.]

The Regional Wetlands Management Plan should: 1) consider all wetlands identified by the California Department of Fish and Game and by the National Wetlands Inventory maps and should identify buffer areas and stream environments; 2) establish wetland habitat goals by identifying wetland habitat needs (e.g., determine the amounts, locations, and types of wetlands necessary to support wetland plant and animal communities); 3) prioritize areas for acquisition and restoration; 4) recommend wetland acquisition, enhancement, and restoration programs by public, nonprofit, and private institutions and organizations; 5) recommend programs to protect and restore non-tidal wetlands surrounding the Bay, including diked historic baylands, abandoned salt ponds, and tributary streams that are hydrologically part of the Bay; and 6) recommend specific guidance to all appropriate agencies, including local and county governments, to help in the development of local wetland protection programs.

When: 1993

Cost: \$5,746,000 estimated total (\$1,091,000 federal and \$4,655,000 state)

ACTION WT-1.2

Encourage geographically focused cooperative efforts to protect wetlands.

Who: California Resources Agency (lead agency), California Coastal Conservancy, San Francisco Bay Conservation and Development Commission, Department of Fish and Game, State Lands Commission, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Soil Conservation Service, local governments, landowners, and non-profit organizations

What: Opportunities should be sought immediately and during development of the Regional Wetlands Management Plan to protect wetland areas particularly threatened by loss. Such areas include, among others, San Pablo Bay wetlands, Delta wetlands, and wetlands identified in the proposed expansion of the San Francisco Bay National Wildlife Refuge. Cooperative efforts of government agencies, landowners, and conservationists should be undertaken to create immediate opportunities for protection, acquisition, and restoration. These efforts will facilitate the implementation of a coordinated strategy for wetlands protection, acquisition, and restoration that should be contained in the Regional Wetlands Management Plan.

When: 1993

Cost: \$16,600,000 estimated total (\$14.6 million federal and \$2 million state)

Objective WT-2

Improve the wetland regulatory system.

ACTION WT-2.1

Establish a comprehensive state wetlands program for the Estuary which, in addition, includes a coordinated regulatory and policy framework.

Who: San Francisco Bay Conservation and Development Commission, Central Valley Regional Water Quality Control Board, San Francisco Bay Regional Water Quality Control Board, Delta Protection Commission, California Resources Agency, California Department of Fish and Game, California Coastal Commission, State Lands Commission, California Environmental Protection Agency, State Water Resources Control Board, local governments, special districts, and California Legislature

What: WT-2.1.1: Establish state wetlands protection policies for the Estuary.

A. Adopt a No Net Loss policy. Establish a consistent “no net loss” policy by all state agencies to prevent any activity that will result in the loss of either wetland acreage or values on a project-by-project basis in the San Francisco Estuary or the land surrounding the Estuary. No net loss should first be accomplished by avoiding destruction or degradation of wetlands, if possible, by minimizing impacts, and by mitigation.

B. Adopt consistent wetland definition and jurisdictional delineation methods. Adopt a standard definition for wetlands based on the broad scientific consensus that all wetlands possess certain general characteristics. Adopt a single corresponding jurisdictional delineation methodology to identify those wetlands in the field. Jurisdictional wetlands should be delineated in a manner which includes all ecological wetlands. This definition and delineation methodology should identify at a minimum all lands that fall under federal CWA Section 404 jurisdiction and should be used by all appropriate state and local regulatory agencies.

Wetland definition. Two options should be considered.

Option 1: A general definition that reflects the three characteristics accepted by the scientific community as indicators of wetland ecology.

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For the purposes of this classification, wetlands must have one or more of the following attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominately undrained hydric soils; and (3) the substrate is non-soil that is saturated with water or covered by shallow water at some time during the growing season of each year.

Option 2: Current federal definition, modified to include sites that reflect California’s unique wetland ecology.

Wetlands are those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. In addition, wetlands include: mudflats, sandflats, unvegetated seasonally ponded areas, vegetated shallows, sloughs, wet meadows, playa lakes, salt ponds, natural ponds, vernal pools, and riparian woodland and scrub.

Jurisdictional delineation methodology. Based on the adopted definition, a delineation method should be developed and adopted to allow consistent and accurate field identification of jurisdictional wetlands.

C. Adopt wetland alteration policies. Adopt policies that require avoidance of fill and other alterations (e.g., removal of vegetation and draining) in wetlands. It is presumed that an alternative location exists for non-water-dependent projects

unless otherwise demonstrated. Exceptions may be considered where the project proponent clearly demonstrates that no feasible alternative non-wetland location exists, or when the project is necessary for the health, safety, or welfare of the residents of the Bay-Delta Estuary region and no feasible non-wetland location exists. Fill should further be limited to projects where:

1. It is demonstrated that the public benefits outweigh the public detriment (e.g., minor filling for wildlife refuges or other wildlife purposes, or minor filling for public access where existing access is inadequate and such access can be designed consistent with protection of sensitive wildlife and wetland habitat);
2. The fill is the minimum necessary to achieve the purpose of the project;
3. The fill minimizes harm to water circulation and quality, fertility of the marsh, and fish and wildlife resources;
4. The fill is engineered to reasonably withstand earthquakes and flooding;
5. In order to prevent a piecemeal approach, the fill project prevents future fill in wetlands at the site; and
6. The fill is limited to areas where ownership has been clearly established so that wetlands are not altered on property without legal authorization.

D. Establish sufficient buffer areas to protect wetlands from adjacent uses. Buffer zones adjacent to wetlands are necessary to provide for adequate transitional and refuge habitat between wetland and developed uses. Buffer zones should be of adequate size and quality to insulate the wetland, transition, and refuge habitat from adverse impacts of nearby developed areas. Buffer areas should be protected consistent with the legal rights of the property owners.

WT-2.1.2: Investigate state assumption of Section 404 of the Clean Water Act.

- A. Study implications for state assumption of 404. A study of state assumption of the Section 404 program should consider effectiveness, efficiency, and cost. Any assumption should maintain the appropriate federal role necessitated by interstate and international responsibilities and consider the establishment of an appeals program for review of state decisions.
- B. If the study indicates that state assumption would improve resource protection, move towards state assumption of 404.
- C. Study methods to improve coordination of wetland regulation, including single agency authority for wetland alteration activities. The purpose of this would be to consolidate the permit process consistent with improved wetland protection.
- D. If the study indicates that improved resource protection would result, move toward allowing consolidated or coordinated permit authority for wetland alteration activities. The purpose would be to consolidate the permit process consistent with improving wetland protection. For instance, agencies with other wetland-related permit activities (e.g., BCDC, RWQCBs, DFG, and Delta agency) could issue permits concurrently under the same application process or issue consistency determinations.

WT-2.1.3: Establish an implementation program to achieve wetlands protection policies. In order to improve wetland protection and reduce regulatory duplication, a uniform and coordinated program should be established that provides state oversight of locally implemented wetlands protection policies. Such a program may be modeled after the Suisun Marsh Protection Plan. The policies themselves (described in Actions WT-2.1, 2.2, and 2.3) should be adopted by the San Francisco Bay and Central Valley RWQCBs, BCDC, and the Delta Protection Commission. Authority and resources to implement these policies should be provided to local governments. In that manner, project sponsors will be informed of



wetland protection requirements early in the application process, thereby minimizing uncertainty and delay. State oversight agencies will coordinate their actions with relevant federal agencies in a manner consistent with the policies and objectives described herein (Actions WT-2.1 through WT-2.4).

Fill gaps in existing wetland regulatory programs consistent with policies recommended above. Based on wetland resource needs, state policies and programs should be implemented to fill in gaps in existing wetland regulatory programs. In particular, this should include the following.

A. The SWRCB and the San Francisco and Central Valley RWQCBs should adopt policies and programs consistent with the Clean Water Act. The SWRCB and/or San Francisco Bay and Central Valley RWQCBs should be directed and allocated adequate resources to:

- ☑ Clarify that wetlands are waters of the state and develop a program to protect wetland resources;
- ☑ Adopt a definition of wetlands as specified in Action WT-2.1;
- ☑ Apply the beneficial uses process developed by San Francisco Bay RWQCB;
- ☑ Develop scientifically based narrative water quality standards for wetlands;
- ☑ Utilize CWA Section 401 authority to certify Section 404 permits;
- ☑ Implement a wetlands anti-degradation policy;
- ☑ Regulate removal of vegetation, draining, and hydrologic modifications to prevent loss of wetlands; and
- ☑ Protect and restore the managed and unmanaged fresh/brackish wetlands of Suisun Marsh and Suisun Bay by providing sufficient Delta outflow and utilizing appropriate management techniques.

B. The McAteer-Petris Act should be amended to:

- ☑ Improve and strengthen BCDC's mandate to protect wetland wildlife habitat values by: a) making its wetland fill provisions consistent with those policies contained in WT 2.1.1; b) clarifying that wetland wildlife habitat values are to be protected to the maximum extent feasible; and c) providing the authority to protect buffer areas along the shoreline.
- ☑ Establish a coordinated regulatory system that relies on the preparation of local government wetland protection programs as part of the local land use planning process, with BCDC oversight, to protect non-tidal wetlands surrounding the Bay, including diked historic baylands and tributary streams that are hydrologically part of the Bay. The Suisun Marsh Preservation Act may be used as a model.
- ☑ Make BCDC's jurisdiction and policies regarding salt ponds and managed wetlands consistent with other state and federal laws and policies on wetlands and other waters, as recommended herein.
- ☑ Provide BCDC with authority over shoreline areas in order to protect fully priority use areas, protect wetland buffer areas, and provide for seismic safety and flood protection (e.g., to minimize the effects from spills from shoreline activities).

C. Establish a program to protect Delta wetlands. The State Legislature should establish authority to implement a Delta component of the Plan that would protect the tidal and non-tidal wetlands of the Sacramento-San Joaquin Delta.

Establishment of a Delta regional authority or augmentation of an existing agency's authority should be employed to accomplish this component. (This component should be modeled after the Suisun Marsh Protection Plan and similar to the BCDC component of the Wetlands Management Program.)

D. Develop and implement local government wetland protection programs to implement the policies of the Bay, Basin, and Delta Plans. Financial and other resources should be provided to local governments that, as part of the local land use planning process and with the assistance of state and federal agencies, develop local wetlands protection plans and ordinances that implement and are consistent with the programs described above. Adequate resources should be allocated to allow thorough and timely processing of applications at the local and oversight level. Real estate point-of-sale disclosure should be required to ensure that wetland protection laws are disclosed to buyer at time of sale of property. Watershed Management Plans and actions to reduce pollutants in runoff should be main components of these programs. The establishment of local government wetland protection programs is consistent with related goals, objectives, and actions contained in the CCMP Land Use Management Program and the Pollution Prevention and Reduction Program.

When: 1993

Cost: \$7,130,000 estimated total (\$2,720,000 federal and \$4,410,000 state)

ACTION WT-2.2

Increase enforcement efforts to curtail illegal wetland alteration and to ensure compliance with permit conditions.

Who: Lead Agencies: U.S. Army Corps of Engineers, U.S. EPA, and California EPA

Lead Agencies for Funding: U.S. Congress and California Legislature

Responsible Parties: San Francisco Bay and Central Valley Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, National Marine Fisheries Service, federal and state justice departments, and local governments

What: Provide increased resources, including funding, staff, and statutory authority, to improve curtailment of illegal wetland alteration and to ensure compliance with permit conditions. These resources should also be devoted to:

- Increase state and federal staff to reduce permit processing time, consistent with wetland protection objectives contained herein.
- Improve enforcement techniques of state and federal agencies (e.g., streamline enforcement processes for administrative cease-and-desist orders or enforcement penalties); enforce cease-and-desist orders in a timely fashion; increase prosecutions by federal and state justice departments; monitor permitted projects to ensure compliance; and issue fines sufficient to compensate for lost resources and to deter future violations within the Estuary.
- Require and enforce appropriate wetlands restoration and corrective measures in those cases where unauthorized wetlands alteration has taken place. Mitigation and permit monitoring should be improved to ensure that such measures are successful. When permit violations that damage wetlands occur or mitigation goals are not met, agencies should exercise their authority to suspend, revoke, or otherwise revise permits and require corrective measures.
- Authority should be provided to allow all fines and penalties collected by public agencies in connection with illegal wetland activities in the Estuary to be used for acquisition and restoration of wetlands within the San Francisco Estuary area.

- ❑ The U.S. Army Corps of Engineers should make available to the public on a regular basis a listing of outstanding cease-and-desist orders, a listing of enforcement cases, and a report on the status of approved mitigation projects.
- ❑ Enforcement outreach programs should be conducted by agencies with enforcement authorities in order to educate the public and other resource agencies about wetland enforcement programs. Information should be provided about how to report potential illegal activities to the appropriate authority.
- ❑ Provide adequate staff and funding for all of the above.

When: 1993

Cost: \$54,020,000 estimated total (\$32.4 million federal and \$21,620,000 state)

ACTION WT-2.3

Develop and adopt uniform compensatory mitigation policies.

Who: California Resources Agency (lead agency), U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, California Environmental Protection Agency, Department of Fish and Game, Department of Water Resources, State Water Resources Control Board, Central Valley and San Francisco Bay Regional Water Quality Control Boards, California Coastal Conservancy, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and local governments

What: No net loss should first be accomplished by avoiding destruction or degradation of wetlands, if possible, then by minimization of adverse impacts and by compensatory mitigation. The relevant agencies should enter into a Memorandum of Agreement (MOA) regarding compensatory mitigation for wetland losses within the Estuary, including the establishment of mitigation banks for small wetland fills. The MOA should incorporate the following criteria concerning a) compensatory mitigation and b) mitigation banking.

A. Compensatory mitigation

1. Mitigation should create new wetlands at the site of the wetland alteration; if on-site mitigation is not feasible, then mitigation should create new wetlands as close as possible;
2. Mitigation must be commensurate with adverse impacts of the wetland alteration and consist of providing similar values and greater wetland acreage than those of the wetland area adversely affected;
3. Mitigation should include an area of adjacent upland habitat for wetland species that require such habitat;
4. Mitigation should, to the extent possible, be provided prior to or concurrently with those parts of the project causing the adverse impacts; mitigation should be carefully planned so as to ensure success, permanence, and long-term maintenance;
5. Mitigation for wetland destruction should be implemented on a currently non-wetland site; and
6. Mitigation sites should be permanently guaranteed for open space and wildlife habitat purposes.

All permitting agencies should develop standardized requirements for compensatory mitigation plans and monitoring to ensure the success of mitigation projects. Requirements should be developed to address minimum reporting criteria,

environmental assessments, and clearly defined goals and success criteria for the mitigation area, including a contingency plan in the event of partial or complete failure of the plan.

B. Mitigation Banking

1. Projects qualifying for use of mitigation banks should be limited to small fills in order to ensure the availability of adequate mitigation sites for the small project sponsor;
2. The mitigation bank site should be within the same segment of the Estuary as the wetland alteration;
3. Use of a mitigation bank should be authorized only after it is successfully functioning and providing in-kind habitat values; and
4. The mitigation bank should be used only if the fill project would otherwise meet criteria specified in the CWA Section 404(b)(1) Guidelines.

When: 1993

Cost: \$185,000 estimated total (\$110,000 federal and \$75,000 state)

ACTION WT-2.4

Improve wetlands protection provided under the Clean Water Act.

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Congress, and California Legislature

What: During reauthorization of the Clean Water Act, the law should be amended to:

1. Include explicit reference to wetlands in the CWA goals section (“...Restore and maintain the chemical, physical, and biological integrity of the nation’s waters, including wetlands...”); all appropriate provisions of the act should contribute to these goals.
 2. Regulate wetland alteration activities, such as dredging, artificial flooding, and the placement of pile-supported and floating structures; the draining of wetlands and the destruction or removal of wetland vegetation should be regulated if such activities are not part of an ongoing farming operation; the draining of wetlands and the destruction or removal of wetland vegetation should be prohibited if the purpose is to achieve immediate or gradual conversion to a non-wetland type; and
 3. Require the U.S. Army Corps of Engineers, in its decisions on permit applications, to follow the biological recommendations from the U.S. FWS, NMFS, and the state fish and wildlife agency unless: a) it makes a finding that these recommendations are inconsistent with U.S. Army Corps of Engineers’ legal requirements; or b) alternatives to the agencies’ recommendations chosen by the Corps are consistent with the wetland alteration policies described in Action WT-2.1.
- Eliminate use in the Estuary of Nationwide Permits (NWP) for filling of wetlands less than ten acres (NWP 26) and bank stabilization (NWP 13); if not feasible to eliminate their use, NWP 26 should have its upper acreage limit reduced from ten acres to one acre, and NWP 13 should have its upper lineal limit significantly reduced from 500 feet. Application of both these Nationwide Permits in California is known to have significant cumulative adverse impact.

The Corps should undertake a study of all other Nationwide and Regional Permits and recommend elimination of any that are resulting in or are likely to result in individual and/or cumulative adverse impacts to wetland resources. For example, certain other Nationwide Permits (including the newly issued amendments to the Nationwide Permit program) may have cumulative adverse effects on wetland resources. In particular, these include NWP 12 (backfill and bedding for utility lines), NWP 14 (minor road crossings), and NWP 15 (U.S. Coast Guard-approved bridges), in addition to NWP 26 and NWP 13.

If Nationwide Permits are continued, the State Water Resources Control Board should decline to certify or should revoke NWP 13 and 26 and any others that have been demonstrated to have significant adverse impacts, thereby requiring individual permits for any activity in California which would otherwise be covered by such Nationwide Permits.

- ❑ The San Francisco and Sacramento Districts of the U.S. Army Corps of Engineers should regulate vernal pools by individual permits rather than Nationwide Permits or General Permits and continue master planning efforts with local governments to protect wetland resources.
- ❑ Where it is currently not doing so, the U.S. Army Corps of Engineers should recognize that Section 404 jurisdiction occurs where Section 10 jurisdiction does, in order to better protect and restore wetlands (and other waters) in diked historic bayland areas.
- ❑ Guidance should be developed for writers and reviewers of NEPA/CEQA documents specific to Estuary wetlands. NEPA and CEQA documents should better assess potential impacts to wetland areas and, in particular, should ensure that cumulative impacts are evaluated and that documents be prepared for any projects in a diked historic baylands that would preclude wetlands restoration.

When: 1993

Cost: \$280,000 estimated total (\$280,000 federal)

Objective WT-3

Protect existing wetlands using current, new, and expanded programs of wetland acquisition, easement agreements, and cooperative management systems.

ACTION WT-3.1

Expand wetlands acquisition programs, or establish a new Estuary-specific wetlands acquisition program.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, Wildlife Conservation Board, State Lands Commission, California Coastal Conservancy, and non-governmental organizations, such as Trust for Public Land and Nature Conservancy

What: Funding and level of effort would be increased for acquisition of priority wetland areas and associated habitat that are immediately threatened, provided that these areas are appropriate for restoration or are not otherwise protected.

- ❑ Increase federal funding for wetland acquisition by expanding allocations from the federal Land and Water Conservation Fund and through other federal funding mechanisms.

Objective WT-4

Expand the wetland resource base by restoring, enhancing, and creating wetland resources using a variety of approaches.

ACTION WT-4.1

Identify and convert/restore non-wetland areas to wetland- or riparian-oriented wildlife habitat. Purchase non-wetland areas to create wetlands. This action should be guided by and consistent with the Regional Wetlands Management Plan.

Who: U.S. Fish and Wildlife Service (lead agency), California Legislature, California Department of Fish and Game, California Coastal Conservancy, Wildlife Conservation Board, Soil Conservation Service, landowners, private non-profit organizations, public trusts, and in coordination with special districts such as mosquito abatement districts

What: By coordinating with other efforts to acquire wetlands already identified as degraded or destroyed and restoring them, wetlands in the Estuary will be increased by at least 50 percent by the year 2000, in accordance with state goals.

- The California Legislature should appropriate funds to the California Wildlife Conservation Board to restore former wetlands that no longer function.
- Large-scale restoration of tidal marsh in the South Bay, where remaining habitat is most fragmented and salt marsh wildlife most threatened, should proceed as rapidly as possible.
- Purchase non-wetland areas on historic wetland sites and restore them to maximize habitat and other associated values.
- Develop and implement plans and programs for restoring and enhancing wetland resources on historic wetland sites that have been degraded.
- Complete expansion of the San Francisco and San Pablo Bays National Wildlife Refuges and establish the proposed Stone Lakes National Wildlife Refuge by restoring non-wetland areas to wetlands.

When: 1993

Cost: \$92,820,000 estimated total (\$45.3 million federal and \$47,520,000 state)

The total estimated cost for the Wetlands Management Program is \$407,021,000.



Wetlands Majority Report

Among the purposes of National Estuary Projects as defined in the Clean Water Act is the “develop(ment) of a comprehensive conservation and management plan that recommends priority corrective actions...to restore and maintain the chemical, physical and biological integrity of the estuary...” Wetlands are essential to the maintenance of estuarine systems, and the approach of the majority was to develop a program that would restore and maintain the Estuary’s wetlands.

California has lost 91 percent of its historic wetlands; the San Francisco Estuary over 80 percent. Fifty-five percent of California’s endangered species depend on wetlands for all or part of their life cycles. The state loses billions of dollars annually because so many wetlands have been lost. Yet wetlands continue to be filled and degraded throughout the Estuary. The goals, objectives, and actions contained in the CCMP are the result of many compromises among the varied conference participants. Issues were deliberated during many meetings over many years through preparation of the Status and Trends Reports and the CCMP. Throughout the process, minority views were heard by majority members and, in an attempt to reach consensus, the majority members weakened or entirely eliminated their positions on a number of key issues.

Some examples of positions majority members believed were important for the preservation of wetlands but that were eliminated or weakened as a result of compromise are:

- ❑ EPA should initiate a 404 C action in South San Francisco Bay where there is a lack of potentially restorable lands. This action would preserve all remaining South Bay wetlands (This position was eliminated as a result of compromise);
- ❑ All Nationwide Permits that have the potential to affect wetlands should be eliminated (This position was weakened in order to accommodate minority viewpoints);
- ❑ Public access adjacent to wetland habitat should be prohibited (weakened);
- ❑ The state should not assume the 404 program because it does not have the necessary funding and because state assumption would render wetlands more vulnerable (eliminated);
- ❑ Streamlining is not appropriate because it can be an excuse for reduced regulatory protection (eliminated);
- ❑ Mitigation banks are not appropriate for the Bay Area (weakened);
- ❑ Adequate upland buffers should be required [one-hundred feet minimum] adjacent to all wetlands (weakened).

In conclusion, we emphasize that these positions were already compromised in an attempt to accommodate all views. To compromise any further would decrease the protection of wetlands, would abdicate our responsibility to the Estuary Program goals, and would be detrimental to the Estuary.

Wetlands Minority Report

Summary of the Wetlands Minority Report submitted by:

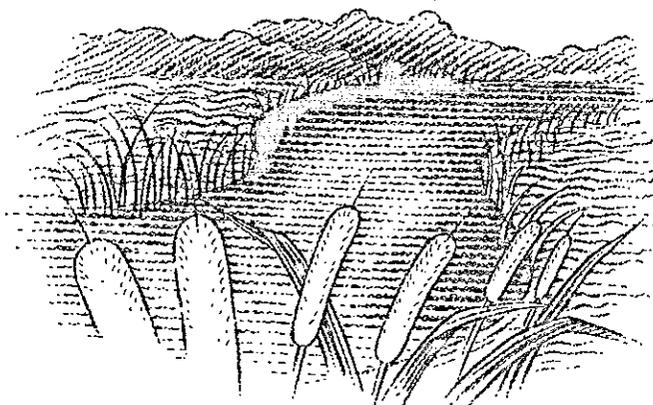
Bay Planning Coalition
 Building Industry Association of Northern California
 Bay Area Council
 California Farm Bureau Federation
 California Department of Food and Agriculture
 Sacramento Metropolitan Chamber of Commerce
 Association of California Water Agencies

Responsible public and private landowners acknowledge the importance of healthy, functioning water bodies and valuable marshes. But for ten years or more, there has been a stalemate between public and private property owners on the one hand and regulatory agencies and environmentalists on the other concerning "wetlands." It is not the current regulatory permit program that has resulted in the loss and destruction of wetlands, but rather the failure to develop an incentive-based approach.

The Wetlands Management Program, if implemented, would involve more than twenty federal, state, regional, and local agencies in wetlands programs. The excessive regulatory duplication and cost is absurd, especially in the face of today's harsh economic realities confronting businesses and local, state, and federal governments. Conventional regulatory policies, as proposed in the Wetlands Management Program, pit economic and environmental goals against one another. While the above signatories all had their own and sometimes different reasons why they could not agree with the Wetlands Management Program, we believe our comprehensive proposal is innovative and provides for practical and economically sensible policies that will advance more effective and efficient management of wetlands.

The above signatories are partners in a broad consensus for effective environmental protection and management. In fact, in practically all cases, we agree with the environmental goals set forth in this document—the question is how to get there. We have prepared specific and detailed proposals, which are contained in a twelve-page document available to anyone upon request to one of the above organizations.

Briefly, to summarize, we differ from the Wetlands Management Program and propose the following policy tools and approaches to wetlands management: a) public and private interests need to be balanced to determine the conditions under which activity in wetlands areas may occur; b) wetland-based economic value for landowners (e.g., appraise land at market value) must be created; c) acknowledge and appreciate that most wetlands are owned by the private sector and could, with the appropriate incentives and regulatory certainty, provide the largest opportunity to enhance, preserve, create, and manage wetlands; d) adopt the U.S. Environmental Protection Agency/U.S. Army Corps of Engineers wetland definition which recognizes three mandatory and integrated parameters (hydrology, soils, and vegetation); e) continue to use the 1987 federal wetlands delineation manual until further investigation yields a determination that certain valuable wetland sites are not within the purview of this definition; f) establish a Permit Appeals Board in the Department of the Army to hear appeals from applicants following decisions of district engineers denying applications for permits, including jurisdictional determinations; g) avoid duplication, overlap, and multiple agency requirements and halt the increase in regulations through possible state assumption of 404 or adoption of a state coordination process for 404 (either may be tested through a pilot program); h) assure adequate funding to local and/or regional agencies implementing wetlands regulations; i) certify the U.S. Army Corps of Engineers Nationwide Permit Program; j) allow that compensatory mitigation may occur through wetlands creation, restoration, and/or enhancement; k) establish workable and flexible mitigation banks; l) develop a wetlands classification system based on scientific functions; and m) develop regional wetland plans that may be resource-driven but must include consideration for harmonizing wetlands preservation goals with planning for and achieving goals to meet social needs.



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Water Use

Goal:

- Develop and implement aggressive water management measures to increase freshwater availability to the Estuary.

Problem Statement

The rivers and streams of the Sacramento and San Joaquin watersheds carry approximately 40 percent of the state's available fresh water. The Sacramento-San Joaquin Delta serves as the vital link between most of the state's available water supply and most of its demand. More than seven thousand diversions for purposes such as irrigation and drinking water storage reduce the annual volume of fresh water entering San Francisco Bay by more than one-half in dry and critically dry years. The federal Central Valley Project and the State Water Project are the two largest diverters, together removing nearly ten million acre-feet per year. Approximately 80 percent of this diverted water is used by agriculture, and 20 percent goes to urban, industrial, and other uses. Construction of currently planned local water development projects and the completion of the State Water Project will likely increase annual diversions from the Estuary water supply by at least 1.1 million acre-feet.

Freshwater inflow is a major determinant of environmental conditions in the Estuary. The volume and timing of freshwater inflow affect the Estuary's circulation and water quality; conditions for wildlife; production and survival of phytoplankton, zooplankton, and all life stages; and survival of aquatic species, including salmon, striped bass, longfin smelt, California bay shrimp, and starry flounder.

As the end of the century approaches, additional water development is pending within the Estuary watershed and in other parts of California. With the state's human population expected to increase from thirty million to more than forty-one million by 2010, and given the current plans of water resource developers, it is safe to assume that future demands on the Estuary's fresh water will be considerable. While growing urban areas demand further freshwater supplies, agricultural interests fear the loss of reliable water supplies for irrigation. California is now struggling to balance competing demands from urban and agricultural communities, while trying to protect the health of the estuarine ecosystem.

Existing Management Structure

California's Constitution governs all water use in the state. It provides that all water within the state is the property of the people of California. However, while water remains a public asset, individuals may acquire an exclusive right to its use in the nature of a property right. The State Water Resources Control Board (SWRCB) oversees the allocation of these rights and the protection of water for the people of California. Private rights are conferred to those who exercise physical control over surface water or groundwater, with the condition that the water be put to a reasonable and beneficial use. The SWRCB administers water rights by issuing water permits. It retains authority to modify these permits to prevent unreasonable use of water. However, unlike diversions of surface water, there is no state-administered permit system for groundwater extraction except in adjudicated basins (groundwater basins that are cooperatively managed by the SWRCB and local government).

The California Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (BOR) provide water through contracts to local water entities, including water agencies, water districts, irrigation districts, mutual water companies, and joint powers authorities. DWR operates the State Water Project to supply water users in urban and agricultural communities. DWR also develops and manages the state's water supplies and provides flood control protection.

BOR develops water supplies for many uses, but primarily for agriculture, and ensures delivery of water through operation of the federal Central Valley Project (CVP). Furthermore, BOR holds water permits from SWRCB entitling it to store, divert, and deliver water to the Central Valley through the CVP. The State Water Project and the CVP, as appropriative rights holders, supply most of the state's agricultural irrigation water. However, appreciable amounts of irrigation water are supplied from groundwater pumping and local surface water.

Although DWR has no jurisdiction over water conservation in California, its Office of Water Conservation has taken the lead to coordinate state, local, urban, and agricultural water conservation efforts. The State Legislature (A.B. 3616 Advisory Committee) and the Department of Water Resources are currently taking further steps to develop and implement agricultural water conservation practices. Water suppliers that contract with BOR (Central Valley Project) are required by the federal Reclamation Reform Act to prepare Water Conservation Plans and update those plans every five years.

Long-standing assistance in the wise use of soil, water, and related resources has been provided by the U.S. Soil Conservation Service (U.S. Department of Agriculture) and the University of California Cooperative Extension. On a local and urban level, major credit for developing and implementing urban water conservation practices in California must be given to municipalities, water suppliers, and environmental organizations. They successfully created and implemented the document, "Memorandum of Understanding Regarding Urban Water Conservation in California."

Regional Water Quality Control Boards (RWQCBs) address region-wide water quality concerns through the creation and triennial update of a Water Quality Control Plan (Basin Plan), which specifies beneficial uses of water, water quality objectives to protect uses, and schedules for achieving objectives.

The California Department of Health Services (DHS) and local health and regulatory agencies are integrally involved in both development and operation of water reclamation projects. Implementation of reclamation projects requires the involvement, approval, and support of a number of agencies, including state and local health departments, RWQCBs, Publicly Owned Treatment Works (POTWs), water districts, and land use planning agencies.

The prospects for future reclamation projects are also dependent on effective coordination between reclamation agencies and land use planning agencies. For example, land use planning agencies can mandate the use of reclaimed water as a condition of development approval, and many reclamation ordinances in California require separate piping systems for drinking water and reclaimed water in new high-rise buildings and other new developments. Furthermore, due to public

health considerations regarding reclaimed water use, the efforts of the State Water Board, DHS, and county health departments must be also coordinated.

In short, no single agency or organization shapes or implements every aspect of water use management throughout the Estuary watershed. Instead, water use management is determined by networks of public and private water organizations and public interaction.

Recommended Approach

Aggressive water conservation measures should be developed and implemented statewide by users in agricultural, urban, and industrial communities. Urban communities have made great progress toward designing and implementing water conservation projects. One of the greatest achievements was the establishment of a memorandum of understanding addressing urban water conservation. Also, agricultural communities have employed conservation practices, most notably the concerted efforts of the farmers of the Imperial Irrigation District, Kern County Water Agency, and Westlands Water District. Some rural areas have installed state-of-the-art irrigation equipment and implemented bold water management practices. The Department of Water Resources' Office of Water Conservation worked with the A.B. 3616 Advisory Committee to develop a list of "Efficient Water Management Practices" (EWMPs) and a strategy for implementing them. By providing funding to universities for research and pilot projects, government can foster further conservation of water used by agriculture.

A plan to increase water supplies and the efficiency of water use should include the utilization of reclaimed water to reduce:

1. The existing diversions of fresh water;
2. The demand for increased diversions; and
3. The existing discharge of wastewater directly into the Estuary.

Use of reclaimed water can be promoted by government on either a local or regional level. A number of communities in California, notably San Diego with its water reclamation ordinance and Santa Barbara with its greywater ordinance, have already taken steps to use reclaimed water within their communities. The Monterey County Water Resources Agency and the Monterey Water Pollution Control Agency are currently developing a project that will use reclaimed municipal wastewater for irrigating crops.

On a larger scale, a study is currently under way that will evaluate the feasibility of using existing infrastructure and developing new facilities to pipe reclaimed water from the Bay Area to the San Joaquin Valley for use in irrigating agriculture. Fully developed, this project could achieve exportation of 25 percent of the treated wastewater from the Bay Area to Central Valley agriculture by the year 2000. In all planning, public involvement is necessary to develop and implement water reclamation projects successfully.

In areas throughout California that are free from groundwater contamination and have rights to surface water, arrangements can be made for the use of groundwater during years of below normal runoff and for the use of surface water during wet years (i.e., "conjunctive use"). Surface water not diverted during dry years can remain in streams to be used for instream needs or other critical needs. In addition, groundwater basins with capacity to store additional water could be employed as water banks. The Department of Water Resources is involved with such a project in Kern County. The project, known as the Kern Water Bank, receives water from the State Water Project from November to April and stores it underground. Extraction of the groundwater can then take place year-round.

The legal and regulatory methods that could lead to the development of new water supplies and more efficient use of existing water supplies include pricing incentives, water-marketing arrangements, legal mechanisms for water transfers, water banking, and groundwater management.

Water Use Recommendations

Objective WU-1

Develop water reclamation and the needed facilities to reuse water.

ACTION WU-1.1

Water reclamation and reuse feasibility studies should be completed by each Publicly Owned Treatment Works (POTW), municipality, and/or water district.

Who: Publicly Owned Treatment Works, local governments, water districts, irrigation districts, State Water Resources Control Board, Regional Water Quality Control Boards, Department of Health Services, Department of Water Resources, and the U.S. Bureau of Reclamation

What: The studies should include:

1. The specific local uses of reclaimed water;
2. Present and potential quantity needs;
3. Timing of needs;
4. Water quality needs;
5. Engineering feasibility of reclamation and reuse systems; and
6. Economic feasibility of reclamation and reuse systems.

When: The year 2000

Cost: \$2.4 million estimated total (\$2.4 million state)

ACTION WU-1.2

Municipalities and counties should adopt water reclamation ordinances encouraging the use of reclaimed water, to the maximum extent practicable, while providing for the protection of public health and the environment.

Who: Municipalities, counties, POTWs, water districts, and irrigation districts

What: 1. Adopt municipal reclamation ordinances and code changes such as: a city reclamation ordinance (e.g., the City of San Diego's reclamation ordinance); plumbing code changes to permit the use of reclaimed water in high-rise buildings (e.g., Irvine Ranch Water District in Southern California); plumbing code changes to permit the use of greywater in landscaping year-round (e.g., the 1989 change to the City of Santa Barbara Building Code Ordinance).

2. Provisions to protect public health must be incorporated into ordinances in situations where the public will come into contact with or be exposed to reclaimed water.

When: Immediately

Cost: No direct cost

ACTION WU-1.3

Local entities interested in implementing reclamation projects should develop and conduct public education programs.

Who: POTWs, water districts, irrigation districts, municipal and county governments, Department of Health Services, county health departments, city health departments, and the environmental community

What: Publicly Owned Treatment Works, county governments, municipal governments, and other entities involved in the promotion, development, and implementation of water reclamation and reuse projects should develop and conduct public education programs. Methods of public education should include public involvement in project development through citizen advisory committees, public workshops, public education programs, and the environmental review process (CEQA). Topics covered through public education should include:

1. Protection of public health and safety of operation;
2. Siting of treatment facility, delivery system, and application;
3. Environmental benefits and impacts;
4. Quality of reclaimed water and specific use; and
5. Economic benefits.

Assistance in developing and conducting the public health component of public education programs should be sought from the Department of Health Services and local health departments.

When: Immediately

Cost: No direct cost

ACTION WU-1.4

Ensure that state water quality standards and Basin Plans encourage water reclamation and reuse.

Who: State Water Resources Control Board and Regional Water Quality Control Boards

What: State water quality standards and Basin Plans should be amended by requiring specific standards for water bodies or streams that are dominated by reclaimed water. Efforts to resolve conflicts between state water quality standards and the Clean Water Act should be resolved.

When: Immediately

Cost: \$600,000 estimated total (\$600,000 state)

ACTION WU-1.5

If practical, use existing facilities and develop new facilities in order to deliver reclaimed and recycled water for beneficial reuse.

Who: Bay Area Publicly Owned Treatment Works (POTWs), Bay Area Water Agencies, Bay Area communities, State Water Resources Control Board (SWRCB), Central Valley Regional Water Quality Control Board, San Francisco Bay Regional Water Quality Control Board, U.S. Bureau of Reclamation (BOR), U.S. Army Corps of Engineers, DWR, California EPA, and Central Valley irrigation districts

What: All Bay Area cities should develop local reclamation and water recycling programs. However, with optimal local use of reclaimed water in the Bay Area, there is the potential for a 400,000 acre-feet a year surplus of reclaimed and recycled water to be achieved (according to a draft report titled, "Updated Evaluation: Export of Reclaimed Water from the Bay Area").

A Joint Powers Agreement among the Bay Area POTWs, water agencies, and communities should be formed to study a full spectrum of uses for surplus reclaimed water. Among options considered, the study should examine the feasibility of exporting reclaimed water to the Central Valley for agricultural irrigation, salinity repulsion, and other viable options. All issues would be completely examined, including agricultural drainage, engineering feasibility, the potential for salt and metal loading in agricultural land, and the long-term productivity to agricultural lands. The cost of the project, who pays and who benefits from the project, and how and when to implement such a project would also be addressed in the feasibility study.

The two primary benefits of full usage of reclaimed water for the Estuary are: 1) a portion of the water that is freed up by this project could remain in the Delta system for the benefit of the environment; and 2) the POTWs of the Bay Area could approach zero discharge of wastewater into the San Francisco Bay.

The feasibility study would examine all the financial implications and the question of who benefits and who pays. The goal would be to spread the cost among as many beneficiaries as possible in order to make the cost of the recycled water affordable to users.

When: A Joint Powers Agreement to fully study the feasibility of this concept would be developed and in place by June, 1993. The study of the concept would require two to three years. If feasible, environmental review and design would take three to four years, and construction would then follow. If feasible and acceptable, export would not begin until the year 2000.

Cost: \$1,625,000 estimated total (\$825,000 federal and \$800,000 state)

ACTION WU-1.6

Address and resolve, as appropriate, the impacts on water reclamation and water conservation caused by the discharge of brine from self-regenerating water softeners and other sources into the wastewater stream.

Who: California Urban Water Conservation Council (CUWCC), POTWs, water districts, reclamation entities, and the water softening industry

What: State legislation or other appropriate action should result from a review process designed to address the water conservation and reclamation impacts caused by self-regenerating water softeners.

Self-regenerating water softeners are on automatic timers that govern the frequency with which the water softeners recharge and flush salts out of the appliance and into the sewer system and/or septic system. The impacts are more adverse from the reclamation standpoint than from the water conservation aspect. The heavy salt load makes reclamation more difficult or can pollute groundwater (septic systems).

The CUWCC has established a subcommittee to explore with representatives of urban water districts, reclamation entities, and water softening interests how best to address the problem in California. The CUWCC is in the process of developing and finalizing a report and recommendations for water softeners. The CCMP should support this process and the recommended actions that result from it.

When: Immediately

Cost: No direct cost

Objective WU-2

Develop water conservation methods and facilities to increase the availability of fresh water for instream uses and water supply.

ACTION WU-2.1

Governmental, agricultural, public, and environmental interests should work together to develop a mechanism to ensure implementation of Efficient Agricultural Water Management Practices.

Who: California Department of Food and Agriculture, Department of Water Resources (DWR), University of California Cooperative Extension, State Water Conservation Coalition (SWCC), California farmers, California Farm Water Coalition, USDA, agricultural water suppliers, California Farm Bureau Federation, SWRCB, U.S. Bureau of Reclamation, U.S. Soil Conservation Service, and the environmental community

What: The Department of Water Resources' Office of Water Conservation, working with the A.B. 3616 Advisory Committee, has developed a list of Efficient Water Management Practices (EWMPs) and a strategy for implementing it. Similarly, the State Water Conservation Coalition (SWCC) recommends that agricultural water suppliers shall continue to plan, evaluate, and implement measures that will achieve greater efficiencies and greater conservation. The goal of SWCC's EWMPs is to achieve a net positive effect on water supply, water quality, and on the environment, both within and outside of the supplier's service area. Another goal of EWMPs should be to provide economic incentives/disincentives for water conservation and adjustments of prices and subsidies to encourage water conservation.

Where feasible, the A.B. 3616 Advisory Committee's and Department of Water Resources' list of EWMPs should also include:

1. Lands that cause the most severe environmental threats when irrigated should revert to dryland farming when feasible or should be permanently retired. Revegetation with native plants should be considered when land taken out of production is subject to wind or water erosion and growth of unwanted weeds.
2. Delivery of water by districts at time of need rather than a predetermined schedule.
3. Research the use of plant breeding for shorter-season crops and adopt planned water shortage techniques during targeted periods of plant growth.
4. Develop crops that consume less water.
5. Use of sprinklers and drip irrigation systems where applicable and feasible.
6. Implement more efficient irrigation scheduling practices and use of other scheduling tools, such as tensiometer and neutron probes, for measuring soil moisture, CIMIS, gypsum blocks, soil probes, and the pressure chambers of cotton.
7. Implement agricultural water metering.
8. Efficient use of surface irrigation systems.
9. EWMPs should also include upgrading existing surface irrigation methods by reducing field lengths and set times, converting to surge irrigation, improving field slopes, compacting furrows, and installing and properly managing tailwater recovery systems.

In addition to stating and defining the EWMPs, the A.B. 3616 and Department of Water Resources list should include performance standards with explicit goals. An oversight council should be formed to enforce the performance standards and the implementation schedules for the EWMPs.

When: Immediately

Cost: \$37,400,000 estimated total (\$1 million federal and \$36.4 million state)

ACTION WU-2.2

New methods of agricultural water conservation should be researched through pilot projects and implemented where feasible.

Who: California Department of Food and Agriculture (CDFA), University of California Cooperative Extension, California farmers, California Farm Bureau Federation, U.S. Soil Conservation Service, Department of Water Resources (DWR), California Farm Water Coalition, U.S. EPA, California EPA, State Water Resources Control Board (SWRCB), and U.S. Department of Agriculture

What: Pilot project studies should provide agriculture with new water conservation practices. They should also provide data on the cost effectiveness of currently available conservation practices. Funding for research is sometimes available through federal and state agencies in the form of research grants. Participating agencies include DWR, SWRCB, U.S. EPA, and California EPA.

Dissemination of pilot project information will be achieved through public outreach to the agricultural, environmental, and urban communities.

When: Immediately

Cost: \$12,640,000 estimated total (\$12,640,000 federal)

ACTION WU-2.3

Water conservation feasibility studies shall be completed and implemented by municipalities and/or water districts.

Who: The California Urban Water Conservation Council (CUWCC), municipalities, and water districts

What: Water conservation methods considered in the feasibility studies should include the Best Management Practices (BMPs) as defined and set forth in the "Memorandum of Understanding Regarding Urban Water Conservation in California."

Studies should include:

1. Present and future quantity needs;
2. Economic feasibility and cost of implementing water conservation projects (Economic feasibility includes evaluation of economic incentives/disincentives for water conservation and adjustments of prices and subsidies to encourage water conservation);
3. Cost-benefit analysis; and
4. Environmental benefits.

Communities and water districts should actively participate in further research, development, and implementation of additional BMPs (i.e., these BMPs would be in addition to the sixteen already adopted by the CUWCC).

Because community and water district implementation of the MOU's BMPs is currently voluntary, state legislation should be enacted to make their implementation mandatory. Furthermore, communities and water districts should be encouraged to implement water conservation practices that are more aggressive than those listed in the MOU.

When: Immediately

Cost: No direct cost

ACTION WU-2.4

Maximize conjunctive use of water through groundwater recharge.

Who: SWRCB, Department of Water Resources, State Lands Commission, water agencies, U.S. Bureau of Reclamation, U.S. FWS, U.S. EPA, and private landowners

What: In areas in California that have usable groundwater and have water rights to surface water, arrangements should be made for the use of groundwater during years of below normal runoff and for the use of surface water during wet years, i.e., "conjunctive use." The surface water not diverted during dry years can remain in streams to be used for instream needs or other critical needs.

In addition, groundwater basins with capacity to store additional water should be employed as "water banks." Any flows in excess of those needed to meet aquatic resource needs in the Delta and streams of origin could be diverted for storage in aquifers for use during dry periods. The Kern Water Bank should be evaluated for use as a model in developing other water banks.

When: Immediately

Cost: \$20,620,000 estimated total (\$70,000 federal and \$20,550,000 state)

ACTION WU-2.5

Study storage of surface water on Delta islands.

Who: Department of Fish and Game, U.S. FWS, State Lands Commission, SWRCB, U.S. Bureau of Reclamation, Department of Water Resources, U.S. Army Corps of Engineers, U.S. EPA, California EPA, municipal water districts, farmers, landowners, and the environmental community

What: Agencies should determine if and to what extent fish and wildlife resources will be enhanced, instream flows will be augmented, and drinking water systems will be impacted if surface water is stored on Delta islands. Studies should discuss the significant impacts on fish and wildlife resources and supplies available for instream flows and drinking water.

When: Immediately

Cost: \$2,375,000 estimated total (\$825,000 federal and \$1,550,000 state)

ACTION WU-2.6

Evaluate and adopt, where appropriate, mechanisms to manage groundwater to protect the long-term integrity of groundwater basins.

Who: State Legislature, the governor, water agencies, water conservation districts, SWRCB, Regional Water Quality Control Boards, Department of Water Resources, U.S. Bureau of Reclamation, U.S. Geographical Survey, and the U.S. EPA

What: Reform state water law to enable management and oversight of groundwater.

When: Immediately

Cost: \$2,051,000 estimated total (\$70,000 federal and \$1,981,000 state)

Objective WU-3

Improve the legal and regulatory mechanisms to facilitate the voluntary transfer of water in order to increase the availability of fresh water for instream uses and water supply.

ACTION WU-3.1

More fully utilize the existing and expand, where appropriate, the legal and regulatory framework to facilitate voluntary water-marketing agreements among agricultural, urban, and environmental interests.

Who: State Legislature, the governor, SWRCB, DWR, U.S. Bureau of Reclamation, DFG, U.S. FWS, farmers, water utilities, and the environmental community

What: Voluntary and compensated water-marketing agreements should be facilitated by state and federal agencies to transfer water from urban and agricultural users to other agricultural and urban areas and for instream uses. Legal and regulatory framework that protects the water rights of the transferor should be developed.

When: Immediately

Cost: \$6.5 million estimated total (\$1.2 million federal and \$5.3 million state)

ACTION WU-3.2

The state should continue to negotiate with the federal government to determine whether, and to what extent, it is appropriate for the federal government to transfer the ownership or operational control of the Central Valley Project (CVP) to a non-federal entity.

Who: U.S. Congress, State Legislature, the governor, Department of Interior, DWR, SWRCB, U.S. Bureau of Reclamation, water suppliers, agricultural community, and the environmental community

What: The state should develop a coordinated pumping schedule for the CVP and the State Water Project to minimize the environmental disruptions caused by the export of water through Delta water diversion facilities.

When: Immediately

Cost: No direct cost

The total estimated cost for the Water Use Program is \$86,211,000.



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Pollution Prevention and Reduction

Goals:

- Promote mechanisms to prevent pollution at its source.
- Where pollution prevention is not possible, control and reduce pollutants entering the Estuary.
- Clean up toxic pollution throughout the Estuary.
- Protect against toxic effects, including bioaccumulation and toxic sediment accumulation.

Problem Statement

Human activities have greatly affected many aspects of the Estuary, including its geography, hydrology, and ecology. The activities relevant to the discussion of pollutants in the Estuary include the introduction of sediments and metals from mining operations, the discharge of domestic sewage, the diversion of fresh water, and the release of persistent, toxic pollutants in industrial discharges and surface runoff.

Each year, an estimated five to forty thousand metric tons of sixty-five or more toxic pollutants are disposed of in the Estuary. Pollutants of concern include trace elements, such as copper, nickel, silver, and zinc, and synthetic organic compounds, such as organochlorine pesticides, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs). These pollutants are produced and mobilized by numerous industrial, agricultural, natural, and domestic activities within the catchment. Pollutants are conveyed to the Estuary by rivers, storm drains, runoff from urban and non-urban lands, wastewater treatment plants, industrial facilities, atmospheric deposition, discharges from maritime vessels, underground seepage, and disposal of dredged material.

To date, most pollution control efforts have focused on direct discharges of sewage and industrial waste. While these efforts continue, controlling pollutants released into urban and non-urban runoff has also become a priority. Pollutants in urban runoff originate from transportation activities and other sources. Pollutants are deposited onto urban surfaces from the atmosphere and flushed through storm drains by rainfall, landscape irrigation, and wash-down practices. Aside from

San Francisco and a small part of Sacramento, where most urban runoff is treated along with municipal wastewater, polluted runoff from urban areas flows untreated into the Estuary.

Non-urban runoff is defined as surface runoff from agricultural lands, rangelands, and forests. Rainfall and irrigation water flush pesticides and other agricultural chemicals into drains, and the runoff flows untreated into the Estuary. Non-urban runoff also includes pollutants leached from soils by rain or irrigation (e.g., selenium), drainage from mine sites, and sediment from eroded soils.

Pollutants are distributed within the Estuary by a combination of physical, chemical, and biological processes. Many persistent pollutants become bound to particulate matter that settles near discharge points and accumulates in areas of sediment deposition with pollutants from past industrial activities. Some of these areas have been identified as "toxic hot spots." Pollutants can become concentrated in organisms directly from the water column and by ingestion of contaminated food. These two processes can lead to high concentrations of pollutants in tissues even though concentrations in the water are low.

The *Status and Trends Report on Pollutants* findings include the facts that:

- Available data from repeated analyses of sediments, sediment cores, mussels, and other animals have demonstrated few pollutant reductions;
- Tissue analyses indicate that the concentrations of ten trace elements, DDT, and PCB sampled in the Estuary's mussels, clams, fish, and birds are significantly elevated compared to samples collected elsewhere in the state;
- PCBs appear to be reducing reproductive success in starry flounder in the eastern portion of Central Bay. PCBs and DDT in black-crowned night heron eggs have been correlated with decreased embryo size and eggshell thickness, respectively; and
- With urban land use expected to increase by 37 percent by 2005, pollutant loading from all sources is expected to increase substantially.

Many effects related to pollutants in the Estuary have been identified, although this evidence is limited by our ability to detect toxic effects and by the complexity of the estuarine ecosystem. While measuring concentrations of pollutants in water, sediments, and animal tissue is technically achievable, determining the overall effect of a pollutant on individual organisms is often extremely difficult. Even more difficult to determine are pollutant effects on populations of a single species or on the entire aquatic community. Evidence of pollutant effects in the Estuary is sufficient, however, to designate much of the Estuary as "threatened or impaired" by combinations of different toxic pollutants.

Persistent pollutants of concern in the Estuary have been increasingly influenced by chemical use and freshwater flow patterns. In contrast to trends in some biodegradable pollutants, trends in persistent pollutants are affected more by the use of chemicals than by treatment methods. Concentrations of toxic metals in sediments and certain organisms are high in some urban industrial portions of the Estuary, and concentrations of most metals do not appear to be decreasing. The concentration of these metals corresponds with their continued use within the catchment despite the treatment of wastewater. Unless patterns of chemical use and land development change, pollutant loads discharged into the Estuary via runoff are likely to increase. Increased diversion of freshwater inflow may also further increase the concentration of some pollutants of concern in the Estuary.

Existing Management Structure

The U.S. Environmental Protection Agency (U.S. EPA) and the California State Water Resources Control Board



(SWRCB) share authority to regulate sources of pollution to the Estuary. The federal Clean Water Act (CWA) and its amendments establish the programs used to control pollution in the Estuary. The CWA is administered by U.S. EPA, but actual implementation in California is performed by the SWRCB and Regional Water Quality Control Boards (RWQCBs). The San Francisco Estuary is within the jurisdiction of the San Francisco Bay and Central Valley Regional Water Quality Control Boards.

In California, the SWRCB shares authority with the RWQCBs for implementation of the CWA and the Porter-Cologne Water Quality Control Act. The Regional Boards conduct planning, permitting, and enforcement activities under the guidance of the State Board. Programs administered by the State and Regional Boards include the National Pollutant Discharge Elimination System (NPDES) program, which regulates municipal and industrial wastewater discharges, and the Nonpoint Source Program, which develops strategies to eliminate pollutant sources before discharges reach conveyances. The state also establishes numerical water quality objectives for toxic pollutants for which U.S. EPA has published water quality criteria.

The Regional Boards prepare Water Quality Control Plans for implementing the state and federal policies for water quality conditions in the region. The plans specify beneficial uses of the receiving waters, water quality objectives, and the strategies and schedules for achieving these objectives. The plans are periodically revised.

In 1987, the State Board started the Bay-Delta Hearings to develop water quality objectives for the Estuary and consider alternative allocations of water rights to achieve the objectives. The Bay Waters Protection and Toxic Cleanup Program was established by state legislation to identify toxic hot spots and plan their cleanup or mitigation.

The U.S. Army Corps of Engineers manages the discharge of dredged material through a permit process. Applicants for permits are required to satisfy conditions designed to prevent unacceptable impacts to the aquatic environment, including release of pollutants during dredging and disposal of material. U.S. EPA reviews such permits and can object to their issuance. The Regional Boards are also actively involved in the regulation of pollutants from dredging activities. They must certify that such activities meet all applicable water quality standards.

The National Oceanic and Atmospheric Administration (NOAA) undertakes programs in estuarine and coastal assessment, research, and prediction. Assessment activities include monitoring ambient levels of pollutants in the sediment and water and research on the effects of pollutants on estuarine habitat, organisms, and human health. NOAA provides recommendations to state and federal agencies on regulatory decisions.

Recommended Approach

Historically, efforts to reduce the input of pollutants to the Estuary have focused on treating direct discharges rather than examining the use of toxic chemicals. Given the environmental problems and the great expense associated with new treatment technologies to control persistent pollutants, pollution prevention techniques represent a promising option for achieving reductions of pollutant loads. Reduced use of toxic chemicals resulted in a 70 to 90 percent reduction in chromium and lead discharges at a local petroleum refinery and was associated with lower copper discharge rates from a number of metal plating and electronics manufacturing plants.

This program proposes both the full implementation of existing regulatory programs and, where necessary, the development of new initiatives that address activities that result in pollution. Many programs are currently under-funded, unintegrated, and inadequately enforced. We have identified actions to better integrate regulatory programs and better enforce existing statutes. At the same time, many potential mechanisms for pollution control remain unexplored. After evaluating proposals for new strategic approaches to pollution control, we have identified policy initiatives that focus on pollution prevention at its source. Pollution prevention will be encouraged by implementation of incentives and enforcement of toxics regulatory requirements. One of the priorities of this program is identifying non-regulatory approaches to assist public and private sector dischargers in addressing their needs at the source.

Both scientific and strategic considerations are needed to solve pollutant issues in the Estuary. Monitoring provides the scientific evidence of pollutant impacts required by decision-makers as they shape regulatory actions. A better long-term, iterative approach to addressing the problems related to pollutants in the Estuary must be established.

Finally, an integrated management approach should be adopted to attain and maintain water quality sufficient to ensure that estuarine species and human health are fully protected from pollutants and anthropogenic toxicity that threatens estuarine populations, habitats, and food supplies. This action plan proposes a three-tiered program for addressing pollution that emphasizes pollution prevention, provides for control of pollutants that cannot be avoided, and finally recommends remediation of existing contamination. A management strategy, which advocates addressing issues comprehensively by watershed, is included within each of the programmatic tiers. This action plan identifies needs for individual watersheds as well as the Estuary as a whole. Watershed management is a planning tool which complements, but does not supersede, existing regulatory programs.

Pollution Prevention and Reduction Actions

A. Pollution Prevention

Objective PO-1
Reduce pollutants entering into the Estuary by establishing a pollution prevention program.

ACTION PO-1.1

Establish specific goals for reducing the discharge of toxic pollution over time and discourage reliance on toxic materials. All dischargers should implement measures to reduce pollutants at their source.

Who: California Legislature, U.S. Congress, California EPA, California Department of Food and Agriculture, California Department of Fish and Game, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, U.S. Soil Conservation Service, and the private sector

What: Building upon the pollution prevention audits required under the 1991 Senate Bill 14, which focuses on hazardous waste and right-to-know reports, pollution prevention should be a primary element in all watershed management plans and regulatory actions. All dischargers should participate in a pollution prevention program, and Publicly Owned Treatment Works should require industrial, commercial, and residential sources connected to their systems to implement pollution prevention measures. Pollution prevention measures should be incorporated into all levels of government planning and enforcement programs. An active public outreach program is also fundamental to a successful pollution prevention program.

A comprehensive pollution prevention program should include the following strategies, where practicable:

1. Redesign or reformulation of products;
2. Substitution of raw materials or alternative chemicals that introduce smaller quantities of hazardous substances into agricultural and industrial production processes;
3. Improved process technology and equipment to alter the primary source of waste generation;



4. Improved plant operations (housekeeping); and
5. Recycling of polluted substances at the site of their generation (closed loop recycling).

Pollution prevention programs should include a comprehensive toxic reduction program, with defined goals for reducing the loading of toxic pollutants over time, identification of areas where pollution prevention techniques should be implemented, and monitoring and reporting of success in meeting these goals.

When: 1993

Cost: \$2,700,000 estimated total (\$300,000 federal and \$2.4 million state)

ACTION PO-1.2

Recommend institutional and financial changes needed to place more focus on pollution prevention.

Who: California Legislature, regulatory agencies, and local agencies

What: Economic incentives should be created to discourage reliance on toxic materials and reduce the discharge of toxic pollutants over time. Resources are needed to fund urban runoff control, pretreatment, and waste minimization programs that are currently being started by federal regulations, state requirements, and local government initiatives. Revenue enhancement measures, in the form of additional fees and direct cost measures, could provide local agencies with needed resources to adequately implement these programs.

The following economic incentives to encourage pollution prevention should be evaluated:

1. Deposit/rebate systems (to encourage recycling of hazardous consumer products that might otherwise be released to the environment); and
2. Effluent taxes based on mass loading to stimulate waste minimization by dischargers.

Economic measures for agricultural discharges should incorporate incentives in water pricing to reduce sediment loading and improve water quality. Provisions of the Food Security Act and the Agricultural Credit Act should be used more aggressively to conserve soils on erosion-prone lands. Voluntary retirement of marginal agricultural lands that currently yield a high discharge of toxic elements, such as selenium, should be encouraged through public/private joint ventures.

When: 1993

Cost: \$60,000 estimated total (\$60,000 federal)

ACTION PO-1.3

Develop environmental audit procedures for all significant users and/or producers of toxic substances.

Who: California EPA, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, and Central Valley Regional Water Quality Control Board

What: California EPA should develop uniform requirements for environmental audits for industrial use of toxics and discharge. The need for legislation to legally mandate pollution prevention audits should be evaluated. Audits could be conducted by the user or discharger. Information collected under this program should be used to encourage corporate management accountability, as well as to provide regulatory agencies with data needed to conduct mass balance analyses of toxics use and wasteload allocations within the Estuary. The program should include a mandatory annual reporting of pollution prevention activities.

The Central Valley and San Francisco Bay Regional Water Quality Control Boards should make pollution prevention audits mandatory for all industrial facilities that discharge significant toxic pollutants into the Estuary. The audits should be mandated in National Pollutant Discharge Elimination System (NPDES) permits and POTW pretreatment programs.

When: 1993

Cost: \$4 million estimated total (\$4 million state)

ACTION PO-1.4

Improve agricultural practices that reduce introduction of pollutants into the Estuary.

Who: Department of Water Resources (DWR) and water districts, landowners, Soil Conservation Service, and the State Legislature as needed

What: DWR and the water districts should coordinate efforts to improve agricultural practices that contribute to the introduction of pollutants into the Estuary. Using best available information, Best Management Practices (BMPs) and water management plans should be developed and implemented.

Agricultural practices should be developed and implemented to encourage efficient water use to reduce pollutants entering the estuarine system.

When: As soon as possible

Cost: \$19,060,000 estimated total (\$9,060,000 federal and \$10 million state)

ACTION PO-1.5

Reinforce existing programs and develop new incentives where necessary to reduce selenium levels in agricultural drainage.

Who: Department of Water Resources, water districts, Bureau of Reclamation (210 Authority), Soil Conservation Service, U.S. EPA (319 program), and the Regional Water Quality Control Boards

What: A strategy based upon existing programs and new incentives should be implemented to reduce selenium levels in agricultural drainage. Components include evaluation of attainment of selenium standards through non-structural methods and on-farm practices before use of drain extensions, use of waste discharge permits by the Regional Boards where cooperative methods are ineffective, and low-cost loans. The San Joaquin Valley Drainage program should be implemented and supported. Use of incentive programs should include awards, developing model programs, educational tools, such as the Agricultural Water Program developed by California Polytechnic University, and recognizing innovative water district programs.

When: As soon as possible

Cost: \$10,560,000 estimated total (\$6,060,000 federal and \$4.5 million state)

**ACTION PO-1.6*****Develop a comprehensive strategy to reduce pesticides coming into the Estuary.***

Who: State Water Resources Control Board, Regional Water Quality Control Boards (RWQCBs), California EPA, Department of Pesticide Regulation (DPR), Department of Fish and Game, U.S. EPA, county commissioners, county agricultural commissioners, and the State Legislature

What: Before a new pesticide is registered for use in risk situations (e.g., rice cultivation), pesticide registrants should demonstrate to the DPR and RWQCBs that use of the pesticide will not result in discharges to surface waters that violate Basin Plan objectives.

Water Quality Control Plans should contain numerical objectives for all pesticides detected in the Estuary. Biototoxicity monitoring should continue to be used or supervised by the RWQCBs, DPR, or other state agencies to ensure the data are reliable. When control programs are required to prevent pesticide discharges from exceeding water quality standards, the costs for the development of the control program and the monitoring needed to verify that the control program is effective should be borne directly or indirectly by the user and manufacturer of the pesticide. Costs of the monitoring should be borne by pesticide manufacturers and users through funds from a mill tax on pesticide sales. Legislation should be enacted to provide adequate funds to supplement the mill tax where necessary.

Biototoxicity monitoring should continue to be used to identify waters where pesticides and other toxic materials are impacting aquatic life. Water Quality Control Plans should contain numerical objectives for all pesticides in the Estuary. Toxicity identification evaluations can then be used to find the chemicals that are causing adverse impacts.

U.S. EPA should ensure that there is an approved laboratory analysis method for every pesticide and significant breakdown products. The detection level should be below concentrations that may impact beneficial uses.

When a pesticide is detected in waters of the Estuary, the DPR should work with the RWQCBs and other appropriate parties to determine whether water quality objectives are violated and to develop control measures, if necessary, that will result in compliance with these objectives.

The U.S. EPA should be notified of detection of pesticides in waters of the San Francisco Estuary. The U.S. EPA should then provide technical and monetary support for the development of any necessary control measures and determine whether the local problem should result in a change in pesticide regulation and label directions.

Contamination of surface water as a result of drift from aerial applications should be quantified. Drift in aerial applications that results in violations of the Basin Plan objectives should be mitigated.

Pesticide users should work with the county agricultural commissioners to keep informed on new control measures. Agricultural Extension and other education and outreach programs can be used to show pesticide users best application methods. The DPR should take strong enforcement action against pesticide users who do not comply with label instructions and other use restrictions.

Where control effort is based on voluntary use of specified management practices versus mandatory restrictions, goals and a timetable must be set to gauge progress toward compliance. Failure to meet the goals on time should result in a regulatory-based program.

When: As soon as possible

Cost: \$46,920,000 estimated total (\$14,420,000 federal and \$32.5 million state)

B. Pollution Control and Reduction**Objective PO-2*****Improve regulatory systems for point and nonpoint source pollution control.*****ACTION PO-2.1**

Pursue a mass emissions strategy to reduce pollutant discharges into the Estuary from point and nonpoint sources and to address the accumulation of pollutants in estuarine organisms and sediments.

Who: San Francisco Bay Regional Water Quality Control Board and Central Valley Regional Water Quality Control Board, U.S. EPA, State Water Resources Control Board, and local pollution control authorities

What: A mass emissions strategy should be developed that includes the following elements, where appropriate:

1. The RWQCBs should implement waste load allocation projects for all water bodies in the Estuary that do not meet water quality standards for pollutants.
2. Pretreatment programs should be expanded to control persistent, accumulative pollutants and to include mass limits.
3. The RWQCBs should impose numerical effluent limitations, toxicity control requirements for point sources, BMPs for nonpoint sources, and other regulatory and enforcement mechanisms to assure compliance with adopted standards.
4. Evaluate marketable discharge permits to ensure that the capacity of the ecosystem to accept pollutants is not exceeded.

When: As soon as possible

Cost: \$8,260,000 estimated total (\$60,000 federal and \$8.2 million state)

ACTION PO-2.2

Adopt water quality objectives that effectively protect estuarine species and human health.

Who: State Water Resources Control Board, San Francisco Bay and Central Valley Regional Water Quality Control Boards (RWQCBs), Department of Health Services, and California EPA

What: The State Board and the Regional Water Quality Control Boards should, to the extent provided by law, revise their Water Quality Control Plans so that water quality objectives protect the most sensitive species in the Estuary. Objectives should be developed for all pollutants of concern that are discharged into the Estuary, taking into account data regarding species sensitivity and, where this sensitivity is unknown, use an appropriate safety factor in the standards to account for this uncertainty. In the long term, toxicity test information and additional research should be performed in order to determine overall species sensitivity.

The RWQCBs should take into account the proportion of receiving water species and conditions that have been tested, known or suspected interactions between pollutants, other sources of stress to receiving water populations, natural variability, and other relevant factors. The RWQCBs should also perform a hazard assessment of affected receiving waters and species.



Water quality objectives for appropriate water body segments for copper, selenium, mercury, and others should be developed and adopted to address bioaccumulation effects and protect aquatic life. Objectives should be developed to protect against potential adverse effects due to accumulation through the food chain.

Chemical-specific or toxicity-based sediment quality objectives that are protective of aquatic life for the Bay and Delta should be developed and adopted. Tissue levels that protect human health and predator species against adverse effects from contaminated fish or shellfish should be adopted.

When: Immediately through 1994

Cost: \$2,412,000 estimated total (\$2,412,000 state)

ACTION PO-2.3

Identify and control sources and sinks of selenium and mercury where they are accumulating in aquatic populations in the Estuary.

Who: State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, and the Soil Conservation Service (with assistance from California Department of Fish and Game)

What: Sources of mercury into the Estuary need to be identified and controlled. Loading of selenium from petroleum refineries, agriculture, sewage treatment, and other identified sources discharging to the Estuary must also be reduced. The State and/or Regional Boards should fund and/or carry out necessary investigations to identify the source(s) of selenium (e.g., oil refineries, agricultural return flows, etc.) and implement necessary regulations to control its discharge. Source loads and areas of accumulation should also be identified.

Based upon results obtained in monitoring bioaccumulation of selenium, discharge permits for petroleum refineries and other significant dischargers need to include mass emission limitations for selenium. The control strategy should include management practices and waste discharge requirements as necessary to limit selenium in agricultural subsurface drainage to reduce selenium loadings to the Delta and attain water quality objectives for selenium in the San Joaquin River.

When: 1992-1997; control measures: 1997-2002

Cost: \$21,400,000 estimated total (\$8.4 million federal and \$13 million state)

ACTION PO-2.4

Improve the management and control of urban runoff from public and private sources.

Who: San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, and local agencies

What: A comprehensive urban runoff management program should include the following elements, which emulate the current baseline NPDES program:

1. Baseline control programs with a focus on prevention in all watersheds;
2. Comprehensive control programs with a focus on prevention and remediation beginning with selected municipalities in urban watersheds;

3. Industrial activity control programs;

4. New development construction;

ACTION PO-2.6

Improve the management and control of agricultural sources of toxic substances.

Who: California EPA, Department of Food and Agriculture, Department of Fish and Game, State Water Resources Control Board, Central Valley Regional Water Quality Control Board, U.S. Soil Conservation Service

What: The State and Regional Boards should utilize existing nonpoint programs in developing and implementing Best Management Practices (BMPs). Specifically, better management of agricultural uses of pesticides (herbicides, fungicides, etc.) is needed to reduce concentrations of these pollutants to below toxic levels in receiving waters. Periodic reviews for the effectiveness of this program should be conducted. Where water quality objectives are not met through BMPs, the RWQCB should consider waste discharge requirements when there is evidence that agricultural drainage is limiting the defined beneficial uses of any body of water.

The California Inland Surface Water Plan and other appropriate policies and laws should be implemented and strengthened where needed to reduce pesticides in the environment.

The Regional Board and water districts should encourage the establishment of legally responsible drainage entities. Farmers could be organized into groups to facilitate water quality monitoring and develop BMP plans to be submitted to the Regional Board for review and approval. These plans could be used to prioritize efforts based upon known or suspected water quality problems and their solutions.

The State and Regional Boards should develop an enforceable instream toxicity program. Elements of this program would include:

1. Continued and expanded ambient biotoxicity monitoring efforts;
2. Relating biotoxicity monitoring to biomonitoring and chemical data; and
3. Development of compliance points for measuring chronic toxicity.

When: Immediately

Cost: \$44,120,000 estimated total (\$28,120,000 federal and \$16 million state)

ACTION PO-2.7

Reduce toxic loadings from mines.

Who: U.S. EPA, California EPA, Department of Health Services, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, California Legislature

What: Require the development and implementation of control measures to reduce the discharge of metals associated with sediments, acid mine drainage, or process wastes and require effective closure of inactive mines. The implementation of a program should include measures prioritized by loadings to particular watersheds. Responsible parties and potential sources of funding should be identified. State and federal Superfund programs should give high priorities to these remediation projects to rapidly correct water quality problems as well as human health problems from abandoned mines.

Regional Boards should use state Clean-Up and Abatement Act funds to correct abandoned mine pollutant discharge. It is needed to limit or exempt the Regional Boards and their members from liability for mine clean-up by the NPDES Stormwater permits.

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When: 1994

Cost: \$8,600,000 estimated total (\$2.6 million federal and \$6 million state)

ACTION PO-2.8

Establish a model environmental compliance program at federal facilities within the jurisdiction of the Estuary Project.

Who: Department of Defense, Department of Energy, U.S. EPA, State of California, Department of the Interior, Department of Agriculture, and other active facilities

What: The Department of Defense, Department of Energy, U.S. EPA, and the Estuary Project should establish a Memorandum of Understanding (MOU) to create a model federal facilities program within the boundaries of the Estuary Project. The MOU would comprehensively address issues affecting environmental quality of the Bay-Delta. Elements to be included in the MOU are:

1. Pollution prevention, including review and revision of contract specifications to allow use of nontoxic or less toxic substitutes by contractors;
2. Improved compliance with environmental regulations;
3. Stormwater and collection systems;
4. Expedited remediation of sites affecting the Bay-Delta; and
5. Restoration/creation of wildlife habitat on unoccupied federal land and adequate funds to implement action.

When: As soon as possible

Cost: \$13,440,000 estimated total (\$13,440,000 federal)

Objective PO-3

Remediate pollution threats to public health and wildlife in the Estuary.

ACTION PO-3.1

Clean up contaminants presently affecting fish, wildlife, their habitats, and food supplies.

Who: U.S. EPA, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, Department of Fish and Game, and U.S. Fish and Wildlife Service

What: A comprehensive watershed analysis should be undertaken to evaluate, identify, and reduce toxicity in problem areas. Where toxic agents and sources are known, the resources agencies should immediately seek damages to effect the clean up or remediation of contaminants affecting public trust resources. Immediate emphasis should be placed on clean up of mercury affecting the California clapper rail. Special attention must also be given to selenium and TBT.

Concern has been raised about the impacts from dredging activities on aquatic organisms and water quality. Dredged material can disturb or bury benthic organisms, such as clams, worms, or crabs, as well as affect fishing success by increasing suspended sediments at the disposal site. Impacts can also occur beyond the disposal site when currents carry dredged material and associated contaminants to other parts of the Estuary. Organisms can also be impacted by contaminants that are redistributed into the water column during disposal of material.

Because of these impacts, new disposal alternatives must be found that maintain vital shipping and boating activities while also protecting the Estuary's resources. Each disposal option—in-bay, ocean, and upland—poses its own set of economic and environmental problems that must be resolved.

Waterway Modification

The physical character of the San Francisco Estuary has been drastically altered by human activities. Modification began with hydraulic gold mining in the 1800s, which brought huge quantities of sediment into the Estuary. This additional sediment blocked waterways, causing flooding during heavy rainfall. Since that time, channelization, dredging, and shoreline riprapping, coupled with urban development and construction of flood control projects, have eliminated or degraded wetland and riparian wildlife habitats. Spawning areas for anadromous fish and habitat for both migrating waterfowl and resident wildlife have also been adversely impacted.

Most of the Estuary's historical tidal marshes have been diked or filled and are now used for agriculture, duck clubs, salt ponds, and urban development. These activities have reduced the tidally influenced area by 60 percent and caused most of the remaining major slough channels to silt up. Channelization of streambeds and diking of flood plains have increased seasonal storm flows and changed sediment movement and distribution in the estuarine system. Upland development has contributed to the volume of sediment entering the system and increased the production of pollutants that adhere to the sediments.

A future rise in sea level as a result of global warming could cause increased coastal flooding and erosion. Delta islands would be especially vulnerable to catastrophic flooding because of land subsidence and the risk of levee failure.

Existing Regulatory Structure

The U.S. Army Corps of Engineers (the Corps) has primary responsibility for maintaining navigable waters in the United States. The Corps' review of proposed dredging activities considers impacts of proposed activities on navigation, fish and wildlife, conservation, pollution, aesthetics, and the general public interest. The National Environmental Policy Act (NEPA) of 1969 requires environmental assessment of each permit application and the preparation of an environmental impact statement where the assessment indicates significant environmental impacts. In 1972, Section 404 of the Clean Water Act and Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) gave the Corps the primary authority to regulate dredging and disposal activities, authority to issue permits for discharge of dredged material into inland and near-coastal waters of the United States, and permitting authority over the transportation of dredged material for dumping into coastal waters and open ocean.

The Clean Water Act and the MPRSA also assign the U.S. Environmental Protection Agency (U.S. EPA) a major role in the management of dredged material. Section 102 of the MPRSA grants U.S. EPA authority to designate ocean disposal sites and cooperate with the Corps in the development of criteria for evaluation of environmental impacts of proposed disposal activities.

Section 404 requires U.S. EPA to perform similar functions in regulation of dredging activities in estuaries and other inland waters. U.S. EPA, in cooperation with the Corps, has developed guidelines for evaluation of environmental impacts of dredged material discharges and responsibility of reviewing permit applications and providing comments to the Corps.

The State Water Resources Control Board (SWRCB) and its nine Regional Water Quality Control Boards regulate water quality in California. Activities affecting water quality are evaluated by the State and Regional Boards. As part of the environmental review specified by the Clean Water Act, Section 401 requires state water quality agencies to verify that a dredged material discharge will not violate water quality standards.

The state McAteer-Petris Act (1965) created the San Francisco Bay Conservation and Development Commission (BCDC) and gave it permitting authority for dredging and filling activities in San Francisco Bay. BCDC reviews proposed activities to ensure compliance with the Bay Plan.

The State Lands Commission (SLC) administers public trust lands in coastal waters (within a three-mile state territorial limit) and other tidal and submerged areas. Written authorization from SLC must be obtained prior to dredging or depositing dredged material on lands under SLC jurisdiction.

Various government agencies are involved in the review of dredging applications and provide comments to the Corps. Some agencies providing comments to the Corps include the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the U.S. Coast Guard, the California Department of Fish and Game, and the California Coastal Commission. Local government agencies have jurisdiction over some types of dredged material disposal activities.

Recommended Approach

A new cooperative effort by state and federal agencies, ports, environmental and fishing groups, and others was recently launched to develop a Long-Term Management Strategy (LTMS) for dredging. The LTMS Project was created in January of 1990 as a multi-participant regional effort to provide a mechanism to build consensus and to support cost-sharing demands. It involves over thirty different participants, including government agencies, environmental organizations, development interests, ports, and fishing organizations. The LTMS Project is led by an Executive Committee of the Corps of Engineers' South Pacific Division Commander, the Environmental Protection Agency's Regional Administrator, the Chairs of the San Francisco Bay Regional Water Quality Control Board and the San Francisco Bay Conservation and Development Commission, and a State Coordinator. This group is regularly advised on pertinent issues by the Policy Review Committee.

The LTMS is designed to develop technically feasible, economically prudent, and environmentally acceptable long-term solutions over the next fifty years. Ocean, in-bay, and upland disposal sites will be evaluated, as well as the potential for using clean dredged materials to create wetlands or restore levees.

Capitalizing on the valuable work of the LTMS Project, most of the dredging activities recommended in this program are drawn from its workplan. In addition, activities to specifically address waterway modification were developed. These include shoreline protection and acquisition of buffer areas. This program is intended to comprehensively address both dredging and waterway modification actions.

Dredging and Waterway Modification Actions

Objective DW-1

Determine the behavior and fate of sediments in the Estuary and adopt policies to manage their modifications.

ACTION DW-1.1

Conduct studies, research, and models of sediment dynamics.

Who: LTMS Project

What: To better understand the behavior and fate of sediments in the Estuary, the following activities have been developed in the LTMS proposed workplan:

- Identify and summarize quantitative models available for application in the Estuary and the current status and variety of existing numerical modeling. As necessary, conduct tracer studies to define the short- and long-term transport of suspended particles from estuarine disposal sites. (LTMS Phase II, Task 3, Work Element F)
- Conduct an annual sediment budget for the period 1956 to 1990 and project next fifty years. Calculate the distribution of in-bay deposits and loss to the ocean by difference between input and net accumulation. Obtain annual maintenance dredging volumes to relate annual sediment supply to maintenance requirements. (LTMS Phase II, Task 3, Work Element F)
- Conduct field and laboratory studies to characterize suspended and deposited sediment. Complete detailed hydrographic surveys of navigation and disposal areas for verification of sediment transport models. (LTMS Phase II, Task 3, Work Element F)
- Measure sediment afflux and influx through the Golden Gate over tidal cycle to determine suspended sediment losses. (LTMS Phase II, Task 3, Work Element F)
- Develop three-dimensional sediment transport models that could be incorporated into existing two-dimensional models. (LTMS Phase II, Task 3, Work Element F)

When: Initiated in July of 1991, with activities to be completed by December, 1993

Cost: Approximately \$780,000

ACTION DW-1.2

Conduct studies on sediment changes aimed to define accumulation and erosion processes in marsh and mudflat areas.

Who: U.S. Geological Survey (lead), NOAA, and Regional Water Quality Control Boards

What: Through the National Coastal Plan program, study estuarine sediment dynamics with particular focus on processes acting in near-shore areas. Identify trends in accumulation and erosion sediment and what management practices may be responsible for those trends. Integrate this effort with the LTMS and other sediment research efforts and watershed plans being developed by the RWQCBs.

When: Begin in 1993

Cost: Approximately \$2,225,000

ACTION DW-1.3

Adopt policies to manage modification of estuarine sediment production, movement, and deposition.

Who: Lead and responsible agencies under CEQA and NEPA (i.e., U.S. Army Corps of Engineers, Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, and State Lands Commission)

What: Require applicants for waterway modification projects to avoid or minimize, where appropriate, project impacts on sediment production, movement, and deposition through development of erosion and sediment control plans and Corps of Engineers' Clean Water Act, Section 404 permits.

- ☑ Condition project approvals to avoid adverse impacts to estuarine sediment dynamics.

When: 1994

Cost: No direct costs

Objective DW-2

Determine the bioavailability of contaminants released by disposal of dredged material through methods such as bulk chemistry assays, toxicity bioassays, and bioaccumulation tests.

ACTION DW-2.1

Conduct laboratory and field bioaccumulation investigations and studies on suspended sediment effects on sensitive life stages throughout the food chain.

Who: LTMS Project

What:

- ☑ Prepare a detailed bioaccumulation study plan and conduct field investigations to produce a baseline bioaccumulation survey with conclusions about the levels of aquatic species contamination related to deposited and suspended sediment conditions. (LTMS Phase II, Task 3, Work Element G)
- ☑ Conduct tests with pelagic eggs of fish species representative of those that spawn in San Francisco Bay. Eggs/embryos/larvae of other species representative of species that spawn in the Estuary might also be considered.
- ☑ Document the distribution of suspended sediment in time and space from individual and multiple disposal activities in relation to long-term background concentrations of suspended sediments in the Central Bay. Hydraulically dredged sediment from hopper dredges and mechanically dredged sediment from barges will be monitored. All the data will be evaluated from a mass balance approach to assess the distribution of disposal-related suspended sediments and the role of disposal operations in the suspended sediment in the Central Bay. (LTMS Phase II, Task 3, Work Element G)

When: December, 1993

Cost: Approximately \$250,000

ACTION DW-2.2***Develop and set sediment quality objectives.***

Who: State Water Resources Control Board and Regional Water Quality Control Boards

What: Develop a more objective method by which the results of sediment testing may be evaluated. Establish criteria that quantitatively define when test results are considered to be significant in predicting an adverse environmental effect. Establish numerical limits for pollutant levels in material proposed for dredging.

When: Initiated in July of 1991, scheduled to be completed by 1997

Cost: \$2,605,000 estimated total (\$105,000 federal and \$2.5 million state)

Objective DW-3

Develop a comprehensive regional strategy to better manage dredging and waterway modification and ancillary activities.

ACTION DW-3.1***Develop a dredge project needs assessment and, as necessary, a prioritization plan, including structural and nonstructural methods to minimize volume requirements.***

Who: LTMS Project

What:

- Compile long-term dredging volume estimates for all federal projects, public and private ports, marinas, and harbors. Prioritize the disposal needs of each individual dredging project. (\$25,000)
- Identify alternative dredging practices and general design considerations for new projects and recommend modifications for existing projects to reduce dredged material volumes. Require implementation of the dredging design modifications for all applicable projects through the Clean Water Act Section 404 permitting process. (LTMS Phase II, Task 3, Work Element C) (\$22,000)

When: June, 1992, through January, 1993

Cost: \$47,000

ACTION DW-3.2***Identify dredged material reuse and non-aquatic disposal opportunities and constraints.***

Who: LTMS Project

What:

- Complete a comprehensive inventory of geographic sites that are suitable for reuse and/or disposal alternatives. Include preliminary cost estimates for the range of sites, review existing state or federal bonds available for restoration projects, and identify monetary benefits and intrinsic value to the public of created habitats. Working with local agencies, constraints on potential reuse sites such as laws, regulations, agency policies, engineering impediments, and environmental considerations, including contaminants, wetland impacts, endangered species, etc., will be evaluated. (LTMS Phase II, Task 2, Work Element B) (\$200,000)

- Document procedures necessary to evaluate acceptable material type, consistency, and contaminant levels for reuse projects; coordinate with regulatory and resource agencies to share information and achieve agreement(s). Estimate amount of material not acceptable for aquatic and unmanaged or unconstrained non-aquatic disposal. Identify potential benefits and impacts resulting from disposal on terrestrial, wetland, and aquatic ecosystems. Plan and conduct field/laboratory experiments/demonstrations as needed to determine effectiveness and feasibility of dredged material reuse techniques. (LTMS Phase II, Task 3, Work Element D) (\$790,000)
- Develop site-specific conceptual reuse/non-aquatic disposal plans. Provide preliminary engineering, with cost estimates, for site improvements, unloading facilities, transportation improvements, site preparation, and maintenance. Develop "value-added" guidelines to determine intrinsic value to the public for restored or created wetlands. Develop "capitalization" programs for dredge material reuse projects, such as federal or state bonds to pay for reuse projects. (LTMS Phase II, Task 3, Work Element E) (\$500,000)
- The United States Congress should authorize and appropriate funding for the U.S. Army Corps of Engineers to purchase and implement upland disposal and reuse sites within the Estuary including Sonoma Baylands Project. In addition, incentives should be developed for private disposal and wetland restoration opportunities.

When: January, 1991, to January, 1994

Cost: Approximately \$1,640,000

ACTION DW-3.3

Develop regulatory land use procedures to promote reuse of dredged material, wetlands restoration and/or creation, and other beneficial uses.

Who: LTMS Project, local land use agencies, and regulatory agencies

What: Evaluate state, regional, and local land use agencies' long-term plans with respect to promoting the beneficial reuse of dredged material for projects such as wetlands restoration/creation. Make recommendations to local land use agencies for procedures to promote the beneficial reuse of dredged material. Follow up with active effort to obtain adoption of recommended procedures by local agencies.

When: July, 1994

Cost: Approximately \$50,000

ACTION DW-3.4

Identify the aquatic and terrestrial resources that are affected by dredging and disposal and are to be protected in the Bay and Delta.

Who: LTMS Project

What: Establish and document existing resources and beneficial uses to be protected. Document health and distribution of resources to be protected. Conduct a two-day intensive workshop on the impacts to resources and beneficial uses caused by dredging. Document effects of dredged material disposal on resources of concern. (LTMS Phase II, Task 2, Work Element A) (\$50,000)

When: January, 1992

Cost: \$50,000

ACTION DW-3.5

Designate dredged material reference sites for use in development of sediment testing protocols.

Who: LTMS Project

What: Determine background concentrations of sediment parameters in the Estuary. Compare sediments of proposed dredging projects to reference sites rather than to proposed disposal sites, in order to assess potential impacts of disposal. (\$20,000)

When: December, 1992

Cost: \$20,000

ACTION DW-3.6

Evaluate retention and removal needs for derelict structures in the Bay and Delta.

Who: U.S. Army Corps of Engineers

What: Various derelict structures along the shoreline are affecting sediment transport and local navigation. A comprehensive inventory should be completed to assess the feasibility of removing these structures on a case-by-case basis.

When: December, 1994

Cost: Approximately \$75,000

ACTION DW-3.7

Adopt regulatory and management policies for Estuary dredging activities and develop dredging and disposal projects that are consistent with the state's existing policies in the San Francisco Bay Plan and in the San Francisco Bay and Central Valley Basin Plans.

Who: Estuary regulatory, planning, and resource agencies and dredging project sponsors

What: Local, state, and federal agencies should modify their policies regarding dredging activities as needed to ensure that they are consistent with the policies of the San Francisco Bay Conservation and Development Commission's San Francisco Bay Plan and the respective Basin Plans of the San Francisco Bay and Central Valley Regional Boards. Ports and other dredging sponsors should plan and conduct dredging activities consistent with the state's dredging policies.

When: Immediately

Cost: No direct cost

Objective DW-4

Encourage the reuse of dredged material for projects such as wetlands creation/restoration, levee restoration, landfill cover, and upland building material where environmentally acceptable.

ACTION DW-4.1

Identify dredged material disposal options, including cost estimates and alternative disposal methods. Conduct periodic review as necessary.

Who: LTMS Project

What:

- ❑ List all available disposal options (See Appendix A for *Status and Trends Report on Dredging and Waterway Modification*) and document studies performed to date that are specific to each option and the Estuary disposal requirement. Identify disposal options feasible for the Estuary together with potential disposal capacity and document unfeasible options. (LTMS Phase II, Task 1, Work Element A) (\$25,000)
- ❑ Prepare cost estimates to a preliminary level (plus or minus 25 percent) for the dredging/disposal combinations under consideration. Develop a cost-estimating model covering the mobilization, excavation, hauling, disposal, and monitoring costs for the main dredging/disposal techniques under consideration. Develop methods for capitalization of costs considering funding by ports versus other methods, such as federal or state bonds. (LTMS Phase II, Task 3, Work Element B) (\$18,000)
- ❑ Summarize disposal options identified from previous actions. Categorize specific disposal options into management options and develop evaluation criteria. Criteria should consider environmental, engineering/economic, and institutional/regulatory factors. (LTMS Phase II, Task 4, Work Elements A, B) (\$20,000)
- ❑ Select dredged material disposal options. Evaluate alternative dredged material disposal approaches based on engineering, economic, and environmental criteria. Select the most practicable dredged material disposal option or options and provide the necessary documentation needed to support this selection. Develop site-specific management plans for the selected options, including site environmental and capacity monitoring, permit requirements, mitigation plans, operation procedures, guidance for site use, and delineation of site management responsibilities. (LTMS Phase III, Tasks 1, 2, and 3)
- ❑ Develop implementation component for dredged material disposal plan. The implementation plan should include administrative, procedural, management, and monitoring requirements; environmental documentation for the life of the plan; long-term water quality certification, site specific and regional permits and authorization; formalized regional mitigation strategies; and implementation of site management requirements. (LTMS Phase IV)
- ❑ Periodically re-evaluate the selected dredged material disposal plan based on changing regulatory, economic, environmental, and technological conditions. This review is to assure that decision-makers will maintain a viable implementation strategy that reflects changing conditions throughout the fifty-year implementation timeframe. (LTMS Phase V)

When: December, 1992

Cost: Approximately \$500,000

ACTION DW-4.2

Conduct modeling and field studies to determine the saltwater intrusion impacts caused by dredging projects.

Who: U.S. Army Corps of Engineers and project proponents

What: Conduct modeling and field studies to determine the saltwater intrusion impacts caused by dredging projects. Based on the results of the studies, manage dredging projects to minimize the impacts caused by saltwater intrusion.

Require project expansions and future projects to mitigate for saltwater intrusion significant impacts as identified during the NEPA process.

When: December, 1993

Cost: No direct cost

ACTION DW-4.3

Revise Public Notice 87-1, "Interim Testing Procedures for Evaluating Dredged Material Suitability for Disposal in San Francisco Bay," and develop testing procedures and protocols for ocean and upland environments.

Who: U.S. Army Corps of Engineers, U.S. EPA, Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, and State Lands Commission

What: Based on past results of regulating dredging projects through Public Notice 87-1, "Interim Testing Procedures for Evaluating Dredged Material Suitability for Disposal in San Francisco Bay," revise and update Public Notice 87-1 to include sediment quality objectives, designated reference sites, and current sediment testing requirements. Prepare and implement testing procedures and protocols for each ocean disposal (using the U.S. EPA testing manual, *Evaluation of Dredged Material Proposed for Ocean Disposal*, February, 1991, No. 503/8-91/001) and wetland restoration/upland disposal projects.

When: December, 1992

Cost: Approximately \$40,000

Objective DW-5

Identify threats to and benefits for Estuary resources from future modifications to waterways.

ACTION DW-5.1

Determine areas subject to flooding and erosion and identify causes.

Who: The U.S. Geological Survey and local governments for local subsidence, U.S. EPA for global changes

What: Submit a report that identifies areas subject to extreme wave events. Determine relative sea level change by:
1) quantifying local elevation changes along the shoreline; and 2) determining the most supportable estimate for change in global sea level.

When: 1993

Cost: Approximately \$650,000

ACTION DW-5.2

Implement waterway modification policies that protect shoreline areas from detrimental flooding and erosion while maintaining natural resource values.

Who: State agencies, San Francisco Bay Conservation and Development Commission, the Delta Estuarine Agency, and local governments

What: Adopt enforceable policies that require preservation, where possible, of upland areas to build or enlarge protective levees or other flood control structures through local zoning, the U.S. Army Corps of Engineers, the Federal Emergency Management Agency, and the Department of Water Resources.

When: 1993

Cost: \$7,720,000 estimated total (\$7,720,000 state)

ACTION DW-5.3

Establish a program to acquire diked historic baylands listed as buffer areas for coastal flooding and sea level rise. (Cross-referenced to Wetlands Program)

Who: State Legislature, California Coastal Conservancy, land trusts, and State Lands Commission

What: Bond and mitigation funds should be provided to purchase diked baylands that can serve as buffer areas for rising sea level or that could be used to mitigate for erosion of tidal marsh.

When: 1992

Cost: \$7,520,000 estimated total (\$7,520,000 state)

The total estimated cost for the Dredging and Waterway Modification Program is \$24,172,000.

Local government has the primary authority to regulate land use and therefore has the potential to minimize impacts associated with land use change. Current California planning law and guidelines provide a framework that can be used to protect natural resources. However, there is no requirement that ensures that the Estuary, its wetlands, and other associated natural resources be given any special protection.

Existing Management Structure

Local government has the principal authority to regulate land use. Decisions about zoning, building permits, infrastructure financing, housing subdivisions, and related development projects are made by local government.

California law provides the authority for local land use decision making and establishes the framework for those decisions. First, the state constitution protects home rule authority. Second, each city and county must prepare a comprehensive General Plan containing state-specified elements oriented toward meeting local goals and needs. All local ordinances, development plans, and activities are required to be consistent with that Plan. However, local plans are not required to be coordinated with plans for adjacent communities, nor are they required to meet regional or state goals and objectives for Estuary protection. Moreover, there is no consistent forum or standard for review of local plans.

According to a survey conducted as part of the SFEP report, *The Effects of Land Use Change and Intensification on the San Francisco Estuary*, a majority of local governments in the twelve-county planning area have adopted General Plan policies that address wetland or stream environment protection. However, fewer than 15 percent have adopted specific ordinances or other regulations to carry out these policies intended to protect the Estuary. Each of the 111 local governments in the Bay-Delta planning area can, and often does, have differing goals, policies, and regulations concerning use and treatment of the Estuary.

The San Francisco Bay Conservation and Development Commission (BCDC) manages the open waters, tidal marshes, managed wetlands, salt ponds, and narrow shoreline band of the San Francisco Bay segment of the Estuary. However, there is no state-legislated regional comprehensive land use planning and regulatory authority. BCDC, which administers the state's federally approved management program for the San Francisco Bay segment of the California coastal zone and the Estuary, does not have jurisdiction over the diked lands that were historically part of the Bay, nor over the tributary streams that are hydrologically part of the Estuary. Further, there is no state comprehensive planning and regulatory authority over the Delta segment of the Estuary. Although the San Francisco Bay and Central Valley Regional Water Quality Control Boards have regulatory control over discharges to the Estuary, they do not have comprehensive land use planning authority and cannot mandate specific land use development and management practices that would minimize pollutants entering the Estuary.

The U.S. Army Corps of Engineers (the Corps) and the U.S. Environmental Protection Agency (U.S. EPA) have regulatory authority over the open waters and adjacent wetlands (as defined by federal regulations). The Corps can require Best Management Practices (BMPs) as part of its Clean Water Act Section 404 permitting process, which is administered on a project-by-project basis. However, these agencies do not have comprehensive land use planning authority to require specific land use development or management practices that would protect the Estuary.

Recommended Approach

The following actions are designed to improve planning and management of the lands surrounding the San Francisco Bay and Sacramento-San Joaquin Delta to protect and enhance the health of the Estuary. The actions recognize the importance of integrating management of the Estuary with the existing functions of state, regional, and local governments. Furthermore, these actions reflect a need to protect and enhance the Estuary while striving to ensure a sustainable economy.



First, actions are identified that would use existing mechanisms to improve the way that state government plans for and manages the resources of the Estuary. These include amendments to state laws and policies and integration of estuarine planning with major initiatives such as growth management and regional biodiversity. Second, actions are identified that would improve the efficiency and effectiveness of land use decision making through improved regional integration. These include using existing regional entities (or if established, new regional entities, such as the Delta Commission), encouraging growth in appropriate areas, and researching future population change. Third, actions are identified to undertake watershed planning to implement land use practices that are geographically targeted, locally tailored, and cost effective. Fourth, actions are identified to improve land use practices through education. In addition, actions are recommended to provide local government with adequate financial support for implementation and to establish economic incentives for resource protection.

Land Use Actions

[Many of the actions identified below will require additional financial resources and technical assistance that must be provided to local governments to enable effective implementation. Actions identified under Objective LU-5 specifically address the provision of financial resources to local government. Also refer to "Chapter 4: Implementation" for further detail regarding financing actions.]

Objective LU-1

Use existing institutional capacity to improve planning, regulatory, and development programs of local, regional, and state agencies to protect the resources of the Estuary, in concert with a sustainable economy.

ACTION LU-1.1

Local General Plans should incorporate watershed protection plans to protect wetlands and stream environments and reduce pollutants in runoff.

Who: Office of Planning and Research and local governments

What: Local governments should more fully integrate Watershed Protection Plans and Stormwater Management Plans into local General Plans to protect wetlands and stream environments and reduce pollutants in runoff. To facilitate this integration in a uniform and consistent manner, state General Plan Guidelines should be strengthened to more clearly define the requirements regarding the Conservation Element, or other related elements, such as Open Space, of the General Plan for the protection of watersheds (including wetlands, stream environments, and pollutants in runoff). The Watershed Protection Plans would be developed as specified in Actions LU-3.1 and 3.2.

As part of these improved General Plan Elements and in cooperation with Watershed Management Plans and Stormwater Management Plans, local governments should: 1) identify wetland and riparian resource areas; 2) establish policies to protect and enhance these resources in General Plans, community plans, and specific plans; and 3) establish policies for reducing pollutants in runoff. Local governments should enact specific ordinances to implement these policies. These programs shall be consistent with other actions contained in the CCMP, including, but not limited to, Action WT-2.1.3(D) (Develop and Implement Local Government Wetland Protection Programs).

When: 1997

Cost: \$22,320,000 estimated total (\$22,320,000 state)

ACTION LU-1.2

Amend the California Environmental Quality Act Guidelines to add simple and concise criteria for assessing the cumulative environmental impacts on the Estuary when adopting or reviewing General Plans.

Who: California Office of Planning and Research, Councils of Governments, and Regional Water Quality Control Boards

What: Amend California Environmental Quality Act (CEQA) Guidelines to define major cumulative impacts and set forth concise criteria for evaluating these classes of impacts, including data to be collected and analyzed. The criteria should address potential impacts to wetlands, streams, and water quality. These Guidelines should apply at the General Plan level in portions of the Estuary planning area where watershed protection plans have not been prepared and certified (as specified in LU-3.1 and 4.3, Watershed Management Plans will include cumulative impact assessment). This is intended to provide an incentive for preparation of Watershed Management Plans.

When: 1993

Cost: \$200,000 estimated total (\$200,000 state)

ACTION LU-1.3

Integrate protection of the Estuary with other state land use-related initiatives.

Who: Resources Agency and California Office of Planning and Research

What: The state should assign staff to integrate significant parallel initiatives, such as growth management, housing needs, and regional biodiversity, with efforts to protect the resources of the Estuary. New institutional arrangements or legislation should incorporate estuarine protection objectives.

Identify how state programs are being used to implement the CCMP land use actions. This should include the study of overlapping jurisdictions sponsored by the State Office of Planning and Research and California EPA's initiative to identify how the development permit process can be streamlined to ensure that existing programs and institutional arrangements are used whenever possible to implement the land use actions. Recommend appropriate programs to address gaps identified in these surveys.

When: 1993-1994

Cost: No direct cost

Objective LU-2

Coordinate and improve integrated, regional management for land use, transportation, housing, and physical infrastructure, to both protect the Estuary and provide for a sustainable economy.

ACTION LU-2.1

Regional agencies should assist in identifying and developing consistent policies that provide an integrated framework for local governments to protect the resources of the Estuary.



Who: Councils of Governments, Regional Water Quality Control Boards (RWQCBs), San Francisco Bay Conservation and Development Commission (BCDC), and potential new regional entities

What: In coordination with local governments, regional agencies, such as the Councils of Governments, the RWQCBs, and BCDC, should establish policies that coordinate land use and transportation patterns and processes. Such coordination should promote restoration and preservation of the Estuary and its natural resources, in concert with a sustainable economy.

The regional agencies should establish a consistent framework for local governments to protect: 1) watersheds; 2) stream environments; and 3) wetlands through coordination with local governments, which will be responsible for preparation of plans and implementing ordinances that carry out the policies. The policies, plans, and ordinances prepared by local governments shall be reviewed by the appropriate state or regional agency. This review would also ensure consistency with federal mandates, such as the 1990 amendments to the Coastal Zone Management Act, which address nonpoint source pollution.

If legislation is enacted to establish new regional agencies, such as the proposed Delta Commission and the proposed Bay Area Regional Commission, the resulting regional policies and plans should be consistent with actions contained within the CCMP. Local governments should make their land use plans and regulations consistent with the regional plans through a cross-acceptance process jointly administered by regional commissions and local governments.

When: 1993-1994

Cost: \$200,000 estimated total (\$200,000 state)

ACTION LU-2.2

Adopt policies and plans to promote compact, contiguous development, in both the nine-county Bay Area and the three-county Delta region.

Who: Councils of Governments, local governments, California Department of Transportation, Metropolitan Transportation Commission, and potential new regional entities

What: Adopt policies that encourage economic development within existing incorporated city limits or existing urban service areas in a manner consistent with protection of the Estuary. Investigate options for accomplishing compact, contiguous development, such as the establishment of clear urban growth boundaries in portions of the nine-county Bay Area and the three-county Delta region. Urban growth boundaries would be intended to create added certainty for communities, landowners, government agencies, and developers, and to provide clearer protection for natural resources than existing state guidelines for the identification of urban sphere-of-influence lines.

Additional options to be investigated for accomplishing compact, contiguous development may include, but are not limited to, tax and zoning incentives, resource protection zones, and infrastructure investment strategies.

As policies and plans are prepared that address land use, population growth, air quality, and transportation, they should be designed to achieve compact, contiguous development. Urban growth should be directed away from resource protection areas, such as wetlands, stream environment zones, and wildlife corridors. Urban growth areas should be identified, and new development encouraged in these areas.

When: 1993-1994

Cost: \$7,520,000 estimated total (\$7,520,000 state)

ACTION LU-2.3

Compile and analyze data pertaining to future population and land use change in the nine-county Bay Area and the three-county Delta region to provide information for improved decision making.

Who: Councils of Governments, Resources Agency, Office of Planning and Research, California Department of Transportation, Metropolitan Transportation Commission, and universities

What: Create a decision-making tool to help achieve future land use patterns that integrate protection and restoration of estuarine resources, a sustainable economy, and human resource development. This would provide information to local, state, and federal agencies and other stakeholders to help make decisions concerning the implementation of appropriate measures to protect and enhance estuarine resources.

Analysis should reflect consideration of the planning area's present and future population, including housing needs, employment skill availability, and job sector needs. The analysis should be conducted for a consistent time horizon (e.g., ten years) and should evaluate the potential impacts of population and land use change on protection and restoration of natural resources, a sustainable economy, and human resources.

When: 1994-1996

Cost: No direct cost

Objective LU-3

Provide for comprehensive watershed planning throughout the Estuary region to protect wetlands and stream environments and reduce pollutants in runoff.

ACTION LU-3.1

Prepare and implement Watershed Management Plans that include the following complementary elements: 1) wetlands protection; 2) stream environment protection; and 3) reduction of pollutants in runoff.

Who: Local governments, Resource Conservation Districts, Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, landowners, and non-governmental organizations

What: Incorporate in local General Plans (as specified in Action LU-1.1) Watershed Management and Stormwater Management Plans that include the following complementary elements:

1. Wetlands protection;
2. Stream environment protection; and
3. Reduction of pollutants in runoff for each of the major watersheds that comprise the nine-county Bay Area and the three-county Delta region.

These Watershed Management and Stormwater Management Plan elements should be prepared in a manner that is consistent with the relevant goals, objectives, and actions contained in other sections of the CCMP, such as the Wetlands Management Program, the Pollution Prevention and Reduction Program, and the Wildlife Program.



Watershed Management and Stormwater Management Plans should be developed through cooperative efforts that may often be undertaken through the leadership of Regional Water Quality Control Boards or other appropriate resource entities. The Regional Boards should help prescribe Best Management Practices (BMPs) and Best Development Practices (BDPs) for each watershed to be included in local General Plans. Assistance grants and technical assistance should be provided to local governments in preparing and implementing policies, plans, programs, and ordinances.

The Watershed Management and Stormwater Management Plans and the corresponding portions of the local General Plans should be submitted to the Regional Water Quality Control Boards and, where appropriate, BCDC for review and certification. These agencies should certify that watershed management policies are in conformity with established Estuary resource protection and enhancement objectives.

When: 1993-1995

Cost: \$8,128,000 estimated total (\$8,128,000 state)

ACTION LU-3.2

Develop and implement guidelines for site planning and Best Management Practices (BMPs).

Who: Local governments, Resources Agency, Regional Water Quality Control Boards, Councils of Governments, landowners, and non-governmental organizations

What: Local governments and resource agencies should cooperate to develop and implement consistent guidelines for site planning to reduce adverse effects on estuarine resources. Such guidelines should provide consistent and uniform criteria and standards that will include erosion control and pollution prevention measures, designation of appropriate buffer areas, construction and design standards, and guidelines for wetland and riparian protection and enhancement. Criteria and standards developed should be flexible enough to address unique site-specific characteristics and should be consistent with programmatic actions contained in other portions of the CCMP (Wetlands Management Program actions concerning mitigation and regulatory authority).

When: 1993-1994

Cost: \$10,000 estimated total (\$10,000 state)

Objective LU-4

Provide educational opportunities for the public and for government institutions as a foundation for protecting and enhancing the resources of the Estuary.

ACTION LU-4.1

Educate the public about how human actions impact the Estuary.

Who: See Public Involvement and Education Program

What: Develop and distribute educational materials that clearly communicate the interrelationship between human activities, including land use and transportation, and impacts on the ecosystem of the Estuary and its tributary waters.

When: 1993

Cost: No direct cost

ACTION LU-4.2

Provide training workshops for local government officials and other key stakeholders to improve land use decision making that affects the Estuary.

Who: See Public Involvement and Education Program

What: Develop training materials and present short courses for permit analysts, planning commissioners, and other local government decision-makers. Invite participation from other key stakeholders, including landowners, developers, and environmental representatives. Such training should increase participants' awareness of policies, programs, financing mechanisms, and tools that local governments can use to help protect and enhance the Estuary's resources. Local governments, including cities, counties, and special districts, should be provided model ordinances, handbooks, and manuals to integrate natural resources protection and enhancement into local decision making, while providing for continued economic development.

When: 1993

Cost: No direct cost

Objective LU-5

Develop new public and private economic incentives and funding mechanisms to promote protection and restoration of the Estuary and provide a forum for stakeholders that improves communication and leads to better estuarine resource management.

ACTION LU-5.1

Create economic incentives that encourage local governments to take action to implement measures to protect and enhance the Estuary.

Who: U.S. Congress and California Legislature

What: Make available federal and state funds for local governments to support planning activities and program administration, to develop implementing ordinances, to fund capital improvement projects, and to maintain local facilities that protect the resources of the Estuary.

When: 1993-1995

Cost: No direct cost

ACTION LU-5.2

Develop new funding mechanisms to pay for plans, physical improvements, and program administration to protect the resources of the Estuary.

Who: California Legislature

What: Create new funding mechanisms that promote the protection of natural resources in the Estuary, such as benefit assessment districts and stormwater utility fees. For example, fees could be assessed in proportion to benefits derived and

resources impacted from use of the Estuary, e.g., a storm drain district could assess dischargers into the Estuary an annual fee on a per-cubic-foot basis to fund Estuary improvement projects and plans.

When: 1993

Cost: No direct cost

ACTION LU-5.3

Investigate and create market-based incentives that promote active participation by the private sector in cooperative efforts to implement goals for protection and restoration of the Estuary.

Who: California Legislature, Councils of Governments, and local governments

What: Develop market-based incentives, such as density bonuses, fast-track permit processing, or utility rate reductions, to encourage protection and restoration of the Estuary. For example, these incentives would be available to developers and project sponsors for projects if specific protection measures are implemented that exceed minimum federal, state, regional, and local requirements to protect the Estuary.

When: 1993-1994

Cost: No direct cost

ACTION LU-5.4

Identify financial barriers to implementing the actions recommended in this Land Use Management Program and propose alternative taxation and funding arrangements.

Who: California Legislature, Councils of Governments, and research organizations, such as Bay Area Economic Forum and the Environmental Defense Fund

What: Create alternative funding arrangements, such as revenue sharing and changes to state law, that allow state, regional, or local agencies to raise the necessary capital for implementing specific land use actions. Emphasize fiscal reforms that encourage environmentally sensitive land use.

When: 1993-1994

Cost: No direct cost

ACTION LU-5.5

Create a forum to improve communication and resolve disputes regarding land use management among different interest groups that have a stake in the protection and enhancement of the Estuary.

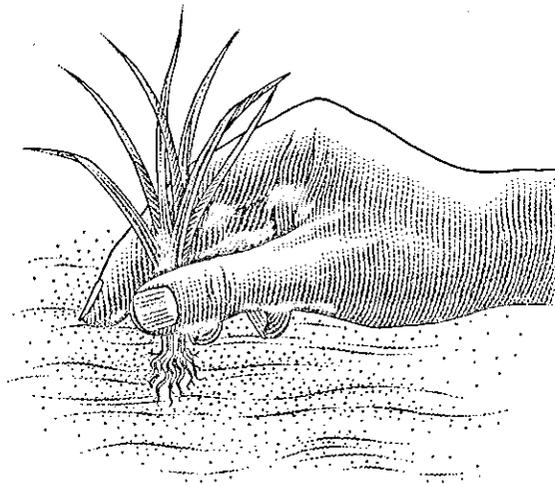
Who: Organizations such as university-based dispute resolution centers and private providers of dispute resolution services

What: Enable continued dialogue among key interest groups to develop land use policies that will guide Estuary management. Include groups that have a stake in the protection and enhancement of the Estuary's natural resources, such as government agencies, business, industry, and environmental and other non-governmental organizations. Create a mechanism to arbitrate differences and achieve cross-acceptance between Watershed Management Plans, local General Plans, and regional plans and policies as one alternative to litigation and as a means of augmenting the legislative hearing process.

When: 1993

Cost: No direct cost

The total estimated cost for the Land Use Management Program is \$38,378,000.



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Public Involvement and Education

Goals:

- Build public understanding of the value of the Estuary's natural resources and the need to restore, protect, and maintain a healthy Estuary for future generations.
- Increase public involvement in the ongoing stewardship of the Estuary.

Problem Statement

The San Francisco Bay-Delta Estuary is one of California's greatest biological and economic resources. The Estuary's watershed provides water to many of the state's farms, industries, and cities. The Bay-Delta region is home to more than seven million people who live, work, play, and invest in its unique environs. During the next twenty years, another one million people will move to the Estuary region to enjoy the benefits that it provides. The demands of the state's ever-increasing population have stressed the carrying capacity of this great Estuary.

While most Californians value the Estuary, few really understand the extent to which it contributes to the state's treasured quality of life. Public attention and involvement are critical at this time to provide the momentum needed to restore and maintain this invaluable resource.

State, federal, and local leaders representing diverse interests have developed the Plan—the CCMP—as a way to restore and protect the Estuary. Public involvement, however, provides the vital link needed to achieve effective implementation of the Plan. It will make the difference between general caring and informed action and between indifference and directed public will. Public involvement is critical for the decision-making process and effective management of the Estuary's resources.

Public awareness of the Estuary's problems is growing, but there is a definite lack of understanding about the need for the public to be involved in solving the Estuary's problems. The people must awaken to their responsibility as stewards of the Estuary and must powerfully speak out for its protection. A united and organized public constituency able to monitor the ongoing management of the Estuary will ensure that the Plan's goals, objectives, and individual actions are achieved.

Existing Management Structure

Currently, the Estuary Project's Public Involvement Program (PIP) operates through a cooperative agreement with the Association of Bay Area Governments. The Program has developed many educational materials and activities, including a series of twelve information sheets about the Estuary's natural resources and its problems; a booklet, *An Introduction to the Ecology of the San Francisco Estuary*; *Estuarywise*, a guide to preventing pollution; outreach to local, state, and federal elected officials; a lecture series; many presentations to diverse community groups; Estuary education curriculum guides; teacher training workshops; academic outreach; a student intern program; multicultural involvement efforts; slide shows; radio and television public service announcements; co-sponsorship of community events and programs; public meetings and workshops on the Estuary's problems; and two State of the Estuary Conferences.

These activities were targeted at four audiences: key decision-makers; the Estuary Project's constituency (those involved in Estuary Project committees); youth; and the general adult public.

An evaluation of the PIP's past activities indicates that much more work needs to be done, specifically in the areas outlined in this action plan.

Recommended Approach

We have an opportunity to support and invest in the Estuary's productivity so that it can continue to provide benefits to us and to future generations. Recognizing that we can only sustain a healthy regional economy by maintaining a healthy Estuary, it is also true that we can only take this kind of action by mobilizing and inspiring our community. In conjunction with the interested public—statewide and nationwide—we can demonstrate our united commitment to building the region's strength.

In a time of severe budget constraints at every level of government and within nearly every private sector organization, the public's skills, energy, and enthusiasm can serve as low-cost resources to solve many Estuary problems that might not otherwise be addressed. Only when it comes to understand and embrace the Plan, however, will the public be able to actively promote it, support it, use it, enforce it, watchdog it, invest in it, and finance its continuance.

The community acting as a resource to solve the action items described in the Plan will maximize public involvement in the actual management, restoration, and protection of the Estuary. The community acting as a resource also will provide informed activism, trained and vigilant monitoring, financial contributions, and even some kind of Conservation Corps. An effective and strong public involvement program will provide an opportunity for educated and motivated volunteers to invest in sustaining and improving our biological resources. In doing so, they will also invest in the preservation of our economic resources.

Public Involvement and Education Actions

Objective PI-1

Develop CCMP public involvement, education, communication, and advocacy programs.

ACTION PI-1.1

Build awareness, interest, and support in the general public and decision-makers for the CCMP's goals and action plans.

Who: Friends of the San Francisco Estuary

What: Develop a high-visibility media campaign to make people aware of the CCMP's existence, how it came about and what it represents (consensus), and its specific action plans. The campaign will credit the groups, agencies, and citizens who worked hard to develop the CCMP. Efforts will include soliciting newspaper, radio, and TV coverage of CCMP issues and actions; scheduling coverage and public service announcement releases in conjunction with major outreach campaigns to decision-makers, business, etc.; and developing, distributing, and using fact sheets, portable displays, public meetings, slide shows, brochures, a slogan, and other support materials.

Develop a strategy to assist government decision-makers in efforts to champion, legislate, and fund the CCMP. Provide information, materials, briefings, and public outreach assistance to cities and counties, local planning authorities, regional conservation districts, and other government agencies working to implement the CCMP.

Educate and mobilize constituencies and interested groups to keep pressure on government representatives and officials so that they continue to implement the CCMP. Research and provide needed information to promote and solicit public funding for CCMP enforcement.

Work with educated and informed private sector interest groups to promote and advocate the CCMP's implementation. Using the Estuary Project's constituency base, form a leadership committee of receptive people from industry, business, public utilities, and environmental and other special interest groups who are instrumental for implementation of the CCMP in the private sector.

Work with the committee to develop a regionwide outreach program focused on concrete (interest-specific) goals based on the CCMP. Provide the program with presentation packages, printed information, easy access to government reports, scientific studies, and information on the successes of other businesses using pollutant source reduction and prevention activities, water conservation, and other environmentally sound management practices.

When: Begin in 1993

Cost: Media campaign: first year cost \$100,000; \$50,000 annually thereafter

Decision-makers' education: \$50,000 annually

Advocacy program: \$50,000 annually

Private sector: \$100,000 annually

ACTION PI-1.2

Provide and encourage opportunities for direct citizen involvement in implementing the CCMP.

Who: Friends of the San Francisco Estuary

What: Provide broad-based public representation, including environmentalists, to encourage implementation of the CCMP. Develop and distribute information about the CCMP's progress. Provide an ongoing forum for citizens to debate and discuss controversial environmental issues related to the Estuary. Provide feedback mechanisms linking the debate forum to government decision-makers and CCMP lead agencies. Organize and provide training programs for citizens on local, state, and federal permit processes and public involvement policies. Publish public meeting schedules of lead agencies for CCMP implementation. Encourage citizen participation and attendance at these meetings.

When: Begin in 1993

Cost: \$100,000 annually

ACTION PI-1.3

Provide and encourage opportunities for direct citizen involvement in following the CCMP and making any necessary revisions to it.

Who: Friends of the San Francisco Estuary

What: Provide an open and public process for regular review of CCMP implementation. Through activities and programs developed to educate and involve the public in managing the Estuary, seek comment and feedback on CCMP policies and issues. Ensure there is public review and approval of any changes to the CCMP. Inform and advise the public, interest groups, elected officials, and decision-makers about CCMP implementation, results, and revisions.

When: 1993

Cost: Costs provided in Action 1.2

ACTION PI-1.4

Serve as a public involvement and education resource for government agencies taking the lead in CCMP management actions.

Who: Friends of the San Francisco Estuary

What: Work with government agencies to implement the CCMP. Through agreements, grants, and contracts, provide assistance in public involvement and education programs to the government agencies responsible for CCMP implementation. Provide support to agencies in the form of staff time, easily understood informational materials for the public, handling of public inquiries, media contact, organizing public meetings and hearings, and consistent, timely communication.

Coordinate CCMP public involvement efforts among all agencies to produce a strong, unified message and image for the CCMP, to maximize impact, and to minimize costs and duplication of effort. Training programs on such topics as using volunteers, consensus building, and conflict resolution could be organized and provided for agency staff.

When: Begin in 1993

Cost: \$150,000 annually

ACTION PI-1.5

Ensure provisions for a central collection and distribution (clearinghouse) point for communication and coordination of all information concerning CCMP issues and the Estuary.

Who: Friends of the San Francisco Estuary

What: Provide and stock clearinghouse with comprehensive, up-to-date information resources, including a library, computer data bases, directories, mailing lists, public reports, pamphlets, and videotapes about the Estuary's natural resources, water quality, and economic and social values.

Advertise and maintain a public hotline to provide public information, handle CCMP inquiries, take citizen watchdog reports of illegal or irresponsible activities affecting the Estuary, refer callers to clearinghouse and other resources, such as the BayKeeper, and screen and direct inquiries to specific agencies.



Facilitate frequent information sharing among public agencies and interest groups by publishing a newsletter on CCMP and Estuary-related activities. Research, produce, and distribute five thousand copies of a monthly newsletter to interest groups, government agencies, the media, citizens, the Bay-Delta Congressional Delegation, and city, county, and regional decision-makers.

When: Begin in 1993

Cost: Equipment, hotline, literature, and library materials start-up costs: \$200,000; \$100,000 annually thereafter
Newsletter: \$85,000 annually (format will be six to ten pages, two-color, with graphics and photos)

ACTION PI-1.6

Develop and/or promote community-designed model projects for public education and participation activities aimed at implementing the CCMP.

Who: Friends of the San Francisco Estuary

What: Interest groups (environmental, industry, education, science, etc.) and government agencies will be identified and asked to submit proposals. Projects might include a series of CCMP television public service announcements, a stenciling program for storm drains, a demonstration farm (water conservation, sustainable agricultural practices, etc.), informational brochures, educational materials, restoration projects, and/or boater education.

Following established procedures for the request for proposal process, research and identify criteria to select proposals for the model projects that will receive funds. Grants may cover all or partial costs of the proposals. Comprehensive evaluation mechanisms will be developed for completed model projects, including direct feedback from target audiences. Follow-up support and funding will be provided for projects selected to serve as models for larger programs.

When: 1993—as soon as funds are secured

Cost: \$100,000 the first year; \$500,000 annually thereafter

ACTION PI-1.7

Seek, encourage, and, where appropriate, actively support environmental projects and/or programs that are consistent with CCMP goals and objectives.

Who: Friends of the San Francisco Estuary

What: Work with fish and wildlife professionals and appropriate trade associations, government agencies, and public interest groups to seek and support new, creative programs that are consistent with the CCMP's goals and action plans. Encourage target programs to apply for model projects funding.

When: Begin in 1993

Cost: \$50,000 annually, in addition to funds provided in Action PI-1.6

Objective PI-2

Promote direct citizen involvement in studying, restoring, and managing a healthy Estuary.

ACTION PI-2.1

Develop, promote, and support multicultural understanding of and involvement in Estuary issues and the decision-making process for these issues.

Who: Friends of the San Francisco Estuary

What: Work with minority leaders and community groups to accomplish mutual goals and programs. Develop outreach programs to people of color, provide opportunities for understanding mutual goals, and encourage and support active participation in the decision-making process for protecting and restoring the Estuary's biological resources. Develop an active outreach program to multicultural neighborhood groups, businesses, farm workers, fishing associations, and urban coalitions.

When: Begin in 1992

Cost: \$100,000 annually

ACTION PI-2.2

Work with education groups, interpretive centers, decision-makers, and the general public to build awareness, appreciation, knowledge, and understanding of the Estuary's natural resources and the need to protect them. This would include how these natural resources contribute to and interact with social and economic values.

Who: Friends of the San Francisco Estuary

What: Work with local and state educators in organizing estuarine ecology materials and producing a coordinated education program for K-12 students. Distribute the Estuary Project's three curriculum guides on Estuary ecology and other appropriate materials to school districts, interpretive centers, and educational institutions. Hold teacher training workshops on the use of the curricula and general Estuary ecology.

Provide opportunities for teachers, students, and parents to participate in Estuary-related field trips and restoration projects. Provide a mechanism, such as the Estuary Project's Volunteer Education Advisory Committee, for coordinating education efforts in the Bay and Delta.

Promote increased funding for all estuarine, fish, and wildlife interpretive centers.

Develop additional materials as needed on fish, wildlife, and their habitats, such as a handbook on habitat protection and enhancement opportunities. These materials should be made available to private landowners, developers, contractors, realtors, and business and industrial organizations.

When: Begin in 1993

Cost: \$200,000 annually

**ACTION PI-2.3**

Promote, support, and cooperate with existing public education and involvement programs concerned with protecting and restoring the Estuary's biological resources.

Who: Friends of the San Francisco Estuary

What: Develop criteria for evaluating existing environmental education programs and set priorities for activities to be funded. Identify environmental education programs and organizations. After completing evaluation and priority tasks, work cooperatively and openly with other groups to avoid duplication of effort. Actively support successful environmental education programs and activities by providing funds, guidance, and in-kind support.

When: Begin in 1992

Cost: \$35,000 annually for staff liaison (specific support funds for programs and activities will come from other programs, such as model projects)

ACTION PI-2.4

Develop or promote necessary public education tools, such as a general education speakers bureau, Bay-Delta "Estuary Watch" bulletin boards, slide shows, brochures, and other support materials on a variety of topics.

Who: Friends of the San Francisco Estuary

What: Recruit and train volunteer speakers on a variety of subjects, including the Estuary, its natural resources, and efforts to implement the CCMP. Research current materials and, where gaps exist, write and produce materials to support the speakers, such as slide shows, information sheets, charts, and graphics.

Negotiate with appropriate businesses and public entities to update and post regularly: 1) educational posters about the Estuary; 2) bulletins indicating the progress of programs and legislation aimed at protecting the Estuary; and 3) information about what people can do to help out, for example, consumer tips, phone numbers for volunteer organizations, and contacts for more information.

When: Begin in 1993

Cost: \$150,000 annually

ACTION PI-2.5

Assist in the development of long-term educational programs designed to prevent pollution to the Estuary's ecosystem and provide assistance to other programs as needed.

Who: Friends of the San Francisco Estuary

What: Building on the efforts of existing programs and the Estuary Project's *Estuarywise*, a citizens' guide to pollution prevention, and storm drain stenciling activities, develop a coordinated, systematic, and long-term pollution prevention education program.

Work with cities, counties, water districts, environmental groups, business, and industry to assist in and coordinate the development of materials on how to prevent pollutants from entering the Estuary's waters. Produce a plan, timeline, and specific products and activities to educate the public on pollution prevention.

When: Begin in 1993

Cost: \$250,000 annually (Costs include funds for staff to develop a plan, timeline/budget, coordination and implementation efforts, and to develop additionally needed educational materials, public meetings, and media coverage.)

ACTION PI-2.6

Hold a State of the Estuary Conference at least every other year.

Who: Friends of the San Francisco Estuary

What: The conference will bring together all CCMP players, Estuary interests, the general public, and the media on an ongoing basis to share progress reports, address challenges, provide public education, and solicit public feedback on CCMP implementation. Information presented should be appropriate to the San Francisco Bay-Delta Estuary. The National Estuary Program, under the Clean Water Act, requires participating programs to report to Congress biennially. The conference would assist in fulfilling this requirement.

When: Begin in 1994

Cost: \$75,000 every other year (in addition to staff time)

Objective PI-3

Develop and implement specific and targeted public education and involvement action plans about fish and wildlife resources and how to restore and improve their populations and habitat.

ACTION PI-3.1

Increase public opportunities to contribute directly to the protection and management of fish and wildlife populations and their habitats within the Estuary.

Who: Friends of the San Francisco Estuary

What: Develop and implement an education program about the introduction of undesirable species to the Estuary and how they are transported. Presentations should be made to sports clubs, environmental groups, schools, etc., on a regular basis to educate people about the implications of illegal or unwanted introduction and transport of non-indigenous biota. Concepts such as the impact of new species on native species and possible impact on the ecosystem need to be stressed. Methods of educating individuals should include signs posted at fishing areas and boating facilities, inclusion of warnings with boat and fishing/hunting licenses, and public service announcements.

Develop support for citizens' fish, wildlife, and habitat monitoring programs coordinated by resource agencies, interest groups, and fish and wildlife associations. Provide for greater public participation in permit review and other actions by regulatory agencies that affect fish and wildlife and their habitats. Organize conferences with the goal of developing a more coordinated approach to resource protection and management and increasing public involvement in this approach.

Develop and implement an education strategy to address wetlands functions, values, the Wetlands Management, Regulatory, and Watershed Plans, and the need to restore and protect wetlands. Targeted audiences should include local governments, schools, the general public, landowners, and professional, civic, and interest groups.



When: Begin in 1994

Cost: Introduction of non-indigenous species program: \$200,000-\$300,000 annually for each affected agency; fish and wildlife monitoring programs: \$250,000 annually; wetlands: \$200,000 annually

ACTION PI-3.2

Using government agencies and citizens, promote the continued development of needed citizen monitoring programs to assist in the restoration and protection of the Estuary.

Who: Friends of the San Francisco Estuary

What: Research and determine the need for monitoring programs that use volunteers to gather information about the Estuary's natural resources. Working with government agencies and knowledgeable interest groups, such as the San Francisco BayKeeper, Urban Creeks Council, and others, develop volunteer teams interested in helping to monitor the health of the Estuary on an ongoing basis. Develop a training program and manual for these volunteers that ensures the usefulness of their monitoring efforts as a supplement to enforcement agency activities. Review and evaluate agency and citizen monitoring efforts and provide feedback on effectiveness.

When: Begin in 1993

Cost: Start-up costs for research, volunteer manual, and equipment: \$100,000
Annual costs for each program: \$50,000

ACTION PI-3.3

Provide opportunities for hands-on citizen action in Estuary restoration activities.

Who: Friends of the San Francisco Estuary

What: Develop, promote, and maintain hands-on activities, such as wetland and creek restoration, recycling activities, and beach clean ups, to enable citizens, businesses, and constituent groups to participate directly in Estuary restoration.

Publish and distribute how-to information on water conservation, source reduction, waste disposal, and other specific restoration actions. Coordinate distribution with public-private sector outreach and media campaigns.

When: Begin in 1994

Cost: \$50,000 annually

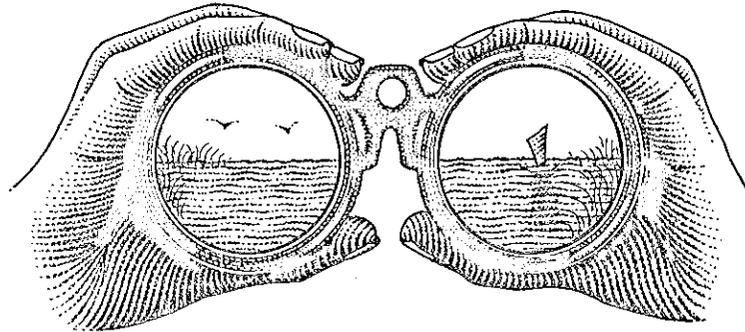
ACTION PI-3.4

Assess the need and, if appropriate, develop and organize an Estuary Conservation Corps.

Who: Friends of the San Francisco Estuary

What: Research and determine the need for an Estuary Conservation Corps to assist in Estuary restoration projects. Work and cooperate with existing Conservation Corps, interest groups, and government agencies in determining the need for an Estuary Corps. Contracts for the Corps' services may include fence building, wetland restoration, and screening projects. Because of the Corps' broader public service of job training, the target for self-financing would be 50 percent.

When: Begin in 1994



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Research and Monitoring

Goal:

- Improve the scientific basis for managing natural resources within the Estuary through an effective monitoring and research program.

Problem Statement

More than seventy monitoring and research programs can be identified as ongoing in the Estuary. These efforts are increasing as the need grows to acquire adequate information for effective management, preservation, and restoration of the area's resources and beneficial uses. Despite the large number of monitoring programs in the Estuary, no overall plan exists for coordinating agency or citizen monitoring. Also, there is no systematic distribution of the information derived from monitoring and research to Estuary managers or the public.

When discussing monitoring needs for the estuaries in the National Estuary Program, confusion often arises between monitoring of estuarine conditions (ambient monitoring) and monitoring the effectiveness of the CCMP. Section 320 of the Clean Water Act calls for each Management Conference "to monitor the effectiveness of actions taken pursuant to the Plan...." Monitoring the CCMP's effectiveness will involve periodically evaluating the success of the Plan's implementation and determining whether the actions have resulted in the desired outcomes. This will require compiling data and information from a variety of sources, including ambient monitoring. This "CCMP effectiveness monitoring" should not be confused with the estuarine monitoring recommendations that are the focus of this chapter.

Managing a resource as complex as the San Francisco Estuary requires a comprehensive understanding of both its biological resources and of human impacts on its ecology. This section recommends actions to help foster this level of understanding and promote environmentally sound management.

Existing Management Structure

Most of the information in this section is taken directly from the Aquatic Habitat Institute's report on the "Status and Assessment of Selected Monitoring Programs in the San Francisco Estuary" dated March, 1992.

Monitoring of physical, chemical, and biological parameters in San Francisco Bay and the Sacramento-San Joaquin Delta has been proceeding at different levels of intensity for more than thirty years. Nearly two dozen agencies at the local, regional, state, and federal levels sponsor, participate in, and report on the results of monitoring and research projects. Monitoring and research are carried out in the Estuary as mandated by state and federal law and regulation, as part of elective state and federal programs to collect background data on riverine and estuarine structure and function, and as special projects aimed at the description and discovery of basic estuarine dynamics.

Monitoring programs in San Francisco Bay and the Sacramento-San Joaquin Delta are primarily focused on water quality and on determining the status of biological resources. The greatest emphasis among monitoring efforts, by far, is the measurement of physical and chemical water quality characteristics in the northern reach and in the South Bay.

Most monitoring in the Estuary is carried out as part of the Interagency Ecological Studies Program (IESP). The IESP was initiated in 1971 through a cooperative agreement with the California Department of Water Resources, the California Department of Fish and Game, U.S. Bureau of Reclamation, and U.S. Fish and Wildlife Service. More recently, the State Water Resources Control Board, U.S. Geological Survey, U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency have joined this coordinated effort. In 1992, the program carried out approximately \$10 million of research and monitoring efforts. Cooperative studies among IESP members have included programs investigating:

- 1) effects of reduced flow on salinity distribution in the Bay-Delta; 2) primary production in the entrapment zone;
- 3) success of striped bass production in the Bay-Delta; 4) concentrations of chemical pollutants throughout the Estuary;
- 5) abundances of benthic and pelagic invertebrate populations that serve as food for important fishes; and 6) circulation and stratification patterns in the South Bay and their effects on sediment transport.

Biological sampling and analyses have concentrated on species of commercial and recreational value, particularly striped bass and Chinook salmon. Other species of importance have received less attention in terms of specific monitoring, and much information regarding these species and their functions in the Estuary has been collected in the course of striped bass studies. Relatively few monitoring programs have been carried out to ascertain the status of birds, mammals, and plants in the Estuary; nonetheless, these programs are active and have made significant contributions to our understanding concerning these resources and their responses to ongoing changes in the Estuary system.

Many monitoring programs are currently under review as to their objectives, design, and execution. IESP members have undertaken an intensive internal review of the efficacy of many of their Suisun Bay and Delta programs. The results of these reviews and revisions have suggested that an increased emphasis on regional monitoring would result in more efficient use of funds, better program design, and more meaningful data.

Other state and federal agencies and authorities conduct monitoring and research programs that are complementary to the programs carried out under the Interagency Ecological Studies Program (IESP). The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) has recently initiated a pilot program for regional monitoring of pollutants in the Bay and Delta. The objectives of the pilot program are, in part, to gather data on baseline chemical parameters related to water and sediment quality.

Recommended Approach

The SFEP recommends the formation of an entity to be responsible for coordinating and integrating research and monitoring in the Estuary. This new entity will also report on findings and ensure that the information is available to resource and regulatory managers and to the public.

Research and Monitoring Recommendations

Objective RM-1

Develop an estuarine research institute for the improved coordination and reporting of monitoring and research on the Estuary.

ACTION RM-1.1

Establish and operate a San Francisco Estuarine Institute for research on and monitoring of land use, biological resources, flow regime, pollutants, and dredging and waterway modification.

Who: Aquatic Habitat Institute, San Francisco Bay Regional Water Quality Control Board, academic institutions, and other agencies as necessary

What: Establish a centralized institute for research and monitoring in the Estuary. Such an institute should coordinate research and monitoring, promote coordination and interaction among agency and academic researchers, and could house research and monitoring programs of various agencies or universities.

This institute will:

1. Oversee the implementation of the Regional Monitoring Strategy;
2. Provide advice for individuals or institutions performing needed research;
3. Provide the linkage between science and resource agency management;
4. Coordinate multidisciplinary teams of scientists and technicians to perform complicated or large studies;
5. Develop a long-term research plan for the Estuary;
6. Evaluate the health of the Estuary and make the linkage between observed degradation and causes; and
7. Periodically report to the academic community, agencies, and the public on the results of research, monitoring, and other special studies conducted in the Estuary.

When: Immediately

Cost: \$13 million estimated total (\$13 million state)

ACTION RM-1.2

Provide a long-term administrative home and regular funding for the Research Enhancement Program (REP).

Who: Interagency Ecological Studies Program (IESP), San Francisco Estuarine Institute (SFEI), Aquatic Habitat Institute, the University of California, Stanford University, and other public and private academic institutions

What: Increase academic and agency involvement in estuarine research by providing a long-term administrative home for the REP, which will include regular funding and contracting mechanisms. The SFEI could provide such a service for this program. The REP, established by IESP and co-sponsored by SFEP, should be continued in order to fund needed basic and applied research on the Estuary.

When: Immediately

Cost: \$900,000 estimated total (\$900,000 state)

Objective: RM-2

Effectively monitor and conduct research on flow regime, pollutants, dredging and waterway modification, fish and other aquatic resources, wildlife, wetlands, and land use within the boundaries of the Estuary, using new and existing facilities, programs, agencies, and public involvement groups.

ACTION RM-2.1

Develop and implement the Regional Monitoring Strategy, which will integrate and expand on existing efforts and eventually be part of a comprehensive Regional Monitoring Program.

Who: Interagency Ecological Studies Program, Association of Bay Area Governments, Aquatic Habitat Institute, and San Francisco Estuarine Institute, in coordination with many other Estuary organizations (U.S. Geological Survey, U.S. Fish and Wildlife Service, California Department of Fish and Game, State Water Resources Control Board, Regional Water Quality Control Boards, and other public and private organizations)

What: Establish a comprehensive monitoring program that follows the Regional Monitoring Strategy. Ensure that this information is available at a central location to decision-makers, the research community, and the public. Research and monitoring programs should fit tightly into the Regional Monitoring Strategy that emphasizes the recovery and long-term survival of desirable species. The program should:

1. Establish long-term, Estuarywide monitoring for phytoplankton, zooplankton, benthos, fish, migratory and resident birds, mammals, and other species as necessary. The program shall be coordinated with and the results analyzed in relation to all other relevant environmental measures;
2. Create a standardized data base of bathymetric data and habitat classification for use in hydrodynamic models and mass balance equations;
3. Create and maintain over the long-term an array of "index" water column/benthic stations with a modest sampling regime of physical, chemical, and biological measurements to quantify year-to-year variability and long-term trends;
4. Through intensive studies with periodic follow-up as necessary, establish mass balances for key chemical pollutants or groups of pollutants, including measurement of their sources and their accumulation or disappearance in terms of the relevant physical, chemical, or biological process. Maintain awareness of new pollutants and new methods of measurement;
5. Refine and extend the analysis of the amounts and relative importance of organic carbon sources and sinks for the Estuary. The results shall be made available and analyzed in the context of other data obtained under the Program; and
6. Expand, coordinate, and standardize the existing biological and chemical monitoring program (of the Department of Fish and Game) for toxics, initially including, but not restricted to, the use of bioassays with larval striped bass and opossum shrimp.



Public education is another important aspect of the estuarine monitoring program. Up-to-date information will be provided to the Estuary's public information programs. Working cooperatively with existing volunteer monitoring programs, the estuarine monitoring program will assist in creating new citizen monitoring programs, with professional training and quality assurance provided as necessary. This will contribute to our knowledge of the health and status of the region's streams, wetlands, and wildlife.

When: Immediately

Cost: \$292,570,000 estimated total (\$4.2 million federal and \$288,370,000 state)

The total estimated cost for the Research and Monitoring Program is \$306,470,000.

IV

IMPLEMENTATION

*"It is not only what we do,
but also what we do not do,
for which we are accountable."*

Molière

Introduction

The Comprehensive Conservation and Management Plan (CCMP) presents a blueprint to restore, maintain, and protect the San Francisco Bay-Delta Estuary's natural resources. The CCMP is the first comprehensive plan aimed at improving resource protection throughout the entire Bay-Delta Estuary. And, just as designing a blueprint is the first step in building a home, completing the CCMP is the first phase in improving our efforts to restore and protect the Estuary.

Implementation is the key to the Plan's success. Its recommended actions must be carried out, which will require ongoing commitment from the entities responsible for implementation. Some actions can be implemented by existing agencies under existing authority. Other actions can be implemented under existing authority, but will require additional resources. Some actions call for changes in federal or state legislation.

The cornerstones of effective implementation are:

- Early implementation efforts;
- An organizational structure that will promote a continued partnership and that will sustain commitments to implementation;
- A strategy for implementation;
- A means to monitor the effectiveness of the Plan's actions; and
- A way to ensure broad public support for and involvement in realizing the Plan's goals.

These aspects of implementation will be critical to fulfilling the CCMP's stated vision.

Early Implementation Efforts

To promote the implementation of actions needed to restore and protect estuarine resources, the National Estuary Program has encouraged estuary projects to carry out actions prior to the completion and adoption of CCMPs. The San Francisco Estuary Project has achieved early implementation through various means, including demonstration projects. Demonstration projects, which are scaled-down versions of CCMP actions, are intended to test the cost and effectiveness of solutions to priority problems. Demonstration projects also encourage agencies, businesses, environmentalists, and other groups to begin implementation.

In 1992, the Estuary Project sponsored a network of demonstration projects that use various approaches to watershed protection, recognizing that such approaches will be key mechanisms for implementing other CCMP actions. This network of nine projects will: 1) improve environmental conditions; 2) institutionalize management arrangements for CCMP implementation; 3) enhance coordination and technical transfer of current watershed management efforts; and 4) encourage increased public and private efforts to cooperatively protect critical estuarine resources.

The projects involve:

- Evaluating aquatic and riparian resources for inclusion in a system of stream preserves;
- Supporting efforts to improve monitoring and research;
- Using Geographic Information System capabilities to improve resource management;
- Improving grazing management to minimize impacts;
- Encouraging citizen monitoring of streams in Santa Clara County;
- Promoting institutional arrangements to improve watershed management;
- Promoting erosion control on vineyards damaged by *phylloxera*;

- ❑ Promoting habitat restoration at the Cosumnes River Preserve; and
- ❑ Developing improved agricultural management methods.

Over the past five years, the Estuary Project has funded other demonstration projects to:

- ❑ Enhance and restore five wetland areas in San Francisco Bay;
- ❑ Evaluate the effectiveness of constructed wetlands designed to trap stormwater pollutants;
- ❑ Develop management practices to control pollutant runoff at gasoline fueling stations;
- ❑ Create an opportunity to reuse dredged material;
- ❑ Prepare model ordinances for local wetlands protection; and
- ❑ Develop a wasteload allocation for South San Francisco Bay.

Implementation Oversight Structure

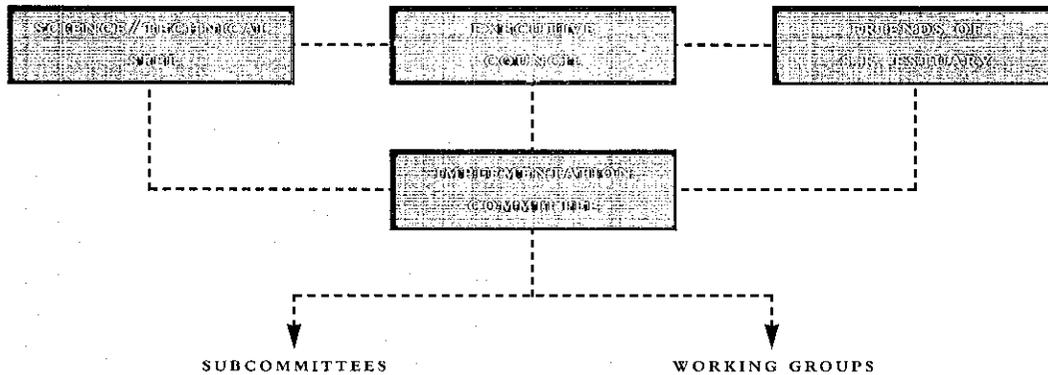
The federal Clean Water Act directs participants in the National Estuary Program to “develop plans for the coordinated implementation of the [CCMP] by the states as well as federal and local agencies participating in the conference; [and to] monitor the effectiveness of actions taken pursuant to the plan...”

The recommendations in this CCMP will require action from most of the resource management and environmental regulatory authorities that have jurisdiction in the San Francisco Bay-Delta Estuary. To be effective, these implementation efforts must be closely integrated and coordinated among the variety of public, private, local, state, and federal organizations responsible for managing the Estuary.

Therefore, the Management Committee proposed an implementation structure that will be committed to carrying out the actions in the CCMP and will be responsible for overseeing and coordinating implementation activities. This structure reflects the alliance among the public, the environmental community, industry, and the many levels of government that will carry out this Plan.

To develop an implementation structure, the Management Committee first established goals that reflect its desire to create a structure that will support efficient implementation and productive public participation in decision making. The implementation structure should:

1. Promote a continuous federal/state/local/private/public partnership in protection and restoration activities;
2. Provide effective public involvement in decision making;
3. Promote an efficient process for decision making consistent with number 2 above;
4. Promote efficient coordination of CCMP implementation;
5. Promote scientific credibility; and
6. Ensure high-level political/governmental commitment.



The Executive Council will have primary responsibility for implementing the CCMP. The Implementation Committee will coordinate implementation activities under the broad policy direction of the Executive Council. The Implementation Committee will convene subcommittees and working groups as necessary.

Friends of the San Francisco Estuary will implement the CCMP's Public Involvement and Education Program and will provide public review and involvement in overall CCMP implementation. The Science/Technical Committee will ensure that the CCMP's Research and Monitoring Program is carried out and will provide technical support for implementation activities.

The Individual Elements of the Implementation Structure

The Executive Council

The Executive Council will:

1. Provide broad policy direction;
2. Approve priorities for CCMP implementation;
3. Approve CCMP workplans and budgets (for federal and non-federal funding);
4. Seek and develop funding sources to carry out the CCMP;
5. Act as a clearinghouse for funding sources;
6. Obtain and direct internal resources for CCMP implementation;
7. Seek changes in legal authorities as necessary for implementation; and
8. Approve CCMP changes that further the goals of the CCMP.

The Management Committee approved by vote the following composition for the Executive Council:

- Regional Administrator, U.S. Environmental Protection Agency, Region IX;
- Regional Director, U.S. Fish and Wildlife Service, Region I;
- Secretary, California Environmental Protection Agency;
- Secretary, California Resources Agency; and
- A Local Elected Official (to be jointly selected by the Association of Bay Area Governments and the Sacramento Council of Governments).

The Implementation Committee

The Implementation Committee will:

1. Coordinate implementation activities of responsible entities;
2. Obtain commitments from all sectors implementing CCMP actions;
3. Identify barriers to CCMP implementation;
4. Develop remedies that remove barriers to implementing the actions;
5. Assure that plans identified in the CCMP are developed by responsible entities;
6. Recommend changes to the CCMP to the Executive Council through a joint meeting with Friends of the San Francisco Estuary;
7. Develop CCMP workplans and budgets for Executive Council approval;
8. Recommend broad priorities for CCMP implementation;
9. Identify and seek changes in legal authorities in conjunction with the Executive Council, as necessary for implementation; and
10. Develop policies for approval by the Executive Council.

The Implementation Committee will have 20-25 members and will be composed of:

- Key local, state, and federal government representatives;
- Three environmental/conservation representatives (to be selected by the current environmental/conservation representatives on the Management Committee);
- Three business/water/discharger representatives (to be selected by the current business/water/discharger representatives on the Management Committee); and
- One fishery representative (to be selected by the current fishery representatives on the Management Committee).

Friends of the San Francisco Estuary (Friends)

Friends of the San Francisco Estuary will:

1. Provide a public involvement and review function to the Executive Council regarding CCMP implementation;
2. Recommend changes to the CCMP to the Executive Council through a joint meeting with the Implementation Committee;
3. Function as a watchdog and advocate for implementation of the CCMP;
4. Ensure that the Public Involvement and Education portion of the CCMP is carried out; and
5. Recommend legislative changes to the Executive Council and Implementation Committee.

Friends will include representatives from the following groups.

- Local government/civic;
- Environmental/conservation;
- Business/water/discharger; and
- State/federal agencies.

Science/Technical Review Committee (San Francisco Estuarine Institute)

The San Francisco Estuarine Institute will provide the scientific and technical review function for CCMP implementation. The San Francisco Estuarine Institute (SFEI) will receive funding from many sources and carry out many activities. Consistent with this, SFEI will have its own board composition.

With respect to the CCMP, the SFEI will:

1. Carry out the *Regional Monitoring Strategy (RMS)*;
2. Coordinate and implement the Research and Monitoring portion of the CCMP;
3. Provide technical support for CCMP implementation activities;
4. Alert the Implementation Committee to new scientific data related to CCMP implementation; and
5. Recommend changes to regional monitoring.

Composition:

1. Eight Member Board of Directors:
 - Regional Administrator, U.S. Environmental Protection Agency, Region IX
 - Secretary, California Resources Agency
 - Secretary, California Environmental Protection Agency

- ❑ Four elected from among the membership of the SFEI Policy Advisory Panel (two representing the regulated community, local government/special districts, and two representing conservation and recreation)
- ❑ One ex-officio member from the Technical Advisory Panel

2. Policy Advisory Panel:

- ❑ Ten governmental members
- ❑ Twelve non-governmental members

3. Technical Advisory Panel

- ❑ Up to twenty researchers from universities, agencies, and other private or public organizations

Preliminary Implementation Strategy

Successful implementation of the CCMP hinges on the will and ability of public and private entities to carry out its recommended actions. To supplement information contained in the CCMP and to facilitate its implementation, SFEP staff and state and federal agency personnel have developed a *Preliminary Implementation Strategy (Preliminary Strategy)*.

The *Preliminary Strategy* details the current and projected involvement required of implementing agencies. Based upon the priorities and schedules provided by federal and state agencies, the *Preliminary Strategy* establishes categories for CCMP actions. It lists potential financial resources available to implement the actions, presents potential ways to generate revenues to finance actions, and identifies actions that will require additional resources, new moneys, and/or new authorities before they can be implemented. It is anticipated that the members of the implementation oversight structure will use the *Preliminary Strategy* to develop a more complete implementation program.

This section of the Implementation Chapter provides an overview of the more detailed *Preliminary Implementation Strategy*. Included in this section are discussions of:

- ❑ The level of agency involvement with CCMP actions;
- ❑ Some of the projected costs of the proposed activities;
- ❑ Potential sources for generating revenue;
- ❑ A mechanism for allocating resources (the Estuary Investment Fund); and
- ❑ Financial incentives.

Levels of Implementation

Many actions within the CCMP will require the participation of public sector agencies. SFEP staff contacted all state and federal agencies listed as implementing agencies to determine their ability to implement the CCMP, the projected cost, and their current and projected level of involvement with implementation of CCMP actions.

According to agency personnel, many CCMP actions are already in progress. Many others could be implemented through a re-direction of funds or with existing funds. Therefore, a critical aspect of this *Preliminary Strategy* focuses on improving interagency coordination and on re-directing existing resources.

For example, the San Francisco Bay Regional Water Quality Control Board is already re-directing funds. Fees charged to dischargers that were used to monitor discharger locations have been reallocated to programs designed to monitor the overall health of the Estuary. The Central Valley Regional Water Quality Control Board is also considering a similar re-direction of discharger fees. Other opportunities may exist to re-direct funds into more urgent or effective programs within agencies.

Costs of Implementing the CCMP

To develop costs, staff contacted state and federal agencies listed as implementing entities within the CCMP. The agencies provided a projected cost for performing the given action. Some costs are shown in ranges or are tied to other actions or programs within the CCMP. All cost figures contained within the CCMP represent direct costs, i.e., costs directly associated with implementing the action, such as labor or equipment.

Staff were unable to determine costs to local agencies due to the many different entities involved in Estuary management. (The majority of actions that call for local agency involvement are in the Water Use and Land Use Programs. The Land Use Program recognizes that local government will need financial assistance to undertake certain CCMP actions. Therefore, several Land Use actions specifically address this financial need.) Costs to private entities have also not been determined. To be implemented, some actions within the CCMP will require significant capital investment. For example, fish screens improvements for the state and federal water projects in the Delta are estimated to cost \$30 million (see Aquatic Resources Action 4.5). Control measures to reduce pollutant urban runoff could cost upwards of \$36 million (see Pollution Prevention Action 2.4). The cost of purchasing refuge lands for wildlife protection is estimated at \$237 million (see Wildlife Action 1.2). Costs for public involvement and education programs could range between \$1 and \$4 million annually (see Public Involvement and Education Program). The estimated cost for implementing all CCMP actions (excluding Aquatic Resources Program) is \$1,588,809,000, based on projected twenty-year costs.

Developing Revenues for the CCMP

The goal of the *Preliminary Implementation Strategy* is to identify sources or potential sources of funding for each action. The *Preliminary Strategy* also suggests a possible source of funding or potential new funding mechanisms to fill gaps where funding is either insufficient or unavailable.

Proposed funding sources are expected to meet the following criteria:

■ Equity

To provide equity, there must be a correlation between the people or groups that are providing the funds and the people who are either causing the problem being addressed or who will benefit from the action.

■ Efficiency

To promote efficiency, the amount it costs to raise funds from a given revenue source must be appropriate to the quantity of funds being raised. In addition, the revenue source must be capable of raising the funds required in a timely fashion.

Revenue Sources

Based on the criteria of equity and efficiency, the most promising revenue sources identified by the Planning Subcommittee and analyzed by outside financial consultants are discussed below.

■ Water Diversion Fee

This would involve a flat-rate surcharge on all waters diverted from the Central Valley water systems. For example, in a normal year, approximately sixteen million acre-feet are diverted. A surcharge of \$1 per acre-foot would produce about \$16 million per year. This source of revenue could be used to implement water-related CCMP actions, such as fish screens, pollution abatement, or water reclamation.

■ Real Estate Transfer Surcharge

This would involve a charge to the gross value of real estate sold in the twelve Estuary counties. It would be administered as a part of the existing real estate transfer fee charged at the county level. The average dollar value of real estate transferred and subject to the existing fee in the twelve-county area is approximately \$70 billion per year.

For example, a rate of \$.0003 per \$1,000 transferred would produce a stream of revenues of approximately \$21 million per year. At this rate, the surcharge would amount to \$60 on a home sale of \$200,000. This source of revenues could be applied to the land-based CCMP actions, such as wetlands acquisition, wildlife habitat acquisition or restoration, and on-land disposal of dredged materials for habitat construction or restoration.

■ Urban Water Users' Surcharge

This source would apply a charge to those water districts with a large base of urban customers in the twelve-county region. With approximately 2.5 million acre-feet going to urban users, the surcharge would be relatively small compared to other existing charges. For example, a charge of \$4 per acre-foot per year would produce a revenue stream of \$10 million per year. At this rate, the average family would pay approximately \$4 per year. This source of revenue could be applied to urban area-related CCMP actions, such as stormwater management, pollution control, and public involvement programs.

■ Pollution Discharge Surcharge

This would apply a surcharge to all holders of National Pollutant Discharge Elimination System (NPDES) permits in the twelve-county Bay-Delta region. This permit allows the holder to discharge wastewater into the Estuary. The surcharge would be in addition to fees that each permit holder already pays. This surcharge could be a flat amount for each permit holder or could be based on the quantity of discharge. Because there are only 301 NPDES permit holders in the Bay-Delta region, a new discharge fee would probably not generate substantial revenues relative to the other sources discussed above.

The *Preliminary Implementation Strategy* provides a more detailed analysis of these potential sources of revenue.

Capital Projects

For large capital cost actions, public borrowing can be a means of providing funds for both public and private sector actions. This could involve the use of existing borrowing authorities or new bond measures designed in part to address CCMP costs that may still require a funding source. Inventories should be conducted to identify local, regional, and state borrowing capacity that has been approved by the voters but has not yet been expended. Such funds may be suitable for CCMP implementation.

Estuary Investment Fund

One potential funding mechanism identified in the *Preliminary Implementation Strategy* is the establishment of an Estuary Investment Fund (Fund), which would allow funds to be accumulated and directed to certain uses as appropriate to CCMP requirements. The Fund could provide a mechanism for the financial management necessary to implement the CCMP.

For example, a governmental entity or private sector firm could obtain funds (grants, loans, etc.) from the Fund to assist in implementing an action in the CCMP.

The Estuary Investment Fund would operate as a coordinating vehicle. It would ensure that financing of CCMP projects occurs in a systematic manner. This coordinating role could ensure that: a) funds flow to projects in the amount necessary and in a timely fashion; b) alternative funding sources have been evaluated, and funds are actually needed for the requested project (i.e., as compared to using other types of incentives or an existing program); c) overlaps and duplication are minimized among the many units of government and private sector organizations; and d) other expenditures in the Estuary area that are not part of implementing the CCMP are consistent with the CCMP.

In another role, the Fund could operate as a source of funds to fill gaps between other sources of funds and the funds needed to carry out CCMP actions. Funds could be provided as grants, cost sharing, or loans, depending upon the project and the criteria for financial support. Enabling legislation or initiative language may be required to institute the Fund.

Financial Incentives to Encourage Private Sector Implementation of the CCMP

In recent years, there has been growing interest in pursuing "nonconventional" policies to encourage private sector actions that protect and enhance environmental quality. This is not to suggest that more conventional command and control technologies are no longer appropriate. However, in certain situations, alternative approaches may lead to better results. For example, in some instances, conventional regulations discourage the private sector from using technologies that provide greater levels of control because no financial incentives exist that encourage businesses and industries to exceed their control targets.

The private sector can help carry out many CCMP actions. In some cases, it can implement these actions without any further assistance or regulation. In other instances, the private sector may need technical or financial assistance to implement the actions.

The CCMP describes private sector incentives that either create a revenue source that could be used to finance the CCMP or that achieve CCMP objectives without additional governmental spending. Examples include developing an improved program to provide tax incentives that would encourage landowners to preserve wetlands in perpetuity or assisting private sector groups in developing the most effective joint-ventures with water pollution abatement programs.

The government could assist private sector actions by providing some type of financial assistance (such as grants, cost-sharing, or low-cost loans) that would initiate the action. Fines and penalties could be used as disincentives to discourage unwanted behavior.

The implementing entity should work closely with the private sector to identify opportunities for creative incentives and for removing barriers that might be preventing CCMP implementation. Industries and businesses affected directly or indirectly by CCMP implementation should be included in the process to determine the most efficient and cost-effective method for carrying out the Plan.

Regional Monitoring

In the San Francisco Bay-Delta Estuary, monitoring includes the collection of environmental information, such as the number and health of the fish residing in the Estuary, the quality and quantity of fresh water flowing into the Estuary system, and the types and amounts of pollutants. Currently, more than seventy Estuary monitoring programs are being conducted for a number of diverse applications—each with different design, sampling, analysis, and data reduction requirements. The limited scope of some monitoring programs makes it difficult to compare results between different studies. In addition, programs are sometimes poorly linked and lack a coordinated Estuarywide approach.

To assist in coordinating research and monitoring programs, the San Francisco Estuary Project has fostered the development of a *Regional Monitoring Strategy (Monitoring Strategy)*. Project staff have worked with representatives of government agencies and scientific institutions to establish the *Monitoring Strategy*, which fulfills an action recommended in the CCMP's Research and Monitoring Program.

Implementation of the *Monitoring Strategy* will strengthen the Estuary Project's continuing effort to promote environmentally sound management of the Bay and Delta by improving the ability to define human-induced stresses on the Estuary, helping to assess the effectiveness of current Estuary management, and monitoring the long-term health of the

Estuary. The *Monitoring Strategy* will also aid in identifying overlapping program elements and areas not being adequately examined. As new programs are instituted by legislation or regulatory requirements, the *Monitoring Strategy* will provide a framework for integration and implementation of these programs in the most efficient and useful manner.

The *Regional Monitoring Strategy* is centered around the five key management issues initially identified by the SFEP Management Conference and addressed in the CCMP. These are:

- ❑ Increased pollutants;
- ❑ Increased dredging and waterway modification;
- ❑ Decline of biological resources;
- ❑ Intensified land use; and
- ❑ Freshwater diversion and altered flow regime.

The primary purposes of the *Regional Monitoring Strategy* are to:

- ❑ Provide information to assess the effectiveness of management actions that have been taken to improve conditions in the Estuary and to protect its resources; and
- ❑ Evaluate the ecological "health" of the Estuary and enhance scientific understanding of the ecosystem.

Development of the *Regional Monitoring Strategy*

The *Monitoring Strategy* builds on the information presented in the Status and Trends Reports, which describe the ecological problems of the Estuary and identify information needs. The *Monitoring Strategy* specifies monitoring objectives for each management issue. Because several methods were used to develop these objectives, differences are evident in both their level of detail and their breadth.

The Project held technical workshops specifically to develop monitoring objectives for three of the management issues: increased pollutants, dredging and waterway modification, and wetlands. The format, number, and technical background of participants varied in all workshops, but a common purpose was to build upon the work presented in the Status and Trends Reports and to define monitoring objectives and corresponding monitoring variables.

The Project also sponsored a series of four workshops to evaluate the responses of estuarine biota and habitats to various conditions of salinity and flow. Through these workshops, participants identified monitoring needs for the management issue of freshwater diversion and altered flow regime. The Interagency Ecological Study Program (IESP) is currently revising its existing monitoring program. This program will form the basis of much of the aquatic resources monitoring efforts in the Estuary.

For the most part, the monitoring objectives presented in the *Monitoring Strategy* are defined in terms of existing conditions in the Estuary. The intent of these objectives is to detect the direction and magnitude of change from existing conditions. The long-term challenge must be to restore and maintain conditions in the Estuary that will support healthy fish and wildlife populations.

To accomplish this, a regional monitoring program developed from the *Monitoring Strategy* must, at some point, specify ecological objectives (or assessment endpoints) and corresponding monitoring variables. Setting these ecological objectives is a risk management task that involves defining reference conditions, as well as balancing costs and ecological risks. Existing water quality criteria and proposed sediment criteria are examples of ecological objectives that can be used in a regional monitoring program. Similar ecological objectives (or assessment endpoints) must be developed for aquatic resources, wetlands, land use, and other monitoring program elements.

Because these endpoints have not been defined, their specification for a regional monitoring program represents a long-term challenge. The *Monitoring Strategy* provides a starting point for discussion between the technical experts and resource managers on the selection of thresholds or endpoints, as well as levels of change that must be detected by a regional monitoring program to guide management decisions.

Principles Upon Which the *Monitoring Strategy* is Based

Seven fundamental principles define the purpose of the monitoring effort, the relationship between monitoring and research, and the short- and long-term goals of the monitoring effort in the San Francisco Bay-Delta Estuary. These principles also determine the nature and scope of the proposed Regional Monitoring Program.

1. Monitoring is focused on the development of data that will provide information on status and trends in the Estuary. While there is a need for basic research in the Estuary, the goal of the proposed monitoring program is to provide fundamental information describing the current status and trends of specified habitats and resources. Measurement variables are limited to those that are easily interpretable.

2. There must be a commitment to the development of an integrated program.

The Regional Monitoring Program must incorporate existing and planned monitoring efforts (or elements from these programs) to minimize duplication of effort, maximize the development of essential information, and reduce the cost of the monitoring effort.

The *Regional Monitoring Strategy* will facilitate the adoption of standard protocols for sampling, analytical procedures, and quality assurance/quality control (QA/QC) methods. To ensure that the data collected by different groups participating in the monitoring program are directly comparable, performance-based, standardized sampling, analytical, and QA/QC protocols must be employed.

The standardization and coordination of existing sampling efforts among local, state, and federal agencies will allow long-term sharing and use of all data collected as part of the Regional Monitoring Program.

3. A data and information plan must be developed to ensure access to essential information.

Historical monitoring data from the Estuary are not readily available, and essential quality assurance information necessary to evaluate the comparability of data sets is often not preserved. A data and information management system must be developed to ensure access to monitoring data.

4. A coordinating entity must be created to manage regional monitoring.

During the Regional Monitoring Workshop in October of 1991, participants agreed that an entity is needed to coordinate regional monitoring and research. The entity would also act as a "clearinghouse" for data and information collected by the various agencies and organizations performing monitoring in the Estuary. The CCMP also recommends the establishment of such an entity. Therefore, the *Monitoring Strategy* proposes that the San Francisco Estuarine Institute serve as this coordinating entity.

5. A complementary special studies (or research) program is needed because regional monitoring alone will not provide insights into cause-and-effect relationships among human actions and environmental responses.

The special studies program will assist regional scientists in their interpretation of monitoring information and will link effects with their most probable causes. Then managers can target specific remedial and preventive actions that will have the most beneficial environmental effects. In addition, scientists and managers periodically have the need to investigate new potential problems (and solutions) that require short-term, intensive, and immediate study.

6. A regional assessment of the monitoring data is needed to determine the ecological health of the Estuary.

Every year, an annual report should be developed from an interpretation of the most current monitoring data. Scientists and managers should decide upon a suite of diagnostic indicators that will provide the entire community with an instantaneous picture of the overall status of the Estuary's physical, chemical, and biological resources. To accomplish this, interpretation plans must be prepared concurrently with the development of the various technical protocols.

7. A successful monitoring program for the San Francisco Bay-Delta Estuary must have the active participation of the managers and scientists at all the key agencies, organizations, private enterprises, and the public.

A comprehensive monitoring program can only be accomplished by the involvement and cooperation of the myriad agencies and organizations currently performing or overseeing the monitoring in the Estuary. The managers and scientists must periodically review the goals and technical merits of programs with the valued and needed input of the public.

Monitoring Program Evaluation

One of the most important steps in the design of a monitoring program is providing for evaluation of expected performance. Without this evaluation, there is a risk of either collecting and analyzing too few samples to detect statistically significant temporal/spatial trends or analyzing an excessive number of samples. Therefore, the *Monitoring Strategy* sets forth design specifications that can be used in conjunction with historical data to evaluate the expected performance of alternative monitoring designs.

Resolving Overlaps and Gaps in Monitoring Efforts and Information Needs

Overlaps and gaps in data have arisen because monitoring programs were developed to fill the specific information needs of a particular agency in a particular part of the Estuary. The Regional Monitoring Program must integrate, coordinate, and consistently collect physical, chemical, and biological data at defined locations on defined synchronous schedules using standard, performance-based protocols. This approach will:

- ❑ Reduce duplication in sampling efforts;
- ❑ Fill data gaps due to incomparable methods and timing of sampling;
- ❑ Increase the efficiency of collecting, checking, and sorting data;
- ❑ Facilitate the time and cost of sharing and analyzing data; and
- ❑ Allow testing of meaningful correlation among several parameters measured over time.

The Role of Special Studies

To solve problems identified in the Estuary, monitoring and special study (research) efforts must be integrated and coordinated toward a common goal. Special studies can provide information essential to understanding the Estuary and its associated watersheds and for developing management options for the long-term protection of the Estuary.

The role of special studies related to monitoring is two-fold. First, it is to provide specific information necessary to make interpretations of changes and relationships observed in the descriptive monitoring data. Second, special studies must provide specific information that is critical in delineating cause-and-effect relationships when monitoring and other data indicate that adverse changes are occurring. Currently, there is sufficient circumstantial evidence from ongoing monitoring to begin focusing specific special studies.

Special study priorities must be established early. Otherwise, special studies will consist of an unfocused and fragmented pattern of agency-sponsored, short-term contract projects. The *Regional Monitoring Strategy* therefore recommends that first priority be given to filling data gaps needed to make accurate assessments of the status of habitats and resources, to understand cause-and-effect relationships, and to adequately detect and interpret changes observed in the regional monitoring data.

Data and Information Management

Development of a data and information management strategy is a key undertaking in the development of a regional monitoring program. The plan for submitting, checking, sorting, updating, retrieving, analyzing, and reporting data is as important to the success of the program as is collecting the data. The need to assimilate, integrate, and disseminate information gathered during the characterization process, as well as from future monitoring efforts, requires the development of a sound, comprehensive data and information management component.

Education and Public Outreach

While volunteer programs to monitor natural resources have been in practice for some time, they have only recently come to the fore in agency monitoring and public outreach. Citizen monitoring has also become a focus of the San Francisco Estuary Project and is addressed in other sections of the CCMP. The Public Involvement and Education Program recommends increased support of citizen monitoring programs, agency involvement in citizens' monitoring, and overall expansion of public involvement in the monitoring process. (See the Public Involvement and Education Program for more details.)

The *Regional Monitoring Strategy* recommends that CCMP actions regarding citizen monitoring be adopted and implemented as soon as possible. Citizen monitoring programs represent an excellent and largely untapped source of information and can greatly enhance agency efforts.

For additional detail, please refer to the separate *Regional Monitoring Strategy*.

Public Involvement

Public participation has been essential to all aspects of the San Francisco Estuary Project since the Project began more than five years ago. More than one hundred people representing a variety of interests have been directly involved in the cooperative effort to develop the CCMP.

These community leaders have identified critical areas of concern, determined the scope of scientific studies, developed policies and recommendations for corrective action, and formed a structure for overseeing implementation of the Plan. Together, they have created a new vision for the San Francisco Estuary, with goals, objectives, and specific actions to restore and preserve its health and productivity.

Recognizing the importance of the public's involvement in caring for the Estuary, the Project created educational materials to focus public attention on the Estuary's problems and promote informed activism. The Project encouraged citizen volunteers to participate in hands-on activities to restore and protect the Estuary.

As the Project moves into the implementation phase, it will be essential to continue this unique public/private partnership. New opportunities will be created for the public to become more actively involved in policy making, management, protection, and restoration of the San Francisco Estuary and to participate directly in the oversight of CCMP implementation.

The public must come to realize the importance of this magnificent Estuary and choose to become personally involved in its protection. Only then will people fully embrace the Plan, then actively promote it, use it, enforce it, watchdog it, invest in it, finance its continuance, and ensure its ultimate success.

The actions recommended in the Public Involvement and Education Program will build public awareness of and appreciation for the many beneficial uses of the Estuary. In turn, the public will build support for CCMP actions that ensure the Estuary's restoration and continued protection. The Public Involvement and Education Program also links concerned members of the public and policy-makers and assists those generating information about the San Francisco Estuary in providing news and data to the general public.

Friends of the San Francisco Estuary (Friends) will implement the CCMP by:

1. Ensuring that the activities recommended in the Public Involvement and Education Program of the CCMP are carried out.

Friends will develop:

- ❑ Educational materials for youth, the general public, and decision-makers;
- ❑ Regionwide outreach programs;
- ❑ An informational hotline and newsletter;
- ❑ Community-designed model projects; and
- ❑ Informational materials that support multicultural understanding of the CCMP's goals and actions.

Friends will serve as a public involvement and education resource for local, state, and federal governmental agencies involved in implementing the CCMP. In addition, it will actively support the environmental programs of other organizations that are consistent with the goals of the CCMP.

Friends will encourage the public to become directly involved in restoring the Estuary through hands-on activities, such as creek and wetland restoration projects, storm drain stenciling, citizen monitoring programs, recycling, and beach clean ups.

2. Functioning as an advocate and watchdog for CCMP implementation.

Friends will educate and mobilize constituencies and the interested public to actively push for implementation of CCMP actions. Once actions are underway, Friends will serve as a mechanism by which the public can monitor the program's effectiveness. Progress reports and recommendations for CCMP changes will be presented at a biennial State of the Estuary Conference for those involved in CCMP implementation, the general public, scientists, and decision-makers.

3. Providing the public involvement and review function within the CCMP institutional implementation structure.

Friends will ensure that there is an opportunity for the public to have direct, meaningful participation in decision making and CCMP implementation oversight activities. Friends will also ensure that the broad public constituency contained within the SFEP Management Conference will have an opportunity to review and comment on the effectiveness of CCMP implementation activities and recommend changes to the CCMP.

4. Recommending and initiating legislative changes to facilitate implementation of the CCMP.

Friends will be responsible for developing a legislative strategy to keep legislators informed. Actions could include briefing legislators and staff, testifying at hearings, and proposing appropriate state and federal legislation as needed to implement the CCMP.

APPENDIX A: *References*

- ABAG, 1989a. *Projections 90. Forecasts for the San Francisco Bay Area to the Year 2005*. Association of Bay Area Governments. Oakland, California. 293 pages.
- Aquatic Habitat Institute, 1992. *Status and Assessment of Selected Monitoring Programs in San Francisco Estuary*. 128 pages and appendices.
- Aquatic Habitat Institute and Phillip Williams & Associates Ltd., 1990. *Status and Trends Report on Dredging and Waterway Modifications in the San Francisco Estuary*. Prepared for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 250 pages and appendices.
- Blanchfield, J.S., R. Twiss, S. McCreary, and J. Sayer, 1992. *Status and Trends Report on the Effects of Land Use Change and Intensification on the San Francisco Estuary*. Prepared by San Francisco Bay Conservation and Development Commission for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 157 pages.
- Cohen, A.N. and J.M. Laws, 1991. *An Introduction to the Ecology of the San Francisco Estuary*, 2nd ed. Prepared by Save San Francisco Bay Association for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 29 pages.
- Davis, J.A., A.J. Gunther, B.J. Richardson, J.M. O'Conner, R.B. Spies, E. Wyatt, E. Larson, and E.C. Meiorin, 1991. *Status and Trends Report on Pollutants in the San Francisco Estuary*. Prepared by the Aquatic Habitat Institute for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 240 pages and appendices.
- Harvey, T.E., K.J. Miller, R.L. Hothem, M.J. Rauzon, G.W. Page, and R.A. Keck, 1992. *Status and Trends Report on Wildlife of the San Francisco Estuary*. Prepared by the U.S. Fish and Wildlife Service for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 283 pages and appendices.
- Herbold, B., A.D. Jassby, and P.B. Moyle, 1992. *Status and Trends Report on Aquatic Resources in the San Francisco Estuary*. Prepared by U.C. Davis for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 257 pages and appendices.
- International Maritime Organization, adopted July 4, 1991. *Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges*. Published in Federal Register, December 12, 1991, Appendix A, Volume 56, #239, P. 64832.
- James M. Montgomery Consulting Engineers, Inc. (currently Montgomery Watson), 1991. *Updated Evaluation: Export of Reclaimed Water from the Bay Area, Draft*. Prepared for the City and County of San Francisco. v.p.
- Meiorin, E.C., J. Calloway, M.N. Josselyn, R. Crawford, K. Miller, R. Pratt, T. Richardson, and R. Leidy, 1991. *Status and Trends Report on Wetlands and Related Habitats in the the San Francisco Estuary*. Prepared by the Association of Bay Area Governments for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 209 pages and appendices.
- Monroe, M.W. and J. Kelly, 1992. *State of the Estuary. A Report on Conditions and Problems in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary*. Prepared by the Association of Bay Area Governments for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 235 pages and appendices.
- Moyle, P.M. and R.M. Yoshiyama, 1992. *Fishes, Aquatic Diversity Management Areas, and Endangered Species: A Plan to Protect California's Native Aquatic Biota*, from the California Policy Seminar Report. University of California Press: Berkeley, California.
- O'Conner, J.M. and J.A. Davis, 1991. *Quality Assurance in Environmental Analysis Applied to the San Francisco Estuary*. Prepared by the Aquatic Habitat Institute for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 57 pages and appendix.

Perkins, Jeanne B., S. Potter, and L. Stone, 1991. *Status and Trends Report on Land Use and Population. The Geomorphology, Land Use and Population Patterns in the San Francisco Bay, Delta, and Central Valley Drainage Basins*. Prepared by the Association of Bay Area Governments for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 72 pages and appendices.

Schubel, J.R., editor, 1993. *Managing Freshwater Discharge to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: The Scientific Basis for an Estuarine Standard, Conclusions and Recommendations of Members of the Scientific, Policy, and Management Communities of the Bay/Delta Estuary*. Prepared for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 17 pages and appendices.

Tetra Tech., Inc., 1993. *Regional Monitoring Strategy*. Prepared for the San Francisco Estuary Project, U.S. Environmental Protection Agency. 144 pages and appendices.

U.S. Environmental Protection Agency, Office of Water, 1992. *National Estuary Program Guidance: Content Requirements and Approval Process for National Estuary Program Comprehensive and Conservation Management Plans*. Document 842-B-92-002. 29 pages and appendices.

U.S. Environmental Protection Agency, Region 9, Oceans, Wetlands, and Estuaries Section, 1993. *Comprehensive Conservation and Management Plan Preliminary Implementation Strategy*. Prepared for the San Francisco Estuary Project. 20 pages and appendices. Unpublished document.

APPENDIX B: *Glossary*

- ACRE-FOOT** – An acre of water one foot deep (approximately 326,000 gallons). The typical California family of five uses an acre-foot of water in and around the home each year.
- AMBIENT** – Refers to the overall conditions surrounding a place or thing. For example, ambient monitoring refers to comprehensive monitoring of water quality, biota, sediments, etc.
- ANADROMOUS** – Fish that live some or all of their adult lives in salt water but migrate to fresh water to spawn (reproduce).
- ANTHROPOGENIC** – Effects or processes that are derived from human activities, as opposed to natural effects or processes that occur in the environment without human influence.
- BENEFICIAL USE** – Uses of the waters of the state that may be protected against quality degradation, including domestic, municipal, agricultural, and industrial supply; recreation and navigation; and the preservation of fish and wildlife.
- BENTHOS** – Zone at the bottom of a body of water inhabited by mussels, clams, crustaceans, and other aquatic life.
- BEST AVAILABLE TECHNOLOGY** – The best economically achievable technology that reduces negative impacts on the environment.
- BEST MANAGEMENT PRACTICE** – A method, activity, maintenance procedure, or other management practice for reducing the amount of pollution entering a water body. The term originated from the rules and regulations developed pursuant to the federal Clean Water Act (40 CFR 130).
- BEST DEVELOPMENT PRACTICE** – Those codes, procedures, or other land-use practices that minimize adverse environmental impacts.
- BIOACCUMULATION** – Accumulation by organisms of contaminants by ingestion or from contact with the skin or respiratory tissue.
- BIOASSAY** – A laboratory test using live organisms to measure biological effects of a substance, factor, or condition.
- BIOAVAILABILITY** – The extent to which a compound is obtainable for biological use by organisms.
- BIOCONCENTRATION** – Chemicals that increase in living organisms resulting in concentrations greater than those found in the environment.
- BIOTA** – All living organisms that exist in a region.
- BRACKISH** – Somewhat salty water that is less salty than sea water.
- BRINE** – Concentrated solution of salts.
- BUFFER AREAS** – Zones created or sustained to minimize the negative effects of land development on animals and plants and their habitats.
- CARCINOGENIC** – Capable of causing or inciting cancer.
- CONJUNCTIVE USE** – The use of land, air, or water for more than one purpose or by more than one person. Conjunctive uses exist side by side or in tandem.
- CONSERVATION EASEMENTS** – Areas that allow for unrestricted movement of biota by connecting protected wildlife regions to each other. These corridors are usually established by joint agreement between landowners and state or federal agencies and may be temporary or perpetual.
- CONTAMINATION** – The impairment of water quality by waste to a degree that creates a hazard to public health through poisoning or through the spread of disease.
- CUMULATIVE EFFECTS** – The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be severe.
- DDE AND DDT** – Dichloro-diphenyldichloro-ethylene and dichloro-diphenyl-trichloroethane are two formerly commonly used pesticides that are now banned in the United States.
- DELTA** – An area formed by alluvial deposits of sand, silt, mud, and other particles at the mouth of a river.
- DETRITUS** – Small particles of organic matter, largely derived from the breakdown of dead vegetation. Detritus is an important source of food in marshes and mudflats.
- DIKING** – A method of artificially changing the direction of a course of water or confining water.
- DIVERSION** – The act of turning the natural course of water for use in other purposes.
- DRAFT** – The measure of the portion of a ship that is below the water's surface.
- DREDGING** – The removal of sediments from the Estuary and ocean floor.
- EFFLUENT** – Wastewater discharged into the Estuary from point sources.
- EIR/EIS** – Environmental Impact Reports and Statements that are required by state law (California Environmental Quality Act) and federal law (National Environmental Policy Act) for major projects or legislative proposals that significantly affect the environment. EIRs (state) and EISs (federal) facilitate decision making as they describe the positive and negative effects of the action and prescribe alternative actions.
- ENDEMIC** – A native species defined in terms of a restricted geographical range.
- ENTRAPMENT ZONE** – The area where salty ocean water moving upstream mixes with fresh water flowing downstream. The mixing dynamics in this zone trap nutrients, organic and inorganic materials (e.g., fish and invertebrate eggs), and other food sources. These circumstances enable considerable plant and animal growth, but an entrapment zone's success depends on its location and surrounding conditions.
- ENTRAINMENT** – The collection and transport of objects caught by the flow of a fluid moving at high velocity. For example, fish are often inadvertently entrained by water diversions.

- ESTUARY** – A body of water at the lower end of a river, which is connected to the ocean and semi-enclosed by land. In an estuary, sea water is measurably diluted by fresh water from the land.
- FILL** – Soil, sand, and debris deposited in aquatic areas, such as wetlands, to create dry land, usually for agricultural or commercial development purposes.
- FOOD WEB** – Network of interconnected food chains and feeding interactions among organisms.
- GROUNDWATER RECHARGE** – Replenishment of water that circulates in underground aquifers.
- HABITAT** – The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life and should be free of harmful contaminants.
- IMPERMEABLE LAYER** – Layer of clay below ground surface that can impede downward percolation of water.
- INDICATOR SPECIES** – A species whose characteristics show the presence of specific environmental conditions and are representative of a certain habitat type or function.
- INDIGENOUS** – Species whose origin has not been introduced from elsewhere.
- INVERTEBRATES** – Small organisms, such as clams and worms, that lack a spinal column. Many of these filter bottom sediments and water for food.
- LEACH** – To pass out or through soil by water percolation.
- LEACHING** – The removal of salts and trace elements from soil by the downward percolation of water.
- LEVEE** – Raised bank of earth built to control or confine water (also known as a dike).
- MARSH** – A wetland where the dominant vegetation is non-woody plants, such as grasses and sedges, as opposed to a swamp, where the dominant vegetation is woody plants like trees.
- MEAN** – Mid-point between high and low.
- MITIGATION** – Actions taken to alleviate the negative effects of a particular project. Wetland mitigation usually takes the form of restoration or enhancement of a previously damaged wetland or creation of a new wetland.
- MOUNDING** – Refers to dredged sediments disposed of in the water that build up instead of dispersing with currents and tides.
- MUTAGENIC** – A substance that tends to increase mutations or chromosomal alterations.
- NATIVE** – Refers to those species originating naturally in a particular region.
- NON-INDIGENOUS** – Species not naturally living or growing in a particular area. (NOTE: For the purposes of the CCMP, desirable non-indigenous species are those that provide beneficial use to the Estuary. For example, striped bass are considered beneficial because they provide an important recreational opportunity.)
- NONPOINT SOURCE POLLUTION** – Pollution that enters water from dispersed and uncontrolled sources, such as surface runoff, rather than through pipes. Nonpoint sources (e.g., forest practices, agricultural practices, on-site sewage disposal, automobiles, and recreational boats) may contribute pathogens, suspended solids, and toxicants. While individual sources may seem insignificant, the cumulative effects of nonpoint source pollution can be significant.
- NPDES** – National Pollutant Discharge Elimination System, a provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state, or another delegated agency.
- PAHS** – Polycyclic or Polynuclear Aromatic Hydrocarbons. A class of complex organic compounds, some of which are persistent and cause cancer. These compounds are formed from the combustion of organic material and are ubiquitous in the environment. PAHs are commonly formed by forest fires and by the combustion of gasoline and other petroleum products. They often reach the environment through atmospheric fallout and highway runoff.
- PCBs** – Polychlorinated Biphenyls. A group of manufactured chemicals, including about seventy different but closely related compounds made up of carbon, hydrogen, and chlorine. If released to the environment, PCBs persist for long periods and can biomagnify in food chains because they have no natural usage in the food web. PCBs are suspected of causing cancer in humans and other animals. PCBs are an example of an organic toxicant.
- PEAT** – Partially carbonized vegetable tissue that forms as plants decompose in water and are deposited and compacted.
- PERMEABLE** – Able to be infiltrated by water.
- PHYTOPLANKTON** – Tiny floating plants that are eaten by minute animals, fish larvae, and other larger organisms.
- PLANKTON** – Microscopic plants and animals that drift with the currents.
- PLUME** – An elongated cloud of suspended sediment.
- POINT SOURCE POLLUTION** – A source of pollutants from a single point of conveyance, such as a pipe. For example, the discharge from a sewage treatment plant or a factory is a point source.
- POLLUTANT** – A harmful chemical or waste material discharged into the environment. Persistent pollutants are those that do not degrade, causing potential long-term chronic toxicity to biotas.
- POLLUTION** – Impairment of land, air, or water quality by agricultural, domestic, or industrial waste to a degree having an adverse effect on beneficial uses or the facilities that serve such beneficial uses.
- POTWS** – Publicly Owned Treatment Works treat municipal sewage and wastewater before discharging it into the Estuary.

- REMEDICATION** – A way of correcting or alleviating a problem or situation. Legally, remediation is either a means of compensating for a violation of the law or for unavoidable impacts resulting from legal activities.
- RESTORE** – For the purposes of the CCMP, restoration implies improving the health of the Estuary. Rather than attempting to completely restore the Estuary to its historical state, the CCMP strives to maintain, protect, and enhance the ecological integrity of the Estuary within the given urban context. The CCMP attempts to regain as much of the altered or destroyed wetlands as possible, to establish the highest restoration or target goals, to ensure continuance of beneficial uses, and to generally provide a sustainable ecosystem.
- REVERSE FLOWS** – When freshwater inflow is low and export pumping is high, the lower San Joaquin River changes direction and flows upstream.
- RIPARIAN** – Habitat occurring along the bank of a natural and freshwater waterway (e.g., a river, stream, or creek) that provides for a high density, diversity, and productivity of plant and animal species.
- RUNOFF** – Water from rain, melted snow, or agricultural or landscape irrigation that flows over the land surface.
- SALTS** – A class of compounds that includes common table salts, sodium chloride, as well as salts of concern in irrigated agriculture, e.g., the various carbonated, bicarbonates, sulfates, phosphates, and chlorides of sodium, calcium, potassium, and magnesium.
- SAVANNAH** – A grassland area containing scattered trees and drought-resistant undergrowth.
- SEDIMENT** – Mud, sand, silt, clay, shell debris, and other particles that settle on the bottoms of waterways.
- SELENIUM** – A naturally occurring element essential to human and animal sustenance. However, selenium is toxic at little over the suggested nutritional levels. Selenium is used in a variety of products, is a bi-product of many industrial activities, and is leached from the soil and becomes agricultural runoff.
- SLOUGH** – A channel through a marsh or mudflat.
- SLURRY** – Sediments mixed with water.
- SOURCE REDUCTION** – An approach that uses raw material substitution and technological improvements to eliminate toxic wastes at their source.
- SPAWN** – The act of reproduction of fish, which includes egg laying and fertilization, and sometimes nest building (e.g., salmon).
- SPECIAL STATUS SPECIES** – Federal and state classifications for plant and animal species that are either listed as threatened or endangered, are formally recognized candidates for a listing, or are declining to a point where they may be listed.
- SUBSIDENCE** – Lowering or sinking of land caused by compaction, wind and water erosion, oxidation of peat soils, and other causes.
- SUBSURFACE DRAINAGE** – When an impermeable clay layer causes water to accumulate just beneath the land's surface. Tile drains remove water from the root zone to a stream, drainage ditch, or evaporation pond.
- SUSPENDED SEDIMENTS** – Undissolved particles floating in water.
- TAILWATER AND SEEPAGE** – Tailwater is the excess irrigation water that runs off the surface of a field; seepage is the excess that sinks in.
- TBT** – Tributyltin. An organic compound used as an additive in many marine anti-foulant paints used to prevent algal and barnacle growth. Tributyltin is highly toxic to many marine organisms.
- THMs** – Trihalomethanes are carcinogens that are by-products of the water disinfection process. They are formed when organic compounds found in water come into contact with chlorine used for disinfection during water treatment.
- TIDE** – The alternating rise and fall of the ocean and bay surface that occurs twice a day, caused by the gravitational pull of the sun and moon upon the earth and by the rotation of the earth, moon, and sun.
- TILE DRAINS** – A network of pipes, formerly made of ceramic tile but now usually plastic, buried in fields below the root zone of plants. The drains are designed to collect excess water and carry it by gravity flow to one point where it can be pumped out to a canal, stream, or evaporation pond.
- TRACE ELEMENTS** – Members of the set of ninety-two naturally occurring elements (such as selenium and silver) found in low concentrations, usually less than one part per million. Trace elements can be found in rocks, soil, and water.
- TREATMENT** – Wastewater treatment is divided into three steps: primary, secondary, and tertiary. Primary treatment uses screens and sedimentation tanks to remove most materials likely to float on the water or settle on the bottom. Secondary treatment uses a biological process to consume organic materials in the waste and disinfect the effluent. Tertiary treatment removes additional nutrients, suspended solids, and other pollutants.
- TURBIDITY** – The clouding of a naturally clear liquid due to suspension of fine solids. Because turbidity reduces the amount of light penetrating the water column, high turbidity levels are harmful to aquatic life.
- WATER COLUMN** – The layer of water between surface and bottom sediments. The water column contains dissolved and particulate matter and provides habitat for plankton, fish, and marine mammals.
- WETLANDS** – Lands that are transitional areas between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Two major wetland types of concern are seasonal wetlands inundated by winter and spring rainfall and flooding, and tidal wetlands flooded daily by ocean tides.
- VERNAL POOLS** – Depressions that fill with rain water in the wet season and dry out in late spring. Vernal pools often contain plants that can withstand extremes in water availability.

APPENDIX C: *Clean Water Act (Sec. 320)*

Sec. 320. (a) Management Conference.—

(1) *Nomination of Estuaries.*—The Governor of any State may nominate to the Administrator an estuary lying in whole or in part within the State as an estuary of national significance and request a management conference to develop a comprehensive management plan for the estuary. The nomination shall document the need for the conference, the likelihood of success, and information relating to the factors in paragraph (2).

(2) *Convening of Conference.*—

(A) *In General.*—In any case where the Administrator determines, on his own initiative or upon nomination of a State under paragraph (1), that the attainment or maintenance of that water quality in an estuary which assures protection of public water supplies and the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife, and allows recreational activities, in and on the water, requires the control of point and nonpoint sources of pollution to supplement existing controls of pollution in more than one State, the Administrator shall select such estuary and convene a management conference.

(B) *Priority Consideration.*—The Administrator shall give priority consideration under this section to Long Island Sound, New York and Connecticut; Narragansett Bay, Rhode Island; Buzzards Bay, Massachusetts; Puget Sound, Washington; New York-New Jersey Harbor, New York and New Jersey; Delaware Bay, Delaware and New Jersey; Delaware Inland Bays, Delaware; Albemarle Sound, North Carolina; Sarasota Bay, Florida; San Francisco Bay, California; and Galveston Bay, Texas.

(3) *Boundary Dispute Exception.*—In any case in which a boundary between two States passes through an estuary and such boundary is disputed and is the subject of an action in any court, the Administrator shall not convene a management conference with respect to such estuary before a final adjudication has been made of such dispute.

(b) *Purposes of Conference.*—The purposes of any management conference convened with respect to an estuary under this subsection shall be to—

(1) assess trends in water quality, natural resources, and uses of the estuary;

(2) collect, characterize, and assess data on toxics, nutrients, and natural resources within the estuarine zone to identify the causes of environmental problems.

(3) develop the relationship between the in-place loads and point and nonpoint loadings of pollutants to the estuarine zone and the potential uses of the zone, water quality, and natural resources;

(4) develop a comprehensive conservation and management plan that recommends priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of the estuary, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected;

(5) develop plans for the coordinated implementation of the plan by the States as well as Federal and local agencies participating in the conference;

(6) monitor the effectiveness of actions taken pursuant to the plan; and

(7) review all Federal financial assistance programs and Federal development projects in accordance with the requirements of Executive Order 12372, as in effect on September 17, 1983, to determine whether such assistance program or project would be consistent with and further the purposes of objective of the plan prepared under this section.

For purposes of paragraph (7), such programs and projects shall not be limited to the assistance programs and development projects subject to Executive Order 12372, but may include any programs listed in the most recent Catalog of Federal Domestic Assistance which may have an effect on the purposes and objective of the plan developed under this section.

(c) **Members of Conference.**—The members of a management conference convened under this section shall include, at a minimum, the Administrator and representatives of—

- (1) each State and foreign nation located in whole or in part in the estuarine zone of the estuary for which the conference is convened;
- (2) international, interstate, or regional agencies or entities having jurisdiction over all or a significant part of the estuary;
- (3) each interested Federal agency, as determined appropriate by the Administrator;
- (4) local governments having jurisdiction over any land or water within the estuarine zone, as determined appropriate by the Administrator; and
- (5) affected industries, public and private educational institutions, and the general public, as determined appropriate by the Administrator.

(d) **Utilization of Existing Data.**—In developing a conservation and management plan under this section, the management conference shall survey and utilize existing reports, data, and studies relating to the estuary that have been developed by or made available to Federal, Interstate, State and local agencies.

(e) **Period of Conference.**—A management conference convened under this section shall be convened for a period not to exceed 5 years. Such conference may be extended by the Administrator, and if terminated after the initial period, may be reconvened by the Administrator at any time thereafter, as may be necessary to meet the requirements of this section.

(f) **Approval and Implementation Plans.**—

(1) **Approval.**—Not later than 120 days after the completion of a conservation and management plan and after providing for public review and comment, the Administrator shall approve such plan if the plan meets the requirements of this section and the affected Governor or Governors concur.

(2) **Implementation.**—Upon approval of a conservation and management plan under this section, such plan shall be implemented. Funds authorized to be appropriated under titles II and VI and section 319 of this Act may be used in accordance with the applicable requirements of this Act to assist States with the implementation of such plan.

(g) **Grants.**—

(1) **Recipients.**—The Administrator is authorized to make grants to State, Interstate, and regional water pollution control agencies and entities, State coastal zone management agencies, Interstate agencies, other public or nonprofit private agencies, institutions, organizations, and individuals.

(2) **Purposes.**—Grants under this subsection shall be made to pay for assisting research, surveys, studies, and modeling and other technical work necessary for the development of a conservation and management plan under this section.

(3) **Federal Share.**—The amount of grants to any person (including a State, interstate, or regional agency or entity) under this subsection for a fiscal year shall not exceed 75 percent of the costs of such research, survey, studies, and work and shall be made on condition that the non-Federal share of such costs are provided from non-Federal sources.

(h) **Grant Reporting.**—Any person (including a State, interstate, or regional agency or entity) that receives a grant under subsection (g) shall report to the Administrator not later than 18 months after receipt of such grant and biennially thereafter on the progress being made under this section.

(i) **Authorization of Appropriations.**—There are authorized to be appropriated to the Administrator not to exceed \$12,000,000 per fiscal year for each of fiscal years 1987, 1988, 1989, 1990, and 1991 for—

- (1) expenses related to the administration of management conferences under this section, not to exceed 10 percent of the amount appropriated under this subsection
- (2) making grants under subsection (g); and
- (3) monitoring the implementation of a conservation and management plan by the management conference or by the Administrator, in any case in which the conference has been terminated. The Administrator shall provide up to \$5,000,000 per fiscal year of the sums authorized to be appropriated under this subsection to the Administrator of the National Oceanic and Atmospheric Administration to carry out subsection (j).

(j) Research.—

(1) Programs.—In order to determine the need to convene a management conference under this section or at the request of such a management conference, the Administrator shall coordinate and implement, through the National Marine Pollution Program Office and the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration, as appropriate, for one or more estuarine zones—

(A) a long-term program of trend assessment monitoring measuring variations in pollutant concentrations, marine ecology, and other physical or biological environmental parameters which may affect estuarine zones to provide the Administrator the capacity to determine the potential and actual effects of alternative management strategies and measures;

(B) a program of ecosystem assessment assisting in the development of (i) baseline studies which determine the state of estuarine zones and the effects of natural and anthropogenic changes, and (ii) predictive models capable of translating information on specific discharges or general pollutant loadings within the estuarine zones into a set of probable effects on such zones;

(C) a comprehensive water quality sampling program for the continuous monitoring of nutrients, chlorine, acid precipitation dissolved oxygen, and potentially toxic pollutants (including organic chemicals and metals) in estuarine zones, after consultation with interested State, local, interstate, or international agencies and review and analysis of all environmental sampling data presently collected from estuarine zones; and

(D) a program of research to identify the movements of nutrients, sediments and pollutants through estuarine zones and the impact of nutrients, sediments, and pollutants on water quality, the ecosystem, and designated or potential uses of the estuarine zones.

(2) Reports.—The Administrator, in cooperation with the Administrator of the National Oceanic and Atmospheric Administration, shall submit to the Congress no less often than biennially a comprehensive report on the activities authorized under this subsection including—

(A) a listing of priority monitoring and research needs;

(B) an assessment of the state and health of the Nation's estuarine zones, to the extent evaluated under this subsection;

(C) a discussion of pollution problems and trends in pollutant concentrations with a direct or indirect effect on water quality, the ecosystem, and designated or potential uses of each estuarine zones, to the extent evaluated under this subsection; and

(D) an evaluation of pollution abatement activities and management measures so far implemented to determine the degree of improvement toward the objective expressed in subsection (b)(4) of this section.

(k) Definitions.—For purposes of this section, the terms “estuary” and “estuarine zone” have the meanings such terms have in section 104(n)(4) of this Act, except that the term estuarine zone shall also include associated aquatic ecosystems and those portions of tributaries draining into the estuary up to the historic height of migration of anadromous fish or the historic head of tidal influence, whichever is higher.

APPENDIX D: *Gaps in Knowledge*

Each of the Status and Trends Reports (STRs) contains a chapter on perceived information gaps in scientific knowledge of the Estuary. SFEP staff have compiled in this CCMP a complete list of the Gaps in Knowledge (GIK) chapters of the following Status and Trends Reports :

- Aquatic Resources of the San Francisco Estuary;
- Wildlife of the San Francisco Estuary;
- Pollutants in the San Francisco Estuary;
- Dredging and Waterway Modification in the San Francisco Estuary; and
- Wetlands and Related Habitats in the San Francisco Estuary.

The original, unedited versions of these GIK chapters are available upon request from SFEP staff. Currently, staff are assessing the degree to which research projects funded under the Research Enhancement Program are filling the perceived gaps in knowledge.

Outline of Gaps in Knowledge From the SFEP Status and Trends Reports

Aquatic Resources

In order to attain a useful understanding of the estuarine ecosystem, several steps are needed:

1. Determine patterns of use for the major species of each embayment, regardless of their economic value.
2. Determine the productivity of the various parts of the Estuary and identify food origins for aquatic animals.
3. Determine the trophic connections of the aquatic resources of the Bay. Production of *Melosira*, *Sinocalanus*, or *Potamocorbula* is unlikely to provide the same fish abundances as equivalent densities of *Asterionella* or *Eurytemora*. Simply determining the number of trophic levels would provide a much more sound basis for estimating potential fish production.
4. Identify the sources of mortality and the mortality rates for representative species in each habitat.
5. Develop an understanding of how introduced species invade the Estuary and establish populations in order to improve prevention and control of unwanted exotics.

The following section contains information needs by subject area:

6. Phytoplankton productivity: Changes in the array of sampling stations are warranted. First, primary productivity in shoal areas dominates that in deeper areas, especially in Suisun Bay, yet most data are collected from channel stations. Second, almost no long-term series of chlorophyll or productivity measurements are available for Central and San Pablo Bays. Little is known, consequently, about the entrapment zone when it is pushed out of Suisun Bay by high flows. Third,

certain areas in South and Suisun Bays appear to be oversampled in space. A commitment needs to be made to a group of "index stations" that will be sampled at a regular frequency.

7. Benthic microalgal productivity: No measurements have yet been made on benthic microalgal productivity, especially in South and Central Bays.
 8. Delta discharge: Delta discharge may be the largest source of organic matter for Suisun Bay and a significant one for the northern reach as a whole. The load of organic carbon to San Francisco Bay from the Delta needs to be measured on a regular basis, and the issue of availability needs to be addressed. BOD measurement offers one perspective on this problem. Ongoing studies of multiple stable isotope and lipid markers need to be continued and extended.
 9. Tidal marsh export: Tidal marsh sources may be important for Suisun Bay, particularly during drought periods. Direct estimates of tidal marsh export are virtually impossible. The uncertain availability of exported organic carbon is another obstacle.
 10. Circulation and mixing: Transport through the Golden Gate requires definition and should be the first objective. A carbon budget for the entire Bay would then be feasible. Further subdivision needs to be done carefully, with due regard to topographical features and existing data.
 11. Food web structure: The structure of the food web connecting organic carbon sources to higher organisms is critical in determining the magnitude of their food supply. The number of trophic linkages, for example, is especially important in controlling the efficiency of energy transfer from sources to macroscopic consumers.
- The emphasis of research on an introduced fish species has delayed recognition of the status of several native species. Studies based on more sensitive species, on species representing a diversity of habitats within the Estuary, and on species of diverse trophic patterns would allow more accurate monitoring.
12. Sampling procedures and programs: Zooplankton studies of the Estuary have been largely concerned with documenting the food chain affecting striped bass. Consequently, zooplankton data for Central and South Bay are extremely sparse.
 13. Life history and habitat requirements: Identification of the critical habitat of threatened and endangered species needs to encompass a large region in order to be sure of adequate protection. Sampling programs are needed to determine specific habitat requirements of native fishes and other organisms and the extent to which Delta species can be managed as a community.
 14. Tributary streams: Surveys are needed to identify which streams are still home to heritage resources, how they might be preserved, and their importance as organic carbon contributors or as spawning habitats.

Pollutants

1. Abundance and distribution of pollutants of concern: There exists a substantial data base on metals discharged to the Estuary in municipal and industrial effluent. However, the data describing the extent to which such discharges have affected the concentration of metals in the water column of the Estuary are less reliable. Few data are available on concentrations of organic pollutants, either in discharges or in the water column.
 - a. Chemical speciation in aquatic toxicology within the Estuary: Studies carried out in the field and in the laboratory make it clear that the toxicity and bioaccumulation of organic and metallic pollutants are affected by chemical state; metals in particular behave differently in the environment depending upon pH, Eh, valence state, association with organic

radicals, and salinity. While understanding of the importance of chemical speciation in aquatic toxicology is adequate, knowledge of speciation in the Estuary is lacking for tin, copper, cadmium, mercury, and virtually all organic pollutants.

b. Organic pollutants: The few data available on organic pollutant abundance and distribution from the Estuary suggest that the sources and behavior of organic pollutants should be rather predictable. By gathering specific information on organic pollutants in the water, sediments, and biota of the Estuary it should be possible to apply existing models to the system, thereby making it possible to control and manage the impact of organic pollution.

2. Pollutant Loads

a. Municipal and industrial effluent: Quantitative data for organic pollutants in effluent discharges are virtually non-existent. Very few analyses have been performed to determine the speciation of trace metals and organic pollutants in these discharges.

The data for Estuary metal loading can be improved in several ways: (1) sampling frequently enough to characterize seasonal and annual trends in loads, (2) applying quality assurance testing and reporting, and (3) using analytical methods with lower detection limits relative to concentrations present in effluent.

b. Urban and non-urban runoff: There is almost a complete lack of information on pollutant concentrations in urban runoff to the Estuary. Data on loads of organic pollutants of concern are virtually non-existent. A developing understanding of the importance of urban runoff as a source of organic pollutants also demonstrates that certain critical cognate data are lacking.

Dry season flows of urban runoff appear to be significant. Evidence of the dry-season runoff contribution to urban runoff loads in Sacramento suggests that the magnitude of dry-season flows throughout the Estuary should be investigated. Associated pollutant loads must be better defined before estimates of urban runoff can be considered accurate.

Pollutant concentrations in non-urban runoff have been measured only for agricultural drainage, and even these data are limited. Considering the wide spectrum and large mass of pesticides used in the drainage of the Estuary, additional knowledge of pollutant concentrations is critical.

Efforts to model loads of pollutants from nonurban runoff are also hampered by a lack of data, including trace element concentrations in soils, soil moisture, and other parameters. Field verification of these models is needed if they are to be used in support of management activities.

c. Riverine loads: Very few data are available on mass transport of pollutants by the Sacramento River, despite the fact that it is the source of 80 percent of the freshwater inflow to the Estuary and probably carries relatively large loads of pollutants. Loads of pesticides and other organic pollutants of concern have not been assessed in either the San Joaquin or Sacramento Rivers. Ambient toxicity testing of riverine waters should be implemented in conjunction with monitoring and other management activities.

d. Dredging and dredged material disposal: Dredging activities have the potential to mobilize pollutants primarily due to the loss of particulate matter during dredging and due to the transport of slowly settling particles away from disposal sites. Existing information provides an insufficient basis for quantitative analysis of pollutant mobilization. Impacts of the large mass of pollutants associated with disposed, dredged material in the Estuary cannot be evaluated until their distribution and bioavailability are known.

e. Additional inputs: Estimates of loads from other minor inputs, including atmospheric deposition, spills, marine vessel discharges, and waste disposal site leachates, are uncertain. Hydrocarbon loads from atmospheric deposition may be significant, and periodic releases of hydrocarbons in spills are significant on a local, and perhaps regional, scale.

3. Fate of pollutants: A paucity of data regarding the distribution and abundance of pollutants in water, sediment, and biota limits our present understanding of the fate of pollutants in the Estuary. Generic fate models have been developed for pollutants in freshwater, estuarine, and oceanic systems. These models may be applied to the San Francisco Estuary, provided sufficient data have been accumulated.

Understanding the importance of pollutant equilibrium partitioning in aquatic systems is more than adequate for the purpose of applying generalized models. However, there are insufficient data from the Estuary at present even for the application of general models. The extent to which pollutant partitioning is determined by physicochemical and environmental factors specific to the Estuary and biological processes unique to the Estuary is not known and must be determined.

Complex patterns of circulation in the Estuary impede estimation of residence times of pollutants. Residence times are likely to vary significantly within each embayment. Accurate estimates of residence times will depend on an improved understanding of the effects of wind, tides, and freshwater inflows, particularly in broad, shallow reaches of the Estuary.

Since many pollutants of concern partition to particles, the influence of processes such as flocculation, deposition, and erosion on their fate and transport must be determined. The highly dynamic nature of the Estuary and complexity of these processes constrains the development of predictive models of particle transport.

Although several pollutants accumulate in biota of the Estuary (including copper, mercury, nickel, selenium, silver, certain pesticides, and PCBs), few data on tissue concentrations are available. Comprehensive data regarding the abundance and distribution of pollutants in water, sediment, and tissue are sorely needed. Accumulation of pollutants in upper trophic level species and the possible contribution of food web transfer to this phenomenon require further study.

4. Pollutant effects on beneficial uses: Areas of extreme contamination have not been thoroughly studied with respect to sources or effects of the pollutants in place. Studies that have established links between toxic effects and specific pollutants (e.g., between PCBs and reproductive effects in fish and birds) in the Estuary have been correlative in nature. Laboratory studies are needed to demonstrate if such relationships are indeed cause and effect.

The effect of extraneous variables on the results of sediment bioassays, bioassays of water, and benthic community analyses confounds interpretation of results. The influence of such variables needs to be better characterized. High concentrations of silver and copper found in tissues of bivalves in some areas of the South Bay are cause for concern.

Some pollutants, such as PCBs and DDT, have declined rapidly in the Estuary because their use has been restricted; that is, trends in pollutant loading follow trends in their use, rather than trends in treatment level or population growth. It is reasonable to conclude that loads to the Estuary of other pollutants, including some metals, can also be reduced due to declining use. When the use of a pollutant declines it will reduce the potential discharge of the pollutant to the Estuary, independent of population growth.

Wildlife

This section discusses the major informational needs for various species groups and their habitats:

Special Status Species

1. Numerous special status amphibians, reptiles, birds, and mammals that breed within the Estuary study area are known or believed to be currently experiencing population declines. More detailed research is needed on the distribution and status of these species within the Estuary study area, as well as on the migratory routes and wintering grounds outside the study area.

2. Because of recent dramatic population declines in the California clapper rail, special attention to the research needs of this species in San Francisco Bay is warranted. Suspected factors contributing to this population decline include predation, contaminants, and habitat degradation. There is a critical need for information on the effect of contaminants in the food web on which clapper rails rely. Invertebrate foods of the rail should be analyzed for contaminants in all portions of the Bay currently or recently inhabited by rails.

Annual surveys in all tidal habitats in the Estuary should be conducted to determine the clapper rail's distribution and population status. In addition, the quality and extent of rail habitat, including any habitat threats, should be quantified. The extent and characteristics of upland refugia for the clapper rail, as well as the salt marsh harvest mouse, also should be quantified.

3. The existence of the California least tern in the Estuary is also precarious, warranting special attention to research needs for this species. More information is needed on the population dynamics and movements of this species. Banding and marking least tern chicks would provide information on age-class structure, mortality rates, and estimates of longevity. These factors could be used to predict long-range stability of tern populations. Other information needs include the degree of colony fidelity, shifts between colonies, establishment of new colonies, age at first nesting, factors affecting clutch size, and breeding success.

To properly manage the tern, additional research is also needed on: (1) the effects of environmental contaminants; (2) factors affecting the choice of location for roosting, loafing, and feeding areas used during the breeding and post-breeding seasons; (3) the amount of habitat needed (measured in terms of fish density) to maintain the current population size or increase it; (4) what constitutes suitable nesting habitat, including beaches, landfills, salt ponds, and estuarine areas; and (5) factors leading to colony disruption and nest site abandonment.

4. Expansion of the introduced bullfrog has contributed to declines in the California red-legged frog, and the nature of this interaction should be investigated. In addition, the possible effects of contaminants on populations of red-legged frogs and the San Francisco garter snake deserve special attention.

5. For many of the special status wildlife species considered to be State Species of Special Concern, very little information exists on distribution, abundance, or population.

Waterfowl

6. One of the most pressing needs is to determine the effects of contaminants on wintering waterfowl, particularly diving ducks. To assess the effects of contaminants on waterfowl, more information is needed on how the waterfowl community uses habitats within the Estuary. Radio telemetry studies in the Bay and Delta would provide information on where wintering waterfowl concentrate and how long they remain in the Estuary. An estimate of the carrying capacity of the Estuary for waterfowl should be made by assessing available food resources and the use of those resources.

Of particular importance in an assessment of available food resources is quantification of the value of salt ponds and seasonal wetlands to wintering waterfowl. Few data exist on this topic even though these habitat types are often most threatened by development. Further research is also warranted for the western population of the canvasback because of the critically low population levels reached in 1988 and 1989.

7. General waterfowl research topics recommended for the Central Valley and Delta include: (1) an assessment of winter food requirements for certain key species and the ability of major habitats to provide these resources; (2) an evaluation of the influence of weather, agriculture, and hunting on the distribution and abundance of waterfowl; (3) an evaluation of the cause, chronology, and magnitude of non-hunting mortality; and (4) an assessment of the physical condition and reproductive potential of waterfowl relative to winter habitat conditions.

8. Further research on limiting factors of waterfowl wintering in the Estuary is warranted. All waterfowl habitats (wetlands, riparian vegetation, agricultural land, and uplands) need to be quantified according to waterfowl requirements. This would include the amount of available habitat that fulfills waterfowl food, shelter, loafing, nesting, and sanctuary needs during the period of the year when these habitats are available. This information may aid in determining which of the wintering requirements is population limiting.

Shorebirds

9. Unlike waterfowl, yearly inventories of shorebird populations in California have not been conducted on a regular basis. To sustain migratory shorebirds, more information is needed on the seasonal abundance patterns of shorebirds. A long-term monitoring program should be initiated to establish population trend data. Coupled with this, improved techniques should be developed to estimate population sizes. Almost no information is available on shorebird abundance and distribution in Suisun Marsh/Bay and the Delta, and long-term monitoring programs should be initiated for these areas of the Estuary.

10. Research is needed to define precisely the roles that seasonal wetlands and salt ponds play in maintaining the Bay's shorebird population in winter. Research on the availability of roosts and patterns of use in the Central Bay area should be conducted to promote protection of suitable roosts in the future.

11. More information is needed regarding factors limiting shorebird populations in the Estuary. Examples are the effects of power lines on shorebird mortality and the effects of contaminants, especially selenium, on wintering shorebirds. The effect of the introduced Asian clam on benthic invertebrates, the major prey of shorebirds, should also be investigated. Studies should also be conducted to find ways of limiting red fox predation on shorebird nests and young.

Colonial Birds

12. The presence of contaminants in the food web of colonial nesting birds should be investigated throughout the Estuary through sampling of sediments, invertebrates, and fish. This information will shed light on the pathways through which contaminants enter the food web and will better define background contaminant levels and hot spots in the Bay. Telemetry studies of black-crowned night herons and other colonial nesting birds during both the breeding and non-breeding season would help determine where the birds are being exposed to contaminants. Species such as the double-crested cormorant or black-crowned night-heron could serve as biological indicators of background contaminant levels.

13. Studies should also be conducted to determine the impact of predators on nesting colonial birds in the Estuary.

Other Wildlife

14. There is a critical need for studies of populations of mammalian predators in the Estuary. More information is needed on the distribution and abundance of predators, such as the red fox, Norway rat, and black rat. Research is needed on various control techniques, including the feasibility of reintroducing the coyote to control red foxes, where appropriate.

15. Because the harbor seal is a conspicuous mammalian member of the Bay food web, research is needed into the possible effects of environmental contaminants on this species.

16. Research is also warranted on the effects of sea level rise on Bay wildlife.

17. Cowbirds and starlings are well-known for their abilities to displace other nesting bird species. The impact that these two species are having on native nesting birds, however, is largely unknown in the Estuary.

Wildlife Habitats

18. Long-term wildlife monitoring studies of several habitat restoration sites are needed to document wildlife recolonization and to determine the true success of each restoration effort.

19. Because tidal marsh erosion is proceeding at an alarming rate in the Bay, particularly in the South Bay, additional research in this subject is warranted. Baywide studies of tidal marshes should be conducted to update where marsh erosion and accretion is taking place and to determine if accelerated rates of erosion are occurring in other locations besides those previously studied. Research is also needed to determine if structural techniques exist to retard erosion and possibly promote marsh expansion.

Contaminants

20. There is a need for basic research at every level to identify significant estuarine processes and to quantify relationships between wildlife and the contaminants present in the Estuary. A first step would be to improve coordination of existing programs.

Certain areas of extreme pollution have not been well studied with respect to sources or effects of pollutants. Further studies are needed regarding forms of arsenic in the Estuary and the biological effects of tin (especially TBT). More congener-specific studies of PCBs are needed, since the toxicological effects of PCBs may be related to only a small number of coplanar forms of these compounds. In the case of correlations of PCBs with reproductive effects in fish and birds, more evidence is needed to determine the significance of observed effects. Additional studies are needed to clarify the role of PCBs that affect economically or biologically important organisms of high trophic levels. Investigations should seek to identify cause-and-effect relationships wherever possible.

21. Clear evidence linking pollution with specific biological effects is lacking in the San Francisco Estuary. Further study needs to be done on the occurrence of chronic or sub-chronic impacts on the biota of the Estuary as the result of exposure to pollutants. In this regard, particular emphasis should be placed upon developing realistic biological indicators of pollutant effects, such as genotoxic effects, physiological effects, or effects on the immune system. Relationships between the accumulation of complex mixtures of pollutants and their effects on the biota of the Estuary should also receive attention.

The effects of many contaminants, including polycyclic aromatic hydrocarbons, industrial chemicals, organotins, current-generation pesticides, and mosquito control agents, on wildlife, and particularly birds, have not been well studied in the San Francisco Estuary. It is important to establish relationships between contaminant concentrations in bird tissues and in those found in their foods to determine sources of contaminants, routes of exposure, and the effects on wildlife.

22. There is a need for field studies and controlled experimental studies that are conceptually related to field observations to determine: (1) acute and chronic toxicity of chemicals for important food-chain organisms and wildlife; (2) the association of contaminant burdens with morphological, histopathological, and biochemical/physiological indices in free-ranging animals; and (3) reproductive success in resident birds and in birds that winter in the Bay but nest elsewhere.

Dredging and Waterway Modification

This section identifies those areas of dredging and dredged material disposal where the lack of knowledge is most critical.

Dredging Activities

1. The precise amounts of dredged material disposed at sites in the Estuary: How much material is disposed of at each site in the Estuary? What types of equipment are used? What is the frequency of disposal at in-water sites and on land?
2. The quantity of sediment dredged in the Delta and used for levee maintenance: Is any of this material contaminated? What are the levels of contamination? What are possible effects?

3. Historical quantities of sediments dredged and disposed of in the Estuary: How well do permitted amounts of dredging coincide with actual quantities dredged and disposed? Is overburden at a site likely to be less or more contaminated than the permitted sediment? Can useful historical trends be constructed by reviewing past dredging permits? How can this information be used to better elucidate the current status of dredging and waterway modification in the Estuary?

Dredged Material Quality: Evaluation and Testing

4. The "background patterns" of sediment contamination in the Estuary: What is the present distribution of contaminants in estuarine sediments? Can any physical characteristics of Bay sediments be correlated with sediment chemical quality? Are there "background" concentrations of contaminants in sediments to which concentrations in dredged material can be compared? Are there regions of the Estuary with "background" concentrations of contamination that can be used for experimental control purposes?

5. The causal mechanisms of toxicity in sediment bioassays: Do sediment bioassays depict chemical toxicity? Are covariant factors in contaminant concentrations actually causing the toxicity observed in sediment bioassays?

6. What bioassays are appropriate for use in examination of contaminated sediments? Are acute, lethal bioassays preferable to chronic bioassays as indicators of potential effects? Are there numerical models adequate for representing potential acute or chronic effects? Which of the many assays currently being tested can be used with confidence? Can any laboratory study adequately represent what results will be in the field? Can data from other parts of the country be transferred directly for use in the Estuary?

7. What sublethal bioassays or endpoints might be suitable for use in evaluating chronic effects? Are chronic bioassays preferable to acute, lethal assays in assessing the effects of dredged material disposal? Do any existing chronic bioassays hold promise for applicability to the Estuary and its dredged material disposal problems? Are there chronic effects for evaluation that may be more useful, or more sensitive, than the bioassays currently used for evaluating dredged material effects? Are there chronic, sublethal assays that allow the identification of effects due to single toxicants, as well as complex mixtures? How can an appropriate suite of chronic assays be developed that will help identify the major contaminants of concern?

8. The ecological significance of test results, including bulk chemistry assays, toxicity bioassays, and bioaccumulation tests: What is the relationship between laboratory tests of contaminated sediment and the actual effects of disposal of this sediment in the Estuary? What is the relationship of contaminant body burden and effects in the Estuary? Can objective standards be developed for determining the types of tests necessary for contaminated sediments and for classifying sediments on the basis of the results of such tests?

The Fate of Disposed Dredged Material

9. The mechanism by which the mound of material formed at the Alcatraz disposal site: How quickly did the mound of material grow? Could the mounding have been slowed or prevented through alternate disposal practices? What is the likelihood of mounding occurring at the other disposal sites?

10. The initial distribution of sediment dispersed from the disposal sites in the Estuary: Where does material dispersed from the disposal sites go initially? What is the rate and magnitude of sediment transport in the Estuary? In subsections of the Estuary? How does the equipment used affect the dispersion of the disposed material? How does the method, timing, and frequency of disposal affect transport (or retention) of dredged material at a given site?

11. The ultimate fate of disposed material in the Estuary: What fraction of material is redeposited in quiescent areas of the Estuary? What fraction of material is redeposited in artificially maintained channels, slips etc.? How important are factors not yet modeled, such as wind-driven currents, in determining the ultimate fate of disposed material? What fraction of disposed dredged sediment leaves the Estuary; how much material returns to navigation channels?
12. How well do the complex hydrodynamic and sediment transport models available actually represent the Estuary? How uncertain are the predictions of these models? How sensitive are the predictions to changes in the assumptions used to build the models?

The Effects of Dredged Material Disposal

13. The fraction of the contaminants in dredged material that is released to the environment during and after disposal: Can accurate estimates of annual loads of contaminants due to the disposal of dredged material be developed?
14. The bioavailability of the released fraction of contaminants: How does contaminant bioavailability vary with such factors as season, salinity, or species? How much of the observed bioaccumulation of toxic contaminants in the Estuary is due to the disposal of dredged material? Do existing models for chemical equilibrium in the environment hold any promise for application to dredging problems in the Estuary?
15. The contribution of dredged material disposal to suspended sediment concentrations in Central Bay: Does disposal of dredged material at the Alcatraz site significantly increase the suspended sediment concentrations in the Central Bay beyond the short time period after disposal? How does frequent use of the disposal sites affect suspended sediment concentrations in the Estuary?
16. Impacts due to increases in the concentration of suspended solids from dredging operations on estuarine biota: Are egg or larval stages of biota in the Estuary adversely affected by increases in suspended solids concentrations? Are the biota affected by particle-associated contaminants? Is there an interaction (i.e., synergism or antagonism) between suspended solids and contaminants and their effects on organisms? Do such increases result in behavioral changes, such as alterations of migratory patterns or avoidance of historical habitat?
17. How well do we understand the trophic structure ("food chain relationships") in the Estuary? Which predators will be affected by changes in the abundance and distribution of invertebrates? Which predators might particularly be expected to be susceptible to contaminant accumulation from their prey?

Recommended Research

A. The precise amounts of dredged material disposed at sites in the Estuary: It is recommended that more detailed data be collected and routinely analyzed to provide precise information regarding dredging and disposal activities in the Estuary. This is particularly the case with respect to dredging activities carried out under permit from the Army Corps of Engineers (the Corps). The San Francisco District of the Corps has undertaken such efforts in the past few years through the appropriate use of post-dredging bathymetric surveys; these activities should be continued and expanded. It is important to obtain accurate estimates of amounts of material and temporal trends in disposal, particularly with respect to the frequency of disposal events. It is also recommended that the Sacramento District of the the Corps develop estimates of the sediment quantities dredged by Reclamation Districts under their jurisdiction in the Delta and examine the quality of these sediments.

It is also recommended that the frequency of disposal activity should be recorded at all sites. Records should include the date and time of disposal, the volume of material disposed, the source of material that was dredged, the type of equipment, and tidal stage.

B. The ecological significance of test results, including bulk chemistry assays, toxicity bioassays, and bioaccumulation tests: The precise relationship between laboratory tests using contaminated sediment and the actual effects resulting from disposal of this sediment in the Estuary will probably never be determined. This is due to difficulties in conducting controlled field experiments, where numerous factors influence contaminant release, bioavailability, and toxic effects under field conditions. Laboratory studies can, however, provide useful information, particularly for testing "worst case" conditions. It is recommended that regulatory agencies endeavor to develop a more objective method by which the results of sediment testing can be evaluated. This will involve the establishment of criteria that quantitatively define the point at which a sediment must be subjected to biological and chemical tests and that define when test results are to be considered significant in predicting adverse effects upon disposal.

Studies should also be undertaken to investigate the causal mechanism of the toxic responses observed in sediment bioassays. Particular attention must be given to the role of sediment grain size and total organic carbon concentrations, as these factors co-vary with contaminant concentrations and confound the interpretation of bioassay results.

C. The ultimate fate of disposed material in the Estuary: Knowledge of the fate of disposed material is vital in understanding the transport of disposed sediments throughout the Estuary (including back to navigation channels), and the consequent distribution of the contaminants associated with dredged material. This topic can be investigated using both models and tracer studies.

(i) It is recommended that the modeling effort currently underway by the Corps be continued, with a clear focus upon circumventing several key limitations. Field data from the San Francisco Estuary must be made available to verify that the models can accurately represent (over appropriate periods) the complex phenomena that contribute to sediment transport. These include the effects of winds and the vertical stratification of currents. The sensitivity of the models to key parameters (including boundary conditions) should be documented. It is considered essential that estimates of uncertainty be included with model predictions, particularly if modeling data are to be used for assessing effects of alternative management strategies.

(ii) It is also recommended that tracer studies be conducted to define the short- and long-term transport of suspended particles from estuarine disposal sites. These studies could provide information regarding the return of disposed material to navigation channels, the dispersion of disposed material under different hydrological regimes, and the possible contribution of dredged material disposal to "hot spot" formation in the Estuary. New highly sensitive and economical tracing techniques using biological tracers (bacteriophages) are now available and could provide information regarding estuarine sediment transport.

D. The bioavailability of contaminants released by disposal of dredged material: Data regarding the bioavailability of contaminants released from dredged material are essential to determine the potential for toxicological effects due to the bioaccumulation of contaminants. It is recommended that a routine biomonitoring program be established at aquatic disposal sites in the Estuary. This program should use the California mussel (*Mytilus californianus*) and follow the established procedures for the use of biomonitors. This program should also be coordinated with the implementation of a local and regional biomonitoring program.

E. The spatial and temporal trends in suspended solid concentrations at disposal sites: It is recommended that the concentration of suspended solids be monitored throughout the water column at the disposal sites in the Estuary, with an emphasis on understanding the contribution of dredged material disposal to suspended sediment concentrations. In particular, suspended sediment concentrations should be documented in the Central Bay during periods of frequent use of the Alcatraz disposal site.

F. The impact of suspended solids from dredging operations on life-stages of estuarine biota: It is recommended that additional laboratory studies be conducted to improve predictions of the impact of suspended sediments upon sensitive life stages of resident species that could be exposed to sediment plumes from dredging and disposal operations. Commercially important species should be emphasized in such studies, and experiments should be designed to simulate field conditions to the maximum possible extent. Such studies should concentrate not only on lethality, but also on the development of sensitive assays useful in estimating the potential for organisms to survive, grow, and reproduce under prevailing conditions in the test aquarium.

Waterway Modification

Gaps in Knowledge

This section briefly summarizes areas of inadequate technical knowledge, or "data gaps," providing examples of management questions raised by these gaps in understanding.

1. Coastal flooding: What are the most recent 100-year high water level estimates for the Estuary? How can they be adjusted to account for the probabilities of flood flows and storm surges? What are the consequences of Delta Island failure on San Francisco Bay morphology, hydrodynamics, and salinity? What is the present condition of the perimeter levees surrounding the Bay and the Delta?
2. Shoreline erosion: What are the long-term trends in shoreline erosion? What are the causative factors? Can a current sediment budget be produced for the Estuary? How can sediment transport data be analyzed to update the sediment budget for the Estuary?
3. The extent (both historical and current) of stream channelization for flood control and stormwater management purposes: How much material has been dredged for this purpose? Over what distances have streams been modified? What effects do these activities have upon local biota, including fisheries and riparian vegetation? What effects do these activities have upon local sedimentation rates and other aspects of habitat viability? Is channelization a significant factor in the loss of fish and other wildlife habitats?

Recommended Research

A. It is recommended that estimates of 100-year high water levels around the Estuary be updated and revised to systematically account for the joint probability of flood flows and storm surges. Consistent flood protection design standards should be developed for different land uses around the Estuary, and analyses should be performed to allow future planning for coastal flood protection to account for projections of sea-level rise. The consequences of failure of the Delta islands upon the morphology, hydrodynamics, and salinity distribution of the Estuary need to be analyzed to determine management strategies. In addition, it is recommended that a comprehensive survey of the condition and elevation of all perimeter levees surrounding the Estuary be undertaken. There is also a need for a detailed topographic survey of low-lying areas around the Estuary in order to determine areas of risk under future hazard scenarios.

B. Existing bathymetric surveys and sediment transport data should be analyzed to update the sediment budget for the Estuary. Periodic bathymetric surveys need to be made of mudflat and shallow intertidal areas to monitor long-term changes in Estuary morphology that might affect shoreline erosion. There is also a need for a coordinated, long-term plan for the future of the Delta.

Wetland Status and Trends Report

Ecological and Biological Questions

1. What are the food web interactions in the Estuary, including species represented, food habits, predator-prey relationships, etc.? What are the fish and invertebrate communities associated with Delta wetlands, especially intertidal zones? What are the invertebrate communities of seasonal wetlands and of riparian communities of the Bay and Delta wetlands? What are the invertebrate, fish, and wildlife communities of perennial and intermittent streams of the Bay-Delta Estuary?
2. What is wetland-associated wildlife's use of farmed wetlands and grazing lands in the Suisun Marsh and diked historic baylands?
3. How would changes in freshwater inflow into the Estuary affect vegetation and wildlife resources in the Suisun Marsh, Suisun Bay, and San Pablo Bay?
4. What specific functions and values are provided by the major wetland habitat types, and what combinations of these wetland types are necessary to maintain and enhance viable fish and wildlife populations in the Delta and in North and South San Francisco Bays? What factors account for the apparent difference in the productivity, diversity, and composition of plant and animal populations found in the North and South Bays?
5. How do tidal hydrodynamics affect the evolution of tidal marshes? What are the relationships between stored marsh and slough channel geometry?
6. Is there evidence that tidal marshes help to control erosion, and, if so, how effectively?
7. What are the best strategies or methods for creating or restoring existing wetlands, and what particular aspects of wetland restoration projects have proven most successful?
8. To what extent do contaminants bioaccumulate or bioconcentrate in plants, invertebrates, fish, and birds using wetlands? Do contaminants from applying treated wastewater to wetlands bioaccumulate in plants and animals?
9. What wetland species, particularly endangered species such as the salt marsh harvest mouse and the clapper rail, require contiguous upland habitat? How wide an area of non-wetland habitat is needed? What habitat characteristics are necessary?
10. What is the habitat preference of the Suisun song sparrow?
11. Would the creation and/or enhancement of North Bay wetlands habitat adequately offset South Bay wetland losses due to development projects?
12. What are the reasons for the recent drastic decline of the California clapper rails in Bay wetland habitats? This inquiry should investigate: (1) the possible effect of contaminants on populations and the food chain, including a sampling of invertebrate populations within rail habitat and rail eggs; (2) laboratory toxicity studies using East Coast rails to determine physiological threshold levels of contaminants; (3) impacts of salinity on invertebrate-prey populations, due to the discharge of fresh water to higher salinity waters; (4) the impacts of red fox predation in South Bay wetlands; and (5) whether dispersion of clapper rails occurs in North Bay wetlands in the winter, or do they simply hide in high marsh vegetation?
13. What neighboring land uses are compatible with wetlands? What features can be incorporated into adjacent project designs and public access facilities to minimize disturbance to sensitive wetlands and sensitive wildlife species?

14. What introduced wetland plant and animal species are spreading in the Bay? How does the productivity and diversity of introduced wetlands compare with wetlands comprised of native plant species?
15. What factors account for the apparent differences in productivity, species diversity, and seasonal use of the various types of salt ponds in the Estuary? How important are the various types of salt ponds to the productivity of the Estuary and the wildlife resources that frequent them?
16. What are the wildlife uses and values of vernal pools in the San Francisco Bay and Delta areas, including those near Santa Rosa?

Historical and Geographical Questions

17. What have been the cumulative wetland losses in the Estuary due to the approval of small (less than ten acres) fill projects, and, in particular, those losses resulting from the Corps' Nationwide Permit No. 26? What have been the cumulative wetland reclamation, conversion, and degradation losses due to unauthorized fill activities?
18. Where do tidal, seasonal, brackish, and freshwater wetlands exist in the Estuary?
19. What have been the riparian habitat losses in the Estuary?
20. What measures can be taken to avoid extensive losses of wetlands as a result of the accelerated rise in sea-level?

Institutional Questions

21. What would a model wetlands protection ordinance look like that would enable local governments to better protect wetland resources?
22. What criteria could be developed to create mitigation banks in the Bay-Delta system that are effective and adequately protective of wetland resources? Could a list of potential sites be identified?
23. What are the economic benefits of various wetland values and functions?
24. What are the recreational benefits of the Estuary's wetlands and the associated impacts of these activities on wetland habitats?

APPENDIX E: *Implementing Entities*

Aquatic Resources Part I	1.1	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	3.1	3.2	3.3	3.4	3.5	3.6
	Improve monitoring	Regulate ship ballast	Prohibit exotic species	Control exotic species	Educate re: exotics	Reduce poaching	Harvest regulations	Contaminants	Reduce incidental take	Recovery plan	Monitor candidate species	Consult re: listed species	Review proposals and actions	Habitat conservation	Species recovery
Bay Conservation & Development Commission															
California Department of Boating and Waterways				•	•										
California Department of Fish and Game		•		•	•	•	•		•	•	•		•		
California Department of Food and Agriculture				•	•										
California Department of Health Services		•													
California Department of Water Resources						•									
California Environmental Protection Agency								•							
California Fish and Game Commission			•				•								
California Reclamation Board															
California Resources Agency															
Caltrans								•							
Central Valley Regional Water Quality Control Board	•						•								
Dischargers								•							
Diversers															
Federal Action Agencies												•			
Federal Energy Regulatory Commission															
Fishing Industry									•						
Friends of the San Francisco Estuary					•										
Industrial Facilities															
Interagency Ecological Studies Program	•														
Land Trust															
Landowners															
Local Governments															
Mosquito Abatement Districts													•	•	
National Marine Fisheries Service									•	•	•	•	•	•	•
Non-Federal Action Agencies													•	•	
Non-Governmental Organizations															
Pacific Fisheries Management Council							•								
Port Authorities		•													

Aquatic Resources Part II		4.1 Standards and operations	4.2 Control entrainment	4.3 Design/install gates	4.4 Fish screens	4.5 Screens at projects	4.6 Reduce predation	4.7 Protect shaded habitats	4.8 Increase shaded habitats	4.9 Protect against erosion	4.10 Avoid habitat damage	4.11 Protect stream remnants	4.12 Fisheries values	5.1 Long-term management	5.2 EIS/EIR	5.3 Implement preferred alternative	6.1 Flows and temperatures	6.2 Upper Sacramento River	6.3 San Joaquin River	6.4 Screen diversions	6.5 Seek damages
Bay Conservation & Development Commission									•	•	•	•	•								•
California Department of Boating and Waterways																					
California Department of Fish and Game		•	•	•	•	•	•	•	•	•	•	•	•	•	•			•	•	•	•
California Department of Food and Agriculture																					
California Department of Health Services																					
California Department of Water Resources	•		•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•
California Environmental Protection Agency														•	•	•	•	•	•	•	•
California Fish and Game Commission																					
California Reclamation Board								•	•												
California Resources Agency												•	•	•	•						
Caltrans																					
Central Valley Regional Water Quality Control Board		•									•	•	•				•				•
Dischargers																					
Diversers				•																	
Federal Action Agencies								•													
Federal Energy Regulatory Commission																•					
Fishing Industry																					
Friends of the San Francisco Estuary																					
Industrial Facilities		•																			
Interagency Ecological Studies Program																					
Land Trust												•									
Landowners									•			•	•								
Local Governments												•	•								
Mosquito Abatement Districts								•	•												
National Marine Fisheries Service			•								•							•	•		•
Non-Federal Action Agencies								•	•												
Non-Governmental Organizations								•	•									•	•		
Pacific Fisheries Management Council																					
Port Authorities																					

<p>Aquatic Resources Part III</p>	<p>1.1 Improve monitoring</p>	<p>2.1 Regulate ship ballast</p>	<p>2.2 Prohibit exotic species</p>	<p>2.3 Control exotic species</p>	<p>2.4 Educate re: exotics</p>	<p>2.5 Reduce poaching</p>	<p>2.6 Harvest regulations</p>	<p>2.7 Contaminants</p>	<p>2.8 Reduce incidental take</p>	<p>3.1 Recovery plan</p>	<p>3.2 Monitor candidate species</p>	<p>3.3 Consult re: listed species</p>	<p>3.4 Review proposals and actions</p>	<p>3.5 Habitat conservation</p>	<p>3.6 Species recovery</p>				
<p>Private Water Projects Reclamation Districts Resource Conservation Districts San Francisco Bay Regional Water Quality Control Board San Francisco Estuarine Institute Sea Grant State Lands Commission State Water Resources Control Board University of California U.S. Army Corps of Engineers U.S. Bureau of Reclamation U.S. Coast Guard U.S. Environmental Protection Agency U.S. Fish and Wildlife Service U.S. Soil Conservation Service Urban Creeks Council Water Districts</p>	<p>• •</p>	<p>•</p>						<p>•</p>	<p>•</p>	<p>•</p>	<p>•</p>	<p>•</p>	<p>•</p>	<p>•</p>					

Aquatic Resources Part IV		4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	4.12	5.1	5.2	5.3	6.1	6.2	6.3	6.4	6.5
		Standards and operations	Control entrainment	Design/install gates	Fish screens	Screens at projects	Reduce predation	Protect shaded habitats	Increase shaded habitats	Protect against erosion	Avoid habitat damage	Protect stream remnants	Fisheries values	Long-term management	EIS/EIR	Implement preferred alternative	Flows and temperatures	Upper Sacramento River	San Joaquin River	Screen diversions	Seek damages
Private Water Projects																					
Reclamation Districts																					
Resource Conservation Districts																					
San Francisco Bay Regional Water Quality Control Board																					
San Francisco Estuarine Institute																					
Sea Grant																					
State Lands Commission																					
State Water Resources Control Board																					
University of California																					
U.S. Army Corps of Engineers																					
U.S. Bureau of Reclamation																					
U.S. Coast Guard																					
U.S. Environmental Protection Agency																					
U.S. Fish and Wildlife Service																					
U.S. Soil Conservation Service																					
Urban Creeks Council																					
Water Districts																					

Wildlife	1.1 California clapper rail	1.2 SFBNWR expansion	1.3 Wetlands acquisition	1.4 Tidal marshes restoration	1.5 Non-wetland restoration	2.1 SFBNWR management plan	2.2 Biodiversity	2.3 Habitat restoration	3.1 Predator control programs	4.1 Recovery plans	4.2 California least tern	4.3 Candidate species status	4.4 Aleutian Canada goose	4.5 Clapper rail captive breeding							
Bay Conservation & Development Commission																					
California Coastal Conservancy																					
California Department of Fish and Game																					
California Department of Transportation																					
East Bay Regional Park District																					
Landowners																					
Local Governments																					
National Park Service																					
Non-Governmental Organizations																					
Pacific Flyway Technical Committee																					
Port of Oakland																					
Public Land Management Agencies																					
State Lands Commission																					
U.S. Army Corps of Engineers																					
U.S. Department of Defense																					
U.S. Department of the Navy																					
U.S. Environmental Protection Agency																					
U.S. Fish and Wildlife Service																					
U.S. Soil Conservation Service																					
Wildlife Conservation Board																					

Wetlands	1.1 Regional wetlands management plan	1.2 Cooperative protection efforts	2.1 Comprehensive state program	2.2 Increase enforcement efforts	2.3 Compensatory mitigation	2.4 Clean Water Act	3.1 Acquisition programs	3.2 Assistance programs	3.3 Wetland protection by-laws	4.1 Convert/restore non-wetlands										
Bay Conservation & Development Commission	•	•	•	•	•			•	•											
California Coastal Commission			•																	
California Coastal Conservancy	•	•			•		•			•										
California Department of Fish and Game	•	•	•		•				•	•										
California Environmental Protection Agency	•		•	•	•		•	•		•										
California Resources Agency	•	•	•		•															
California Secretary of Resources				•				•		•										
California State Legislature			•			•		•		•										
Central Valley Regional Water Quality Control Board	•		•	•	•															
Delta Regional Authority (Commission)			•																	
Department of Water Resources	•				•															
Landowners		•						•		•										
Local Governments	•	•	•	•	•					•										
National Marine Fisheries Service	•	•		•	•															
Non-Governmental Organizations							•													
Non-Profit Organizations		•								•										
Public Trusts										•										
San Francisco Bay Regional Water Quality Control Board	•		•	•	•															
Soil Conservation Service	•	•								•										
Special Districts	•		•																	
State Lands Commission	•	•	•				•	•												
State Water Resources Control Board	•		•		•															
University of California Cooperative Extension Service								•	•											
U.S. Army Corps of Engineers	•	•		•	•	•		•		•										
U.S. Congress				•		•														
U.S. Environmental Protection Agency	•	•		•	•	•														
U.S. Fish and Wildlife Service	•	•		•	•		•	•		•										
Wildlife Conservation Board							•	•		•										

Water Use														
	1.1 Feasibility	1.2 Adopt water reclamation ordinance	1.3 Public education	1.4 Encourage reclamation and reuse	1.5 Reclaimed and recycled delivery	1.6 Address impacts of brine	2.1 Efficient management practices	2.2 New methods of conservation	2.3 Conservation feasibility studies	2.4 Maximize conjunctive use	2.5 Storage of surface water	2.6 Groundwater management	3.1 Voluntary water marketing	3.2 Transfer of ownership
Agricultural Community														
Agricultural Water Suppliers		•	•				•							•
California Department of Fish and Game							•			•		•		
California Department of Food and Agriculture							•	•						
California Department of Health Services			•				•	•						
California Department of Water Resources	•				•		•	•	•	•	•	•	•	
California Environmental Protection Agency							•	•	•	•	•	•	•	
California Farm Bureau Federation							•	•						
California Farm Water Coalition							•	•						
California State Legislature											•	•	•	
California Urban Water Conservation Council						•			•					
Central Valley Irrigation Districts					•									
Central Valley Regional Water Quality Control Board	•			•	•						•			
Environmentalists			•				•			•		•		
Farmers							•	•		•		•	•	
Governor											•	•	•	
Local Governments	•	•	•		•				•					
Publicly Owned Treatment Works	•	•	•		•	•								
Private Owners									•	•				
San Francisco Bay Regional Water Quality Control Board	•			•	•						•			
State Farm Water Coalition							•							
State Lands Commission									•	•				
State Water Conservation Coalition							•	•			•	•	•	
State Water Resources Control Board	•			•	•	•	•	•	•	•	•	•	•	
University of California Cooperative Extension							•	•						
U.S. Army Corps of Engineers					•					•				
U.S. Bureau of Reclamation	•				•		•		•	•	•	•	•	
U.S. Congress													•	
U.S. Department of Agriculture							•	•						
U.S. Department of the Interior													•	
U.S. Environmental Protection Agency								•	•	•	•	•		
U.S. Fish and Wildlife Service									•	•		•		
U.S. Geological Survey											•	•		
U.S. Soil Conservation Service							•	•						
Water Conservation Districts											•			
Water Districts	•	•	•		•	•		•	•	•	•	•	•	
Water Suppliers														

Pollution Prevention and Reduction																
	1.1 Toxic pollution discharge	1.2 Institutional and financial change	1.3 Environmental audit procedures	1.4 Agricultural practices	1.5 Selenium levels in drainage	1.6 Pesticide reduction	2.1 Mass emissions strategy	2.2 Water quality objectives	2.3 Selenium and mercury	2.4 Urban runoff	2.5 Pollutant loadings	2.6 Agricultural toxic substances	2.7 Toxic loadings	2.8 Model environmental compliance	3.1 Clean up contaminants	3.2 Toxic hot-spots
Association of Bay Area Governments																
Bay Area Air Quality Management District																
California Air Resources Board																
California Department of Fish and Game	•					•		•				•			•	
California Department of Food and Agriculture	•											•				
California Department of Health Services								•					•			
California Department of Pesticide Regulation						•							•			
California Department of Water Resources				•	•											
California Environmental Protection Agency	•		•			•		•				•	•			
California State Legislature	•	•				•						•	•			•
Caltrans											•					
Central Valley Regional Water Quality Control Board	•		•		•	•	•	•	•	•		•	•		•	•
Hazardous Waste Control Agencies											•					
Landowners				•												
Local Agencies		•				•	•		•							
Local Congestion Management Agencies										•						
Metropolitan Transportation Commission										•						
Private Sector	•															
Regulatory Agencies		•														
San Francisco Bay Regional Water Quality Control Board	•		•		•	•	•	•	•		•	•		•	•	
State Water Resources Control Board	•		•		•	•	•	•	•		•	•		•	•	
U.S. Bureau of Reclamation					•											
U.S. Congress	•															
U.S. Department of Agriculture														•		
U.S. Department of Defense														•		
U.S. Department of Energy														•		
U.S. Department of the Interior														•		
U.S. Environmental Protection Agency					•	•	•					•	•	•	•	
U.S. Fish and Wildlife Service														•		
U.S. Soil Conservation Service	•			•	•			•			•					
Water Districts			•	•	•											

Dredging and Waterway Modification	1.1 Sediment dynamics	1.2 Marsh and mudflats	1.3 Estuarine sediment production	2.1 Suspended sediment effects	2.2 Sediment quality objectives	3.1 Dredge projects	3.2 Dredge materials for reuse	3.3 Reuse regulatory procedures	3.4 Resources affected by dredging	3.5 Reference sites	3.6 Removal of derelict structures	3.7 Adopt regulatory and management policies	4.1 Disposal options	4.2 Saltwater intrusion	4.3 Revise notice 87-1	5.1 Flooding	5.2 Flood control policies	5.3 Diked historical baylands		
Bay Conservation & Development Commission California Coastal Conservancy Central Valley Regional Water Quality Control Board Delta Estuarine Agency Diverse Agencies Land Trusts Lead & Responsible Agencies Under CEQA & NEPA Local Governments Local Land Use Agencies LTMS Project National Oceanic and Atmospheric Administration Project Proponents San Francisco Bay Regional Water Quality Control Board State Agencies State Legislature State Water Resources Control Board U.S. Army Corps of Engineers U.S. Environmental Protection Agency U.S. Geological Survey	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		

Public Involvement and Education	1.1 Build support for CCMP
Friends of the San Francisco Estuary	•
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Publications of the San Francisco Estuary Project

STATUS AND TRENDS REPORTS

Aquatic Resources (March, 1992)
Dredging and Waterway Modification (March, 1990)
Effects of Land Use Change and Intensification (August, 1992)
Land Use and Population (February, 1991)
Managing Freshwater Discharge to the San Francisco Bay/Delta Estuary:
The Scientific Basis for an Estuarine Standard (1993)
Pollutants (March, 1991)
Wetlands and Related Habitats (December, 1991)
Wildlife (January, 1992)

OTHER TECHNICAL REPORTS

An Introduction to the Ecology of the San Francisco Estuary (September, 1990)
Comprehensive Conservation and Management Plan (June, 1994)
Quality Assurance in Environmental Analysis Applied to the San Francisco Estuary (July, 1991)
State of the Estuary: A Report on Conditions and Problems in the San Francisco Bay/
Sacramento-San Joaquin Delta Estuary (June, 1992)

INFORMATION BROCHURES

Agricultural Drainage
Aquatic Resources and Wildlife
Dredging and Waterway Modification
How We Use the Estuary's Water
Land Use
Monitoring and Research
Pollutants
Sacramento-San Joaquin Delta
San Francisco Bay-Delta Estuary
Watershed Management
Wetlands
Who Manages the Bay and Delta?

OTHER PUBLIC INFORMATION PUBLICATIONS

Estuarywise: A Citizen's Guide to Pollution Prevention
Estuary (Bi-monthly newsletter)

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