Executive Summary

The objective of the CALFED Water Quality Program is to provide good water quality for environmental, agricultural, drinking water, industrial, and recreational beneficial uses.

OVERVIEW

The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta System. The Program consists of five components that address problems associated with ecosystem restoration, water quality, system integrity, water use efficiency, and water supply reliability.

All components of the CALFED Program, are being developed and evaluated at a programmatic level. The complex and comprehensive nature of a Bay-Delta solution means that it will necessarily be composed of many different programs, projects, and actions, that will be implemented over time. During the current phase of the Program, solution alternatives will be evaluated as sets of programs and projects so that broad benefits and impacts can be identified. In the next phase of the Program, more focused analysis, environmental documentation, and implementation of specific programs and actions will occur.

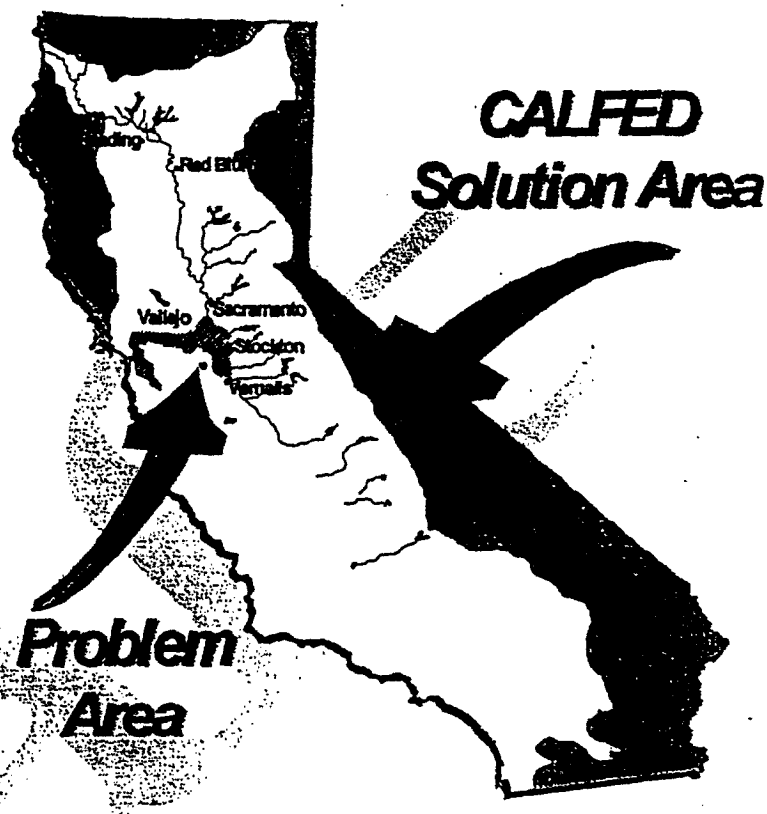
Water Quality Component

CALFED's objective for water quality is to provide good water quality for urban, agricultural, industrial, environmental, and recreational beneficial uses. This objective will be achieved through development and implementation of the CALFED Water Quality Program (WQP). The WQP will recommend action strategies that address identified parameters of concern to beneficial uses. These action strategies will have measurable performance targets and indicators of success that will be used to judge program effectiveness and facilitate adaptive management.

Adaptive Management Cycle

Geographic Scope of Water Quality Program

The geographic focus of the WQP is the Delta, which has been identified as the primary "problem" area by CALFED. This area consists of the legally defined Delta, Suisun Bay to Carquinez Strait, and Suisun Marsh. Some species (e.g., anadromous fish) that inhabit the Delta are impacted by conditions outside the Delta. Also, areas outside the Delta are sources of water quality problems affecting the Delta, its inhabitant species, and users of Delta water. In resolving the water quality problems of the Delta, the WQP recommends that actions be taken throughout the geographic solution area, as necessary.



WATER QUALITY COMPONENT REPORT

The Water Quality Component Report defines the basic structure of the WQP including:

- beneficial use water quality issues,
- water quality parameters of concern to beneficial uses,
- sources and loadings of parameters of concern,
- water quality beneficial use problem areas,
- existing programs to address parameters of concern,
- CALFED recommended action strategies,
- a monitoring and assessment framework to and evaluate action effectiveness, and
- a description of how CALFED's water quality activities may be coordinated with ongoing watershed management activities.

In addition to defining the CALFED Water Quality Program information from the Water Quality Component Report will be used to assess impacts as part of the CALFED Programmatic EIS/EIR process. Following is a summary of the main components of the Water Quality Component Report.

Selecting Parameters of Concern

The CALFED Water Quality Program has accessed and utilized a large group of water quality technical experts to assist in the development of the Water Quality Program. These stakeholders, known as the Water Quality Technical Group, represent federal, state and local

agencies, environmental advisory groups, industry, (pesticide, mining, etc.), agriculture, recreation, urban water supply, and watershed interests.

Initially, three technical teams of stakeholders were formed to identify the source water quality requirements of the ecosystem, urban and agricultural water users. The ecosystem team was primarily comprised of federal and state agency representatives (California Department of Fish and Game, US Fish and Wildlife Service, US Environmental Protection Agency, California Departments of Fish and Game and Pesticide Regulation, US Fish and Wildlife Service and Environmental Protection Agency, and State and Region 2 and 5 Water Quality Control Boards). The urban team included both agency staff and urban water agency representatives. The agricultural team was represented by agency staff, farmers, and agricultural water suppliers. Using available data and technical knowledge the teams identified "parameters of concern" that were of concern to their beneficial use of water. The teams also identified actions that might be taken to reduce these parameters. CALFED then invited additional stakeholders to join in the process, specifically those who might be impacted from implementation of the recommended water quality actions.

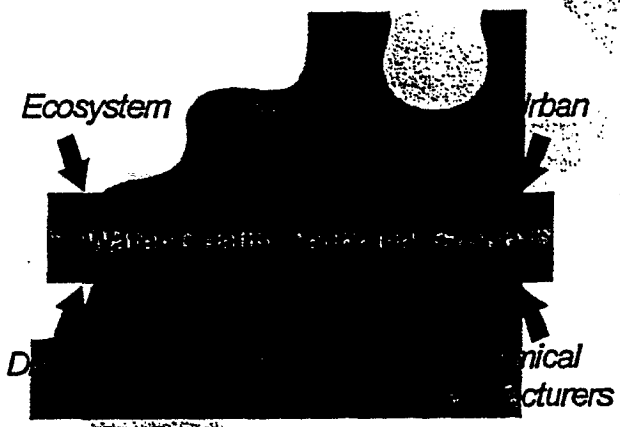


Table E-1 identifies parameters that have been identified by the Water Quality Technical Group as currently of concern to beneficial uses of water. This list may change over time in response to additional knowledge and understanding of these and other parameters.

In addition to the technical workgroup meetings CALFED has held workshops to inform the general public about the water quality program's activities. CALFED staff have also met with a variety of groups including the Clean Water Caucus, California Water Environment Association, and the California Urban Water Agencies. The CALFED Bay Delta Advisory Committee has been kept appraised of the water quality program's progress through informational segments at their regularly scheduled meetings.

Table E-1 Parameters of Concern to Beneficial Uses

Environmental		Drinking Water	Agriculture	Recreational	Industrial
Metals&Toxic Elements	**Other**	**Disinfection By-Product Precursors**	**Other**	**Metals**	**Other**
Cadmium	Ammonia	Bromide	Boron	Mercury	Salinity
Copper	Dissolved Oxygen	TOC	Chloride	**Organics/Pesticides**	pH
Mercury	Salinity (TDS, EC)	**Other**	Nutrients (Nitrate)	PCBs	Alkalinity
Selenium	Temperature	Pathogens	pH (Alkalinity)	DDT	Phosphates
Zinc	Turbidity	Turbidity	Salinity (TDS, EC)	**Other**	Ammonia
Organics/Pesticides	Unknown Toxicity*	Salinity (TDS)	SAR	Pathogens	
Carbofuran		Nutrients (Nitrate)	Turbidity	Nutrients	
Chlordane		pH	Temperature		
Chlorpyrifos					
DDT					
Diazinon					
PCBs					
Toxaphene					

*Unkown toxicity refers to observed aquatic toxicity the source of which is unknown.

Impacts to Beneficial Uses of Water

Drinking Water

The Delta is a source of drinking water for about 20 million, or two-thirds, of all Californians. Beneficial use of drinking water can be impacted by loadings of bromide, nutrients, salinity, organic carbon, turbidity, pathogens or changes in pH. Pathogens such as *Cryptosporidium parvum* in source water can adversely affect municipal drinking water supplies. Nutrient loading, and subsequent algae blooms, can impair the taste and odor of municipal water supplies and increase the expense of treating the water. Elevated turbidity due to suspended solids can be responsible for increasing treatment costs for municipal water supplies.

A major problem during periods of low Delta outflows is tidal mixing of salt into the Delta channels. Salts are a major concern with regard to municipal drinking water supplies because of the presence in sea water of bromide, which contributes to unwanted disinfection byproducts (DBPs). Salt can result in aesthetic problems such as salty taste, corrosion of appliances, plumbing and industrial facilities, and reduced opportunity for waste water recycling. Salts also are present in freshwater inflows to the Delta due to municipal and agricultural discharges. The most heavily concentrated sources of agricultural drainage to the Delta is the San Joaquin River.

Organic carbon in source water can adversely affect municipal drinking water supplies by combining with water treatment disinfectants to produce harmful by-products such as trihalomethanes. Of particular concern to drinking water is agricultural drainage from Delta Islands because the peat soils of the Delta contribute organic carbon to the agricultural drainage water. Delta diversions through the State Water Project H.O. Banks and North Bay

Pumping Plants, the Central Valley Project Tracy Pumping Plant, and the Contra Costa Water District Pumping Plant at Rock Slough supply water for municipal purposes. Figure E-1 depicts the interaction between municipal water intakes located in the Delta and sources of bromides, salinity and organic carbon.

Agriculture

More than 1,800 agricultural diversions are located within the Delta. These diversions supply irrigation water to over 450,000 acres of fertile Delta farmlands. Irrigation water destined for use on millions of acres in the San Joaquin Valley and Southern California is also diverted in the Delta at the same intakes used for municipal water diversion. Beneficial uses of water by agriculture can be impacted by loadings of boron, salts, nutrients, pH, sodium absorption ratios, and turbidity. Excess salts can result in plant toxicity and negative effects on plant growth and crop yield.. Salts affect the ability of a plant to take up water. Salts coupled with a disproportionate amount of sodium in the water, can cause the soil surface to seal, limiting water infiltration. Excessive vegetative growth or delayed crop maturity can result from excessive nutrients and white deposits on fruit or leaves can occur due to sprinkling with high pH water. Turbidity and nutrients can also foul irrigation systems.

Environment

The Delta is the West Coast's largest estuary, one of the country's largest systems for fish production, and provides habitat for more than 120 fish species. An estimated 25 percent of all warm water and anadromous sport fishing species and 80 percent of the state's commercial fishery species either live in or migrate through the Delta. Beneficial uses of water for environmental purposes, specifically fishery resources, have been impacted due to toxic pollutants such as trace metals and synthetic organic compounds. Also, nutrients, pathogens, pH, dissolved oxygen and temperature have the potential to affect Delta species. Populations of striped bass and other species have declined significantly from historical levels. Causes of the declines are uncertain, although water quality conditions in the Bay and Delta, decreases in Delta inflow and outflow rates, habitat loss, agricultural and other instream diversions, and in-Delta exports are thought to be contributing factors. Metals, pesticides, salts, and ammonia in elevated concentrations can be toxic to early life stages of fish and invertebrate species. Mercury can bioaccumulate in the upper levels of the food chain, affecting larger fish, birds and mammals. Pathogens can adversely affect fish either acutely (lethality) or chronically (histopathological effects, impaired reproduction). Solids can increase turbidity in water bodies, reducing photosynthesis and available food for fish. Solids can also cause siltation of water bodies, burying and ruining spawning gravels that are essential fish reproduction habitat. Nutrient loading can lead to direct or indirect (abnormal algae blooms) depletion of dissolved oxygen in water bodies, which can suffocate aquatic organisms, and lead to observable fish kills. Nutrient limitations may at times limit food availability to aquatic species.

Recreation

The Delta supports about 12 million public user days a year through a variety of recreational opportunities including fishing, camping, and boating. 120 marinas, shown in Figure E-2, are

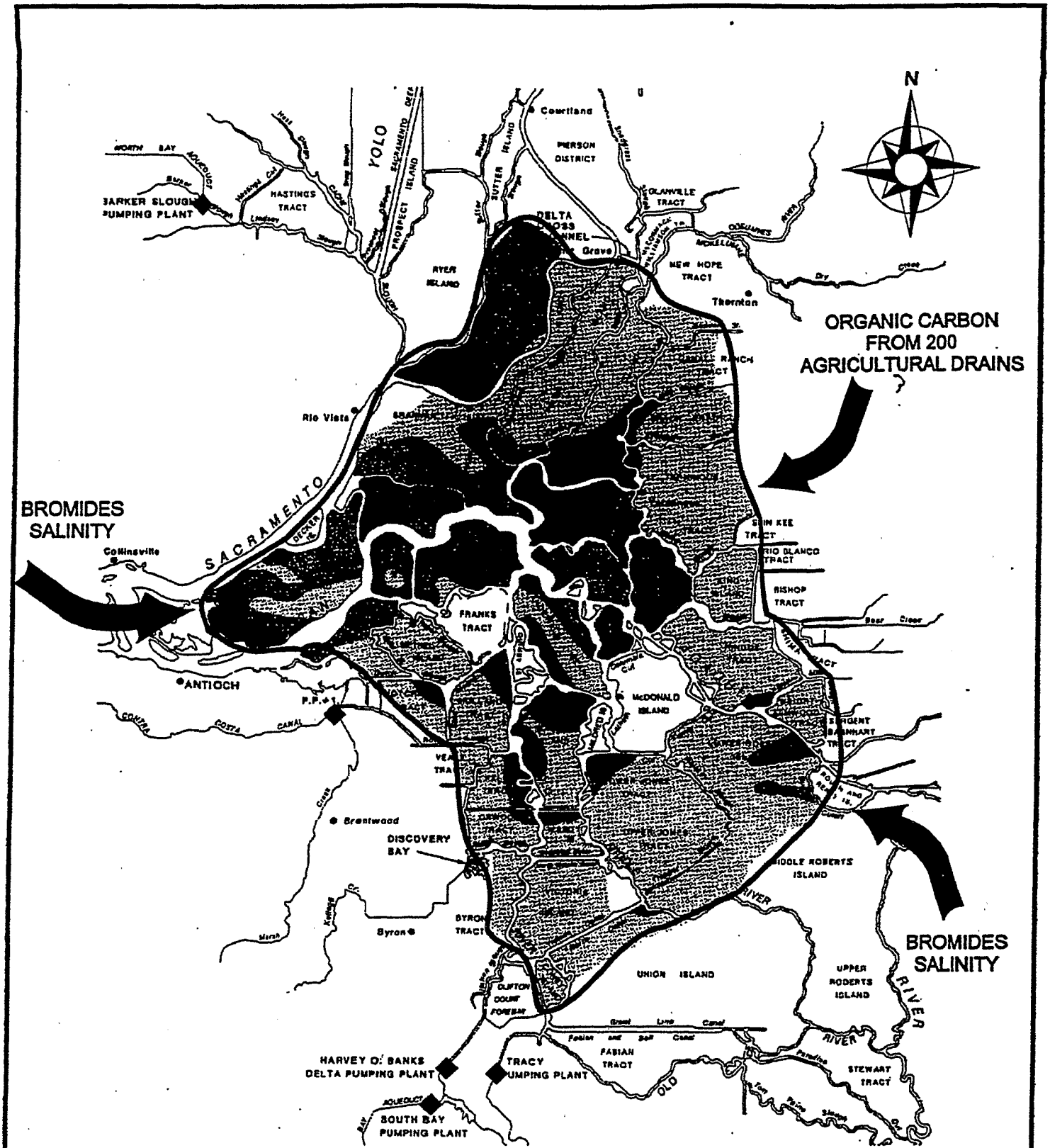
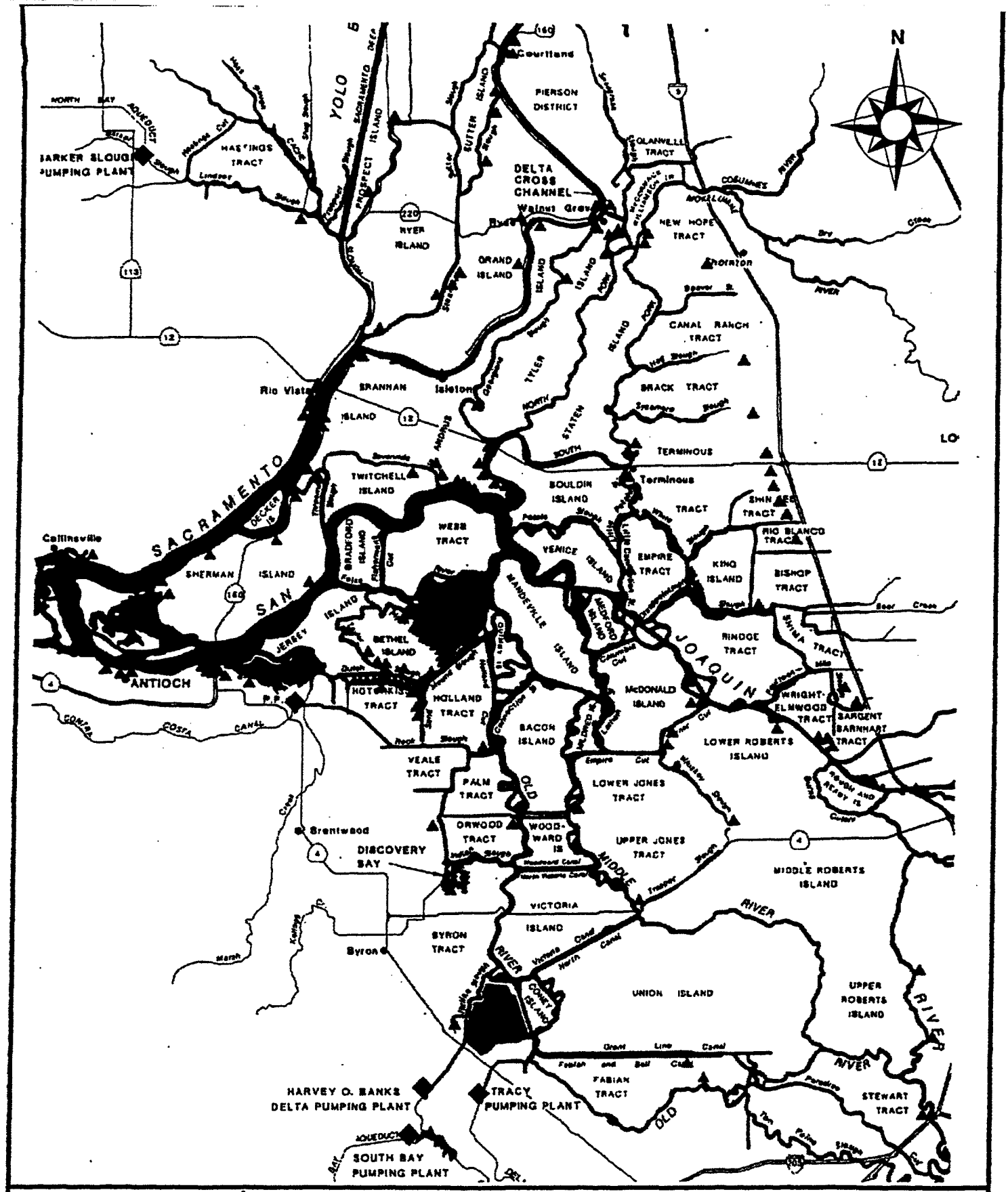


FIGURE E-1 - LOCATION OF MUNICIPAL WATER INTAKES IN RELATION TO SOURCES OF BROMIDES, SALINITY, AND TOTAL ORGANIC CARBON



LEGEND

- ◆ DRINKING WATER INTAKES
- ▲ MARINA

FIGURE E-2 - MARINAS LOCATED IN THE DELTA

E-015542

located within the Delta's boundary and approximately 82,000 boaters utilize the Delta's waterways. Recreational beneficial uses in the Delta may be affected due to pathogens, metals, pesticides, solids, or nutrients. Microbial pathogens can adversely affect the health of those who are participating in water contact recreation, such as swimming, water skiing, or windsurfing. Pathogen contamination of fish or shellfish can adversely affect public health. Certain metals and pesticides, such as mercury and DDT, bioaccumulate in the food chain and can adversely affect recreational fishers who consume contaminated fish and shellfish. Solids loading can increase the turbidity of waters and interfere with the aesthetic enjoyment of these natural resources and constitute a hazard to swimmers. Solids loading is also a mechanism by which pathogens, metals, pesticides, and nutrients are transported into waters that support recreational beneficial uses. Nutrient loading can promote algal blooms that reduce water clarity and sometimes cause unsightly, odorous floating mats and fouling of boat hulls.

Industrial

The Delta supports a wide variety of industries from sugar production to oil refineries. Industrial water is diverted directly from the Delta or conveyed through the same facilities used for municipal purposes. Some industrial processes divert water from municipal systems prior to treatment and treat the raw water to the level required for their specific industrial process. Industrial uses of water may be impaired due to salinity, phosphates, ammonia and pH. Salinity has adversely affected industrial processes such as paper manufacturing through corrosion and mineral scaling of industrial equipment. For refineries, a major user of industrial water, high concentrations of phosphates can aggravate scaling concerns in cooling water systems and high levels of ammonia can cause cracking in brass cooling heat exchangers.

Prioritizing Problem Areas

Defining what constitutes a "problem" is a controversial and debatable issue. Very few of the parameters of concern have been studied sufficiently to understand their fate, transport and impact on beneficial uses of water. If a parameter is measured against an existing objective, criteria or standard a decision must be made 1) whether the standard is appropriate, 2) what the standard is meant to protect, and 3) what level of exceedance is relevant (e.g., duration, season, geographic location, etc.). For example, an exceedance of copper in the Upper Sacramento River during the fall-run chinook salmon juvenile outmigration period might be devastating to the population however, during other times of the year (when fall-run are not present) there may be virtually no biological impact. For some parameters such as temperature and salinity extensive data has been collected. For other parameters such as pesticides minimal information is known. Given the inherent difficulties in attempting to measure data against published standards the Water Quality Program has adopted the following approach to identifying and prioritizing beneficial use problem areas.

- For environmental and recreational beneficial uses, problem areas are primarily designated based on Section 303(d) of the Clean Water Act. This Act requires each

state to develop a list, known as a 303(d) list, of water bodies that are impaired with respect to water quality and to identify the sources of impairment (e.g., mine drainage, agricultural drainage, urban and industrial runoff, and municipal and industrial wastewater discharges). Water bodies impaired by CALFED water quality parameters of concern are shown in Figure E-3.

- For drinking water beneficial uses, problem areas are determined based on the suitability of Delta drinking water sources to be treatable, at reasonable cost, to meet current and future federal and State health-based drinking water standards.
- For agricultural beneficial uses, problem areas are determined according to the impact of irrigation source water on sustainable productivity of agricultural lands.
- In addition a problem area can be defined based on scientific studies and data that indicate a potentially significant problem exists.

Identifying Sources of Problems

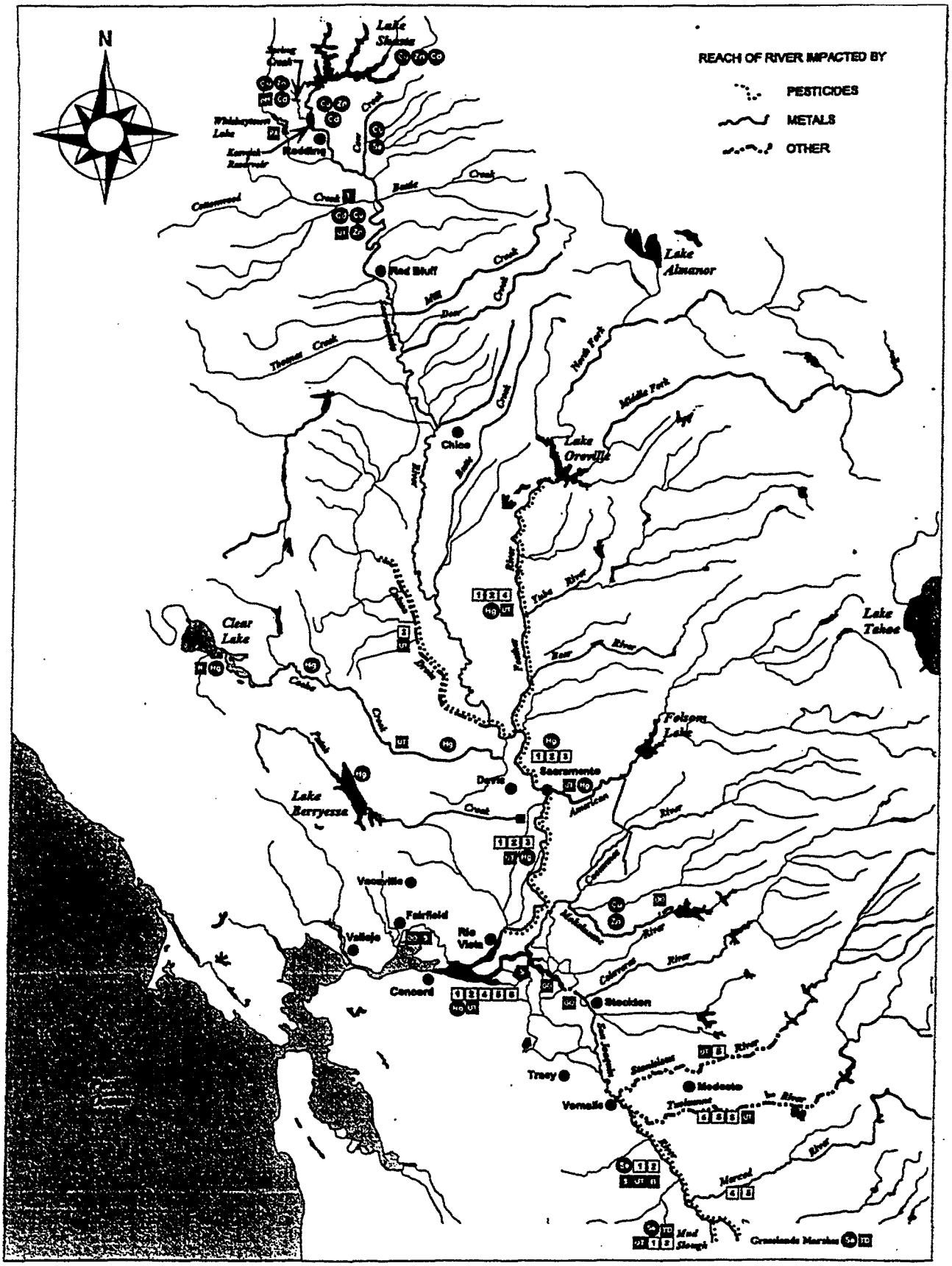
To effectively take action to improve water quality conditions it is not sufficient to only know where a problem exists in a water body, the source of the water quality problem must also be identified. Sources of water quality parameters of concern in the Delta and its tributaries include:

- acidic drainage from inactive and abandoned mines that introduce metals such as cadmium, copper, zinc, and mercury;
- stormwater inflows and urban runoff that may contribute metals, selenium, turbidity, pathogens, organic carbon, nutrients, pesticides, petroleum and other chemical residues;
- municipal and industrial discharges that may contribute salts, metals, trace elements, nutrients, pathogens, chemical residues, oil and grease, and turbidity;
- agricultural tail water, or return flows, that may contribute salts, nutrients, pesticide residues, pathogens, and turbidity; and,
- subsurface agricultural drainage that may contribute salts, selenium and other trace elements, nutrients, and pesticides (some fungicides).

The general locations of the major sources of water quality parameters of concern are shown in Figure E-4.

Developing Action Strategies

Action strategies have been developed to address water quality parameters of concern in the Delta and its tributaries. The strategies are recommended actions that will result in improvements to source water quality by reducing source loadings of parameters (e.g., mine drainage, agricultural drainage, urban and industrial runoff, and municipal and industrial wastewater treatment facilities); upgrading water treatment plants; or changing water management practices.

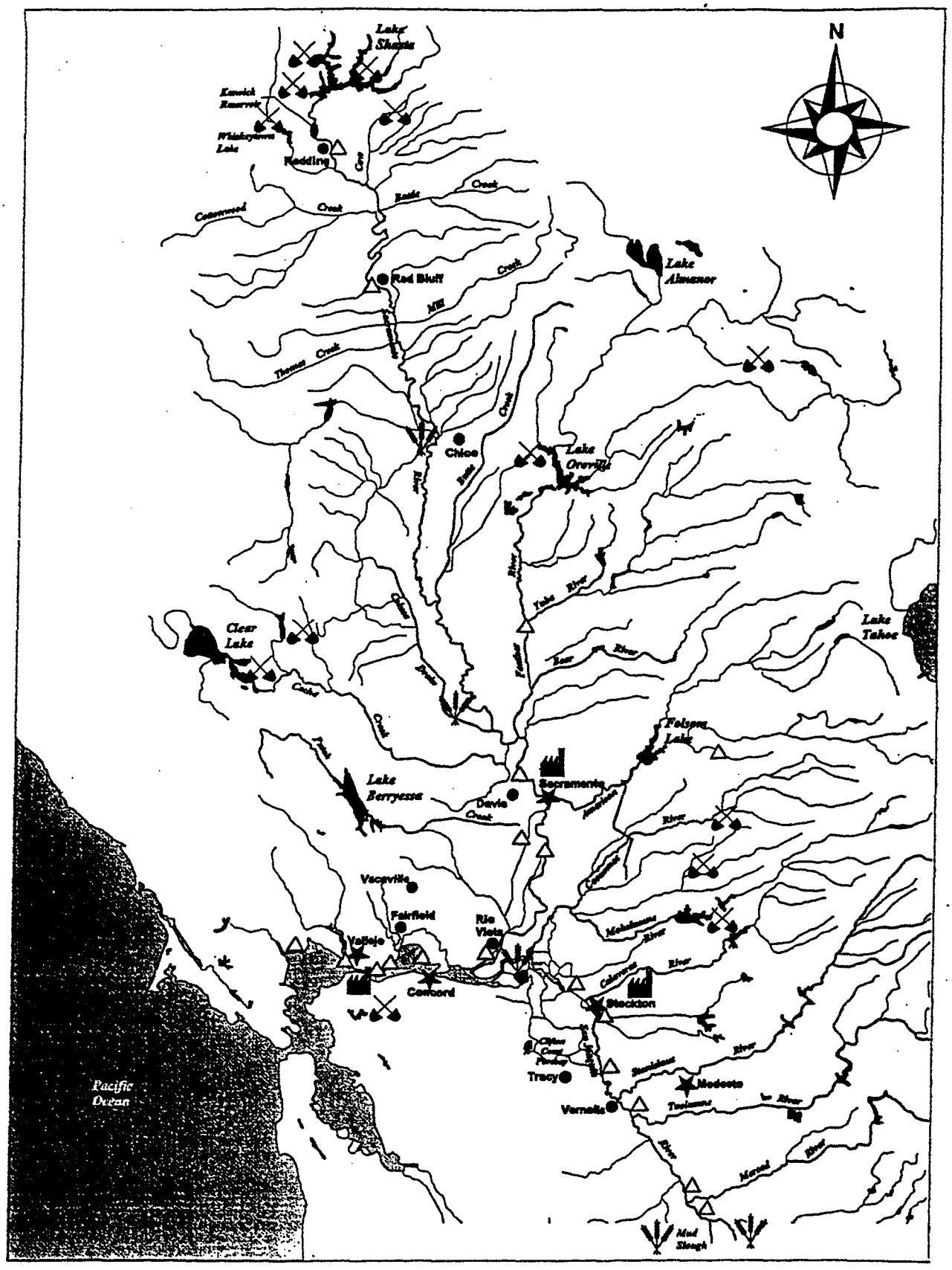


PARAMETERS OF CONCERN

TRACE ELEMENTS	PESTICIDES	OTHER
Hg MERCURY	1 DIAZINON	DO DISSOLVED OXYGEN
Cu COPPER	2 CHLORPYRIFOS	PA PATHOGENS
Zn ZINC	3 CARBOFURAN	TDS TDS
Se SELENIUM	4 TOXAPHENE	pH pH
Cd CADMIUM	5 DDT	UT UNKNOWN TOXICITY
	6 CHLORDANE	N NITRATE
		T TEMPERATURE
		S SALT
		B BORON

FIGURE E-3 - CALFED IMPAIRED WATER BODIES BASED ON CWA SECTION 303(D) LIST

E-015545



LEGEND

- WASTEWATER TREATMENT PLANT
- CITIES UNDER 100K POPULATION
- CITIES OVER 100K POPULATION
- AGRICULTURAL DRAINS
- INDUSTRIAL FACILITIES
- MINE - INACTIVE OR ABANDONED

FIGURE E-4 - POTENTIAL SOURCES OF PARAMETERS OF CONCERN

Action strategies to address water quality parameters of concern include a combination of research, pilot studies and full-scale actions. For some parameters, such as mercury, there is inadequate understanding about its sources, the bioavailability of the various sources, and the load reductions needed to reduce fish tissue concentrations to levels acceptable for human consumption. For this parameter further study is recommended before full-scale actions are taken. For other parameters, such as selenium, sources are better documented, and source control or treatment actions can be taken with a reasonable expectation of positive environmental results.

Performance targets have been established to measure the effectiveness of actions to improve water quality. Performance targets may be quantifiable reductions in loadings of parameters. For example, the target for copper in the Sacramento River is to reduce copper loadings in the Upper Sacramento River from 65,000 pounds to 10,000 pounds per year. For actions that recommend further study of a parameter the performance target may be a focussed outcome. For example, an action for mercury is further research to better understand the sources and mechanisms of mercury accumulation in the Delta estuary. The performance target is a targeted action plan that specifies selection and prioritization of the most effective mercury remediation actions.

Indicators of success are generally numerical or narrative water quality targets, or biological indicators, that have been developed for each parameter of concern. Targets relate to in-stream, sediment, or tissue concentrations of parameters. They will be used to gauge action and alternative effectiveness at protecting beneficial uses. Targets are based on Water Quality Control Plans (Basin Plans) of the Bay Area and Central Valley Regional Water Quality Control Boards or U.S. Environmental Protection Agency ambient water quality objectives (when available), standard agricultural water quality objectives, and target source drinking water quality ranges as defined by technical experts. Some parameters, such as pathogens have no regulatory objectives. In these cases indicators of success are generally a quantifiable reduction in counts before and after action is taken.

Table E-2 summarizes the Action Strategies for each parameter of concern included in the CALFED Water Quality Program.

Comprehensively Conducting Monitoring, Assessment and Research

The Water Quality Program, and indeed all CALFED activities, must be based on the application of rigorous science. While there is some information on the existence of water quality problems in the CALFED solution area, much is yet to be learned. CALFED is developing a Comprehensive Monitoring, Assessment, and Research Program (CMARP) to address the need for adequate scientific support not only in the water quality area, but also for the system integrity, ecosystem restoration, and water supply reliability resource areas. The CMARP is central to the CALFED philosophy of adaptive management. The water quality component of the CMARP will provide for:

- Establishing a quality assurance/quality control plan to assure the scientific validity of CALFED data collection included in this plan will be recommendations for standardized data collections and handling practices to assure that all data collected for CALFED are compatible;

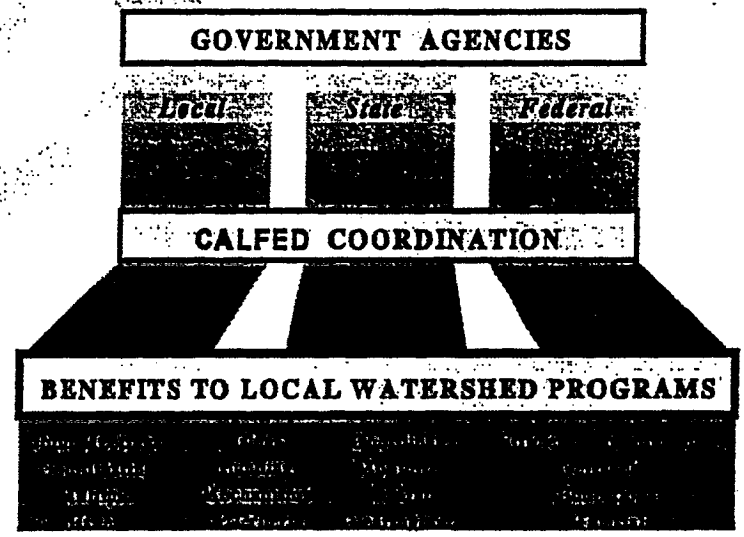
- Establishing the actual existence and severity of water quality problems, including evaluating the ecosystem effects of water quality parameters;

- Establishing baseline water quality conditions against which the effectiveness of CALFED actions will be measured; and,

- Evaluating the effectiveness of CALFED water quality improvement actions and identifying the need for adaptive management actions.

Coordinating Watershed Activities

CALFED may work with local agencies to assist in the formation of alliances and cooperative projects to improve water quality for beneficial uses on a larger scale than might be possible with local agencies working alone or in more narrowly scoped programs. CALFED's system-wide watershed focus on water quality will help to better integrate and coordinate State/Federal resource management programs with local watershed activities, while ensuring long-term benefits for the Bay-Delta estuary.



CALFED activities are being coordinated with existing or new watershed management programs affecting the Bay-Delta system including, but not limited to, the Sacramento River Watershed Program, the San Joaquin Valley Drainage Implementation Program, the San Francisco Estuary Project Comprehensive Conservation and Management Plan and the federal, State, and Regional Water Quality Control Board's Watershed Management Initiative Programs.

E-015548