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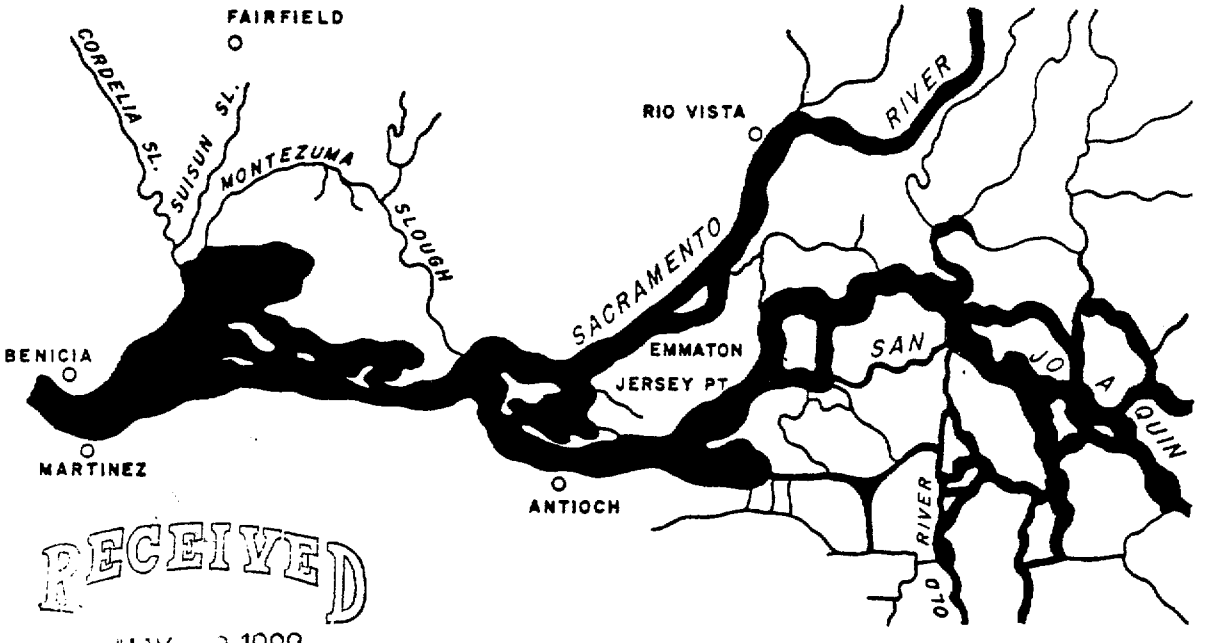
Sacramento-San Joaquin Delta and Suisun Marsh



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STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 78-43

ADOPTION OF WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH

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WHEREAS:

1. A responsibility of the State Water Resources Control Board is the regulation of activities and factors which affect or may affect the quality of the waters of the State in order to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters, and the beneficial uses involved.

2. The State Board has undertaken a proceeding, under its full water right and water quality authority, to develop a single comprehensive set of water quality standards to protect beneficial uses of the waters of the Sacramento-San Joaquin Delta.

3. The State Board has conducted 32 days of evidentiary hearing initiated on November 15, 1976 and concluded on October 7, 1977 in accordance with the Federal Clean Water Act (P.L. 95-217) and the California Water Code, and has considered the evidence introduced at the hearing.

4. Based on the evidentiary record, a draft water quality control plan for the Sacramento-San Joaquin Delta and Suisun Marsh and a Draft Environmental Impact Report were formulated and submitted for public review on March 15, 1978.

5. The State Board conducted a public hearing on the draft water quality control plan and Draft Environmental Impact Report on May 30, 1978, after notice to all interested persons, in accordance with federal and State requirements and has considered the oral and written comments submitted.

6. The Water Quality Control Plan and Environmental Impact Report have been revised to incorporate appropriate comments received from the interested persons.

7. The water quality standards in the Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh will be reviewed at least once every three years.

8. The State Board will reopen the Delta water right hearing not later than eight years from the adoption of this plan for the purpose of receiving further evidence relating to salinity control, protection of fish and wildlife in the Bay-Delta estuary, and coordination of terms and conditions of the permits for the Delta water supplies of the federal Central Valley Project and the State Water Project.

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9. The Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh does not mandate the construction of facilities or mandate activities outside of the State Board's jurisdiction.

10. By approval of the Water Quality Control Plan the Board does not intend to affect negotiations among various Delta water agencies and the Department of Water Resources and U.S. Bureau of Reclamation regarding agreements on water quality and water quantity in the Delta.

11. The Water Quality Control Plan is an adjunct to the Basin Plans; it includes all necessary elements of water quality control plans in accordance with Section 13241 and 13242 of the California Water Code and federal requirements.

12. The State Board has certified the Environmental Impact Report on the Water Quality Control Plan (and corresponding Water Right Decision).

THEREFORE BE IT RESOLVED:

1. That the State Board adopts the Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh (Delta Plan) in accordance with Section 13170 of the Water Code.

2. That the Delta Plan supersedes the Basin Plans to the extent of any conflict with specific water quality standards (salinity) and will be in effect until the end of calendar year 1988 unless modified earlier.

3. That adoption of the water quality standards (salinity) in the Delta Plan should not be construed as representing final action by the State Board on water quality standards for the Delta and Suisun Marsh and that water quality standards may be modified if necessary to protect beneficial uses of Delta water supplies.

4. That the Executive Director is directed to forward copies of the Water Quality Control Plan to the Environmental Protection Agency in accordance with requirements of the Federal Clean Water Act (as amended by P.L. 95-217).

CERTIFICATION

The State Water Resources Control Board has determined that there is no state mandate for a new program or increased level of service on any unit of local government as a result of the foregoing resolution because such resolution is not an executive regulation pursuant to the Revenue and Taxation Code, Section 2209.

The undersigned, Executive Director of the State Water Resources Control Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on August 16, 1978.

Dated: AUG 16 1978

Executive Director
Larry F. Walker

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CHAPTER I

INTRODUCTION

The Sacramento-San Joaquin Delta and Suisun Marsh include about 120 square miles of surface water area where northern and central California's major river systems converge and flow westward, meeting the incoming seawater from San Francisco Bay and the Pacific Ocean. The Delta area is the largest, most important estuary for fish and waterfowl production on the Pacific Coast of the United States, and, at the same time, one of the state's most fertile and important agricultural regions and the location of a major water-related industrial corridor in the vicinity of Antioch.

The Delta is a vital link between the water surplus areas in the Sacramento Valley and the water deficient areas to the south and west of the Delta. Two major systems - one state and one federal - export surplus supplies from the Delta to areas of need. These systems are the State Water Project (SWP) operated by the Department of Water Resources (Department) and the Central Valley Project (CVP) operated by the U. S. Bureau of Reclamation (Bureau).

Competition for Delta water supplies between in-basin and export uses has increased substantially over the last few years and will become yet more intense in the future. This increased demand will test the ability of state and federal water officials over the next few years to ensure an adequate Delta water supply to meet all in-basin and export uses.

The Delta has been the subject of the most extensive and intensive water quality planning ever undertaken for any major area of the state. Notwithstanding this, much is unknown about this complex estuary. In addition there is uncertainty regarding what future water facilities may be constructed and affect the Delta and Suisun Marsh. A Delta transfer facility, overland facilities to western Delta islands and Suisun Marsh, internal water circulation facilities in the southern Delta, additional export pumps, the relocation of the Contra Costa Canal Intake, and the construction of additional storage facilities have all been proposed.

In 1967 the water quality control and water right functions of the state were merged in order that necessary inter-relationships between water quality and availability of unappropriated water could be considered together by a single state agency. The current proceeding is the first time that water quality control and water right functions of the Board have been fully combined in the development of a single set of water quality standards.

This water quality control plan for the Sacramento-San Joaquin Delta and Suisun Marsh (Delta Plan) represents the culmination of thirty-two days of evidentiary hearing initiated on November 15, 1976, and concluded on October 7, 1977. The evidentiary record also has been used in formulating a water right decision to implement applicable provisions of the plan through revisions of terms and conditions in permits of the Department and Bureau.

The applicable terms and conditions which have been incorporated into permits of the Department and Bureau are set forth in the plan.

Even though two documents have been adopted by the Board (a water quality control plan and a water right decision), they represent a unified effort by the Board to develop under its full authority a single comprehensive set of water quality standards to protect beneficial uses of Delta water supplies, recognizing the respective rights of all users to such supplies.

Since the two distinct approvals constitute the whole of a single project, a single environmental impact report (EIR) has been prepared and approved by the Board for both of these documents.

A. GEOGRAPHIC DESCRIPTION

The Sacramento-San Joaquin Delta as defined in Section 12220 of the California Water Code is a roughly triangular area of about 738,000 acres extending from Chipps Island near Pittsburg on the west to Sacramento on the north and to the Vernalis Gauging Station on the south (see Plate 1). The Delta generally is comprised of those waterways above the confluence of the Sacramento and San Joaquin Rivers which are influenced by tidal action, and about 510,000 acres of agricultural lands which derive their water supply from these waterways. The total surface area of these waterways is over 48,000 acres with an aggregate navigable length of 550 miles.

Suisun Marsh as defined by Section 29101 of the Public Resources Code is an intricate land-water area of marsh, ponds, sloughs and estuaries which furnish habitat for a variety of plants and animals. The Marsh includes the waterways north of Suisun and Honker Bays which are subject to tidal action and the adjacent lands whose management is dependent on tidal action in those waters (see Plate 1). The area contains approximately 50,000 acres of diked, managed wetlands, 5,500 acres of tidal marsh, and 30,000 acres of bays, sloughs and other waterways. These wetlands are a unique and highly productive interface between fresh and saltwater environments and play an important role in providing wintering habitat for waterfowl of the Pacific Flyway.

B. BOARD AUTHORITY

Water Quality Control

The Board is charged with responsibility under the California Water Code to regulate activities which affect or may affect the quality of waters of the state in order to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the beneficial uses involved. Section 13170 of the Water Code provides that the Board may adopt water quality control plans for surface waters.[1/]

1/ Such plans must be adopted in accordance with the provisions of Sections 13240 to 13247 of the Water Code.

A water quality control plan is a management document which identifies the municipal, industrial, agricultural, and instream environmental use of water within a specified area and sets forth an effective program to protect those uses. Such plans, when adopted, supersede any regional water quality control plan (basin plan) adopted by a Regional Board for the same waters to the extent of any conflict.

In addition, the Federal Water Pollution Control Act, as amended,[2/] requires the establishment of water quality standards[3/] for all surface waters of the state. Section 303(e) of the Act provides that each state is responsible for the establishment of such water quality standards through water quality control plans which must be submitted and approved by the Environmental Protection Agency.

Water Rights

The water right permits of the Department and Bureau which are the subject of this proceeding are set forth in the appendix to this plan (Appendix A).

2/ Referred to as the Clean Water Act of 1977 (PL 95-217)

3/ Under the California Water Code, "water quality objectives" mean enforceable numerical limits on water quality characteristics which are established to protect beneficial uses. However, the term "objectives" is commonly understood to mean goals or other non-binding guides. For this reason, "water quality standards" is used herein to convey the concept of enforceable numerical limits.

The Board's authority to review and amend these permits is derived from Section 1394 of the California Water Code, jurisdiction expressly reserved in the subject permits, Water Code Section 100 and the continuing authority of the Board, as stated in the terms of the permits, to prevent waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water.

In exercising its reserved jurisdiction, the Board has two broad areas of concern based upon its statutory responsibilities. These are (1) protection of vested water rights, and (2) protection of the public interest.

Protection of Vested Water Rights

Prior vested water rights include those of riparian lands, pre-1914 appropriators and appropriators whose rights are based upon water right permits with priority earlier than those of the Department and the Bureau. In addition, the permits of both the Department and Bureau for use outside the Delta or the Sacramento River watershed are subject to use by appropriators within the Delta and watershed regardless of when such use was or is initiated (Water Code Section 11460 and Decisions D 990 and D 1275). The effect of this limitation is to make the rights of all legal users of water in the Delta and in the watershed senior to the rights of either the Department or the Bureau to store or divert water for use outside the Delta or the watershed.

The projects must be operated so as not to cause any material deterioration of water quality which would impair its usefulness

for the reasonable beneficial uses which are made of water by senior right holders. The Department and Bureau can be relieved of this responsibility only if they provide an adequate substitute supply without additional expense to Delta water users (Water Code Section 12202). However, the rights of water users on riparian lands and appropriators in the Delta extend only to water quality and quantity which would have been available in the absence of the projects, taking into consideration upstream uses under vested rights. If Delta water users desire additional benefits in excess of their vested rights they can seek such benefits from project operators.

Although the Board in this proceeding is not adjudicating or determining the validity of individual vested water rights, it must nonetheless identify the extent to which such rights would have been satisfied in the absence of the projects to ensure that the operation of project facilities does not adversely encroach upon these uses.

Public Interest

"Public interest" is one of the primary statutory standards guiding the Board in acting upon applications to appropriate water (see Johnson Rancho County Water District v. State Water Rights Board, 235 Cal. App. 2d 863, 45 Cal. Rptr. 589 (1965); California Water Code Sections 1253-1258).

The Water Code provides in several sections that the Board should consider the broad public interest in making water right determinations. Section 1257 directs that the Board consider the relative benefit to be derived from all beneficial uses of the water concerned and further provides that the Board may subject appropriations to such terms and conditions as in its judgment will best develop, conserve and utilize in the public interest, the water sought to be appropriated. Similarly, Section 12581 provides that in studying water development projects, full consideration shall be given to all beneficial uses of the state's water resources, including irrigation, generation of electric energy, municipal and industrial consumption of water and power, repulsion of salt water, preservation and development of fish and wildlife resources, and recreational facilities, but not excluding other beneficial uses of water. Finally, with regard to the SWP, Section 11900 mandates that preservation of fish and wildlife should be provided for in connection with the construction of project facilities.

Another source of guidance in determining the public interest is the California Environmental Quality Act of 1970 (Public Resources Code, Div. 13) which provides that it is the state policy to:

> (a) Develop and maintain a high-quality environment now and in the future, and take all action necessary to protect, rehabilitate, and enhance the environmental quality of the state.

(b) Take all action necessary to provide the people of this state with clean air and water, enjoyment of aesthetic, natural, scenic, and historic environmental qualities, and freedom from excessive noise.

(c) Prevent the elimination of fish or wildlife species due to man's activities, insure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities and examples of the major periods of California history.

(d) Ensure that the long-term protection of the environment shall be the guiding criterion in public decisions.

(e) Create and maintain conditions under which man and nature can exist in productive harmony to fulfill the social and economic requirements of present and future generations.

(f) Require governmental agencies at all levels to develop standards and procedures necessary to protect environmental quality.

(g) Require governmental agencies at all levels to consider qualitative factors as well as economic and technical factors and long-term benefits and costs, in addition to short-term benefits and costs, and to consider alternatives to proposed actions affecting the environment.

A more specific mandate governing the Board in this decision is Part 4.5 of Division 6 of the Water Code, referred to as the Delta Protection Act. The Delta Protection Act accords first priority to satisfaction of vested rights and public interest needs for water in the Delta and relegates to lesser priority all exports of water from the Delta to other areas for any purpose. These statutory policies are subject to the overriding constitutional provision that all uses of water and diversions of water must be reasonable (Article 10, Section 2, California Constitution).

C. SCOPE OF BOARD ACTIONS

The jurisdiction reserved by the Board to revise or formulate additional terms and conditions in the water right permits issued to the Department and Bureau affecting Delta water supplies covers three general areas: (1) salinity control, (2) protection of fish and wildlife, and (3) coordination of terms and conditions of the respective permits for the SWP and CVP.

The principal focus of this plan is limited to current and near-term conditions in the Delta. The water quality standards are based on conditions expected to prevail over the next ten years. The Board, in limiting the effective period of the plan, recognizes the uncertainty associated with proposed project facilities to be constructed and the need for additional information on the Delta-Bay ecosystem. As new facilities are constructed and additional information gathered on the Delta, the Board will review water quality standards to ensure that beneficial uses of Delta supplies are protected.

This is consistent with Section 303(c)(1) of the Federal Water Pollution Control Act (PL 92-500) which requires review at least once every three years of water quality standards established in water quality control plans.

D. THE WATER QUALITY CONTROL PLAN

The Delta Plan consists of three elements: (1) designation of beneficial uses to be protected, (2) establishment of water quality standards for reasonable protection of the beneficial uses, and (3) establishment of a program of implementation needed for achieving these water quality standards (Water Code Section 13050(j). The implementation program set forth in Chapter VII of the plan provides both specific measures which must be taken to satisfy water quality standards during the effective period of this plan, and broad policy guidance to assist location, state and federal agencies in finalizing plans for additional project facilities.

Chapter II of this report discusses water quality conditions in the Delta and Suisun Marsh and Chapter IV describes the past proceedings undertaken by the Board and its predecessor agencies (the State Water Quality Control Board and the State Water Rights Board) to protect beneficial uses of Delta supplies.

The water quality standards are presented in Chapter VI. These standards reflect a closer fit to hydrologic conditions and available water supplies than current water quality objectives contained in the basin plans. Even though the standards require less freshwater outflow because of a more efficient use of Delta outflows and a better understanding of beneficial use needs in the Delta, the overall protection under the standards is greater than that provided by the current basin plan objectives (see Chapter IV of EIR). In addition, the water quality control plan requires mitigation of project impacts on Suisun Marsh by October 1, 1984.

The Delta Plan supersedes Figure IV-1 and the Delta salinity standards of Table IV-2 both contained in the Water Quality Control Plan for the Sacramento-San Joaquin Delta Basin (Basin 5B Plan). Also, the Delta Plan supersedes the Chipps Island and Suisun Marsh standards of the Water Quality Control Plan for the San Francisco Bay Basin (Basin 2 Plan), as modified by State Board Resolution 76-61.

The water quality control plan for the Delta and Suisun Marsh will be submitted to the Environmental Protection Agency for approval in accordance with requirements of PL 92-500 as amended. This water quality control plan, when considered as an adjunct to the comprehensive basin plans, satisfies all federal requirements.

CHAPTER II

WATER QUALITY CONDITIONS

Water quality conditions in the Delta and Suisun Marsh depend on water quantity. Delta waters are a mixture of seawater and freshwater including return flows of various salinity levels. The salinity of the mixture is extremely variable geographically, seasonally and from year to year. The extent of salinity intrusion into the Delta is determined by the relative magnitude of the opposing forces of tidal action and Delta outflow.

Upstream storage facilities, in-basin depletions and Delta exports have all reduced and seasonally altered the natural freshwater outflow from the Delta. This alteration of natural outflow has significantly affected the extent and duration of seawater intrusion into the Delta and Suisun Marsh.

Salinity is the major water quality factor affecting beneficial uses of Delta supplies and is directly influenced by operations of project facilities. Therefore, the discussion on water quality conditions in the Delta is restricted to salinity intrusion.

The major factors affecting Delta outflow are natural runoff, the regulatory effects of upstream developments which either reduce runoff or change its time of occurrence, and SWP and CVP operations which transport water through the Delta and pump water from it for export.

Storage facilities constructed by the state, federal government and other public and private agencies have reduced winter and spring flows but have increased summer and fall flows through storage releases. However, expected increases in export rates will lower the mid and late fall outflows below natural levels. Since riparian water rights in the Delta extend only to natural flows, measured flows must be adjusted to reflect these man-induced alterations to natural hydrology to assess impacts on vested water rights.

A hydrologic classification of year types has been developed for this plan. The water quality standards set forth in Table VI-1 provide for adjustments in the level of protection to beneficial uses according to the hydrologic year type.

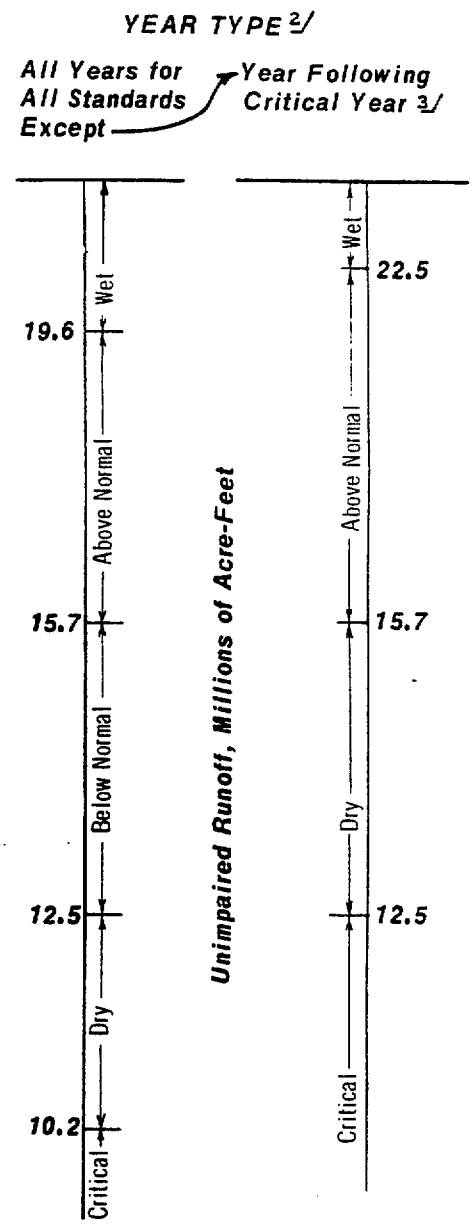
A new year type classification system was proposed by the Department during the hearing process (Department Exhibit 1)[1/]. Figure II-1 shows the year classification system developed for the Delta Plan. It is the same as the Department's proposal except that the "Year Following Critical Year" designation does not apply to agricultural, municipal and industrial standards. This modification is necessary to provide those uses the full protection to which they are entitled under their vested water rights. The system is based on unimpaired runoff to the Sacramento Valley from the four principal tributaries to it: Sacramento River, Feather River, Yuba River and American River. Although there were some objectives, the only other substantial modification offered to the Department's classification system was one which included San Joaquin River flows. The evidence does not indicate that the addition of San Joaquin River inflows would improve the classification system.

1/ References herein to the hearing record may be to either exhibits identified by party and exhibit number or testimony identified by reporter's transcript (RT) volume and page number.

YEAR CLASSIFICATION

Year classification shall be determined by the forecast of Sacramento Valley unimpaired runoff for the current water year *(October 1 of the preceding calendar year through September 30 of the current calendar year)* as published in California Department of Water Resources Bulletin 120 for the sum of the following locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River at Smartville; American River, total inflow to Folsom Reservoir. Preliminary determinations of year classification shall be made in February, March and April with final determination in May. These preliminary determinations shall be based on hydrologic conditions to date plus forecasts of future runoff assuming normal precipitation for the remainder of the water year.

YEAR TYPE	*RUNOFF, MILLIONS OF ACRE-FEET*
Wet 1/	equal to or greater than 19.6 (except equal to or greater than 22.5 in a year following a critical year). 3/
Above Normal 1/	greater than 15.7 and less than 19.6 (except greater than 15.7 and less than 22.5 in a year following a critical year). 3/
Below Normal 1/	equal to or less than 15.7 and greater than 12.5 (except in a year following a critical year). 3/
Dry	equal to or less than 12.5 and greater than 10.2 (except equal to or less than 15.7 and greater than 12.5 in a year following a critical year). 3/
Critical	equal to or less than 10.2 (except equal to or less than 12.5 in a year following a critical year). 3/



1/ *Any otherwise wet, above normal, or below normal year may be designated a subnormal snowmelt year whenever the forecast of April through July unimpaired runoff reported in the May issue of Bulletin 120 is less than 5.9 million acre-feet.*

2/ *The year type for the preceding water year will remain in effect until the initial forecast of unimpaired runoff for the current water year is available.*

3/ *"Year following critical year" classification does not apply to Agricultural, Municipal and Industrial standards.*

The following discussion is divided into three parts: pre-project, post-project, and without project water quality conditions. Pre-project water quality reflects those conditions existing during the period 1920-1944. This is the most complete period of record for which salinity intrusion data on the Delta is available, prior to operation of SWP and CVP facilities. The post-project period 1945-1976, commencing with initial operation of Shasta Dam in 1945, encompassed an increasing number of regulatory facilities and stream depletions. The without project condition is a theoretical condition. It refers to the water quality that would occur in 1980 had the CVP and SWP facilities not been constructed. The without project condition reflects the effect of other non-project regulatory facilities and stream depletions.

A. PRE-PROJECT CONDITIONS

Under pre-project conditions (1920-1944), seawater moved upstream toward and into the Delta when freshwater inflows to the Delta decreased. Typically, this salinity intrusion began in late spring and continued through the summer, with maximum intrusion occurring sometime in August or September. Figure II-2 shows the maximum salinity intrusion each year for pre-project conditions, as reflected by the location of the 1000 ppm chloride line.[2/] The wide

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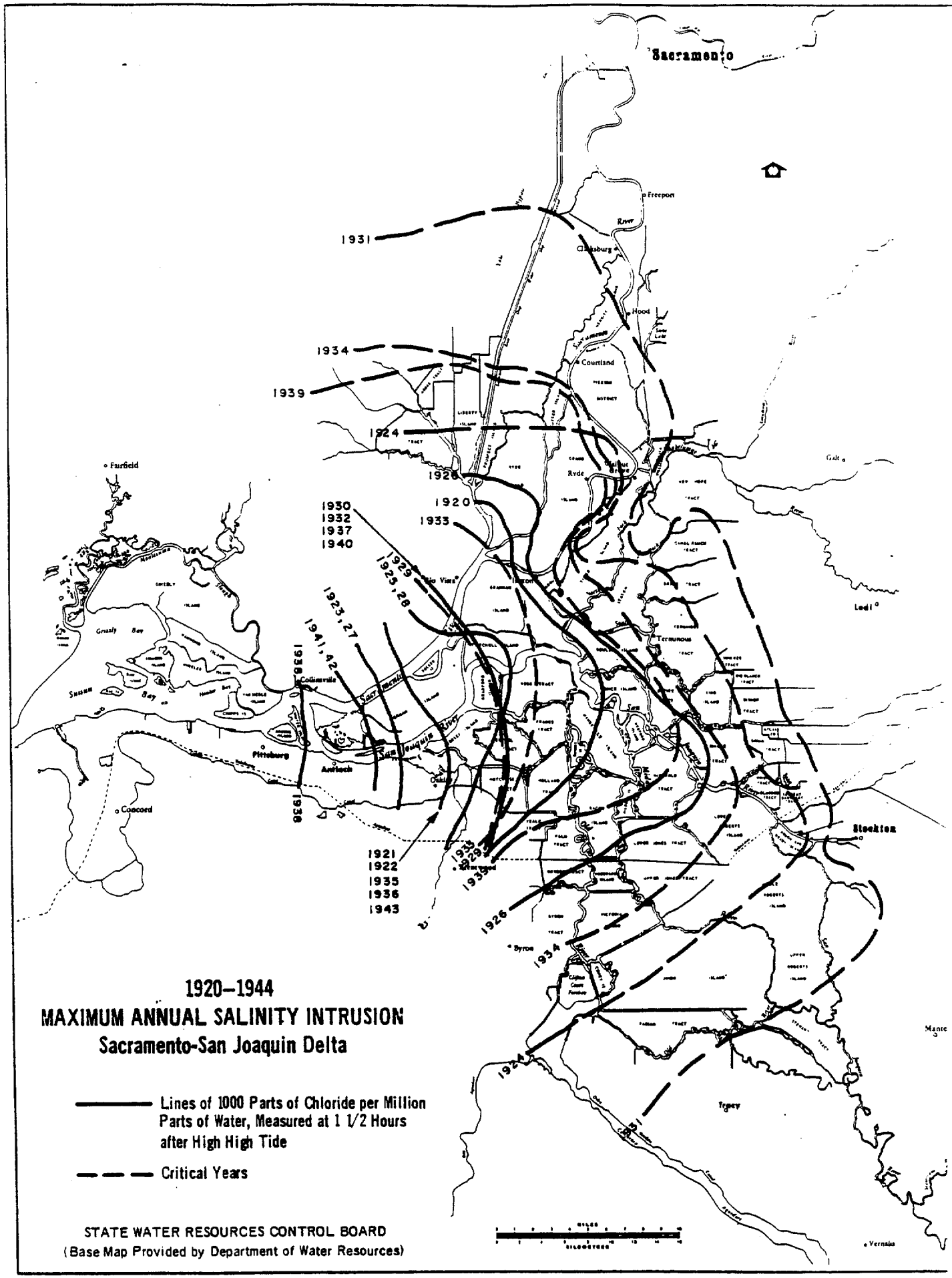
2/ For purposes of this plan, salinity is expressed in terms of chloride ion concentration, total dissolved solids (TDS) or electrical conductivity (EC). Chloride ion concentration and TDS are expressed interchangeably as parts per million parts of water (ppm) or as milligrams per liter of water (mg/l). EC is expressed in terms of millimhos per centimeter at 25°C (mmhos). Seawater has an average chloride concentration of 18,000 ppm and predominantly freshwater river flows into the Delta have a chloride concentration of 10-20 ppm. The 1000 ppm chloride concentration, which is unusable for most beneficial uses in the Delta, has been used historically as a measure of salinity intrusion since the 1920's.



1920–1944
MAXIMUM ANNUAL SALINITY INTRUSION
Sacramento-San Joaquin Delta

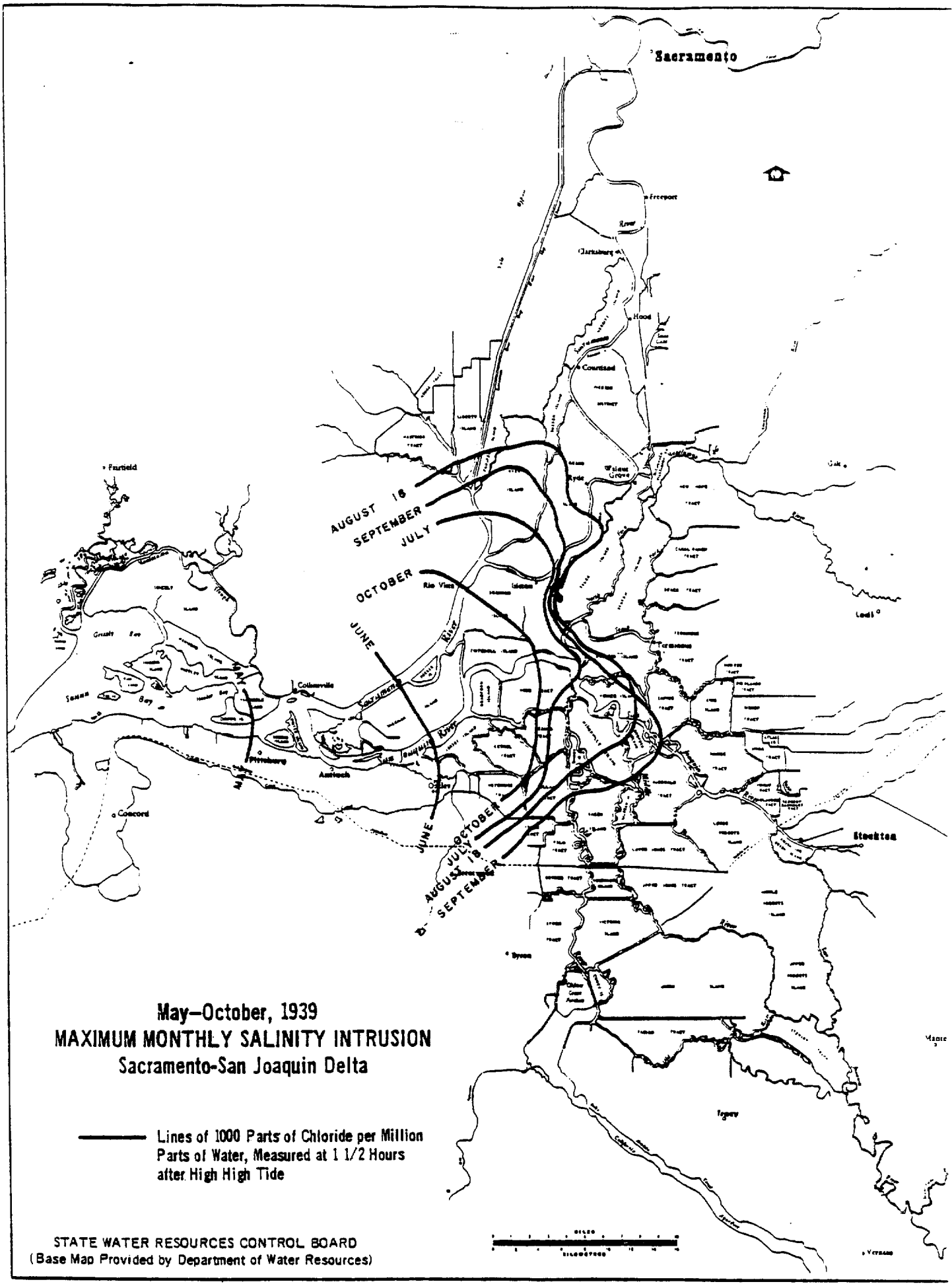
Lines of 1000 Parts of Chloride per Million Parts of Water, Measured at 1 1/2 Hours after High High Tide

Critical Years

STATE WATER RESOURCES CONTROL BOARD
(Base Map Provided by Department of Water Resources)

fluctuation in the maximum salinity intrusion from year to year is due to the large-scale variations of freshwater Delta inflows from tributary streams experienced during the 1920-1944 period. These variations reflect differences not only in total annual inflows, but also in the seasonal distribution of those inflows. For instance, reduced freshwater inflows into the Delta during 1924 and 1931, both of which were critical water supply years, as defined by the runoff of the Sacramento Valley tributaries described in Figure II-1, resulted in extensive salinity intrusion. Conversely, high runoff in the Central Valley during 1938 held the maximum salinity intrusion to the western border of the Delta. Under preproject conditions, the extent of salinity intrusion was not affected by CVP or SWP regulatory facilities or by upstream and export uses induced by those facilities.

Figure II-3 illustrates the progressive intrusion of seawater during a typical critical year, 1939. As shown in this figure, salinity intrusion into the western Delta commenced sometime in June, gradually pushing its way into the central portion of the Delta by August and September. The maximum salinity intrusion into the Sacramento River portion of the Delta occurred on August 18. After that date, freshwater inflows to the Delta increased sufficiently to repulse salinity. These increased inflows marked the close of the irrigation season for many crops in the Sacramento Valley resulting in a substantial accretion in return flows from upstream development. In the southern portion of the central Delta, along the San


Sacramento
Freeport
Courtland
Hood
Fairfield
Rio Vista
Collinsville
Pittsburg
Antioch
Concord
Stockton
Lodi
Tracy
AUGUST 18
SEPTEMBER
JULY
OCTOBER
JUNE
JUNE
JULY
OCTOBER
AUGUST 18
SEPTEMBER
May–October, 1939
MAXIMUM MONTHLY SALINITY INTRUSION
Sacramento-San Joaquin Delta
Lines of 1000 Parts of Chloride per Million Parts of Water, Measured at 1 1/2 Hours after High High Tide
STATE WATER RESOURCES CONTROL BOARD
(Base Map Provided by Department of Water Resources)

Joaquin River, the maximum salinity intrusion did not occur until September and salinity repulsion was much slower than in the Sacramento River portion of the Delta.

Pre-project conditions generally provided adequate protection of many Delta beneficial uses in most years. In dry and critical years, maximum salinity intrusion extended inland as indicated by the monthly intrusion pattern for 1939, shown on Figure II-3. Thus, even in dry and critical years there was suitable water quality for many uses during much of the summer. The occurrence and extent of seawater intrusion is important in assessing its impact on Delta beneficial uses. Figures II-4 and II-5 illustrate variations in these factors under the various hydrologic year types for Emmaton and Jersey Point in the western Delta and for Central Landing (on Andrus Island near the mouth of the Mokelumne River) and Webb Pump (on False River near Old River) in the interior Delta.

Figures II-4 and II-5 are based on the same historical water quality data as Figure II-2. The basic data represent water quality samples taken 1-1/2 hours after high high tide.[3/] These salinity values are somewhat greater than comparable mean tide values. These basic data have been adjusted to represent the

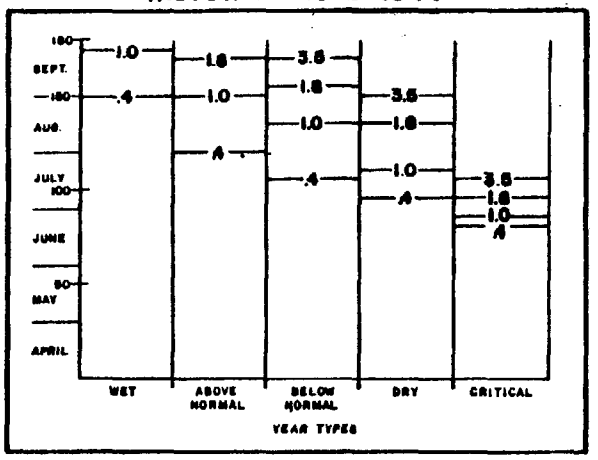
---

3/ The higher of the two high tides in each tidal cycle of about 25 hours.

WESTERN DELTA WATER QUALITY (electrical conductivity), DURING APRIL THROUGH SEPTEMBER FOR EACH YEAR TYPE [1/]

SACRAMENTO RIVER AT EMMATON

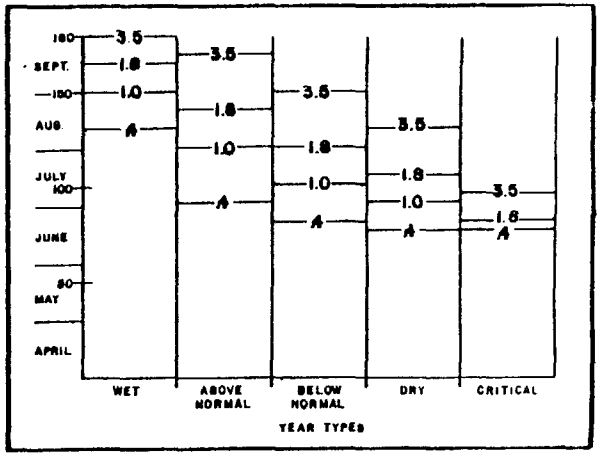
HISTORIC 1922-1944



APPROXIMATE CONVERSIONS

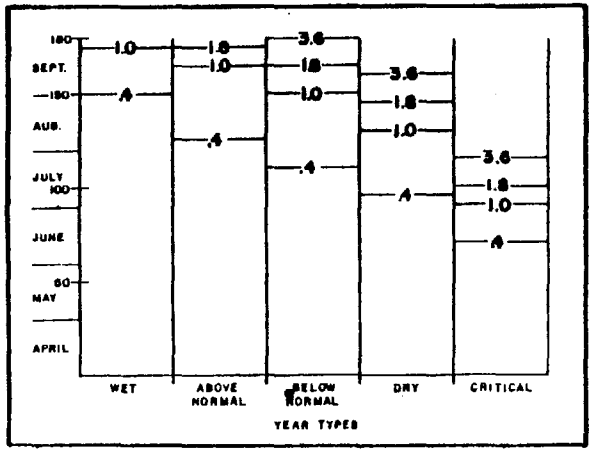
EC mm/cm	Cl^- mg/l	TDS mg/l
.4	73	258
1.0	252	611
1.8	536	1091
3.5	1000	2139

WITHOUT PROJECT (SWP/CVP) CONDITIONS WITH 1980 DEPLETIONS



SAN JOAQUIN RIVER AT JERSEY POINT

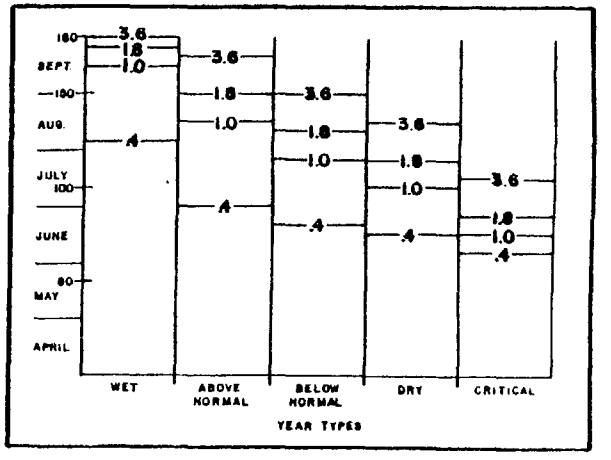
HISTORIC 1922-1944



APPROXIMATE CONVERSIONS

EC mm/cm	Cl^- mg/l	TDS mg/l
.4	62	244
1.0	241	580
1.8	476	1055
3.6	1000	2225

WITHOUT PROJECT (SWP/CVP) CONDITIONS WITH 1980 DEPLETIONS



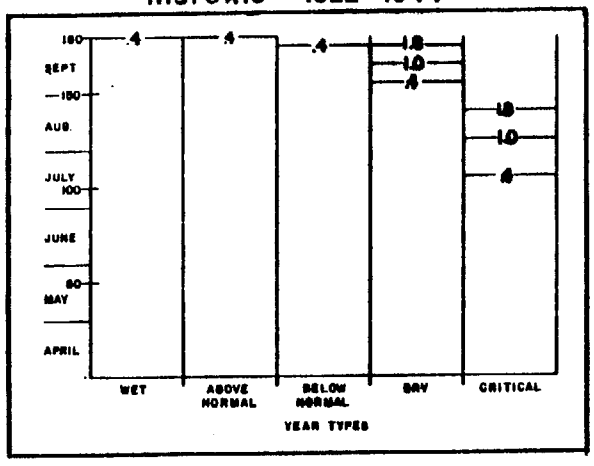
1/ Data corrected to represent mean tide conditions

FIGURE II-4

INTERIOR DELTA WATER QUALITY (electrical conductivity), DURING APRIL THROUGH SEPTEMBER FOR EACH YEAR TYPE 1/

MOKELUMNE RIVER AT CENTRAL LANDING

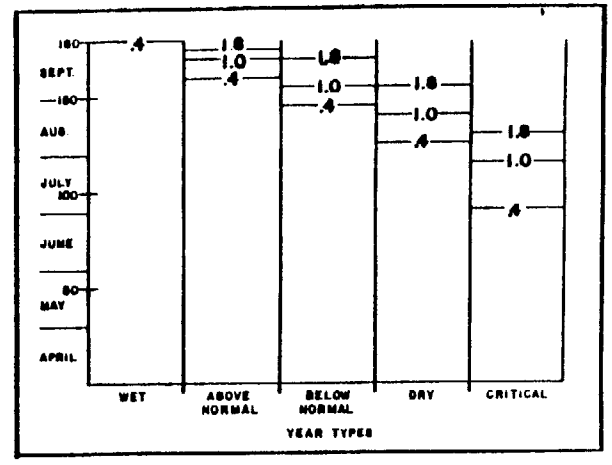
HISTORIC 1922-1944



APPROXIMATE CONVERSIONS

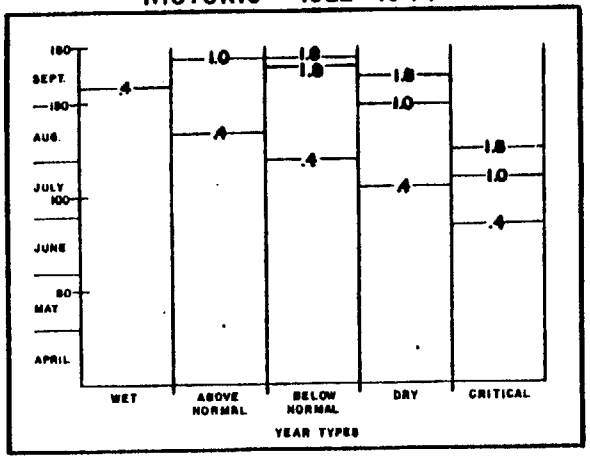
EC mm/cm	Cl⁻ mg/l	TDS mg/l
.4	61	280
1.0	174	700
1.8	325	1260

WITHOUT PROJECT (SWP/CVP) CONDITIONS WITH 1980 DEPLETIONS



FALSE RIVER AT WEBB PUMP

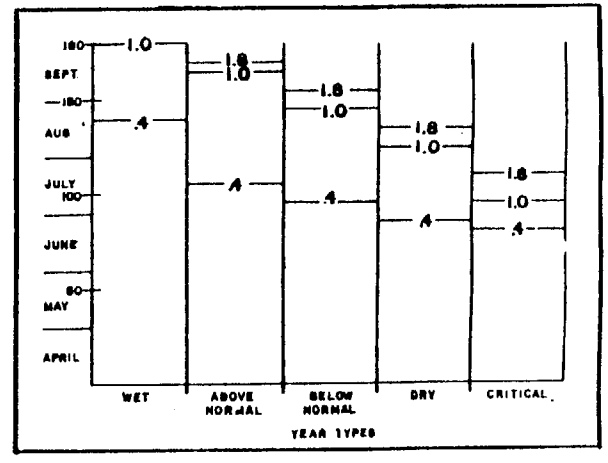
HISTORIC 1922-1944



APPROXIMATE CONVERSIONS

EC mm/cm	Cl⁻ mg/l	TDS mg/l
.4	62	258
1.0	218	582
1.8	483	1014

WITHOUT PROJECT (SWP/CVP) CONDITIONS WITH 1980 DEPLETIONS



1/ Data corrected to represent mean tide conditions

FIGURE II-5

mean tide conditions shown in Figure II-2. (see RT Vol. XX, p. 39, et seq., and Staff Exhibits 4 and 5 for methodology on development of these figures).

The occurrence and duration of water quality equal to or better than salinity levels[4/] experienced during the irrigation season (April-September) of typical wet through critical hydrologic year types are shown in Figures II-4 and II-5. As reflected in these figures, there are significant differences in the occurrence and duration of these salinity levels between the western and interior Delta during the irrigation season. The western Delta experienced exceptionally good water quality during most of the irrigation season only in above-normal and wet years. Even though good water quality was experienced early in the season in dry years and in critical years, the quality deteriorated rapidly as low summer Delta inflows allowed extensive salinity intrusion. However, the water quality conditions at the two interior Delta stations, depicted in Figure II-5, were good except in critical years at the Webb Pump station. Water quality differences between the two interior Delta stations are due primarily to the respective influences of the major river systems. At Central Landing station the Sacramento River with substantial flows is the major influence whereas at Webb Pump station the low flowing and more saline San Joaquin River is the primary influence.

4/ The specified salinity levels have been selected to identify the extent that water quality conditions in the Delta would be suitable for agricultural uses.

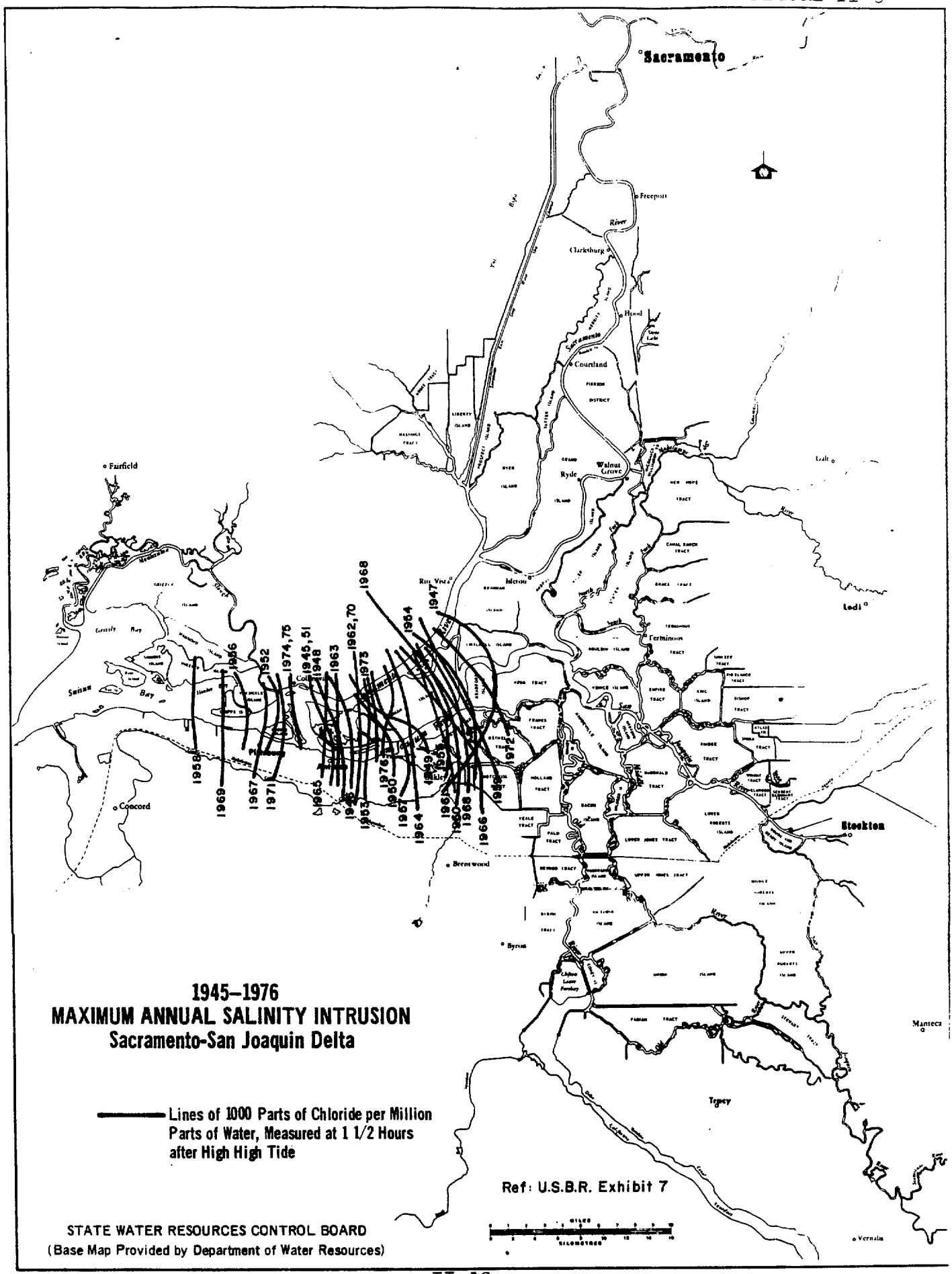
B. POST-PROJECT CONDITIONS

Operations of the CVP and SWP and other water development projects have resulted in substantial regulation of stream flows tributary to the Delta. Major reservoirs in the watersheds tributary to the Delta have more than twenty million acre-feet of storage capacity. Figure II-6 shows the maximum annual salinity intrusion into the Delta for the post-project period 1945-1976. Project operations have reduced winter and spring outflows and increased summer and fall outflows. These operational outflow modifications generally have kept the maximum salinity intrusion into the Delta (the 1000 ppm chloride line) at a point further west than would otherwise have been the case. In most years since 1945, maximum salinity intrusion has not extended much beyond Emmaton and Jersey Point, because project reservoirs have stored the high spring flows and have released this water to increase summer and fall flows. Thus, salinity over the last 30 years through much of the summer generally has been somewhat less than would have occurred naturally, but the 1000 ppm chloride line reached Antioch earlier in the year during below normal, dry and critical runoff years of the post-project period than in similar year types prior to project operations (NDWA Exhibit D). However, it has not extended as far upstream as under pre-project conditions.

C. WITHOUT PROJECT CONDITIONS

Without project conditions have been established by adjusting pre-project salinities to reflect 1980 levels of upstream depletions attributable to sources other than the state and federal projects.

FIGURE II-6



1945–1976
MAXIMUM ANNUAL SALINITY INTRUSION
Sacramento-San Joaquin Delta

Lines of 1000 Parts of Chloride per Million Parts of Water, Measured at 1 1/2 Hours after High High Tide

Ref: U.S.B.R. Exhibit 7

STATE WATER RESOURCES CONTROL BOARD
(Base Map Provided by Department of Water Resources)

Data used in calculating these depletion adjustments is limited (Department Exhibit II-12). Consequently, these estimates may require refinement in future revisions of this water quality control plan. The results of this analysis are shown in Figures II-4, II-5 and II-7.[5/] The theoretical conditions shown in these figures should closely approximate those conditions which would exist in the absence of the CVP and SWP.

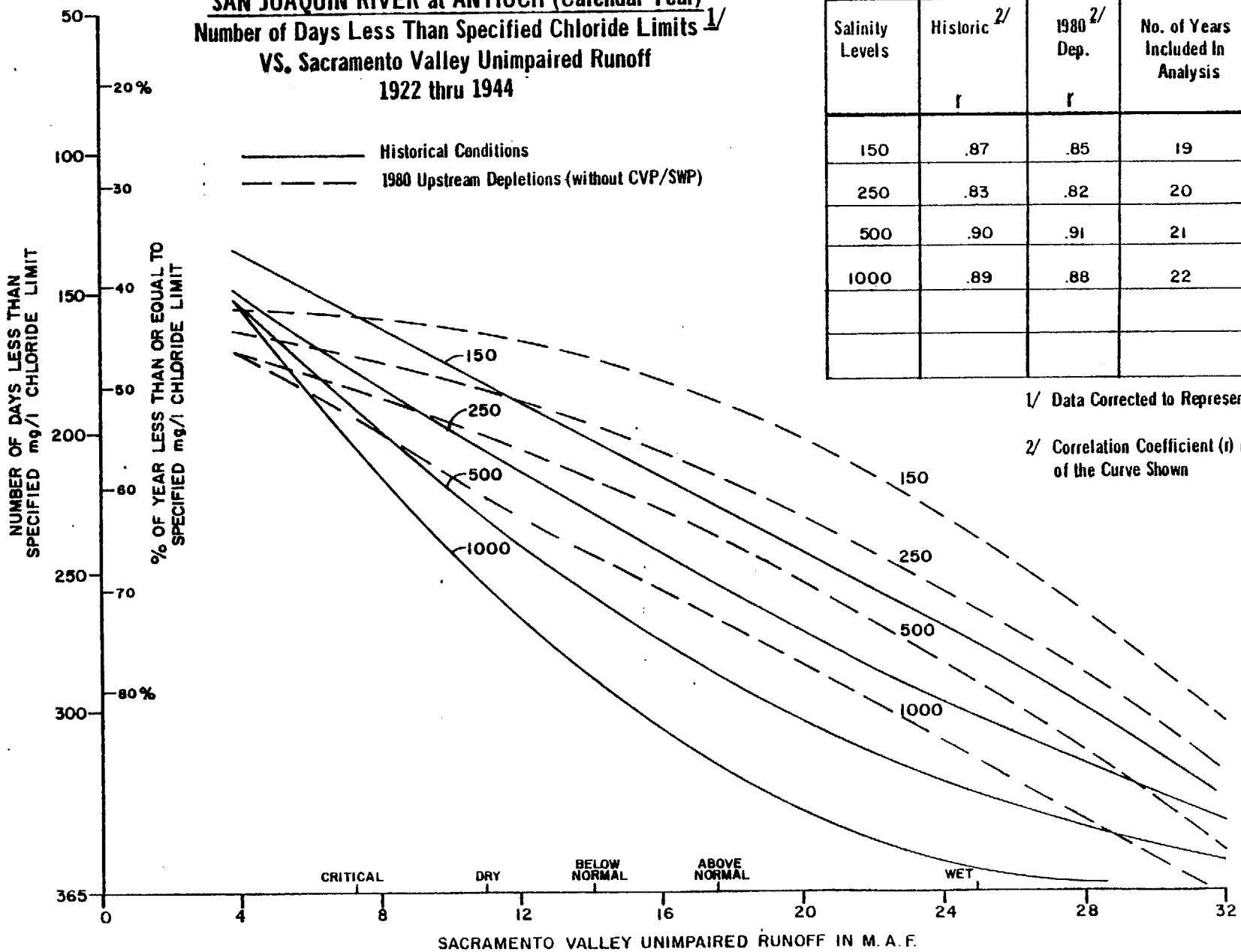
Upstream water development (including non-state/federal facilities) has continued to increase since 1945. This development includes storage facilities for irrigation and municipal supplies and for hydroelectric power generation, as well as substantial increases in upstream consumptive uses. The effect of these increased non-state/federal upstream depletions and regulations on Delta water quality has been masked to a substantial degree by CVP operation from 1945-1967, and since 1967 (when SWP operation began) by both CVP and SWP operations. The federal and state projects presently have more available yield than needed for their contractors. Consequently the projects have released large quantities of water that increased Delta outflows in the summer and fall. Over the last decade, the availability of these surplus project supplies has decreased as project export demands have increased. Continued decrease natural levels.

One of the primary concerns in preparing a water quality control plan for the Delta is the evaluation of CVP and SWP operations and

5/ See RT Vol. XX, p. 47, et seq. and Staff Exhibits 4 and 5 for methodology on the development of these figures.

SAN JOAQUIN RIVER at ANTIOCH (Calendar Year)

Number of Days Less Than Specified Chloride Limits 1/ VS. Sacramento Valley Unimpaired Runoff 1922 thru 1944



Salinity Levels	Historic 2/ r	1980 2/ Dep. r	No. of Years Included In Analysis	Years Not Included In Analysis Due to Lack of Data
150	.87	.85	19	22,23,24,33
250	.83	.82	20	22,24,33
500	.90	.91	21	22,33
1000	.89	.88	22	33

1/ Data Corrected to Represent Mean Tide Conditio

2/ Correlation Coefficient (r) is Only for that Portio of the Curve Shown

FIGURE II-

exports on Delta vested water rights. Without project conditions reflect that theoretical water quality which would occur in the absence of the CVP and SWP. If without project conditions in the Delta, as limited by reasonable beneficial use, are provided by this plan, vested water rights will be protected from infringement by project operations.

Delta salinity under without project conditions would have been worse in summer and fall months in wet and normal years than occurred under pre-project conditions. Delta salinity in critical years would be about the same under either set of conditions.

There are two primary factors contributing to the differences in effects between pre-project and without project conditions. Summer flow in the Sacramento and San Joaquin River systems essentially had been fully appropriated by the mid-1950's. In-basin use of water, unassociated with project development and in excess of the available natural supply has depended on the development of reservoir storage and the use of groundwater to meet these needs, resulting in less Delta inflow than would have otherwise occurred. However, many reservoirs are operated for hydroelectric power production. These hydroelectric projects generally store water during high flow periods and release the water during the low flow summer and fall months to meet their power demands. This regulation provides the Delta with some benefit from carryover of stored flows into dry and critical years.

D. DELTA FLOW PATTERNS/SALINITY DISTRIBUTION

Operations of the SWP and CVP have caused a significant shift in flow patterns and salinity distribution in the Delta and Suisun Marsh. Prior to development of upstream storage facilities and project export of significant quantities of water from the southern Delta, water entering the Delta from the Sacramento Valley flowed down the main channel of the Sacramento River, through Georgiana Slough connecting the river with the Mokelumne River, and through Three Mile Slough and lower Sherman Island channels connecting it with the San Joaquin River system. Of these channels only Georgiana Slough is far enough upstream so that it could effectively transfer fresh Sacramento River water to the San Joaquin River channels in times of salinity intrusion. From the south, San Joaquin River water flowed through the channels of the southern and central portions of the Delta (San Joaquin River, Old River, Middle River, and Paradise Cut) eventually mingling with Sacramento River water in the western portion of the Delta. Historically, inflow to the Delta from the San Joaquin River has been considerably less than that from the Sacramento River.

The hydraulic capacity of Georgiana Slough is insufficient to convey the necessary flows to satisfy project demands through interior channels of the Delta to export facilities during low flow periods.

Because of these flow limitations, the Bureau constructed the Delta Cross Channel in 1951 connecting the Sacramento and Mokelumne Rivers via Snodgrass Slough. The Delta Cross Channel provides the required additional capacity by controlled diversions into the Mokelumne River through a gated structure. The initial export pumping facilities for the Delta-Mendota Canal were also constructed by the Bureau in 1951, marking the commencement of CVP induced flow and salinity modifications in the Delta. These flow and salinity changes became more pronounced in 1967 when SWP exports commenced.

Under current operational practices of the SWP and CVP, flow reversals normally occur each year in Old and Middle Rivers, between the San Joaquin River in the south central portion of the Delta and the export pumps near Tracy. Flow reversals also occur in other channels with low San Joaquin River inflow, high Delta consumptive use, and high export rates. Flow reversal in the main channel of the San Joaquin River from Stockton south to the bifurcation with Old River near Mossdale occurs generally when the export rates are greater than five times the San Joaquin River inflow at Vernalis (RT Vol. IV, p. 163). Additionally, from the earliest days of CVP operation and more frequently in recent years, reverse flows have occurred around the lower end of Sherman Island from the Sacramento River to the San Joaquin River and up to the San Joaquin River to Old and Middle Rivers.

These flow reversals have caused changes in salinity distribution in the Delta. For example, areas receiving Sacramento River water (central Delta, Middle River) usually have low salinity concentrations, similar to Sacramento River water quality. Likewise, Old River in the central and western portions of the Delta and many of the western Delta channels contain a mixture of Sacramento River water and water drawn in from the San Joaquin River west of the Delta. Accordingly, high export rates under low Delta inflow conditions improve salinity conditions in the central Delta, worsen conditions in the southwestern Delta, and have mixed effects in the southern Delta.

CHAPTER III

BENEFICIAL USES

The establishment of beneficial uses is the initial step in development of a water quality control plan. The waters of the Delta and Suisun Marsh serve a wide variety of purposes and uses not only for Delta residents but also for the entire state. The beneficial uses in the Delta and Suisun Marsh have been classified historically under three broad categories: Fish and Wildlife, Agriculture, and Municipal and Industrial. These categories of use have been maintained in this plan.

Once the beneficial uses are identified, corresponding water quality standards and other water quality control policies are formulated for the reasonable protection of these uses. This chapter, in addition to identifying specific beneficial uses, presents the factors which were considered in selecting the level of protection for each beneficial use.

A. FISH AND WILDLIFE

It is unlikely that all of the information necessary to understand the complex interrelationships among the numerous estuarine organisms in Suisun Marsh and the Delta will ever be available. However, current knowledge is sufficient to make some sound judgments on the requirements for general protection of these organisms in the estuary.

Fishery

During the hearing, the Department of Fish and Game (Fish and Game) emphasized certain key fishery species, striped bass and salmon, (Fish and Game Exhibit 11[1], p. 6; RT Vol. XXIII pp. 15-16). These key species were selected primarily because of their overall importance in the Delta and Suisun Marsh and the current state of knowledge on these species relating environmental factors to expected fishery population levels. Striped bass and salmon also are particularly sensitive to operation of the water projects in the Delta and Suisun Marsh (Fish and Game Exhibit 3, Chapter I). A discussion of other important estuarine organisms including zooplankton, phytoplankton, zoobenthos, other anadromous fish and resident game and non-game fish is contained in the EIR prepared for this plan.

Striped Bass. Striped bass, one of the State's top ranking sport fish, was first introduced into California from the East Coast in 1879. It is a semi-anadromous, semi-resident fish highly adapted

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1/ Since 1970 Fish and Game, the Department, U.S. Fish and Wildlife Service (USFWS), and the Bureau have participated in coordinated ecological studies of the estuary. Currently, these parties are negotiating a memorandum of understanding which would provide for maintenance of fish and wildlife resources on the average at levels which have occurred in the recent past, as well as providing for realization of water projects' potential for enhancement of these resources. The April 1977 draft of this memorandum of understanding, or Four-Agency Agreement, was presented as an exhibit in the Delta hearing (Fish and Game Exhibit 11).

to estuarine life. The striped bass sports fishery accounts for two million angler days annually drawing fishermen from throughout the nation. Its net economic value for 1970 was estimated by Stanford Research Institute in 1965 dollars at about 7.5 million dollars per year (Fish and Game Exhibit 3, p. III-1). The striped bass life cycle in the Bay-Delta estuary, depicted in Figure III-1, is based on Fish and Game testimony during the Delta hearing (Fish and Game Exhibit 3).

Critical stages in the striped bass life cycle appear to be spawning and young survival. Certain flow and salinity conditions are necessary in each of these stages to maintain a successful fishery. Recommended water quality standards for these stages in the life cycle are enumerated in Fish and Game Exhibit 11 based on the information contained in their Exhibit 3. The key to survival of young bass, after the first few weeks of life, is Neomysis mercedis, a small shrimp found in the estuary. Neomysis is the principal food source for young striped bass and numerous other fishes in the Delta (Fish and Game Exhibit 3, p. III-2). Protection of the striped bass fishery requires protection of this principal food source.

An increasingly significant striped bass fishery has developed in SWP reservoirs and canals south of the Delta. This development is a result of physical removal of juvenile bass and bass eggs from

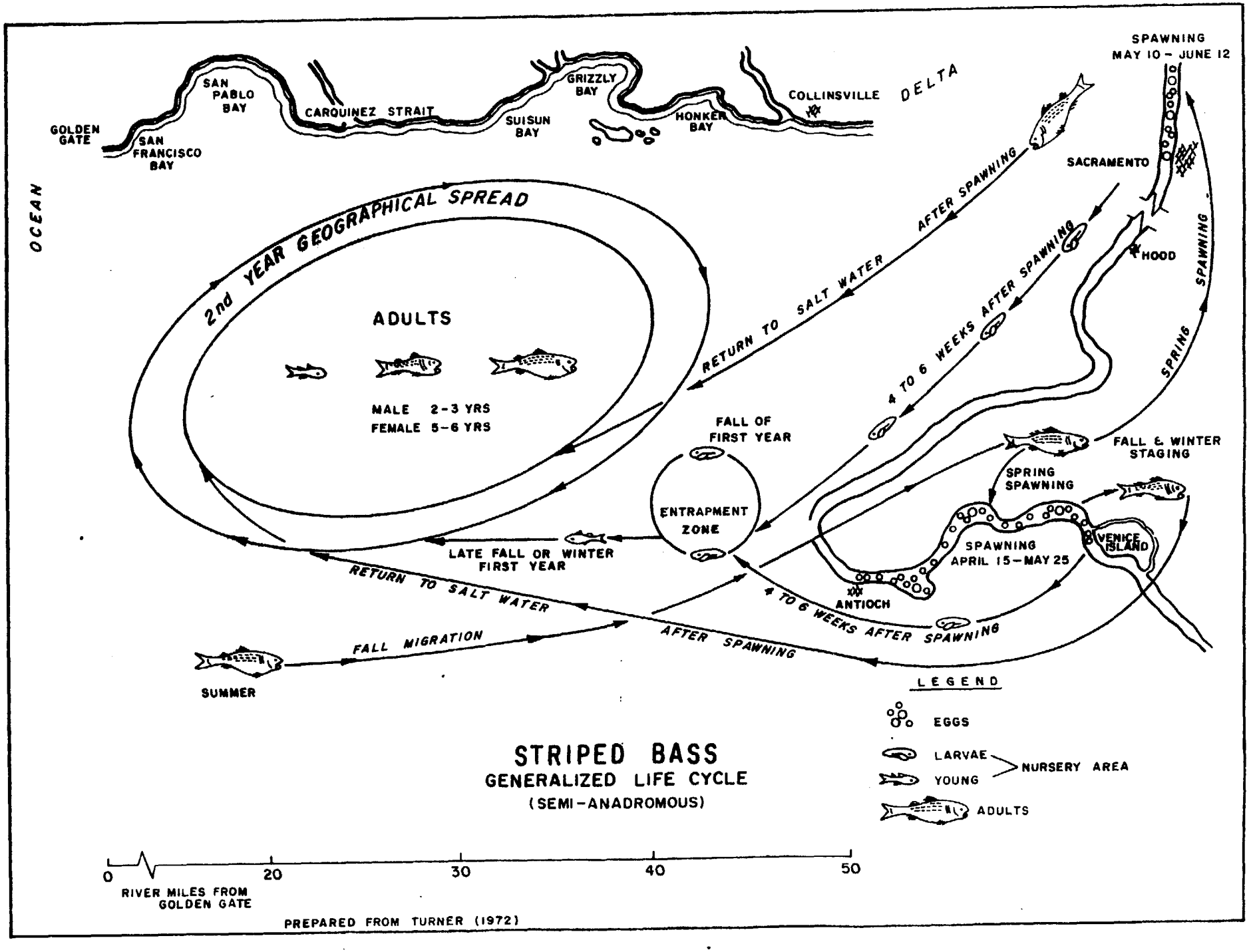

OCEAN
GOLDEN GATE
SAN FRANCISCO BAY
SAN PABLO BAY
CARQUINEZ STRAIT
SUISUN BAY
GRIZZLY BAY
HONKER BAY
COLLINSVILLE
DELTA
SPAWNING MAY 10 - JUNE 12
SACRAMENTO
HOOD
2nd YEAR GEOGRAPHICAL SPREAD
ADULTS
MALE 2-3 YRS
FEMALE 5-6 YRS
RETURN TO SALT WATER AFTER SPAWNING
4 TO 6 WEEKS AFTER SPAWNING
SPRING SPAWNING
FALL OF FIRST YEAR
ENTRAPMENT ZONE
LATE FALL OR WINTER FIRST YEAR
FALL & WINTER STAGING
SPRING SPAWNING
SPAWNING APRIL 15 - MAY 25
VENICE ISLAND
ANTIOCH
RETURN TO SALT WATER AFTER SPAWNING
4 TO 6 WEEKS AFTER SPAWNING
FALL MIGRATION
SUMMER
LEGEND
EGGS
LARVAE
YOUNG
NURSERY AREA
ADULTS
STRIPED BASS
GENERALIZED LIFE CYCLE
(SEMI-ANADROMOUS)
0
20
30
40
50
RIVER MILES FROM GOLDEN GATE
PREPARED FROM TURNER (1972)

Figure III-1

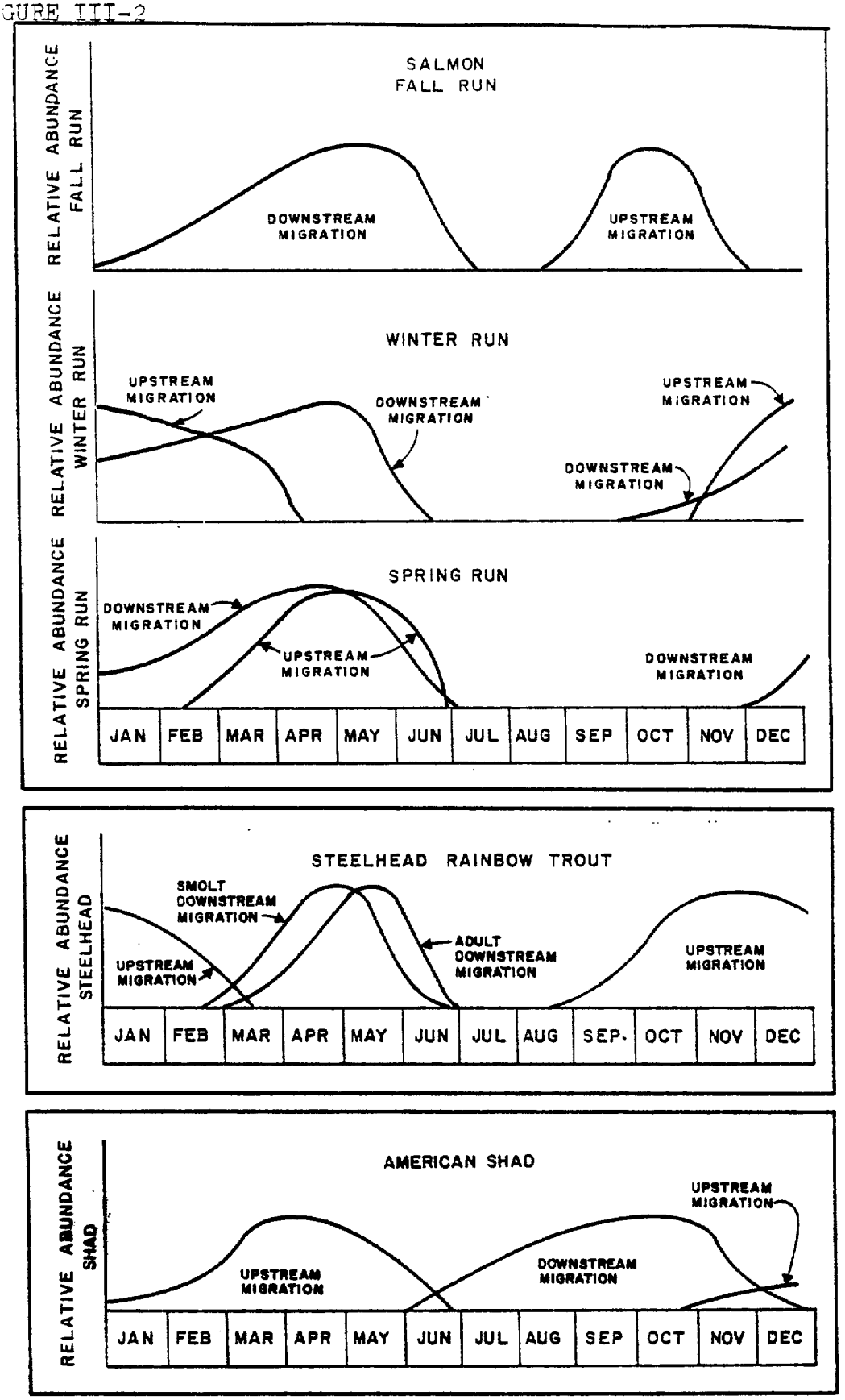
the Delta through the export pumps, and exists "...at the expense of the fishery in the estuary" (Fish and Game Exhibit 3, p. III-4).

The striped bass fishery in the southern Delta, south of the head of Old River, at one time was significant, but has declined substantially due to a combination of reduced inflow from the San Joaquin River and degraded water quality (RT Vol. XXIII, p. 58).

Salmon. King salmon also play an important role in the State's commercial and sport fisheries, contributing to both the inland and ocean fisheries. Salmon which utilize the Delta and Suisun Marsh account for about 75-80% of the State's commercial catch in ocean waters, and are valued in 1975 dollars at about 7.5 million dollars annually (Fish and Game Exhibit 3, p. II-1; RT Vol. XXIV, p. 38).

The king salmon migration patterns in the Bay-Delta estuary are illustrated in Figure III-2, based upon Fish and Game hearing testimony (Fish and Game Exhibit 3, Chapter II). The Delta is the gateway for adult king salmon to migrate to upstream freshwater spawning areas. Also, the Delta and Suisun Marsh provide young salmon with areas for feeding and gradual acclimation from fresh waters to ocean waters. The upper estuary is important as a nursery area for young salmon. Fish and Game Exhibit 11, reflecting these concerns, recommended specific Sacramento River flows to

FIGURE III-2



Graphical description of general times of occurance of salmon, steelhead rainbow trout and American shad in the Sacramento-San Joaquin estuary (based on DF&G Exhibit 3, Chapters II & IV).

facilitate upstream and downstream migrations throughout the year (Fish and Game Exhibit 11, p. 9). However, an additional concern is the possible adverse effect on the fishery from alterations of the normal Delta hydraulic regime by the projects' operations. These alterations often result in reverse flow in main channels in the southern and southwestern Delta which interfere with salmon migration. In addition, the projects' operations create high net velocities in many Delta channels which reduce food production and cause direct fishery losses at the export pumps.

Wildlife

Wildlife in the Delta and Suisun Marsh is an extremely valuable natural resource. Testimony presented by various parties at the Delta hearing concentrated on waterfowl in the Delta and Suisun Marsh, with major emphasis on Marsh waterfowl habitat.

Suisun Marsh provides habitat for some 36 species of mammals, over 200 species of birds, and 7 species of rare or endangered wildlife (Fish and Game Exhibit 3, p. VI-1). Fish and Game, discussing primarily waterfowl in the Marsh, testified during the hearing that management of waterfowl resources likely would protect other wildlife species (Fish and Game Exhibit 3, p. VI-1).

Waterfowl. Suisun Marsh is a major wintering area for waterfowl using the Pacific Flyway (RT Vol. XII, pp. 100, 101). The Flyway is the westernmost migratory route for waterfowl traveling from Alaska and Canada to wintering areas in the United States and Mexico. Survival of waterfowl using the Flyway depends upon protection and management of all wetlands, including Suisun Marsh.

The Marsh at times has provided habitat for almost 30% of California's waterfowl population. It represents almost 15% of the remaining natural wetlands in the State (USFWS Exhibit 4, p. 4; Fish and Game Exhibit 3, pp. VI-1 and VI-2). Total wetlands in California were once 5 million acres. Less than 10% of that now remains; thus, the use and importance of the Marsh has intensified (USFWS Exhibit 4, p. 4). Lack of sufficient wintering habitat is the critical factor affecting waterfowl in the Pacific Flyway (California Waterfowl Association (CWA) and Suisun Resource Conservation District (SRCD) Exhibit 1, p. 2). The importance of the Marsh is further reflected in international wildlife treaties between the United States, Canada, Mexico, and Japan (USFWS Exhibit 4, p. 4; RT Vol. XXIV, p. 59).

Waterfowl activity in the Marsh is seasonal, with peak populations experienced in the fall. Average monthly waterfowl populations during the fall generally vary between 100,000 and 500,000 birds, but occasionally exceed 1,000,000 (Fish and Game Exhibit 3, p. VI-2). Substantial waterfowl or wildlife activity also exists during the remainder of the year. A recent study issued by the Bay Conservation and Development Commission (BCDC) indicates that 1975 recreational use in Suisun Marsh was more than 115,000 person-days, with over half directly associated with Marsh waterfowl aspects (CWA and SRCD Exhibit 1, p. 3).

Approximately 89% of Suisun Marsh land area is artificially managed as a brackish water marsh. Proper management of wetlands is necessary to provide adequate habitat for waterfowl. Waterfowl need both large areas of water and sufficient food supplies. The preferred foods in Suisun Marsh in recent years for the vast majority of types and numbers of the waterfowl population are seeds produced from the plants alkali bulrush, brass buttons, and fat hen (Fish and Game Exhibit 3, pp. VI-4 to VI-8). Sustained seed production by these plants at their historical potentials requires primarily that the level of salinity in Marsh soils not exceed a certain maximum amount. The soil salinity levels are controlled through flooding of Marsh lands with water from adjacent waterways. Consequently, the salinity of this applied water determines the availability of the Marsh as a wintering area for migratory waterfowl.

Export Area Wildlife. A beneficial use of SWP water exported from the Delta is wildlife habitat in southern California (State Water Service Contractors (SWSC) Exhibit 29; RT Vol. XVIII, p. 96). These benefits occur primarily at storage reservoirs of both the SWP and its contractors south of the Delta (Department Exhibit 15A, pp. 65-68). Additional wildlife benefits are experienced in the Grasslands Water District in the San Joaquin Valley, a wildlife refuge managed by Fish and Game. Fifty thousand acre-feet of water are delivered annually through the Delta-Mendota Canal to this area under a long-term contract with the Bureau (Bureau Exhibit 64, p. 10).

B. AGRICULTURE

Delta Agriculture

About three-fourths of the Delta land area (500,000 acres) is farmed in some manner, producing a wide variety of crops with substantial yields (Department Exhibit II-18). Soils in the Delta fall generally into two distinct categories: organic and mineral soils. Organic soils are found generally in the Delta lowlands which consist of areas in the Delta below an elevation of +5 feet mean sea level. Mineral soils are found in both the Delta lowlands and uplands. The Delta uplands are those areas in the Delta above +5 feet mean sea level. Delta management and cropping practices for organic and mineral soils are different, and thus are presented separately below.

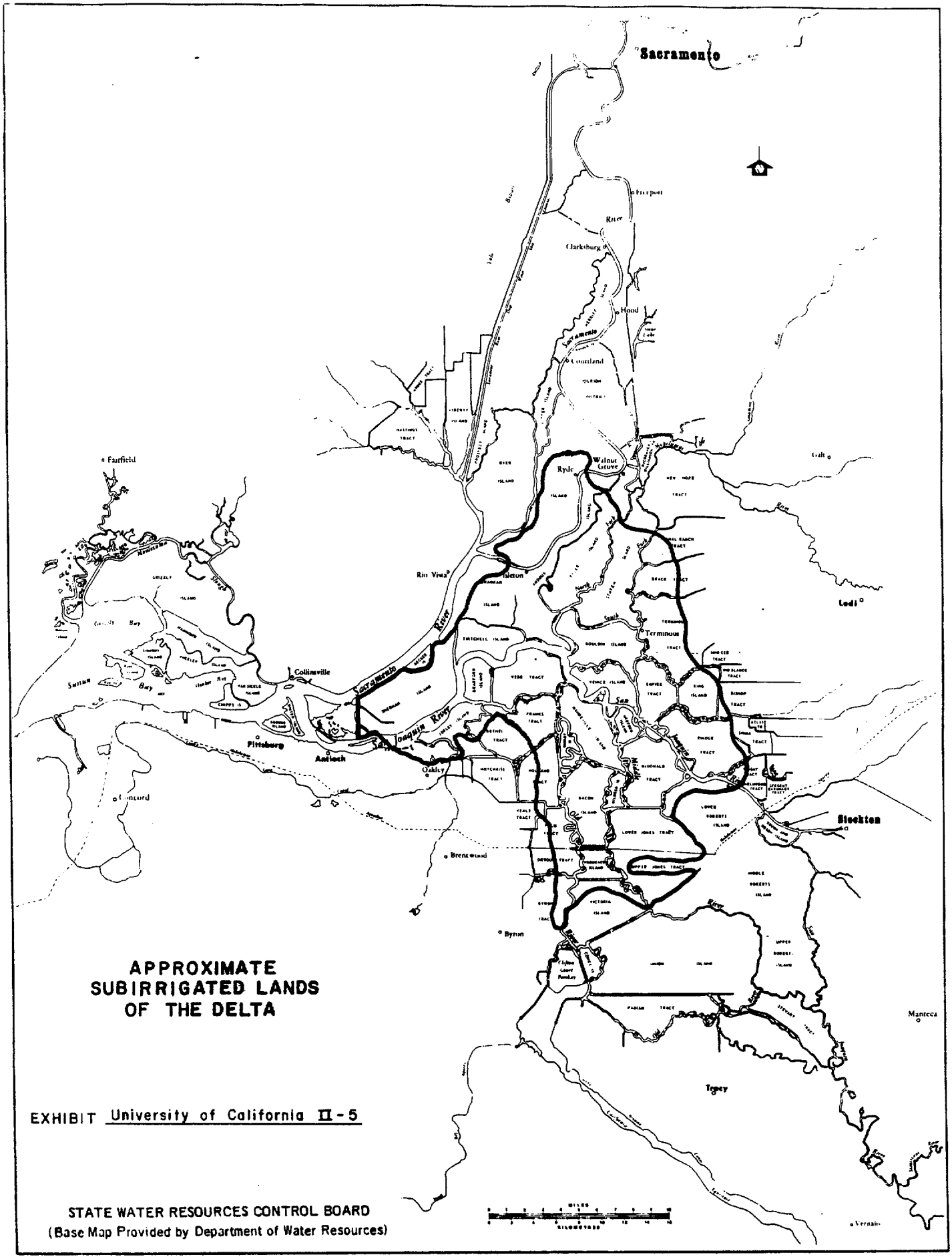
Organic Soils. Delta organic soils were formed through biological and chemical breakdown of marsh-type plants and grasses that existed prior to development of the present levee system. The amount of organic soils in the Delta is constantly being reduced due to continued decomposition and oxidation as a result of both natural processes and ongoing farming activities. In 1941 there were over 250,000 acres of organic soils in the Delta. By 1976 this acreage had been reduced by half (RT Vol. XIII, p. 23).

The high permeability of organic soils coupled with their low surface elevation with respect to surrounding waterways produce high groundwater table conditions. The high groundwater table along with problems associated with uneven decomposition and

settlement of organic soils make subirrigation a desirable method of water application for crop production. Subirrigation is the delivery of water to plant roots by capillary action from the underlying saturated soil strata, and is the primary method of irrigation in the Delta organic soils (RT Vol. XX, pp. 112-115). As practiced in the Delta, subirrigation may be the most efficient irrigation process in California from the standpoint of net water consumption (RT Vol. XIII, pp. 107-108). However, because of soil and crop management constraints, this form of irrigation must be tied to a winter leaching program to remove salts accumulated in the root zone (RT Vol. XIII, p. 47). The general area of the Delta subirrigated soils is shown in Figure III-3.

Mineral Soils. Delta mineral soils were formed through deposition of soils and minerals eroded from the Sierra by various streams tributary to the Delta. These soils, which are much less permeable than organic soils, generally are found at higher elevations in the Delta, and are not affected as much by high groundwater conditions. Consequently, subirrigation generally is not necessary in the Delta mineral soils, and thus the more conventional irrigation methods are utilized. Water is applied to the surface of the soil, usually through furrows, flood irrigation, or sprinklers. Soil and crop management practices are much the same as in many other areas in California, with leaching of the soils required and with occasional changes in cropping patterns.

FIGURE III-3


Sacramento
Freeport
Clarksburg
Hood
Courtland
Walnut Grove
Ryde
Rio Vista
Isleton
Fairfield
Collinsville
Pittsburg
Antioch
Oakley
Concord
Brentwood
Byron
Terminous
Lodi
Stockton
Tracy
Manteca
Vernalis
Suisun Bay
Grizzly Bay
Sacramento River
San Joaquin River
APPROXIMATE
SUBIRRIGATED LANDS
OF THE DELTA
EXHIBIT University of California II-5
STATE WATER RESOURCES CONTROL BOARD
(Base Map Provided by Department of Water Resources)

Delta Cropping Practices. The Department presented detailed information on 1976 levels of agricultural production in the Delta. In order to obtain cropping patterns for the organic and mineral soils in the Delta, the Department's island-by-island information was considered along with information presented by the University of California Cooperative Extension at the hearing. These cropping patterns are shown in Table III-1.

As indicated in the table, corn is the predominant crop in the organic soils, accounting for almost half of the total acreage of organic soils. Grain is grown on an additional one-fourth of the organic soils, with asparagus, alfalfa, and other crops accounting for the remainder.

In the mineral soils grain is grown on about 22% of the acreage, closely followed by corn on 17%. About 42% of the total acreage of mineral soils appears to be distributed fairly evenly among sugar beets, tomatoes, alfalfa, and mixed pasture. The remaining acreage is in miscellaneous crops such as fruits, nuts, beans and sorghum.

Agriculture Outside the Delta

The SWP and CVP export large quantities of water from the Delta to the San Joaquin Valley and southern California for agricultural uses. In total agricultural production, Fresno and Kern Counties consistently rank first and second, respectively, in the nation

TABLE III-1

PREDOMINANT DELTA CROPS, 1976

Organic Soils

Crop	Percent of Organic Soils Acreage
Corn	48
Grain	25
Asparagus	7
Alfalfa, Sugar Beets, Tomatoes, Sorghum, Miscellaneous	20

Mineral Soils

Crop	Percent of Mineral Soils Acreage
Grain	22
Corn	17
Sugar Beets	11
Tomatoes	11
Alfalfa	11
Mixed Pasture	9
Fruits, Nuts, Beans, Sorghum, Miscellaneous	19

(Compiled from Department Exhibit II-18 and U. C. Exhibit II-5)

each year. This portion of the San Joaquin Valley is considered the most productive agricultural area in the world (RT Vol. XXXIV, p. 17). The San Joaquin Valley utilizes water from many sources for crop irrigation including imported Delta supplies, local surface supplies and groundwater. Accordingly, it is difficult to assign a particular acreage to the service areas of either project.

The following information was presented on the crop diversity in SWP service areas (SWSC Exhibit 106M):

TABLE III-2

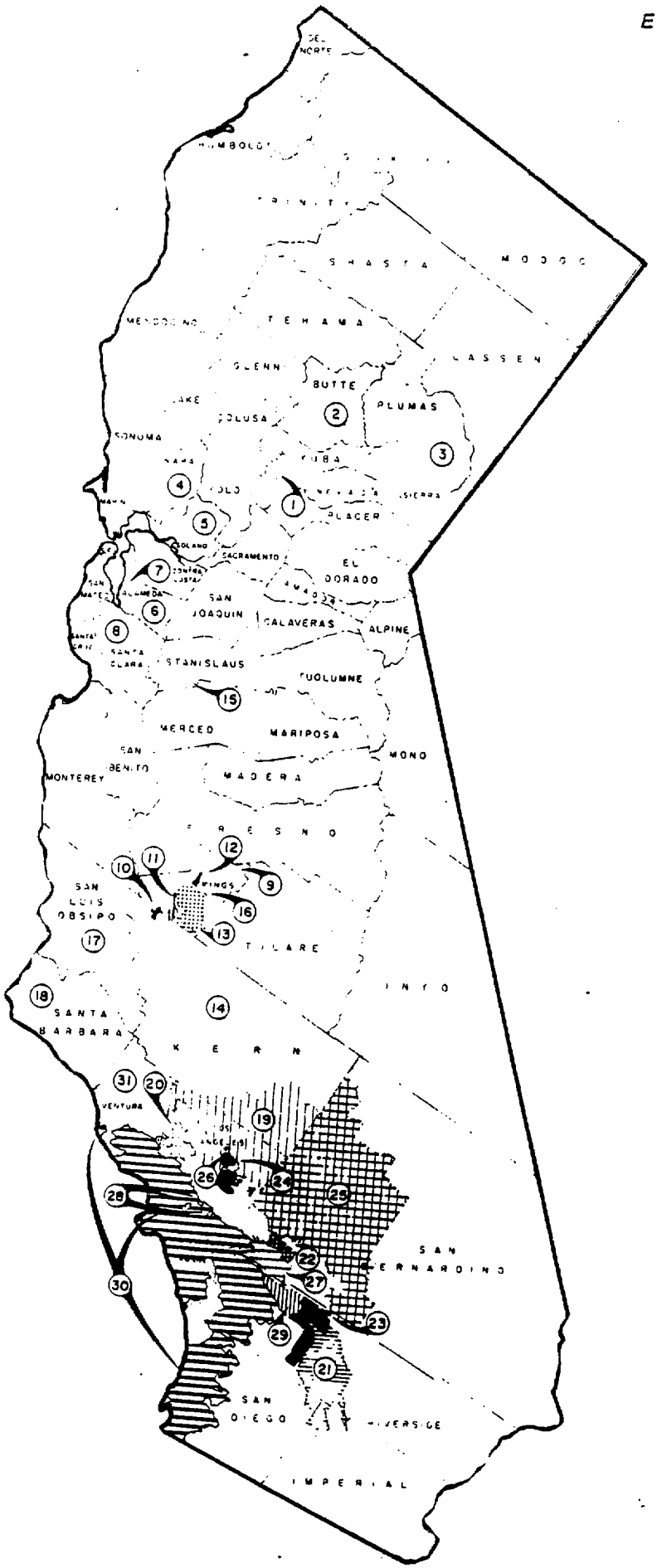
Crop v. Acreage Distribution
State Water Project

Crop	Percent of Acreage
Fruits, Vines, and Nuts	18
Cotton, Vegetable Crops, Field Crops, Except Grains	52
Alfalfa, Barley and Other Grains	30

The SWP agricultural service area is predominantly in the San Joaquin Valley, but includes portions of the South Bay area and southern California. Figure III-4 shows the SWP service area with the predominantly agricultural area noted. The maximum annual entitlements of SWP agricultural users in the San Joaquin Valley amount to 1,236,000 acre-feet, with 1977-level entitlements of 534,000 acre-feet (Department Exhibit 15A, p. 119; SWSC Exhibit 6).

FIGURE III-1

STATE WATER PROJECT
EXISTING AND PROJECTED SERVICE AREAS



Location No.	Contracting Agency
	UPPER FEATHER AREA
1	City of Yuba City
2	County of Butte
3	Plumas County Flood Control and Water Conservation District
	NORTH BAY AREA
4	Napa County Flood Control and Water Conservation District
5	Solano County Flood Control and Water Conservation District
	SOUTH BAY AREA
6	Alameda County Flood Control and Water Conservation District, Zone 7
7	Alameda County Water District
8	Santa Clara Valley Water District
	SAN JOAQUIN VALLEY AREA*
9	County of Kings
10	Devil's Den Water District
11	Dudley Ridge Water District
12	Empire West Side Irrigation District
13	Hacienda Water District
14	Kern County Water District
15	Oak Flat Water District
16	Tulare Lake Basin Water Storage District
	CENTRAL COASTAL AREA
17	San Luis Obispo County Flood Control and Water Conservation District
18	Santa Barbara County Flood Control and Water Conservation District
	SOUTHERN CALIFORNIA AREA
19	Antelope Valley–East Kern Water Agency
20	Castaic Lake Water Agency
21	Coachella Valley County Water Agency
22	Crestline-Lake Arrowhead Water Agency
23	Desert Water Agency
24	Littlerock Creek Irrigation District
25	Mojave Water Agency
26	Palmdale Water District
27	San Bernardino Valley Municipal Water District
28	San Gabriel Valley Municipal Water District
29	San Gorgonio Pass Water Agency
30	The Metropolitan Water District of Southern California
31	Ventura County Flood Control District

*predominantly agricultural

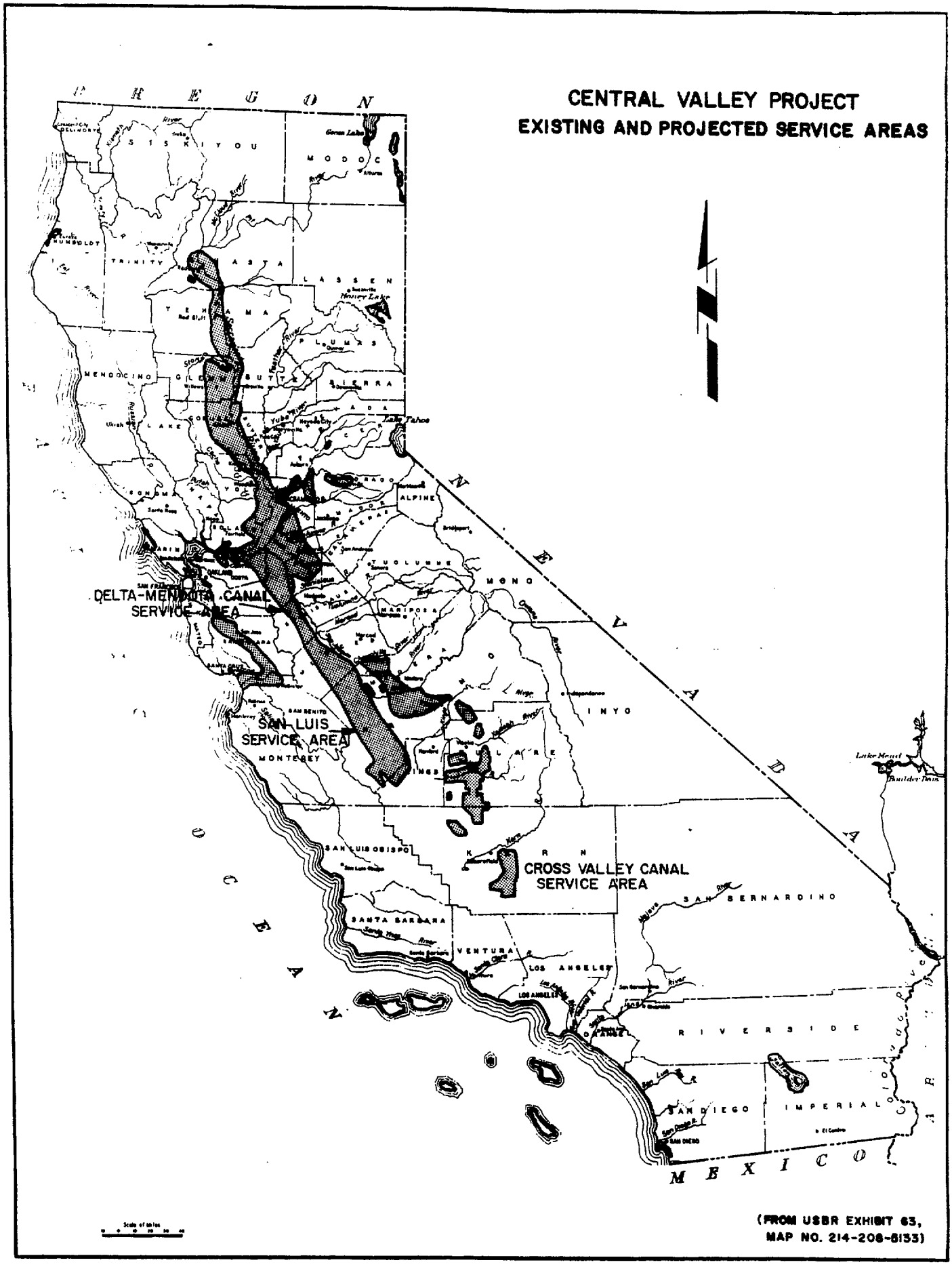
(From SWSC Exhibit 1, p. 2, and DWR Exhibit 15A)

Water exported from the Delta by CVP facilities is used in the Delta-Mendota Canal service area, the Cross-Valley Canal service area, and the San Luis Unit of the CVP. The San Luis Unit has an irrigable acreage of more than 550,000 acres along the west side of the San Joaquin Valley. It comprises land within the Westlands, San Luis, and Panoche Water Districts (RT Vol. XVII, pp. 156, 169). Westlands Water District accounts for most of the total San Luis Unit acreage (RT Vol. XVII, p. 156, and Westlands Water District Exhibit II-3). A wide variety of crops are grown in the District (RT Vol. XVII, pp. 174-175, and Westlands Water District Exhibits 5A, 5B, 5C, 5D, 5E, 5F, 6). The CVP service areas are shown on Figure III-5, and include both existing and projected service areas as well as areas served by local supplies. Under its existing long-term contracts, the CVP will export from the Delta to the San Joaquin Valley up to 2,750,000 acre-feet annually (Bureau Exhibit 59), which is predominantly for agricultural uses.

C. MUNICIPAL AND INDUSTRIAL

There are significant municipal and industrial uses of Delta waters both in the Delta and in areas outside of the Delta. The export areas from the Delta include portions of Alameda, Contra Costa, Solano and Santa Clara Counties, portions of the San Joaquin Valley, and major metropolitan areas in southern California (Department Exhibit 15A, pp. 128-131). Future proposed export service areas include San Luis Obispo, Santa Barbara and Napa Counties, and additional areas in Solano County.

FIGURE III-5


CENTRAL VALLEY PROJECT
EXISTING AND PROJECTED SERVICE AREAS
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
DELTA-MENDOTA CANAL SERVICE AREA
SAN LUIS SERVICE AREA
CROSS VALLEY CANAL SERVICE AREA
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
LAKE
NEVADA
ALPINE
SONOMA
MARIN
TUOLUMNE
MONO
MARIPOSA
INYO
MONTEREY
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
RIVERSIDE
SAN DIEGO
IMPERIAL
(FROM USBR EXHIBIT 63, MAP NO. 214-208-6133)

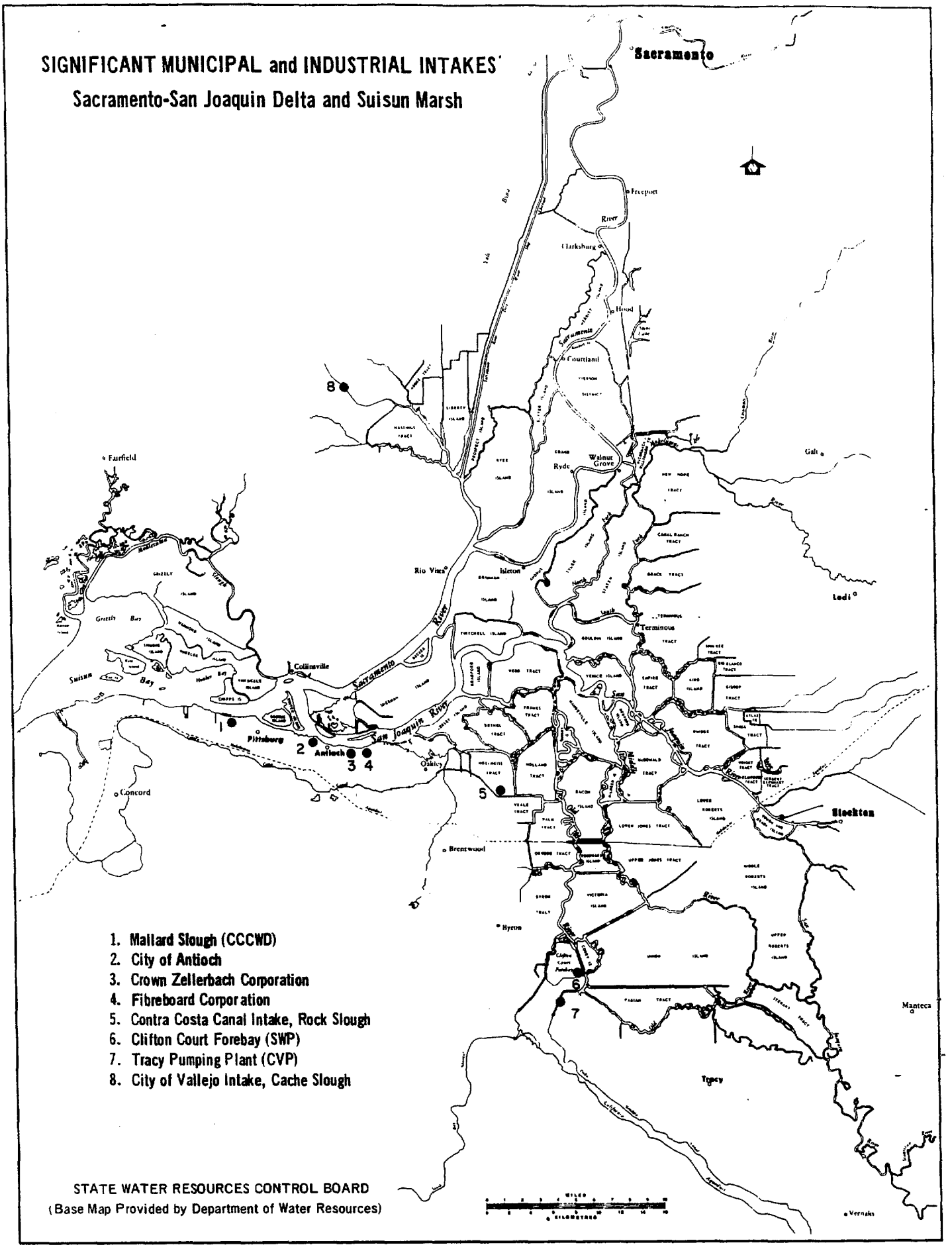
In addition, emergency supplies were furnished to many municipal and industrial users in the San Francisco Bay area during 1977 to augment local supplies depleted by the 1976-77 drought.

Figure III-6 shows the locations of significant water supply intakes for municipal and industrial uses in the Delta and Suisun Marsh. Each of these diversions is discussed below.

Contra Costa Canal Intakes: Rock Slough and Mallard Slough

The Contra Costa Canal provides water for about 240,000 people throughout eastern and central Contra Costa County, and also serves a large number of important industries throughout that area (RT Vol. XVI, pp. 161-163). The Canal is a unit of the federal CVP, but is operated by the Contra Costa County Water District (CCCWD). There is year-round demand for water from the Contra Costa Canal. Most of this water is diverted into the Canal at Rock Slough under a long-term contract for CVP water. Also, during periods of high freshwater Delta outflow when channel salinities are suitable for domestic and industrial consumption, water is withdrawn under a CCCWD appropriative water right from Mallard Slough generally when chloride concentrations are less than 100 ppm (RT Vol. XVI, p. 164). The area served by the Canal includes a portion of the legal Delta as well as areas outside the Delta to the west. Some of the industries served by the Canal also divert water directly from the San Joaquin River, but rely on Canal water whenever river salinities

FIGURE III-6


SIGNIFICANT MUNICIPAL and INDUSTRIAL INTAKES
Sacramento-San Joaquin Delta and Suisun Marsh
Sacramento
Freeport
Clarksburg
Courtland
Walnut Grove
Ryde
Isleton
Rio Vista
Fairfield
Collinsville
Pittsburg
Antioch
Oakley
Concord
Brentwood
Byron
Terminous
Lodi
Galt
Stockton
Manteca
Tracy
Vernalis
Suisun Bay
Grizzly Bay
Honker Bay
Sacramento River
San Joaquin River
1. Mallard Slough (CCCWD)
2. City of Antioch
3. Crown Zellerbach Corporation
4. Fibreboard Corporation
5. Contra Costa Canal Intake, Rock Slough
6. Clifton Court Forebay (SWP)
7. Tracy Pumping Plant (CVP)
8. City of Vallejo Intake, Cache Slough
STATE WATER RESOURCES CONTROL BOARD
(Base Map Provided by Department of Water Resources)

become too high (RT Vol. XVI, pp. 164, 165). The city of Antioch also utilizes a separate water supply intake when favorable salinity conditions prevail. Many other industries depend on the Contra Costa Canal as their sole water supply.

In order to sustain municipal and industrial beneficial uses within the Canal service area, salinity levels must be maintained below prescribed limits (CCCWD Exhibit 5, 6, 7). Of special concern is the adverse effect on industrial production as salinity increases in the water supply above specific critical levels (RT Vol. XVI, pp. 184-197). Also, the paramount uses of municipal and domestic drinking water supplies must be protected (RT Vol. XVI, pp. 197-203).

Paper Mills in Vicinity of Antioch

The Fibreboard and Crown Zellerbach Corporations both operate paper mills which are located about one mile east of the City of Antioch, abutting the San Joaquin River and within the Delta. While both mills are served by the Contra Costa Canal, each has separate facilities for direct diversion from the San Joaquin River (RT Vol. XVII, pp. 76-77, 136). Combined employment for both mills is about 1600 people (RT Vol. XVII, pp. 76, 135). The importance of these industries to the local economy is great, with a combined annual payroll of around $28,000,000 (RT Vol. XVII, pp. 76, 135). Additional economic effects are directly associated with gross production of the mills, and support services required from other local industries and services.

Much of the production at both mills consists of salt-sensitive paper grades. With normal manufacturing processes, this production requires a water supply with chloride concentration of 150 ppm or less (RT Vol. XVII, pp. 77, 137). Thus, low chlorinity water is essential for their processes (RT Vol. XVII, pp. 72-106, 131-147).

Clifton Court Forebay/California Aqueduct (SWP)

Clifton Court Forebay is the diversion point for the SWP California Aqueduct, which delivers water to municipal and industrial service areas in the San Francisco Bay Area, the San Joaquin Valley, and southern California (agricultural deliveries through such facilities are discussed in the preceding section). In the future, water also may be delivered to municipal and industrial users in the Central Coastal area, consisting of portions of San Luis Obispo and Santa Barbara Counties. The 1978-level water entitlements, maximum annual entitlements under long-term contracts, and 1975 population in the SWP service areas are listed in Table III-3 (SWSC Exhibit 6; SWSC Exhibit 1, p. 7; Department Exhibit 15A, pp. 118-121).

In addition to domestic, municipal and industrial uses, these supplies are used for related groundwater replenishment (SWSC Exhibit 29; RT Vol. XVIII, pp. 121, 122, 133; RT Vol. XXXIII, pp. 129, 130). Control of land subsidence and groundwater salinity intrusion is an additional related benefit in the SWP South Bay service area (RT Vol. XVIII, p. 143; RT Vol. XXXIII, pp. 134, 140, 141). Compliance

TABLE III-3

State Water Project

Municipal and Industrial Entitlements to Water and Service Area Populations

Service Area	1978-Level Long-Term Contracted Annual Entitlements, Ac-Ft/Yr	Maximum Long-Term Contracted Annual Entitlements, Ac-Ft/Yr	1975 Population of Service Area 1/
North Bay	0 2/	63,000	1,751,000
South Bay	131,000	188,000	
Central Coast	0	83,000	
San Joaquin Valley	64,000	119,000	780,000
Southern California	1,061,000 3/	2,438,000 3/	11,922,000
Total	1,256,000	2,891,000	14,453,000

1/ These estimates represent the total population in the respective service areas, and are not intended to reflect the actual population served by SWP supplies.

2/ Prior to 1980 non-project water will be delivered from outside of the Delta area pumped through an interim facility.

3/ Includes small amount of water used for agricultural purposes.

with water quality standards in the Water Quality Control Plan for the Santa Ana River Basin (Basin 8 Plan) depends on availability of good quality (low salinity) SWP water for municipal and industrial uses and for groundwater recharge (RT Vol. XXXI, pp. 1-3). Economic value of SWP water for municipal and industrial uses ranges from $500 to $800 per acre-foot (SWSC Exhibit 106K; RT Vol. XXXII, pp. 56-79).

Tracy Pumping Plant/Delta-Mendota Canal (CVP)

The Tracy Pumping Plant, located in the southern Delta near Clifton Court Forebay, is the diversion point for the federal CVP Delta-Mendota Canal. Municipal and industrial users served by this diversion through the San Luis Division of the California Aqueduct (joint federal-state facility) include those in the Cross-Valley Canal service area in the southern San Joaquin Valley as well as a few municipal and industrial users in the western portion of the Valley. Through the Cross-Valley Canal, up to 128,000 acre-feet of water per year will be delivered for a multitude of uses, including municipal and industrial supplies (Bureau Exhibit 64, p. 10; RT Vol. VIII, p. 166). The municipal and industrial users in the western San Joaquin Valley have a maximum contract entitlement of 27,500 acre-feet per year (Bureau Exhibit 64, p. 10). Water quality needs of these export uses are specified in the contracts for water delivered through the Tracy Pumping Plant.

Also, municipal and industrial deliveries of 216,000 acre-feet per

year through the Delta-Mendota Canal are planned by the Bureau for the San Felipe Unit. In addition, a portion of the 650,000 acre-feet per year which would be delivered through the as-yet-unauthorized Mid-Valley Canal would be used for municipal and industrial purposes (Bureau Exhibit 64, p. 10; RT Vol. VIII, pp. 166, 167).

City of Vallejo and City of Antioch Intakes

No substantial testimony was presented regarding either of these two municipal water intakes. However, both intakes were included in the Board staff's trial objectives (Staff Exhibit 3, p. 18). Antioch has used its intake only when water quality has been adequate, generally in the winter and through the spring of most years (RT Vol. XVI, pp. 164, 165). The City of Vallejo Intake is located on Cache Slough in the northern portion of the Delta, and probably is influenced much more under the current configuration of the Delta by Sacramento River water quality and local agricultural drainage than by the effects of salinity intrusion. This intake provides a year-round supply of municipal and industrial water to the City of Vallejo.

CHAPTER IV

HISTORICAL WATER QUALITY STANDARDS

Water quality standards are limits or levels of water quality constituents which are established for the reasonable protection of specific beneficial uses of water. Even though beneficial uses of Delta supplies have been well established for some time, water quality standards for this important water body have been periodically reviewed and modified to reflect the current knowledge.

A. PAST PROCEEDINGS

The Board has previously established water quality standards through water quality control plans and water right decisions. A brief chronology of those actions is presented below. As previously noted, the current proceeding marks the first time for the Delta that the Board's water quality and water right authorities have been so closely integrated.

Decision D 1275 (Water Rights)

The development of comprehensive water quality standards for the Delta began with the so-called November 19, 1965 criteria. These criteria were developed by a group consisting of representatives of the Sacramento River and Delta Water Association, the San Joaquin Water Rights Committee, the Department and the Bureau. The criteria have had a continuing influence on subsequent development of water quality standards. The State Water Rights Board in

Decision D 1275, the principal water right decision on the SWP[1] adopted May 31, 1967, ordered that the permits for the SWP be subject to the November 19, 1965 criteria (referred to in Decision D 1275 as SRDWA Exhibit 17) insofar as those criteria did not conflict with other terms included in the permits. The Board also included in Decision D 1275 a limitation on pumping from the Delta and on collecting water to storage in Oroville Reservoir under certain conditions of water quality. These pumping limitations, however, were modified by Decision D 1291 on November 30, 1967.

1967 Water Quality Control Policy (Water Quality)

The Federal Water Pollution Control Act as amended by the Water Quality Act of 1965 provided in Section 10(c)(1) that by June 30, 1967 each state was to establish water quality criteria applicable to interstate waters or portions thereof within the state. Consistent with the requirements of this legislation, the Board's predecessor agency, the State Water Quality Control Board, on June 23, 1967, transmitted to the Secretary of the Interior a statement of policy for the control of water quality in California's interstate waters including those of the Sacramento-San Joaquin Delta

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1/ The principal water right decision on the CVP, Decision D 990 adopted on February 9, 1961, does not include any water quality standards. However, the Water Rights Board in this decision (as in other decisions on the CVP and SWP) reserved jurisdiction to establish permit terms and conditions for salinity control in the Delta.

and Suisun Marsh. On July 19, 1968, the federal government expressed concern that the water quality control policy for the Delta did not adequately protect municipal, industrial, agricultural and fishery uses and proposed some supplemental water quality objectives for chloride and total dissolved solids concentrations. Following receipt of the federal comments and an additional hearing on the water control policy for the Delta on October 24, 1968, the Board adopted a supplemental water quality control policy for the Delta through its Resolution 68-17. By letter of January 9, 1969, the Secretary of the Interior notified the Board that he had approved the state water quality standards even though they failed to satisfy the recommendation of the federal government regarding the spawning of striped bass and the municipal, industrial and agricultural water uses of the western part of the Delta. The Secretary indicated that his approval was taken in reliance upon the commitment from the Board to conduct public hearings during 1969 and to consider before June 30, 1970 the matter of supplementing the salinity standards.

Decision 1379 (Water Rights)

In accordance with the commitment made in Resolution 68-17, a hearing was initiated on July 22, 1969, and continued with intermittent recesses until October 5, 1970. Based on that hearing record, the Board issued Decision 1379 on July 28, 1971. Minor modifications in this decision were made by the Board by supple-

mentary orders dated September 16 and October 13, 1971. This decision established new water quality requirements for the Delta and Suisun Marsh and rescinded those in Decision D-1275. However, Decision 1379 has been stayed by the courts since October 1971 as a result of litigation originally instituted by the Central Valley East Side Project Association and the Kern County Water Agency to set aside the decision. In July 1974, the Federal District Court deferred any further action on these cases pending a final decision in California v. United States, a case in which the principal issue is the jurisdiction of the state to condition water rights of federal projects.[2/] Due to the court order staying implementation of Decision 1379, the Decision D-1275 requirements remained in effect.

Interim Water Quality Control Plan (Water Quality)

In 1971, interim water quality control plans for the 16 planning basins comprising the state, including the Delta and Suisun Marsh, were adopted by the respective Regional Water Quality Control Boards and approved by the State Water Resources Control Board. The adoption of the interim plans marked the completion of the first phase of a comprehensive statewide planning effort which culminated in the adoption of the basin plans, discussed below.

Supplement to 1967 Water Quality Control Policy (Water Quality)

The Regional Administrator of the Environmental Protection Agency in a letter dated August 15, 1972, called the Board's attention to

2/ On July 3, 1978, the United States Supreme Court, issued its decision in California v. United States upholding the position of the State that state imposed conditions on permits issued for federal reclamation projects are valid unless inconsistent with congressional directives respecting the projects.

the fact that there were considerations outstanding from the conditional approval previously received from the federal government. In response to that letter, the Board held a hearing on proposed supplemental water quality objectives for the Delta and on April 19, 1973, by Resolution No. 73-16 adopted "Water Quality Control Plan Supplementing State Water Quality Control Policies for Sacramento-San Joaquin Delta."

Basin Plans (Water Quality)

In line with the responsibility of the State and Regional Boards and in compliance with the provisions of Public Law 92-500, comprehensive water quality control plans have been developed for the 16 basins comprising the state. The Delta and Suisun Marsh are included in the water quality control plans for the Sacramento-San Joaquin Delta Basin (Basin 5B Plan) and the San Francisco Bay Basin (Basin 2 Plan), respectively. The Basin 2 Plan was approved by Board Resolution 75-28 on April 17, 1975, and amendments to it were approved by Board Resolution 76-61 on June 17, 1976. The Basin 5B Plan was approved by Board Resolution 75-80 on August 21, 1975. The long-term standards contained in these basin plans are summarized in Appendix B of this plan (the water quality standards in D-1275 were incorporated into the Basin 5B Plan, except for the operational constraint at Blind Point).

Drought Emergency Actions (Water Quality)

Because of the unprecedented drought during 1976-77, the Board found it necessary to take two separate emergency actions during 1977 to mitigate the impact of the drought on beneficial uses of Delta water throughout the state. By Resolution No. 77-6, on February 8, 1977, the Board adopted a 1977 (interim) Water Quality Control Plan for the Delta and Suisun Marsh. This plan was intended to remain in effect only until the end of calendar year 1977 and during that period was to supersede the basin plans to the extent of any conflicts with specific water quality standards.

However, prompted by the increased severity of the drought, the Board found it necessary to take further emergency measures to conserve water supplies upstream of the Delta and to provide continued protection of the Delta from deep seawater intrusion. Accordingly, on June 2, 1977, the Board adopted an emergency regulation, Section 764.20 of Title 23 of the California Administrative Code and extended it through calendar year 1978 on December 15, 1977. This emergency regulation was to be in effect no longer than necessary to protect the Delta. In view of substantial improvements in the water supply situation and Delta recovery from salinity intrusion, the Board repealed the emergency regulation February 2, 1978.

B. EVOLUTION OF DELTA OUTFLOW REQUIREMENT

As described in Chapter II, beneficial uses of Delta water supplies are dependent upon adequate outflow of freshwater to repel seawater intrusion and to provide suitable habitat for fish and wildlife. Delta water quality standards established to protect these uses have all recognized the need to maintain sufficient Delta outflow even under the most adverse water supply conditions.

However, net outflow from the Delta is not directly measured at present due to the complex effects of tidal fluctuation and flow patterns. In an effort to provide a common base for operation of SWP and CVP facilities, the Department and Bureau have jointly established a Delta Outflow Index.[3/]

The Delta outflows thought necessary to ensure the maintenance of specific salinity levels throughout the Delta have changed over the last two decades. Experience in implementing specific salinity requirements and major improvements in mathematical models of the Delta have brought about better estimates of outflow needs to satisfy particular salinity levels in the Delta. This evolution is illustrated below by tracing the minimum Delta outflow which was thought

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3/ Delta Outflow Index is a calculated net Delta outflow which is equal to (1) Delta inflow through the major tributaries, minus (2) net Delta consumptive use, minus (3) SWP and CVP export pumping. The inflow and export values are measured, while the consumptive use figures are fixed in an April 9, 1969 federal-state agreement (Bureau Exhibit 576 in the proceeding leading to Decision 1379 and an October 10, 1969 Bureau memorandum to the Department).

to be needed to satisfy the water quality standard at Emmaton on the Sacramento River.

The Emmaton standard was initially presented in the November 19, 1965 criteria for the protection of western Delta channels from seawater intrusion. It requires a maximum 10-day mean (14-day mean in the Basin 5B Plan) daily chloride concentration of 1000 mg/l. Past studies by the Department and Bureau have generally used this standard in determining the minimum Delta outflow requirement.[4] Estimates of this outflow requirement have increased over time as understanding of flow salinity relationships in the Delta has expanded.

In 1964 the Interagency Delta Committee[5] concluded that an outflow of 1500 cfs would be required to satisfy this salinity level at Emmaton.[6] However, in 1966 the Department presented information at the hearing leading to Decision D 1275 which set the Delta

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4/ This was the case until August 1975 when the Board approved the Basin 5B Plan which contained the Chipps Islandstandard for protection of Neomysis. This objective provides a maximum 14-day running average chloride concentration of 4000 mg/l, which generally requires somewhat more outflow than that needed to meet the Emmaton objective.

5/ The Interagency Delta Committee was a committee composed of representatives from the U.S. Army Corps of Engineers, Bureau and Department with the task of evaluating various water development plans for the Delta.

6/ Draft of Task Force Report to the Interagency Delta Committee on a coordinated plan for the Sacramento-San Joaquin Delta, 1964, p. IV-3.

outflow necessary to meet this same salinity level at 1800 cfs (D 1275, Department Exhibit 81, p. 27).

Information presented by the Department during the current Delta proceeding in its Exhibit 5B indicates that 2500 cfs would be required as Delta outflow to meet the Emmaton standard (Department Exhibit 7B; RT Vol. VII, p. 171).7/

The water quality standards established to protect beneficial uses in the Delta are not the only factors affecting Delta outflow. When water is being exported, sufficient Delta outflow must be provided to prevent intrusion of saline water at the export pumps. This outflow required to meet export contractual water quality criteria is called "carriage water." Under controlled flow conditions, the carriage water requirement of the projects is governing much of the time.

When project exports are greater than about 4000 cfs and Delta inflow is low, Sacramento River water is drawn around the western end of the Delta and back up the San Joaquin River to the export pumps. The export water becomes more saline due to seawater intrusion as it approaches the western Delta. In order to meet export quality criteria under controlled flow conditions, the projects must increase the Delta

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7/ Recent studies by Department staff indicate that outflows in excess of 3000 cfs may be required to meet the same standard at Emmaton.

outflow to satisfy the carriage water requirements when exports exceed 4000 cfs. For instance, in order to satisfy the SWP quality requirements at its export pumps, a Delta outflow in excess of 6000 cfs might be required during the spring of dry years when the projects are exporting at their current full capacity.

Even though estimates of outflow necessary to satisfy the Emmaton standard have increased, the estimates of carriage water required to satisfy export water quality have increased proportionately. Thus, now as in the past, the carriage water needs of the projects are generally controlling Delta outflow (see Chapter III of the EIR for a discussion on carriage water requirements of export project facilities).

Contrary to a common belief, past increases in estimated Delta outflow requirements have not occurred solely as a result of more restrictive water quality standards, but also as a result of better understanding of outflow/salinity relationships in the Delta, including the great quantities of outflow necessary to protect the export operations.

C. PRESENT PROCEEDING

In approving the Basin 5B Plan, the Board indicated that it would convene hearings on the Delta no later than July 1, 1978 for the purpose of receiving further evidence relating to salinity control, protection of fish and wildlife in the Delta, and coordination of terms and conditions of the permits of the SWP and CVP.

CHAPTER V

ALTERNATIVES FOR PROTECTION OF BENEFICIAL USES

The most important phase in the formulation of water quality standards is the analysis of alternative approaches for the protection of beneficial uses. It is both a state and federal requirement that alternatives to a proposed action be investigated where such action has the potential to affect significantly the quality of the human environment (Section 21001 of California Environmental Act of 1969). An objective evaluation of alternative solutions or actions is required in order not to overlook or foreclose options which could protect beneficial uses while at the same time minimizing the impact on project operations. This analysis forms the basis for the selection and refinement of recommended actions.

This chapter presents a discussion of the various alternatives considered and the procedure used in the selection and refinement of the adopted water quality standards.

In accordance with the jurisdiction reserved in the permits of the SWP and CVP, the purpose of this water quality control plan is to provide water quality limits for salinity control and for protection of fish and wildlife, and to coordinate terms and conditions of the various SWP and CVP permits currently before the Board. The water quality standards established by the Board under this reserved jurisdiction are directed toward conditions expected to prevail

over the next ten years. However, possible longer term solutions for all the major water quality problems in the Delta and Suisun Marsh have been kept in sight, and the Board's plan contains the necessary initial steps for their long-term resolution.

As previously discussed in Chapter III, beneficial uses in the Delta are classified into three categories: fish and wildlife, agriculture, and municipal and industrial. The plan establishes water quality standards for each of these categories to ensure that reasonable protection is provided to each of these uses in its own right. The standards are established for different year types, in accordance with the natural hydrologic regime of the Delta.

A. TRIAL SET OF WATER QUALITY OBJECTIVES

On March 15, 1977, a trial set of water quality objectives for the three categories of uses was transmitted by the Board staff to all interested parties to help focus the Phase II hearing. As explained in the staff transmittal, the trial objectives were developed from information gathered solely during Phase I of the hearing and did not reflect the consideration and trade off of factors presented during Phase II.

As in the current conceptual alternatives presented below, consumptive and non-consumptive uses were generally distinguished in the development of the trial set of objectives. The trial objectives for fish and wildlife (non-consumptive uses) were essentially those contained in the April 12, 1977 draft of the

Four-Agency Fish and Wildlife Agreement (Fish and Game Exhibit 11). This basic approach has been retained as one of the conceptual alternatives for fish and wildlife presented below.

The trial objectives for agriculture and municipal and industrial uses (consumptive uses) reflected the level of protection which would have been available under pre-project conditions (1922-1944). However, as many parties pointed out, water quality standards based on pre-project conditions would require the SWP and CVP to offset increased upstream depletions, unrelated to project operations, which have occurred since 1944 to the extent such upstream depletions infringe upon Delta riparian rights. The trial standards thus would require the projects to provide water quality levels significantly better than conditions which would prevail in the absence of the projects. Consequently, the staff trial objectives for consumptive uses have been replaced by conceptual alternatives to reflect without project conditions at 1980 level of depletions.

B. CONCEPTUAL ALTERNATIVES

Conceptual alternatives have been developed to reflect a broad range of possible levels of protection for each category of use. Generally, at least three basic alternatives have been considered for each of the three broad beneficial use categories:

o No Action. In accordance with Section 15143 of the CEQA Guidelines, the specific alternative of "no action" must be evaluated. If the Board took no action, the existing basin plans (Basins 5B and 2) and Decision D-1275, as amended by D-1291, would be controlling.

o Without Project Conditions/Preservation of Fish and Wildlife at Historical Levels. Under this basic approach, protection of consumptive uses in the Delta would provide only that water quality which would have existed in the absence of the SWP and CVP, as limited by the constitutional requirement of reasonable beneficial use. The comparable alternative for fish and wildlife would provide necessary protection to maintain the resource at historical levels which existed between 1922 and 1967. (see Section C of this chapter).

o Modified Without Project Conditions/Interim Protection of Fish and Wildlife. Under this basic approach, the entitlement of Delta water users would be satisfied by providing water quality conditions which would result in benefits better than or equivalent to without project conditions. Hydrologic conditions in the Delta have been substantially altered by both project operations and upstream development. This conceptual alternative takes into account both the beneficial and adverse aspects of project operations. Fishery resources, as represented principally by striped bass, would be maintained at levels approximating without project conditions. Wildlife resources in the Marsh would be provided increasing levels of interim protection until full protection is achieved in 1984.

The specific application of these basic approaches to each broad beneficial use category is presented below. Shown in Appendix C of this plan is a tabulation of these conceptual approaches.

C. FISH AND WILDLIFE

To date fish and wildlife uses have not been granted vested water rights under California water law. However, many statutes assure that these uses shall be protected for the public interest. For many years water right permits issued by the Board have included conditions to protect fish and wildlife. As previously stated, the basin plans recognize uses of water for fish and wildlife as beneficial uses. The Board's authority to protect fish and wildlife is expressly stated in various sections of the Water Code and policy statements previously cited.

The question is at what population level this resource should be protected. The position of Fish and Game is that the fish and wildlife resource should be preserved at "recent historical levels", herein called historical levels, on a long-term basis. These levels are defined by Fish and Game (Fish and Game Exhibit 11) as the average abundance of a fish or wildlife resource estimated to have existed between 1922 and 1967. Conditions upstream of the estuary may limit the abundance of some species. Fish and Game's policy deals only with those factors in the estuary that limit species abundance. However, Fish and Game recognizes that until additional project facilities are constructed, historical levels cannot be achieved (Fish and Game Exhibit 11, p. 4). Furthermore, fish and wildlife possess natural reproduction mechanisms which

allow them to recover from drought and low flow conditions, much like other beneficial uses. The objective of Fish and Game is to share good as well as poor water supplies along with other beneficial uses.

No Action

If the Board took no action, the fish and wildlife standard of the basin plans (5B and 2) would be controlling. Unlike the standards for agricultural and municipal and industrial uses, the basin plan fish and wildlife standards do not include any provisions for relaxation during dry and critical years.

Preservation

Maintenance of historical levels of the fish and wildlife resource is essentially equivalent to preservation of the resource. With existing project facilities, protection of Suisun Marsh could be provided only through Delta outflow. In excess of 18,000 cubic feet per second (cfs) of Delta outflow, along with substantial curtailment of exports, would be required from May through July of normal years to protect striped bass at historical levels.

Four-Agency Fish and Wildlife Agreement (Fish and Game Exhibit 11)

Protection under this alternative is intended to maintain fish and wildlife resources on the average at historical levels (as in the preservation alternative), but recognizes that historical levels cannot realistically be maintained with existing project facilities and project demands. In view of

this, this alternative provides interim water quality standards to maintain fish and wildlife on the average at less than historical levels until additional project facilities are constructed.

However, these interim standards will not be sufficient to protect the Marsh during dry and critical years. In order to fully protect the Marsh solely with outflow, in excess of 2 million acre-feet per year of Delta outflow (in terms of project yield) above that needed to satisfy the interim standards would be required (RT Vol. XXII, pp. 100-101). This would constitute about one-third of the combined CVP and SWP exportable yield. An additional 2 million acre-feet of Delta outflow in dry and critical years for this purpose is not consistent with the best interest of the State. The long-term protection for the Marsh in low runoff years can be guaranteed only through construction of physical facilities, proper management of the Marsh lands and a supplemental supply.

D. AGRICULTURE

The current Delta water quality standards for the protection of agricultural uses are essentially the November 19th criteria (see discussion on page IV-1). These standards are contained in Decision D 1275 and the Basin 5B Plan.

No Action

Under this alternative, the agricultural standards in Decision D 1275 and the Basin 5B Plan would remain in effect. These standards represent numbers that have not been changed substantially for over 12 years.

Evidence introduced during the course of this proceeding has raised considerable doubt as to the adequacy of these standards to protect agriculture in the Delta. Since the adoption of the Basin Plan, agricultural uses have been under an umbrella of protection provided by the fish and wildlife standards The relatively higher flows required to meet the fish and wildlife standards have kept salinity levels in the Delta generally far below the levels of the agricultural standards This incidental protection, however, would no longer be available under the approach suggested in the draft Four-Agency Fish Agreement.

Without Project Conditions

Under the without project alternative, the level of protection provided Delta agricultural uses would be that which would have been available to the Delta in the absence of the projects. Without project conditions have been determined in terms of the number of days that water of suitable quality would be available at various points of diversion throughout the Delta based on calculated conditions which would occur without the projects.

The water utilized by the plants is that in the root zone. The quality of this water is in effect a composite of the quality of all water applied during the irrigation season. In view of this, water quality standards under this alternative represent an

average of without project water quality conditions over the major portion of the irrigation season (April 1 to August 15). This average reflects the number of days that certain water quality levels would be experienced.

The water quality standards for agriculture would be set at levels necessary to prevent any infringement on Delta vested water rights by the projects. Thus, the extent of Delta agricultural vested rights would be measured by reasonable beneficial use, not to exceed flows which would have reached the Delta had the SWP and federal CVP not been built, taking into account current upstream uses under vested rights.

It should be noted that upstream riparian uses have not changed appreciably since 1930. Also, for the critical July/August period, the Board has not issued any appropriative permits since 1955. Thus, even though Delta protection would be subject to non-project current upstream uses, these uses in the low flow season have not undergone much change over the last 20 years.

Modified Without Project Conditions

Under this alternative, the flow requirements to meet water quality standards imposed on the projects would be essentially equivalent to without project outflow requirements.

The basic difference between the modified without project alternative and the without project alternative is the manner in which protection is provided. As previously stated, the without project alternative is an average from April 1 through August 15 of water quality conditions which would have been available in the absence of the projects. The modified without project alternative would provide generally greater protection of agricultural uses early in the irrigation season, and less protection in the later portion of the irrigation season. The weighted average of these water quality conditions would be the same under both alternatives. It is anticipated that the impacts of both these alternatives will be nearly identical in terms of crop yield. However, the modified without project alternative which provides better water quality early in the irrigation season may provide better protection of seedlings and young plants and might provide better overall protection to Delta agriculture. Although this alternative is believed to be more beneficial to Delta agriculture, the possible benefits are not currently quantifiable in terms of crop yield.

Specific Areal Alternatives

The general conceptual alternatives presented above do not lend themselves to resolving water quality problems in certain areas of the Delta. This is especially true in the extreme western Delta and the southern Delta. In view of this, specific alternatives have been developed to resolve the special problems encountered in these areas.

Western Delta. The general conceptual approaches are designed to provide specific levels of protection to Delta agriculture. If the present agricultural uses on Sherman Island, Jersey Island,

Hotchkiss Tract and other islands in the western Delta are to be continued, the water available to them must be suitable for irrigation. Under this alternative, project operators would have the option of satisfying in-channel quality requirements through substitute supplies, consistent with Section 12202 of the Delta Protection Act. If the project operators elect to provide a substitute supply in lieu of meeting particular water quality standards,[1] no added financial burden would be placed on Delta interests. If the project operators and Delta interests agree on water supply qualities better than their respective vested water rights, such agreement and compensation for benefits derived therefrom would be a matter to be resolved by the parties themselves and not by the Board so long as the capability of the projects to meet water quality standards is not jeopardized.

Southern Delta. An implementable solution for the southern Delta has eluded the best efforts of responsible public agencies for well over twenty years. Prior to 1944 water quality in the southern Delta was suitable for agricultural uses. Upstream depletions and water quality degradation of the San Joaquin River and its tributaries have greatly reduced the flows and quality available for protection of the southern Delta.

1/ See discussion on Page VII-20 of this plan regarding substitute supplies for the western Delta.

Riparians rights (taking into account upstream diversions by other riparians) would be generally sufficient to satisfy water quality needs of agricultural users in the southern Delta without regard to hydrologic year type. However, the permits of water development facilities in the San Joaquin River watershed, including those of the Bureau[2/], which may be major contributors to southern Delta quality and quantity deterioration are not before the Board, nor has any jurisdiction been reserved in those permits to amend or supplement terms and conditions therein. Notwithstanding this, the permits do provide that such appropriations are subject to prior vested rights.

The direct effects of SWP and CVP diversions covered by permits currently before the Board do not result in major impact on water quality conditions in the southern Delta. It is questionable whether the Board could justify imposing terms and conditions in the permits before the Board to resolve all of the water quality problems in this area.

Thus, it would appear that the Board's vested water right authority through which terms and conditions are imposed in water right permits will not yield an implementable solution based on a consideration only of project facilities on the Sacramento River system and the Delta.

Under this specific areal alternative, water quality standards for the southern Delta would be established through the Board's water

2/ The SWP has no facilities on the San Joaquin River system. Also, in addition to the New Melones Project on the Stanislaus River, the CVP has the Friant Project on the San Joaquin River where that river accounts for less than 30 percent of the unimpaired Delta inflows from the San Joaquin River Basin.

quality control authority. The level of protection provided agricultural uses in the southern Delta would be set to satisfy riparian rights. Implementation of these standards could be achieved through the Board's broad enforcement authority. As previously indicated, all of the water right permits for the San Joaquin River Basin upstream of the Delta include a paramount provision that appropriations under these Board entitlements are subject to prior vested rights.

E. MUNICIPAL AND INDUSTRIAL

Water supply for human consumption has long been considered the highest use of water. Water quality standards developed for such uses must ensure that those supplies are potable and do not endanger human lives or health. Thus, the standards for municipal and domestic supplies developed for each of the alternatives presented below have been established at necessary levels to fully protect these uses.

No Action

The Basin 5B Plan standards for municipal and industrial uses would be controlling if the Board took no action. Municipal and industrial standards have been established at three locations in the Delta: Antioch, Rock Slough and City of Vallejo Intake at Cache Slough.

The Antioch standard includes a termination provision which would void the standard upon a determination by the Board that adequate

substitute supplies are available to all existing municipal and industrial users in the Antioch and Pittsburg areas. During the hearing, the Department requested that the Board make such a determination on the basis that an adequate substitute supply is available to those users through the Contra Costa Canal.

The Rock Slough standard provides that the chloride concentration never exceed 250 mg/l and also that it stay below 100 mg/l at least 65 percent of the year. Basically, this standard reflects average water quality conditions that occurred at Rock Slough beginning with the operation of Shasta Reservoir in 1945 and continuing to 1966. On the basis of 1976 and 1977 conditions, it is unlikely that the 100 mg/l chloride limit could be met by the projects for the required period during dry and critical years.

The City of Vallejo Intake standard protects the export uses of the City of Vallejo. Seawater intrusion does not appear to have affected water quality significantly in the vicinity of Cache Slough, even during 1977 hydrological conditions.

Public Interest/Without Project Conditions

Under this alternative, protection of municipal and domestic uses would be provided under the Board's public interest authority. The principal basis of water quality standards for municipal water

supply would be the protection of public health. The standards for drinking water contained in the proposed secondary drinking water standards of the Environmental Protection Agency developed under the "Safe Drinking Water Act" and the California State Department of Health criteria (Section 64473 of Title 22, California Administrative Code) would be followed. The question of compensation for benefits received by virtue of the operation of project facilities is left for resolution by the project operators and municipalities involved.

The level of protection for industries, on the other hand, would be based on the Board's vested water right authority. As in the case of agricultural supplies, industries would be provided at least that quality of water which they would have received in the absence of the projects.

Municipal uses are greatly enhanced in terms of taste and suitability for landscape watering by water quality levels better than the public health standards. The U. C. Guidelines for protection of chloride-sensitive vegetation and CCCWD Exhibit 17 indicate that taste suitability and landscape watering uses could be protected at the 150 mg/l chloride limit. It is proposed that municipal users be provided this higher level of protection to the extent that such quality would have been available to them in the absence of the projects.

Under this alternative, water quality standards for municipal and industrial uses in the vicinity of Antioch would be established to

ensure the necessary water quality offshore of Antioch.

Substitute Supplies

As previously stated, municipal and industrial users in the vicinity of Antioch have adequate substitute supplies available through the Contra Costa Canal. Under this alternative, offshore water quality in the vicinity of Antioch would not be protected. The level of protection provided municipal supplies at Rock Slough under the Board's public interest authority would be identical to that of the previous alternative. The industrial standards would be based on providing a substitute water supply through the Contra Costa Canal equivalent to that which would have been available offshore at Antioch.

Modified Without Project Conditions

Under this alternative, the number of days that the 150 mg/l chloride level is provided at Rock Slough would be permitted to vary with hydrologic conditions experienced. However, the chloride level would never be allowed to go above that required for public health. This alternative may provide long-term protection for industrial uses comparable to that of the substitute supply approach presented above.

F. SELECTION PROCESS

The individual conceptual alternatives outlined above have been sorted into alternative plans which include a complete set of standards covering all beneficial uses in the Delta and Suisun Marsh.

Each alternative strategy reflects the same general level of protection to beneficial uses.

See Chapter IV of the EIR for a full discussion of the impacts of these strategies on project operations and the environment. Based on the analysis contained in the EIR, the degree of protection provided by each alternative strategy and its impact on project operations can be compared. The water quality standards set forth in Chapter VI of this plan were selected from such comparative analysis of resulting benefits and detriments.

CHAPTER VI

WATER QUALITY STANDARDS

The water quality standards set forth in this chapter are the result of a full examination of agricultural, municipal and industrial, and fish and wildlife uses in the Delta; the beneficial uses of water exported from the Delta; and available Delta supplies, regulated and otherwise. After analysis of the major alternatives outlined above and the impacts of each outlined in the EIR, the following water quality standards are adopted.

A. FISH AND WILDLIFE

The fish and wildlife standards contained herein are those recommended to the Board by Fish and Game (Fish and Game Exhibit 11)[1/] with minor modifications explained below. The Department in its closing brief endorsed the Fish and Game recommendations. The standards were developed through extensive negotiations among the Department, Bureau, Fish and Game and U. S. Fish and Wildlife Service. However, these agencies have not yet executed an agreement.

The Fish and Game recommendations are based on maintenance of fish and wildlife resources on the average at recent historical levels (1922-1967)[2/], but recognize that these levels cannot be

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1/ April 12, 1977 draft of the so-called Four-Agency Fish Agreement.

2/ Conditions upstream of the estuary may limit the abundance of some species. This recommendation deals only with those factors in the Delta estuary that limit species abundance.

achieved with existing project facilities and current export levels (Fish and Game Exhibit 11, p. 4). Until additional project facilities are constructed and operational, the recommendations provide, except as to Suisun Marsh (discussed below), for the maintenance of the fishery (as represented principally by striped bass) in the Delta estuary at levels which would approach those that would have existed in the absence of the SWP and CVP.

The recent historical fishery levels in the Delta have exceeded what would have occurred in the absence of the SWP and CVP. The Board believes that the fishery in the Delta should be maintained at these historical levels. Higher levels of protection involving greater Delta outflows are not realistic. Any future Delta transfer facility should be operated to ensure the maintenance of these recent historical levels. In the absence of such a facility, the fishery resource should be maintained as close as practicable to those levels which would have existed in the absence of the SWP and CVP (without project conditions).

As discussed in Chapter V and in more detail in the EIR, other alternatives in addition to the Fish and Game recommendations were evaluated. Based on this evaluation, the Fish and Game recommendations, with modification of the striped bass spawning and survival relaxation provisions, and interim Suisun Marsh standards, are the most appropriate water quality standards for the reasonable protection of fish and wildlife resources. These standards are shown in Table VI-1.

Presented below is a brief discussion on the rationale and technical basis for the fish and wildlife standards. More detailed information is contained in the EIR as well as in the extensive testimony and exhibits introduced by Fish and Game during the Delta hearing.

Striped Bass Spawning

As indicated in Chapter III, striped bass have been selected as a key species for establishing Delta fish and wildlife criteria. The striped bass spawning locations on the Sacramento and San Joaquin River systems are shown in Figure III-1. Salinity affects striped bass spawning on the lower San Joaquin River (Fish and Game Exhibit 3, p. III-8). Spawning in this reach of the river typically occurs in the main channel and connecting sloughs between Antioch and Prisoners Point on Venice Island. Salinity limits of 1.5 mmhos EC (1000 mg/l TDS) and 0.55 mmhos EC (350 mg/l TDS) at Antioch and Prisoners Point, respectively, have been established as maximum allowable levels for striped bass spawning on a long-term basis (see Appendix B). However, it may be possible to exceed these values for brief periods with little adverse effect on spawning (Fish and Game Exhibit 3, p. III-8). Information gathered during 1977, currently being evaluated by Fish and Game, should help clarify this concern.

Substantial spawning on the San Joaquin River generally commences in mid to late April and continues for about 5 weeks (Fish and Game Exhibit 12A). The Antioch spawning standard requires sufficient outflow to achieve minimum acceptable salinity levels by the time substantial spawning starts, and the maintenance of suitable salinity during the first several weeks of spawning. Under steady state conditions, a 6700 cfs outflow should result in approximately 1.5 mmhos EC at Antioch (Department Exhibit II-9 Attachment No. 3). During the latter part of the spawning period, salinities are influenced by the striped bass survival standard.

The previous Antioch spawning standard in the Basin 5B Plan was triggered when water temperatures reached a specific level (see Appendix B). This presented two problems. First, the required spawning salinity was often provided prior to any significant spawning. Second, the triggering date was difficult to establish due to fluctuation of stream temperatures near this limit (RT Vol. XXII, p. 157).

Relaxation Provision

Both Fish and Game and the Department recommended relaxation of the striped bass spawning standard during periods of extreme water shortage. Relaxation would be commensurate with the deficiencies imposed on firm supplies to SWP and CVP water users. During periods

of extreme water shortage these agencies recommended that the Antioch spawning standard, plus the 6,700 cfs outflow provision for the first 15 days of the spawning standard period, be replaced by minimum total flows of 470,000 acre-feet during the 35-day period (470,000 acre-feet is equal to about 6,700 cfs for 35 days), less an amount equal to 10 percent of the annual deficiencies in deliveries of firm supplies by the projects, excluding any deficiencies in the Friant Division of the CVP.

This outflow-related relaxation criteria has serious flaws. The parameter of concern in striped bass spawning is salinity, not outflow. Also, the Delta Outflow Index during the beginning of the irrigation season (around April) may not be representative of true outflow in some years (EIR, Chapter III), and the assumption that 6,700 cfs can maintain 1.5 mmhos EC at Antioch is based on water quality models that do not account for the effects of exports on the salinity-flow relationships in this area of the Delta. The occurrence of such effects during the early portion of the irrigation season may require larger outflows at higher export rates in order to maintain the target salinity condition at Antioch.

In view of these deficiencies, the recommended striped bass spawning relaxation standard has been modified to maintain salinity levels at Antioch rather than outflow while retaining the original intent of the recommended relaxation provision. This approach was used in the trial set of objectives and was not challenged by

any of the hearing participants.

Striped Bass Survival and Neomysis Protection

The goals of this standard are twofold. The first is to maintain striped bass populations on the average at levels which approach without project conditions prior to construction and operation of a Delta transfer facility. The second is to maintain populations on the average at recent historical levels after the operation of such a facility. The standard also benefits opposum shrimp, Neomysis, the critical food source for young striped bass.

The Striped Bass Index, a measure of young bass survival through their first summer, is the parameter of concern for striped bass survival. The Striped Bass Index is a measurement of relative abundance rather than an estimate of the actual number of striped bass present. However, the use of the Striped Bass Index as a water quality control parameter poses some technical problems. Therefore, the Striped Bass Index has been translated to the environmental conditions most directly related to it. The most direct mechanism to monitor these environmental conditions is through the use of the Delta Outflow Index. The technical basis for this approach is set forth in the hearing record (Fish and Game Exhibit 3, pp. III-13 to III-34 and RT Vol. XXII, pp. 168-175).

The recommended standard is based on statistical relationships

between striped bass abundance, Delta outflow and water diversions from Delta channels for both local and export uses (Fish and Game Exhibit 3, Figures III-13 and III-6, and Fish and Game Exhibit 11, Appendix C, p. 5). Using known or estimated recent historical outflow and diversions, the average abundance of striped bass for the period 1922-1967 was found to be 106 Striped Bass Index units. In order to derive a standard that would achieve the long-term goal for fishery preservation, mean May, June and July flows for the six hydrologic year types (see Figure II-1) were selected which produce a mean Striped Bass Index of 106, assuming the historical occurrence of year types coupled with export curtailments sufficient to eliminate detriments due to exports (Fish and Game Exhibit 11, Appendix C, pp. 5 and 6, and RT Vol. XXII, pp. 166-175).

Analysis of the striped bass survival standard indicates that striped bass, on the average, can be maintained at levels that approach without project levels under the expected export conditions during the effective period of this plan (see EIR, Chapters IV and V).

The without project level of striped bass, based on June and July flows, is about 71 Striped Bass Index units. However, other factors may also affect striped bass survival. For instance, conditions prior to and after the June/July period affect striped bass abundance. The magnitude of this impact cannot be quantified at this time. The nature of this impact suggests that something higher than 71 index units would be required to maintain striped bass abundance at without project levels (see EIR, Chapter V, Section B). How much higher is unknown.

The average Striped Bass Index under this plan is about 79 index units. Even though without project levels would be somewhat higher than 71, it is believed that the striped bass levels (79) under this plan would approximate without project levels if the effects of all factors at all times of year could be properly evaluated. This striped bass survival standard will in any event provide substantially better protection to striped bass than the previous basin plan objectives (63 index units), while having a lesser impact on project exports (EIR, Chapter V).

Even though the current method used to assess without project levels of striped bass lacks the precision necessary to identify fully project mitigation responsibilities, it is sufficient to indicate a project responsibility to provide immediate protection to the fishery resource. While this level of protection falls short of full mitigation of all project impacts on the fishery, it is nonetheless a reasonable level of protection.

The method used to assess without project levels of striped bass is at best only a rough approximation of project impacts on striped bass abundance. Prior to any attempt to fix project responsibilities for mitigating impacts on the fishery, the analytical tools for assessing project impacts must be refined. As with the Draft Four-Agency standards, the Department, Bureau, Fish and Game, and U. S. Fish and Wildlife Service should work together to develop a mutually acceptable approach to identify project impacts on the fishery.

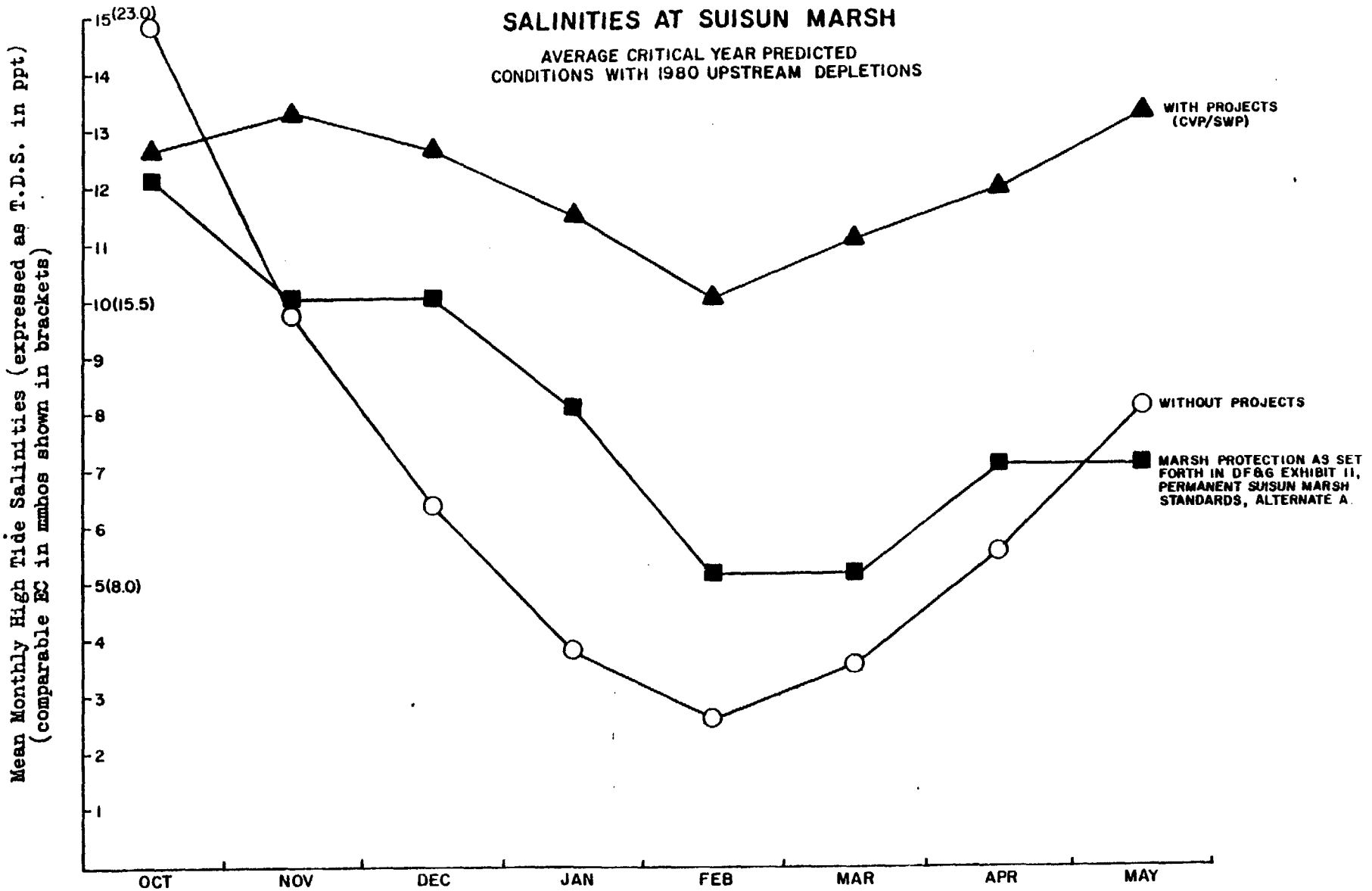
The striped bass standards are expected to benefit species other than striped bass, as previously discussed. The spring and early summer flows provided in the above standards coincide with the spawning and migration period of many species which presumably are adapted to the natural high flows occurring during this period (see Figure III-2). While the Delta Plan approaches without project levels of protection for striped bass, there are many other species, such as catfish, shad and salmon, which would not be protected to this level. In order to provide full mitigation of project impacts on all fishery species now would require the virtual shutting down of the project export pumps. Such extreme action would not be in the best public interest.

Salmon Migration

The salmon standard reflects the minimum flows which Fish and Game believes would be suitable for salmon migration. Fish and Game's recommendation is based largely on information from the San Joaquin River which relates river flows to abundance of returning adult salmon (Fish and Game Exhibit 3, Chapter II). However, the information necessary to refine this standard is not currently available (Fish and Game Exhibit 11, p. 6). Notwithstanding this, the standard is an appropriate base from which more definitive standards can be established in the future.

Suisun Marsh

Full protection of Suisun Marsh at present poses an extremely difficult problem. As shown in Figure VI-1, the interim standards set forth in Fish and Game Exhibit 11 plus anticipated uncontrolled flows will not fully protect Suisun Marsh in typical critical years.



Predicted salinities are shown for the mouth of Suisun Slough which was estimated at 0.75 times the Port Chicago salinities (from DF&G Exhibit 24, DWR Exhibit II-13-B).

This figure also shows that under 1980 without project conditions, the Marsh would have been protected in average critical years. Thus, the interim standards do not fully mitigate the adverse effects of the projects on the Marsh.

State and federal legislation require the SWP and CVP to mitigate the adverse environmental effects of project operations.[3/] Standards providing such mitigation measures to the Marsh are evaluated in the EIR. Full protection of the Marsh solely with outflow could require in excess of 2 million acre-feet (in terms of project yield) in addition to that outflow required to meet the interim Marsh standards (RT Vol. XXII, p. 101). This would result in a one-third reduction in combined SWP and CVP exportable yield from existing facilities. The Bureau, the Department, Fish and Game and the U. S. Fish and Wildlife Service are working to develop supplemental water supplies for the Marsh. Such supplemental supplies are a more desirable method for protecting the Marsh and mitigating the adverse impacts of the CVP and SWP on this extremely valuable resource.

Recognizing the effort currently underway by this Four-Agency group, a time schedule has been developed for the completion of the necessary measures to mitigate the projects' impacts on Suisun Marsh. Initial phases of this program should be completed by January 1, 1980, with full mitigation required by October 1, 1984. A more detailed discussion of this program is set forth in the program of implementation, Chapter VII.

3/ Section 11900 of California Water Code; The California Environmental Quality Act (Public Resources Code Section 21000, et seq.); Fish and Wildlife Coordination Act [16 U.S.C. Section 661, et seq. (1970)]; and National Environmental Policy Act of 1969 [42 U.S.C. Section 4321 et seq. (1970)].

The interim standards do not provide complete protection to Suisun Marsh. The interim standards require some modification of project operations to benefit the Marsh, but rely primarily on the occurrence of uncontrolled outflows to protect the Marsh until 1984.

Fish and Game recommended relaxation of the interim Marsh standards whenever the projects impose deficiencies in firm scheduled water deliveries. This recommendation was based on attaining full protection for the Marsh by January 1, 1982. However, during the public hearing on the draft plan, the Department indicated that full Marsh protection could not be achieved until the fall of 1984. In view of this, the control date by which full Marsh protection would be required was extended to October 1, 1984. In order to ensure sufficient protection over this extended interim period, relaxation of interim Marsh standards will not be allowed in the critical months of January through May.

The Board supports the long-term goal of Fish and Game that all managed wetlands of Suisun Marsh (except those on Ryer, Roe, Snag and Freeman Islands) should be provided with sufficient quantities of adequate quality water to attain a soil water electrical conductivity of 14 mmhos EC (9 parts per thousand TDS) in the first foot of soil during May, using best practical water management practices (Fish and Game Exhibit 11, p. 13). Best available information indicates that water quality conditions to achieve this goal would have been available even in most critical years had the projects not been constructed. Therefore, provision of water quality conditions to achieve this goal is a project responsibility. These

conditions are included as standards to be achieved at specific locations in the Marsh by October 1, 1984. The program of implementation in Chapter VII of the plan sets forth the specific actions that must be taken by the project operators to mitigate their impacts on the Marsh in the interim period prior to October 1, 1984.

Operational Constraints

In addition to the interim fish and wildlife standards, Fish and Game has recommended that CVP and SWP facilities be required to operate in a manner which would minimize their impact on the Delta fishery. Even though such operating criteria are not a usual element of a water quality control plan, they are proper considerations for a water right decision. In view of the dual nature of this proceeding, these operating criteria are included in Table VI-1.

The most important operational requirement is a curtailment of exports to protect striped bass. The export curtailment, in combination with the spring and summer flows for striped bass survival, is an important factor in approaching the without project level of this resource. In order to ensure the attainment of this goal, the operational constraints recommended by Fish and Game have been modified so that SWP export curtailment would be required regardless of Delta outflow conditions.

Other constraints include restrictions on the operation of the Delta Cross-Channel and requirements on the operation of the fish protective facilities at the SWP and CVP export locations.

B. AGRICULTURE

Water quality standards to protect Delta agricultural uses have been developed for three general geographic areas: the western, interior and southern Delta. The particular needs of each area are determined by its location in the Delta, its soil types and irrigation practices. While the general approach for all three areas is substantially the same, the agricultural water quality standards have been tailored to the particular characteristics of each area.

The approach used in developing the agricultural standards involves an initial determination of the water quality needs (criteria) of significant crops, predominant soil types, and irrigation practices in each area. The extent to which these water quality needs would be satisfied in various portions of the Delta under without project conditions was then determined. The agricultural standards are based on this determination and ensure that project operations do not encroach upon Delta vested rights. The level of protection provided agricultural uses under these standards will extend no further than without project conditions, as limited by reasonable beneficial use. However, additional needs could be met through contracts with the Department and Bureau under the statutory preference accorded Delta beneficial uses.

Water Quality Criteria

Subirrigated Organic Soils. As indicated above, a substantial portion of the western and interior Delta organic soils are subirrigated (see Figure III-4). This method of irrigation is very

energy efficient. However, since subirrigation wets the soil from below the surface, effective leaching is reduced. This reduced leaching makes it necessary to irrigate with high quality (low salinity) water. Subirrigation has been practiced historically with good success in the Delta. The widespread use of this method of irrigation is due largely to the fact that organic soils cannot be successfully irrigated by furrow or border check methods (RT Vol. XIII, p. 29). The water quality criteria developed for organic soils is based on the high water quality required when subirrigation is practiced.

However, there are other acceptable methods for irrigating organic soils which could reduce the need for this high quality water. One such method is sprinkler irrigation which was discussed during the hearing as a possible alternative to subirrigation. Sprinkler irrigation of Delta organic soil would require a substantial additional capital and operating cost (RT Vol. XIII, p. 46-47). In view of the considerable expense involved, such alternative means of irrigation have been treated in the same manner as the substitute supplies provision of the Delta Protection Act. Under the Delta Protection Act, Delta water users would not incur additional expense if a substitute supply is provided by the project operators (see discussion in Chapter I).

In order to determine the water quality needs of the Delta organic soils, the crop of major significance to this area's economy was identified. As indicated in Chapter III, corn is the principal crop grown on subirrigated soils. In accordance with the Delta Protection Act provision to maintain and expand Delta agriculture, water quality requirements have been established to provide 100% crop yields for corn.

The University of California (UC) Guidelines and Irrigation and Drainage Paper 29 of the Food and Agriculture Organization of the United Nations (FAO) (UC Exhibits 1 and 2) provide a methodology for determining the maximum salinity of the applied water which allows a 100% yield of specific crops. However, the equations used in this determination must be modified for subirrigated organic soils (UC Exhibit 8). The FAO report assumes a soil water salinity concentration of three times that of the applied water. However, Exhibit 8 indicates that the applied water salinity is actually concentrated from five to ten times in the organic soils of the Delta where subirrigation is practiced. If a concentration factor of 7.5 is substituted into the FAO equations, the applied water salinity requirement for corn on subirrigated organic soils would be 0.45 mmhos EC.

Throughout the extensive testimony of the U. C. Cooperative Extension electrical conductivity is used as the best measure of salinity impacts on Delta agriculture. While total dissolved solids and chloride ion concentration have been employed traditionally as measures of Delta water quality, electrical conductivity is more closely related to osmotic pressure (which the plant is responding to) than any other measure of salinity. Figures II-4 and II-5 list the conversion factors from electrical conductivity to chloride ion concentration and total dissolved solids for representative stations in the Delta.

The 0.45 mmhos EC water quality requirement will be imposed only during the irrigation season, April 1 to August 15. It was not

possible to establish the water quality needs of this area during other periods of the year because of the lack of information in the hearing record.[4/]

However, the water which the plant uses may not be solely that which is directly applied in the field (RT Vol. XX, p. 181). The mechanics of this water movement through the soil has not been well defined, but preliminary research by the U. C. Cooperative Extension indicates that water applied in spud ditches may be adding additional upward force to the underlying groundwater and that the plant might actually be using the groundwater for consumptive use. If these preliminary indications prove to be valid, the quality of the groundwater could be the most important factor in the consideration of water quality needs in subirrigated organic soils. The complexity of factors affecting groundwater quality and water movement are not fully understood at this point. Future research may clarify these relationships.

Mineral Soils. As more fully described in Chapter III, mineral soils are found predominantly in the northern and southern portions of the Delta. Unlike the organic soils which are predominately subirrigated, mineral soils permit surface irrigation. Some leaching

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4/ The interim agreement between the Department, North Delta Water Agency and Reclamation District 341 executed on June 21, 1977, due to the drought does make provisions for supplying specific quality levels to areas in the western Delta for a two-week period in December 1977 for preirrigation.

of the mineral soils is accomplished by surface irrigation during the growing season. The water quality needs of mineral soils are not as high as those for subirrigated soils for the same crop yields. Therefore, the water quality standards developed for the protection of the subirrigated organic soils in the western and interior Delta will provide suitable water quality for the mineral soils in the northern portion of the Delta.

Water quality and quantity needs in the southern Delta are a different matter. A major portion of the southern Delta has a considerable amount of clay intermixed in the soil profile. These soils tend to have low permeability, and drainage and water movement is often restricted.

The drainage and high water table problems in portions of the southern Delta limit the type of crops which can be grown. For instance, beans were grown on about 20,000 acres in the southern Delta during the early 1930's. Field beans are now grown on only about 2,400 acres in the southern Delta. A reason advanced for this decline is the poorer water quality presently available to the southern Delta. Most of the beans now grown in this area are black-eyed beans, because they are more salt tolerant. Even these salt tolerant beans are grown generally in areas receiving Delta-Mendota Canal water due to its better quality (RT Vol. XIII, p. 157).

Beans are an important crop to the southern Delta due to market demand and suitability to climate and soil. Also, beans are well suited to crop rotation in this area. The U. C. Guidelines recommend an applied water quality of 0.7 mmhos EC during the irrigation season, April through August, to maintain beans at a 100% yield (UC Exhibit 1). Other important crops in the southern Delta are alfalfa, pasture and sugar beets. These crops use water throughout the year. Also, during a major portion of the year, one area or another of the southern Delta is in the seedling stage of growth (RT Vol. XIV, p. 86). In view of the year-round demand for irrigation water, the water quality needs of this area for months other than April through August must be considered.

The U. C. Guidelines indicate that alfalfa requires an applied water of 1.3 mmhos EC for a 100% yield. Because of permeability problems, associated winter leaching factors and the water quality requirements of crops in the seedling stage, an applied water quality of 1.3 mmhos EC would not fully avoid crop decrement. In order to provide sufficient protection to crops in the southern Delta outside of the April through August irrigation season, the quality of applied water has been set at 1.0 mmhos EC during the period September 1 to March 31. The ongoing research by the U. C. Cooperative Extension in the southern Delta may produce information which will show a need for future revision of these water quality criteria.

Water Quality Standards.

Western Delta. In order to establish water quality standards for the western Delta organic soils, water quality data at representative locations were analyzed to determine without project water quality conditions (i.e., conditions which would exist in the absence of CVP and SWP). Figure II-4 shows this level of water quality for Emmaton and Jersey Point.

Under without project conditions, the high quality water needed for full crop yields in the western Delta would not be available throughout the entire irrigation season in most years. In most years, water with extremely good quality would be available during the early portion of the irrigation season, but the quality would deteriorate rapidly during the later portion of the season. The start of the deterioration would depend upon the year type. Standards designed solely to reproduce such conditions would require large quantities of water for little benefit. In order to provide the extremely good quality water early in the irrigation season, Delta outflows in excess of 10,000 cfs would be required. In most years, uncontrolled flows provide much of the needed outflow. However, since without project conditions would allow rapid and extensive salinity intrusion during the latter part of the irrigation season, the benefits to agriculture provided by reproducing such conditions would appear to be offset by the detriments. Thus, the direct application of without project conditions without some

modification would result in unreasonable standards. Equivalent without project conditions have been developed by providing the western Delta the same weighted average salinities over the period April 1 through August 15 as those shown on Figure II-4. Such modification will benefit both agricultural users in the western Delta and project operators.

The agricultural standards for the western Delta shown in Table VI-1 are based on these equivalent without project conditions. Under these standards, a water quality of 0.45 mmhos EC would be assured for that portion of the irrigation season during which it would have occurred in the absence of the projects, in all years except critical years. The water quality provided for the remaining portion of the irrigation season would reflect a salinity which when weighted with the 0.45 mmhos EC value would be equivalent to the without project weighted average over the entire irrigation season. In some years, particularly wet and above normal years, the combined effect of both of these factors result in a requirement of 0.45 mmhos EC for the entire period April 1 through August 15. In such cases the 0.45 mmhos EC requirement is shown for the entire period in the first column of the agricultural standards in Table IV-1.

Provision of the 0.45 mmhos EC early in the irrigation season would be unreasonable during critical years, because of the relatively large outflows required. In view of this, the water quality standards for the western Delta during critical years are based on the time-weighted average water quality conditions over the entire period April 1 through August 15. These time-weighted averages are the same as the without project average conditions for such years.

Interior Delta. The agricultural water quality needs of the interior Delta are essentially the same as those of the western Delta subirrigated organic soils, 0.45 mmhos EC during the irrigation season. The without project water quality conditions for representative locations in the interior Delta are shown in Figure II-5. Central Landing on the Mokelumne River is representative of water quality in the portions of the interior Delta influenced directly by the Sacramento and Mokelumne Rivers. Webb Pump on False River represents water quality of the interior Delta affected by the San Joaquin River. As shown in Figures II-4 and II-5, water quality in the interior Delta under without project conditions would be considerably better than in the western Delta during the irrigation season. Also, water quality in that portion of the interior Delta influenced by the Sacramento and Mokelumne Rivers is better than that of areas influenced by the San Joaquin River.

The water quality standards developed for the interior Delta are based on the same general principles as those for the western Delta. These standards are shown in Table IV-1. In the absence of a cross-Delta water transfer facility, salinity protection of the interior Delta south of the San Joaquin River is afforded by the Jersey Point standards. The Board intends to adopt standards for specific locations in the interior Delta south of the San Joaquin River if such a facility is constructed.

Southern Delta. In Chapter V, the problems associated with development of implementable water quality standards for the southern Delta are discussed. In recognition of the concerns expressed therein, a

phased approach has been developed to resolve the long standing water quality problems in the southern Delta. The current Vernalis objective contained in the Basin 5B Plan is used as an interim level of protection for the southern Delta. However, achievement of this interim level of protection cannot be ensured until New Melones Reservoir is operational.

The most practical solution for long-term protection of southern Delta agriculture is construction of physical facilities to provide adequate circulation and substitute supplies. If necessary physical facilities are constructed, the circulation flows needed may be only a moderate increase above those committed from New Melones Reservoir.[5/] Negotiations concerning such facilities are currently underway between the project operators and the South Delta Water Agency.

C. MUNICIPAL AND INDUSTRIAL

The principal concerns in development of water quality standards for municipal and industrial uses in the Delta are public health protection and the needs of established salt sensitive industries. The development of suitable standards is complicated by the effect of established water supplies from both historical water right diversions and substitute sources.

5/ See Memorandum Agreement for the Protection and Enhancement of the Water Quality of the Stanislaus and San Joaquin Rivers as Affected by the New Melones Project under Water Right Application 19304 of the United States of America and by Municipal and Industrial Wastes, between the Bureau and Central Valley Regional Water Quality Control Board dated July 2, 1969.

Contra Costa Canal Intake

Historically, diversions for municipal and industrial uses have been made not only from the Delta in the Antioch/Pittsburg area, but also downstream from the Delta as far as Crockett in the Carquinez Strait area (Department of Public Works Bulletin 27, Plate IV).

As stated in Chapter V, water quality standards for public drinking supplies have been developed at levels necessary to provide full protection regardless of a particular entity's vested rights. In accordance with Section 64473 of Title 22 of the California Administrative Code, the standard for drinking water has been established at 250 mg/l chloride.

The level of protection provided industrial uses and municipal supplies (other than drinking supplies) extends to at least that quality of water which would have existed in the absence of the projects. These without project water quality conditions offshore at Antioch are shown in Figure II-7, and their development is discussed in Chapter II. As indicated in Chapters II and V, the production of salt-sensitive paper, drinking water taste enhancements and irrigation of salt-sensitive plants require a chloride concentration of 150 mg/l or less (RT Vol. XVII, p. 137; CCCWD Exhibit 17, p. 11; UC Exhibit 1, p. 1).

The maintenance of without project conditions offshore at Antioch would require additional Delta outflow of 22 to 44 acre-feet to protect each acre-foot of use (RT Vol. XXIV, p. 151). Even though previous water quality standards provided limited protection offshore at Antioch during portions of the year, these standards were intended to be in effect only until a substitute supply was available to areas in the vicinity of Antioch.

All principal water users in the vicinity of Antioch now have an alternate source of supply from the Contra Costa Canal, which has its intake at Rock Slough (RT Vol. II, pp. 56 and 57, and Vol. XVII, p. 72). The Department has offered to pay any increased cost incurred by these principal water users in taking water from the Contra Costa Canal as a result of reduced availability of suitable offshore supplies due to SWP operations (RT Vol. II, p. 57). The Department has already contracted with CCCWD (Mallard Slough Intake) and the City of Antioch to make such compensation (RT Vol. XXIV, p. 148). Based on recent negotiations, it appears that the remaining issues with the other principal users can be resolved. In view of this and the large Delta outflow required to protect offshore uses in the vicinity of Antioch, a specific offshore Antioch standard has not been included in this plan.

However, in accordance with the Delta Protection Act, such substitute supply should provide Delta users at least that water quality which would have been available to them in the absence of the projects. The standard for municipal and industrial uses

in the vicinity of Antioch is based on providing a substitute supply through the Contra Costa Canal equivalent to that available offshore at Antioch. Thus, this standard provides a chloride limit of 150 mg/l at Rock Slough for periods equal to those during which water of that quality would occur offshore at Antioch. Users in the vicinity of Antioch have no vested water right at Rock Slough. Therefore, the intent of this standard is to protect this substitute supply. The station selected for monitoring compliance with this standard is the CCCWD Pumping Plant No. 1. The quality at this station will closely reflect the delivered water quality. Substantial differences in water quality can occur between Rock Slough and CCCWD Pumping Plant No. 1. These differences are due to agricultural return flows (RT Vol. IV, pp. 175-177; Department Exhibits 10a, 10b, 10c) (See page VII-3 for discussion of action concerning the agricultural return flow problem). There is no requirement that the quality of this substitute supply be maintained consecutively for the entire period shown in Table VI-1, but it must be provided in intervals of at least two weeks duration. Whenever users in the vicinity of Antioch elect to satisfy their vested water rights through offshore supplies, compliance will be measured at either Pumping Plant No. 1 or Antioch, provided that the durational requirement is satisfied.

The Department has proposed a Contra Costa Canal Intake (Rock Slough at Old River) standard which would allow greater variation in the period when the 150 mg/l chloride level is provided, especially during drier years (Department's Closing Brief, p. 31). Under this

proposal, the 150 mg/l chloride level would be provided more than 65% of the time on an annual overall average assuming the historical occurrence of year types. The annual overall average for the proposed Rock Slough standard shown in Table VI-1 is 53%. Even though the Department's proposal provides for a greater average annual occurrence of high quality water at Rock Slough and takes better account of low water supply conditions, this proposal was not selected as a standard since it would not provide a substitute supply equivalent to that available offshore at Antioch during dry and critical years. The Board has concluded that Rock Slough water quality levels should not go below this minimum.

City of Vallejo Intake (Cache Slough)

The City of Vallejo has an appropriative right to divert water at Cache Slough for use outside the Delta. Riparian uses and earlier priority appropriations elsewhere in the Sacramento Basin limit the availability of water for exercise of this right in critically dry years. The previous water quality standards for Cache Slough provided a maximum total dissolved solids limit of 250 mg/l (100 mg/l chloride). However, data from 1972 to 1976 shows that this standard has been met only half of the time and that it is often exceeded during periods of high Delta inflow and outflow. This suggests that local return drainage affects this area's water quality more directly than project operations. Also, saltwater intrusion during 1977 did not appear to influence significantly water quality in the vicinity of Cache Slough. The 250 mg/l chloride limit proposed in this plan will protect this supply for

municipal uses in accordance with Section 64473 of Title 22, California Administrative Code.

Although current operations of the projects do not seem to significantly affect water quality at the City of Vallejo Intake, future activities of the projects might adversely affect this quality. Therefore, the City of Vallejo Intake standard will be included in the water right permits of the Department and Bureau.

Clifton Court and Tracy Pumping Plant

Diversions from Delta channels for municipal and industrial uses outside the Delta occur at Clifton Court and Tracy Pumping Plant. Consistent with the chloride limits for drinking water discussed previously, a maximum of 250 mg/l chloride is included as the water quality standard at these locations. However, water supply contracts of the SWP and CVP presently require better water quality. Thus, water quality at the project export facilities will be significantly better than that provided by the water quality standards established in this plan as a result of project operations.

Table VI-1

WATER QUALITY STANDARDS

FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH[1]

BENEFICIAL USE PROTECTED and LOCATION	PARAMETER	DESCRIPTION	YEAR TYPE[2]	VALUES	
MUNICIPAL and INDUSTRIAL					
Contra Costa Canal Intake at Pumping Plant No. 1	Chloride	Maximum Mean Daily Cl^- in mg/l	All	250	
Contra Costa Canal Intake at Pumping Plant No. 1 or Antioch Water Works Intake on San Joaquin River	Chloride	Maximum Mean Daily 150 mg/l Chloride for at least the number of days shown during the Calendar Year. Must be provided in intervals of not less than two weeks duration. (% of Year shown in parenthesis)		Number of Days Each Calendar Year Less than 150 mg/l Chloride	
			Wet	240 (66%)	
			Ab. Normal	190 (52%)	
			Bl. Normal	175 (48%)	
			Dry	165 (45%)	
			Critical	155 (42%)	
City of Vallejo Intake at Cache Slough	Chloride	Maximum Mean Daily Cl^- in mg/l	All	250	
Clifton Court Forebay Intake at West Canal	Chloride	Maximum Mean Daily Cl^- in mg/l	All	250	
Delta Mendota Canal at Tracy Pumping Plant	Chloride	Maximum Mean Daily Cl^- in mg/l	All	250	
AGRICULTURE				0.45 EC April 1 to Date Shown	EC from Date Shown[3] to Aug. 15
WESTERN DELTA					
Emmaton on the Sacramento River	Electrical Conductivity	Maximum 14-day Running Average of Mean Daily EC in mmhos	Wet	Aug. 15	--
			Ab. Normal	July 1	0.63
			Bl. Normal	June 20	1.14
			Dry	June 15	1.67
			Critical	--	2.78
Jersey Point on the San Joaquin River	Electrical Conductivity	Maximum 14-day Running Average of Mean Daily EC in mmhos	Wet	Aug. 15	--
			Ab. Normal	Aug. 15	--
			Bl. Normal	June 20	0.74
			Dry	June 15	1.35
			Critical	--	2.20
INTERIOR DELTA					
Terminous on the Mokelumne River	Electrical Conductivity	Maximum 14-day Running Average of Mean Daily EC in mmhos	Wet	Aug. 15	--
			Ab. Normal	Aug. 15	--
			Bl. Normal	Aug. 15	--
			Dry	Aug. 15	--
			Critical	--	0.54
San Andreas Landing on the San Joaquin River	Electrical Conductivity	Maximum 14-day Running Average of Mean Daily EC in mmhos	Wet	Aug. 15	--
			Ab. Normal	Aug. 15	--
			Bl. Normal	Aug. 15	--
			Dry	June 25	0.58
			Critical	--	0.87
SOUTHERN DELTA					
Vernalis on the San Joaquin River	Total Dissolved Solids	Maximum 30-day Running Average of Mean Daily TDS in mg/l	All (after New Melones Reservoir becomes operational and until the standards below become effective)	500	
				Apr. 1 to Aug. 31	Sept. 1 to March 31
Tracy Road Bridge on Old River Old River near Middle River Brandt Bridge on San Joaquin River Vernalis on San Joaquin River	Electrical Conductivity	Maximum 30-day Running Average of Mean Daily EC in mmhos	All (to become effective only upon the completion of suitable circulation and water supply facilities)[4]	0.7	1.0

Table VI-1

WATER QUALITY STANDARDS

FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH[1]

BENEFICIAL USE PROTECTED and LOCATION	PARAMETER	DESCRIPTION	YEAR TYPE[2]	VALUES
FISH AND WILDLIFE				
• *STRIPED BASS SPAWNING*				
Prisoners Point on the San Joaquin River	Electrical Conductivity	Average of mean daily EC for the period not to exceed	All	April 1 to May 5 0.550 mmhos
Chipps Island	Delta Outflow Index in cfs	Average of the daily Delta outflow index for the period, not less than	All	April 1 to April 14 6700 cfs
Antioch Waterworks Intake on the San Joaquin River	Electrical Conductivity	Average of mean daily EC for the period, not more than	All	April 15 to May 5 1.5 mmhos
Antioch Waterworks Intake	Electrical Conductivity (Relaxation Provision – replaces the above Antioch and Chipps Island Standard whenever the projects impose deficiencies in firm supplies[5])	Average of mean daily EC for the period, not more than the values corresponding to the deficiencies taken (linear interpolation to be used to determine values between those shown)	All – whenever the projects impose deficiencies in firm supplies[5]	Total Annual Imposed Deficiency MAF / April 1 to May 5 EC in mmhos 0 / 1.5 0.5 / 1.9 1.0 / 2.5 1.5 / 3.4 2.0 / 4.4 3.0 / 10.3 4.0 or more / 25.2
• *STRIPED BASS SURVIVAL*				
Chipps Island	Delta Outflow Index in cfs	Average of the daily Delta outflow index for each period shown not less than		May 6–31 / June / July
			Wet	14,000 / 14,000 / 10,000
			Ab. Normal	14,000 / 10,700 / 7,700
			Bl. Normal	11,400 / 9,500 / 6,500
			Subnormal Snowmelt	6,500 / 5,400 / 3,600
			Dry[6]	4,300 / 3,600 / 3,200
			Dry[7] or Critical	3,300 / 3,100 / 2,900
• *SALMON MIGRATIONS*				
Rio Vista on the Sacramento River	Computed net stream flow in cfs	Minimum 30-day running average of mean daily net flow		Jan. / Feb. 1–Mar. 15 / Mar. 16–June 30
			Wet	2,500 / 3,000 / 5,000
			Ab. Normal	2,500 / 2,000 / 3,000
			Bl. Normal	2,500 / 2,000 / 3,000
			Dry or Critical	1,500 / 1,000 / 2,000
				July / Aug. / Sept. 1–Dec. 31
			Wet	3,000 / 1,000 / 5,000
			Ab. Normal	2,000 / 1,000 / 2,500
			Bl. Normal	2,000 / 1,000 / 2,500
			Dry or Critical	1,000 / 1,000 / 1,500
• *SUISUN MARSH*				
Chipps Island at O&A Ferry Landing	Electrical Conductivity	Maximum 28-day running average of mean daily EC		Jan.–May / Oct.–Dec.
			Wet	12.5 mmhos / 12.5 mmhos
			Ab. Normal	12.5 mmhos / 12.5 mmhos
			Bl. Normal	12.5 mmhos / 12.5 mmhos
			Dry or Critical	12.5 mmhos / 15.6 mmhos
		(The 15.6 mmhos EC Standard applies only when project water users are taking deficiencies in scheduled water supplies[8] otherwise the 12.5 mmhos EC remains in effect.)		
Chipps Island	Delta Outflow Index in cfs	Average of the daily Delta outflow index for each month, not less than values shown	Wet	February–May 10,000 cfs
			Subnormal Snowmelt	February–April 10,000 cfs
		Minimum daily Delta outflow index for 60 consecutive days in the period	Ab. Norm. and Bl. Norm.	January–April 12,000 cfs

Table VI-1

WATER QUALITY STANDARDS

FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH[1/]

BENEFICIAL USE PROTECTED and LOCATION	PARAMETER	DESCRIPTION	YEAR TYPE[2/]	VALUES
FISH AND WILDLIFE				
• *SUISUN MARSH*				
Chipps Island (continued)	*Delta Outflow Index in cfs*	*Average of the daily Delta outflow index for each month, not less than values shown*	*All (if greater flow not required by above standard)—whenever storage is at or above the minimum level in the flood control reservation envelope at two out of three of the following: Shasta Reservoir, Oroville Reservoir, and CVP storage on the American River*	*Jan.–May* 6,600 cfs
Collinsville on Sacramento River (C–2) *Miens Landing on Montezuma Slough (S–64)* *Montezuma Slough at Cutoff Slough (S–48)* *Montezuma Slough near mouth* *Suisun Slough near Volanti Slough (S–42)* *Suisun Slough near mouth (S–31)* *Goodyear Slough south of Pierce Harbor (S–35)* *Cordelia Slough above S. P. R.R. (S–32)*	*Electrical Conductivity*	*The monthly average of both daily high tide values not to exceed the values shown (or demonstrate that equivalent or better protection will be provided at the location)*	*All – To become effective Oct. 1, 1984*	*Month* / *EC in mmhos* Oct. 19.0 Nov. 15.5 Dec. 15.5 Jan. 12.5 Feb. 8.0 Mar. 8.0 Apr. 11.0 May 11.0
• *OPERATIONAL CONSTRAINTS*				
Minimize diversion of young striped bass from the Delta	*Diversions in cfs*	*The mean monthly diversions from the Delta by the State Water Project (Department) not to exceed the values shown.*	*All*	*May* 3,000 *June* 3,000 *July* 4,600
		The mean monthly diversions from the Delta by the Central Valley Project (Bureau), not to exceed the values shown	*All*	*May* 3,000 *June* 3,000
Minimize diversion of young striped bass into Central Delta		*Closure of Delta cross channel gates for up to 20 days but no more than two out of four consecutive days at the discretion of the Department of Fish and Game upon 12 hours notice*	*All – whenever the daily Delta outflow index is greater than 12,000 cfs*	*April 16–May 31*
Minimize cross Delta movement of Salmon		*Closure of Delta Cross Channel gates (whenever the daily Delta outflow index is greater than 12,000 cfs)*	*All*	*Jan. 1–April 15*

Table VI-1
WATER QUALITY STANDARDS
FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH 1/

FISH PROTECTIVE FACILITIES

Maintain appropriate records of the numbers, sizes, kinds of fish salvaged and of water export rates and fish facility operations.

STATE FISH PROTECTIVE FACILITY

The facility is to be operated to meet the following standards to the extent that they are compatible with water export rates:

(a) King Salmon – from November through May 14, standards shall be as follows:
- (1) Approach Velocity – 3.0 to 3.5 feet per second
- (2) Bypass Ratio – maintain 1.2:1.0 to 1.6:1.0 ratios in both primary and secondary channels
- (3) Primary Bay – not critical but use Bay B as first choice
- (4) Screened Water System – the velocity of water exiting from the screened water system is not to exceed the secondary channel approach velocity. The system may be turned off at the discretion of the operators.

(b) Striped Bass and White Catfish – from May 15 through October, standards shall be as follows:
- (1) Approach Velocity – in both the primary and secondary channels, maintain a velocity as close to 1.0 feet per second as is possible
- (2) Bypass Ratio
  - (i) When only Bay A (with center wall) is in operation maintain a 1.2:1.0 ratio
  - (ii) When both primary bays are in operation and the approach velocity is less than 2.5 feet per second, the bypass ratio should be 1.5:1.0
  - (iii) When only Bay B is operating the bypass ratio should be 1.2:1.0
  - (iv) Secondary channel bypass ratio should be 1.2:1.0 for all approach velocities.
- (3) Primary Channel – use Bay A (with center wall) in preference to Bay B
- (4) Screened Water Ratio – if the use of screened water is necessary, the velocity of water exiting the screened water system is not to exceed the secondary channel approach velocity
- (5) Clifton Court Forebay Water Level – maintain at the highest practical level.

TRACY FISH PROTECTIVE FACILITY

The secondary system is to be operated to meet the following standards, to the extent that they are compatible with water export rates:

(a) The secondary velocity should be maintained at 3.0 to 3.5 feet per second whenever possible from February through May while salmon are present

(b) To the extent possible, the secondary velocity should not exceed 2.5 feet per second and preferably 1.5 feet per second between June 1 and August 31, to increase the efficiency for striped bass, catfish, shad, and other fish. Secondary velocities should be reduced even at the expense of bypass ratios in the primary, but the ratio should not be reduced below 1:1.0

(c) The screened water discharge should be kept at the lowest possible level consistent with its purpose of minimizing debris in the holding tanks

(d) The bypass ratio in the secondary should be operated to prevent excessive velocities in the holding tanks, but in no case should the bypass velocity be less than the secondary approach velocity.

FOOTNOTES

1/ Except for flow, all values are for surface zone measurements. Except for flow, all mean daily values are based on at least hourly measurements. All dates are inclusive.

2/ The year type shall be determined as described in FIGURE II-1. The type determined for any year shall remain in effect until the February forecast for Bulletin 120 or until an earlier estimate becomes available.

3/ When no date is shown in the adjacent column, EC limit in this column begins on April 1.

4/ If contracts to ensure such facilities and water supplies are not executed by January 1, 1980, the Board will take appropriate enforcement actions to prevent encroachment on riparian rights in the southern Delta.

5/ For the purpose of this provision firm supplies of the Bureau shall be any water the Bureau is legally obligated to deliver under any CVP contract of 10 years or more duration, excluding the Friant Division of the CVP, subjec only to dry and critical year deficiencies. Firm supplies of the Department shall be any water the Department would have delivered under Table A entitlements of water supply contracts and under prior right settlements had deficiencies not been imposed in that dry or critical year.

6/ Dry year following a wet, above normal or below normal year.

7/ Dry year following a dry or critical year.

8/ Scheduled water supplies shall be firm supplies for USBR and DWR plus additional water ordered from DWR by a contractor the previous September, and which does not exceed the ultimate annual entitlement for said contractor.

NOTE: EC values are mmhos/cm at 25°C.

CHAPTER VII

PROGRAM OF IMPLEMENTATION

Although the implementation program contained herein has been developed primarily for the next 10 years, the Board recognizes that the state and federal agencies responsible for water development are considering additional project facilities and operating agreements to satisfy the water demands of the state beyond the effective period of this plan.

The program contains not only the control actions necessary for implementation of the plan, but also offers policy assistance to the project operators for use in their long-range planning activities.[1/]

In addition, a monitoring program to assess the effectiveness of the plan in protecting beneficial uses is included.

A. CONTROL ACTIONS

State Water Resources Control Board

At the time it adopts the final water quality control plan, the Board will adopt a corresponding water right decision amending

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1/ The Board has determined that there would be no state mandate for a new program or increased level of service on any unit of local government as a result of the Board's adoption of this plan because it is not an executive regulation pursuant to Section 2209 of the Revenue and Taxation Code.

terms and conditions for permits issued for SWP and CVP. Such terms and conditions will supplement the relevant provisions of this plan. However, a series of other actions by the Board will be required in order to implement the plan more fully and resolve all the concerns which cannot now be fully addressed for various reasons.

Adoption of Water Right Decision. The water right decision to accompany final plan adoption will require the maintenance of the salinity and other standards of this plan through amendments in the form of terms and conditions in SWP and CVP water right permits identified in Chapter I. These terms and conditions are in accordance with the jurisdiction reserved by the Board in the subject permits to formulate terms and conditions relative to salinity control, protection of fish and wildlife, and coordination of terms and conditions of the respective permits for the SWP and CVP. In view of the near-term focus of this decision, the Board will continue the reserved jurisdiction contained in these permits.

Water Quality Action. Existing and potential salinity problems associated with drainage from irrigated agriculture in the San Joaquin Valley are under study in the Interagency Drainage Program, in which the Board is participating with the Department and

Bureau. Achievement of the program's goals will require successful solution to the problem of disposal of increasing volumes of high-salinity drainage.

Under Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), the Board is evaluating the effects of irrigation return flow on water quality, and is working to develop best management practices where appropriate to reduce detrimental effects. Two specific areas previously mentioned in this plan that are affected by such drainage are the Cache Slough and Rock Slough areas. Both are sources of municipal and industrial supplies. The Board in conjunction with the California Regional Water Quality Control Board, Central Valley Region, will pursue the determination of appropriate management practices and take prompt action designed to reduce the detrimental effects on water quality of these return flows.

Ongoing Review. To the extent of its authority, the Board will monitor and review contract negotiations among the Bureau, Department and Delta water interests. The Board will annually review and modify, if necessary, the monitoring program set forth in this chapter to ensure that the program is achieving its intended purpose. The Board will ensure the coordination of the various efforts of state, federal and local agencies to minimize duplication.

Department of Water Resources and U. S. Bureau of Reclamation

To the full extent of their operational capabilities, the Department and Bureau are responsible for meeting the water quality standards of this plan.[2/] As stated above, these water quality standards will be incorporated in their respective water right permits.

Suisun Marsh Facilities. As stated in Chapter VI, additional facilities are needed in Suisun Marsh to mitigate current impacts attributable directly to the operation of the CVP and SWP. These mitigation facilities have the capability to fully protect the Marsh as set forth in Fish and Game Exhibit 11, page 13, in all but extremely critical years. In view of this and the extremely large Delta outflows that would be required to fully protect the Marsh solely with outflow (as would be the case until such facilities are constructed), interim standards are adopted which guarantee only partial protection of the Marsh in years of low runoff and prior to construction and operation of the physical facilities.

2/ As provided by Section 13247 of the Water Code, the Department is required to comply with water quality control plans adopted by the Board. Also, it is the State's position that the Federal Water Pollution Control Act (PL 92-500 as amended in 1977 by PL 95-217) requires the Bureau to comply with such water quality control plans. In addition, the Department and Bureau must comply with terms and conditions in their water right permits.

Protection of the Marsh is a mitigation responsibility of both the SWP and CVP. For this reason, the Department and Bureau shall:

1. Develop a plan for Suisun Marsh by July 1, 1979, in cooperation with other agencies which will ensure that the standards in Table VI-1 for full protection of the Marsh are met. Such plan must be satisfactory to the Board and shall include appropriate EIR/EIS documentation, a monitoring network, physical facilities, operating and management procedures, and assurances to restore and maintain Suisun Marsh primarily as a brackish water marsh capable of producing high-quality feed and habitat conditions for waterfowl and other marsh-related wildlife using best practical management practices.

2. Implement fully such Suisun Marsh plan by October 1, 1984. Under this plan water quality standards for full protection of Suisun Marsh shall be met no later than October 1, 1984.

3. Implement initial components of the Suisun Marsh plan, on which there is general agreement by affected parties, to achieve the following goals by January 1, 1980:

- Conveyance and delivery of water from Montezuma Slough to wetland areas on Grizzly, Simmons, Wheeler, Dutton, Van Sickle, and Hammond Islands which are presently flooded with water from Honker, Suisun and Grizzly Bays.
- Conveyance and delivery of water from Goodyear Slough to certain adjacent wetland areas and provision of outflow from Goodyear Slough into either Grizzly or Suisun Bays.

4. Report to the Board on January 15 of each year on progress toward implementation of mitigation facilities.

Southern Delta. The current negotiations between the project operators and the South Delta Water Agency concerning the construction of physical facilities to provide adequate circulation in the southern Delta are discussed in Chapter VI. These negotiations appear to be directed toward the most practical solution for long-term protection of southern Delta agriculture and should be concluded as soon as practicable, at least by January 1980. In view of its importance, the Department and Bureau should report to the Board on the status and progress of negotiations every six months beginning January 1, 1979. If the agreement is not executed by January 1, 1980, the Board will examine in detail southern Delta water rights, determine the causes and sources of any encroachment, and take appropriate action to the extent of the Board's authority.

Improvements in Delta Outflow Determination. Recent experience has shown that as a result of the complexity of the Delta hydrologic system continuing and variable operating problems arise in sustaining Delta water quality standards. Part of the difficulty relates to the mix of estimates and measurements. In order to assure compliance with standards, the Department and Bureau must improve the accuracy of Delta outflow determinations, either through improved measurement techniques or a refinement of the inputs that are used to compute the Delta Outflow Index. Also, to ensure compliance with the Rio Vista flow requirement a method of measuring or

estimating that flow must be developed. The Bureau and Department should report to the Board by January 1, 1979 on the methods to be used in determining flows past Rio Vista and improving accuracy of Delta outflow estimates or on studies to be commenced by that date to determine such procedures. Concurrently, the Department and Bureau shall report annually on methods for making precise projections of salinity distribution in the Delta under varying inflow, outflow and export conditions. These salinity distribution projections are necessary predictive tools for analysis of alternate operational schemes, including possible near-term provision of supplies to some agricultural areas in the Delta for water conservation purposes. Reports on the progress of these activities should be made available to the Board annually.

Coordinated Project Operations. An early long-term operations agreement between the Department and the Bureau is essential for proper management of Delta water resources for water quality control and project operation. The parties should work diligently to finalize such an agreement as soon as possible.

Hydrologic Studies. The hydrologic experience of the dry cycle beginning in 1976 will be evaluated by the Department and Bureau to determine if yield estimates of the SWP and CVP have been affected. It may not be appropriate to continue to estimate delivery capabilities of the projects on the basis of the 1928-1934 dry cycle.

B. MONITORING PROGRAM

A carefully designed monitoring program is necessary to determine compliance with a water quality control plan. The following program

provides for collection of the data necessary to measure compliance with the water quality standards. Also, this program outlines the special studies or monitoring surveys that are needed to help address the major concerns that cannot confidently be resolved due to lack of data. The monitoring program set forth below is needed primarily to ensure that current and proposed project operations of the CVP and SWP maintain the water quality standards in this plan. The program is based upon the Department's recommendations, but the program will have to be implemented cooperatively by both the Department and Bureau (Department Exhibit II-22). The Department and Bureau will be required to do so through conditions in their respective water right permits currently before the Board in this proceeding.

The Board will assist in seeing that these program activities are coordinated with the activities of other agencies to minimize duplication and to enhance the usefulness of the data collected and study results. The data and study results should be made available to the Board and interested parties upon request.

Design of a monitoring program that maintains its effectiveness through time is difficult. A monitoring program must be sufficiently flexible to respond to advances in knowledge of the system being studied. Consequently the monitoring program places special emphasis on the general goals to be accomplished. The compliance monitoring and special studies are designed to accomplish these

goals. If it becomes apparent that the general goals are not being achieved through the monitoring program or if some of the data proves to be of minor value, the Department and the Bureau should propose appropriate modifications for the concurrence of the Board. Progress reports summarizing the previous year's findings and detailing future study plans should be made to the Board each year.

The goals and the monitoring program to accomplish them can be divided into two general areas: compliance monitoring and special studies.

Compliance Monitoring Goals

- Ensure compliance with existing water quality standards contained in this plan,

- Identify meaningful changes in any significant water quality parameters potentially related to project operations, and

- Reveal trends in ecological changes potentially related to project operations.

Monitoring Activities. Activities to accomplish these goals:

1. Operate and maintain continuous electrical conductivity recorders at the stations indicated in Table VII-1 and Figure VII-1 to report mean daily water quality conditions representative of each location.

2. Conduct the discrete sampling program shown in Figure VII-1 and Table VII-1 bound at the end of this chapter. The sampling frequency may vary as appropriate. When the monthly Delta Outflow Index is projected to average greater than 10,000 cfs, the program operators may reduce the sampling frequency of the base parameters to once each month. When the outflow is below 10,000 cfs the sampling frequency of base parameters should be increased to at least twice a month, if necessary, to achieve the monitoring goals.

3. Conduct water quality profiles in the main navigation channels between Carquinez Strait on the west and Stockton and Rio Vista on the east, using a boat-mounted continuous recorder for the following parameters: Water temperature, electrical conductivity, pH, dissolved oxygen, turbidity, and *in vivo* chlorophyll.

4. Establish continuous recorders at representative stations in the Delta and Suisun Bay to collect information on air and water temperature, wind velocity and direction, pH, dissolved

oxygen, turbidity, and where feasible, *in vivo* chlorophyll. These data should be evaluated and correlated with conditions as they exist in the adjacent main channels.

5. Conduct ongoing and future monitoring surveys recommended by Fish and Game and concurred in by the Board concerning food chain relationships and fisheries impacts as they are affected by CVP and SWP operations in the Delta and Suisun Marsh.

Special Studies Goal

Develop a better understanding of the hydrodynamics, water quality, productivity and significant ecological interactions of the Delta and Suisun Marsh so that more accurate predictions of enviromental impacts related to project operations can be made.

Activities. To accomplish this goal:

1. Conduct special studies to meet specific needs and to take advantage of particular circumstances where the data obtained are of significant value. Such studies would include but should not be limited to fish population and zooplankton measurements, waterfowl food plant production measurements, intensive phytoplankton studies, tissue analysis of selected biota, photosynthesis rates, sediment profile and composition, and water velocity.

2. Develop and improve water quality and biological predictive tools for the following areas of the estuary:

a. Western Delta and Suisun Bay area, including Suisun Marsh
b. San Francisco Bay to Golden Gate Bridge
c. Interior Delta

Emphasis should be placed on improving the understanding of flow/salinity/phytoplankton relationships in the western Delta, and on improving hydraulic characteristics in existing models to represent more closely true channel characteristics.

3. Participate in research studies described in Section C of this chapter.

Reporting

Provide to the Board and other interested agencies upon request results of the above monitoring as soon as practicable following the month during which the monitoring was accomplished. Annual reports summarizing the previous calendar year's findings and detailing future study plans shall be submitted to the Board by January 15 of each year. Detailed reports containing the previous year's monitoring results shall be submitted by August 1 of each year.

C. CHANGING CONDITIONS

The Delta's ecology and man's activities relating to it undergo change. This section identified areas of probable changes and seeks to provide guidance for the longer term, beyond the effective period of this plan.

The changing conditions have been subdivided into two basic categories: those having a potential significant impact on future project facilities and those which could have an impact on current project operations.

Impact on Future Facilities

Water development agencies in the state are currently planning substantial new water facilities. As part of this planning process, these agencies must make sound determinations of the firm yield expected from such proposed facilities. These determinations are based on the operations of potential future SWP and CVP facilities over a period of historical hydrology. Theoretical operation of these future facilities is usually superimposed over the 1922-71 hydrologic period with emphasis on the seven year dry cycle (1928-34). The yield of future facilities in the Sacramento River Basin will depend largely on the amount of unregulated flow available for appropriation from this source.

The factors listed under this section may greatly affect the amount of unregulated flow available for future appropriation. In this section the Board provides general guidance on these factors in order to assist the Department and the Bureau in planning their activities for conditions substantially beyond the effective period of the plan.

San Francisco Bay. Concerns were expressed by some hearing participants regarding the possible adverse impacts on San Francisco Bay and the estuary in general which might occur unless sufficient unregulated Delta outflows are reserved for its protection (RT Vol. XXIII, p. 10; Vol. XXXIV, pp. 126-27, 140). The Board has a

statutory responsibility to protect all beneficial uses of water, including uses of the Bay. In determining the amount of water available for appropriation, the Board must take into account the amount of unregulated water needed to remain in the source for the protection of all beneficial uses (Water Code Section 1243.5). Future project facilities and increasing export rates under existing water right permits could substantially reduce the quantity and frequency of flushing and other unregulated flows available to San Francisco Bay. In making allocations of the remaining unregulated flows, consideration must be given to the outflow needs in San Francisco Bay.

Unregulated outflows, particularly short bursts of moderate flows, have been found to have a substantial effect on hydraulic and salinity conditions in the Bay (RT Vol. XXXIV, pp. 116-127). This was determined through examination of outflow and salinity conditions from 1939 to the present (period for which adequate outflow information is available). In order to bring about significant salinity changes in the central and south-central portions of the Bay, an increase in outflow of about 10,000 cfs (or greater) occurring within five to ten days is necessary. However, the Association of Bay Area Governments (ABAG) and others who presented testimony on this subject indicated that current knowledge allows only qualitative identification of the likely beneficial effects of such flows.

The ecological benefits of unregulated outflows and the salinity gradients established by them have been suggested to include the

following: (1) alteration of the distribution and migrations of free-swimming organisms, (2) creation of counter-currents moving upstream along the bottom of the Bay which are hypothesized to be necessary for the brackish water migration of certain crabs and shrimps, and (3) transportation of young anadromous fish and maintenance of adequate food supplies (RT Vol. XXXIV, pp. 122-123). Until the necessary information quantifying the beneficial effects of such unregulated outflows is developed, the adoption of specific outflow standards by the Board for San Francisco Bay would be premature.

In view of the fact that no additional project facilities are expected to be completed for at least ten years, current levels of unregulated Delta outflow should not be appreciably reduced during the effective period of this plan. Full consideration will be given to the unregulated outflow needs of San Francisco Bay in the Board's periodic review of the water quality standards in this plan. It is imperative that the necessary studies to determine the effects of these flows be initiated as soon as possible. In view of the pressing need for such studies, and in accordance with Water Code Sections 13165 and 13163(b), the Department shall iniate by October 1, 1979, the necessary studies to provide more complete and reliable information regarding the outflow needs of San Francisco Bay. The Board will work closely with the Department and other agencies to develop a comprehensive program identifying the scope of such studies by June 1, 1979. Participation of interested agencies and consultants in the design, implementation and interpretation of these studies is essential. To ensure that

an effective and meaningful program is carried out, the Board will coordinate the activities of agencies related to Bay/Delta studies.

The Board will ensure that the costs of such studies bear a reasonable relationship to the need for them.

In the meantime, the following policy guidance is offered to assist water development agencies in evaluating possible future water development facilities:

1. Operation studies for planning purposes should allow for surges in Delta outflow of at least 10,000 cfs within a five to ten day interval on an average of four times per year for the historical hydrologic period from 1939 to 1976. This means that either additions to upstream storage facilities or increased exports of unregulated Delta inflows should not interfere with these short-term bursts of increased Delta outflow. The need for such outflow is based on the average historical occurrence of incremental increases in Delta outflow of this magnitude and duration from 1939 to 1976. The frequency of such incremental increases has ranged from two per year to nine per year, except in water year 1976 (one per year) and water year 1977 (no occurrences) (RT Vol. XXXIV, pp. 123-126).

2. Incremental increases in Delta outflow of at least 10,000 cfs should occur within a five to ten day interval at least once each year over the yield-determining seven year dry cycle (1928-1934).

Upper-Estuary Productivity. Fish and Game has developed many relationships relating late spring and summer Delta outflows to Neomysis and young striped bass abundances. These relationships are based on conditions experienced during years when winter flows were sufficiently high so that they probably were not limiting estuary productivity (RT Vol. XI, p. 81). Fish and Game has expressed concern regarding the low estuary production in 1976 when controlled low flow conditions existed during the winter (RT Vol. XI, pp. 78-89 and Vol. XXIII, pp. 127-128).

There is a need for caution in establishing long-term fishery standards based on these historical flow-abundance relationships, particularly with the future prospects of extended periods of low-flow conditions in the Delta (RT Vol. XI, p. 129). While 1976 production in the estuary was low, relationships between spring and summer Delta outflow and Neomysis and young striped bass abundances generally predicted the actual indexes measured that year.3/

In view of this, the following policy guidance for long-term water development planning has been established until this concern is more fully understood:

3/ In a prepared statement given at a special meeting of the Board on October 27, 1977 concerning the substantial impacts on the Delta ecosystem during 1977, Mr. Harold K. Chadwick, representing Fish and Game, stated that flows in 1977 prior to June were likely insufficient to (1) support adequate production at lower levels of the food chain, (2) stimulate upstream migration of adult striped bass, (3) provide suitable salinities for striped bass spawning in the San Joaquin River, and (4) distribute young bass over the entire nursery area.

In closing he stated: "We recognize that the observations during 1977 raise various questions about the adequacy of some of the proposed standards in the April draft (Fish and Game Exhibit 11). We believe that any adjustments (of these recommendations) should await a thorough evaluation of all evidence."

The 14-day mean electrical conductivity values at Pittsburg during January, February and March should not exceed those experienced for the same period in 1976, throughout the 50-year hydrologic planning period (1922-1971).

Studies to determine the cause of the dramatic 1977 reductions in estuary production are currently underway by Fish and Game and the Bureau. Additional studies to determine the need for winter flows for long-term protection of striped bass and other aquatic organisms in the Delta shall be conducted by the Department.

Maintenance of Fishery Resources at Historical Levels.

Based on existing conditions the Board has determined that fishery resources in the Bay-Delta estuary should be maintained at levels that at least approach those levels that would have existed had the CVP and SWP not been built. Higher levels of fishery resources are desirable, but cannot be attained in the public interest with current project facilities. However, any future Delta transfer facility or upstream project facilities should:

(1) ensure the maintenance of fishery resources in the estuary on the average at historical levels (1922-1967). (Conditions upstream of the estuary may limit the abundance of some species. This policy deals only with those factors in the Bay-Delta estuary that limit species abundance), and

(2) include a fish screen system capable of salvaging 95 percent of the fish more than 1-1/4 inches long.

Net Downstream Flows in Delta Channels. Project caused net flow reversals in Delta channels are detrimental to the fishery that live in or pass through the Delta. Any future Delta water transfer facilities should:

(1) restore net downstream flows at all times in all Delta channels, and

(2) provide water in the San Joaquin River upstream of the Mokelumne River, in Old River and in Middle River to be primarily of San Joaquin River origin from September 1 through November 30.

Impact on Current Project Operations

There are also other factors which could have an impact (both favorable and adverse) on current project operations. These factors can be addressed now only in a general way because of a lack of information and the uncertainty of future actions by other agencies. They are presented below:

Mechanism by which Salinity Changes in Surrounding Waterways Affect Plant Growth in the Subirrigated Areas in the Delta. As stated in Chapter VI, the U. C. Cooperative Extension expressed the possibility that crops in Delta subirrigated soils may be drawing water from groundwater, rather than from surface water applied in spud ditches (RT Vol. XX, p. 181). A determination of the predominant source of water for these crops is important in future review of agricultural water quality standards The U. C. Cooperative Extension researched

this area during the 1977 irrigation season. However, an expanded research program will be required to yield a full understanding. The Board and other state and local agencies will be participating with the U. C. Cooperative Extension.

Additional Data Needs to be Developed for the Subirrigated Organic Soils in the Delta. A better understanding of the water quality needs of agriculture in the organic soils is necessary. The Board will take an active role in coordinating this research with other interested agencies including the U. C. Cooperative Extension and the U. S. Salinity Laboratory, and other hearing participants. Some of the areas where additional research is necessary include the correlation of electrical conductivity of the applied irrigation water (EC_w) to electrical conductivity of the soil saturation extract (EC_e), the relationship between the yield of corn and EC_w and EC_e and the determination of the threshold tolerance of corn. The quality of water which is necessary outside of the irrigation season (April 1 to August 15) also needs to be investigated. This investigation could include an evaluation of leaching practices and related necessary water quality and also a determination of water quality needed for crops which are irrigated during the period outside of the normal irrigation season.

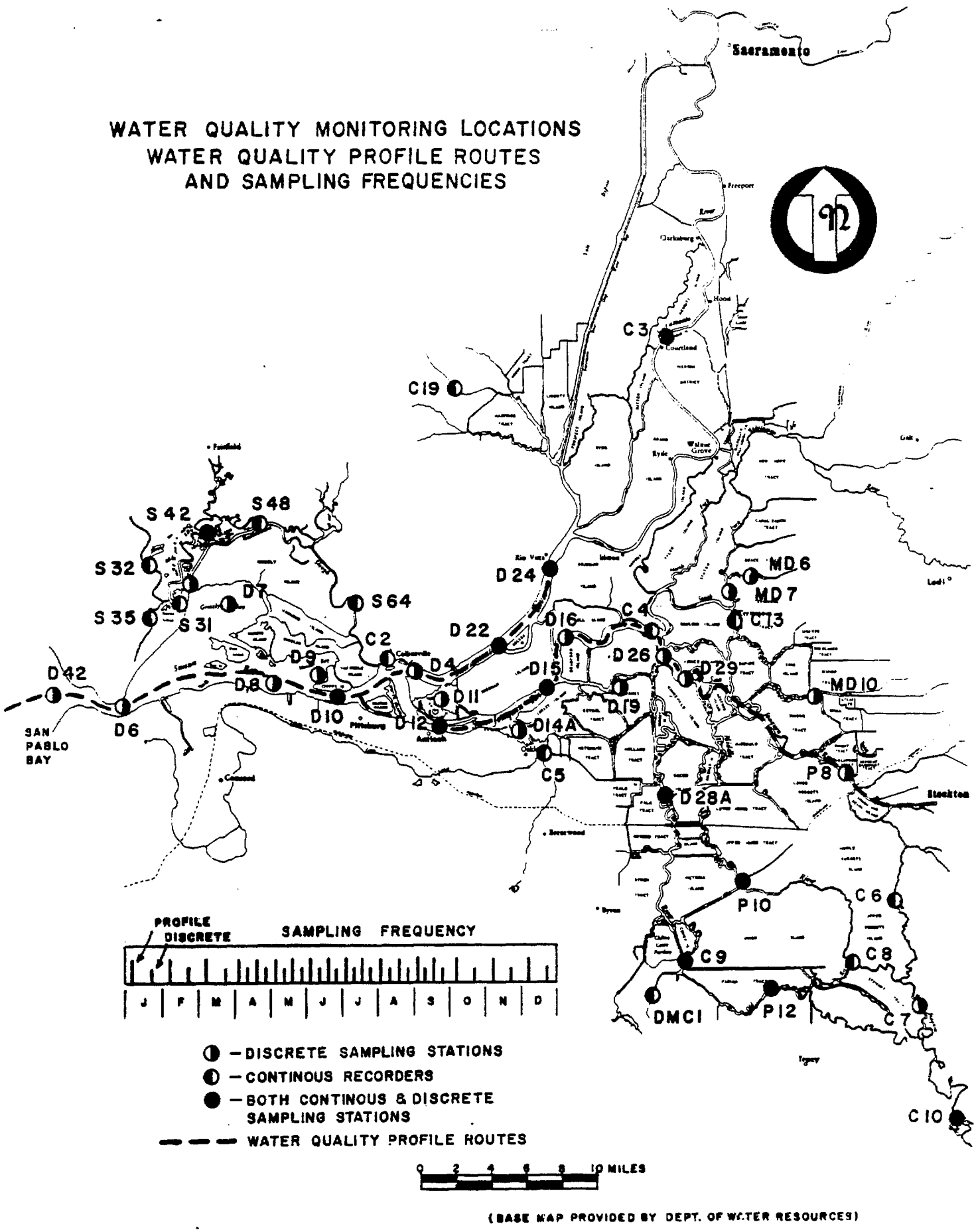
Overland Supplies to Western Delta. Overland supplies to the western Delta are currently being considered by the project operators and Delta interests as a possible method to conserve water and fully protect western Delta agriculture. If successful, the Emmaton and Jersey Point water quality standards for agriculture could be reduced.

It is important to keep in mind that the Emmaton and Jersey Point standards afford benefits to the entire western Delta, not just protection for agriculture on Sherman and Jersey Islands.

Also, as discussed above, there are significant questions related to the mechanism by which water makes its way to the root zone in subirrigated soils. If groundwater quality plays an important role, the water quality of the surrounding channels may continue to be of great importance. This would suggest some caution in finalizing plans for converting permanently to overland delivery systems.

Finally, changes in irrigation practices could be incorporated in plans to change the points of diversion to sources further upstream. Such modifications could include the installation of sprinkler irrigation systems. Chapter VI discusses this alternative briefly. Changes in irrigation practices should be handled in the manner prescribed by the Delta Protection Act. The conversion of large areas of the western Delta to sprinkler irrigation could have significant impacts on cropping patterns, energy costs, Delta consumptive use of water and farm operating costs.

FIGURE VII-1



(BASE MAP PROVIDED BY DEPT. OF WATER RESOURCES)

TABLE VII-1

DELTA ESTUARY WATER
QUALITY MONITORING PROGRAM

Station Location	Electrical Conductivity	Base Parameters 1/	Phytoplankton 2/	Phosphorus, TDS and Cl 3/	Heavy Metals, Pesticides 4/	Benthos 5/
C2 Sacramento River @ Collinsville	C					
C3 Sacramento River @ Greens Landing	C	SM/M	SM/M	M	SA	SA
C4 San Joaquin River @ San Andreas Landing	C					
C5 Contra Costa Canal @ PP #1	C					
C6 San Joaquin River at Brandt Bridge	C G.H.					
C7 San Joaquin River @ Mossdale		SM/M	SM/M	M	SA	SA
C8 Old River near Middle River	C					
C9 West Canal @ mouth/intake to Clifton Ct. Forebay	C	SM/M	SM/M	M		
C10 San Joaquin River @ Vernalis	C Flow	SM/M		M		
C13 Mokelumne River @ Terminous	C					
C19 Cache Slough @ City of Vallejo Intake	C					
D4 Sacramento River above Point Sacramento		SM/M	SM/M	M	SA	SA
D6 Suisun Bay at Bulls Head Point nr. Martinez		SM/M		M	SA	SA
D7 Grizzly Bay @ Dolphin nr. Suisun Slough		SM/M	SM/M	M		SA
D8 Suisun Bay off Middle Point nr. Nichols		SM/M	SM/M	M		
D9 Honker Bay near Wheeler Point		SM/M	SM/M	M	SA	SA
D10 Sacramento River @ Chipps Island	C	SM/M		M		
D11 Sherman Lake near Antioch		SM/M		M	SA	SA
D12 San Joaquin River @ Antioch Ship Channel		SM/M	SM/M	M	SA	
D12* San Joaquin River @ Antioch Water Works	C					
D14A Big Break near Oakley		SM/M		M	SA	SA
D15 San Joaquin River @ Jersey Point	C	SM/M	SM/M	M		
D16 San Joaquin River @ Twitchell Is.		SM/M		M		
D19 Franks Tract near Russo's Landing		SM/M		M	SA	SA
D22 Sacramento River @ Emmaton	C	SM/M		M		
D24 Sacramento River below Rio Vista Bridge	C Flow	SM/M	SM/M	M		
D26 San Joaquin River @ Potato Point		SM/M	SM/M	M		
D28A Old River near Rancho Del Rio	C	SM/M		M	SA	SA
D29 San Joaquin River @ Prisoners Point	W					
D42 San Pablo Bay near Rodeo		SM/M	SM/M	M		
DMC1 Delta Mendota Canal	C					

(Continued on next page)

TABLE VII-1

DELTA ESTUARY WATER QUALITY MONITORING PROGRAM

Station Location		Electrical Conductivity	Base Parameters 1/	Phytoplankton 2/	Phosphorus, TDS and Cl 3/	Heavy Metals, Pesticides 4/	Benthos 5/
MD6	Sycamore Slough near Mouth		SM/M		M		SA
MD7	South Fork Mokelumne River below Sycamore Slough		SM/M	SM/M	M		SA
MD10	Disappointment Slough @ Bishop Cut		SM/M	SM/M	M		
P8	San Joaquin River at Buckley Cove		SM/M	SM/M	M	SA	SA
P10	Middle River @ Borden Highway	C G.H.	SM/M		M		
P12	Old River @ Tracy Road Bridge	C G.H.	SM/M		M		
S31	Suisun Slough near mouth	C					
S32	Cordelia Slough above S.P.R.R.	C					
S35	Goodyear Slough so. of Pierce Harbor	C					
S42	Suisun Slough near Volanti Slough	C	SM/M	SM/M	M		
S48	Montezuma Slough at Cutoff Slough	C					
S64	Miens Landing on Montezuma Slough	C					
D7*	Montezume Slough near mouth	P					

* Location close to the station shown
C - Continuous
W - Weekly (April 1 - May 5)
SM - Semi-monthly (twice a month)
M - Monthly
SA - Semi-annually (spring and fall)
G.H. - Gage Height
P - Periodic, to obtain adequate correlation with other stations

1/ Air and water temperature, electrical conductivity, pH, dissolved oxygen, turbidity, water depth to 1% light intensity, secchi disc depth, volatile and non-volatile suspended solids, nitrate, nitrite, ammonia, total organic nitrogen, extracted chlorophyll a, silica.

2/ Enumeration and identification to the species level where possible.

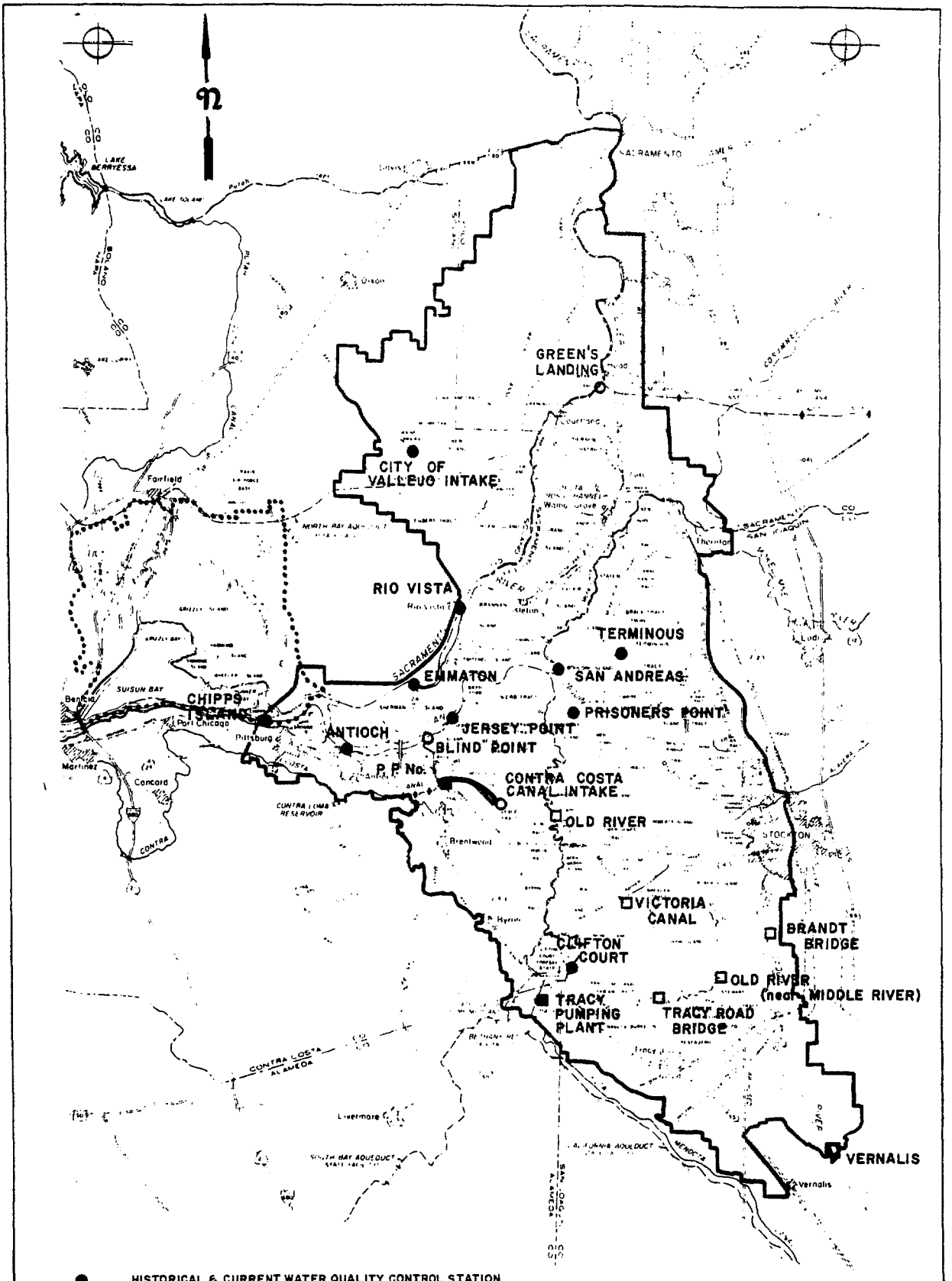
3/ Orthophosphate and total phosphorus.

4/ Heavy metals - arsenic, cadmium, chromium (all valences), copper, iron, lead, manganese, mercury, zinc.

Pesticides - chlorinated hydrocarbons to include: Aldrin, Altrazine, BHC, Chlordane, Dacthal, DDD, DDE, DDT, Dieldrin, Endrin, Endosulfan, Heptachlor, Kelthane, Lindane, Methoxychlor, Simazine, Toxaphene, PCB.

Sampling to take place in water column and bottom sediments. Sediment samples are to be taken in transects across the channel.

5/ Benthic samples are to include identification and enumeration to the lowest taxonomic level possible. Samples to be taken in transects across the channel. Continuation of this aspect of the monitoring program will be reevaluated annually.



● HISTORICAL & CURRENT WATER QUALITY CONTROL STATION

○ HISTORICAL WATER QUALITY CONTROL STATION

■ NEW WATER QUALITY CONTROL STATION

□ POSSIBLE FUTURE WATER QUALITY CONTROL STATION

•••• SUISUN MARSH BOUNDARY

—— LEGAL DELTA BOUNDARY

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

SACRAMENTO-SAN JOAQUIN DELTA

NOTE:
BASE MAP BY THE BUREAU OF RECLAMATION

PLATE I

APPENDIX A

TABLE A-1 PERMITS FOR DELTA WATER SUPPLY OF FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

TABLE A-1

PERMITS FOR DELTA WATER SUPPLY
of
FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
			Quantity (cfs)	Season	Quantity (AF)	Season	
5625	12720	Sacramento River	11,000	Jan.1 to Dec. 31	3,190,000	Oct. 1 to June 30	Power
5626	12721	Sacramento River	8,000	Jan.1 to Dec. 31	3,190,000	Oct. 1 to June 30	Irrigation, domestic, stockwatering navigation and recreation
5627	11966	Trinity River	1,100	Jan.1 to Dec. 31	1,540,000	Jan. 1 to Dec. 31	Power
5628	11967	Trinity River	2,500	Jan.1 to Dec. 31	1,540,000	Jan. 1 to Dec. 31	Irrigation, domestic, navigation, salinity control and flood control
5629	16477	Feather River	7,600	Jan.1 to Dec. 31	380,000	Oct. 1 to July 1	Power, recreation, fish and wildlife enhancement
5630	16478	Feather River	1,400	Oct.1 to July 1	380,000	Oct. 1 to July 1	Irrigation, domestic, municipal, industrial, salinity control, recreation, fish and wildlife enhancement
9363	12722	Sacramento River	1,000	Jan.1 to Dec. 31	310,000	Oct. 1 to June 30	Municipal and industrial

TABLE A-1 (Continued)

PERMITS FOR DELTA WATER SUPPLY
of
FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
			Quantity(cfs)	Season	Quantity(AF)	Season	
9364	12723	Sacramento River	9,000	Jan. 1 to Dec. 31	1,303,000	Oct. 1 to June 30	Irrigation, flood control, domestic, stockwatering, navigation & recreation
9365	12724	Sacramento River	2,275	Jan. 1 to Dec. 31	1,303,000	Oct. 1 to June 30	Power
9366	12725	Rock Slough	200	Jan. 1 to Dec. 31	--	--	Irrigation and domestic
9367	12726	Rock Slough	250	Jan. 1 to Dec. 31	--	--	Municipal and industrial
9368	12727	Old River	4,000	Jan. 1 to Dec. 31	--	--	Irrigation and domestic
13370	11315	American River	8,000	Nov. 1 to Aug. 1	1,000,000	Nov. 1 to July 1	Irrigation, salinity control and flood control
13371	11316	American River	700	Nov. 1 to Aug. 1	300,000	Nov. 1 to July 1	Municipal, industrial, domestic and recreational
13372	11317	American River	8,000	Jan. 1 to Dec. 31	1,000,000	Oct. 1 to July 1	Power

TABLE A-1 (Continued)

PERMITS FOR DELTA WATER SUPPLY
of
FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

Application No.	Permit No.	Source	Direct Diversion Quantity(cfs)	Direct Diversion Season	Storage Quantity(AF)	Storage Season	Purpose
14443	16479	Feather River,	1,360	Jan. 1 to Dec. 31	3,500,000	Sept. 1 to July 31	Irrigation, domestic, municipal, industrial, salinity control, recreational, fish and wildlife enhancement
		Sacramento-San Joaquin Delta Channels	6,185	Jan. 1 to Dec. 31	42,100	Jan. 1 to Dec. 31	
14444	16480	Feather River	11,000	Jan. 1 to Dec. 31	3,500,000	Oct. 1 to July 1	Power, recreational and fish and wildlife enhancement
14445A	16481	Italian Slough	2,115	Oct. 1 to July 1	44,000	Oct. 1 to July 1	Irrigation, domestic, municipal, industrial, salinity control, recreational and fish and wildlife enhancement
14662	11318	American River	--	--	300,000	Oct. 1 to July 1	Power
14858	16597	Stanislaus River	--	--	980,000	Nov. 1 to June 30	Recreational, water quality control and preservation and enhancement of fish and wildlife

TABLE A-1 (Continued)

PERMITS FOR DELTA WATER SUPPLY
of
FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
			Quantity(cfs)	Season	Quantity(AF)	Season	
14859	16598	Stanislaus River	6,000	Jan. 1 to Dec. 31	980,000	Nov. 1 to June 30	Power
15374	11968	Trinity River	300	Jan. 1 to Dec. 31	200,000	Jan. 1 to Dec. 31	Municipal and industrial
15375	11969	Trinity River	1,700	Jan. 1 to Dec. 31	1,800,000	Jan. 1 to Dec. 31	Irrigation, domestic, fish & wildlife propagation, navigation, water quality control and recreation
15376	11970	Trinity River	3,525	Jan. 1 to Dec. 31	1,800,000	Jan. 1 to Dec. 31	Power
15764	12860	Old River	--	--	1,000,000	Oct. 1 to April 30	Irrigation, domestic, stockwatering municipal, industrial and recreation
16767	11971	Trinity River	--	--	700,000	Jan. 1 to Dec. 31	Irrigation, domestic and water quality control
16768	11972	Trinity River	175	Jan. 1 to Dec. 31	700,000	Jan. 1 to Dec. 31	Power

TABLE A-1 (Continued)

PERMITS FOR DELTA WATER SUPPLY
of
FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
			Quantity(cfs)	Season	Quantity(AF)	Season	
17374	11973	Trinity River	1,500	Jan. 1 to Dec. 31	--	--	Irrigation, domestic, municipal, industrial, salinity control, recreation, fish and wildlife enhancement
17375	12365	Clear Creek	1,900	Jan. 1 to Dec. 31	250,000	Nov. 1 to April 1	Power
17376	12364	Clear Creek	3,600	Nov. 1 to April 1	250,000	Nov. 1 to April 1	Irrigation, domestic and recreational
17512	16482	Italian Slough and San Luis Creek	--	--	1,100,000	Oct. 1 to July 1	Irrigation, domestic, municipal, industrial, salinity control, recreation, fish and wildlife enhancement
17514A	16483	Lindsey Slough	135	Oct. 1 to July 1	--	--	Municipal and industrial
18115	13776	Stony Creek	--	--	160,000	Nov. 1 to April 30	Irrigation, domestic, municipal and industrial

TABLE A-1 (Continued)

PERMITS FOR DELTA WATER SUPPLY
of
FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
			Quantity(cfs)	Season	Quantity(AF)	Season	
18721	16209	North Fork American River and Knickerbocker Creek	100	Nov. 1 to Aug. 1	1,700,000	Nov. 1 to July 1	Irrigation, recreation, incidental domestic and water quality control
18723	16210	North Fork American River and Knickerbocker Creek	6,300	Jan. 1 to Dec. 31	1,700,000	Nov. 1 to July 1	Power, incidental recreation and domestic
19303	16599	Stanislaus River	--	--	1,420,000	Nov. 1 to June 30	Power
19304	16600	Stanislaus River	--	--	1,420,000	Nov. 1 to June 30	Recreational, water quality control and preservation and enhancement of fish and wildlife
21542	15149	Old River	--	--	1,000,000	Nov. 1 to April 30	Power
21636	16211	North Fork American River and Knickerbocker Creek	600	Jan. 1 to Dec. 31	800,000	Nov. 1 to July 1	Power

TABLE A-1 (Continued)

PERMITS FOR DELTA WATER SUPPLY
of
FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
			Quantity(cfs)	Season	Quantity(AF)	Season	
21637	16212	North Fork American River and Knickerbocker Creek	900	Nov. 1 to July 1	800,000	Nov. 1 to July 1	Irrigation, municipal, industrial, domestic, recreation, fish and wildlife enhancement and water quality control
22316	15735	Rock Slough	--	--	5,400	Oct. 1 to June 30	Irrigation, domestic, municipal, industrial, water quality control and recreation

TABLE A-1 (Continued)

PERMITS FOR DELTA WATER SUPPLY
of
FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
			Quantity (cfs)	Season	Quantity (AF)	Season	
21637	16212	North Fork American River and Knickerbocker Creek	900	Nov. 1 to July 1	800,000	Nov. 1 to July 1	Irrigation, municipal, industrial, domestic, recreation, fish and wildlife enhancement and water quality control
22316	15735	Rock Slough	--	--	5,400	Oct. 1 to June 30	Irrigation, domestic, municipal, industrial, water quality control and recreation

APPENDIX B

TABLE B-1-HISTORICAL WATER QUALITY OBJECTIVES FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH

TABLE B-1

HISTORICAL WATER QUALITY OBJECTIVES

FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH

Beneficial Use Protected and Location	Parameter	Description	Shasta Inflow Water Yr. Type	Value	Rationale	Source
Municipal and Industrial						
Antioch on San Joaquin River (These objectives shall not apply when the State Bd. determines that adequate substitute supplies are available to all M&I users in the Antioch and Pittsburg areas.)	TDS	Maximum 14-day running average of the mean daily TDS for:			Interim protection of municipal and industrial water supplies taken from the San Joaquin River.	Basin 5 Plan (1967 policy and supplements - Res. 73-16, Fed. B. 5) 3/
		150 days	Normal and below normal	450 mg/l		
		120 days	Dry	450 mg/l		
		100 days	Critical	450 mg/l		
Contra Costa Canal Intake at Rock Slough	TDS	Maximum mean tidal cycle	All	750 mg/l	Acceptable short-term maximum TDS value	Basin 5 Plan (1967 policy and supplements - 1971 Interim Plan)
	TDS	Maximum mean tidal cycle, 65% of the year	All	380 mg/l	Based on average historical water quality (1945-1966)	
	Chloride	Maximum mean tidal cycle	All	250 mg/l	Cal. Admin. Code maximum desirable chloride content of drinking water from taste standpoint	
	Chloride	Maximum mean tidal cycle, 65% of the year	All	100 mg/l	Based on average historical water quality (1945-1966)	

TABLE B-1

HISTORICAL WATER QUALITY OBJECTIVES

FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH

Beneficial Use Protected and Location	Parameter	Description	Shasta Inflow Water Yr. Type	Value	Rationale	Source
Municipal and Industrial						
City of Vallejo Intake at Cache Slough	Chloride	Maximum (instantaneous)	All	100 mg/l		Basin 5 Plan (1967 policy and supplements - 1971 Interim Plan)
	TDS	Maximum (instantaneous)	All	250 mg/l		
Agriculture Blind Point on the San Joaquin River	EC	Maximum 14-day running average of mean daily EC in mmhos	Non-crit.	AMJJ 2.2 / ASOND[1] 3.1	Protection of Delta agriculture without an overland supply to western Delta. Blind Point is below lowest agricultural intake on San Joaquin River. Water quality should not degrade to poor during the irrigation season except during critical years	Basin 5 Plan
			Critical	3.6 / 3.6		
Blind Point on - San Joaquin River	Permit Condition Limiting Storage and Direct Diversion	The SWP shall make no direct diversions and shall not collect water to storage during the period from April 1 through June 30 at any time the maximum surface zone chloride ion content exceeds 250 parts per million				D 1275 as modified by D 1291

TABLE B-1

HISTORICAL WATER QUALITY OBJECTIVES

FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH

Beneficial Use Protected and Location	Parameter	Description	Shasta Inflow Water Yr. Type	Value	Rationale	Source
Agriculture Jersey Point on the San Joaquin River and Emmaton on the Sacramento River	Chloride	Maximum 14-day[2] running average of mean daily chloride	Non-critical Critical	1000 mg/l Jan/July 1000 mg/l Aug/Dec 1400 mg/l	Based on Nov. 19th criteria for the protection of western Delta channels from ocean salinity intrusion. This objective is predicated on an overland supply to some 12 to 15 thousand acres in the extreme western Delta	Basin 5 Plan (D-1275) (1967 Policy and Supplements - Res. 68-17)
	Chloride	Average mean daily concentration for a period of at least 10 consecutive days	Non-dry or critical	Sometime between April 1 to May 31, 200 mg/l	Based on Nov. 19th criteria. To provide suitable water quality for seed germination at the beginning of the irrigation season and limited salt flushing flows	Basin 5 Plan (D-1275) (1967 Policy and Supplements - Res. 68-17)

TABLE B-1

HISTORICAL WATER QUALITY OBJECTIVES
FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH

Beneficial Use Protected and Location	Parameter	Description	Shasta Inflow Water Yr. Type	Value JFM	Value AMJJ	Value ASOND[1]	Rationale	Source
Agriculture								
Terminous, Rio Vista, San Andreas Landing, Clifton Court Ferry and, with the peripheral canal, Bifurcation of Old and Middle River	TDS	Maximum 14-day[2] running average of mean daily TDS in mg/l	Normal or above	700	700	700	Based on Nov. 19th criteria for protection of interior Delta channels to provide water of suitable quality for agricultural uses	Basin 5 Plan (D-1275) (1967 Policy and Supplements - Res. 68-17)
			Below Norm.	700	700	800*		
			Dry or Crit.	700	800*	800*		
		Average of mean daily TDS in mg/l for any calendar month not to exceed	Normal or above	500	500	500		
			Below Norm.	500	500	600*		
			Dry or Crit.	500	600*	600*		
		Average of mean daily TDS in mg/l for any calendar year not to exceed	Normal or above		450			
			Below Norm.		450			
			Dry or Crit.		500			
Green's Landing on the Sacramento River	TDS	Whenever maximum 14-day[2] running average or mean monthly water quality at this station exceeds 150 mg/l TDS the objectives at the above (interior Delta) stations are changed by adding to those values the product of $1\frac{1}{2}$ times the amount by which the recorded TDS at Green's Landing exceeds 150 mg/l	All		150 mg/l		Modifier of interior Delta agricultural objectives which provides for instances or extreme salt water intrusion on the Sacramento River	Basin 5 Plan (D-1275) (1967 Policy and Supplement - Res. 68-17)

* The TDS value at any of these five stations may reach but not exceed the asterisked values, provided the average of the TDS value at all five stations does not exceed the adjacent non-asterisked value.

TABLE B-1

HISTORICAL WATER QUALITY OBJECTIVES
FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH

Beneficial Use Protected and Location	Parameter	Description	Shasta Inflow Water Yr. Type	Value	Rationale	Source
Agriculture						
San Joaquin River at Vernalis	TDS	Maximum 30-day average	All	500 mg/l	Protection of Southern Delta agriculture	Basin 5 Plan (D-1275 with New Melones) (1967 Policy and Supplements-1971 Interim Plan)
Eastern Delta Channels	TDS	Maximum mean monthly	All	700 mg/l		Basin 5 Plan (1967 Policy and Supplements-1971 Interim Plan)
Fish and Wildlife						
Bays and Intertidal Sloughs of Suisun Marsh	TDS	Water quality to produce average TDS in first 12 inches of soil of Suisun Marsh	All	April 15 to June 1 9,000 mg/l	Optimal seed production of alkali bulrush, an important food for waterfowl	Basin 2 Plan
	TDS	Maximum mean monthly	All	18,000 mg/l	Protection of permanent stands of alkali bulrush	Basin 2 Plan
Chipps Island at O & A Ferry	Chloride	Maximum 14-day running average of mean daily chloride	All	4,000 mg/l	Protection of *Neomysis* and striped bass	Basin 2 Plan
Antioch Water Works Intake on the San Joaquin River	EC	Maximum 14-day running average of mean daily EC when water temperature has increased to 60°F and for 5 weeks thereafter	All	1,500 umhos	Protection of striped bass spawning areas on the San Joaquin River. This objective can be modified for experimental purposes	Basin 5 Plan (1967 Policy and Supplements - Res. 73-16 Fed. B.2) 3/

TABLE B-1

HISTORICAL WATER QUALITY OBJECTIVES

FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH

Beneficial Use Protected and Location	Parameter	Description	Shasta Inflow Water Yr. Type	Value	Rationale	Source
Fish and Wildlife						
Prisoners Point on the San Joaquin River	EC	Maximum 14-day running average of mean daily EC when water temperature has increased to 60°F and for 5 weeks thereafter	All	550 umhos	Antioch and Prisoners Point are the historical striped bass spawning area limits. Spawning generally occurs as temperature is increasing from 60°F with salinities between 1500 umhos and 550 umhos EC (approx. 1000 mg/l and 350 mg/l TDS)	Basin 5 Plan (1967 Policy and Supplements - Res. 73-16, Fed. B.2) 3/

1/ October-December based on Shasta Inflow water year type for previous water year.

2/ 10-day running average in D-1275

3/ Recommended by Department of Interior Task Force established to consider salinity standards in the Delta. Also recited in letter dated January 9, 1969, from Secretary of the Interior Stewart L. Udall to Governor Reagan (D 1379 Exhibit USBR 524).

APPENDIX C

CONCEPTUAL ALTERNATIVES

Conceptual Alternatives

MUNICIPAL AND INDUSTRIAL	A. NO ACTION (Basin Plan)			B. NEED LIMITED BY "WITHOUT PROJECT" CONDITIONS and WATER RIGHTS			C. OPTION B with RECOGNITION OF CURRENT WATER SUPPLY ALTERNATIVES			D. OPTION C with REASONABLENESS CONSIDERATION (DEPARTMENT PROPOSAL)		
LOCATION	DESCRIPTION	YEAR TYPE	VALUE	DESCRIPTION	YEAR TYPE	VALUE	DESCRIPTION	YEAR TYPE	VALUE	DESCRIPTION	YEAR TYPE	VALUE
1. Antioch on San Joaquin River	Max 14 day TDS (mg/l) for 150 days 120 days 100 days	 Below Normal (BN) & Normal (N) Dry (D) Critical (C)	 450 450 450	Max mean daily Cl⁻ (mg/l) for No. of days shown (% of years in parens)	 Wet (W) Above normal (AN) BN D C	150 250 240 265 (66) (73) 190 220 (52) (60) 175 195 (48) (53) 165 185 (45) (51) 155 170 (42) (47)	Objective for this location should be dropped, provided quality of an alternative supply to these riparians is at least that shown in Option B.			SAME AS OPTION C		
2. Rock Slough at Contra Costa Canal Intake	Max mean tidal cycle (MTC) (mg/l) Max MTC 65% of year (mg/l)	All All	TDS Cl⁻ 750 250 380 100	Water supply is a contract right - therefore water qualities to be provided are determined by those contracts. Public Interest Needs Max mean daily Cl⁻ (mg/l)	All	250	Max mean daily Cl⁻ of 150 mg/l for No. of days shown (% of years in parens)	W AN BN D C (weighted average Public Interest Needs Max mean daily Cl⁻ (mg/l)	240 (66) 190 (52) 175 (48) 165 (45) 155 (42) 53 %) All 250	Max mean daily Cl⁻ of 150 mg/l for % of year determined by linear interpolation between values shown	YEAR AFTER W or AN BN D or C (weighted average Public Interest Needs Max mean daily Cl⁻ (mg/l)	Sacto Valley Unimpaired Runoff Runoff in MAF (5 8 10 > 15.7 30 45 60 90 15 30 50 80 0 15 35 65 > 65%) All 250
3. Cache Slough	Max (instantaneous) (mg/l)	All	TDS CL 750 100	Public Interest Needs Max mean daily Cl⁻ (mg/l)	All	250	Public Interest Needs Max. mean daily Cl⁻ (mg/l)	All	250	Public Interest Needs Max. mean daily Cl⁻ (mg/l)	All	250
4. Intake to Clifton Court Forebay at West Canal				Max mean daily Cl⁻ (mg/l)	All	250	Max mean daily Cl⁻ (mg/l)	All	250			
5. Delta Mendota Canal at Tracy Pumping Plant				Max mean daily Cl⁻ (mg/l)	All	250	Max mean daily Cl⁻ (mg/l)	All	250			

Table C-1

Conceptual Alternatives (continued)

AGRICULTURE

LOCATION	A. NO ACTION (Basin Plan) DESCRIPTION	YEAR TYPE	VALUE	B. NEED LIMITED BY AVERAGE WITHOUT PROJECT CONDITIONS DESCRIPTION	YEAR TYPE	VALUE	C. SAME AS ALTERNATIVE B EXCEPT RECOGNIZES THAT GOOD WATER QUALITY CONDITIONS EXISTED EARLY IN THE SEASON DESCRIPTION	YEAR TYPE	VALUE
1. WESTERN DELTA									
Emmaton on Sacramento River	Max 14-day Cl mg/l	All but C C	1000 Jan. July 1000 Aug. Dec 1400	Max 14 day EC (mmhos)		Apr 1-Aug 15	Max 14 day EC (mmhos)		0.45 EC Until / EC to Aug 15
					W	0.45		W	Aug 15
					AN	0.51		AN	July 1 0.63
					BN	0.73		BN	June 20 1.14
					D	0.99		D	June 15 1.67
	30 day avg Cl mg/l same time from Apr. 1-May 30	All except D or C	200		C	2.70		C	June 15 5.69
Jersey Point on San Joaquin River	(SAME AS EMMATON)			Max 14 day EC (mmhos)		Apr 1 Aug 15			0.45 EC Until / EC to Aug 15
					W	0.45		W	Aug 15
					AN	0.45		AN	Aug 15
					BN	0.57		BN	July 20 0.74
					D	0.85		D	June 15 1.37
					C	2.20		C	June 5 3.87
			AMJJ ASOND						
Blind Point on San Joaquin River	Max 14 day EC (mmhos)	All except C C	2.2 1.1 3.6 3.6	(NOT INCLUDED)			(NOT INCLUDED)		
			JFM AMJJ ASOND						
2. CENTRAL DELTA									
Terminous, Rio Vista, San Andreas Landing, Clifton Court Ferry	Max 14-day TDS (ppm)	N or above BN D or C	700 700 700 700 700 800 700 800 800						
	Max monthly TDS (ppm)	N or above BN D or C	500 500 500 500 500 600 500 600 600						
	Max yearly TDS (ppm)	N or above BN D or C	450 500 500						
			* Provided avg at all 5 stations for balance of yr does not exceed adjacent lower value						
Greens Landing	When 14 Day or mean monthly max TDS exceeds 150 mg/l		Add to Central Delta TDS levels 1/2 times the amount by which TDS at Greens Landing exceeds 150 mg/l						
Terminous (Based on Central Landing)				Max 14 day EC (mmhos)		Apr 1 Aug 15	Max 14 day EC (mmhos)		0.45 EC until / EC to Aug 15
					W	0.45		W	Aug 15
					AN	0.45		AN	Aug 15
					BN	0.45		BN	Aug 15
					D	0.45		D	Aug 15
					C	0.54		C	July 1 0.72
San Andreas Landing (Based on Webb Pump)				Max 14 day EC (mmhos)			Max 14 day EC (mmhos)		
					W	0.45		W	Aug 15
					AN	0.45		AN	Aug 15
					BN	0.45		BN	Aug 15
					D	0.50		D	June 25 0.[illegible]
					C	0.87		C	June 30 1.48
3. SOUTHERN DELTA									
Vernalis on San Joaquin River	Max 30 day avg TDS mg/l	All	500	Max 30 day avg TDS mg/l	All	500	Max 30 day avg TDS mg/l	All	500
					(After New Melones Res becomes operational and until the objective below becomes effective)			(After New Melones Res becomes operational and until the objective below becomes effective)	
Eastern Delta Channels	Max mean monthly TDS mg/l	All	700						
Tracy Road Bridge on Old River, Old River near Middle River, Brandt Bridge on San Joaquin River, Vernalis on San Joaquin River				Max 30 day EC (mmhos)	All	Apr 1 Aug 31 / Sept 1 Mar 31 0.[illegible] / 1.0	Max 30 day EC (mmhos)	All	Apr 1 Aug 31 / Sept 1 Mar 31 0.[illegible] / 1.0
					(To become effective only upon the completion of suitable circulation and water supply facilities)			(To become effective only upon the completion of suitable circulation and water supply facilities)	

Table C-1

Conceptual Alternatives (continued)

FISH AND WILDLIFE

LOCATION	A. NO ACTION (Basin Plan) DESCRIPTION	YEAR TYPE	VALUE	B. PRESERVATION AT HISTORICAL LEVELS* DESCRIPTION	YEAR TYPE	VALUE	C. INTERIM PROTECTION TO THE FISHERY AND SUISUN MARSH (4-Agency Fish Agreement, Fish and Game Exhibit 11) DESCRIPTION	YEAR TYPE	VALUE
1. STRIPED BASS SPAWNING Pittsburg Point on San Joaquin River	Max 14-day average EC for 5 weeks when water temperature reaches 60°	All	0.550 mmhos	Max 14-day average EC for 5 weeks when water temperature reaches 60°	All	0.550 mmhos	Average EC not to exceed	All	Apr 1 - May 5 0.550 mmhos
							Average Delta outflow not less	All	Apr. 1 - Apr. 15 6,700 cfs
Antioch on the San Joaquin River	Max 14-day average EC for 5 weeks when water temperature reaches 60°	All	1.500 mmhos	Max 14-day average EC for 5 weeks when water temperature reaches 60°	All	1.500 mmhos	Average EC not to exceed	All	Apr. 15 - May 5 1.5 mmhos
							Relaxation provision (replaces the above outflow and Antioch objectives) when SWP and CVP apply deficiencies to firm supplies (determined by linear interpolation between values shown)	All	Total Ann. Def. (MAF) — Apr 1 - May 5 EC 0.0 — 1.5 0.5 — 1.9 1.0 — 2.5 1.5 — 3.4 2.0 — 4.4 3.0 — 10.3 4.0 or more — 25.2
2. STRIPED BASS SURVIVAL Chipps Island at O&A Ferry	Max 14-day average Cl⁻ (thousands and striped bass)	All	4,000 mg/l	Average outflow index (thousands of cfs) for the period not less than	W AN BN D C	May: 33.6, 27.6, 16.8, 13.5, 6.8 June: 32.0, 23.0, 16.0, 10.0, 4.5 July: 24.0, 17.0, 12.0, 8.0, 3.5	Average outflow index (thousands of cfs) for the period not less than 1/ Subnormal Snowmelt 2/ Dry after wet, above normal or below normal 3/ Dry after dry or critical	W AN BN SnSm 1/ D 2/ D&C 3/	May 6 - 31: 14.0, 14.0, 11.4, 6.5, 4.3, 3.3 June: 14.0, 10.7, 9.5, 5.4, 3.6, 3.1 July: 10.0, 7.7, 6.5, 3.6, 3.2, 2.9
Minimize Diversion of Young Striped Bass into the Central Delta				Closure of Delta Cross Channel Gates up to 20, but no more than 2 of 4 consecutive days on 12 hrs notice by DFG	All	April 16 - May 31 when outflow index > 12,000 cfs	Closure of Delta Cross Channel Gates up to 20 but no more than 2 of 4 consecutive days on 12 hrs notice by DFG	All	Apr. 16 - May 31 whenever outflow index > 12,000 cfs
Minimize Diversion of Young Striped Bass from the Delta				When daily outflow index < 10,000 cfs, mean monthly export rates from Delta will not exceed (cfs): SWP CVP	All	May - July 2,000 2,000	Mean monthly export rates from Delta will not exceed (cfs):	All	May - June / July SWP: 3,000 / 4,600 CVP: 3,000
3. SALMON MIGRATIONS	Flow direction	All	Positive net downstream flow in all main Delta channels	(SAME AS ALT. C)					
Minimize Cross Delta Movement of Salmon				Closure of Delta Cross Channel gates	All	Jan. 1 - April 15 when Delta outflow index > 12,000 cfs	Closure of Delta Cross Channel gates	All	Jan. 1 - April 15 When Delta outflow index > 12,000 cfs
							Min. 30-day average of computed net mean daily flow at Rio Vista (thousands of cfs)	W AN BN D&C	Jan. - Mar.15: 2.5, 2.5, 2.5, 1.5 Feb.1 - June 30: 3.0, 2.0, 2.0, 1.0 Mar.16 - June 30: 5.0, 3.0, 3.0, 2.0 July: 3.0, 2.0, 2.0, 1.0 Aug.: 1.0, 1.0, 1.0, 1.0 Sept.1 - Dec.31: 5.0, 2.5, 2.5, 1.5
4. SUISUN MARSH Bays and Intertidal Sloughs of Suisun Marsh	Sufficient water quality so as not to exceed specified soil salinity (TDS in top 12" of soil)	All	April 15 - June 1 9,000 mg/l	Suisun Marsh channel water EC (mmhos) (The monthly average of both daily high tide values not to exceed)	All	Oct. 19.0 Nov. 15.5 Dec. 15.5 Jan. 12.5 Feb. 8.0 Mar. 8.0 Apr. 11.0 May 11.0	Average Delta outflow index for the month not less than	W	February - May 10,000 cfs
	Max mean monthly TDS (mg/l)	All	10,000 mg/l				Min. daily outflow index for 60 consecutive days	SnSm	February - April 10,000 cfs
								AN	January - April 12,000 cfs
								BN	12,000 cfs
							Avg outflow index for each month not less than (if greater flow not required by above objective)	All	January - May 6,600 cfs Whenever storage at or above min. flood control res. envelops level at any two of Shasta, Oroville, and CVP storage on American River
Chipps Island at O&A Ferry							Max. 28 day EC (mmhos) When no deficiences in project scheduled water supplies	All	Oct - May 1/ 12.5
							In months when project water users take deficiencies in scheduled supplies		15.6
							1/ From Jan. 1 to Feb. 15 objective is the same as in previous December		

* In order to approach historical levels for the fishery, positive net downstream flow in all Delta Channels is required

Table C-1