

## CHAPTER IX. RECOMMENDED ACTIONS

The SWRCB intends to implement the objectives in the draft plan, to the extent feasible, through amendments to the water right permits of water right holders in the Central Valley. The SWRCB realizes, however, that some of the objectives cannot reasonably be achieved through water right permit changes exclusively and that the aquatic resource values of the Bay-Delta Estuary are dependent on many factors beyond the regulatory authority of the SWRCB, as described in Chapter V. Therefore, the SWRCB is making the following recommendations to other parties in order to ensure that all water quality objectives are achieved and the aquatic resources of the Bay-Delta Estuary are protected through a comprehensive, ecosystem-based approach.

The recommendations are divided into two categories: recommendations to achieve water quality objectives and recommendations to improve estuarine habitat.

### A. RECOMMENDATIONS TO ACHIEVE WATER QUALITY OBJECTIVES

The four water quality objectives that will require action by other entities to ensure that they are met are: (1) San Joaquin river dissolved oxygen objective; (2) narrative objective for salmon protection; (3) narrative objective for brackish tidal marshes of Suisun Bay; and (4) southern Delta agricultural salinity objectives.

#### 1. San Joaquin River Dissolved Oxygen Objective

Factors which contribute to low levels of dissolved oxygen in the lower San Joaquin River include: the Stockton Wastewater Treatment Plant; upstream sources of biochemical oxygen demand (BOD); the deepened Stockton ship channel; the commercial use of the dead-end portion of the ship channel; the enlarged turning basin at the Port of Stockton; and low river flows in the fall. Feasible measures to implement the dissolved oxygen objective in this plan include: (1) regulating the effluent discharged from the Stockton Wastewater Treatment Plant and other upstream discharges that contribute to the BOD load; (2) providing adequate flows in the San Joaquin River; and (3) installing barriers at locations (e.g., head of Old River) to increase flows in the river past Stockton. Wastewater discharges to the river are currently regulated by the Central Valley RWQCB. The RWQCB is requiring the City of Stockton to make improvements in its wastewater treatment plant to achieve reduced BOD loadings. This plan's objectives for flows in the San Joaquin River at Vernalis are expected to contribute to achieving the dissolved oxygen objective and additional flow-related measures will be considered by the SWRCB during the water rights proceeding. The DWR and the USBR are evaluating the effectiveness of a barrier at the head of Old River, as described more fully in section B.5 of this chapter.

## **2. Narrative Objective for Salmon Protection**

It is uncertain whether implementation of the numeric objectives in this plan alone will result in achieving the narrative objective for salmon protection. Therefore, in addition to the timely completion of a water rights proceeding to implement river flow and operational requirements which will help protect salmon migration through the Bay-Delta Estuary, other measures may be necessary to achieve the objective of doubling the natural production of chinook salmon from average 1967-1991 levels. This narrative objective is consistent with the anadromous fish doubling goals of the CVPIA; thus, prompt and efficient actions taken to implement this CVPIA goal, in concert with other recommended actions in this plan, are important to achieving the narrative salmon protection objective. Monitoring results will be considered in the ongoing review to evaluate achievement of this objective and the development of numeric objectives to replace it.

## **3. Narrative Objective for Brackish Tidal Marshes of Suisun Bay**

Implementation of the numeric objectives in this plan, particularly the Delta outflow objectives, will likely result in achieving the narrative objective for the brackish tidal marshes of Suisun Bay. However, because the extent of the effectiveness of the numeric objectives in providing water quality conditions necessary to achieve a brackish marsh throughout all elevations of tidal marsh bordering Suisun Bay is still uncertain, additional measures by other agencies are recommended under section B.14 of this chapter, including the formation of a Suisun Marsh Ecological Work Group. Among the actions indicated in section B.14, the work group will identify specific measures to implement the narrative objective and make recommendations to the SWRCB in the ongoing review to evaluate achievement of this objective and the development of numeric objectives to replace it.

## **4. Southern Delta Agricultural Salinity Objectives**

The draft plan contains objectives for salinity levels in the southern Delta. Objectives to protect these beneficial uses previously have been implemented largely through releases of fresh water from New Melones Reservoir. The fresh water releases help compensate for diversions of fresh water that have left mainly salty return flows in the San Joaquin River. While fresh water releases should continue, they do not prevent salts from entering the river. Return flows and drainage from agricultural operations add salts to the San Joaquin River. Also, there has not been enough fresh water available in every year to meet the water quality objectives. Therefore, actions are needed to reduce the amounts of salts in the San Joaquin River during periods when higher levels of salt would violate the objectives.

The following measures have the potential to reduce the salt loads entering the river and to help meet the salinity objectives in the southern Delta. These measures, excluding out-of-valley disposal of salts, have been recommended by the San Joaquin Valley Drainage Program. The measures are described in the September 1990 report, titled "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San

Joaquin Valley". An implementation program for these measures is described in a 1991 document, titled "A Strategy for Implementation of the Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley". Some of these measures currently are underway. The SWRCB recommends that the agencies that have agreed to implement the following activities move forward with their commitments.

a. Source Control. In the 1991 Bay-Delta Plan, the SWRCB asked the Central Valley RWQCB to develop and adopt a salt-load reduction program that would reduce annual salt loads discharged to the San Joaquin River by at least 10 percent. The Central Valley RWQCB has been working with agricultural water users to implement source control programs that reduce the discharge of salts to the San Joaquin River resulting from the application of irrigation water. Source control programs include farm-by-farm irrigation audits, technical assistance and consultation with growers, and land retirement as appropriate. However, to date this program has not resulted in the achievement of the objectives.

The failure to meet the water quality objectives is due, in part, to two factors. First, less water has been delivered to San Joaquin Valley irrigators in recent years, so the salts from return flows are more concentrated. The reduction in water deliveries is due both to drought conditions reducing the available water and to restrictions under the ESA on pumping water from the southern Delta export pumps. Second, the USBR, under the CVPIA, section 3406(d), increased its deliveries of water to wetlands in the San Joaquin Valley. In the past two years drainage from the wetlands increased the salt loading to the river by 20 percent, because the wetlands are low-lying areas that received salty runoff historically and can add substantial amounts of naturally occurring salts to water when they are flooded (Dennis Westcot, Central Valley RWQCB, pers. comm., November 2, 1994).

The SWRCB recommends that the Central Valley RWQCB continue its efforts to achieve additional source control of salts draining from agricultural land in the San Joaquin Valley. The U.S. Soil Conservation Service (SCS) and the DWR also will provide technical support. USBR, DWR, SCS, and SWRCB have committed to provide support for demonstration projects. The DFA will conduct research to help select irrigation methods and crops for water and salt management.

Land retirement with cessation of irrigation should be used as a source control measure in areas which either overlay shallow ground water with elevated levels of selenium, have soils that are difficult to drain, have low economic returns, or contribute disproportionately to drainage problems. Water Code section 14900 authorizes the DWR to purchase land suitable for retirement using funds obtained from selling the irrigation water supply of the retired lands. Additional activities related to land retirement include monitoring the hydrologic and social effects of discontinuing irrigation (DWR), technical assistance to facilitate land use changes (USBR), hydrologic analyses (USGS), assistance in evaluating land reserve/retirement options under the USDA conservation reserve program (SCS), and evaluation of the potential use of retired land for use as wildlife habitat (DFG and USFWS). If there are transfers of water or water rights which require SWRCB approval, the SWRCB

will be involved. Under its water right authority, the SWRCB also could require cessation of water use on specific lands if it finds that use of water on these lands is unreasonable.

b. **Drainage Reuse.** Reuse of drainage water on progressively more salt-tolerant plants will reduce the volume of drainage water and concentrate the salts to facilitate disposal. Demonstration projects are underway to develop reuse technologies, and treatment and disposal technologies, for the remaining solids or liquids. The DWR is funding research on the impacts of reuse on wildlife; the DFG is conducting field studies of potential impacts on wildlife; the DFG and the USFWS should evaluate the potential impacts of agroforestry plantation on wildlife; the DFA and the SCS should continue testing and demonstration of agroforestry and the use of halophyte plants; the DFA should coordinate the demonstration projects and provide quality control; the SCS should assist farmers to plan, design, and manage drainage reuse programs; the USGS should provide technical assistance and analysis regarding ground water and effluent storage to effect reuse of drainage water.

c. **Evaporation Systems.** Evaporation ponds for storage and evaporation of drainage water after reuse on salt-tolerant plants accomplish the final segregation and containment of salts. Construction of evaporation ponds will require site specific planning and linkage with other actions, including reuse and treatment. Any evaporation system should include safeguards for wildlife.

The DWR and the USFWS should fund studies of impacts on wildlife; the DFG and the USFWS should conduct the studies; the DWR should support demonstration projects of evaporation pond design improvements; the DFG should continue to coordinate work with the Central Valley RWQCB, which is responsible for ensuring that ponds conform to the applicable water quality control plan; the USBR should fund demonstration projects for new or improved evaporation pond technologies; the SCS should work with farmers to develop and evaluate pond design and management criteria. The SWRCB recommends that the DWR, the USFWS, and the DFG include, as part of their programs, field testing and demonstration projects to avoid or minimize wildlife hazards.

d. **Ground Water Management.** In some places near-surface water tables can be lowered by pumping ground water from deep wells in a semi-confined aquifer. This can be an effective interim and possibly long-term measure for management of agricultural drainage problems where ground water in the root zone of crops creates problems requiring drainage. For the best results, this measure requires a planned, sustained, and coordinated approach in which the right volume of extraction takes place in the right location. Also, the extracted water should be suitable for irrigation or wildlife habitat. Several activities are planned. The planned activities include developing a monitoring program (DWR), detailed hydrologic analyses to implement demonstration projects to test ground water management (USGS); development and demonstration of on-farm high water table management (SCS), and the use of water transfers to encourage ground water management (USBR).

e. **Institutional Measures.** Several institutional measures could help reduce drainage problems. These include the use of tiered water pricing where advantageous, water marketing, improved scheduling of water deliveries, and formation of regional drainage management organizations. The DWR should encourage and support methods such as tiered water pricing and water marketing; the USBR should seek to initiate trial arrangements for funding drainage projects; the USFWS should draft and propose comprehensive legislation to authorize and fund the San Joaquin Valley Drainage Program's drainage management plan. The SWRCB will participate in a study of the use of an environmental recovery fund and price controls in water markets.

f. **Discharges to the San Joaquin River.** Controlled and limited discharges of agricultural drainage water to the San Joaquin River must occur in a manner that meets water quality objectives. This may be best accomplished by coordinating the release of drainage water with higher flows in the river during the winter and spring periods when more dilution water is available. Adequate coordination may require the execution of agreements with dischargers, waste discharge requirements that restrict the discharge of drainage water to the river, or time-specific waste discharge prohibitions. Furthermore, the actions of dischargers in isolating and transporting agricultural drainage water must contribute to the needs of fish and wildlife.

The agencies committed to implementing actions related to the drainage water discharge to the San Joaquin River should continue or initiate the activities identified by the San Joaquin Valley Drainage Program. These activities include: completion of the five-year interagency effort by the San Joaquin River Management Program (established and funded by the State Legislature, and led by the DWR) to develop a plan which includes management of agricultural drainage to the river; the DWR and the USBR real-time salt monitoring program for the river (with the cooperation of the Central Valley RWQCB); the USGS investigations of surface water and ground water interaction to evaluate the quantity, quality, and timing of ground water contributions to the river; the DFG and the USFWS monitoring of the effects of implementing discharge controls to the river on fish and wildlife; and the USBR planning for the San Luis Unit which could contribute substitute water supply and provide water control facilities needed to convey drainage water to the San Joaquin River downstream of the confluence with the Merced River. The SWRCB, with the support and cooperation of appropriate entities, is willing to investigate the concept of a discharger with high productivity soils purchasing another discharger's waste load allocation, once developed, in the San Joaquin River basin.

In addition to the planned measures identified by the San Joaquin Valley Drainage Program, these agencies and the affected water districts should consider taking advantage of winter flood flows to remove salts from low-lying areas in the San Joaquin Valley, either as part of a flood control program or pursuant to a permit from the SWRCB to appropriate water during high flow events. Also, the operators of wetlands receiving new water from the USBR under the CVPIA should participate in real-time management of their discharges to ensure that they do not cause violation of water quality objectives. If funding is needed for

further work on salt discharge management, the Central Valley RWQCB could seek a grant under Clean Water Act section 319(h).

**g. Out-of-Valley Disposal of Salts.** Inadequate drainage, and accumulating salts and trace elements, are increasingly persistent problems in many parts of the San Joaquin Valley. These drainage problems threaten water quality, agriculture, fish and wildlife, and public health. Ultimately, it will be necessary for the in-basin management of salts to be supplemented by the disposal of salts outside of the San Joaquin Valley for protection of these beneficial uses to continue.

The USBR should reevaluate alternatives for completing a drain to discharge salts from agricultural drainage outside of the San Joaquin Valley and pursue appropriate permits. This evaluation should include the development of information on the potential effects on fish and wildlife habitat and populations in the receiving waters, and the physical and economic feasibility of the various alternatives.

## **B. RECOMMENDATIONS TO IMPROVE HABITAT CONDITIONS**

The parties have recommended actions in addition to setting and implementing water quality objectives that the SWRCB or other agencies should take to protect the fish and wildlife uses of the Bay-Delta Estuary. The SWRCB intends to conduct proceedings to consider implementing measures discussed below that are within its jurisdiction. The SWRCB also recommends that other agencies and entities consider taking certain actions under their authorities. This section describes measures that the SWRCB believes should be considered and specifies the agencies that should take the actions.

The funding of these activities is expected to require a substantial financial commitment. Approximately 60 million dollars per year over the next three years should be allocated for this purpose. A portion of the funds needed for these activities will come from a prioritization of existing programs. Additional funds will be secured through a combination of federal and State appropriations, user fees, and other sources, as required. The water user community has agreed, through the December 15, 1994 "Principles for Agreement on Bay-Delta Standards Between the State of California and the Federal Government", to make available, by February 15, 1994, an initial financial commitment of \$10 million annually for three years. An open process including water user groups, State and federal agencies, and environmental interests will determine priorities and financial commitments for the implementation of these activities. The SWRCB expects that the detailed process for prioritizing and funding these activities will be developed before March 31, 1995.

The recommendations discussed in this section, together with the objectives and the implementation measures to meet the objectives, are a part of a comprehensive plan of protection for the Bay-Delta Estuary's fish and wildlife resources. Because these measures will require the commitment of many agencies and entities, a comprehensive plan should be a multi-agency effort. The SWRCB is committed to investigating the measures within its

authority and to conducting proceedings if it appears fruitful to do so, but the efforts of other agencies are also required.

## 1. Unscreened Water Diversions

Unscreened water diversions for agricultural, municipal, and industrial uses present a known threat to fish populations. Studies as early as the early and middle 1970's showed that large numbers of egg and larval striped bass and significant numbers of chinook salmon were entrained by agricultural diversions in the Sacramento River watershed. More recent studies confirm that large numbers of fish continue to be entrained.

More than 300 unscreened diversions on the Sacramento River between Redding and Sacramento divert approximately 1.2 MAF of water per year. In the Delta, about 1,800 unscreened agricultural diversions divert over 2 MAF of water per year according to the NMFS.

Diversions into conduits with a capacity in excess of 250 cfs must be screened if the DFG determines that a screen is necessary to prevent fish from passing into the conduit. (Fish & G. Code §5981) The DFG may install a screen on a conduit smaller than 250 cfs, and the owner of the conduit must allow the DFG the right of access to the conduit and screen. (Fish & G. Code §6024) Further, DFG can obtain injunctive relief against a diverter's operation of a diversion in a manner that results in the killing of endangered species. (Department of Fish and Game v. Anderson-Cottonwood Irr. Dist. (1992) 11 Cal.Rptr.2d 222, 8 Cal.App.4th 1554) Likewise, federal agencies enforcing the federal ESA can obtain an injunction prohibiting the take of an endangered species in the course of pumping water. (United States of America v. Glenn-Colusa Irrigation District (1992) 788 F.Supp. 1126)

Currently, the NMFS is considering a requirement for screens on Sacramento River diversions. The use of screens on water diversions that need screening would aid in the survival of salmon upstream of the Delta, and incidentally could increase the number of salmon passing through the Delta. Additionally, the need for screens in the Delta should be evaluated.

The SWRCB recommends that the NMFS continue its work in the Sacramento River and that the NMFS, the USFWS, and the DFG also institute a program to evaluate water diversions within the Delta. In the Sacramento and San Joaquin rivers and in the Delta, these agencies should assess whether (1) changes in the timing of diversions could be made to avoid peak concentrations of fish and (2) changes in management of water uses would be feasible to avoid entraining large numbers of fish. In evaluating the diversions, these agencies should (1) decide where screens are needed, (2) consider whether diversion points should be relocated or consolidated to reduce entrainment, and (3) give their recommendations on changes in points of diversion to the SWRCB for consideration in a water right proceeding. The SWRCB will provide available information to these agencies to facilitate their locating

diversions and contacting diverters. The SWRCB may conduct inspections of diversion facilities in cases where the other agencies are unable to obtain access.

The program should include collection of data regarding the size and approach velocity of diversions and the proximity of fish to the diversions when they are operating. The agencies should develop (1) performance criteria for diversions by June 1996, (2) testing specifications to show whether or not diversions are having an unreasonable effect on fish by June 1996, (3) incentives by June 1996 to encourage diverters to consolidate and relocate diversions to the least environmentally sensitive locations, (4) a program by June 1997 for notifying diverters of requirements for their diversions and of a time schedule for completing the requirements, (5) requirements to install devices at the highest priority diversions by June 1999 and at selected lower priority diversions by June 2004, (6) a monitoring program to inspect the devices upon their installation and periodically thereafter.

## **2. Improve Fish Survival at the SWP and the CVP Export Facilities**

Despite the presence of screens at the diversion facilities of the SWP and the CVP, substantial fish mortality occurs with operation of the facilities. At the SWP facilities, the water and fish first enter the Clifton Court Forebay. There, predatory fish consume many of the smaller fish. Next, the water is drawn into the pumps through fish screens. Fish are salvaged from the screens, trucked to another location in the Delta, and released. Many fish do not survive the salvage operation. When the fish are released, they are again subject to predation as they regain their orientation in the water. The CVP does not use a forebay, but predatory fish nevertheless consume smaller fish near the intake. The screens at the CVP diversion should be updated and improved to ensure that fewer fish are entrained. Better fish survival at the export facilities could make it feasible to increase the maximum export rates and reduce outflow requirements, allowing a greater volume of exports than will be possible under this plan.

The SWRCB recommends that the DWR and the USBR in consultation with the DFG, the USFWS, and the NMFS implement all feasible measures and programs to reduce the mortality of fish salvaged at the facilities, including improvements in the screening efficiency at the export facilities, improved fish salvage and handling, changes in facility operations, and predator management programs at both the SWP and the CVP intakes to reduce predation losses. With respect to the entrainment of fish, the SWRCB recommends that the DWR and the USBR develop programs to (1) monitor entrainment on a real-time basis to identify periods of peak susceptibility of various species to entrainment and (2) coordinate operations of the two diversions to reduce the combined losses at the two facilities. The SWRCB will consider requiring implementation of these measures and programs in a water right proceeding that will follow adoption of this plan.



### **3. Regulation of Fishing**

Current levels of legal sport fishing and commercial fish harvests may be contributing to reduced fish populations. Therefore, the effects of sport fishing and commercial harvest should be reviewed and appropriate measures should be taken to ensure that genetic pools are maintained.

The SWRCB recommends that the DFG, the Fish and Game Commission, the Pacific Fisheries Management Council, and the NMFS take the following actions within their respective authorities and jointly:

(a) Develop and implement a fisheries management program to provide short-term protection for aquatic species of concern through seasonal and area closures, gear restrictions to reduce capture and mortality of sub-legal fish, and other appropriate means.

(b) Review and modify if necessary existing harvest regulations to ensure that they adequately protect aquatic species. The agencies should consider implementing a regular periodic review of these regulations at least every two years.

(c) Seek changes in trawling methods used by the commercial shrimp industry to reduce the incidental take of other fish species. The changes could be effected either through an agreement with the industry or through regulations.

### **4. Illegal Fishing**

Annually, about 500,000 undersized striped bass and an uncounted number of salmon are taken illegally. The DFG has estimated that sport fishing regulations have been violated at a rate in excess of 65% in the Delta. In 1992, the DFG and the DWR agreed to a three-year program to increase enforcement efforts and deter illegal take of Delta fishery resources. Their goal is to reduce violations by 20% in the Delta.

The SWRCB recommends that the DWR and the DFG continue the enforcement program and expand it to provide more enforcement. Sources of additional funding should be explored. Additionally, the DFG should explore the feasibility of developing and implementing an educational program to curb poaching of fishery resources, and should implement such a program if feasible.

### **5. The Use of Barriers in the Delta**

The USBR maintains a gate at the entrance of the Delta Cross Channel, and opens and closes the gate to meet standards adopted by both the SWRCB and other agencies. The gate's operation affects export rates, entrainment rates of fish at the export pumps, flooding in the central Delta, and water quality in the central Delta. Based on tests conducted in the past few years, the use of additional gates or barriers in some Delta channels shows promise for helping to improve the survival of certain fish species, especially migrating salmon and steelhead. Some reservations have been expressed, however, as to the effect of the barriers

on Delta smelt and on water quality in the central Delta. Apparently further study and testing is needed before it can be finally determined that barriers should be used, so this plan does not include an objective for the installation and operation of barriers. Therefore, the SWRCB recommends that the DWR and the USBR, in consultation with the DFG, the USFWS, and the NMFS, (1) test the use of barriers at the head of Old River and at other strategic locations within the lower San Joaquin River and Delta as a means of improving survival of migrating chinook salmon and steelhead and (2) evaluate the advisability of closing Georgiana Slough by using either a physical barrier or an acoustical barrier. The tests should also determine whether the barriers will have adverse effects on other species, including Delta smelt. If the barriers are effective and will neither harm the Delta smelt nor have other significant adverse effects on the environment, the DWR and the USBR should consider using them.

If the use of barriers changes the location or method of meeting a water quality objective, the DWR or the USBR could request a change in this water quality control plan. With adequate documentation, such a request could be processed at a triennial review of this plan, or sooner if necessary.

#### **6. Control the Introduction of Exotic Species**

Numerous fish and invertebrate species have been intentionally and accidentally introduced into the Bay-Delta Estuary. Accidental introductions of species have occurred primarily through the discharge of ballast waters from international shipping traffic. The introduction of exotic species apparently has caused major changes in the composition of aquatic resources in the Bay-Delta Estuary.

The impacts of introduced species relative to other factors in the decline of Bay-Delta fish populations is not clear. Therefore, a program should be developed to gather, compile, and analyze information on the biological needs of the introduced species and their interrelationships with native species. With this information, responsible agencies can decide whether they could substantially benefit native fisheries by putting resources into control or eradication measures.

Measures should be taken to limit the accidental future introduction of non-indigenous species. The federal Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990, at 16 U.S.C. §§4701 to 4751, includes comprehensive provisions for regulating the introduction of non-indigenous species, including: (1) regulating the discharge of ballast water from ships; (2) establishing of a task force, chaired by the Director of the USFWS and the Under Secretary of Commerce for Oceans and Atmosphere, which is to implement a program to prevent the introduction and dispersal of aquatic nuisance species, to monitor, control and study such species, and to disseminate related information; and (3) technical and financial assistance to eliminate the environmental, public health, and safety risks associated with aquatic nuisance species.

In 1992, the California Legislature enacted Fish and Game Code sections 6430-6439. These sections: (1) declare that the State's fishery resources are threatened by the introduction of non-indigenous aquatic organisms and that ballast water is a possible source of disease-causing bacteria and viruses; (2) provide for the DFG's adoption of State policy regarding the discharge of ballast water and sediment; and (3) require the use of a ballast water control report form to monitor compliance with State policy.

The SWRCB recommends that the DFG, the USFWS, and the NMFS pursue programs to determine the impacts of introduced species on Bay-Delta fisheries and the potential benefits of control measures. These agencies should consider information and analysis provided by other public and private entities who have an interest in finding ways to preserve and enhance native species in the Bay-Delta. These agencies should determine where ballast water can be released without posing a threat of infestation or spread of aquatic nuisance species and should limit the release of ballast water to those areas. If new laws are needed, these agencies should draft and propose legislation.

The DFG also should consider preparing a comprehensive management plan as described in the federal law, to obtain federal assistance in dealing with the introduced species. Additionally, the California Fish and Game Commission should deny all requests for introduction of new aquatic species into the watershed of the Bay-Delta Estuary unless it finds, based on strong, reliable evidence, that an introduction will not have deleterious effects on indigenous species.

#### **7. Improve Hatchery Programs for Species of Concern**

It is important that the genetic variability of wild fish stocks be retained. Because hatchery fish share a limited gene pool, reliance solely on hatcheries to maintain populations of a given species could result in extinction or loss of vigor.

Hatchery production of various fish species that use the Delta is important for mitigating the loss of stream spawning and rearing habitat and to provide short-term support for various species until other programs to improve fish survival within the watershed of the Bay-Delta are implemented. Hatcheries appear particularly important to rebuild depleted stocks and to maintain populations during dry and critically dry years. Hatchery production should complement and not substitute for improvements in natural production and survival of fish species. Hatchery management practices should take into account the need for genetic diversity, the maintenance of the integrity of different runs of salmon, diet and pre-release conditioning, the locations where the fish will be released, and other factors affecting survival.

The Coleman National Fish Hatchery, operated by the USFWS on Battle Creek tributary to the Sacramento River, requires substantial maintenance and repair and should be extensively rehabilitated. The hatchery is an important factor in maintaining the fall-run chinook salmon

and steelhead populations, and also has been used experimentally in recent years to propagate winter-run chinook salmon. Additional hatchery capacity is needed for winter-run and spring-run chinook salmon and other salmonids. A hatchery has been proposed for this purpose on the Sacramento River adjacent to Keswick Dam. A hatchery also is needed in the San Joaquin River drainage to replace losses of salmon and steelhead. These fisheries have suffered substantial declines in the San Joaquin drainage, probably due to instream flow conditions, habitat quality, entrainment at water diversions, operation of reservoirs, and elevated temperatures during spawning, egg incubation, rearing and emigration. These adverse conditions require improvement, and measures that can be expected to improve these conditions are discussed elsewhere in this plan. A hatchery should be designed and managed to rebuild the salmon and steelhead stocks to complement other measures that will improve the habitat conditions in the San Joaquin River drainage.

The SWRCB recommends that the DFG, the NMFS, and the USFWS carefully examine and periodically reexamine the role and contribution of hatchery production for various fish species including chinook salmon, steelhead, striped bass, and other fish species including experimental hatchery programs for Delta smelt. The SWRCB also recommends that these agencies evaluate strategies for improving the survival of hatchery fish, both before and after release, including timing releases relative to the presence or absence of other species, the use of multiple release points, and the size and life stage of fish to be released. The SWRCB also recommends that these agencies, together with the USBR, take steps to rehabilitate the Coleman Fish Hatchery and to construct both the Keswick Hatchery and a hatchery in the San Joaquin River watershed.

#### **8. Minimize Losses of Salmon and Steelhead Due to Flow Fluctuations**

Because of the construction of dams on most of the rivers tributary to the Delta, releases of water from the dams can influence the locations where salmon and steelhead spawn. Higher flows in the reaches below a dam can lead to spawning at locations in the riverbed that may be dewatered by later downward fluctuations before the eggs hatch. Reductions in flow can strand fry in side channels and shallow backwaters that are isolated from the main river channel. While short-term increases in flow from storms often cannot be avoided, flow fluctuations because of scheduled releases can be managed to reduce adverse impacts on downstream fisheries.

The SWRCB recommends that the DFG, the USFWS, and the NMFS evaluate the releases from the impoundments upstream of the Delta and make recommendations where appropriate for changes in the operations of those impoundments to minimize adverse fishery impacts caused by flow fluctuations. These agencies should consider factors that include the allowable size of flow reductions, appropriate ramping rates for increasing or decreasing flows, and flood control operations. Where appropriate, these agencies should seek agreements from the dam operators or make recommendations to the SWRCB for necessary changes in the water rights of these facilities.

**9. Expand the Gravel Replacement and Maintenance Programs Downstream from Dams in the Tributaries to the Delta**

The construction of dams on the major tributaries of the Delta blocks the movement of gravel eroding from upstream areas. Salmonids spawn in gravel in the river beds. The lack of suitable spawning habitat can limit the success of salmonid reproduction. Programs exist to replace gravels and improve the spawning habitat on some rivers. The programs for the Sacramento and San Joaquin river systems should be expanded.

The SWRCB recommends that the DWR, the USBR, and other agencies that currently conduct gravel replacement and spawning habitat improvement programs on the Sacramento and San Joaquin river systems increase their efforts in the reaches where salmonids are likely to spawn.

**10. Evaluate the Benefits and Costs Associated with Alternative Water Conveyance and Storage Facilities Including Changes in the Points of Diversion of the SWP and the CVP in the Delta**

The current water diversion facilities of the CVP and the SWP in the southern Delta adversely impact fish populations. These facilities or alternative facilities are needed to meet water supply demands in areas south and west of the Delta. Various alternatives have been identified to minimize fisheries impacts while meeting water supply demands. The proposed alternatives include construction of a water diversion intake on the Sacramento River equipped with state-of-the-art fish screens, isolated and through-Delta water conveyance facilities, and new water storage within and south of the Delta. The feasibility, biological impacts and benefits, and likely operational criteria for each of these alternatives should be evaluated.

Consistent with the Framework Agreement regarding a long-term Bay-Delta Estuary solution, the agreement's signatory agencies should: (1) evaluate the feasibility, biological impacts and benefits, and likely operational criteria of various alternatives to the current water diversion facilities in the southern Delta; and (2) based on the evaluation, develop a project that will meet the dual goals of minimizing impacts to aquatic resources while providing a reasonable supply of water for export.

**11. Develop an Experimental Study Program to Study the Effects of Pulse Flows on Fish Eggs and Larvae**

The magnitude of freshwater outflow passing through the Delta affects the geographic distribution of many planktonic fish eggs and larvae. The egg and larval stages of many fish species occur in the Delta during a relatively short period of time in the spring (April - June). When there is high freshwater outflow, the planktonic eggs and larvae are moved downstream into Suisun Bay where they are less susceptible to entrainment at the SWP and

the CVP diversions and at other diversion points within the Delta. Absent high outflows, the larvae tend to remain in the Delta.

Short-term artificial increases in freshwater flows (pulse flows) can be used to move the eggs and larvae into Suisun Bay. To improve the efficiency of water used for this purpose, it would be helpful to experimentally quantify the magnitude and duration of pulse flows needed to move a substantial proportion of fish eggs and larvae into Suisun Bay. Any experiment also should determine whether short-term pulse flows have a lasting benefit or whether, when outflows are reduced after a pulse flow, the larval fish are drawn back into interior Delta areas.

The SWRCB recommends that the DWR and the USBR conduct experiments to investigate and evaluate the biological benefits of pulse flows to move planktonic fish eggs and larvae into Suisun Bay. Flows should be released from both the Sacramento and San Joaquin rivers, and real-time biological monitoring should be used to determine the most favorable times for the pulse flows and the effects of the pulse flows on the eggs and larvae. These experiments should be conducted as soon as feasible, taking into account base flows and availability of water supplies. If results were obtained soon enough, they could be used to refine potential pulse flow requirements in a water right decision implementing this water quality control plan.

## **12. Habitat Restoration**

Most of the historical fish and wildlife habitat in the Delta and throughout the Central Valley has been eliminated or disturbed. The construction of dams for water storage on nearly all of the Bay-Delta Estuary's tributary streams and the conversion of natural habitat to croplands eliminated significant amounts of habitat for species in the Central Valley. In the Delta, less than 100,000 acres of the total 738,000 acres remains as marsh, riparian, and upland habitat. The remainder of the area is highly altered due to conversion to agricultural land, industrial and urban development, and actions for flood control and navigation, such as dredging channels and riprapping banks. Furthermore, many of the alterations that have already occurred require extensive ongoing maintenance, which also disrupts fish and wildlife habitat. Restoration of fish and wildlife habitat in and upstream of the Delta would benefit many species of the Bay-Delta Estuary.

State and federal agencies should require, to the extent of their authority, habitat restoration in the Delta and upstream of the Delta as a condition of approving projects. For example, the Delta Protection Commission, in all of its actions under the Delta Protection Act of 1992 (Public Resources Code section 29700 et seq.) which provides for the coordination of local land use decisions in the Delta, should consider the need to restore and preserve marsh, riparian, and upland habitat in the Delta. The DFG, when it considers approving stream alterations, and the DFG, USFWS, and NMFS, when they consider projects that affect endangered species, should consider habitat requirements. The U.S. Army Corps of Engineers should consider habitat requirements in connection with applications for permits

under Clean Water Act section 404. The Federal Emergency Management Agency should consider habitat requirements in establishing flood insurance requirements and levee standards. Within their authorities, these agencies should provide for: (1) levee setback requirements; (2) improvements in the productivity of aquatic areas throughout the Central Valley; (3) reductions in the depth of selected Delta channels, by using either dredge material from navigational channels or natural infill, to restore more productive shallows and shoals; (4) conversion of low-lying Delta islands to habitat areas; and (5) other habitat enhancement measures. The SWRCB will consider habitat requirements where needed to meet water quality standards under the Clean Water Act when approving section 401 certifications. Additionally, responsible governmental agencies and private parties should institute programs to increase riverine cover in the Bay-Delta Estuary watershed, if demonstrated to be effective in lowering water temperatures by providing shading.

### **13. Temperature Control**

Water temperature is a key factor influencing spawning, egg incubation, and juvenile rearing of chinook salmon and steelhead throughout the rivers of the Central Valley. Seasonal changes in ambient air temperature, the temperature of water released from rim reservoirs, and agricultural drainage return flows are the most important factors influencing temperature within the spawning and rearing areas of chinook salmon and steelhead.

Vertical stratification in water temperatures within rim reservoirs offers the opportunity for releases of relatively cold water during the late spring, summer and fall when water temperatures may otherwise be elevated to levels that are detrimental to growth and survival of various life stages of both chinook salmon and steelhead. A proposal for construction of a temperature curtain at Shasta Reservoir has been made, which would permit the selective withdrawal of water from various locations within the water column while continuing to generate hydroelectric power. The SWRCB recommends that the USBR completes this project as soon as possible. The SWRCB further recommends that the operators of other rim reservoirs evaluate the temperature impact of their operations and take actions to correct any significant, negative temperature effects. The SWRCB will consider incorporating appropriate temperature standards into the water right permits of rim reservoir operators, as a means of making the most efficient use of the available water supply.

The Central Valley RWQCB should evaluate best management practices that could be implemented to reduce the impact of agricultural drainage return flows on the temperature of Central Valley rivers.

### **14. Suisun Marsh Improvements**

The objectives for Suisun Marsh regulate salinity in the channels. The purpose of these objectives is to make irrigation water available for the managed wetlands in Suisun Marsh that will bring soil salinity into the range capable of supporting the plants characteristic of a brackish marsh. Four entities, the DWR, the USBR, the DFG, and the SRCD, negotiated

and signed the SMPA, which proposes changes in the salinity objectives for Suisun Marsh in certain dry years. The SMPA objectives, like the objectives adopted in 1978, would regulate channel water salinity. The soil water salinity is not directly regulated, and depends upon the irrigation practices used by the various property owners of the managed wetlands in the Suisun Marsh. To provide more consistent protection for the managed wetlands in Suisun Marsh and the species these wetlands support, management practices should be used that will promote adequate soil salinity levels. With more uniform water distribution, it may be possible to protect the beneficial uses of water more efficiently than under current practices.

The DWR, the USBR, the DFG, and the SRCD should: (1) continue the actions, including facility plans, identified for implementation of the SMPA; (2) conduct a study to determine the relationship between channel water salinity and soil water salinity under alternative management practices (including an assessment of whether the current channel water salinity objectives are needed to support the beneficial uses and whether different water quality objectives, including soil water salinity objectives, would provide equivalent or better protection for the beneficial uses if favorable management practices also are used); and (3) employ, together with the property owners in the Suisun Marsh, a watermaster to direct the timing and amounts of water diverted in the Marsh to ensure that the water is used efficiently and the protection of beneficial uses is maximized. Additionally, pursuant to Public Resources Code section 9962, the SRCD should oversee and enforce water management plans for achieving water quality objectives for salinity in the Suisun Marsh. If possible, the watermaster should be employed under the provisions of Part 4, Division 2 of the Water Code (Wat. C. §§4000-4407), under which the parties could negotiate an agreement that includes the property owners in the Marsh. The agreement should determine the rights to the use of water from the channels of the Suisun Marsh among the various claimants, and should specify rules for managing the water in the marsh to maximize the salinity control benefits of the water. To be valid, the agreement would have to be recorded in the office of the county recorder for Solano County, in which the Suisun Marsh is situated. Alternatively or conjunctively, the parties to the SMPA and the San Francisco Bay Conservation and Development Commission should establish a Suisun Marsh water master to help implement water management plans on private seasonal wetlands (i.e., managed diked wetlands).

Additionally, the DWR should convene a Suisun Marsh Ecological Work Group, consisting of representatives of the SWRCB, San Francisco Bay RWQCB, DWR, DFG, USBR, USEPA, USFWS, NMFS, USEPA, National Biological Survey, San Francisco Bay Conservation and Development Commission, SRCD, Ducks Unlimited, California Waterfowl Association, National Audubon Society, California Native Plant Society, and other interested parties. Topics that the Ecological Work Group should consider include: (1) evaluate the beneficial uses and water quality objectives for the Suisun Bay and Suisun Marsh ecosystem; (2) assess the effects on Suisun Bay and Suisun Marsh of the water quality objectives in this plan and the federal Endangered Species Act biological opinions; (3) identify specific measures to implement the narrative objective for tidal brackish marshes of Suisun Bay and make recommendations to the SWRCB regarding achievement of the objective and



development of numeric objectives to replace it; (4) identify and analyze specific public interest values and water quality needs to preserve and protect the Suisun Bay/Suisun Marsh ecosystem; (5) identify studies to be conducted that will help determine the types of actions necessary to protect the Suisun Bay area, including Suisun Marsh; (6) perform studies to evaluate the effect of deep water channel dredging on Suisun Marsh channel water salinity; (7) perform studies to evaluate the impacts of urbanization in the Suisun Marsh on the Marsh ecosystem; and (8) develop a sliding scale between the normal and deficiency objectives for the western Suisun Marsh.

In evaluating, and in developing numeric objectives for, the narrative objective for the tidal marshes of Suisun Bay, the work group should consider the habitat value of these wetlands, including their importance as reproductive habitat for fish and other organisms. In addition, the work group should consider not only species listed under the federal ESA (such as the salt marsh harvest mouse and the California clapper rail), but also other species that are vulnerable to increasing salinity in the tidal marshes contiguous with Suisun Bay. These species include candidate species (Mason's lilaeopsis, delta tule pea, Suisun Slough thistle, Suisun aster, soft-haired bird's beak, Suisun song sparrow, California black rail, tri-colored blackbird, saltmarsh common yellowthroat, Suisun ornate shrew, and southwestern pond turtle) and other vulnerable species (tules, bulrush, river otter, beaver, nesting snowy egret, nesting black-crowned night heron, marsh wren, American bittern, Virginia rail, sora, common moorhen, and ducklings of breeding ducks such as mallard, gadwall, and cinnamon teal).