Appendix E. U.S. Fish and Wildlife Service Biological Opinion

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

IN REPLY REFER TO:
1-1-00-I-1573

April 26, 2000

Tom Coe, Chief
Sacramento/San Joaquin Delta Office
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

Subject: Adoption of Sacramento Splittail Conference Opinion for the Formal Programmatic Consultation and Conference on the proposed Delta Wetlands project (1-1-97-F-76) as a Biological Opinion

Dear Mr. Coe:

The U.S. Fish and Wildlife Service (Service) received your request, dated November 22, 1999, to adopt the conference opinion on the Delta Wetlands project (1-1-97-F-76) for the Sacramento splittail (*Pogonichthys macrolepidotus*) (splittail) as a biological opinion. As stated in your letter, no changes in circumstances or in the proposed project are anticipated that would alter the conclusions regarding the splittail. Therefore, we adopt your conference opinion as a biological opinion.

Please contact Stephanie Brady or Ken Sanchez of my staff at (916) 414-6625, if you have questions regarding this response.

Sincerely,

Karen J. Miller

Karen J. Miller
Chief, Endangered Species Division

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
Sacramento Field Office
3310 El Camino, Suite 130
Sacramento, California 95821-6340

IN REPLY REFER TO:

1-1-97-F-76

May 6, 1997

Mr. Jim Monroe
Chief, Sacramento/San Joaquin Delta Office
U.S. Army Engineer District, Sacramento
Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Subject: Formal Consultation and Conference on the Army Corps Public Notice Number 190109804 for the Delta Wetlands Project, Contra Costa and San Joaquin Counties, California

Dear Mr. Monroe:

This is in response to your March 5, 1997, letter requesting reinitiation of formal consultation with the U.S. Fish and Wildlife Service (Service) pursuant to section 7(a)(2) of the Endangered Species Act of 1973, as amended (Act). This document represents the Service's biological opinion on the effects of the Department of the Army Public Notice Number 190109804 for the Delta Wetlands Project (DW) on the delta smelt (*Hypomesus transpacificus*).

This biological opinion addresses effects of DW on the delta smelt. On January 6, 1994, a proposed rule to list the Sacramento splittail (*Pogonichthys macrolepidotus*) as a threatened species (Service 1994a) was published in the **Federal Register**. On December 19, 1994, a final rule designating critical habitat for the delta smelt was published (Service 1994c). This biological opinion also incorporates a conference opinion prepared pursuant to 50 CFR §402.10, which addresses project effects on the proposed threatened Sacramento splittail, and a biological opinion on delta smelt critical habitat. Should the Sacramento splittail become listed, the Army Corps of Engineers (Corps) may request that the Service adopt the conference opinion incorporated in this consultation as a biological opinion issued through formal consultation. If a review of the proposed action indicates that there have been no significant changes in the action as planned, or in the information used during the conference, the Service will adopt the conference opinion as the biological opinion and no further section 7 consultation will be necessary. Insignificant project effects occur on the bald eagle (*Haliaeetus leucocephalus*), California clapper rail (*Rallus longirostris obsoletus*), salt marsh harvest mouse (*Reithrodontomy raviventris*), valley elderberry longhorn beetle (*Desmoceros californiacus dimorphus*), and giant garter snake (*Thamnophis gigas*).

Pursuant to 50 CFR §402.08, the Corps and the permit applicant have agreed to name Jones and Stokes Associates, Incorporated (JSA), as the designated non-

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Federal representative for purposes of preparing and assisting in the evaluation of the biological assessment. Representatives from the Service, Corps, National Marine Fisheries Service (NMFS), California Department of Fish and Game (DFG), California State Water Resources Control Board (SWRCB), Natural Resources Consulting Scientists, HYA Consulting Engineers, Ellison and Schneider Law Firm, Kemper Insurance (project financier), JSA, and Delta Wetlands Corporation (DWC) have met since October 1993 to discuss the effects of the proposed project on listed fish species. DW does not have a water right: Issuance of the water right will be determined by the SWRCB after the delta smelt and winter-run chinook salmon biological opinions have been issued. A summary of significant events resulting from these meetings and related Federal actions affecting the development of the proposed project follows:

1. At a July 7, 1994, meeting, it was determined that to mitigate for project effects for delta smelt adaptive management should be used. Adaptive management uses real-time monitoring to avoid or minimize operational effects on delta smelt.

2. On September 2, 1994, DWC transmitted a draft fish monitoring proposal to facilitate use of adaptive management.

3. On December 15, 1994, the Bay-Delta Accord (Accord) was signed (see Appendix 1 for Accord CVP and SWP operations relevant to DW).

4. On March 6, 1995, the Service issued a delta smelt biological opinion for the operation of the Central Valley Project (CVP) and State Water Project (SWP) (Service 1995) that implemented relevant sections of the Accord.

5. At the May 3, 1995, meeting, the loss of listed fish due to conveyance of DW water at the CVP and SWP pumping plants was discussed. A suggested method for covering this "take" was to reinitiate the delta smelt and winter-run chinook salmon consultations on the operation of the CVP and SWP.

6. On May 17, 1995, NMFS issued a winter-run chinook salmon biological opinion for the operation of the CVP and SWP (NMFS 1995).

7. On October 3, 1995, DFG transmitted a draft proposal to avoid or minimize DW effects using both rigid measures such as a QWEST (defined as the calculated flows on the San Joaquin River as measured at Vernalis and used as measurement of reverse flows caused by south Delta pumping) criteria, complete diversion curtailment in certain months, and adaptive management measures.

8. On October 24, 1995, DWC responded with a counter proposal that included adaptive management measures.

9. On November 28, 1995, the Service, NMFS, DFG, and other interested parties met to develop a coordinated proposal to reduce project effects on listed and non-listed Delta fish species.

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10. On December 7, 1995, a draft "Delta Wetlands Aquatic Resources Management Plan" was transmitted to DWC by DFG that combined avoidance and minimization measures recommended by the Service, NMFS, and DFG to minimize effects on delta smelt, winter-run chinook salmon, and several non-listed species. Adaptive management measures were used in this document.

11. On March 29, 1996, the Service's Portland Regional Office transmitted a draft jeopardy biological opinion to the Sacramento Corps District Engineer.

12. On June 28, 1996, NMFS transmitted a draft non-jeopardy biological opinion to the Corps.

13. On May 10, 1996 (1-1-96-I-936), the Service responded to nine questions posed by DWC.

14. On August 5, 1996 (1-1-96-I-1087), the Service responded to 37 additional questions posed by JSA and transmitted by the Corps.

15. On March 5, 1997, the Corps reinitiated consultation with the Service and provided comments on the Service's draft jeopardy biological opinion and a proposed mitigation matrix to avoid or minimize adverse project effects.

16. Discussions between the Service and DWC concerned the draft jeopardy biological opinion's treatment of DW discharges in relation to the export/inflow ratio implemented in the March 6 delta smelt biological opinion and operations of the CVP and SWP pumps. As a result of those discussions, DWC transmitted to the Service an October 18, 1996, issue letter which set out the following agreement:

    - DWC does not intend to seek a SWRCB ruling on whether DW discharges should be included as inflow for purposes of calculating the export/inflow ratio during its water rights hearing.

    - DW discharges for export will be limited so as to not cause total exports at the SWP and CVP pumping plants in the South Delta to exceed the export/inflow ratio as defined by the SWRCB.

    - While reserving its right to take a position before the SWRCB, if a proceeding to reconsider the export/inflow ratio is initiated, the Service will not take a position or impose a condition within DWC's final biological opinion that would preclude DW discharges from being considered as inflow under the export/inflow ratio should the SWRCB make such a determination.

The following sources of information were used to develop this biological opinion: (1) November 8, 1994, site visit to project area; (2) June 21, 1995, Biological Assessment: "Impacts of the Delta Wetlands Project on Fish Species"; (3) administrative draft Environmental Impact Report and Environmental Impact Statement (EIR/EIS) for DW; (4) March 5, 1997, Corps

letter containing DW mitigation operations matrix; (5) various meetings with DWC, JSA, Ellison and Schneider and the Corps; (6) telephone discussions with the Corps; (7) references cited in this biological opinion; and (8) unpublished information in Service files. A complete administrative record of this consultation is contained at the Service's Sacramento Field Office.

BIOLOGICAL OPINION

Description of the Proposed Action

Project Overview.

The purpose of DW is to divert surplus Delta inflows, transferred water, or banked water for later sale and/or release for Delta export or to meet Bay-Delta estuary (Estuary) water quality or flow requirements. Additionally, DW will provide for managed wetlands, wildlife habitat, and recreational uses. DWC currently does not have a water right to implement the proposed action. The SWRCB will issue its determination for such a right following issuance of biological opinions on the proposed DW project by the Service and NMFS.

DW involves water storage on four islands in the Delta (Figure 1). The proposed project involves the potential year-round diversion and storage of water on two "reservoir" islands, Bacon Island and Webb Tract (Figure 2). It also involves the seasonal diversion and use of water for wildlife management and wetland creation on two "habitat" islands, Bouldin Island and Holland Tract (Figure 2). Bacon Island, Webb Tract, and Bouldin Island are wholly owned by DWC. Holland Tract is partially owned by DWC.

DWC intends to implement a habitat management plan on the two habitat islands. Water from these islands may also be used for the same purposes as water released from the reservoir islands. DWC will improve levees on all four islands and install additional siphons and water pumps on the reservoir islands. Inner levee systems would also be installed on both the reservoir and habitat islands for wetland management and shallow-water control.

DW will undertake its diversion and discharge operations pursuant to the "final operations criteria" which are set out in Appendix 2. DW would divert water onto the reservoir islands during periods of availability throughout the year and discharge it from the islands into Delta channels during any period of demand, subject to Delta regulatory limitations and channel and pump capacities. Export of DW water would mainly take place at the CVP and SWP pumps. DW would divert water onto the habitat islands for wetland and wildlife habitat creation and management. Wetland diversions would most likely begin in September and water would be circulated throughout the winter. Habitat island water discharges would be scheduled to maintain wetland and wildlife values. Portions of the habitat islands and the reservoir islands, if not used for water storage, may be flooded to shallow depths during the winter to attract wintering waterfowl and support private hunting clubs. Reservoir island operations may include shallow-water management during periods of non-storage at the discretion of DWC and incidental to the proposed project.

DW Operations

1. DW water may be purchased to supply water for export to the SWP, CVP, and third-party purchasers that use SWP or CVP facilities for transport of water ("wheeling"). Estimated mean annual DW project water available for export would be approximately 154,000 acre-feet (TAF) (JSA 1996).

2. DW project water may be purchased to improve Delta water quality; it may be of higher quality for urban and agricultural use with respect to temperature, turbidity, oxygen, dissolved metals and organics, and nutrient contents.

3. DW water may be purchased to meet environmental flow requirements. Flows having the greatest effect on Delta biological resources are: (1) Delta inflow; (2) flows from the Sacramento River through the Delta Cross Channel; (3) reverse flows caused by water project and local agricultural diversions; (4) agricultural return flows; (5) Delta outflow and salinity; and (6) transport flows.

4. DW reservoir islands may be used for wetland habitat management during periods of non-storage. Diversions would typically begin after September 1, and wetland habitats would be flooded as storage water becomes available.

Specific Operation of the Reservoir Islands

As noted above, Bacon Island and Webb Tract would be managed for water storage pursuant to DW's final operations criteria. Facilities that would be needed for these proposed water storage operations include intake siphon stations to divert water onto the reservoir islands, and pump stations to discharge stored water from the islands. DWC proposes to construct two intake siphon stations on each reservoir island with 16 new siphons each, for a total of 64 siphons. One discharge pump station with 32 new pumps would be installed on Webb Tract and a pump station with 40 pumps installed on Bacon Island, for a total of 72 new pumps.

Storage Capacity. The two reservoir islands will be designed for water-storage levels up to a maximum pool elevation of +6 feet relative to mean sea level. This provides a total estimated initial capacity of 238 TAF, allocated between Bacon Island and Webb Tract at 118 TAF and 120 TAF, respectively. Water availability, permit conditions, and requirements of the California Department of Water Resources (DWR) Division of Safety of Dams may limit storage capacities and may result in a final storage elevation of less than +6 feet.

The total physical storage capacity of the reservoir islands may increase over the life of the project as a result of soil subsidence (caused by oxidation of peat soil). Subsidence on the reservoir islands is currently estimated to average two to three inches per year and is thought to be caused by agricultural operations. With water storage operations replacing agricultural operations, the rate of subsidence on the reservoir islands is expected to be greatly reduced. DWC estimates that the reservoir islands could subside at a rate of approximately 0.5 inches per year, which includes sedimentation due to

filling. Thus, the reservoir storage capacity could increase by nine percent in 50 years, increasing total storage capacity of the reservoir islands to 260 TAF.

Multiple Storage. The reservoir islands will be filled, drawn down, and refilled in years when water availability, demands, and operational criteria contained in Appendix 2 allow. These years are classified as multiple storage years. Multiple storage would generally occur during years of moderate precipitation. This management scenario depends on the availability of surplus water early in the year and a demand for the water to allow an early discharge of the reservoir followed by another period of available surplus water.

Carry-Over Storage. During years of low water demand, water would remain in the reservoirs at the end of the water year (*i.e.*, September 30), and thus could be released in subsequent years. Carry-over storage would generally occur during wet years with low demand.

Diversions. DW diversions for storage would occur only when the volume of allowable water for export (*i.e.*, the lesser amount specified by the export limits and the amount of available water) is greater than the permitted pumping rate of State and Federal export pumps and when the conditions in Appendix 2 are met. The former condition would occur when two conditions are met: (1) all Delta outflow requirements are met and the export limit is exceeded; and (2) water that is available and is allowable for export is not being exported by the CVP and SWP pumps. For purposes of modeling these alternatives, the second condition is assumed to occur only when water that is allowable for export exceeds the permitted pumping rate. However, the CVP and SWP may not be pumping at capacity because of low demands during the winter, and under these conditions DW will still be able to divert water for storage.

Any diversion of water by DW will be controlled by its final operations criteria shown in Appendix 2. These criteria set variable diversion rates and conditions based on a number of factors including: (1) location of X2; (2) Fall Midwater Trawl Survey (FMWT) index values; and (3) availability percentages applied to the total surplus water available, the previous day's net Delta outflow, and San Joaquin River inflow.

The timing and volume of diversions onto the reservoir islands will depend on how much water flowing through the Delta is not put to a reasonable beneficial use by senior water-right holders or is not required for environmental protection. A procedure for coordinating daily DW diversions with CVP and SWP operations will be established to ensure that DW diversions capture only available Delta flows, satisfy 1995 State Water Quality Control Plan (SWQCP) water quality objectives, and maximize DW water storage efficiency.

Diversion rates of water onto reservoir islands would vary with pool elevation and water availability. The maximum rate of diversions possible onto either Webb Tract or Bacon Island would be 4,500 cfs (9 TAF per day) at the time diversions begin (*i.e.*, when the head differential between channel water elevation and the island bottom is greatest) with decreases occurring from intake screening criteria and operational criteria in Appendix 2. The diversion rate also would be reduced as reservoirs fill and head differentials

diminish. The combined maximum daily average rate of diversion for all islands (including diversions to habitat islands) will not exceed 9,000 cfs.

Discharges. Releases from DW would be exported by the CVP and SWP pumps when an unused capacity within the permitted pumping rate exists. DW discharges will be allowed to be exported in any month subject to the limitations described below. The project will operate in the context of existing Delta facilities, demand for export, and operating constraints as defined in Appendix 2. Export of DW discharges is limited by the 1995 SWQCP Delta outflow requirements, the Corps permitted combined pumping rate of the export pumps, and the delta smelt and winter-run salmon biological opinions for operation of the CVP and SWP.

Timing of Discharges. Discharge of DW project water will occur pursuant to DW's final operations criteria as set out in Appendix 2. Stored water will be discharged from reservoir islands during periods of demand, subject to 1995 SWQCP Delta outflow requirements, the Corps permitted combined pumping rate of the export pumps; and the delta smelt and winter-run salmon biological opinions for operation of the CVP and SWP.

The final operations criteria set out several limitations on discharge operations, including:

1. no discharges for export from Webb Tract from January through June;

2. limiting discharges from Bacon Island from April through June during the San Joaquin River pulse flow interval and peak delta smelt period of downstream movement to 50 percent of San Joaquin River flows at Vernalis (*i.e.*, if Vernalis flow is 1,000 cfs, then maximum Bacon Island discharge of 500 cfs); and

3. percentage limitations of unused export capacity at the CVP and SWP pumps for DW discharges from February through July.

Shallow-water Management. Incidental to project operations and at times when water is not being stored, the project may include shallow-water management on Bacon Island and Webb Tract to enhance forage and cover for wintering waterfowl. From September through May, reservoir islands may be flooded to shallow depths (approximately one acre-foot of water per acre of wetland) for creation of habitat, typically 60 days after reservoir drawdown. During years of late reservoir drawdown, additional time may be necessary before shallow flooding begins to allow seed crops to mature. Once shallow water flooding for wetland management occurs, water will be circulated through the system of inner levees until deep flooding occurs or through April or May. If reservoir islands are not deeply flooded by April or May, water in seasonal wetlands will be drawn down in May, and if no water is available for storage, island bottoms will remain dry until September when the cycle will potentially be repeated. DW water used for shallow water flooding in April and May may be available for sale.

Siphon Station Design. Two new siphon stations for water diversions would be installed along the perimeter of each reservoir island. Each station would

consist of 16 siphon pipes, each 36 inches in diameter. Screens to prevent entrainment of fish in diversions will be installed around the intake end of each existing and new siphon pipe. The individual siphons will be placed at least 40 feet apart to incorporate fish screen requirements. Existing reservoir island siphons may be used to create shallow-water wetland habitat. In-line booster pumps will be available on the reservoir islands to supplement siphon capacity during the final stages of reservoir filling.

Pump Station Design. One discharge pump station will be located on each reservoir island. Webb Tract will have 32 new pumps and Bacon Island will have 40 new pumps, each with 36-inch-diameter pipes discharging to adjacent Delta channels. Typical spacing of the pumps will be 25 feet on center. An assortment of axial-flow and mixed-flow pumps will be used to accommodate a variety of head conditions throughout drawdown. Actual rates of discharge for each pump will vary with pool elevations. As water levels decrease on the islands, the discharge rate of each pump will decrease. Existing pump stations on the islands may be modified and used when appropriate to help with dewatering or for water circulation to improve water quality. Pump station pipes will discharge underwater to adjacent Delta channels through a 3-foot by 10-foot expansion chamber, protected by guard piles adjacent to the expansion chambers and including riprap on the channel bottom to protect against erosion.

Levee Improvements and Maintenance. Exterior levees on the reservoir islands will be improved to bear the stresses and potential erosion of interior island water storage and drawdown. The perimeter levees on reservoir islands will be raised and widened to hold water at a maximum elevation of +6 feet. Levee improvements will be designed to meet or exceed criteria for levees outlined in DWR Bulletin 192-82. Levee design will address control of wind and wave erosion through placement of a rock revetment on levee slopes, and control of project-related seepage through an extensive monitoring and control system.

Exterior levees on all four islands will be buttressed and improved as described for Webb Tract and Bacon Island. In addition, an inner levee system will be constructed and maintained on the bottom of the islands. This system will consist of a series of low-height levees and connecting waterways, and will facilitate the management of shallow water during periods of non-storage. The inner levees will be broad, earthen structures similar to structures currently in place on existing farm fields.

Specific Operation of the Habitat Islands

Bouldin Island and Holland Tract would be managed for wetland and wildlife habitats. An incidental operation of the habitat islands will involve the sale or use of water drained from the islands. Wetland management on the habitat islands will require grading areas, re-vegetating, and diverting water. Improvements will be made to existing pump and siphon facilities, and to perimeter levees, including levee buttressing to meet DWR's recommended standards for levee stability and flood control. No new siphon or pump stations will be constructed on habitat islands. Recreation facilities will be constructed on perimeter levees.

Diversions and Discharges. Bouldin Island and Holland Tract will be managed for improvement and maintenance of wetland and wildlife values through use of a Habitat Management Plan (HMP). The HMP was primarily developed (and finalized in the early 1990s) by DFG and DWC to address project effects on waterfowl. The timing and volume of diversions onto the habitat islands will depend on the needs of wetland and wildlife habitats. Wetland diversions will typically begin in September, and water will be circulated throughout the winter. Existing siphons will be used for diversions to the habitat islands. Fish screens will be installed on all siphons used for diversions.

The maximum rate of proposed diversions onto Holland Tract and Bouldin Island will be 200 cfs per island. Diversions onto the habitat islands will not cause the combined daily average maximum diversion rate of 9,000 cfs for all four project islands to be exceeded. Water will be applied to the habitat islands for management in each month of the year to maintain acreages of open water, perennial wetlands, flooded seasonal wetlands, and irrigated croplands specified in the HMP. On an annual basis, approximately 19 TAF will be diverted onto the habitat islands.

Water will be discharged from the habitat islands based on wetland and wildlife management needs. Typically, water will be drawn down by May and the habitat islands will remain dry until September, except for permanently watered areas and other areas maintained for wetland vegetation. Existing pumps will be used for discharges and for water circulation on the habitat islands. If new appropriative rights are approved for water diverted onto the islands for wetland and wildlife management needs, water may be sold when it is discharged, provided conflicts do not arise with the HMP.

Recreation Facilities. Recreation facilities on the habitat islands will be similar to those described above for the reservoir islands. Consistent with the HMP, up to 10 new recreation facilities will be constructed on Bouldin Island, and six new recreation facilities on Holland Tract. New boat docks will accommodate more than 1,200 vessels at final build-out. The Bouldin Island airstrip will be available for use by hunters and other recreationists.

Operation and Maintenance. Operation and maintenance activities will include: (1) siphon and pump unit operations and routine maintenance; (2) management of habitat areas, including (but not limited to) the control of undesirable plant species, the maintenance or modification of inner levees, and water circulation in ditches, canals, open water, and shallow flooded habitats to facilitate flooding and drainage; (3) fish screen maintenance and monitoring during water diversions for habitat maintenance; (4) wildlife and habitat monitoring under the HMP; (5) perimeter levee inspections and maintenance; (6) aircraft operations for seeding, fertilizing, *etc.*; (7) operation of recreational facilities using seasonal workers; and (8) monitoring and enforcement of hunting restrictions.

Fish Screens

Fish screens will be installed around the intake of each existing and new siphon to prevent entrainment and impingement of most adult and juvenile fish that are present in the Delta. DW fish screens shall not exceed a 0.2 fps approach velocity for diversions. The average approach velocity will decrease

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rapidly as the islands are filled because of decreases in siphon head differential. The preliminary fish screen design consists of a barrel-type screen on the inlet side of each siphon with a hinged flange connection at the water surface (for cleaning). Each siphon opening will be enclosed by a stainless steel, woven wire mesh consisting of seven openings per inch in a screen of 0.035-inch-diameter number 304 stainless steel wire with a pore diagonal of 0.1079 inches. Siphon pipes, with their individual screen modules, will be spaced approximately 40 feet apart on center. Final design elements and installation guidelines will be subject to approval by the Corps, SWRCB, the Service, DFG, and NMFS.

Operations to Mitigate Project Effects

The Corps formally transmitted modifications to DW project operations to the Service on March 5, 1997 (Corps 1997). The intent of these changes, which are described in detail in Appendix 2, was to mitigate project effects on listed and proposed fish species and critical habitat. The revisions to the proposed action addressed: (1) diversion criteria; (2) discharge to export criteria; (3) discharge limits based on temperature and dissolved oxygen criteria; and (4) compliance and coordination with CVP and SWP Delta operations.

Introduction. This narrative reflects final operations criteria for the DW that would take the place of the operations criteria previously proposed by JSA on March 1, 1996. These operations criteria are intended to ensure that the DW project operations do not jeopardize the continued existence of delta smelt, Sacramento splittail, winter-run chinook salmon, or steelhead trout. DW expects that non-listed species will also benefit from these criteria and such criteria will replace the related mitigation measures for fishery impacts proposed in the context of the CEQA/NEPA process.

Under these operations criteria, DW will not be inconsistent with conditions set forth in the March 6, 1995, delta smelt biological opinion (Appendix 1) or the SWRCB 1995 WQCP for the Bay-Delta estuary. These revised operations criteria set forth multi-layered diversion and discharge parameters. In the instance where two or more conditions apply, the condition that is the most restrictive on DW operations will control.

Additional restrictions apply if the delta smelt FMWT index declines to less than 239. The FMWT index refers to the most current four month (Sep-Dec) FMWT index in place at the time of the intended diversion. A diversion prior to January can utilize either the previous year's FMWT index or the partial FMWT index for the months available, whichever is greater. Any changes in the FMWT index calculation methodology will be adjusted so that the FMWT index values applied herein can continue to be the standard for DW operations criteria.

A delta smelt FMWT index measurement of less than 84 (FMWT<84) is new information under the reinitiation regulations (50 C.F.R. § 402.16) and requires reinitiation of this biological opinion. [#26,45][1]

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[1] The number(s) in brackets are provided as a reference to the DW ESA Matrix which summarizes the final operations criteria as compared to the March 1, 1996, JSA proposed terms.

The following enables DW to conform with water transfer criteria set forth in the Service's March 6, 1995 CVP/SWP delta smelt biological opinion (see Appendix 3 for water transfer language from March 6 biological opinion):

> DW will not enter into any contractual agreement(s) which would provide for the export of more than 250,000 AF of DW water on a yearly (calendar year) basis. This provides for, but is not limited to, the following types of transfers: a c-user, short-term, opportunistic water transfer; a long-term water transfer; and any other such agreement, or contract for sale or transfer which is consistent with water transfer language in the March 6, 1995, biological opinion on the CVP/SWP (Appendix 3), the SWRCB's 1995 WQCP for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (1995 WQCP), and the improved environmental baseline established under the March 6, 1995, CVP/SWP delta smelt biological opinion (Appendix 1). If such agreement(s) were determined to result in an adverse effect to delta smelt, delta smelt critical habitat or the Sacramento splittail in a manner or to an extent not previously identified, the contractual agreement(s) would be subject to some level of further environmental review.

Diversion Measures. DW shall limit diversions to the four project islands as set forth in the following measures:

1. In the period from September through November, DW shall not undertake its initial diversion to storage for the current water year until X2 is located at or downstream of Chipps Island. For example, if DW's initial diversion to storage has not taken place by November 30, 1997, DW shall not undertake its initial diversion to storage for the current water year until X2 is located at or downstream of Chipps Island for a period of ten (10) consecutive days. After the initial X2 condition is met, diversions shall be limited to a combined maximum rate of 5,500 cfs for five consecutive days. Information documenting achievement of the X2 condition and resultant operational changes shall be submitted to the Service, DFG, and NMFS within 24 hours of implementation of operational changes. [#2, 3, 4]

   The location of X2 shall be defined as the average daily location of a surface water salinity of 2.64 EC, determined by interpolating the average daily surface EC measurements at existing Bay-Delta monitoring stations. Should this traditional X2 methodology be replaced, superseded, or become otherwise unavailable, DW shall follow whatever equivalent practice is developed, subject to approval of the resources agencies and notice to the responsible agencies.

2. In the period from September through March, DW shall not divert water to storage when X2 is located upstream (east) of the Collinsville salinity gauge. When the delta smelt FMWT index is less than 239 (FMWT<239), DW shall not divert water to storage when X2 is located upstream of a point 1.4 kilometers west of the Collinsville salinity gauge. [#5, 6, 7, 19]

3. In the period from October through March, DW shall not divert water to storage if the effect of DW diversions would cause an upstream shift in the X2 location in excess of 2.5 km. The resultant shift in X2 shall be determined by a comparison of the modeled estimates of the X2 location outflow, with and without the DW project, using a mathematical model, *e.g.*, Kimmerer and Monismith equation. [#8, 9]

4. In the period from April through May, DW shall not divert water to storage. If the previous year's delta smelt FMWT index is less than 239 (FMWT<239), DW shall not divert water for storage from February 15 through June 30. [#10, 20]

5. DW diversions to storage shall be limited to the following percentage of available surplus water as derived pursuant to the 1995 WQCP (*e.g.*, export/inflow ratio, outflow). [#13]

Table 1: Surplus Availability

Month	FMWT>239	FMWT<239
October	90%	90%
November	90%	90%
December	90%	90%
January	90%	90%
February 1-14	75%	75%
February 15-28	75%	NA
March	50%	NA
April	NA	NA
May	NA	NA
June	50%	NA
July	75%	75%
August	90%	90%
September	90%	90%

6. DW diversions to storage shall not exceed a percentage of the previous day's net Delta outflow rate (cfs), as set forth in the following table: [#11, 23]

Table 2: Outflow Diversion Limit

Month	Percent Outflow (1)	
	FMWT>239	FMWT<239
October	25%	25%
November	25%	25%
December	25%	25%
January	15%	15%
February 1-14	15%	15%
February 15-28	15%	NA
March	15%	NA
April	NA	NA
May	NA	NA
June	25%	NA
July	25%	25%
August	25%	25%
September	25%	25%

(1) The percent of Delta outflow is calculated without consideration of DW diversions; therefore, the calculation could use the previous day's actual Delta outflow added to the previous day's DW diversions to yield an outflow value that would not include DW operations.

7. In the period from December through March, DW diversions to storage shall not exceed the percentage of the previous day's San Joaquin River inflow rate (cfs) for the maximum number of days, as set forth in the following table: [#12, 24]

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Table 3: SJR Diversion Limit

Month	Percent SJR Inflow [1]	
	FMWT > 239	FMWT < 239
Application [2]	15 days	30 days
December	125%	125%
January	125%	100%
February 1 - 14	125%	50%
February 15 - 28	125%	NA
March	50%	NA

[1] The percent of SJR inflow is calculated from the previous day's inflow at Vernalis.

[2] The application of the SJR diversion limit is subject to a specific election on the part of the responsible fishery agencies for a maximum number of days, as specified above. The election to invoke the SJR diversion limit shall be based upon available monitoring data (*e.g.*, project specific monitoring, FMWT data).

8. DW shall implement a monitoring program to minimize or avoid adverse effects of DW diversions to storage, as set forth below: [#15, 16, 21, 22]

   a. DW shall implement a monitoring program in accordance with the attached, "Delta Wetlands Fish Monitoring Program" (Appendix 4).

   b. DW shall provide daily in-channel monitoring (Appendix 4 for description of monitoring) from December through August during all diversions to storage, except as provided below.

   c. DW shall provide daily on-island monitoring (Appendix 4 for description of monitoring) from January through August during all diversions to storage, except as provided below.

   d. Monitoring shall not be required at a diversion station if the total diversion rate at the station is less than 50 cfs and the maximum fish screen approach velocity is less than 0.08 fps (*e.g.*, topping-off).

   e. DW shall reduce the diversions at a diversion station to 50 percent of the previous day's diversion rate during the presence of delta smelt. Should delta smelt be detected on the first day of diversions to storage, the diversion rate shall be immediately reduced to 50 percent of the current day's diversion rate. This reduced diversion rate will remain in place until the monitoring

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program no longer detects a presence of delta smelt at the diversion station. For the purpose of this mitigation measure, delta smelt presence is defined as a two-day running average in excess of one (1) delta smelt per day at any reservoir diversion station. The definition of presence may be revisited from time to time as new information or monitoring techniques become available.

9. During periods when the Delta Cross Channel (DCC) gates are closed for fisheries protection purposes, between November 1 and January 31, and the inflow into the Delta is less than or equal to 30,000 cfs, DW shall restrict diversions onto the reservoir islands to a combined instantaneous maximum of 3,000 cfs. When the DCC gates are closed for fishery protection purposes and the inflow into the Delta is between 30,000 and 50,000 cfs, DW shall restrict diversions onto the reservoir islands to a combined instantaneous maximum of 4,000 cfs. At Delta inflows greater than 50,000 cfs, DW diversions shall not be restricted by the closure of the DCC for fishery protection purposes. For purposes of this provision, Delta inflow is defined in accordance with the 1995 WQCP. [#17]

10. Nothing in measures 1 through 9 above shall limit DW from diverting water onto Bacon Island and Webb Tract from June through October in order to offset actual reservoir losses of water stored on those islands, hereafter referred to as "topping-off" reservoirs. Daily topping-off diversions shall be subject to the following conditions: [#18, 25]

a. Topping-off diversions shall not exceed the maximum per island diversion rate (cfs) and maximum monthly quantity (TAF) listed below for both islands:

Table 4: Maximum Topping-Off Diversion Rates

Month	Jun	Jul	Aug	Sep	Oct
Maximum diversion rate (cfs)	215	270	200	100	33
Maximum monthly quantity (TAF)	13	16	12	6	2

b. Topping-off diversions shall occur through screened diversions with approach velocities less than 0.10 fps.

c. A mechanism acceptable to the Service, NMFS, and DFG shall be devised and used by DW to document actual reservoir losses.

d. The maximum topping-off diversion rates shown above shall be further limited by diversions onto the habitat islands. The maximum topping-off diversion rate and quantity shall be reduced by an amount equal to the habitat island diversions during the same period.

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Discharge Measures. DW shall limit discharges from the four project islands:

1. In the period from April through June, DW shall limit discharges for export or rediversion from Bacon Island to one-half (50 percent) of the San Joaquin River inflow measured at Vernalis. [#34]

2. In the period from January through June, DW shall not discharge for export or rediversion from Webb Tract. [#33]

3. DW shall not discharge for export or rediversion any water from the habitat islands. [#41]

4. From February through July, DW discharges for export shall be limited to the following percentage of the available unused export capacity at the CVP and SWP facilities as derived pursuant to the 1995 WQCP. [#35, 36]

Table 5: Export Availability

Month	Bacon	Webb
February	75%	NA
March	50%	NA
April	50%	NA
May	50%	NA
June	50%	NA
July	75%	75%

6. DW shall provide a quantity of "environmental water" for release as additional Delta outflow: [#38, 42]

   a. DW shall provide a quantity of environmental water equal to 10 percent of all discharges for export that occur in the period from December through June. If the delta smelt FMWT index is less than 239 (FMWT<239), this environmental water percentage shall be increased to 20 percent of all discharges for export that occur in the period from December through June.

   b. Environmental water shall be released between February and June of the same water year as the discharge for export that generated the water and may not be banked for future use in subsequent water years.

   c. Habitat island discharges may be credited toward the environmental water quantities required above, if:

      i. habitat island discharges occur between February and June;

ii. habitat island discharge credits are limited to the net flow quantity (*e.g.*, habitat discharge minus habitat diversion);

iii. habitat island discharges occur during a period of time when 75 percent of the spacial distribution of the delta smelt population is located downstream of the discharge location, where the determination of spacial distribution is based on the most recent distribution data available (*e.g.*, IEP);

iv. the habitat island discharge rate does not vary on a daily basis more than 1 percent of the average gross flow rate in the adjacent channel, either upstream or downstream, when delta smelt are spawning in the area;

v. DW makes a best effort to minimize fluctuations in daily discharge rates;

vi. and the habitat island discharges are consistent with the HMP.

d. Environmental water, less habitat island discharge credits, shall be discharged at the discretion of the Service. NMFS and DFG to maximize fishery benefits. Coordination of these discharges shall be performed by the DFG Bay-Delta office.

7. DW shall implement a monitoring program to minimize or avoid adverse effects of DW discharges for export, as set forth below: [#39, 40, 43, 44]

a. DW shall implement a monitoring program in accordance with the attached, "Draft Proposed Delta Wetlands Fish Monitoring Program" (Appendix 4).

b. DW shall provide daily in-channel monitoring from April through August during all discharges for export, except as provided below.

c. Monitoring shall not be required if the total discharge for export rate is less than 50 cfs.

d. DW shall reduce the discharge for export rate to 50 percent of the previous day's diversion rate during the presence of delta smelt. Should delta smelt be detected on the first day of discharges for export, the discharge rate shall be immediately reduced to 50 percent. This reduced diversion rate will remain in place until the monitoring program no longer detects a presence of delta smelt at the in-channel sampling sites. For the purpose of this mitigation measure, delta smelt presence is defined as a two-day running average in excess of one (1) delta smelt per day at the Old and Middle River sampling sites. The definition of presence may be revisited from time to time as new information or monitoring techniques become available.

e. DW shall provide for this monitoring either by contributing financial support commensurate with the proportionate share of DW exports to the Bay/Delta monitoring programs, or when no other monitoring is being conducted at appropriate sites, DW shall provide for direct monitoring in river channels as described above.

Other Measures:

1. Fish screen design: [#49]

The DW fish screens will be generally consistent with the design presented in the DEIR/EIS except that DW shall not exceed a maximum of 0.2 fps approach velocity for diversions. Final design elements and installation guidelines will be subject to approval by the regulatory agencies including the Service, Corps, DFG, SWRCB, and NMFS. Final design, including a monitoring program to evaluate performance criteria will be submitted for approval at least 90 days prior to commencing operations.

2. Rearing and Spawning Habitat. [#50, 51]

Prior to construction, DW will secure a perpetual conservation easement (easement) for 200 acres of shallow-water aquatic habitat not currently protected by easement or covenant. The easement shall fully protect in perpetuity the shallow-water aquatic habitat. A management plan for the easement area shall be developed for the habitat covered by the easement, and shall be incorporated as an exhibit to the easement.

The easement (along with a title report for the easement area) and management plan shall be approved by the Service prior to recordation. After approval, the easement and management plan shall be recorded in the appropriate County Recorders Office(s). A true copy of the recorded easement shall be provided to the Service within 30 days after recordation.

Additionally, DW shall provide to the Service documentation that there is adequate financing for the perpetual management of the habitat protected by the conservation easement consistent with the terms of this biological opinion and the management plan including that (1) adequate funds for the management of habitat in perpetuity protected by the conservation easement have been transferred to an appropriate third-party, (2) the third party has accepted the funds, and (3) such funds have been deposited in an interest-bearing account intended for the sole purpose of carrying out the purposes of this easement.

3. Boat Wake Erosion [#53]

DWC shall contribute $100 per year to DFG for each net additional berth beyond conditions existing at the time of issuance of this biological opinion added to any of the four project islands. These funds shall be in January 1996 dollars and shall be adjusted annually for inflation.

4. Aquatic Habitat [#54]

The actual effect to aquatic habitat acreage for construction and operation of siphon and pumping facilities and waterside boat docks shall be surveyed prior to construction and submitted to the Service, NMFS, the Corps, DFG, and the SWRCB, and mitigation shall take place on a 3:1 basis after approval by the Service, NMFS, the Corps, DFG, and the SWRCB.

5. Temperature Limits [#55]

DW shall implement a temperature program to minimize or avoid adverse effects of DW discharges for export (see Appendix 4 for details of program):

a. DW shall not discharge reservoir water for export if the temperature differential between the discharge and the adjacent channel temperature is greater than or equal to 7° C.

b. If the natural receiving water temperature of the adjacent channel is greater than or equal to 13° C and less than 19° C, DW discharges for export shall not increase channel temperature by more than 3° C.

c. If the natural receiving water temperature of the adjacent channel is greater than or equal to 19° C and less than 25° C, DW discharges for export shall not cause an increase of more than 1° C.

d. If the natural receiving water temperature of the adjacent channel is greater than or equal to 25° C, DW discharges for export shall not cause an increase of more than 0.5° C.

e. DW shall develop temperature monitoring and implementation plans to ensure that the project does not adversely affect channel temperature levels as described above. The monitoring plan shall include reservoir and channel temperature monitoring. The monitoring and implementation plans shall be completed after the project is permitted, but at least 90 days prior to start of project operations. The plans shall be submitted to the responsible agencies for approval with the concurrence of the resource agencies.

6. DO Limits [#56]

DW shall implement a dissolved oxygen (DO) program to minimize or avoid adverse effects of DW discharges for export (see Appendix 4 for details of program):

a. DW shall not discharge reservoir water for export if the discharge DO level is less than 6.0 mg/l without authorization from the resource agencies and notice to the responsible agencies.

b. DW shall not discharge reservoir water for export if the discharge would cause channel water DO levels to fall below 5.0 mg/l.

c. DW shall develop DO monitoring and implementation plans to ensure that the project does not adversely affect the channel DO levels as described above. The monitoring plan shall include reservoir and channel DO monitoring. The monitoring and implementation plans shall be completed after the project is permitted, but at least 90 days prior to project operations. The plans shall be submitted to the Service, NMFS, the Corps, DFG, and SWRCB for approval.

7. Incidental Entrainment Compensation Provided to DFG [#57]

Certain life stages of key fish species may not be effectively screened during periods of diversions for storage. DW will, therefore, sample DW diversions during the periods specified below and compensate for losses to selected target fish. DW diversions onto the reservoir islands will be sampled for egg, larval, and juvenile life stages of the selected target fish. Those losses will be mitigated using a formula which ties measured losses with mitigation as specified below.

This provision covers entrainment of non-listed species, as well as, delta smelt and splittail (that are, respectively, listed and proposed species).

Should on-island monitoring detect the presence of eggs, larvae, and juveniles during the months specified in the incidental entrainment monitoring guidelines, DW shall provide monetary compensation to DFG for incidental entrainment, as set forth in the following tables:

Table 6: Incidental Entrainment Monitoring Guidelines

Species and Life Stages	Jan	Feb	Mar	Jun	Jul	Aug
Striped Bass						
larvae and juveniles				X	X	X
American Shad						
larvae and juveniles				X	X	X
Delta Smelt						
larvae	X	X	X	X	X	
juveniles		X	X	X	X	X
Splittail						
larvae	X	X	X	X	X	X
juveniles		X	X	X	X	X
Longfin Smelt						
eggs and larvae	X	X	X			
juveniles	X	X	X	X	X	X

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Table 7: Incidental Entrainment Compensation Provided to DFG

Measured Density	Mitigation/TAF
10-999 eggs, larvae, and juveniles/AF	$500
1,000-5,000 eggs, larvae, and juveniles/AF	$750
>5,000 eggs, larvae, and juveniles/AF	$1,000

Should DW be unable to perform on-island monitoring, the maximum mitigation compensation will be assumed, unless waived or modified by the responsible agencies, with concurrence of the resource agencies. Funds are in January 1996 dollars and shall be adjusted annually for inflation. Monetary reimbursement shall be deposited into a mitigation fund on a semiannual basis. The use of the mitigation funds shall be at the discretion of the state agencies but shall be used to plan and implement actions that improve habitat for the target species in the Estuary.

8. Construction Period [#60]

All construction activities taking place in the tidal waters of the adjacent channels or affecting a tidal water habitat shall occur between June 1 and November 1.

Status of the Species

Delta smelt

The delta smelt was federally listed as a threatened species on March 5, 1993, (58 FR 42:12854-12864). Please refer to Service (1993, 1994a, 1994c) and DWR and Reclamation (1994) for additional information on the biology and ecology of the delta smelt. The delta smelt is a slender-bodied fish with a steely blue sheen on the sides and seems almost translucent (Moyle 1976). The delta smelt, which has a lifespan of one year, has an average length of 60 to 70 mm (about 2 to 3 inches) and is endemic to Suisun Bay upstream of San Francisco Bay through the Delta in Contra Costa, Sacramento, San Joaquin, and Solano counties, California. Historically, the delta smelt is thought to have occurred from Suisun Bay upstream to at least the city of Sacramento on the Sacramento River and Mossdale on the San Joaquin River (Moyle *et al.* 1992, Sweetnam and Stevens 1993). The delta smelt is an euryhaline species (tolerant of a wide salinity range) that spawns in fresh water and has been collected from estuarine waters up to 14 parts per thousand (ppt) salinity (Moyle *et al.* 1992). For a large part of its annual life span, this species is associated with the freshwater edge of the mixing zone (saltwater-freshwater interface and also called X2), where the salinity is approximately 2 ppt (Ganssle 1966, Moyle *et al.* 1992, Sweetnam and Stevens 1993).

The delta smelt is adapted to living in the highly productive Estuary where salinity varies spatially and temporally according to tidal cycles and the amount of freshwater inflow. Despite this tremendously variable environment,

the historical Estuary probably offered relatively constant suitable habitat conditions for delta smelt, because they could move upstream or downstream with the mixing zone (Moyle, pers. comm., 1993). The final rule to list the delta smelt as threatened describes in detail the factors that have contributed to this species' decline (Service 1993).

Shortly before spawning, adult delta smelt migrate upstream from the brackish-water habitat associated with the mixing zone to disperse widely into river channels and tidally-influenced backwater sloughs (Radtke 1966, Moyle 1976, Wang 1991). Migrating adults with nearly mature eggs were taken at the CVP's Tracy Pumping Plant from late December 1990 to April 1991 (Wang 1991). Spawning locations appear to vary widely from year to year (DWR and Reclamation 1993). Sampling of larval delta smelt in the Delta suggests spawning has occurred in the Sacramento River, Barker, Lindsey, Cache, Georgiana, Prospect, Beaver, Hog, and Sycamore sloughs, in the San Joaquin River off Bradford Island including Fisherman's Cut, False River along the shore zone between Frank's and Webb tracts, and possibly other areas (Dale Sweetnam, DFG, pers. comm., Wang 1991). Delta smelt also may spawn north of Suisun Bay in Montezuma and Suisun sloughs and their tributaries (Meng, Service, pers. comm., Sweetnam, DFG, pers. comm.).

Delta smelt spawn in shallow, fresh, or slightly brackish water upstream of the mixing zone (Wang 1991). Most spawning occurs in tidally-influenced backwater sloughs and channel edgewaters (Moyle 1976, Wang 1986, 1991, Moyle *et al.* 1992). Although delta smelt spawning behavior has not been observed in the wild (Moyle *et al.* 1992), the adhesive, demersal eggs are thought to attach to substrates such as cattails, tules, tree roots, and submerged branches (Moyle 1976, Wang 1991).

The spawning season varies from year to year and may occur from late winter (December) to early summer (July). Moyle (1976) collected gravid adults from December to April, although ripe delta smelt were most common in February and March. In 1989 and 1990, Wang (1991) estimated that spawning had taken place from mid-February to late June or early July, with peak spawning occurring in late April and early May. A recent study of delta smelt eggs and larvae (Wang and Brown 1994 as cited in DWR and Reclamation 1994) confirmed that spawning may occur from February through June, with a peak in April and May. Spawning has been reported to occur at about 7° to 15° C. Results from a University of California at Davis (UCD) study (Cech and Swanson 1995) indicate that although delta smelt tolerate a wide range of temperatures (<8° C to >25° C), warmer water temperatures restrict their distribution more than colder water temperatures.

Laboratory observations indicate that delta smelt are broadcast spawners that spawn in a current, usually at night, distributing their eggs over a local area (Lindberg 1992 and Mager 1993 as cited in DWR and Reclamation 1994). The eggs form an adhesive foot that appears to stick to most surfaces. Eggs attach singly to the substrate, and few eggs were found on vertical plants or the sides of a culture tank (Lindberg 1993 as cited in DWR and Reclamation 1994).

Delta smelt eggs hatched in 9 to 14 days at temperatures from 13° to 16° C during laboratory observations in 1992 (Mager 1992 as cited in Sweetnam and Stevens 1993). In this study, larvae began feeding on phytoplankton on day four, rotifers on day six, and *Artemia* nauplii at day 14. In laboratory studies, yolk-sac fry were found to be positively phototaxic, swimming to the lightest corner of the incubator, and negatively buoyant, actively swimming to the surface. The post-yolk-sac fry were more evenly distributed throughout the water column (Lindberg 1992 as cited in DWR and Reclamation 1994). After hatching, larvae and juveniles move downstream toward the mixing zone where they are retained by the vertical circulation of fresh and salt waters (Stevens *et al.* 1990). The pelagic larvae and juveniles feed on zooplankton. When the mixing zone is located in Suisun Bay where there is extensive shallow-water habitat within the euphotic zone (depths less than four meters), high densities of phytoplankton and zooplankton may accumulate (Arthur and Ball 1978, 1979, 1980). In general, estuaries are among the most productive ecosystems in the world (Goldman and Horne 1993). Estuarine environments produce an abundance of fish as a result of plentiful food and shallow, productive habitat.

Delta smelt swimming behavior. Observations of delta smelt swimming in the swimming flume and in a large tank show that these fish are unsteady, intermittent, slow-speed swimmers (Swanson and Cech 1995). At low velocities in the swimming flume (<3 body lengths per second), and during spontaneous, unrestricted swimming in a 1-meter tank, delta smelt consistently swam with a "stroke and glide" behavior. This type of swimming is very efficient; Weihs (1974) predicted energy savings of about 50 percent for "stroke and glide" swimming compared to steady swimming. However, the maximum speed delta smelt are able to achieve using this preferred mode of swimming, or gait, was less than three body lengths per second, and the fish did not readily or spontaneously swim at this or higher speeds (Swanson and Cech 1995). Juvenile delta smelt proved stronger swimmers than adults. Forced swimming at these speeds in a swimming flume was apparently stressful; the fish were prone to swimming failure and extremely vulnerable to impingement. Unlike fish for which these types of measurements have been made in the past, delta smelt swimming performance was limited by behavioral rather than physiological or metabolic constraints (*e.g.*, metabolic scope for activity; Brett 1976).

Delta Smelt Critical Habitat

Please refer to Service (1994c) for additional information on delta smelt critical habitat. In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation and that may require special management considerations or protection (50 CFR §424.12(b)).

The Service is required to list the known primary constituent elements together with the critical habitat description. Such physical and biological features include, but are not limited to, the following:

1. space for individual and population growth, and for normal behavior;

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2. food, water, air, light, minerals, or other nutritional or physiological requirements;

3. cover or shelter;

4. sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and

5. generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

In designating critical habitat, the Service identified the following primary constituent elements essential to the conservation of the delta smelt: physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration. Critical habitat for delta smelt is contained within Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties (Figure 3b).

Spawning habitat. Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay (Figure 3b).

Larval and juvenile transport. Adequate river flow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay and to ensure that rearing habitat is maintained in Suisun Bay (Figure 3a). To ensure this, X2 must be located westward of the confluence of the Sacramento-San Joaquin Rivers, located near Collinsville (Confluence), during the period when larvae or juveniles are being transported, according to historical salinity conditions (Figure 3c). X2 is important because the "entrapment zone" or zone where particles, nutrients, and plankton are "trapped," leading to an area of high productivity, is associated with its location. Habitat conditions suitable for transport of larvae and juveniles may be needed by the species as early as February 1 and as late as August 31, because the spawning season varies from year to year and may start as early as December and extend until July.

Rearing habitat. An area extending eastward from Carquinez Straits, including Suisun, Grizzly, and Honker bays, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat (Figure 3b). Three Mile Slough represents the approximate location of the most upstream extent of historical tidal incursion. Rearing habitat is vulnerable to impacts from the beginning of February to the end of August.

Adult migration. Adequate flow and suitable water quality are needed to attract migrating adults in the Sacramento and San Joaquin river channels and their associated tributaries, including Cache and Montezuma sloughs and their tributaries (Figure 3b). These areas are vulnerable to physical disturbance and flow disruption during migratory periods.

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The Service's 1994 and 1995 biological opinions provided for larval and juvenile transport flows, rearing habitat, and protection from entrainment for upstream migrating adults (Service 1994b, 1995).

Sacramento Splittail

Please refer to Service (1994a, 1994d, 1995) and DWR and Reclamation (1994) for additional information on the biology and ecology of the Sacramento splittail. The Sacramento splittail is a large cyprinid that can reach greater than 12 inches in length (Moyle 1976). Adults are characterized by an elongated body, distinct nuchal hump, and a small blunt head with barbels usually present at the corners of the slightly subterminal mouth. This species can be distinguished from other minnows in the Central Valley of California by the enlarged dorsal lobe of the caudal fin. Sacramento splittail are a dull, silvery-gold on the sides and olive-grey dorsally. During the spawning season, the pectoral, pelvic and caudal fins are tinged with an orange-red color. Males develop small white nuptial tubercles on the head.

Sacramento splittail are endemic to California's Central Valley where they were once widely distributed in lakes and rivers (Moyle 1976). Historically, Sacramento splittail were found as far north as Redding on the Sacramento River and as far south as the site of Friant Dam on the San Joaquin River (Rutter 1908). Rutter (1908) also found Sacramento splittail as far upstream as the current Oroville Dam site on the Feather River and Folsom Dam site on the American River. Anglers in Sacramento reported catches of 50 or more Sacramento splittail per day prior to damming of these rivers (Caywood 1974). Sacramento splittail were common in San Pablo Bay and Carquinez Strait following high winter flows up until about 1985 (Messersmith 1966, Moyle 1976, and Wang 1986 as cited in DWR and Reclamation 1994).

In recent times, dams and diversions have increasingly prevented upstream access to large rivers and the species is restricted to a small portion of its former range (Moyle and Yoshiyama 1989). Sacramento splittail enter the lower reaches of the Feather (Jones and Stokes 1993) and American rivers (Charles Hanson, State Water Contractors, *in litt.*, 1993) on occasion, but the species is now largely confined to the Delta, Suisun Bay, and Suisun Marsh (Service 1994a). Stream surveys in the San Joaquin Valley reported observations of Sacramento splittail in the San Joaquin River below the mouth of the Merced River and upstream of the confluence of the Tuolumne River (Saiki 1984 as cited in DWR and Reclamation 1994).

Sacramento splittail are long-lived, frequently reaching five to seven years of age. Generally, females are highly fecund, producing more than 100,000 eggs each year (Daniels and Moyle 1983). Populations fluctuate annually depending on spawning success. Spawning success is highly correlated with freshwater outflow and the availability of shallow-water habitat with submersed, aquatic vegetation (Daniels and Moyle 1983). Sacramento splittail usually reach sexual maturity by the end of their second year at a size of 180 to 200 mm. There is some variability in the reproductive period since older fish reproduce before younger individuals (Caywood 1974). The largest recorded Sacramento splittail have measured between 380 and 400 mm (Caywood 1974, Daniels and Moyle 1983). Adults migrate into fresh water in late fall

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and early winter prior to spawning. The onset of spawning is associated with rising temperature, lengthening photoperiod, seasonal runoff, and possibly endogenous factors from the months of March through May, although there are records of spawning from late January to early July (Wang 1986). Spawning occurs in water temperatures from 9° to 20° C over flooded vegetation in tidal freshwater and euryhaline habitats of estuarine marshes and sloughs and slow-moving reaches of large rivers. The eggs are adhesive or become adhesive soon after contacting water (Caywood 1974, and Bailey, University of California at Davis, pers. comm. 1994 as cited in DWR and Reclamation 1994). Larvae remain in shallow, weedy areas close to spawning sites and move into deeper water as they mature (Wang 1986).

Sacramento splittail are benthic foragers that feed on opossum shrimp, although detrital material makes up a large percentage of their stomach contents (Daniels and Moyle 1983). Earthworms, clams, insect larvae, and other invertebrates are also found in the diet. Predators include striped bass and other piscivores. Sacramento splittail are sometimes used as bait for striped bass.

Sacramento splittail can tolerate salinities as high as 10 to 18 ppt (Moyle 1976, Moyle and Yoshiyama 1992). Sacramento splittail are found throughout the Delta (Turner 1966), Suisun Bay, and Suisun and Napa marshes. They migrate upstream from brackish areas to spawn in freshwater. Because they require flooded vegetation for spawning and rearing, Sacramento splittail are frequently found in areas subject to flooding.

The 1985 to 1992 decline in Sacramento splittail abundance (Figure 4b) is concurrent with hydrologic changes to the Estuary. These changes include increases in water diversions during the spawning period from January through July. Diversions, dams and reduced outflow, coupled with severe drought years, introduced aquatic species, and loss of wetlands and shallow-water habitat (DFG 1992) have reduced the species' capacity to reverse its decline.

Environmental Baseline

Delta smelt

Adult delta smelt spawn in central Delta sloughs from February through August in shallow water areas having submersed aquatic plants and other suitable substrates and refugia. These shallow water areas have been identified in the draft Delta Native Fishes Recovery Plan (Service 1994d) as essential to the long-term survival and recovery of delta smelt and other resident fish. A no net loss strategy is proposed in this Recovery Plan.

The delta smelt is adapted to living in the highly productive Estuary where salinity varies spatially and temporally according to tidal cycles and the amount of freshwater inflow. Despite this tremendously variable environment, the historical Estuary probably offered relatively consistent spring transport flows that moved delta smelt juveniles and larvae downstream to the mixing zone (Peter Moyle, UCD, pers. comm.). Since the 1850's, however, the amount and extent of suitable habitat for the delta smelt have declined dramatically. The advent in 1853 of hydraulic mining in the Sacramento and San Joaquin

rivers led to increased siltation and alteration of the circulation patterns of the Estuary (Nichols *et al.* 1986, Monroe and Kelly 1992). The reclamation of Merritt Island for agricultural purposes, in the same year, marked the beginning of the present-day cumulative loss of 94 percent of the Estuary's tidal marshes (Nichols *et al.* 1986, Monroe and Kelly 1992).

In addition to the degradation and loss of estuarine habitat, the delta smelt has been increasingly subject to entrainment, upstream or reverse flows of waters in the Delta and San Joaquin River, and constriction of low salinity habitat to deep-water river channels of the interior Delta (Moyle *et al.* 1992). These adverse conditions are primarily a result of drought and the steadily increasing proportion of river flow being diverted from the Delta by the CVP and SWP (Monroe and Kelly 1992). Figure 4a shows the relationship between the portion of the delta smelt population west of the Delta as sampled in the summer townet survey and the natural logarithm of Delta outflow from 1959 to 1988 (DWR and Reclamation 1994). This relationship indicates that the summer townet index increased dramatically when outflow was between 34,000 and 48,000 cfs placing X2 between Chipps and Roe islands. Placement of X2 at Chipps and Roe islands would duplicate these favorable conditions.

Hydrodynamics in channels adjacent to DW's islands depend largely on overall Delta hydrodynamics. Channels bordering Bacon Island and Holland Tract function primarily as transport channels moving water toward the export pumps. Net flow in these channels generally moves upstream toward the CVP and SWP pumps and the Contra Costa Water District intake. Sand Mound Slough along the west side of Holland Tract is blocked by a tide gate at the Rock Slough confluence. This tide gate permits flow only to the north during ebb tides, to prevent water and salt movement into Rock Slough. Existing irrigation diversions and agricultural drainage discharges probably have minor effects on adjacent channel hydrodynamics.

Webb Tract is bordered by the San Joaquin River on the north and east, Fishermans Cut on the west, and False River on the southwest. Franks Tract, a flooded island area, is south of Webb Tract. Net flow near Webb Tract is usually westerly, except during periods of low Delta inflow and high export volumes, when net flow reverses and water is transported into Old River and toward the CVP and SWP pumps.

Bouldin Island is bordered by the Mokelumne River on the north and west, Little Potato Slough on the east, and Potato Slough on the south. Net flow around Bouldin Island is nearly always toward the San Joaquin River. Reverse flows, during periods of low Delta inflow and high export volumes, occur in an easterly direction in Potato Slough along the southern edge of the island.

The results of seven surveys (Figure 5a) currently done by the IEP corroborate the dramatic decline in delta smelt attributable to baseline conditions. Existing baseline conditions provide sufficient Delta outflows from February 1 through June 30 to transport larval and juvenile delta smelt out of the "zone of influence" of the pumps, and provide them low salinity, productive rearing habitat (Figures 3a,3b). This zone of influence has been delineated by DWR's Particle Tracking Model and expands or contracts with CVP and SWP combined pumping increases or decreases (DWR and Reclamation 1993). With the effects of tidal movement contributing additional movement, the influence of the pumps

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may entrain larvae and juveniles as far west as the Confluence. Placement of X2 downstream of the Confluence, Chipps and Roe islands provides delta smelt with protection from entrainment and low salinity, allowing for productive rearing habitat that increases both smelt abundance and distribution.

The seven abundance indices used to record trends in the status of the delta smelt showed that this species was consistently at low population levels in the last ten years (Stevens *et al.* 1990) (Figure 5a). These same indices also show a pronounced decline from historical levels of abundance (Stevens *et al.* 1990). The summer townet abundance index is thought to be one of the more representative indices because data have been collected over a wide geographic area (from San Pablo Bay upstream through most of the Delta) for the longest period of time (since 1959). Figure 6a shows the distribution of summer townet sampling sites. The summer townet abundance index measures the abundance and distribution of juvenile delta smelt and provides data on the recruitment potential of the species. Except for three years since 1983 (1986, 1993, and 1994), this index has remained at consistently lower levels than experienced previously (Figure 6b). As indicated in Figure 3c, these consistently lower levels correlate with the 1983 to 1992 mean location of X2 upstream of the Confluence, Chipps and Roe islands.

The second longest running survey (since 1967), the FMWT, measures the abundance and distribution of late juveniles and adult delta smelt in a large geographic area from San Pablo Bay upstream to Rio Vista on the Sacramento River and Stockton on the San Joaquin River (Figure 7a)(Stevens *et al.* 1990). The FMWT provides an indication of the abundance of the adult population just prior to upstream spawning migration. The index that is calculated from the FMWT uses numbers of sampled fish multiplied by a factor related to the volume of the area sampled. Figure 7b shows that until recently, except for 1991, this index has declined irregularly over the past 20 years. Since 1983, the delta smelt population has exhibited more low FMWT abundance indices, for more consecutive years, than previously recorded. The 1994 FMWT index of 101.7 is a continuation of this trend (Figure 7b). This occurred despite the high 1994 summer townet index of 13.0. The 1995 summer townet was a low index value of 3.2 but resulted in a high FMWT index of 898.7 reflecting the benefits of large transport and habitat maintenance flows with the March 6 biological opinion in place and a wet year. The 1996 summer townet was 11.1 and resulted in a low FMWT index of 128. Historically, wet years have resulted in low FMWT indices due to dispersal of delta smelt west of Carquinez Strait where suitable rearing habitat is unavailable. In 1995, another wet year, delta smelt were sampled in the Napa River drainage early in the season but disappeared in later surveys. This may have been due to the lack of suitable habitat in the Napa river to allow for juvenile or adult survival.

Delta Smelt Critical Habitat

Delta smelt critical habitat has been affected by activities that destroy spawning and refugial areas. Critical habitat has also been affected by diversions that have shifted the position of X2 upstream. This shift has caused a decreased abundance of delta smelt (Figure 7b). Existing baseline conditions and implementation of the Service's 1994 and 1995 biological opinions provide a substantial part of the necessary positive riverine flows and estuarine outflows to transport delta smelt larvae downstream to suitable

rearing habitat in Suisun Bay outside the influence of marinas, agricultural diversions, and Federal and State pumping plants.

Sacramento Splittail

Figure 4b shows the decline of the Sacramento splittail over the past 10 years using FMWT data. Figure 5b shows this decline using eight surveys done by IEP. This decline is due to hydrologic changes in the Estuary and loss of shallow water habitat due to dredging and filling. These changes include increases in water diversions during the spawning period of January through July. Most of the factors that caused delta smelt to decline have also caused the decline of this species. Diversions, dams and reduced outflow, coupled with severe drought years, introduced aquatic species such as the Asiatic clam (Nichols *et al.* 1990), and loss of wetlands and shallow-water habitat (DFG 1992) appear to have perpetuated the species' decline.

Effects of the proposed action

Effects of the proposed action will be similar for delta smelt, delta smelt critical habitat, and Sacramento splittail.

Relationship of DW operations to the CVP and SWP. The March 6, 1995, delta smelt biological opinion on the CVP and SWP established a monthly incidental take limit for the operation of the pumping plants including measurable direct losses at the pumps and immeasurable indirect losses such as hydrological changes and predation. Using a 20-year delta smelt CVP and SWP fish facility salvage data base, a high range was calculated and subsequently used in the biological opinion with the intent that operations not be controlled through take exceedance and biological opinion reinitiation and with the understanding that beneficial actions implemented through the March 6 delta smelt biological opinion would reverse the decline of listed species.

Any export of water above the new CVP and SWP project baseline resulting from new projects would result in: (1) a decrease in the beneficial effects of actions implemented through the March 6 delta smelt biological opinion; (2) an increase in direct and indirect losses of delta smelt and thus a higher probability that the take limit would control operations of the CVP and SWP pumping plants. Decreases in the beneficial effects of the March 6 delta smelt biological opinion would necessitate a re-analysis of all CVP and SWP project effects with a resulting re-analysis of the use of the high range for take number.

One of the actions included in the analysis of the CVP and SWP in the March 6 delta smelt biological opinion was water transfers. Historical transfers modeled and analyzed for effects consisted of short-term, opportunistic, c-user water transfers such as Stockton-East where the CVP and SWP pumps would be used if capacity existed. The Service's intent was to facilitate these types of transfers. Some water transfers could have a beneficial effect to fish if managed effectively by providing fish with transport flows toward rearing habitat in Suisun Bay.

DW relies almost exclusively on CVP and SWP pumping to convey discharged water. Hence, DW is interdependent and interrelated to the operation of the

CVP and SWP. Due to this linkage between projects, effects of the conveyance of Delta Wetlands water by the CVP and SWP must be considered. The Corps has an agreement on the operation of the CVP and SWP that limits pumping to historic levels with the addition of the four new pumps at Banks pumping plant. A method must be derived by which conveyance of DW water is included within the context of the water transfer section of the March 6, 1995, delta smelt biological opinion to allow DW water conveyance by the CVP and SWP.

Relationship of DW operations to the Environmental Baseline Established by the March 6 Delta Smelt Biological Opinion. DW operations would not have a substantial adverse effect on the environmental baseline established by the March 6 delta smelt biological opinion. This is due to the final operations criteria in Appendix 2 that mitigate effects on export/inflow ratios, position of X2, and larval transport flows. In the March 6 delta smelt biological opinion, CVP/SWP export/inflow ratios were calculated based on historic Delta inflows from upstream rivers and tributaries including (1) Sacramento, (2) San Joaquin, (3) Mokelumne, (4) Consumnes, (5) Stanislaus, (6) Merced, (7) Tuolumne, and (8) Feather rivers. They were developed to replace and lead to, at a minimum, equivalency with previously existing criteria, including QWEST.

The biological benefits from these inflows include (1) transport and behavioral cues for eggs, larvae, juveniles, and smolts, (2) water quality maintenance, and (3) dilution of heavy metals and other contaminants. These biological benefits have a seasonal component with various species of fish that have adapted to use higher winter flows to move downstream for rearing or upstream for spawning. Therefore, the seasonal components were used to devise export/inflow ratios that attempted to balance biological benefits with water user demand. The end result did not achieve a perfect balance but the flexibility of the biological opinion allowed for changes in real-time operation of the water projects. The CVPIA 800 TAF is targeted at providing additional fish benefits. This water must not be diverted or subjected to adverse hydrological changes so that fish benefits are realized.

DW discharges were not part of the historical inflows modeled to produce the export/inflow ratios. Additionally, DW discharges do not have benefits similar to inflows produced by the previously mentioned rivers because of their central Delta location. Therefore, DW discharges are not counted as part of the export/inflow ratios for the purpose of this opinion.

Further, criteria developed for the March 6, 1995, delta smelt biological opinion (Service 1995) were based on historical: (1) operation of the CVP and SWP, (2) water transfers, (3) salvage numbers, and (4) fish surveys. Removal of the jeopardy environmental baseline in the Delta occurred through implementation of these March 6 delta smelt biological opinion criteria. New projects proposed subsequently to the March 6 delta smelt biological opinion that incrementally lower the Delta environmental baseline back toward the jeopardy threshold will need additional rigorous criteria to avoid and minimize adverse project effects. Finalized operational criteria contained in Appendix 2 accomplish this for DW.

Delta smelt

The proposed DW operations and associated construction activities and recreational facilities will have immediate effects related to in-water work, including pile-driving, shading of aquatic habitat, soil excavation, rip-rapping and construction of intakes and out takes. These activities will affect delta smelt through direct destruction of spawning and refugial habitat. Aquatic plants may need 2-3 years to recolonize affected areas. Mobilized sediments may contain contaminants and may affect upstream migrating adult spawners. These sediments may also affect delta smelt eggs and larvae. The extent of the effected area is difficult to quantify but may involve up to 50.0 acres. This will be mitigated through securing of an easement on 200-acres of shallow water habitat managed in perpetuity.

DW's project includes operation of reservoir and habitat islands with recreational activities that will have long-term effects related to (1) island filling resulting in entrainment and impingement and changes to Delta hydrology, (2) discharges from islands resulting in changes in Delta hydrology and erosion, and (3) recreational boating resulting in bank erosion and water contamination from spilled fuel and oil. Finalized operational criteria contained in Appendix 2 will remove the effects of these operations.

The following is a summary of the DW project effects remaining with implementation of final operational criteria contained in Appendix 2 (these effects will be mitigated through securing of an easement on shallow water habitat, operational changes, and entrainment compensation):

1. DW project will directly entrain delta smelt larvae;

2. DW project construction will degrade delta smelt spawning and rearing habitat;

3. DW project will increase predation losses due to fish screen structures, siphon and pump stations, and boat docks (this is due to the turbulence caused by structures that disorients fish making them susceptible to predation).

Diversions. Water will be diverted for storage on Bacon Island and Webb Tract with smaller amounts diverted on Bouldin Island and Holland Tract to enable habitat management. Maximum storage will be about 154 TAF and will increase over the life of the project. Water will be diverted to the reservoir islands at a maximum average monthly diversion rate of 4,000 cfs and will take about a month to fill the islands. Maximum initial diversion rate will be 9,000 cfs for several days.

Discharges. Discharges from DW reservoir islands will be exported by the CVP and SWP when unused capacity within the permitted pumping rate exists at the CVP and SWP pumps and if a method is devised for dealing with increased fish loss (*i.e.*, "take") not covered by existing permits. Reclamation and DWR will ultimately be responsible for developing a plan that allows export of DW water. On finalization of a plan to export DW water at the CVP and SWP, new modeling should be done to determine the effects. Modeled changes to operations and resulting effects should include, but are not limited to:

(1) changes to scheduled deliveries, (2) changes to diversions at Rock Slough, (3) changes to diversions at Barker Slough, and (4) changes to operation of all other CVP and SWP facilities effecting position of X2, through Delta transport flows, and Delta hydrology resulting from conveyance of DW water.

Hydrodynamics. Net Delta outflow will be reduced by DW diversions. When reservoir islands are filling, X2 will be shifted upstream in Suisun Bay. This decreases the amount of shallow water habitat available for rearing and the productivity of the entrapment zone. Additionally, flow direction around the reservoir islands will be changed that affect upstream migrating spawning adults and downstream moving larvae and juveniles. This reduction in outflow with resulting upstream shift to X2 and localized changes in flow direction will be mitigated for by measures included in Appendix 2.

Sacramento Splittail

DW project effects for Sacramento splittail are similar to effects for delta smelt. Sacramento splittail spawn in the central Delta and are transported by flows to rearing habitat associated with X2 in Suisun Bay. Sacramento splittail spawn on newly flooded vegetation. Flooding of these shallow areas is dependent on adequate flows that overflow areas of low elevation. Based on available information, reduced outflow attributable to DW project operations will not have a significant effect on Sacramento splittail spawning habitat due to operational constraints in Appendix 2. Entrainment of Sacramento splittail larvae and early juveniles will occur if DW project intakes are located in areas that support spawning and rearing and will affect local production but compensation will be provided. Presence of adults and juveniles near DW project diversions may coincide with the timing of diversions. Although juvenile and adult Sacramento splittail may be effectively screened, larval fish may be entrained or impinged. Construction of DW project facilities could affect localized Sacramento splittail habitat, and DW project diversions could increase entrainment. Sacramento splittail spawning and rearing habitat will be affected near proposed DW project intakes, discharge pumps, and boat docks. Mitigative measures included in Appendix 2 will minimize or, in critical months, avoid these effects.

Delta Smelt Critical Habitat

Construction of DW facilities will not adversely modify or destroy delta smelt critical habitat by affecting the constituent elements listed previously because of the modified operational criteria contained in Appendix 2. Spawning habitat affected by construction of DW project facilities including intake structures, levees, and boat docks will be fully compensated for through an easement on 200-acres of shallow-water habitat managed for perpetuity. Larval and juvenile transport to suitable rearing habitat has been identified as a constituent element of critical habitat. Decreases by DW diversions will be mitigated through operational constraints in Appendix 2. Rearing habitat will not be adversely modified due to diversions that change the location of X2. These effects will be reduced or avoided by implementation of finalized operational criteria contained in Appendix 2.

Cumulative effects

Cumulative effects include the effects of future State, local, or private actions affecting listed species and their critical habitat that are reasonably certain to occur in the area considered in this biological opinion. Future Federal actions not related to this proposed action are not considered in determining the cumulative effects, but are subject to separate consultation requirements pursuant to section 7 of the Act.

Cumulative effects on the delta smelt or its proposed critical habitat also include any continuing or future non-federal diversions of water that may entrain adult or larval fish or that may decrease outflows incrementally, thus shifting upstream the position of the delta smelt's preferred habitat. Water diversions through intakes serving numerous small, private agricultural lands and duck clubs in the Delta, upstream of the Delta, and in Suisun Bay contribute to these cumulative effects. These diversions also include municipal and industrial uses, and provide water for power plants. State or local levee maintenance and channel dredging activities also affect critical habitat by disturbing spawning or rearing habitat. Delta smelt adults seek shallow, tidally-influenced, fresh water (*i.e.*, less than 2 ppt salinity) backwater sloughs and edgewaters for spawning. To assure egg hatching and larval viability, spawning areas also must provide suitable water quality (*i.e.*, low concentrations of contaminants) and substrates for egg attachment (*e.g.*, submerged tree roots, branches, and emergent vegetation). Suitable water quality must be provided by addressing point sources of contaminants so that maturation is not impaired by pollutant concentrations. Levee maintenance disturbs spawning and rearing habitat, and resuspends contaminants into these waters.

Of the entities with water storage greater than 100 TAF, the percent of total storage is the following:

1. Reclamation stores 40.6 percent of Delta water, 42.8 percent of Sacramento River water, and 37.7 percent of San Joaquin River water.

2. DWR stores 17.4 percent of Delta water, 29 percent of Sacramento River water, and has no storage for San Joaquin River water.

3. Therefore, the non-Federal entities (excluding DWR) represent 42.0 percent of Delta water, 28.2 percent of Sacramento River water, and 62.3 percent of San Joaquin River water of those with storage greater than 100 TAF.

DW project effects on hydrodynamic conditions are inextricably tied to past and present hydraulic modifications that have been made in the Delta for various purposes, such as levee construction for land reclamation and flood control; channel dredging for navigation and levee maintenance; channel enlargement and deepening for navigation; operation of diversion pumps, siphons, and drainage pumps; and construction of non-federal export pumping plants and associated facilities for water management. DW project operations will not affect upstream conditions. Upstream conditions for fish, however, will continue to deteriorate. Increased demands may further reduce reservoir storage and will adversely affect riverine conditions. Without criteria to

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reduce Delta habitat degradation (including entrainment losses), ongoing factors and future projects will reduce the survival and abundance of all fish species. Under future conditions, surplus flows are likely to be less available than under existing conditions. Reduced availability will result from: (1) operations that reduce the frequency of spill from upstream reservoirs; (2) build out by senior water right holders; and (3) changes in the criteria that define surplus flows.

Additional cumulative effects result from the impacts of point and non-point source chemical contaminant discharges. These contaminants include selenium and numerous pesticides and herbicides associated with discharges related to agricultural and urban activities. Implicated as potential sources of mortality for delta smelt and Sacramento splittail, these contaminants may adversely affect delta smelt and Sacramento splittail reproductive success and survival rates. Spawning habitat may also be affected if submersed aquatic plants used as substrates for adhesive egg attachment are lost due to toxic substances.

Conclusion

After reviewing the current status of the delta smelt and the Sacramento splittail, the environmental baseline, the effects of the proposed Delta Wetlands Project, and the cumulative effects, it is the Service's biological opinion that the Delta Wetlands Project, as proposed, including the implementation of final operational criteria contained in Appendix 2 is not likely to jeopardize the continued existence of the delta smelt and the Sacramento splittail and not result in the destruction or adverse modification of critical habitat for delta smelt.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary and must be implemented by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity

that is covered by this incidental take statement. If the Federal agency (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Incidental Take

The Service anticipates that operation of the Delta Wetlands Project including the avoidance and minimization measures in Appendix 2, will result in the take (by killing and harassment) of delta smelt through (1) construction activities, (2) recreation, maintenance, and monitoring activities, and (3) filling and discharging of reservoir and habitat islands. This take includes that incurred by use of pile-driving, soil excavation, and rip-rapping during construction of recreation facilities, intakes, and outtake structures and wake caused erosion, oil and gas spills, shading from boat docks, and herbicide applications used for plant management. Additionally, take (by killing, harassment, and harm) is expected from normal operation of the reservoir and habitat islands including filling and discharging water resulting in entrainment and impingement, and changes to central Delta hydrology and upstream movement of X2. This take will be difficult to quantify due to the unlikelihood of finding dead or impaired individuals. Adults, juveniles, and larvae may be present in the project area (Figure 1) from December 1 through August. Larval and juvenile delta smelt and Sacramento splittail are flushed to the eastern Suisun Bay by outflows during this interval and removed from the influence of most direct project effects by August 31. With implementation of the reasonable and prudent measures described below, the incidental take of **all** delta smelt killed and harassed as a result of pile-driving, soil excavation, and rip-rapping during construction of recreation facilities, intakes, and outtake structures and wake caused erosion, oil and gas spills, shading from boat docks, herbicide applications used for plant management, monitoring, and normal operation of the reservoir and habitat islands including filling and discharging water as described above or historical operation of the islands for agricultural production, will not be considered a prohibited taking. Fifty acres of habitat will be destroyed and killing, harassing, and harm resulting from this destruction will additionally not be considered a prohibited taking if the following measures are implemented. If listed, Sacramento splittail take due to killing, harassment, and harm will similarly not be considered a prohibited taking if the following measures are implemented.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy of the above-listed and proposed species.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of take of delta smelt. The measures below are non-discretionary, and must be undertaken:

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1. The Corps shall minimize the impacts on delta smelt associated with emersed vegetation resulting from soil excavation, placement of rip-rap, and construction of recreation facilities, intake and outtake structures.

2. The Corps shall minimize the impacts on delta smelt associated with submersed vegetation resulting from all in-water work, including, but not limited to, soil excavation, pile-driving, and rip-rapping, associated with the construction of recreation facilities, intake and outtake structures.

3. The Corps shall minimize the impacts on delta smelt associated with normal operation of the reservoir and habitat islands including filling and discharging water as described above or historical operation of the islands for agricultural production.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions deal with both the near-term, emergency, and the longer-term, routine levee repairs and are non-discretionary:

1. The Corps shall minimize the impacts on delta smelt resulting from the permanent loss of spawning and refugial habitat due to destruction of emersed plants caused by placement of rip-rap, or construction of intake or outtake structures by avoiding areas having emersed plants.

2. The Corps shall minimize the impacts on delta smelt resulting from the permanent loss of spawning and refugial habitat due to destruction of submersed aquatic plants during construction and maintenance by avoiding, to the maximum extent practicable, areas having submersed aquatic plants. All in-water work shall take place between June and November unless real-time monitoring indicates the presence of delta smelt, at which point no in-water work shall occur until delta smelt are no longer present.

3. The Corps shall minimize the impacts on delta smelt associated with normal operation of the reservoir and habitat islands including filling and discharging water as described above or historical operation of the islands for agricultural production by implementing the avoidance, minimization, and compensation measures contained in Appendix 2. Additionally, the "Draft Proposed Delta Wetlands Fish Monitoring Program" (Appendix 4) shall be finalized at least 90 days prior to start of any project related construction.

Reporting Requirements

The Corps shall require DW when performing construction activities to report immediately any information about take or suspected take of delta smelt (and Sacramento splittail should this species be listed). The Corps shall immediately notify the Service within one working day of any such information.

Notification must include the date, time, and precise location of the incident and specimen, and any other pertinent information. The Service contact is the Chief for Endangered Species Division at (916) 979-2725. Any killed specimens that have been taken shall be properly preserved in accordance with the Natural History Museum of Los Angeles County policy of assessioning (10% formalin in a quart jar or freezing). Information concerning how the fish was taken, length of the interval between death and preservation, the water temperature and outflow/tide conditions, and any other relevant information shall be written on 100% rag content paper and included in the container with the specimen. This preserved specimen shall be delivered to the Service's Division of Law Enforcement at 3110 El Camino, Suite 140, Sacramento, California 95821 (telephone 916-979-2987).

Sacramento Splittail

The above requirements for delta smelt will concurrently minimize the impacts of take on Sacramento splittail.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species and the ecosystems upon which they depend. Conservation recommendations are Service suggestions regarding discretionary agency activities to promote the recovery of listed species. Therefore, the Service recommends the following additional actions to promote the recovery of federally listed species and their habitats:

1. The Service recommends that the Corps implement recovery activities in the Delta Native Fishes Recovery Plan.

2. The Service recommends that the Corps develop procedures that minimize the effects of in-water construction activities.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation and conference for the proposed Delta Wetlands Project. You may ask the Service to confirm the conference opinion as a biological opinion issued through formal consultation if the Sacramento splittail is listed. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during conference, the Service may confirm the conference opinion as the biological opinion on the project and no further section 7 consultation may be necessary.

As required by 50 CFR §402.16, reinitiation of formal consultation is required if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that

causes an adverse effect to the listed species or critical habitat that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take ceases to have the protective coverage of section 7(o)(2) of the Act.

If you have any questions regarding this biological opinion, please contact Mr. Robert Pine at the Sacramento Field Office at (916) 979-2710.

Sincerely,

Wayne S. White
Field Supervisor

Enclosures

cc: Mark Littlefield, FWS-SFO, Wetlands, Sacramento, CA
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Appendix 1. March 6, 1995, delta smelt biological opinion changes to the environmental baseline.

The December 14, 1994, signing of the Bay-Delta Accord and its subsequent implementation through the March 6 delta smelt biological opinion provided significant beneficial actions to the Delta. The following are some of the process changes and beneficial actions that changed the Delta environmental baseline:

On December 23, 1994, the CVP and SWP began operations in accordance with the Bay-Delta Accord. The "CALFED Process" is an element of the Bay-Delta Accord and consists of the following process--

(a) Initial deliberations and decisions occur in the "Ops Group". The "Ops Group", or CVP and SWP Operations-Endangered Species Coordination Group, is defined in Exhibit B of the Framework Agreement and consists of representatives of the Service, Reclamation, NMFS, EPA, DWR, and SWRCB. The Ops Group exchanges information and facilitates coordination of water project operations with requirements of the delta smelt and winter-run salmon biological opinions, Federal and State water quality standards, and the CVPIA.

Issues that may be presented within the Ops Group include:

1. review of project operations;

2. review of operating parameters in biological opinions;

3. review of fish distribution and fish population levels;

4. review of status of endangered species take;

5. discussion of strategies for implementation of fishery protections to resolve conflicts between operations, water quality requirements, and fishery needs in the Estuary and its watershed;

6. coordination of the winter-run salmon monitoring and operations and management work groups with the delta smelt management and work groups and with IEP;

7. discussion of strategies for implementation of Estuary standards;

8. review and comment on the annual CVPIA water allocation and on other CVPIA activities related to the Estuary such as the Anadromous Fish Restoration Program; and

9. cooperation with the IEP and others to determine factors affecting Delta habitat and health of fisheries, and to identify appropriate corrective measures for the CVP and SWP.

Ops Group deliberations shall be conducted in consultation with water user, environmental and fishery representatives. Briefings shall periodically be provided to the Governor's Water Policy Council, Club Fed, and other interested groups. The Delta Smelt Working Group, defined in the Reporting Requirements below, will provide technical information to the Ops Group.

(b) If the Ops Group disagrees on a particular issue, or if an Ops Group action requires additional water that it is believed cannot be made up within existing requirements, the issue will be decided by CALFED.

(c) If CALFED cannot reach agreement, and if the issue involves listed species, a final decision will be made by the appropriate listing agency. Other issues not involving the Endangered Species Act will be decided by the appropriate regulatory or resources management agency.

The following water quality standards and operational constraints contain biological benefits:

(a) Delta outflow--

Table 1 shows the minimum monthly average Net Delta Outflow index.

Table 1. Minimum monthly average Net Delta Outflow Index (cfs)

Water Year Type*	Time Period**	Outflow (cfs)
All	January	4,500***
All	February-June	****
Wet, Above Normal	July	8,000
Below Normal	July	6,500
Dry	July	5,000
Critical	July	4,000
Wet, Above and Below Normal	August	4,000
Dry	August	3,500
Critical	August	3,000
All	September	3,000
Wet, Above and Below Normal, Dry	October	4,000
Critical	October	3,000
Wet, Above and Below Normal, Dry	November-December	4,500
Critical	November-December	3,500

*The Sacramento Valley 40-30-30 water year hydrologic classification index at the 50 percent exceedance level applies.

**For the May-January objectives, if the value is less than or equal to 5,000 cfs, the 7-day running average shall not be less than 1,000 cfs below the

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value; if the value is greater than 5,000 cfs, the 7-day running average shall not be less than 80 percent of the value.

***The objective is increased to 6,000 cfs if the best available estimate of December's Eight River Index (ERI or 8RI) is greater than 800 TAF. The ERI is defined as the sum of the unimpaired runoff as published in the DWR Bulletin 120 for the following locations: Sacramento River flow at Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River flow at Smartville; American River, total inflow to Folsom Reservoir; Stanislaus River, total inflow to New Melones Reservoir; Tuolumne River, total inflow to Don Pedro Reservoir; Merced River, total inflow to Exchequer Reservoir; and San Joaquin River, total inflow to Millerton Lake.

****The minimum daily Net Delta Outflow Index shall be 7,100 cfs for this period, calculated as a 3-day running average. This requirement is also met if either the daily average or 14-day running average EC at the Confluence is less than or equal to 2.64 mmhos/cm (Collinsville, station C2). Determination of compliance with an objective expressed as a running average begins on the last day of the averaging period. If the objective is not met on the last day of the averaging period, all days in the averaging period are considered out of compliance. The above standard for March may be relaxed upon the recommendation of the Ops Group (previously defined) established under the Framework Agreement, if the best available estimate of the ERI for February is less than 500 TAF. Disputes will be resolved by the CALFED policy group. The above standard does not apply in May and June if the best available estimate of the May Sacramento River Index for the water year is less than 8,100 TAF at the 90 percent exceedance level. Under this circumstance, a minimum 14-day running average flow of 4,000 cfs is required in May and June.

(b) X2 protection measures--

X2 protection shall be based on Footnote 11 for Table 3 on page 23 of the draft WQCP with errata with the following adjustments: Chipps Island requirement in February will be zero days when the ERI in January is less than 800 TAF and 28 days when it is greater than 1,000 TAF with linear interpolation between 800 and 1,000 TAF. The requirement at the confluence shall be 150 days, except when the best available estimate of the May 1, 90 percent exceedance Sacramento River Index is less than 8,100 TAF, the maximum outflows for May and June shall be 4,000 cfs, with all other flow requirements removed. When the February index falls below 500 TAF, the requirement of March will be reviewed by the Ops Group defined above. Additional refinements, which will involve no further water costs above those which are required for this paragraph may be subsequently made (however some water costs associated with other sections of this Project Description may be above those required for this paragraph).

Table 2 shows the number of days when maximum daily average EC of 2.64 mmhos/cm must be maintained at Chipps Island and Port Chicago.

Number of days when maximum daily average EC of 2.64 mmhos/cm must be maintained at Chipps Island and Port Chicago-- The number of days that an EC of 2.64 mmhos/cm must be maintained at Chipps Island and Port Chicago is determined by the Previous Months ERI (PMI). The number of days from February

through June at different PMI is described in Footnote 11 for Table 3 on page 23 of the draft WQCP with errata. The requirement can also be met with maximum 14-day running average EC of 2.64 mmhos/cm, or 3-day running average Delta outflows of 11,400 cfs and 29,000 cfs, for Chipps Island and Port Chicago, respectively. When the PMI is between 800 TAF, the number of the maximum daily average EC of 2.64 mmhos/cm (or maximum 14-day running average EC of 2.64 mmhos/cm, or 3-day running average Delta outflow of 11,400 cfs) must be maintained at Chipps Island in February is determined by linear interpolation between 0 and 28 days. The Port Chicago standard applies only in months when the average EC at Port Chicago during the 14 days immediately prior to the first day of the month are equal to or less than 2.64 mmhos/cm.

(c) San Joaquin River protection measures--

Not later than three years following the adoption of this plan, the SWRCB shall assign responsibility for the following flows, together with other measures in the watershed sufficient to meet all criteria in the San Joaquin River at Vernalis among the water right holders in the watershed. During this three-year period, Reclamation shall provide these flows. Table 3 shows these flows, which are interim flows and will be reevaluated as to timing and magnitude within the next three years.

Table 3. San Joaquin River flows

Year Type*	February-June flows (cfs)**	April-May pulse flows (cfs)***
Critical	710 or 1,140	3,110 or 3,540
Dry	1,420 or 2,280	4,020 or 4,880
Below Normal	1,420 or 2,280	4,620 or 5,480
Above Normal	2,130 or 3,420	5,730 or 7,020
Wet	2,130 or 3,420	7,330 or 8,620

*San Joaquin Valley 60-20-20 water year classification index at the 75 percent exceedance level applies (see Other Operation Changes section below concerning use of 90 percent exceedance).

**higher flows provided when the standard requires the positioning of X2 west of Chipps Island.

***A Vernalis flow for October of 1,000 cfs is provided with up to an additional 28 TAF pulse and attraction flow during all water year types. The pulse flow will be scheduled by the Ops Group defined above. The additional 28 TAF is not required in a critical year following a critical year.

(d) Delta Cross Channel Gate Closure--

During the period November to January, the Delta Cross Channel will be closed a maximum of 45 days. The timing and duration of the closures will be determined by the Ops Group. During the period May 21 through June 15, the

Delta Cross Channel may be rotated closed four consecutive days each week, excluding weekends.

(e) Combined export rate* limits--

In all water year types, during the April and May, 30-day pulse flow interval, maximum combined export rate is 1,500 cfs or 100 percent 3-day running average of San Joaquin River flow at Vernalis, whichever is greater (see below, Other Operational Changes section, for additional San Joaquin River requirements). Variations to this maximum combined export rate are authorized subject to the "CALFED Process" defined above. In all water year types, from February-June, maximum combined export rate is 35 percent of Delta inflow diverted** and from July-January, 65 percent of Delta inflow diverted. This may be changed by the Ops Group, as defined by the flexibility clause.

*Combined export rate for this objective is defined as the Clifton Court Forebay inflow rate (minus actual Byron-Bethany Irrigation District diversions form Clifton Court Forebay) and the export rate of the Tracy pumping plant.

**Percent of delta inflow diverted is defined on page 22 of the draft Water Quality standards. The export rate for this calculation is defined as a 3-day running average. The 14-day averaging period for Delta inflow is reduced to a 3-day period when the CVP or SWP is making storage withdrawals for export. The percent Delta inflow diverted values can be varied either up or down. Variations are authorized if agreed to by the Ops Group previously defined.

February protections-- If the best available estimate of the January ERI is less than or equal to 1.0 MAF, the export limit for February is 45 percent of Delta inflow diverted. If the best available estimate of the January ERI is between 1.0 MAF and 1.5 MAF, the export ratios for February will be adjusted by the Ops Group defined above within the range of 35 percent to 45 percent. Disputes within the Ops Group will be resolved by CALFED as described in the "CALFED Process" above. If the best available estimate of the January ERI is greater than 1.5 MAF, the February export limit is 35 percent of Delta inflow diverted.

March through June protections-- During March through June, exports shall be no greater than 35 percent of Delta inflow, subject to the flexibility provisions described below.

July through January-- During July through January, exports shall be no greater than 65 percent of Delta inflow, subject to the flexibility provisions described below. The criteria will be developed by the Ops Group.

(f) Daily export limits--

Daily export limits shall be based on the average Delta inflow over the preceding three days, when CVP or SWP is making storage withdrawals for exports (as defined in the Coordinated Operations Agreement), or 14 days under all other conditions.

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(g) Operational flexibility--

Decisions to exercise operational flexibility under the Ops Group process may increase or decrease water supplies in any month and must be based on best available biological data to ensure biological protection and be consistent with requirements for delta smelt, delta smelt critical habitat, winter-run salmon, and the proposed Sacramento splittail.

(h) All CVP water provided pursuant to these principle's shall be credited toward the CVP obligation under CVPIA Section 3406(b)(2) to provide 800 TAF of project yield for specified purposes.

(i) Brackish tidal marshes of Suisun Bay protections--

Water quality conditions sufficient to support a natural gradient in species composition and wildlife habitat characteristic of a brackish marsh throughout all elevations of the tidal marshes bordering Suisun Bay shall be maintained. Water quality conditions shall be maintained to prevent the loss of diversity.

Other Operational Changes Made to Benefit Delta Smelt, Delta Smelt Critical Habitat, and the Proposed Sacramento Splittail

1. Starting gate-- If the best estimate of the Eight River Index is more than 900 TAF in January, the daily average or 14-day running average electrical conductivity at Collinsville (station C2) shall attain 2.64 mmhos/cm or less between February 1 and February 14 for at least one day. If the Eight River Index is between 650 TAF and 900 TAF in January, the operations coordination group established by the Framework Agreement shall decide if the daily average or 14-day running average electrical conductivity at Collinsville (station C2) shall attain 2.64 mmhos/cm for at least one day between February 1 and February 14. Disputes will be resolved by the CALFED policy group previously described.

   At the discretion of the Ops Group, the starting gate requirement may also be met by a minimum daily Delta 3-day running average outflow of 7,100 cfs, if the January Eight River Index is between 650 and 900 TAF.

2. San Joaquin River pulse flow-- The operating criteria listed above specifies that during the April and May 30-day pulse flow period, combined CVP and SWP exports may be the greater of 1,500 cfs or 100 percent of the Vernalis flow. Reclamation will pursue acquisition of additional flow (acquired flow) to provide San Joaquin flows at Vernalis during the April and May 30-day pulse in excess of those exported by the CVP and SWP. Any such acquired flows will be identified as being in excess of those attributable to CVP releases, unregulated accretions or unstorable flows. Through the CALFED process and other associated discussions, Reclamation and DWR will encourage measures that will minimize the diversion of acquired flows during the 30-day pulse flow period. An Operations Plan shall be submitted to the Service by April 1 of each year describing Reclamation's and DWR's Delta operations and forecasted San Joaquin River flows during the April and May 30-day pulse

flow. The objective of this Operations Plan is to provide a flow at Vernalis that exceeds CVP plus SWP export by an amount equal to 50 percent of the identified pulse flow associated with the most recently available forecasted San Joaquin 60/20/20 Index (at 90 percent of exceedance).* In an effort to accomplish this goal, Reclamation and DWR will also consider re-allocation within the Principles for Agreement or other means to provide Vernalis flows or Delta exports consistent with this objective.

*Two examples of possible Operations Plans that meet the stated objective:

(a) "Above Normal" San Joaquin Index with X2 requirement west of Chipps Island--
Base flow = 5,400 cfs (Reclamation will identify base flow in Operations Plan)
CVP+SWP export = 5,400 cfs (equal to 100 percent of base flow)
Identified pulse flow = 7,020 cfs
Acquired flow objective = 3,510 cfs (equal to 50 percent of identified pulse flow)
Total flow objective at Vernalis = 8,910 cfs (base flow plus acquired flow)

(b) "Critical" San Joaquin Index with X2 requirement at the Confluence--
Base flow = 1,400 cfs
CVP+SWP export = 1,500 cfs (greater of 1,500 cfs or base flow)
Identified pulse flow = 3,110 cfs
Acquired flow objective = 1,555 cfs (equal to 50 percent of identified pulse flow)
Total flow at Vernalis = 3,055 cfs (1,500 cfs export plus acquired flow)

3. San Joaquin River exceedance forecast-- A 90 percent exceedance forecast shall be used to determine required San Joaquin River flows.

4. North Bay Aqueduct Diversion at Barker Slough and Prospect Island:

(a) When monitoring at Barker Slough indicates the presence of delta smelt larvae (under 20 mm), diversions from Barker Slough shall be reduced to a 5-day running average rate of 65 cfs not to exceed a 75 cfs daily average for any day, for a minimum of 5 days, and when monitoring shows no delta smelt are present. Presence is defined as a weighted average of one or more larval delta smelt sampled at Barker Slough stations 720, 720a (between stations 720 and 721), and 721 during a single sampling day. Barker Slough monitoring stations shall be weighted as follows:

station 720-- 20 percent
station 720a (between stations 720 and 721)-- 30 percent
station 721-- 50 percent

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If replicate samples are taken, the count used at each monitoring station shall be the average of all replicate samples taken at the monitoring station.

The averaging period for the 65 cfs shall begin 24 hours after the presence of delta smelt is detected. The Service shall be notified within 24 hours when diversions are reduced due to the presence of delta smelt juveniles and larvae and when diversions are subsequently increased due to the absence of delta smelt juveniles and larvae.

(b) A monitoring plan will be developed and submitted to the Service to provide baseline information to allow an estimation of delta smelt numbers and distribution in the Barker/Lindsey/Cache Slough-Prospect Island area. If this monitoring shows increases in delta smelt numbers and distribution when Prospect Island has become operational as a shallow-water habitat, the Working Group will meet and make a recommendation to the Service to amend 4(a) above.

With regard to the new environmental baseline created through implementation of actions within the Bay-Delta Accord, consideration of any future biological opinions based on new or re-initiated consultation will recognize three major initiatives that will shape the dynamics of future estuarine conditions for delta smelt. First, in accordance with a Framework Agreement (1994) between the Governor's Water Policy Council of the State of California (Council) and the Service, National Marine Fisheries Service (NMFS), EPA, and Reclamation (collectively known as "Club Fed"), the SWRCB has drafted water quality standards that will be finalized in 1995. This will occur while water right proceedings are under way to allocate responsibility among water right holders in the Bay-Delta watershed. Second, section 7(a)(1) of the Act imposes an affirmative obligation on Federal agencies to carry out programs for the conservation (recovery) of listed species. With the January 6, 1995, **Federal Register** notice of availability of the draft Delta Native Fishes Recovery Plan (Service 1994e), the Service expects that participating and affected local, State, and Federal agencies will fulfill their responsibilities by assisting in the completion of tasks and objectives in the Recovery Plan. Third, and related to number two above, the scheduled renewal or reopening of water contracts and licenses (such as, reopened or expired Federal Energy Regulatory Commission (FERC) licenses, expired CVP water contracts) will provide an additional opportunity under sections 7(a)(1) and 7(a)(2) of the Act to implement Recovery Plan objectives and meet EPA's or SWRCB's water quality standards. Collectively, these initiatives will result in a phased improvement to habitat requirements for the delta smelt and Sacramento splittail. Accordingly, the Service anticipates that adverse modification or destruction of critical habitat will be avoided by the CVP and SWP through implementation of the above described initiatives.

Additionally, the CVPIA is providing beneficial actions in the Delta. Part of these actions consist of management of 800 TAF of CVP Yield Under the CVPIA. To date, management of the 800 TAF of CVP Yield under the CVPIA has consisted of the following:

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1. Springtime pulse flows in the Stanislaus River, and in the lower San Joaquin River.

2. Springtime restrictions on Delta pumping and closure of the Delta Cross Channel gates.

3. Spawning and rearing flow improvements in the mainstem Sacramento, lower American, and Stanislaus rivers in fall and early winter.

4. Carryover storage of a portion of the dedicated yield in New Melones Reservoir as a contingency against future drought-induced reductions.

Appendix 2. Matrix showing DW operations

REF	MEASURE	JSA BA ALTERNATIVE	Final Operations Criteria
1	Export cap	None	250 TAF (see Term I language)
2	Initial diversion Sep-Nov	10 days past Chipps 5 day ramp @ 5500 cfs	X2 at or downstream of Chipps 5 day ramp @ 5500 cfs - no split
3	Initial diversion Dec-Jan	10 days past Chipps 5 day ramp @ 5500 cfs	10 days past Chipps 5 day ramp @ 5500 cfs - no split
4	Initial diversion Feb-Mar	None	10 days past Chipps 5 day ramp @ 5500 cfs - no split
5	X2 position Sep-Nov	West of km 81 (Collinsville)	West of Collinsville salinity gauge
6	X2 position Dec-Jan	West of km 81 (Collinsville)	West of Collinsville salinity gauge
7	X2 position Feb-Mar	None	West of Collinsville salinity gauge
8	X2 shift Oct-Jan	Shift < 2.5 km	Shift < 2.5 km
9	X2 shift Feb-Mar	None	Shift < 2.5 km
10	Fixed prohibitions	No diversions during Apr-May pulse	No diversion Apr-May
11	Outflow limits Oct/Nov/Dec Jan/Feb/Mar Apr/May/Jun Jul/Aug/Sep	Outflow limit (%) 25/25/25 25/na/na na/na/na na/na/na	Outflow limit (%) 25/25/25 15/15/15 na/na/25 25/25/25
12	SJR limits Oct/Nov/Dec Jan/Feb/Mar Apr/May/Jun Jul/Aug/Sep	None	SJR flow limit (%) (applies up to 15 days) na/na/125 125/125/50 na/na/na na/na/na

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REF	MEASURE	JSA BA ALTERNATIVE	Final Operations Criteria
13	Available limits Oct/Nov/Dec Jan/Feb/Mar Apr/May/Jun Jul/Aug/Sep	% of available surplus na/na/na na/75/50 25/25/50 75/na/na	% of available surplus 90/90/90 90/75/50 0/0/50 75/90/90
14	Enviro-water Oct/Nov/Dec Jan/Feb/Mar	None	None
15	DS monitoring period	None	In-channel monitoring Dec-Aug if > 50cfs On-island monitoring Jan-Aug if > 50 cfs
16	DS monitoring restrictions	None	Reduce diversions to 50% of previous day's rate during presence of delta smelt
17	DCC gate limits Nov-Jan	None	If DCC is closed for fishery protection, reduce maximum diversion rate to: 3,000 cfs if Delta inflow ≤ 30,000 cfs 4,000 cfs if inflow is 30,000 to 50,000 cfs
18	Summer top-off for evaporation Jun-Oct	None	Max. top-off rate for Jun-Oct in cfs: 215/270/200/100/33 including habitat island diversions
19	FMWT < 239 X2 position	Not applicable	1.4 km west of Collinsville salinity gauge
20	FMWT < 239 Fixed prohibitions	Not applicable	No diversions Feb 15 - Jun 30 except top-off (see # 25)

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REF	MEASURE	JSA BA ALTERNATIVE	Final Operations Criteria
21	FMWT < 239 DS monitoring period	Not applicable	In-channel monitoring Dec-Aug if > 50cfs On-island monitoring Jan-Aug if > 50 cfs
22	FMWT < 239 DS monitoring restrictions	Not applicable	Reduce diversions to 50% of previous day's rate during presence of delta smelt
23	FMWT < 239 Outflow limits Jan/Feb/Mar	Not applicable	Outflow limit (%) 15/15/na
24	FMWT < 239 SJR limits Dec/Jan/Feb	Not applicable	SJR flow limit (%) 125/100/50 (applies up to 30 days)
25	FMWT < 239 Summer top-off for evaporation Jun-Oct	Not applicable	Max. top-off rate for Jun-Oct in cfs: 215/270/200/100/33 including habitat island diversions
26	FMWT < 84 Fixed prohibitions	Not applicable	Considered "new information" and reinitiation of BO may occur
27	FMWT < 84 DS monitoring period	Not applicable	Not applicable
28	FMWT < 84 DS monitoring restrictions	Not applicable	Not applicable
29	FMWT < 84 Outflow limits	Not applicable	Not applicable
30	FMWT < 84 SJR limits	Not applicable	Not applicable
31	FMWT < 84 Summer top-off for evaporation	Not applicable	Not applicable

REF	MEASURE	JSA BA ALTERNATIVE	Final Operations Criteria
Ref	Measure	JSA BA Alternative	Final Operations Criteria
32	Delta inflow	DW not included	BO will adopt a neutral position with respect to this action, see DW letter of 10/18/96
33	Fixed prohibitions	None	Webb: no discharges Jan-Jun
34	SJR limits: Bacon	None	50% SJR Apr-Jun
35	Export capacity fraction: Webb	Feb 75% Mar-Jun 50% Jul 75%	Feb-Jun NA Jul 75%
36	Export capacity fraction: Bacon	Capacity available Feb 75% Mar-Jun 50% Jul 75%	Feb 75% Mar-Jun 50% Jul 75%
37	Bacon pulse-flow period exports	Only if Old & Middle flow south	None
38	Enviro-water	None	10% match for export during Dec-Jun subject to Feb-Jun habitat island credit
39	DS monitoring period	None	In-channel monitoring Apr-Aug if > 50cfs
40	DS monitoring restrictions	Not applicable	Reduce diversions to 50% of previous day's rate during presence of delta smelt
41	Habitat island discharge limits	None	No export but may be used for enviro-water match from Feb-Jun (see #38)

REF	MEASURE	JSA BA ALTERNATIVE	Final Operations Criteria
42	FMWT<239 Enviro-water	Not applicable	20% match for export during Dec-Jun subject to Feb-Jun habitat island credit
43	FMWT < 239 DS monitoring period	Not applicable	In-channel monitoring Apr-Aug if > 50cfs
44	FMWT < 239 DS monitoring restrictions	Not applicable	Reduce diversions to 50% of previous day's rate during presence of delta smelt
45	FMWT < 84 Fixed prohibitions	Not applicable	Considered "new information" and reinitiation of BO may occur
46	FMWT < 84 Enviro-water	Not applicable	Not applicable
47	FMWT < 84 DS monitoring period	Not applicable	Not applicable
48	FMWT < 84 DS monitoring restrictions	Not applicable	Not applicable
49	Fish screen design	Not included	0.2 fps approach velocity
50	Rearing habitat	Not included	200 acres
51	Spawning habitat	Not included	Included above
52	SRA habitat	Not included	None
53	Boat wake erosion	Not included	$100/yr/berth for each net additional berth
54	Aquatic habitat	Not included	Replace actual losses at 3:1 ratio

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REF	MEASURE	JSA BA ALTERNATIVE	Final Operations Criteria
55	Temperature limits	Per CVRWQB (Basin Plan)	No $\Delta T > 7^{\circ}$ C No channel increase > 1° C for 13° C to 19° C No channel increase > 1° C for 19° to 25°C No channel increase > 0.5° C over 25° C
56	DO limits	Per CVRWQB (Basin Plan)	No DO discharge < 6 mg/l Do not cause channel to drop below 5 mg/l
57	Incidental entrainment comp.	None	$500-$1000 per TAF for scheduled species, Jan through Aug
58	Service area conditions	None	None
59	HMP conditions	None	Actual costs plus overhead
60	Construction period	Not included	Jun-Nov for in-water work

Appendix 3. - Water Transfer Language from March 6, 1995, Delta Smelt Biological Opinion and Historical Water Transfers (1993 and 1994).

March 6, 1995, Water Transfer Language (Page 5, Water Transfers)

Water transfers that are relevant to this opinion are those transfers where a water right holder within the Delta watershed undertakes actions to make water available for transfer generally south of the Delta. Transfers requiring export from the Delta are done at times when pumping capacity at the Federal and State pumping plants is available to move the water. Reclamation and DWR will work to facilitate transfers in accordance with the Principles for Agreement and this biological opinion.

Historical Water Transfers

1993. Fifteen water transfers from the "Exchange Contractors" to the San Luis Unit were approved in April and May of 1993. Two water transfers from the "Exchange Contractors" to the San Luis Unit were approved in July of 1993.

Transfers to Westlands Water District (WD) Total Water include:

1. 37,693 AF Approved by Reclamation in April and May, 1993
2. 36,000 AF Approved through State Board petition, June 22, 1993
3. 60,000 AF Merced Irrigation District (ID) and Merced Wildlife Refuge, approved by State Board petition, no conveyance available
4. 82,000 AF Approved by State Board petition, no conveyance available

Transfers to Pacheco WD include:

1. 2,000 AF Approved by Reclamation in April and May, 1993

Transfers to Panoche WD include:

1. 41,120 AF Approved by Reclamation in April, May, and July, 1993

Transfers to San Luis WD include:

1. 1,205 AF Approved by Reclamation in April, May, and July, 1993

1993 Water Transfer Total:

228,018 AF

C-063269

1994. Transfers for either the San Joaquin or the Sacramento Valley or the State Water Bank -

San Joaquin Valley

From		Quantity	To
(1)	Columbia Canal Company	310 AF	San Luis WD
(2)	Central California ID	3,580 AF	San Luis WD
(3)	Contra Costa ID	400 AF	Westlands WD
(4)	Firebaugh Canal WD	152 AF	Westlands WD
(5)	Firebaugh Canal WD	552 AF	Westlands WD
(6)	Firebaugh Canal WD	1,070 AF	Westlands WD
(7)	Firebaugh Canal WD	190 AF	Panoche WD
(8)	Firebaugh Canal WD	118 AF	San Luis WD
(9)	San Luis Canal Company	2,250 AF	Panoche WD
(10)	Central California ID	90 AF	Panoche WD
(11)	Merced Refuge	30,000 AF	Westlands WD
(12)	Kern County Water Agency	3,000 AF	Westlands WD
Total		37,213 AF	

Sacramento Valley

(1)	Provident Water District	≤2,300 AF	Kanawha, Glide, and Orland-Artois Wds
(2)	Sutter Mutual Water Company	5,000 AF	Tehama-Colusa Water Users Association
(3)	City of Redding	2,000 AF	Bella Vista WD
Total		9,300 AF	

State Water Bank

(1)	Reclamation Contractor Districts Pelger Mutual Water Company	2,000 AF
(2)	Reclamation District 1004	12,000 AF
(3)	Baber	1,250 AF
(4)	Glenn-Colusa ID	22,363 AF
(5)	Hershey Land	338 AF
(6)	PCG ID	512 AF
(7)	Reclamation District 108	536 AF
Total		39,000 AF

1994 Grand Total **85,513 AF**

Appendix 4. DW Fish Monitoring Program

Delta Wetlands Fish Monitoring Program. The following sets forth a general description of the fish monitoring program that DWC will implement to provide data to minimize, avoid, and compensate for adverse impacts of DW project operations on fish. There are seven components of the program: (1) daily in-channel monitoring for the presence of juvenile and adult delta smelt in the immediate vicinity of DW diversion sites during diversions to storage, (2) daily on-island multiple species monitoring of entrainment of eggs, larvae, and juveniles during diversions to storage, (3) daily in-channel monitoring for the presence of juvenile and adult delta smelt in the general vicinity of DW reservoir islands during discharges for export, (4) reporting requirements, (5) sample handling and quality assurance/quality control (QA/QC) requirements, (6) IEP coordination, and (7) establishing a monitoring technical advisory committee (MTAC). The monitoring program as set forth below is intended to establish general parameters, with final details and specifications determined during final design of the monitoring program. This final design shall be completed after the project is permitted and must be accepted, in writing, by the responsible agencies prior to project operations with concurrence by the resource agencies.

1. In-Channel Monitoring of Diversions to Storage

The objective of this component shall be to provide for the detection of juvenile and adult delta smelt that could be vulnerable to entrainment at DW diversions. This DW sampling program would be supplementary to the existing IEP monitoring programs in the Delta. In the event that IEP monitoring is being conducted in a manner and location that satisfies DW sampling requirements, with the concurrence of the resource agencies and notice to the responsible agency, DW would use those data and would not be required to duplicate monitoring effort at those locations (*e.g.*, Real-Time Monitoring Program sampling in Middle River and Old River near DW reservoir islands). To the extent possible, sampling frequency will be stratified to obtain samples representative of any variation in specific conditions with respect to diel and tidal periodicity at each site. In-channel monitoring will utilize sampling technologies consistent with current IEP protocol (sampling gear may vary with season and life stage). Complete siting and sampling specifications will be determined during final design of the DW monitoring program.

DW shall provide daily in-channel monitoring during diversions to storage during allowable periods from December through August, except as provided below. Monitoring stations shall be located in the immediate vicinity of each of the four (4) DW diversion points. Each diversion point shall require two monitoring sites, for a maximum of eight (8) sites. The final location of each monitoring site shall be determined during final design of the DW monitoring program. Monitoring shall begin at a diversion point on the first day of diversions to storage from that site and shall continue throughout the diversion event. In-channel monitoring shall not be required if the total diversion rate at the diversion point is less than 50 cfs and the fish screen approach velocity is less than 0.08 fps (*e.g.*, topping-off).

Should DW be unable to perform in-channel monitoring for any reason except operational safety constraints, the monitoring mitigation measure shall automatically trigger unless waived by the responsible agencies, with concurrence by the resource agencies.

2. On-Island Monitoring of Entrainment during Diversions

The objective of this component shall be to provide for the detection of eggs, larvae, and juveniles entrained by DW diversions to storage. Certain life stages of key fish species may not be effectively screened during diversions to storage. These incidental losses shall therefore be mitigated using a monetary formula which ties measured losses to compensation that can be utilized, to the fullest extent possible, to plan and implement actions that maintain or enhance habitat for target species in the Bay-Delta estuary.

DW shall provide on-island monitoring during diversions to storage during allowable periods from January through August, except as provided below. A typical siphon located at each reservoir diversion point shall be fitted with a sampling apparatus attached to the floating siphon platform at the discharge end of the assembly. The final selection of the specific siphon to be monitored and complete specifications of the sampling apparatus will be determined during final design of the DW monitoring program. These sampling sites shall provide for installation of a variety of fish entrainment sampling gear using DFG-approved methodologies. Therefore, four sampling sites would be constructed (*i.e.*, 1 sampling site within a sixteen-siphon station times 2 siphon stations, times 2 reservoir islands, equals 4 total sampling sites). To the extent possible, sampling at each operating siphon station will be conducted as stratified subsamples with respect to diel and tidal periodicities so that total daily sampling time will be at least two hours each day. Monitoring shall begin at a diversion point on the first day of diversions to storage from that site and shall continue throughout the diversion event. On-island monitoring shall not be required if the total diversion rate at the diversion point is less than 50 cfs and the fish screen approach velocity is less than 0.08 fps (*e.g.*, topping-off).

3. In-Channel Monitoring of Discharge for Export

The objective of this component shall be to provide for the detection of juvenile and adult delta smelt that could be vulnerable to entrainment at the Delta export facilities during the export of DW discharges. This DW sampling program would be supplementary to the existing IEP monitoring programs in the Delta. In the event that IEP monitoring is being conducted in a manner and location that satisfies DW sampling requirements, with concurrence by the resource agencies and notice to the responsible agency, DW would use those data and would not be required to duplicate monitoring effort at those locations (*e.g.*, Real-Time Monitoring Program sampling in Middle and Old Rivers near DW reservoir islands). To the extent possible, sampling frequency will be stratified to obtain samples representative of any variation in specific conditions with respect to diel and tidal periodicity at each site. In-channel monitoring will utilize sampling technologies consistent with current IEP protocol (sampling gear may vary with season and life stage). Complete siting and sampling specifications will be determined during final design of the DW monitoring program.

DW shall provide daily in-channel monitoring during discharges for export from April through August, except as provided below. Monitoring stations shall be

located at paired transects at each of the two discharge stations, one in Middle River near Webb Tract and one in Old River near Bacon Island to be selected based on Real-Time Monitoring Program results and technical experience to provide indication of delta smelt density and distribution in this region of the Delta. The final location of each of monitoring site will be determined during final design of the DW monitoring program. Monitoring shall begin on the first day of discharges for export from Webb Tract and shall continue throughout the discharge event. In-channel monitoring shall not be required if the total discharge for export rate is less than 50 cfs.

Reporting

Weekly monitoring reports will be transmitted by FAX and daily reports by INTERNET to the fishery agencies as follows:

Service, Sacramento Field Office
NMFS, Protection Resources and Habitat Conservation Division
DFG, Bay-Delta and Special Water Projects Division

5. *Sample Handling Protocol*

DW will retain samples for a minimum of one year after collection. Agency biologists and law enforcement personnel shall have 24 hour access to fish monitoring personnel, fish samples, and daily fish capture data. A QA/QC protocol, acceptable to the fishery agencies, will be developed by DW and provided to the fishery agencies as part of the final monitoring program plan. The QA/QC protocol will include, but is not limited to, measures to ensure correct identification of larval and juvenile fishes.

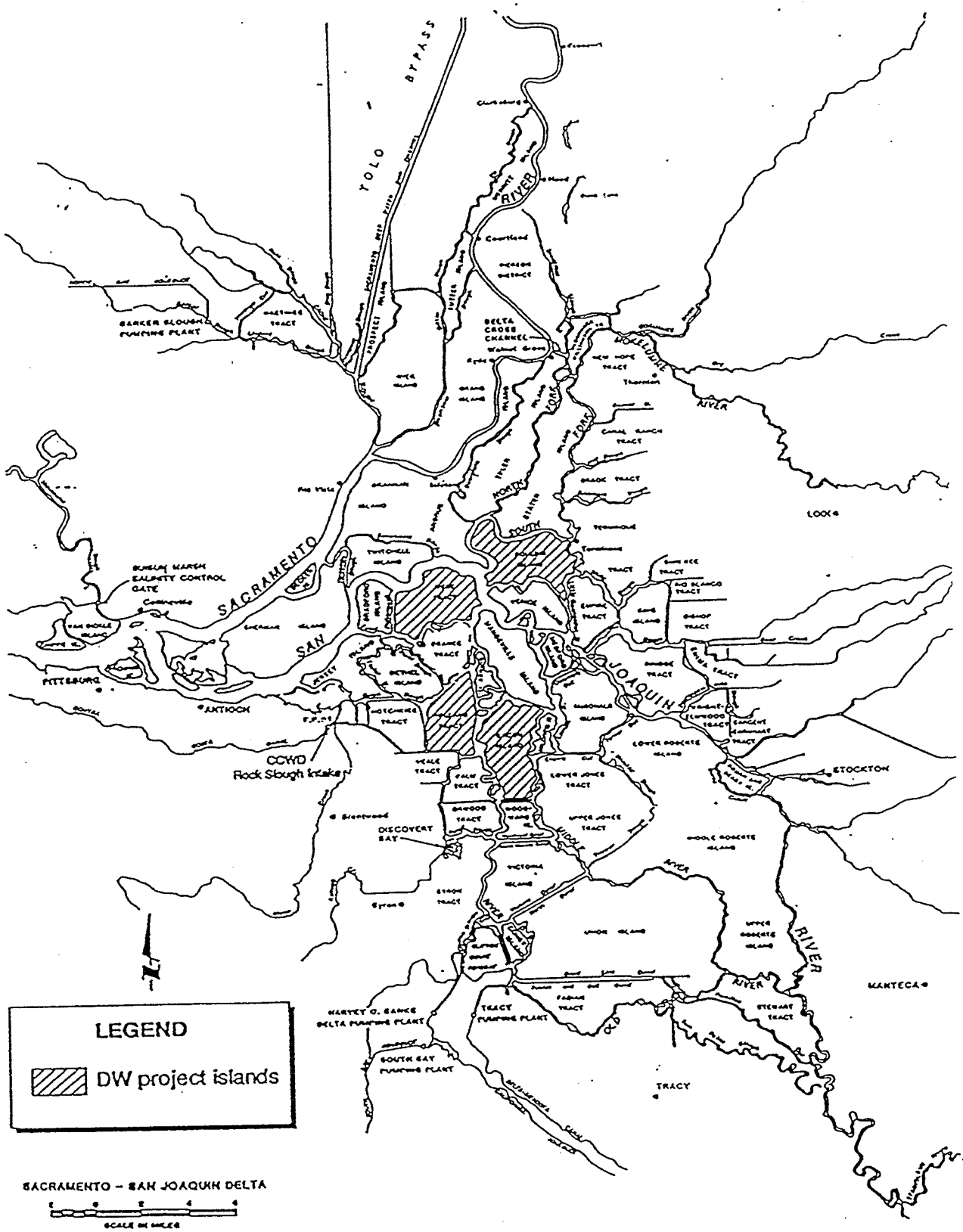
6. *Coordination with IEP Monitoring Programs*

DW will be solely responsible for conducting the required monitoring. In the event that IEP monitoring is being conducted in a manner and location that satisfies the previously described operations requirements, DW may use the data collected and will not be required to conduct duplicate monitoring at those sites. If DW is able to make use of the IEP monitoring data in lieu of project specific monitoring, DW shall compensate IEP for the use of this data by contributing financial support to the IEP monitoring program commensurate to the proportionate share of DW exports to the total Delta exports for the period.

7. *Monitoring Technical Advisory Committee*

The objective of this component is to establish a monitoring technical advisory group (MTAC) to advise and resolve monitoring issues that may develop over the life of the DW project. The MTAC shall be made up of voluntary participants from a variety of agencies, including, but not limited to, invitees from SWRCB, Corps, the Service, NMFS, DFG, DWR, Reclamation, EPA, and DW. DW may convene the MTAC to evaluate and recommend adjustments to the DW monitoring program.

Initially, DW shall work directly with DFG to resolve daily technical monitoring issues but may convene the MTAC to act in a technical capacity to provide review and address any technical inadequacies or disagreements that may occur. The committee may also provide advisory review on issues of waiver occurring during implementation of the monitoring program. Any modifications to the monitoring program must be made with the approval of the responsible agencies and concurrence of the resource agencies who will continue to retain final approval or disapproval of any monitoring changes.



Source: Adapted from California Department of Water Resources 1993a.

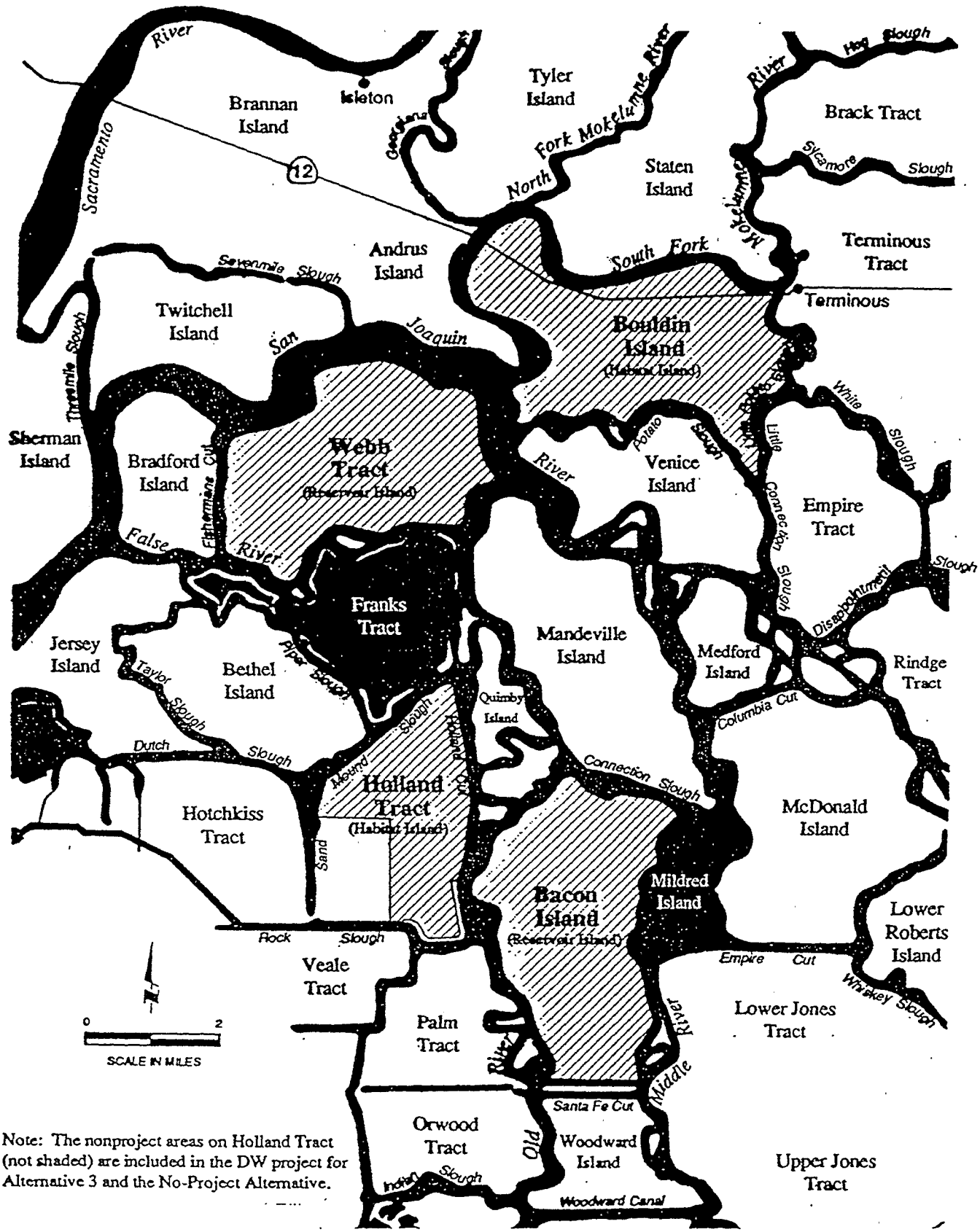
Figure 1.
Sacramento-San Joaquin Delta

DELTA WETL
PROJE

Prepared by: Jones & Stokes A

C—063275

C-063275



Note: The nonproject areas on Holland Tract (not shaded) are included in the DW project for Alternative 3 and the No-Project Alternative.

Source: Adapted from California Department of Water Resources 1993.

Figure 2
DW Project Islands

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

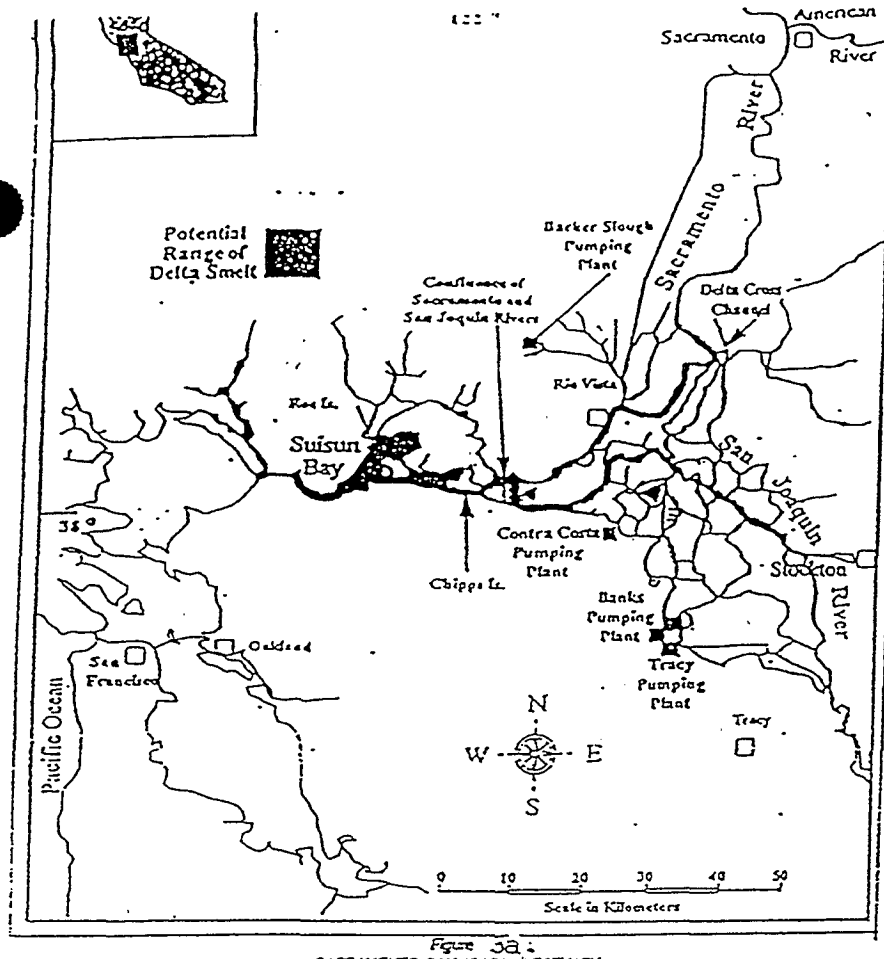


Figure 3a.
SACRAMENTO-SAN JOAQUIN ESTUARY

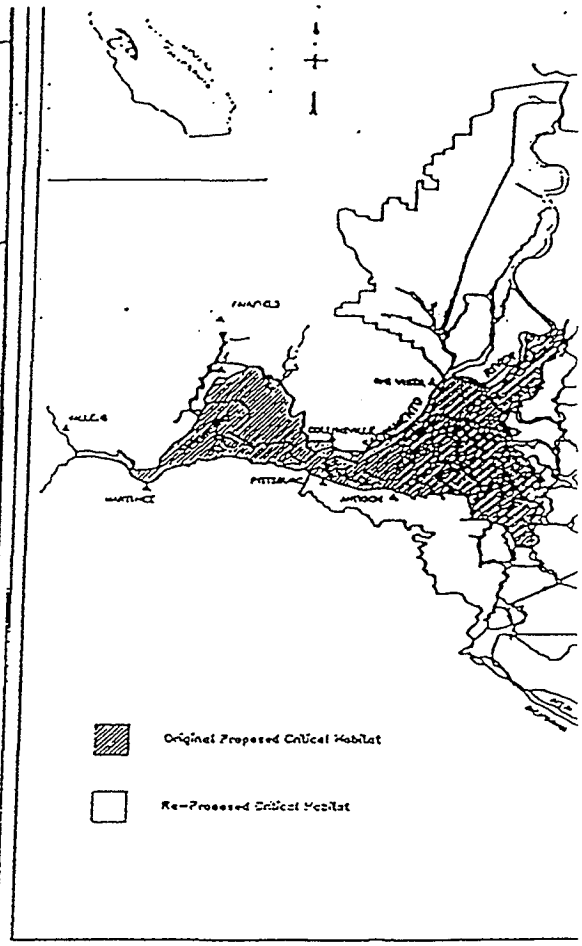


Figure 3b.

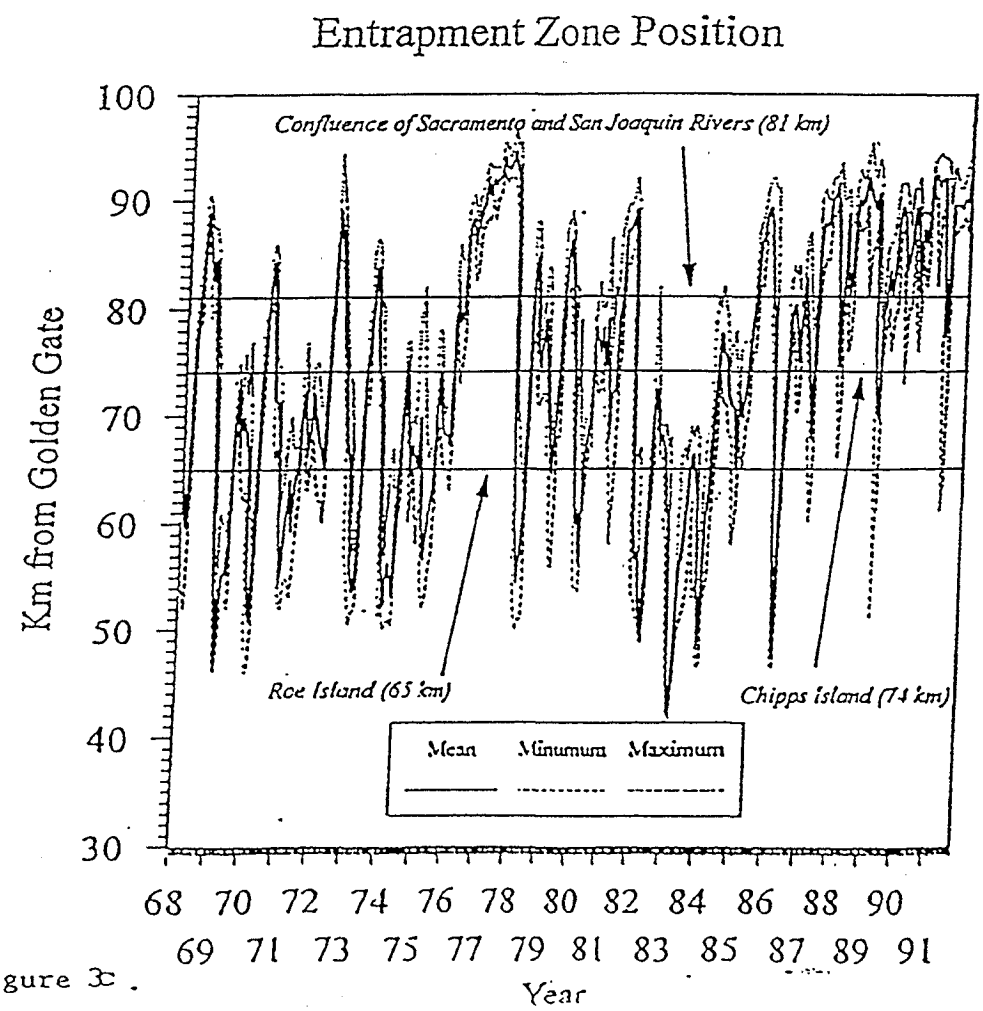


Figure 3c.

C—063277

C-063277

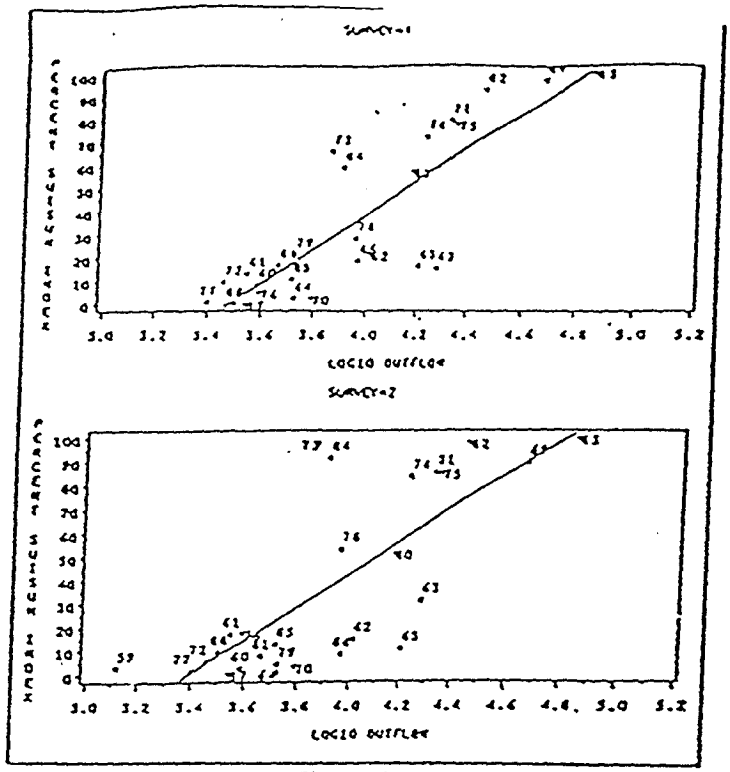
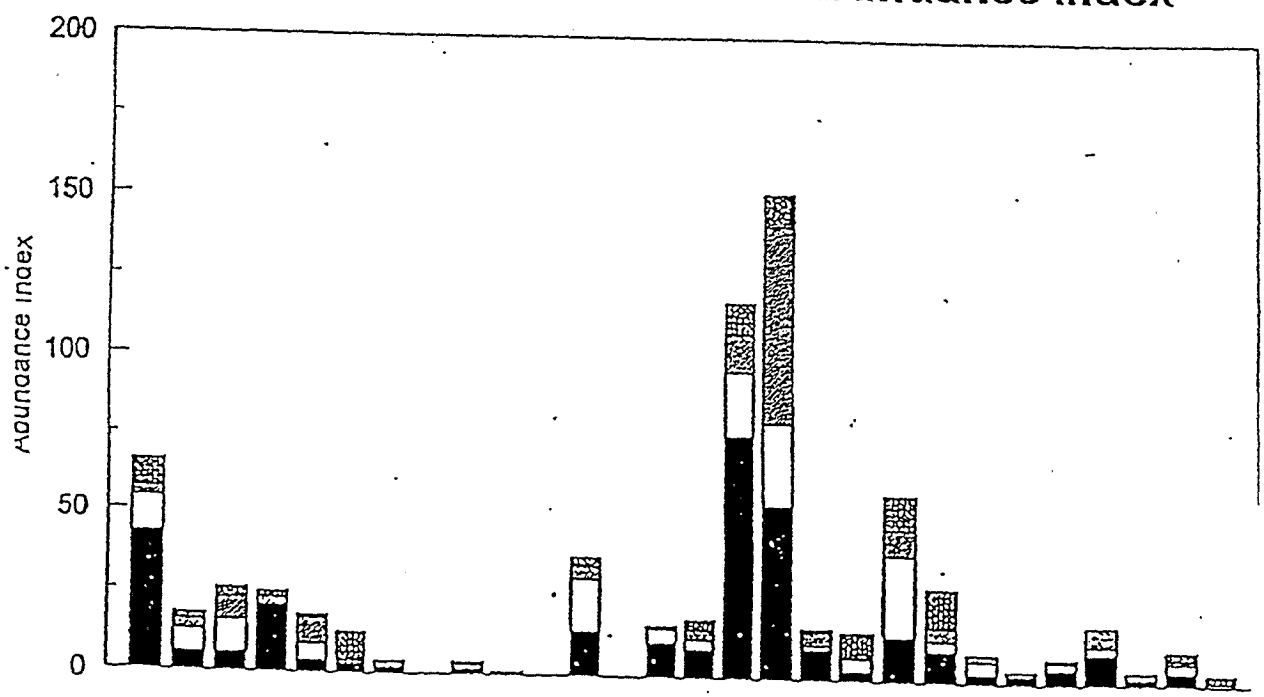


Figure 4a.
RELATIONSHIP BETWEEN THE PORTION OF DELTA SMELT POPULATION WEST OF THE DELTA AND LOG DELTA OUTFLOW DURING THE SURVEY MONTH FOR SUMMER TOW-NET SURVEY, 1959 TO 1988
For arcsine transformed percentages, $r^2 = 0.74$ for survey 1 and $r^2 = 0.55$ for survey 2.
Source: Sweetnam and Stevens 1993.

Figure 4b.

Splittail Fall Midwater Trawl Abundance Index



Year	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
Sep	43.0	6.0	6.0	21.0	4.0	3.0	2.0		2.0	0.0	0.0	14.0		11.0	9.0	78.0	54.0	10.0	3.0	14.0	10.0	3.0	3.0	5.0	10.0	2.0	4.2	0.0
Oct	11.0	7.0	10.0	0.0	5.0	0.0	0.0		1.0	0.0	0.0	16.0		4.0	3.0	20.0	26.0	1.0	4.0	25.0	3.0	4.0	1.0	2.0	2.0	0.0	2.8	1.0
Nov	3.0	3.0	7.0	2.0	8.0	1.0	2.0		0.0	1.0	0.0	4.0		1.0	3.0	12.0	62.0	4.0	0.0	8.0	4.0	2.0	0.0	1.0	6.0	2.0	1.2	0.0
Dec	9.0	2.0	3.0	2.0	1.0	9.0	0.0		1.0	0.0	0.0	3.0		0.0	3.0	10.0	10.0	1.0	8.0	11.0	12.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4
ANNUAL	66.0	18.0	26.0	25.0	18.0	13.0	4.0	0.0	4.0	1.0	0.0	37.0	0.0	16.0	18.0	116.0	152.0	16.0	15.0	58.0	29.0	9.0	4.0	8.0	18.0	4.0	10.6	3.4

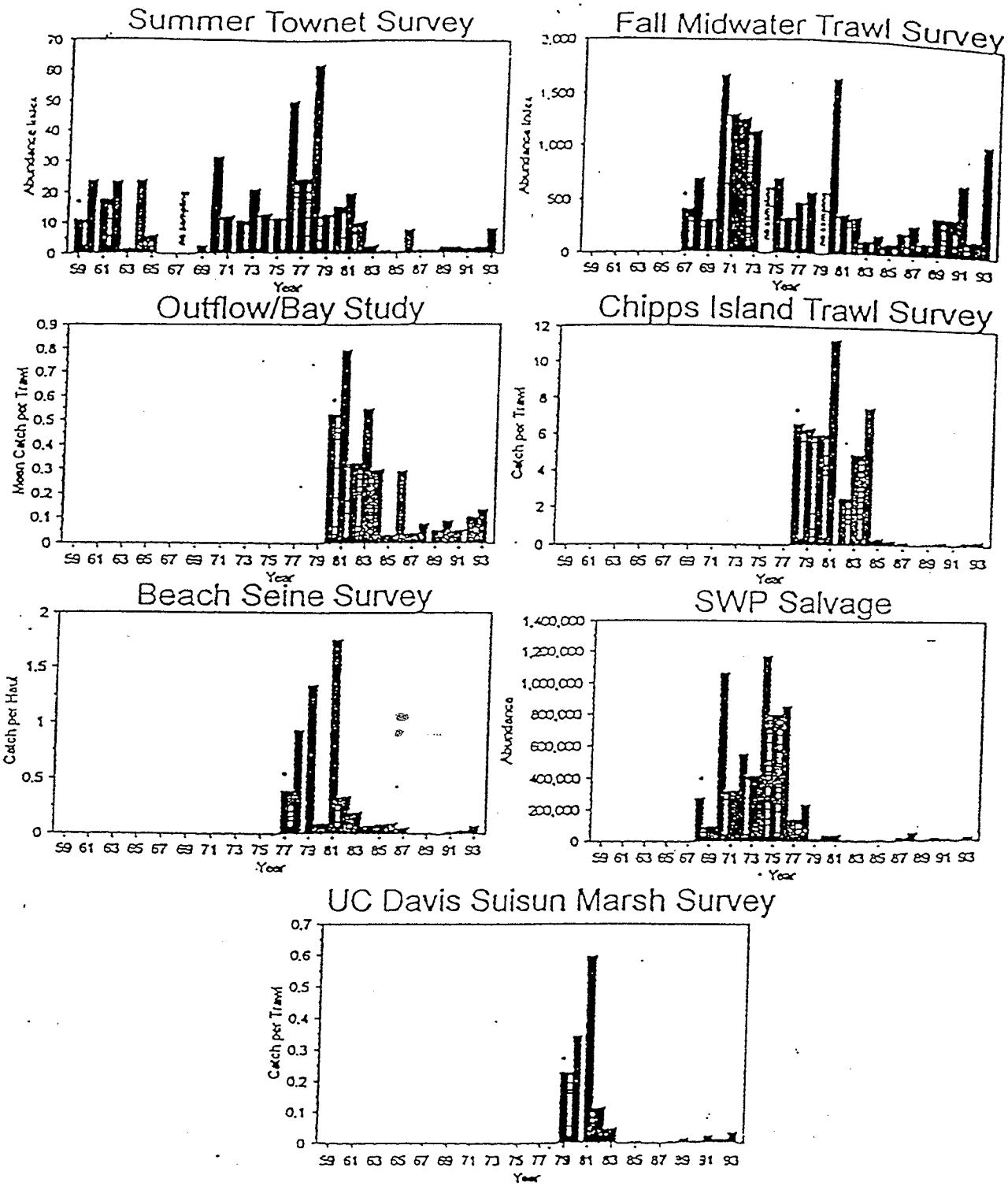


Figure 5a.

TRENDS IN DELTA SMELT POPULATIONS, AS INDEXED BY SEVEN INDEPENDENT SURVEYS

Note that not all surveys were conducted in all years shown.

Source: Department of Fish and Game, updated from Stevens *et al* 1990.

C-063279

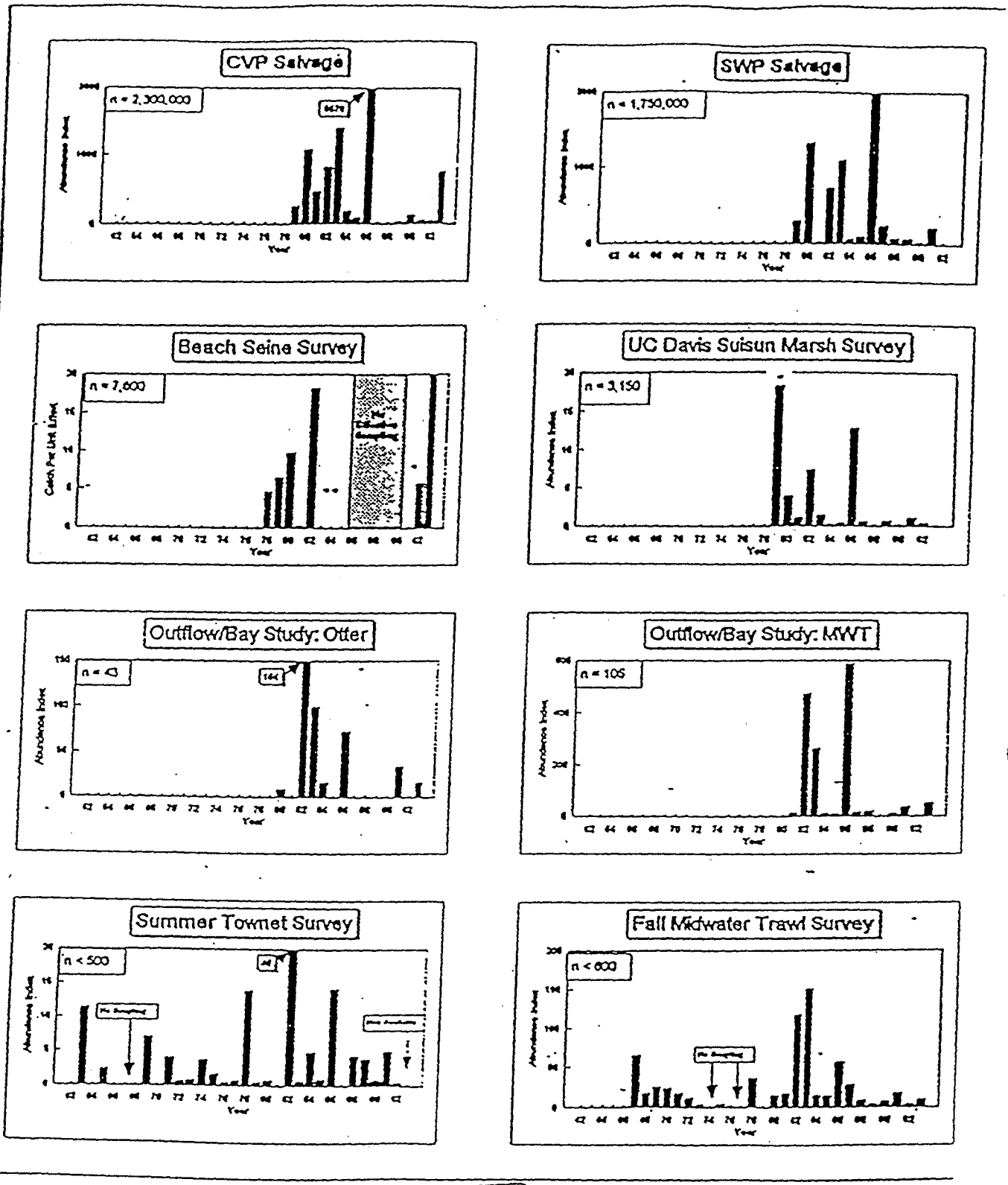


FIGURE 5b Trends in Young-of-the-Year Splittail Abundance, as Indexed by Eight Independent Surveys

C-063280

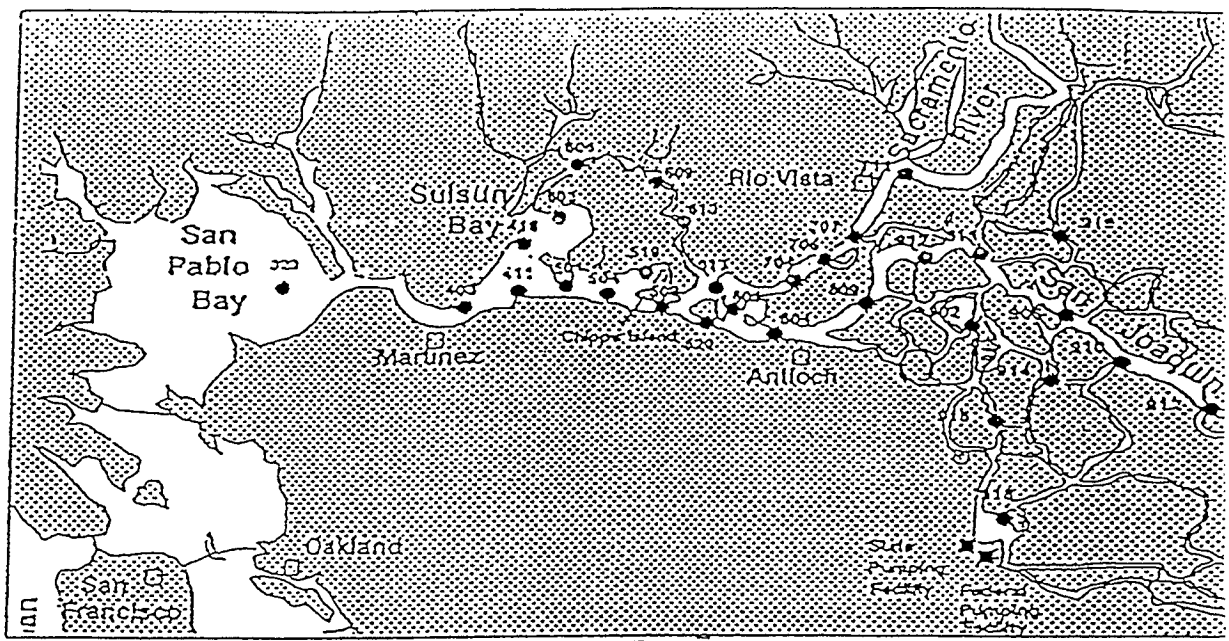


Figure 6a.

SUMMER TOW-NET SURVEY SAMPLING SITES IN THE SACRAMENTO-SAN JOAQUIN ESTUARY

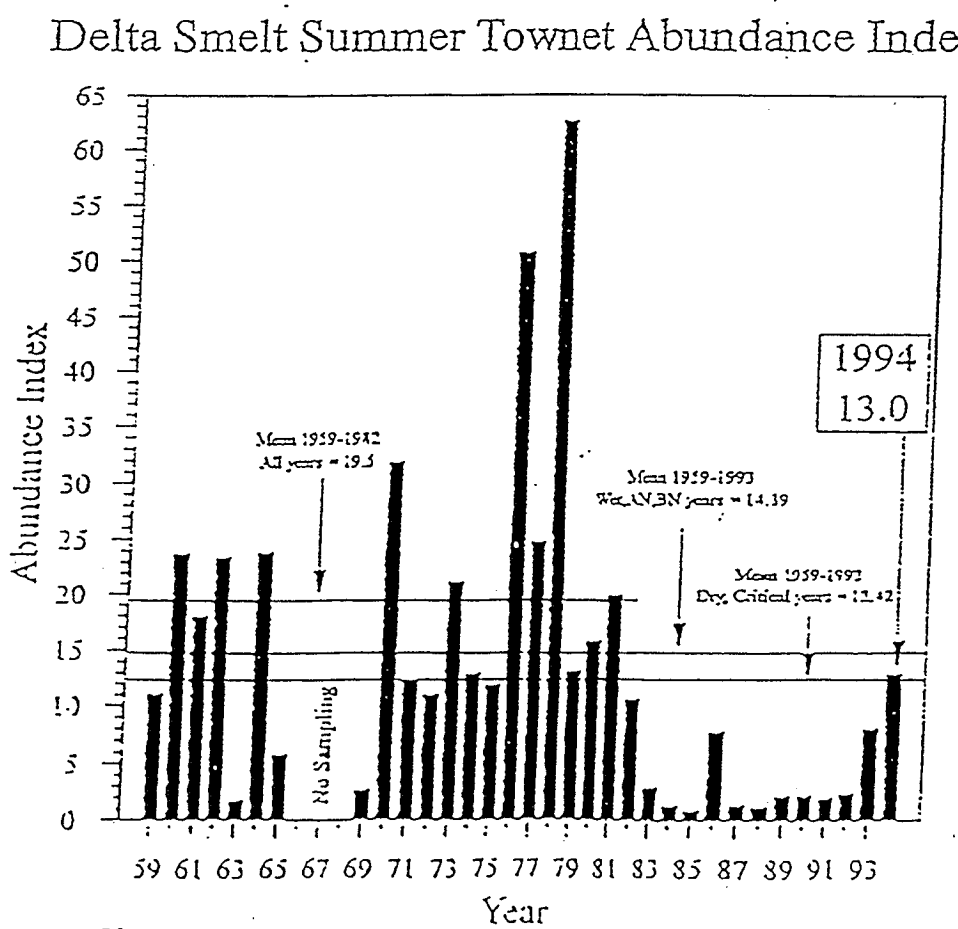


Figure 6b.

C-063281

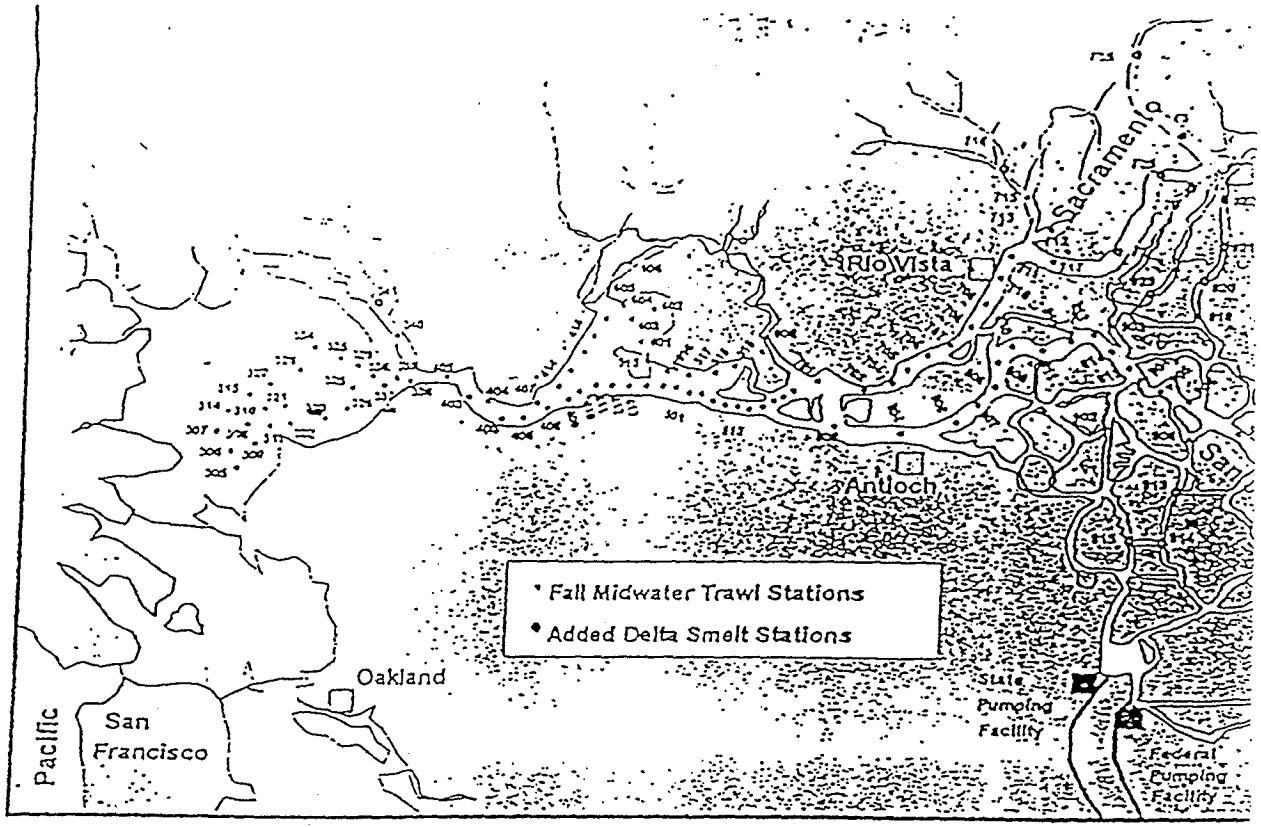
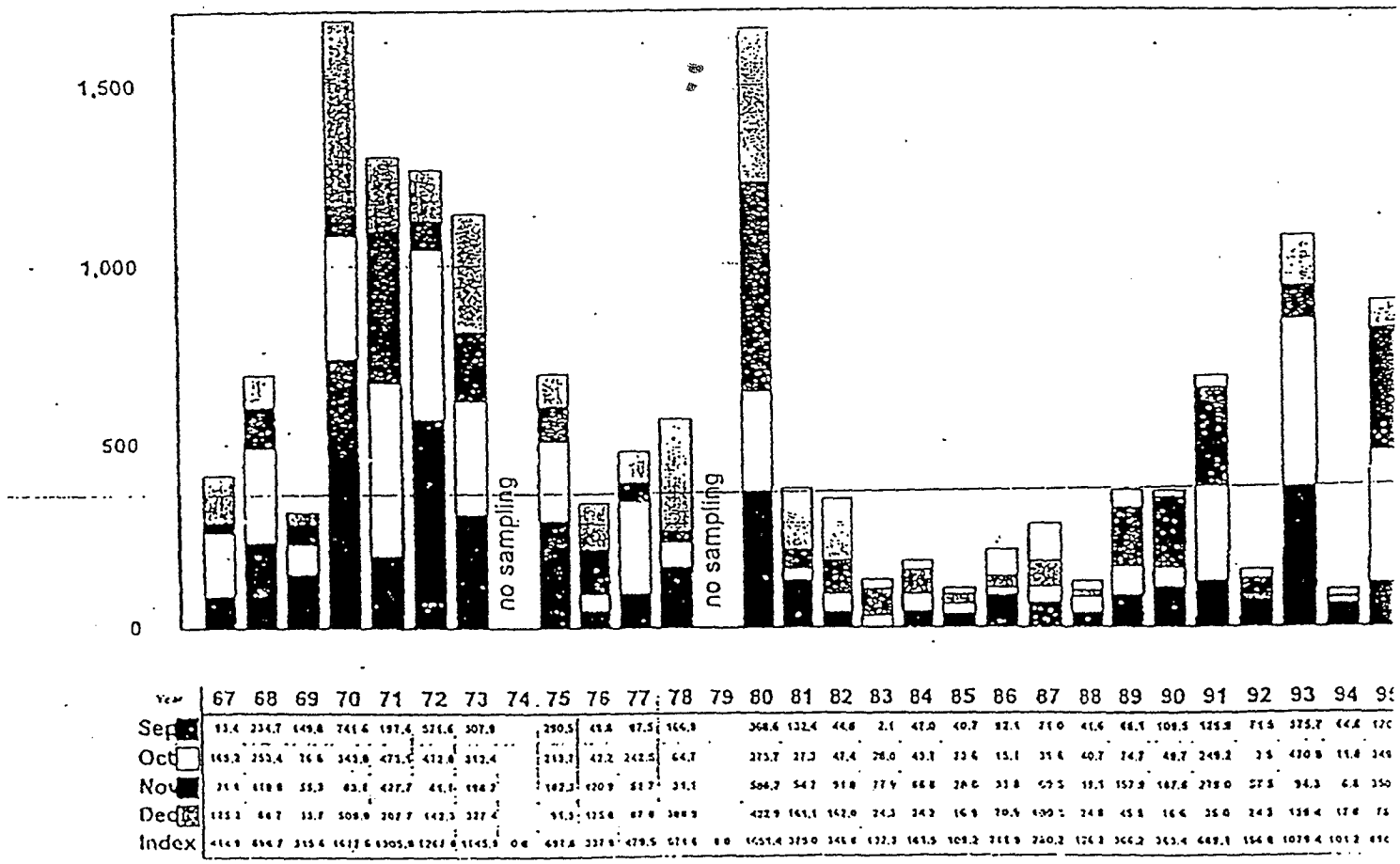


Figure 7a. Fall midwater trawl sampling sites in the Sacramento-San Joaqu

Delta Smelt Fall Midwater Trawl Abundance Inc



Year	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
Sep	33.4	234.7	149.8	741.6	197.4	571.6	307.8		250.5	43.8	87.5	166.9		368.6	132.4	44.8	2.1	47.0	40.7	92.1	21.0	41.6	66.1	109.5	125.8	71.5	375.7	64.4	170
Oct	163.2	253.4	36.6	343.8	471.5	432.8	313.4		213.2	42.2	242.5	64.7		373.7	27.3	47.4	26.0	43.1	23.6	15.1	35.6	40.7	24.7	48.7	249.2	3.5	430.8	11.8	349
Nov	21.1	418.8	55.3	63.6	427.7	41.0	194.2		162.3	120.9	51.7	31.1		506.2	54.2	91.8	77.9	66.8	28.0	31.8	69.5	19.1	157.9	167.6	278.0	27.5	94.3	6.8	350
Dec	133.1	66.7	33.7	509.9	207.7	142.3	327.4		95.3	125.6	67.8	388.9		422.9	165.1	152.0	24.3	34.2	16.9	70.5	190.1	24.8	45.8	16.6	35.0	24.3	139.4	17.6	75
Index	414.9	694.7	315.6	1617.6	1305.8	1267.6	1145.9	0.0	691.8	337.8	479.5	674.6	0.0	1651.4	379.0	345.6	132.3	161.5	109.2	211.9	240.2	126.3	366.2	353.4	668.1	154.8	1079.4	101.2	819

Figure 7b. Fall midwater trawl index showing decline from 1981 to 1992. No
in 1991 and 1993.

C-063282