Appendix D. National Marine Fisheries Service Biological Opinion

C-063137

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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MAY 7 1997

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

Dear Mr. Monroe:

Please find enclosed the National Marine Fisheries Service's (NMFS) final biological opinion and draft conference opinion concerning the effects of the proposed construction and operation of the Delta Wetlands (DW) project (PN 190109804) on the endangered Sacramento River winter-run chinook salmon and proposed Central Valley Steelhead Evolutionarily Significant Unit (ESU), respectively. Please note that these two opinions have been combined into a single document.

The biological and draft conference opinions conclude that the Corps of Engineers' issuance of a Department of Army permit for the DW project is not likely to jeopardize the continued existence of the Sacramento River winter-run chinook salmon or the Central Valley Steelhead ESU which is proposed as endangered. The biological opinion also concludes that the proposed project will not result in the adverse modification of winter-run chinook salmon critical habitat. However, because NMFS believes there will be some incidental take of winter-run chinook salmon as a result of project operations, an incidental take statement is also attached to the biological opinion. This take statement includes several reasonable and prudent measures that NMFS believes are necessary and appropriate to reduce, minimize, and monitor project impacts. Terms and conditions to implement the reasonable and prudent measures are presented in the take statement and must be adhered to in order for incidental take to be authorized. The take statement also addresses the incidental take of Central Valley ESU Steelhead, however, the prohibitions against take in section 9 of the Endangered Species Act do not apply to a proposed species. In the event of a listing, the

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incidental take statement included in this document will apply to the Central Valley Steelhead ESU.

Please note that the incidental take statement does not provide incidental take authorization for the re-diversion of Delta Wetlands discharges by other parties including the Delta pumping plants operated by the Central Valley Project (CVP) or the State Water Project (SWP). The operations of these facilities and the related incidental take of winter-run chinook salmon are already covered under the CVP-OCAP biological opinion issued by NMFS to the Bureau of Reclamation (Bureau). I expect that the Bureau and the Department of Water Resources will follow their general practice of coordinating with NMFS to assess the potential effects of the transfer of DW water through their project facilities on the endangered winter-run chinook salmon to determine whether the projects will be able to comply with the requirements of the CVP-OCAP opinion (as amended) on project operations.

Finally, the biological and conference opinions also provide several advisory conservation recommendations for winter-run chinook salmon and the Central Valley Steelhead ESU that include the use of levee maintenance procedures that will increase or enhance the quantity and quality of riparian habitat, and studies designed to explore juvenile salmonid rearing and migratory behaviors in the Sacramento/San Joaquin Delta.

If you have questions concerning the final biological and draft conference opinions or incidental take statements, please contact Ms. Penny Ruvelas at (707) 575-6062.

Sincerely,

William T. Hogarth, Ph.D.
Acting Regional Administrator

Enclosure

cc: Michael Thabault, USFWS, Sacramento
D. McKee, CDFG, Sacramento
Frank Wernette, CDFG, Stockton

BIOLOGICAL AND CONFERENCE OPINIONS

Agency: Sacramento District, U.S. Army Corps of Engineers.

Activity: Delta Wetlands (PN 190109804)

Consultation Conducted By: Southwest Region, National Marine Fisheries Service.

Date Issued: MAY 7 1997

I. BACKGROUND

The U.S. Army Corps of Engineers (USACE) first requested formal consultation pursuant to section 7 of the Endangered Species Act with the National Marine Fisheries Service (NMFS) on the Delta Wetlands Project (DW) in January, 1991. However, concerns with the 1991 DW proposal resulted in its withdrawal for revision by the project proponents.

A biological assessment (BA) for the revised DW proposal was prepared by Jones & Stokes Associates (JSA) and submitted to NMFS on June 21, 1995. Formal consultation for the endangered winter-run chinook salmon was initiated by the USACE with NMFS on July 10, 1995. The draft environmental impact report and environmental impact statement (DEIR/EIS) for the revised DW proposal was released on September 11, 1995.

Early in the consultation period, questions about DW and the interrelated and interdependent water export operations at the Federal Central Valley Project (CVP) and State Water Project (SWP) were raised by the U.S. Fish and Wildlife Service (FWS), the California Department of Fish and Game (CDFG), and NMFS. As proposed by DW, the CVP and SWP pumping plants in Sacramento-San Joaquin Delta would increase water exports from the Delta above current levels. However, the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) were not participants in this section 7 consultation and consistency with the existing biological opinions for CVP/SWP issued by NMFS (2/13/93 and amended 5/95) and FWS (3/6/95) was unclear. To address this issue, the USACE, NMFS, FWS, and DW agreed at a meeting on February 1, 1996 that the consultation would: (1) assess the construction and operation of all DW facilities, (2) assess the diversion of water from, and discharge

of water to, adjacent waterways within the Delta, and (3) assess reasonably foreseeable impacts resulting from CVP/SWP export operations associated with DW discharges. However, it was also agreed that the incidental take of listed species at the CVP/SWP facilities would be addressed and authorized through the existing biological opinions issued to Reclamation and DWR for the long-term operations of the CVP/SWP.

Based on discussion and analysis during 1995 and early 1996 consultation meetings, the DW project proposal was further revised to include measures to reduce potential adverse effects to listed species. This mitigation plan was submitted to NMFS and FWS by the USACE on February 20, 1996, and NMFS issued a draft biological opinion based on this mitigation plan to the USACE on June 28, 1996.

In response to the March 29, 1996 draft FWS biological opinion and reasonable and prudent alternative for the listed delta smelt and proposed Sacramento splittail, DW requested that the USACE delay their comments on the NMFS and FWS draft biological opinions until agreement regarding the operations of the DW project could be reached. On May 13, 1996, The USACE requested that NMFS and FWS deliver their final biological opinions 60 days after the receipt of USACE comments on the draft biological opinions. These comments were delayed to explore other operational scenarios that would not jeopardize a listed species.

On September 12, 1996, the USACE requested formal conferencing on the impacts of the DW project on the proposed as endangered Central Valley Evolutionarily Significant Unit (ESU) steelhead trout. This biological opinion for the endangered winter-run chinook salmon contains the conference opinion on impacts to the Central Valley steelhead.

Further discussions on potential measures to avoid or reduce impacts to listed species continued until early February, 1997, resulting in an operations matrix of measures to reduce impacts to listed species. On February 21, 1997, the USACE transmitted their formal comments on the NMFS draft biological opinion and DW's proposed mitigation measures to reduce impacts to listed species, thereby starting the 60-day clock for delivery of the final opinion.

II. PROPOSED ACTIVITY

DW proposes a water storage project on four islands within the Sacramento-San Joaquin Delta: Bacon Island, Webb Tract, Bouldin Island, and Holland Tract. Bacon Island, Webb Tract, and Bouldin Island are owned by DW. Holland Tract is partially owned by DW. Bacon Island and Webb Tract will be managed as "reservoir islands". Surplus Delta inflows, transferred water, or banked water would be diverted by siphon onto the two reservoir islands for later sale and/or release for Delta export or to meet Bay-Delta estuary water quality or flow requirements. Bouldin Island and Holland Tract will be managed as "habitat islands" through wetland creation and wildlife habitat management. DW currently does not have a water right to implement the proposed activity. The State Water Resources Control Board (SWRCB) will issue its determination for such a water right following issuance of the final biological opinions on the proposed DW project.

Portions of the habitat islands will 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 DW and incidental to the proposed project.

Reservoir Islands

DW will undertake its diversion and discharge operations pursuant to the "final operations criteria" which are set out in Appendix 1. Bacon Island and Webb Tract will be managed for year-round water storage. Two intake siphon stations and one discharge pumping station will be constructed along the perimeter of each reservoir island.

Each reservoir island will be designed for water storage levels up to a maximum pool elevation of +6.0 feet relative to mean sea level. The implementation of the final operations criteria, water availability, permit conditions, and requirements of the California Department of Water Resources Division of Safety of Dams may limit storage capacities and may result in a final storage elevation of less than +6 feet. The +6.0 feet pool elevation provides an initial estimated combined capacity of 238 thousand acre-feet (TAF) for Bacon Island (118 TAF) and Webb

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Tract (120 TAF). The total physical storage capacity of the islands may increase over time as a result of soil subsidence. Subsidence normally occurs at a rate of 2 to 3 inches per year. Due to the replacement of agriculture operations with water storage operations, this subsidence is estimated to occur at approximately 0.5 inches per year, resulting in an increase in combined storage capacity to 260 TAF in 50 years.

Diversion operations. Water diversions onto the reservoir islands would occur when there is surplus water in the Delta under the requirements of the State Water Resource Control Board's (SWRCB) 1995 Water Quality Control Plan (WQCP). This surplus water is defined as the amount of water remaining within the specified export/inflow ratio for that month after all other WQCP requirements have been met and all senior water rights have been appropriated within these WQCP requirements and permitted pumping capacities. This 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, 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 the DW project will still be able to divert water for storage.

Because the reservoir islands will be managed for possible year round storage of water, there may be years during which multiple diversion and subsequent discharges of the reservoirs may occur. The reservoir islands will be filled, drawn down, and refilled in years when the operations criteria, water availability and demands allow. 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.

During years of low water demand, water would remain in the reservoirs at the end of the water year (i.e., September 30). Under the DW project, water could remain on a reservoir island for release in subsequent years. Carry-over storage would generally occur during wet years with low demand.

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

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 project diversions with CVP and SWP operations will be established to ensure that DW project diversions capture only available Delta flows, satisfy 1995 State Water Quality Control Board (SWQCB) water quality objectives, and maximize efficiency of DW project water storage operations.

Diversion rates of water onto reservoir islands would vary with pool elevation and water availability. The initial diversion rate for each water year is limited to a combined maximum of 5,500 cfs for a five-day period. Thereafter, the maximum rate of diversions onto either Webb Tract or Bacon Island would be 4,500 cfs (9 TAF per day) at the time diversion begin (i.e., when the head differential between channel water elevation and the island bottom is greatest). The diversion rate 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. The proposed maximum average monthly diversion rate will be 4,000 cfs.

Discharge operations. Export of DW project water would mainly take place at the CVP and SWP pumps. Discharges of water from the DW project islands would occur when the CVP/SWP pumping plants are not pumping at full capacity. DW discharge for export at the CVP/SWP would be regulated in a manner that the CVP/SWP export limits, as defined by the WQCP, are not exceeded. Actual timing and volume of discharges from the reservoir islands will depend on periods of demand, Delta regulatory limitations, and CVP/SWP export pumping capacities. For the purposes of this biological opinion, discharges from the DW project islands are

not counted as inflow to the Delta, as defined by the 1995 WQCP. Treatment of DW discharges as Delta inflow will constitute new information and may require further consultation.

Discharge of DW project water will occur pursuant to DW's final operations criteria as set out in Appendix 1. Stored water will be discharged from reservoir islands during periods of demand, subject to Delta regulatory limitations and export pumping capacities. Discharges will be pumped at a combined maximum daily average of 6,000 cfs per reservoir island. Combined monthly average reservoir island discharge will be up to 4,000 cfs. Pump stations will discharge under the surface of receiving channel water.

DW's final criteria have several limitations on discharge operations, including: no discharges for export from Webb Tract from January through June; limiting discharges from Bacon Island from April through June to 50% of San Joaquin River flows at Vernalis; and percentage limitations on discharges from February through July based on unused export capacity at the CVP/SWP pumps.

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 1 foot of water per acre of wetland) to create 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 a 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 may be repeated. DW project 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 will be installed along the perimeter of each reservoir island. Each station would consist of 16 siphon pipes,

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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 through drawdown. Actual discharge rates 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 stress and potential erosion caused by 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 rock revetment on levee slopes, and control of project-related seepage through an extensive monitoring and control system. Maintenance activities would include, but are not limited to, placement of fill material, placement or installation of erosion protection material, reshaping or grading of fill material, herbicide application, selective burning, and regrading or patching of the levee road surface.

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

Habitat Islands

As proposed, Bouldin Island and Holland Tract would be dedicated to management for wildlife and wetland habitat values to offset impacts to terrestrial wildlife and wetlands resulting from operations of the two reservoir islands. A variety of habitats will be created or protected to provide foraging and breeding habitats for a wide range of wildlife and waterfowl species. DW will not discharge for export or rediversion any water from the habitat 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. Routine levee maintenance activities would not differ from current practices including replenishing riprap, placing fill material, grading, disking, mowing, selectively burning, controlling rodents, and installing rock revetment.

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 CDFG and DW 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.

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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 water 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. For the purposes of this biological opinion, habitat island discharges shall be treated as not available for sale, export, or rediversion. Sale, export, or rediversion of habitat island discharges will constitute new information and may require further consultation.

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.

Recreation facilities

DW proposes to construct 11 recreational facilities on each reservoir island and 10 new recreation facilities on Bouldin

Island and 6 new recreation facilities on Holland Tract. Specific types of facilities have not been described by DW. Each recreational facility will be constructed on approximately 5 acres and will include vehicle and boat access. A total of 1200 boat docks and 1472 piles will be placed around exterior island levees in association with the recreation facilities and siphon/pumping stations. The Bouldin Island airstrip will be available for use by hunters and other recreationalists to fly to the island.

Fish Screens

For all four islands, fish screens will be installed around the intake of each existing and new siphon to prevent entrainment and impingement of all adult and most juvenile fish that are present in the Delta. The DW fish screens will maintain a 0.2 fps approach velocity for diversions. The average approach velocity will decrease 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 inch. 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 USACE and SWRCB with concurrence by USFWS, DFG and NMFS.

III. LISTED AND PROPOSED SPECIES

Sacramento River Winter-run Chinook Salmon

The Sacramento River winter-run chinook salmon (Oncorhynchus tshawytscha) is a unique population of chinook salmon in the Sacramento River. It is distinguishable from the other three Sacramento chinook runs by the timing of its upstream migration and spawning season. NMFS listed winter-run chinook salmon as threatened under emergency provisions of the Endangered Species Act (ESA) in August 1989, and formally listed the species in

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November 1990. The State of California listed winter-run chinook as endangered in 1989 under the California State Endangered Species Act. On January 4, 1994, NMFS reclassified the winter-run chinook as an endangered species (59 FR 440). On June 16, 1993, NMFS designated critical habitat for the winter-run chinook from Keswick Dam (Sacramento River mile 302) to the Golden Gate Bridge in San Francisco Bay (58 FR 33212).

Prior to construction of Shasta and Keswick Dams in 1945 and 1950, respectively, winter-run chinook were reported to spawn in the upper reaches of the Little Sacramento, McCloud, and lower Pit Rivers (Moyle et al. 1989). Specific data relative to the historic run sizes of winter-run chinook prior to 1967 are sparse and anecdotal. Numerous fishery researchers have cited Slater (1963) to indicate that the winter-run chinook population may have been fairly small and limited to the spring-fed areas of the McCloud River before the construction of Shasta Dam. However, recent CDFG research in California State Archives has cited several fisheries chronicles that indicate the winter-run chinook salmon population may have been much larger than previously thought. According to these qualitative and anecdotal accounts, winter-run chinook salmon reproduced in the McCloud, Pit and Little Sacramento Rivers and may have numbered over 200,000 (Rectenwald 1989).

Completion of the Red Bluff Diversion Dam (RBDD) in 1966 enabled accurate estimates of all salmon runs to the upper Sacramento River based on fish counts at the fish ladders. These annual fish counts document the dramatic decline of the winter-run chinook population. The estimated number of winter-run chinook passing the dam from 1967 to 1969 averaged 86,509. During 1990, 1991, 1992, 1993, 1994, and 1995, the spawning escapement of winter-run chinook past the dam was estimated at 441, 191, 1,180, 341, 189, and 1,361 adults, respectively.

The first winter-run chinook salmon upstream migrants appear in the Sacramento-San Joaquin Delta during the early winter months (Skinner 1972). On the upper Sacramento River, the first upstream migrants appear during December (Vogel and Marine 1991). The upstream migration of winter-run chinook typically peaks during the month of March, but may vary with river flow, water-year type, and operation of the RBDD. Keswick Dam completely blocks any further upstream migration, forcing adults to migrate

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to and hold in deep pools downstream, before initiating spawning activities.

Since the construction of Shasta and Keswick dams, winter-run chinook spawning has primarily occurred between RBDD and Keswick Dam. The spawning period of winter-run chinook generally extends from mid-April to mid-August with peak activity occurring in June (Vogel and Marine 1991). Aerial survey of spawning redds have been conducted annually by the CDFG since 1987. These surveys have shown that the majority of winter-run chinook spawning in the upper Sacramento River occurs between the upper Anderson Bridge at RM 284 and the Anderson-Cottonwood Irrigation District Dam at RM 298. However, some winter-run chinook may also spawn below Red Bluff (RM 245) in some years. In 1988, for example, winter-run chinook redds were observed as far downstream as Woodson Bridge (RM 218).

Winter-run chinook eggs hatch after an incubation period of about 40-60 days depending on ambient water temperatures. Maximum survival of incubating eggs and pre-emergent fry occurs at water temperatures between 40° F and 56° F. Mortality of eggs and pre-emergent fry commences at 57.5° F and reaches 100 percent at 62° F (Boles 1988). Other potential sources of mortality during the incubation period include redd dewatering, insufficient oxygenation, physical disturbance, and water-borne contaminants.

The pre-emergent chinook salmon fry remain in the redd and absorb the yolk stored in their yolk-sac as they grow into fry. This period of larval incubation lasts approximately 2 to 4 weeks depending on water temperatures. Emergence of the fry from the gravel begins during late June and continues through September. The fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure.

The emigration of juvenile winter-run chinook from the upper Sacramento River is highly dependent on streamflow conditions and water year type. Once fry have emerged, storm events may cause en masse emigration pulses. Thus, emigration past Red Bluff may begin as early as July, generally peaks in September, and can

continue until mid-March in drier years (Vogel and Marine 1991). Data combined from 1981-1992 trapping and seining efforts show that winter-run chinook emigrants occur between early July and early May from Keswick to Princeton (RM 302 to RM 158). Emigration monitoring of Glenn Colusa Irrigation District (GCID) at RM 206 shows that juvenile winter-run chinook migrate past GCID as early as mid-July and may continue through April (HDR Engineering Inc., 1993).

In the Sacramento-San Joaquin Delta, juvenile winter-run chinook generally occur from December through April as evidenced from trawling, seining, and CVP/SWP fish salvage data (CDFG 1993a). Low to moderate numbers of juvenile winter-run chinook may occur in the fall, or later in the spring depending on the water year type. Smolt outmigration typically occurs from late January through April (Stevens 1989, Perry 1992).

In an estuarine environment such as the Delta, juvenile chinook salmon forage in intertidal and shallow subtidal areas, such as marshes, mudflats, channels, and sloughs. These habitats provide protective cover and a rich food supply (McDonald 1960, Dunford 1975). The distribution of the juvenile fish appears to change tidally in an estuarine environment. Juvenile chinook have been observed moving with the flood tide from deeper tidal channels into the tidally flooded nearshore areas for feeding (Healy 1991, Levy and Northcote 1981, Levings 1982). With the receding tide these juveniles retreat back into tidal channels. Large fry and smolts tend to congregate in the surface waters of main and subsidiary sloughs and channels, moving into shallow subtidal areas only to feed (Allen and Hassler 1986).

Optimal water temperatures for the growth of juvenile chinook salmon in an estuary are 54-57°F (Brett 1952). In Suisun and San Pablo Bays water temperatures reach 54°F by February in most years. Other Delta waters do not reach 54°F until March. The specific cues that trigger juvenile chinook salmon to migrate from the Sacramento-San Joaquin Estuary are not well understood, but water temperatures of 59°F and higher have been observed to induce migration in Northwest estuaries (Dunford 1975, Reimers 1973: cited from Cannon 1981). High river flows in the winter and early spring assist juvenile fish migrate downstream to the estuary, while positive outflow from the Delta improves juvenile survival and migration to the ocean.

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Proposed Central Valley Steelhead ESU

On May 20, 1993, NMFS announced that it would conduct a status review to identify all coastal steelhead ESU(s) within California, Oregon and Washington and to determine whether any of these ESU(s) warranted listing under the ESA (58 FR 29390). Subsequently, on February 16, 1994 NMFS received a petition from the Oregon Natural Resources Council and 15 co-petitioners to list all steelhead (or specific ESUs, races or stocks) within California, Oregon, Washington and Idaho. On August 9, 1996, NMFS proposed the listing of 10 ESUs within California, Oregon, Washington, and Idaho (61 FR 41541). Within California, all six ESUs have been proposed for listing under the ESA. Threatened status has been proposed for the Klamath Mountains Province and Northern California ESUs. Endangered status has been proposed for the Central California Coast, South/Central California Coast, Southern California, and Central Valley ESUs.

Steelhead (Oncorhynchus mykiss) are considered to have the greatest diversity of life history patterns of any Pacific salmonid species, including varying degrees of anadromy and plasticity of life history patterns between generations (Barnhart 1986). Biologically, steelhead can be divided into two basic run-types, based on the state of sexual maturity at the time of river entry and duration of spawning migration. The stream-maturing type, often referred to as summer steelhead, enters fresh water in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns shortly thereafter (Barnhart 1986).

The Sacramento and San Joaquin Basins may once have had multiple runs of steelhead of both winter and summer types. However, through hatchery practices and modifications to the natural hydrology of the systems caused by large-scale water projects, most of the runs throughout the system have been extirpated, and the remaining runs are commonly thought to be winter steelhead only. Previous run size estimates of greater than 10,000 fish in the upper Sacramento River were reported in the late 1960's. Currently, run sizes in the upper Sacramento River are approximately 1,500 fish. In the San Joaquin Basin, small populations may remain in the Mokelumne, Tuolomne and Stanislaus Rivers. Steelhead primarily utilize the habitats in the upper

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tributaries of rivers. Many of these areas are no longer accessible to steelhead due to the major dams built in many of the lower river reaches throughout the valley. Over 95% of the habitat formerly available to steelhead migrants has been lost due to these barriers.

In the Sacramento-San Joaquin Delta, the CVP and SWP pumping plants have a serious effect on the habitat conditions available to migrating steelhead. Reverse flows delay migrating adults and juveniles. Juveniles are entrained into Clifton Court Forebay, where predation and entrainment may result in tremendous mortalities.

In the Central Valley ESU, spawning migrations may occur throughout the year with seasonal peaks of activity. Adult steelhead enter fresh water from July through May, with two peaks in September and February. Spawning occurs between November and June with peak activity in January and February. Steelhead are iteroparous, meaning that they do not always die after spawning like other Pacific salmon. However, more than two spawning migrations appears to be unusual. Iteroparous steelhead are predominantly female (McEwan and Jackson 1996). Most of the natural production of steelhead within the Central Valley ESU occurs in Antelope, Deer and Mill Creeks which are tributaries to the upper Sacramento River below the RBDD. The American, Feather, Yuba, and possibly the Mokelumne Rivers also have naturally spawning populations.

Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Barnhart 1986; Everest 1973). Steelhead eggs generally incubate between February and June (Bell 1991), and fry typically emerge from the gravel 2 to 3 weeks after hatching (Barnhart 1996). After emergence, steelhead fry usually inhabit shallow water along perennial stream banks. Older fry establish territories which they defend. The majority of steelhead in their first year of life occupy riffles, although some larger fish inhabit pools or deeper runs. Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Juvenile steelhead live in freshwater for between one and four years (usually two years in the Pacific Southwest) and then become smolts and migrate to the sea from November through May with peaks in March,

April and May. The smolts can range from 14 to 21 cm in length. Steelhead spend between one and four years in the ocean (usually two years in the Pacific Southwest) (Barnhart 1986).

Water temperatures affect all metabolic and reproductive activities of the fish, including growth, swimming ability, and the ability to capture and assimilate food. Productive steelhead streams should have summer temperatures in the 10 to 15 degrees Celsius range, with an upper limit of 20 degrees Celsius. Steelhead have difficulty extracting oxygen from water which is above 21 degrees Celsius (69.8 degrees Fahrenheit) in temperature, regardless of the amount of oxygen available (Hooper 1973). Bell (1973) listed 23.9 degrees Celsius (75 degrees Fahrenheit) as the upper lethal limit of steelhead. Juvenile steelhead smoltification abruptly ceased when temperatures increased to 14 to 18 degrees Celsius (57.2 to 64.4 degrees Fahrenheit) (Wagner 1974, Kerstetter and Keeler 1976).

Environmental Baseline

Sacramento-San Joaquin Delta. The Sacramento River Basin provides approximately 75% of the water flowing into the Delta (DWR 1993). With the completion of upstream reservoir storage projects, the Sacramento River, San Joaquin River, and Delta waterways are now highly regulated systems, such that the current seasonal distribution of flows differs from historical patterns. The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round.

To a great extent, streamflow volume and runoff patterns regulate the quality and quantity of habitat available to juvenile salmonids. Salmon are highly adapted to seasonal changes in flow. Increased stream flows in the fall and winter stimulate juvenile salmonid downstream migration, improve rearing habitat, and improve smolt survival to the ocean. Changes in runoff patterns from upstream reservoir storage, and changes in natural flow patterns in Delta waterways from CVP/SWP pumping in the

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south Delta have adversely affected Central Valley salmonids, including winter-run chinook salmon and Central Valley ESU steelhead, through reduced survival of juvenile fish.

Juvenile salmon migrate downstream from their upper river spawning and nursery grounds to lower river reaches and the Delta prior to entering the ocean as smolts. Historically, the tidal marshes of the Delta provided a highly productive estuarine environment for juvenile anadromous salmonids. During the course of their downstream migration, juvenile winter-run chinook and steelhead utilize the Delta's estuarine habitat for seasonal rearing, and as a migration corridor to the sea. Since the 1850's, reclamation of Delta islands for agricultural purposes caused the cumulative loss of 94 percent of the Delta's tidal marshes (Monroe and Kelly 1992).

In addition to the degradation and loss of estuarine habitat, downstream migrant juvenile salmon in the Delta are currently subject to adverse conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmon are adversely affected by: (1) water diversion from the mainstem Sacramento River into the Central Delta via the manmade Delta Cross Channel, Georgiana Slough, and Three-mile Slough; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; and (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay. In addition, salmonids are exposed to increased water temperatures from late spring through early fall in the lower Sacramento and San Joaquin River reaches and the Delta. These temperature increases are primarily caused by the loss of riparian shading and thermal inputs from municipal, industrial, and agricultural discharges.

Diversion into the Central and South Delta. Juvenile salmon emigrating from spawning and rearing areas in the Sacramento River may be diverted into the interior Delta through the manmade Delta Cross Channel, Georgiana Slough, or Three-Mile Slough. Fisheries investigations by Schaffter (1980) and Vogel et al. (1988) suggest winter-run chinook salmon juveniles are diverted in proportion to flow into the central Delta at the Delta Cross Channel.

Studies conducted using fall-run chinook salmon smolts have demonstrated substantially higher mortality rates for those fish

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passing into the interior Delta (USFWS 1990; USFWS 1992). The increased mortality rates reflect increased susceptibility to predation, delays in migration, exposure to increased water temperatures, and increased susceptibility to entrainment losses at the CVP/SWP export pumps and other water diversion locations within the Delta.

Reverse Flows. Channel hydrodynamics in the lower San Joaquin River and other southern Delta waterways are altered by CVP/SWP water export operations in the south Delta. CVP/SWP pumping can change the net flow in these channels from a westward direction to an eastward direction, particularly during periods of drought and high pump rates. When present, these 'reverse' flows move the net flow of water east up the San Joaquin River and then south towards the CVP/SWP export facilities, via Old and Middle Rivers. In general, magnitude of reverse flow increases with the rate of export pumping. Although the mechanism is not well understood, juvenile salmon frequently pass with the net flow of water into a complex network of channels leading to the CVP/SWP water export facilities in the south Delta. Indirect losses of juvenile salmon are thought to occur in these southern Delta channels through predation, disorientation, and delayed out-migration. Direct losses to predation and entrainment are known to occur in Clifton Court Forebay and at the CVP/SWP pumping plants.

Entrainment at CVP/SWP and Clifton Court Forebay. The CVP and SWP Delta pumping plants presently have maximum capacities of 4,600 cfs and 10,300 cfs, respectively. However, the State's existing COE permit generally restricts the SWP's level of pumping by limiting the monthly maximum average inflow into Clifton Court Forebay to 6,680 cfs. Both projects operate fish collection facilities within the intake channels of their canals using a louver system which resembles venetian blinds and acts as a behavioral barrier. Although the slots are wide enough for fish to enter, approximately 75 percent of the chinook salmon encountering the louvers sense the turbulence and move along the face of the louvers to enter the bypass system. The remaining 25 percent are lost to the pumping plant and canal. Additional losses occur inside the fish screening facilities from predation to striped bass and other predators. Significant handling and trucking losses also occur during the process used to transport salvaged fish to a release site in the western Delta.

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Clifton Court Forebay is a 31 TAF regulating reservoir at the pump intake to the SWP's California Aqueduct. The forebay is operated to minimize water level fluctuations at the intake by draining water through open gates at high tide and closing the gates at low tide. When the gates are opened, inflow can exceed 20,000 cfs for a short time and then decreases as the water levels inside and outside the forebay reach equilibrium. Within the forebay, juvenile salmon are subject to severe predation loss. In a series of investigations by CDFG, predation loss rates of marked hatchery fall-run salmon released in Clifton Court Forebay during April, May, and June ranged from 63 to 97 percent.

Delta Water Quality. Increased water temperatures, insufficient dissolved oxygen, and contaminants have degraded the aquatic habitat quality of rearing and migrating salmonids. Discharges from industrial and agricultural sources have led to increased water temperatures and contaminant levels. Water temperatures typically exceed 60 or 66 degrees Fahrenheit from April through September. Contaminants such as mercury from mine discharges may be well above 'safe' levels for beneficial uses in the Delta. Dissolved oxygen (DO) levels are affected by municipal, industrial, and agricultural discharges. Salmonids function normally at DO levels of 7.75 mg/L and may exhibit distress symptoms at 6.0 mg/L (Reiser and Bjornn 1979). Low dissolved oxygen levels impair metabolic rates, growth, swimming ability, and the overall survival of young salmonids.

Current Operations Under the Bay-Delta Accord and 1995 WQCP. Significant actions to protect beneficial uses in the Delta were initiated by a three-year agreement between the Federal government, State of California, water users, and environmental interests in the Bay-Delta Accord of December 15, 1994 (Accord). Through the Accord and the 1995 WQCP, water quality objectives for the protection of fish and wildlife have been established for the following parameters: dissolved oxygen, salinity, Delta outflow, river flows, export limits, and Delta Cross Channel gate operation. An "operations" group (CALFED Ops Group) coordinates CVP/SWP project operations, using current biological and hydrological information for management of water quality, endangered species, and the Central Valley Project Improvement Act. Water quality objectives and criteria established by the Accord are based on historical operations of the CVP/SWP and the

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life history needs of the fish species affected by Delta water operations. The combined effect of these various criteria seems to have improved the environmental baseline of the Delta to a level which provides adequate protection for the conservation of listed species and critical habitat.

For the purposes of this biological opinion, the No-Project Alternative includes water project operations in the Central Valley Basin as defined by the 1995 WQCP and 1994 Accord.

IV. ASSESSMENT OF IMPACTS

The DW project operations are likely to adversely effect the endangered winter-run chinook salmon and the proposed as endangered Central Valley steelhead, and diminish some of the fisheries habitat benefits gained in the Bay-Delta Accord. Juvenile winter-run chinook salmon and steelhead will be adversely affected through reduced Delta outflow, higher reverse flows in central and south Delta waterways, and entrainment in local diversions of the central and southern Delta, and entrainment at the CVP/SWP pumping plants. Impacts to winter-run chinook salmon and steelhead are expected to occur during the filling of the reservoir and habitat islands (diversions), and during the discharge of water from the islands for subsequent export at the CVP/SWP pumping plants or habitat island drawdowns. Some construction related impacts may occur, but are likely to be minor in nature.

Hydrologic data discussed in the assessment of impacts which follows were provided by JSA. The results of JSA's computer model analyses were provided to NMFS in a December 20, 1996 memorandum analyzing the proposed operations matrix and the no-project alternative, or baseline condition. These databases are used in the following assessment which focuses on the months of September through May to evaluate impacts to winter-run chinook salmon and steelhead.

A. Diversion Operations

Effects on Winter-run Chinook Salmon

The DW project proposal relies on diversion of 'surplus' Delta inflows during the winter and early spring months. DW project

operations during the months of September through May coincide with the presence of winter-run chinook salmon in the Delta.

The inflow-export criteria[1] established by the Accord were developed to replace and lead to, at minimum, equivalency with the historic QWEST[2] criteria for protection of juvenile winter-run chinook salmon. Historic Delta inflows from upstream rivers and existing CVP/SWP operations under the inflow-export criteria were simulated by computer models to aid in the QWEST equivalency determination. In addition to the Accord's water quality criteria, the NMFS assessment and equivalency determination during the development of the Accord assumed the CVP and SWP exports were limited by: (1) current CVP/SWP pumping plant capacities, (2) existing Corps permits, (3) south of Delta storage capacity, (4) the independent operation of the CVP/SWP pumping plants under their existing State water rights, and (5) inflow originating from upstream sources. These limits on export and the Accord's criteria resulted in Delta conditions which are frequently above the minimum WQCP standards.

As proposed, DW diversion operations will frequently reduce Delta outflow. The decrease in outflow may reach an average daily maximum rate of 9,000 cfs and an average monthly maximum rate of 4,000 cfs. Delta outflows would be reduced by 5 percent or greater in approximately 10 percent of the simulated years (1922-1991) with a maximum reduction in outflow of 25 percent. On an annual basis, DW diversions would directly decrease outflow by a mean of 192 TAF and a maximum of 490 TAF. In comparison, the CVP and SWP export an average of 6.1 million acre feet per year. Water diversions to the DW islands will increase the percent of inflow diverted in all months of the year.

Project water diversions will also directly reduce the net western flow of freshwater in the central Delta (QWEST). Reduced QWEST in the central Delta will be in direct proportion to the DW

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[1] The Accord established inflow-export limits for the CVP/SWP pumping plants as 65 percent in September, October, November, December and January, 35-45 percent in February, and 35 percent in March, April and May.

[2] QWEST is the calculated estimate of the net flow from the central Delta to the western Delta. It represents the sum of the flows in the lower San Joaquin River, False River, and Dutch Slough. Negative QWEST values mean 'reverse flow', or net flow from the western Delta into the central Delta.

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diversion rate. DW diversions will also directly increase the net reverse flows down Old and Middle rivers between Webb Tract and Bacon Island by a maximum of 4,500 cfs.

Analysis of DW diversion opportunities shows that diversions on to the reservoir islands can occur as much as 36 percent of the time simulated during September through May. Table 1 presents the number of years by month over the 70 year modeled simulation that DW was able to divert water onto the reservoir islands and the monthly average maximum diversion rate. Most DW diversion events occur in October through February.

Table 1. Diversion frequency during the 70 year modeled simulation and maximum diversion rates (cfs) (from JSA 1996).

	Diversions (years out of 70)	Average Maximum Rates of Diversion (cfs)
September	8	4,000
October	21	3,871
November	29	4,000
December	28	3,871
January	45	3,600
February	40	4,000
March	39	1,144
April	0	0
May	0	0

These changes in Delta hydrodynamics during the critical rearing and emigration period for juvenile winter-run chinook salmon is expected to adversely affect the species. Decreases in Delta outflow, increases in export-inflow levels, and reductions in QWEST are likely to reduce the survival of rearing and emigrating juvenile fish. Existing reverse flow conditions in the lower San Joaquin River, Old River, and Middle River will be exacerbated by DW diversions. Natural flow cues for emigrating winter-run chinook salmon smolts and migrating adults will be adversely affected. The number and rate of juvenile winter-run chinook salmon drawn from their typical migration route into central and southern Delta waterways is also likely to increase.

Once in the complex configuration of waterways in the central and southern Delta, fish are subjected to a variety of adverse conditions that decrease their chances for survival (FWS 1987). Lower survival rates are expected due to the longer migration route, where fish are exposed to increased predation, higher water temperatures, unscreened agricultural diversions, poor water quality, reduced availability of food, and entrainment at the CVP/SWP export facilities. Through reduced Delta outflow and

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decreases in net westerly flow, DW diversion operations are expected to degrade chinook salmon rearing habitat in the Delta, degrade conditions for natural smolt outmigration stimulus and seaward orientation, and generally reduce smolt survival. During dry and critical water years, DW diversions have an even greater potential for adversely affecting channel hydrodynamics and reducing winter-run chinook salmon survival already strained by low flows, poor water quality, and high CVP/SWP entrainment rates.

Fish screens installed on all DW intakes are expected to adequately prevent the direct entrainment of juvenile winter-run chinook salmon onto DW reservoir and habitat islands. Eliminating existing unscreened diversions on DW reservoir and habitat islands is expected to provide a minor project benefit to winter-run chinook salmon. However, the benefits attributable to foregone unscreened agricultural diversions is small, because the timing of current agricultural diversions has little overlap with the seasonal presence of juvenile winter-run chinook salmon.

Effects on Proposed Central Valley Steelhead ESU

Impacts to Central Valley ESU steelhead trout are expected to be similar to impacts experienced by winter-run chinook salmon in the months of November through May. The level of impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

B. Discharge Operations

Effects on Winter-run Chinook Salmon

As currently proposed, DW's discharge operations rely on the CVP/SWP pumping plants in the south Delta to transport project water to potential buyers. Export of DW discharges by the CVP/SWP is expected to increase winter-run chinook salmon losses in the Delta through entrainment, predation, and diversion with the net flow down Old and Middle rivers.

During DW discharge operations, water will be released from the reservoir islands to Delta waterways for re-diversion at the CVP/SWP pumping plants. Water released from the habitat islands

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will not be available for rediversion or export and should add to Delta outflow, providing some benefit to Delta species if the habitat island releases occur during favorable aquatic habitat conditions in the Delta. CVP/SWP export rates are expected to increase above baseline levels as a result of reservoir island releases. The frequency of CVP/SWP operations approaching or reaching maximum inflow-export levels will increase.

Analysis of DW discharge opportunities shows that discharges from the reservoir islands generally occur 14 percent of the simulated time from September through May. Most of these discharge events occur in April and May. Table 2 presents the number of years by month over the 70-year modeled simulation that DW was able to discharge water from the reservoir islands and the monthly average maximum discharge rate. Annual discharges from the DW reservoir islands range from zero to 306 TAF, with an average annual diversion of 154 TAF. Most annual DW discharge events occur in April through September.

Table 2. Discharge frequency during the 70 year modeled simulation and maximum discharge rates (cfs) (JSA 1996).

	Discharges (years out of 70)	Maximum Rates of Discharge (cfs)
September	15	1,777
October	8	962
November	5	743
December	6	1,758
January	2	956
February	5	1,742
March	4	1,088
April	20	450
May	29	599

Discharges from the DW reservoir islands would occur during critical rearing and emigration periods of the juvenile winter-

run chinook salmon. These discharges to export at the CVP/SWP pumping plants will increase the reverse flows in Old and Middle rivers by an average maximum of 1765, 1161, 500, and 660 cfs during February, March, April, and May, respectively, or by 25 percent, 19 percent, 8 percent, and 10 percent over average baseline conditions. Winter-run chinook salmon typically undergo smoltification during the months of February through April. Winter-run chinook smolts emigrating in the Central Delta may have difficulty following net flows to the ocean under these conditions. Proposed discharge prohibitions for Webb Tract in January through June should minimize potential adverse affects to emigrating juveniles from increased reverse flows that might have occurred between Webb Tract and Bacon Island in the absence of discharge prohibitions. Additionally, DW opportunities for discharge to export at the CVP/SWP pumping plants increase during some dry and critical water year types. Impacts from low river flows, poor water quality, and high CVP/SWP entrainment rates during dry and critical water years will be exacerbated by DW discharges for export.

Discharges from the habitat islands may also supply Delta channels with prey organisms of the winter-run chinook salmon, increasing food availability and benefitting rearing juveniles. Potential impacts from dissolved oxygen level reductions caused by high biological oxygen demand of the release water are addressed below.

Effects on Proposed Central Valley Steelhead ESU

Impacts to Central Valley ESU steelhead trout are expected to be similar to impacts experienced by winter-run chinook salmon in the months of November through May. Steelhead smolts pass through the Delta in peak numbers during March, April, and May. The level of impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

C. Combined DW Operations Impacts to Baseline Conditions

Effects on Winter-run Chinook Salmon

Combined operations of the DW project include diversions of water onto, and discharges of water from, the reservoir and habitat

islands. Since DW proposes to operate alternatively between diversions and discharges within a season, combined DW project operations and its effects on channel hydrodynamics must be assessed for periods of juvenile winter-run chinook salmon rearing and emigration.

Analysis provided by JSA indicates that many of the flow variables important to juvenile salmon survival in the Delta, such as outflow, QWEST, and flows in Old and Middle rivers are often negatively affected by DW operations.

Decreases in QWEST and outflow from baseline conditions in December through February by 1,000 cfs or greater occurred 14 to 20 percent of the time modeled (JSA 1996). Increases in QWEST and outflow values during February through May also occurred. These increases were generally less than 100 cfs, however there were several instances where the increases exceeded 100 cfs.

The combined effects of DW diversions onto Bacon Island and discharges from both reservoir islands increase the net southerly flow in the Old and Middle rivers north of the export facilities. Increased reverse flows occurred from January through May with 40 and 55 percent of DW operations resulting in increased reverse flows in April and May. Reverse flows in Old and Middle rivers increased by greater than 1,000 cfs during DW operations 6.0, 4.0, and 1.5 percent of the time in December, February, and March, respectively. DW operations in December showed an incremental improvement to reverse flow conditions in Old and Middle Rivers during 35 percent of DW operations. It is also important to consider that the JSA operations model simulates monthly average DW operations and monthly average Delta hydrological conditions. Daily conditions can vary widely from the monthly averages generated by the model and include other significant variables such as tidal fluctuations.

The combined operation of DW water diversions onto the reservoir islands, discharges into adjacent Delta waterways, and the subsequent export of DW water at the CVP/SWP pump plants is expected to directly and indirectly reduce the survival of juvenile winter-run chinook salmon in the Delta. Decreases in Delta outflow, higher net southerly flows in Old and Middle rivers, and decreases in QWEST adversely affect winter-run chinook salmon primarily through increased entrainment into the

central and southern Delta waterways where they are subject to longer migration routes, increased predation, unscreened diversions, poor water quality, decreased westward flow cues, and losses at the CVP/SWP export facilities.

Appendix 2 shows average monthly values for CVP/SWP export levels, QWEST, Delta outflow, and Old and Middle Rivers flows for baseline and DW operations conditions. These values are generated from the DeltaSOS monthly modeling simulation results provided by JSA.

Effects on Proposed Central Valley Steelhead ESU

Impacts to Central Valley ESU steelhead trout are expected to be similar to impacts experienced by winter-run chinook salmon in the months of November through May. The level of impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

D. Specific Criteria Impacts

Effects on Winter-run Chinook Salmon

The following discusses the effects of specific proposed operational criteria on winter-run chinook salmon. These measures have been proposed by DW to minimize project impacts to the winter-run chinook salmon.

In general, most of the operational criteria proposed by DW for minimizing impacts do reduce the potentially significant adverse effects the project would have on the winter-run chinook salmon. Reductions in the rate and volume of diversions, required X2 positions for diversion initiation, and diversion prohibitions or limitations during sensitive periods all contribute to reduced degradation of the existing environmental baseline. Limiting diversions to a certain percentage of the Delta outflow in critical emigration months may provide significant reductions in the level of impact that would otherwise occur in critical or dry water year types.

Webb Tract discharge prohibitions from January through June avoid significant impacts to aquatic habitat quality in the Webb Tract

vicinity that would have occurred during peak winter-run chinook salmon juvenile presence months. Habitat island releases, which are not available for export or rediversion, should benefit juveniles present in the vicinity, provided the existing hydrologic conditions allow for proper environmental cues to emigrating salmonids.

Fish screens installed on all of the project intakes should eliminate entrainment of winter-run chinook salmon onto the project islands. The proposed fish screens will have a maximum approach velocity of 0.2 feet per second, which surpasses the NMFS screening criterion for screens to protect anadromous salmonids. Final screen designs have yet to be reviewed by NMFS fish passage engineers.

Creating 200 acres of delta smelt rearing habitat and the replacement of lost aquatic habitat, due to construction related impacts, at a 3:1 ratio should also provide usable rearing habitat for salmonid juveniles. However, lost riparian and shaded riverine aquatic habitat (SRA), discussed below, is not currently mitigated. Proposed June through November construction windows will minimize construction related impacts to winter-run chinook salmon.

Measures proposed by DW for years in which the Fall Midwater Trawl Index of the delta smelt is less than 239 are more restrictive than the measures analyzed in this opinion, providing substantial reductions in project effects to winter-run chinook salmon and steelhead when they are implemented. However, for the purposes of making determinations as to whether the DW project is likely to jeopardize the winter-run chinook salmon, only the 'base case' scenario of proposed operational criteria has been assessed.

Effects on Proposed Central Valley Steelhead ESU

Impacts and benefits to Central Valley ESU steelhead trout are expected to be similar to impacts and benefits experienced by winter-run chinook salmon in the months of November through May. The level of impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

E. Water Quality

Effects on Winter-rurn Chinook Salmon

Potential water quality impacts from DW project releases off of the reservoir and habitat islands include increased water temperatures and decreased dissolved oxygen(DO)levels. The months of April, May, and September often have Delta water quality conditions that are not suitable for salmonid rearing and migratory behaviors. DW proposes to increase water temperatures by a maximum of four degrees Fahrenheit when channel temperatures are between 55 and 66 degrees Fahrenheit and by a maximum of two degrees Fahrenheit when channel temperatures are 66 to 77 degrees Fahrenheit. At channel temperatures above 60 degrees, increases of up to four degrees Fahrenheit across the entire channel may cause physiological sublethal stress effects, impair predation avoidance abilities, terminate smoltification, and cause migration delays or blockages (Boles 1988, Brett 1982, Wedemeyer et al. 1980, Zaugg and Adams 1972). Higher temperatures decrease aquatic habitat productivity, while nutritive needs of salmonids increase. Impacts to salmonids may decrease if temperature changes affect only a portion of the channel, thereby allowing for avoidance of increased temperature plumes. Impacts to salmonids can be avoided if release-water temperatures are less than or equal to channel temperatures.

Island releases that cause local dissolved oxygen levels to drop below 6.0 mg/L may also cause sublethal physiological impacts to emigrating salmonids. Reiser and Bjornn (1979) found that salmonids exhibit various distress symptoms at 6.0 mg/L. Low dissolved oxygen levels impair metabolic rates, growth, swimming ability, and the overall survival of young salmonids. DW proposes to prohibit discharges when the island water DO is below 6.0 mg/L. Additionally, DW proposes to prohibit discharges that will cause a DO drop in the receiving water to below 5.0 mg/L. Localized DO drops to 5.0mg/L may adversely affect rearing and emigrating juveniles if the drop affects the entire channel cross-section. Impacts to salmonids may be decreased if effects are temporary in nature or affect only a portion of the channel, thereby allowing for avoidance of decreased DO areas.

Effects on Proposed Central Valley Steelhead ESU

Impacts to Central Valley ESU steelhead trout are expected to be similar to impacts experienced by winter-run chinook salmon in the months of November through May. The level of impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

F. Levee Maintenance

Effects on Winter-run Chinook Salmon

While losses of low salinity or freshwater habitat from levee failure may be reduced through improved levee protection, maintenance of levees on the habitat and reservoir islands may result in damage or loss of riparian vegetation. Shaded riverine aquatic cover (SRA), or the zone of overhanging riparian vegetation along the stream banks, provides temperature moderation, protective cover, and allochthonous materials and energy input to the stream. It provides food and habitat for invertebrates that in turn become prey of salmonids and other fish. Removal of this vegetation, or large reductions in the quality and quantity of SRA vegetation eliminates these inputs from the stream and estuary. Juvenile winter-run chinook salmon rearing or emigrating through areas that have suffered vegetation losses may be at a greater risk of predation, increased physiological stress from lack of cover and high temperatures, and have reduced food availability.

Permanent losses to this habitat are expected to occur during normal levee construction and maintenance if methods such as grading, riprap placement, herbicide application, selective burning and mowing are used. Approximately 152 acres of exterior levee slopes around the reservoir islands will be improved and maintained to protect the water storage capabilities of the islands. If strict vegetation control methods are used, existing vegetation on the project's 152 acres of levees may be permanently lost.

Effects on Proposed Central Valley Steelhead ESU

Impacts to Central Valley ESU steelhead trout are expected to be similar to impacts experienced by winter-run chinook salmon in the months of November through May. The level of impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

G. Recreation Facilities, Siphon Stations and Pumping Stations

Effects on Winter-run Chinook Salmon

Construction activities at the recreation and siphon/pump facilities may temporarily affect juvenile winter-run chinook salmon through disturbance or degradation of water quality. Boat wakes may increase levee erosion (increasing levee maintenance) and raise local turbidity levels. Increased inputs of oil and gasoline from increased boat traffic and storage will continue to degrade the water quality within the channels and reservoirs. Permanent impacts to winter-run chinook salmon rearing habitat may occur through destruction of shallow water vegetated habitat and the creation of predator habitat under docks and around siphon/pump station pilings. DW proposes to limit their construction activities to June through November to minimize construction related impacts to juvenile salmonids.

Effects on Proposed Central Valley Steelhead ESU

Impacts to Central Valley ESU steelhead trout are expected to be similar to impacts experienced by winter-run chinook salmon in the months of November through May. The level of impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

H. Delta Smelt Monitoring

Effects on Winter-run Chinook Salmon

DW proposes a sampling program in the vicinity of their reservoir islands from December through August to monitor the presence of delta smelt. Presence of delta smelt triggers 50 percent

reductions in diversion and discharge activities on the reservoir islands. The sampling program may incidentally capture juvenile winter-run chinook salmon depending on gear types and sampling methodologies used. The final monitoring plan will be developed after issuance of this biological opinion.

Effects on Proposed Central Valley Steelhead ESU

Impacts to Central Valley ESU steelhead trout are expected to be similar to impacts experienced by winter-run chinook salmon in the months of November through May. The level of impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

I. Interrelated and Interdependent Effects: CVP/SWP operations

Effects on Winter-run Chinook Salmon

Modeling of CVP/SWP operations in coordination with DW discharge operations was performed by JSA with a Delta operations model (DeltaSOS). These results are presented in the BA and DEIR/EIS. While the DeltaSOS model uses results from the CVP/SWP operations model (DWRSIM), an integrated analysis of DW project operations with the participation of Reclamation (CVP) and DWR (SWP) has not been performed to date. Concern has been expressed that DW's analysis has not integrated some important components of CVP/SWP operations. Specifically, the re-operation of upstream reservoirs has the potential to adversely affect winter-run chinook salmon in the Sacramento River.

Although project proponents stated during consultation that they do not anticipate DW operations will result in the re-operation of upstream CVP and SWP reservoirs, NMFS and the CVP/SWP water projects believe the potential does exist. In commenting on the DEIR/EIS, DWR expressed concern with JSA's model analysis for DW, because: (1) the DeltaSOS model does not have the ability to account for upstream and downstream reservoir storage, and (2) there has been no consideration for real-time operational adjustments for reducing incidental take of ESA listed fish (DWR 1995).

Potential adverse affects to winter-run chinook salmon from re-operating upstream reservoirs relate primarily to upper Sacramento River instream flow levels and water temperature control. Releases from Shasta and Trinity reservoirs could be reduced if DW discharges replace a portion of water exports at the Delta pumping plants. Flow reductions which approach or meet minimum instream flows in the upper Sacramento River are likely to result in the stranding of juvenile fish in side channels with shallow inverts and broad, flat-gradient, near-shore areas. Temperature control operations could be adversely effected by re-operation of upstream reservoirs. Re-scheduling of CVP water deliveries may occur with the availability of additional DW water supplies to the south of Delta water users. The re-scheduling of CVP deliveries could alter seasonal reservoir storage levels and adversely effect temperature control operations designed to protect incubating winter-run chinook eggs and larvae. However, it must be noted that significant re-operation of the CVP or SWP will result in the re-initiation of consultation on these projects with Reclamation and DWR.

Effects on Proposed Central Valley Steelhead ESU

The re-operation of upstream reservoirs has the potential to adversely affect steelhead in the Sacramento, San Joaquin, Mokelumne, Tuolomne and Stanislaus Rivers. Impacts to Central Valley ESU steelhead trout are expected to be similar to impacts experienced by winter-run chinook salmon in the months of November through May. The level of some impacts may be reduced from winter-run impact levels due to the older age and larger size of steelhead juveniles rearing and emigrating through the Delta.

Summary of Impacts: Winter-run Chinook Salmon and Proposed Central Valley Steelhead ESU

DW project operations will diminish many of the fisheries benefits gained in the Bay-Delta Accord and adversely affect the endangered winter-run chinook salmon and Central Valley ESU steelhead. As proposed, the DW project will operate frequently during the peak months of adult and juvenile winter-run chinook salmon and steelhead presence in the Delta. These fish will be adversely affected through reduced Delta outflow, reduced QWEST, increased reverse flows in central and south Delta waterways, and

increased entrainment into the central and southern Delta. Higher rates of juvenile fish loss at the CVP/SWP pumping plants are expected. Impacts are expected to be greatest during below normal, dry, and critical water years.

The changes in Delta hydrodynamics as a result of DW operations are expected to increase entrainment of juvenile winter-run into the interior Delta and reduce their survival rates. Lower survival rates are expected due to the longer migration route where fish are exposed to increased predation, higher water temperatures, unscreened agricultural diversions, poor water quality, reduced availability of food, and entrainment at the CVP/SWP export facilities. Through reduced Delta outflow and reductions in net westerly flow, DW diversion operations are expected to degrade chinook salmon and steelhead trout rearing habitat in the Delta, degrade conditions for proper smolt outmigration stimulus and seaward orientation, and generally reduce smolt survival.

Fish screens will reduce direct entrainment of juvenile winter-run chinook salmon and steelhead trout onto the DW project islands; however, the screens have no effect upon the indirect impacts resulting from the hydrological changes described above.

Finally, due to the uncertainty of CVP/SWP operational changes in response to the availability of DW project water, it is not possible to fully assess the impacts to winter-run chinook salmon and steelhead trout resulting from potential re-operation of upstream reservoirs.

V. CONCLUSIONS

Sacramento River Winter-run Chinook Salmon

Based on the best available information and the analysis in this biological opinion, it is NMFS's biological opinion that the proposed construction and operation of the DW water storage project is not likely to jeopardize the continued existence of the winter-run chinook salmon or result in the adverse modification of winter-run chinook salmon critical habitat.

Proposed Central Valley Steelhead ESU

Based on the best available information and the analysis in this conference opinion, NMFS's has concluded that the proposed construction and operation of the DW water storage project is not likely to jeopardize the continued existence of the proposed Central Valley steelhead ESU.

VI. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These "conservation recommendations" include discretionary measures that the USACE can take to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, the NMFS provides the following conservation recommendations that would reduce or avoid adverse impacts on the Sacramento River winter-run chinook salmon and Central Valley ESU steelhead:

1) The USACE should encourage the use of levee maintenance designs that would increase and enhance the quantity and quality of riparian and shaded riverine aquatic (SRA) habitat.

2) The USACE should support, through funding and other means, studies which evaluate juvenile salmonid rearing and migratory behavior in the Sacramento/San Joaquin Delta, including the effects of various water management operations on juvenile survival and behavior.

VII. REINITIATION OF CONSULTATION

Reinitiation of formal consultation is required if there is discretionary Federal involvement or control over the action and if (1) the amount or extent of taking specified in any incidental

take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The USACE may ask NMFS to adopt the conference opinion incorporated in this document as a biological opinion if the Central Valley ESU steelhead is listed. This request must be in writing. If NMFS reviews the action and finds that there have been no significant changes in the actions planned or in the information used during the conference, NMFS will adopt the conference opinion on the project and no further section 7 consultation will be necessary, unless one or more of the reinitiation requirements described above apply.

INCIDENTAL TAKE STATEMENT

Section 7 (b)(4) of the ESA provides for the issuance of an incidental take statement for the agency action if the biological opinion concludes that the proposed action is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. In such a situation, NMFS will issue an incidental take statement specifying the impact of any incidental taking of endangered or threatened species, providing for reasonable and prudent measures that are necessary to minimize impacts, and setting forth the terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures. Incidental takings resulting from the agency action, including incidental takings caused by activities authorized by the agency, are authorized under the incidental take statement only if those takings are in compliance with the specified terms and conditions.

This incidental take statement is applicable to the construction and operations of the Delta Wetlands (DW) project as described in the biological assessment submitted on June 21, 1995, the draft environmental impact report/environmental impact statement issued on September 11, 1995, and as modified by the February 21, 1997, letter and proposed operations matrix from the USACE to the National Marine Fisheries Service (NMFS).

Sacramento River winter-run chinook salmon

The construction and proposed operations of the DW project are expected to result in the incidental take of winter-run chinook salmon. In-water and streambank construction activities will adversely affect winter-run chinook by destruction of riparian vegetation and disturbances from operation of construction equipment. Operation of the DW project will adversely affect hydrodynamic and habitat conditions for rearing and emigrating juvenile winter-run chinook salmon in the interior Delta. DW operations are expected to reduce the survival of juvenile winter-run chinook in the Delta through reduced Delta outflow, reduced QWEST, increased reverse flows in central and south Delta waterways, and increased entrainment into the central and southern Delta. Higher rates of juvenile fish loss at the

CVP/SWP pumping plants are expected. Impacts are expected to be greatest during below normal, dry, and critical water years.

The magnitude of winter-run chinook salmon incidental take associated with construction and operation of the DW project cannot be accurately quantified since: (1) the timing of construction and specific location of some of the facilities is uncertain, (2) the adequacy of the screen design and maintenance procedures are uncertain, (3) the variability and uncertainty in the winter-run chinook salmon population size, run size, and the timing of the downstream migration, and (4) an integrated analysis of DW project operations with the participation of the U.S. Bureau of Reclamation and the California Department of Water Resources has not been performed.

Proposed Central Valley Steelhead ESU

The construction and proposed operations of the DW project are expected to result in the incidental take of Central Valley ESU steelhead. In-water and streambank construction activities will adversely affect steelhead through destruction of riparian vegetation and disturbances from operation of construction equipment. Operation of the DW project will adversely affect hydrodynamic and habitat conditions for rearing and emigrating juvenile steelhead in the interior Delta. DW operations are expected to reduce the survival of juvenile winter-run chinook in the Delta through reduced Delta outflow, reduced QWEST, increased reverse flows in central and south Delta waterways, and increased entrainment into the central and southern Delta. Higher rates of juvenile fish loss at the CVP/SWP pumping plants are expected. Impacts are expected to be greatest during below normal, dry, and critical water years.

The magnitude of Central Valley ESU steelhead incidental take associated with construction and operation of the DW project cannot be accurately quantified since: (1) the timing of construction and specific location of some of the facilities is uncertain, (2) the adequacy of the screen design and maintenance procedures are uncertain, (3) the variability and uncertainty in the steelhead population size, run size, and the timing of the downstream migration, and (4) an integrated analysis of DW project operations with the participation of the U.S. Bureau of

Reclamation and the California Department of Water Resources has not been performed.

Reasonable and Prudent Measures: Winter-run Chinook Salmon

The NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of winter-run chinook salmon caused by DW.

1. Measures shall be taken to reduce the extent of entrainment and predation during DW diversion operations through the use of properly designed fish screens.

2. Measures shall be taken to reduce degradation of Delta habitat during construction, operation, and maintenance activities.

3. Measures shall be taken to reduce impacts to juvenile winter-run chinook salmon from discharge monitoring activities.

4. Measures shall be taken to monitor DW operations and Delta hydrologic conditions.

In order to be exempt from the prohibitions of Section 9 of the ESA, the USACE is responsible for DW compliance with the following terms and conditions that implement the reasonable and prudent measures described above:

1. **Measures shall be taken to reduce the extent of entrainment and predation during DW diversion operations through the use of properly designed fish screens.**

Terms and conditions:

a) The USACE shall ensure the final fish screen design and construction schedule is submitted to NMFS Southwest Region for review and acceptance prior to construction. At least 90 percent of the design shall

be submitted to NMFS at least two months prior to the completion of the design process.

b) The USACE shall ensure that a hydraulic monitoring program for evaluating the performance of the fish screens and conformance with NMFS criteria is submitted to NMFS Southwest Region for review at least two months prior to the start of operations.

c) The USACE shall ensure the fish screens are adequately operated and maintained by submitting to NMFS a proposed operations and maintenance plan which includes:

(1) periodic underwater inspections;
(2) periodic hydraulic measurements;
(3) periodic assessment of screen performance - component reliability, component durability, and screen-cleaning system effectiveness.

d) The USACE shall ensure that DW annually submits a log record to NMFS Southwest Region that documents compliance with measures 1-3 above.

2. **Measures shall be taken to reduce degradation of Delta habitat during construction, operation, and maintenance activities.**

Terms and conditions:

a) Riparian vegetation and/or SRA lost or damaged during construction or maintenance shall be mitigated by adherence to the "Guidelines for Revegetation" in Appendix 3.

b) Levee maintenance and bank protection activities shall adhere to the material guidelines described in Appendix 4.

c) Steel pilings and sheetpile may not be treated with chemical antifouling products.

d) Wood piles, or wood cores within concrete piles, may not be creosote-treated wood or chromated copper arsenate pressure-treated wood.

3. **Measures shall be taken to reduce impacts to juvenile winter-run chinook salmon from discharge monitoring activities.**

Terms and conditions:

a) Captured chinook salmon shall be handled with extreme care and kept in cool local water to the maximum extent possible during the sampling and processing procedures. Artificial slime products or anesthetics may be used to reduce physiological or osmotic stress. Chinook salmon handled out-of-water for the purpose of recording biological information shall be anesthetized, when necessary, to prevent mortality. Anesthetized fish shall be allowed to recover (e.g. in a recovery bucket) before being released. Fish that are simply counted shall remain in water but do not need an anesthetic. All captured salmonids shall be returned to the water as soon as possible.

b) With gear that capture a mixture of species, chinook salmon shall be removed, processed first and returned to the water as soon as possible.

c) Identification of the listed juvenile fish authorized to be captured and handled by this permit shall be based on NMFS-approved size criteria until other identification methods are formally approved by NMFS.

d) The following information shall be collected on each fish identified as a winter-run chinook salmon in the field:

(1) Location of capture, including nearshore habitat type and water stage;

(2) Date and time of capture;

(3) Fork length; and

(4) Fish condition, including abrasions, or other obvious injuries or scale losses.

This information shall be submitted to NMFS as a part of the weekly reports described below.

e) Any winter-run chinook salmon mortalities shall be placed in labeled whirl-pak bags and promptly frozen. Labels shall include the date/location of capture and the fork length of the fish. NMFS shall be notified as soon as possible of any winter-run chinook salmon mortalities.

f) An annual report of DW operations shall include:

(1) a description of the total number of winter-run chinook salmon taken, the manner of take, and the dates and locations of take, the condition of winter-run chinook salmon taken, the disposition of winter-run chinook salmon in the event of mortality, and a brief narrative of the circumstances surrounding injuries or mortalities;

(2) This report shall be submitted to the addresses given below.

4. Measures shall be taken to monitor DW operations and Delta hydrologic conditions.

Terms and conditions:

a) The USACE shall ensure that DW develops a comprehensive monitoring plan designed to collect the hyrologic and project operational information described below in (1)-(6). This monitoring plan shall be submitted to NMFS Southwest Region for review and approval prior to its implementation. The results of this monitoring program will be used to determine if the DW project is affecting winter-run chinook salmon to an extent not previously considered. The USACE, in

coordination with DW, shall provide weekly monitoring reports of diversions and discharges to NMFS. These reports shall include the following information:

(1) daily diversions at each intake siphon station on the reservoir and habitat islands;

(2) daily discharges at each discharge station on the reservoir and habitat islands;

(3) daily amount of DW discharged water exported at the CVP and SWP pumping plants;

(4) daily average QWEST;

(5) net flow in cfs in the Old and Middle rivers north of the CVP/SWP pumping plants; and

(6) daily receiving water temperature and dissolved oxygen conditions and resultant changes to those conditions from DW discharges.

b) The USACE in coordination with DW shall summarize the above weekly reports into an annual report of the DW project operations and Delta hydrological conditions for the previous water year (July 1-June 30) for submittal to NMFS by September 30 of each year.

c) All weekly and annual reports shall be submitted by mail or fax to:

(1) Administrator, Southwest Region, NMFS
501 West Ocean Boulevard, Suite 4200
Long Beach, California, 90802
Fax: 562/980-4047

(2) Ms. Penny Ruvelas
NMFS, Santa Rosa Field Office
777 Sonoma Ave, Room 325
Santa Rosa, California, 95404
Fax: 707/578-3435

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Reasonable and Prudent Measures: Proposed Central Valley Steelhead ESU

The NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of Central Valley ESU steelhead caused by DW.

The prohibitions against taking species found in section 9 of the ESA do not apply to the proposed Central Valley ESU steelhead until this species is listed. However, NMFS advises the USACE to consider implementing the following reasonable and prudent measures. If this conference opinion is adopted as a biological opinion following a listing, these measures, with their implementing terms and conditions, will be nondiscretionary.

1. Measures shall be taken to reduce the extent of entrainment and predation during DW diversion operations through the use of properly designed fish screens.

2. Measures shall be taken to reduce degradation of Delta habitat during construction, operation, and maintenance activities.

3. Measures shall be taken to reduce impacts to juvenile steelhead from discharge monitoring activities.

4. Measures shall be taken to monitor DW operations and Delta hydrologic conditions.

In order to be exempt from the prohibitions of Section 9 of the ESA, the USACE is responsible for DW compliance with the following terms and conditions that implement the reasonable and prudent measures described above:

1. **Measures shall be taken to reduce the extent of entrainment and predation during DW diversion operations through the use of properly designed fish screens.**

Terms and conditions:

a) The USACE shall ensure the final fish screen design and construction schedule is submitted to NMFS Southwest Region for review and acceptance prior to construction. At least 90 percent of the design shall be submitted to NMFS at least two months prior to the completion of the design process.

b) The USACE shall ensure that a hydraulic monitoring program for evaluating the performance of the fish screens and conformance with NMFS criteria is submitted to NMFS Southwest Region for review at least two months prior to the start of operations.

c) The USACE shall ensure the fish screens are adequately operated and maintained by submitting to NMFS a proposed operations and maintenance plan which includes:

(1) periodic underwater inspections;
(2) periodic hydraulic measurements;
(3) periodic assessment of screen performance - component reliability, component durability, and screen-cleaning system effectiveness.

d) The USACE shall ensure that DW annually submits a log record to NMFS Southwest Region that documents compliance with measures 1-3 above.

2. **Measures shall be taken to reduce degradation of Delta habitat during construction, operation, and maintenance activities.**

Terms and conditions:

a) Riparian vegetation and/or SRA lost or damaged during construction or maintenance shall be mitigated by adherence to the "Guidelines for Revegetation" in Appendix 3.

b) Levee maintenance and bank protection activities shall adhere to the material guidelines described in Appendix 4.

c) Steel pilings and sheetpile may not be treated with chemical antifouling products.

d) Wood piles, or wood cores within concrete piles, may not be creosote-treated wood or chromated copper arsenate pressure-treated wood.

3. Measures shall be taken to reduce impacts to juvenile steelhead from discharge monitoring activities.

Terms and conditions:

a) Captured steelhead shall be handled with extreme care and kept in cool local water to the maximum extent possible during the sampling and processing procedures. Artificial slime products or anesthetics may be used to reduce physiological or osmotic stress. Steelhead handled out-of-water for the purpose of recording biological information shall be anesthetized, when necessary, to prevent mortality. Anesthetized fish shall be allowed to recover (e.g. in a recovery bucket) before being released. Fish that are simply counted shall remain in water but do not need an anesthetic. All captured salmonids shall be returned to the water as soon as possible.

b) With gear that capture a mixture of species, steelhead shall be removed, processed first and returned to the water as soon as possible.

c) The following information shall be collected on each fish identified as a steelhead in the field:

(1) Location of capture, including nearshore habitat type and water stage;

(2) Date and time of capture;

(3) Fork length; and

(4) Fish condition, including abrasions, or other obvious injuries or scale losses.

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This information shall be submitted to NMFS as a part of the weekly reports described below.

d) Any steelhead mortalities shall be placed in labeled whirl-pak bags and promptly frozen. Labels shall include the date/location of capture and the fork length of the fish. NMFS shall be notified as soon as possible of any steelhead mortalities.

e) An annual report of DW operations shall include:

(1) a description of the total number of steelhead taken, the manner of take, and the dates and locations of take, the condition of steelhead taken, the disposition of steelhead in the event of mortality, and a brief narrative of the circumstances surrounding injuries or mortalities;

(2) This report shall be submitted to the addresses given below.

4. **Measures shall be taken to monitor DW operations and Delta hydrologic conditions.**

Terms and conditions:

a) The USACE shall ensure that DW develops a comprehensive monitoring plan designed to collect the hyrologic and project operational information described below in (1)-(6). This monitoring plan shall be submitted to NMFS for review and approval prior to its implementation. The results of this monitoring program will be used to determine if the DW project is affecting Central Valley ESU to an extent not previously considered. The USACE, in coordination with DW, shall provide weekly monitoring reports of diversions and discharges to NMFS. These reports shall include the following information:

(1) daily diversions at each intake siphon station on the reservoir and habitat islands;

(2) daily discharges at each discharge station on the reservoir and habitat islands;

(3) daily amount of DW discharged water exported at the CVP and SWP pumping plants;

(4) daily average QWEST;

(5) net flow in cfs in the Old and Middle rivers north of the CVP/SWP pumping plants.

b) The USACE in coordination with DW shall summarize the above weekly reports into an annual report of the DW project operations and Delta hydrological conditions for the previous water year (July 1-June 30) for submittal to NMFS by September 30 of each year.

c) All weekly and annual reports shall be submitted by mail or fax to:

(1) Administrator, Southwest Region, NMFS
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(2) Ms. Penny Ruvelas
NMFS, Santa Rosa Field Office
777 Sonoma Ave, Room 325
Santa Rosa, California, 95404
Fax: 707/578-3435

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Appendix 1. Proposed mitigation package for impacts to listed species from the proposed operations of the DW project.

This narrative reflects final operations criteria for the Delta Wetlands (DW) project that would take the place of the operations criteria previously proposed by Jones & Stokes Associates 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 be consistent with, and in many instances, exceed the conditions set forth in the State Water Resources Control Board's (SWRCB) 1995 Water Quality Control Plan 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 Fall Mid-Water Trawl (FMWT) index shows a significant decline in delta smelt abundance. 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 Fall Mid-Water Trawl index measurement of less than 84 (FMWT<84) is new information under the reinitiation regulations (50 C.F.R. § 402.16) and may require reinitiation of the USFWS biological opinion. [#26,45][3]

The following text represents the final language for replacement of Term I of the USFWS draft biological opinion: [#1]

> 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 the March 6, 1995 biological opinion on the CVP/SWP, the SWRCB's 1995 Water Quality

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[3] 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.

Control Plan 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 Section 7 consultation performed in conjunction with implementation of the *Principles for Agreement on Bay-Delta Standards Between the State of California and the Federal Government* (Bay-Delta Agreement). 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. If DW's initial diversion to storage has not taken place by November 30, 1996, 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 CDFG, USFWS, 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 Fall Mid-Water Trawl 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 delta smelt Fall Mid-Water Trawl 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., E/I 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]

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, MWT data).

8. DW shall implement a monitoring program to minimize or avoid adverse impacts 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."

b. DW shall provide daily in-channel monitoring from December through August during all diversions to storage, except as provided below.

c. DW shall provide daily on-island 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% 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%. This reduced diversion rate will remain in place until the monitoring 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 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 diversion rate (cfs) and maximum monthly quantity (TAF) listed in below:

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 USFWS, NMFS, and CDFG 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.

Discharge Measures

Delta Wetlands (DW) shall limit discharges from the four project islands as set forth in the following measures:

1. In the period from April through June, DW shall limit discharges for export or rediversion from Bacon Island to one-half (50%) 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. In the period 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, as set forth in the following terms and conditions: [#38, 42]

a. DW shall provide a quantity of environmental water equal to 10% of all discharges for export that occur in the period from December through June. If the delta smelt Fall Mid-Water Trawl index is less than 239 (FMWT<239), this environmental water percentage shall be increased to 20% 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% 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% 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 USFWS, NMFS and CDFG to maximize fishery benefits. Coordination of these discharges shall be performed by the CDFG Bay-Delta office.

7. DW shall implement a monitoring program to minimize or avoid adverse impacts 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."

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% 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%. 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 maintain a 0.2 fps approach velocity for diversions. Final design elements and installation guidelines will be subject to approval by the responsible agencies with concurrence by the resource agencies. 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.

Additionally, DW shall provide to the USFWS 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, and (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.

The easement (along with a title report for the easement area) and management plan shall be approved by the USFWS 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 USFWS within 30 days after recordation.

3. Boat Wake Erosion [#53]

DW shall contribute $100 per year for each net additional berth beyond pre-project conditions 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 impact to aquatic habitat acreage for construction and operation of siphon and pumping facilities and waterside boat docks shall be verified prior to construction and mitigation shall take place on a 3:1 basis.

5. Temperature Limits [#55]

DW shall implement a temperature program to minimize or avoid adverse impacts of DW discharges for export, as set forth below:

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 20°F.

b. If the natural receiving water temperature of the adjacent channel is greater than or equal to 55°F and less than 66°F, DW discharges for export shall not increase the channel temperature by more than 4°F.

c. If the natural receiving water temperature of the adjacent channel is greater than or equal to 66°F and less than 77°F, DW discharges for export shall not cause an increase of more than 2°F.

d. If the natural receiving water temperature of the adjacent channel is greater than or equal to 77°F, DW discharges for export shall not cause an increase of more than 1°F.

e. DW shall develop temperature monitoring and implementation plans to ensure that the project does not adversely impact the 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 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 impacts of DW discharges for export, as set forth below:

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 impact 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 responsible agencies for approval with the concurrence of the resource agencies.

7. Incidental Entrainment Compensation [#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, respectfully, listed and candidate species). Coverage of non-listed species is intended as a CEQA/NEPA mitigation measure and is only included here for ease of understanding.

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 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 juveniles	X	X X	X X	X X	X X	 X
Splittail larvae juveniles	X	X X	X X	X X	X X	X X
Longfin Smelt eggs and larvae juveniles	 X	X X	X X	 X	 X	 X

Table 7: Incidental Entrainment Compensation

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 semi-annual basis. The use of the mitigation funds shall be at the discretion of the resource agencies (e.g., CDFG Bay-Delta office) but shall be used to the fullest extent possible 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 impacting a tidal water habitat shall occur between June and November.

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Appendix 2. Baseline and DW operations conditions, September through May, 70 year simulation (JSA 1996).

		CVP/SWP export levels	QWEST	Delta Outflow	Old and Middle Rivers flow
September	Baseline	7147	-540	4951	-6660
	DW	7411	-800	4691	-6924
October	Baseline	8695	-456	7578	-9300
	DW	9019	-1062	6972	-9355
November	Baseline	9107	-3212	11287	-7597
	DW	9127	-3902	10597	-7616
December	Baseline	10138	-1848	22257	-8216
	DW	10229	-2241	21864	-8307
January	Baseline	11025	570	34981	-8176
	DW	11226	0.1	34410	-8197
February	Baseline	10487	4011	47215	-6861
	DW	10568	3542	46746	-6950
March	Baseline	9420	3450	38703	-6252
	DW	9456	3423	38676	-6288
April	Baseline	6666	3614	25665	-6219
	DW	6753	3655	25707	-6306
May	Baseline	6191	1914	17458	-6418
	DW	6314	1950	17494	-6540

Appendix 3. Guidelines for Revegetation of Woody Riparian and Shaded Riverine Aquatic Habitat.

NMFS anticipates that adherence to these guidelines will result in 'no net loss' of riparian vegetation or SRA habitat within the project area.

1. All remaining, natural woody riparian or SRA habitat shall be avoided or preserved to the maximum extent practicable.

2. Re-planting ratios for woody riparian and SRA shall replace lost habitat at 3:1.

3. Species chosen for replanting should reflect native species lost during the permitted activity or native species usually found in the riparian and SRA zones of the project location.

4. Plantings should be done during the optimal season for the species being planted. Therefore, completion of the entire mitigation plan may not occur at the same time as the permitted activity.

5. Maintenance plans for revegetated sites should continue for at least three growing seasons to allow the vegetation to establish.

6. Remediation plans should be prepared in the event of a planting failure.

Appendix 4. Material Guidelines for Levee Maintenance and Bank Stabilization Projects.

These guidelines should be applied to all bank stabilization and levee maintenance projects.

1. No petroleum products such as asphalt may be used.

2. Concrete or other similar rubble shall be free of trash or reinforcement steel.

3. If anchoring and stabilizing fabrics (geotextiles, armorflex, etc.,) are used, they shall be slit in appropriate locations to allow for plant root growth.

4. No fill material other than clean, silt-free gravel or river rock shall be allowed to enter the live stream.

5. When possible, hard points, fish groins, or tethered trees should be incorporated into the levee or bank protection design.