UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

JUN 20 2008

In response refer to:
2007/08985

Mr. Brian Person
Area Manager
Bureau of Reclamation
Northern California Area Office
16349 Shasta Dam Blvd.
Shasta Lake, California 96019-8400

Colonel Chapman
District Engineer, Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Dear Mr. Person and Colonel Chapman:

Please find enclosed NOAA's National Marine Fisheries Service's (NMFS) final biological opinion concerning the effects of lower Stony Creek water management operations on the endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), the Central Valley steelhead (*O. mykiss*), and the designated critical habitats for Central Valley spring-run Chinook salmon and Central Valley steelhead.

The final biological opinion concludes that the proposed action is not likely to jeopardize the continued existence of the above-listed species, nor will it result in the adverse modification of their respective designated critical habitats. Because NMFS believes there is the likelihood of incidental take of listed species as a result of the proposed water management operations, an incidental take statement also is attached to the biological opinion. This take statement includes reasonable and prudent measures that NMFS believes are necessary and appropriate to avoid, minimize, or 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 take incidental to this project to be authorized.

We appreciate your continued cooperation in the conservation of listed species and their habitat, and look forward to working with you and your staff in the future. If you have any questions regarding this document, please contact Mr. Michael Tucker in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Mr. Tucker may be reached by telephone at (916) 930-3604 or by Fax at (916) 930-3629.

Sincerely,

Russell M Strach

for Rodney R. McInnis
Regional Administrator

cc: Copy to file: ARN151422SWR2000SA5904
NMFS-PRD, Long Beach, CA

Enclosure 1

BIOLOGICAL OPINION

Agencies: U.S. Bureau of Reclamation and U.S. Army Corps of Engineers

Activity: Lower Stony Creek Water Management

Consultation Conducted By: Southwest Region, NOAA's National Marine Fisheries Service (TN 2000/1910)

Date Issued: JUN 20 2008

I. CONSULTATION HISTORY

From March 2000 through March 2002, the U.S. Bureau of Reclamation (Reclamation) and the U.S. Army Corps of Engineers (Corps) conducted informal and eventually formal consultation with NOAA's National Marine Service (NMFS) concerning the two agencies' integrated water management operations on lower Stony Creek in Glenn and Tehama Counties, California.

On March 11, 2002, a final biological opinion (BO) was issued to Reclamation and the Corps by NMFS concerning these operations. An expiration date was established for the 2002 BO such that the total time period covered under that BO was not to exceed 3 years from the date of its issuance. The time limit was established because several important studies were underway which were expected to provide extensive new information on the environmental impacts associated with lower Stony Creek water management operations and the potential methods to address those impacts. The research work included a fisheries monitoring and habitat evaluation study on lower Stony Creek, a Northside Diversion Dam barrier analysis, a fish passage/water supply study at Red Bluff Diversion Dam (RBDD), a Stony Creek watershed water supply analysis, and two feasibility studies on the potential rehabilitation of the Orland Project distribution system. Aside from the fish passage/water supply study at Red Bluff Diversion Dam, which has been postponed indefinitely, all of these studies and analyses have now been completed.

In a letter dated February 28, 2005, Reclamation requested reinitiation of formal consultation on the integrated water management operations conducted by Reclamation and the Corps on lower Stony Creek. In a subsequent letter dated March 9, 2005, Reclamation requested that the time period covered by the 2002 BO be extended until the new consultation and BO could be completed.

NMFS replied to Reclamation's February 28, 2005, letter on April 5, 2005, stating that additional information concerning the proposed operations' impacts on listed species and critical habitat would be required prior to reinitiation of formal consultation. In a subsequent letter dated April 11, 2005, NMFS replied to Reclamation's March 9, 2005, request for a time extension on the 2002 BO with an amendment extending the BO through March 11, 2006.

Reclamation provided additional information on the project, and in a letter dated August 5, 2005, again requested reinitiation of formal consultation. Since that time additional information on the current project description has been requested by NMFS and provided by Reclamation and the Corps, with the most recent submission provided via e-mail on February 15, 2006.

In a letter dated March 9, 2006, NMFS confirmed that all information necessary to complete an updated, comprehensive analysis of the effects of the proposed project on listed salmonids had been received. In this letter, NMFS also extended the time period covered by the 2002 BO through May 30, 2006. A second letter, dated October 5, 2006, again extended the time period covered by the 2002 BO through January 31, 2007. A third letter, dated April 2, 2007, again extended the time period covered by the 2002 BO through November 30, 2007.

NMFS issued a final draft BO to Reclamation and the Corps on January 29, 2007. Comments and proposed edits were received back from Reclamation and the Corps over a period of several months, with the final comments received on January 31, 2008. NMFS responded to those comments and has now issued this final BO.

II. DESCRIPTION OF THE PROPOSED ACTION

Reclamation and the Corps are proposing to continue to manage the water resources of the Stony Creek watershed by controlling the release of flows from Black Butte Lake (in coordination with upstream reservoir operations) for the purposes of flood control, water delivery for agricultural use, recreation, and natural resource management.

A. Delineation and Description of the Action Area

The projects and specific facilities associated with Stony Creek water management operations include the Orland Project (East Park Dam and Reservoir; Stony Gorge Dam and Reservoir; Rainbow Diversion Dam and East Park Feeder Canal; South Diversion Intake and South Canal; and Northside Diversion Dam (NDD) and the North Canal), Black Butte Project (Black Butte Dam, Lake and Powerplant), and the Central Valley Project (CVP) (Black Butte Lake storage; and the Tehama Colusa Canal (TCC) with associated Constant Head Orifice (CHO)).

The action area for this project includes the active stream channels and riparian corridors of Stony Creek and Little Stony Creek below Rainbow Diversion Dam and East Park Reservoir respectively. Although the listed salmonids addressed in this opinion have long been excluded from the upper watershed above Black Butte Dam, discretionary actions taken during standard operations of the impoundments and facilities in the upper watershed have direct impacts on the timing and magnitude of flows and other habitat conditions in the lower creek. These areas must be considered as part of the action area.

B. Facilities and Operations

1. <u>Orland Project</u>

The Orland Project was authorized by the Secretary of the Interior on October 5, 1907, to store water for irrigation purposes. The project incorporates parts of neighboring Glenn, Tehama, and Colusa Counties. Although not officially authorized by the project, additional beneficial uses include recreation and fish and wildlife habitat enhancement. The main facilities of the Orland Project include East Park Dam and Reservoir (51,000 acre-feet storage capacity); Stony Gorge Dam and Reservoir (50,300 acre-feet storage capacity); Rainbow Diversion Dam/East Park Feeder Canal; South Diversion Intake/South Canal; and NDD/North Canal. The South and Northside Diversions supply water to almost 17 miles of canals and 139 miles of smaller lateral ditches.

a. *East Park Dam*

East Park Dam is located on Little Stony Creek in Colusa County approximately 2 miles from the confluence with Stony Creek at creek mile (CM) 62. East Park Reservoir extends 2.25 miles up Little Stony Creek and 4.5 miles up Indian Creek. Runoff from Little Stony Creek watershed provides water to the reservoir. East Park Reservoir also receives inflows from the East Park Feeder Canal which diverts water from Stony Creek at the Rainbow Diversion Dam (approximately CM 65). The East Park Feeder Canal is 7 miles long and has a design capacity of 300 cubic feet per second (cfs). The canal provides water from the main stem of Stony Creek into East Park Reservoir. Releases and spills from East Park Reservoir flow down Stony Creek 18 miles for re-storage in Stony Gorge Reservoir.

The Orland Unit Water Users Association (OUWUA) proposes to operate the East Park Dam based on demand according to the following standard operational procedures. Storage in East Park Reservoir will be maintained as close to the maximum level as possible and water levels will be kept stable until at least June 1 of each year, unless irrigation demands necessitate releases. When necessary, East Park Reservoir storage will be released for irrigation to the minimum storage of 5,000 acre-feet. In the last 16 years (1991 through 2006), East Park Reservoir has been maintained close to the maximum storage for 13 of 16 years and has consistently re-filled in the winter/spring following the draw-down years. The 1964 Exchange Agreement allows Orland Project water held in East Park Reservoir to be exchanged with CVP water stored in Black Butte Lake; releases of Orland Project water are then made from Black Butte Lake storage instead of from East Park Reservoir.

OUWUA proposes to operate the Rainbow Diversion Dam and the East Park Feeder Canal on an as-needed basis to provide supplemental water to East Park Reservoir.

b. *Stony Gorge Dam/Reservoir*

Stony Gorge Dam is located on Stony Creek at CM 46 in Glenn County. It regulates flows along the middle reaches of Stony Creek and stores surplus water for irrigation purposes. Releases from the reservoir travel 22 to 26 miles down Stony Creek to the Orland Project's diversion points at Black Butte Dam (South Diversion Intake/South Canal) and NDD/North Canal, respectively.

OUWUA proposes to operate the Stony Gorge Dam based on demand according to the following standard operational procedures. Winter storage at Stony Gorge is restricted to 38,311 acre-feet (10 feet below the full storage capacity) in order to provide a buffer to prevent overtopping of the dam during high flow events. Operating procedures state that Stony Gorge Reservoir has no flood storage and is therefore operated to pass all high flows above the maximum winter elevation of 831 feet. Spilling above the 831-foot level continues until approximately the end of February depending upon the long-range forecast. Storage in Stony Gorge Reservoir will be maintained as close to the maximum allowable storage level as possible, unless irrigation demands necessitate releases. When necessary, Stony Gorge Reservoir storage can be released for irrigation to the minimum storage of 7,500 acre-feet. The 1964 Exchange Agreement allows Orland Project water held in Stony Gorge Reservoir to be exchanged with CVP water stored in Black Butte Lake; releases of Orland Project water are then made from Black Butte Lake storage instead of from Stony Gorge. Water left in Stony Gorge Reservoir early in the season is available for releases into lower Stony Creek later in the summer or early fall.

c. *South Diversion Intake and South Canal*

The South Diversion Intake and South Canal were built in conjunction with Black Butte Dam in 1963. Water from Black Butte Dam is released into an afterbay before it is either diverted into the South Diversion Intake structure or allowed to flow downstream into lower Stony Creek. The South Diversion Intake is located approximately 300 yards downstream of Black Butte Dam and at the southern end of the 5- to 10-acre afterbay. The water flows by gravity from the afterbay into the headworks of the South Canal. Orland Project water can originate from several sources including: (1) water released from storage directly from East Park or Stony Gorge Reservoirs, (2) water stored in East Park or Stony Gorge Reservoirs that is exchanged with CVP water stored in Black Butte Lake, or (3) water resulting from available natural inflows.

The maximum design capacity of the South Canal inlet structure is 530 cfs; however, the maximum operating capacity is 250 cfs between Black Butte Dam and Interstate 5 (I-5). Below I-5, the capacity is reduced to 200 cfs, and further reduced to 80 cfs in Lateral 40.

OUWUA proposes to operate the South Diversion Intake and South Canal based on demand for the life of the Orland Project according to the following standard operational procedures. Diversions typically will occur from March through November. Year-round operation may occur depending on water demands and weather patterns. In conjunction with the terms of the Exchange Agreement, diversions into the South Diversion Canal may result in reductions of Black Butte Lake storage, reducing the amount of water available for release down lower Stony Creek.

d. *Northside Diversion Dam and North Canal*

NDD and North Canal were completed in 1913 and are located on lower Stony Creek approximately four miles below Black Butte Dam. NDD consists of a low concrete weir rising approximately 10 feet above the base streambed level, on top of which metal jacks and wooden flashboards are installed to impound water during the irrigation season. The weir is 375 feet long, trapezoidal, and situated on a clay base. There is an associated concrete apron on the downstream side of the weir that is approximately 20 feet wide along the entire length of the weir. The north end of the diversion dam structure contains a 36-foot-long sluiceway which contains a 12-foot-long by 6-foot-wide, electronically operated drum gate that allows water to be bypassed downstream during diversions into the North Canal. The North Canal headworks is also located on the north side of the dam and is approximately 10 feet wide with two mechanically operated metal gates placed within a concrete frame. The North Canal intake has a maximum design capacity of 150 cfs, however the maximum operating capacity is 130 cfs.

When the flashboards are placed into the diversion dam structure, water from lower Stony Creek is diverted into the North Canal headworks up to a maximum of 130 cfs with an associated minimum bypass of 30 cfs. When water is no longer needed for irrigation or when flood control criteria are triggered, the flashboards are removed to allow Black Butte Lake releases to flow downstream unimpeded. Typically, flashboards are installed in the spring and removed in the fall. However, flashboards may be installed and removed several times during the year due to major flood control releases (*e.g.*, boards were installed/removed three times in the spring of 1998 with the heavy rainfall and flows). If Black Butte Lake is in flood control stage during the irrigation season, the OUWUA is notified by Reclamation prior to major releases (>1500 cfs) and the flashboards are removed to prevent damage to the dam structure. The boards are re-installed after flood releases subside if there is continued demand for irrigation water. If the irrigation demand is 35 cfs or less, diversion can occur without installing the boards. It typically takes 4 to 5 hours to install and remove the flashboards. During placement and removal, flows in the creek must be limited to a maximum of 30 cfs for approximately 24 hours for workers to safely access flashboards.

During diversions into the North Canal, an operational bypass of 30 cfs flows into lower Stony Creek by informal agreement between Reclamation, the California Department of Fish and Game (DFG) and the OUWUA. The Orland Project is entitled to natural flow not to exceed 279 cfs (or 553 acre-feet per day) which is typically taken first if available, plus a maximum of 102,000 acre-feet per year of storage water, if available.

Reclamation retains ownership of the Orland Project facilities, however the facilities have been operated since 1954 by the OUWUA under contract #14-06-200-3502 dated August 26, 1954.

e. *Exchange Agreement*

An Exchange Agreement (contract #14-06-200-1020A) was implemented between Reclamation and the OUWUA in 1964. This agreement allows the exchange of CVP water stored in Black Butte Lake with Orland Project water stored in Stony Gorge and East Park Reservoirs. As a result of the 1964 Exchange Agreement minimum reservoir storage was established for East Park (5,000 acre-feet to protect the fisheries), Stony Gorge Reservoir (5,000 acre-feet, subsequently amended to 7,500 acre-feet, to protect the fisheries and provide municipal water supplies to Elk Creek and water users along Stony Creek), and Black Butte Lake (20,000 acre-feet to protect the fisheries). A recent update to the Area and Capacity Table for Black Butte Lake (September 2001), showed that storage capacity behind Black Butte Dam has been lost to sedimentation. Consequently, the interim water control diagram indicates that in the event maximum storage behind Black Butte Dam is necessary, between 15 December and 5 April the minimum reservoir storage will be zero; not 20,000 acre-feet. East Park Reservoir is the most difficult of the three Stony Creek reservoirs to fill, and carryover storage left in East Park Reservoir at the end of the irrigation season normally is retained.

f. *Memorandum of Understanding (MOU)*

In 1971, Reclamation, the Corps, DFG and OUWUA entered into an MOU and set forth a document entitled "General Operating Objectives for Stony Creek Reservoirs." The objective of the MOU is to provide stable water levels during a 3 week period in late spring for the maintenance of crappie (*Pomoxis* spp.) spawning habitat in Stony Gorge Reservoir (odd years) and Black Butte Lake (even years). The guidelines state that when water surface temperatures reach 60 °F in the spring, all agencies will endeavor to limit reservoir elevation fluctuations to within plus or minus 2 feet for 3 weeks. In order to accomplish this, a water exchange is made with OUWUA to maintain the 2-foot criteria in Black Butte Lake. Under normal operating conditions, Stony Gorge Reservoir elevation in most years remains within the 2-foot criteria and requires minimal manipulation during the crappie spawning period. This MOU has subsequently been adopted and revised within the State Water Resource Control Board permit #13776 to state that the period for stable water levels be increased from 3 weeks to 4 to 5 weeks.

g. *Ongoing and Proposed Future Orland Project Operations*

OUWUA proposes to continue diversions into the North and South Canals based on water demands and to continue coordinating operations of East Park, Stony Gorge, and Black Butte Dams with Reclamation according to the 1964 Exchange Agreement and the 1971 MOU, with a minimum 30 cfs bypass below the North Canal during diversion activities. Diversions for the Orland Project typically will occur between March and November; however, diversions for irrigation purposes can occur in every month of the year, depending on weather patterns and demand. Based on past operations, annual diversions can be expected to range from 73,900 to 104,824 acre-feet per year although the only restrictions on amounts of irrigation water used are available natural flow not to exceed 279 cfs plus a maximum of 102,000 acre-feet per year of storage from the upper reservoirs, if available.

As described above, flashboards will be installed at NDD prior to diversion into the North Canal, and will be removed after irrigation demands no longer exist. If releases in excess of 1500 cfs are called for, Reclamation will notify the OUWUA and allow them the opportunity to remove the flashboards to protect the diversion structure, conditions permitting. For safety purposes, it is necessary to reduce flows from Black Butte Dam to 30 cfs for 24 hours during the removal of the boards. Once the boards are removed, the releases will commence. Once releases are no longer necessary, flashboards may be reinstalled if there are continued irrigation demands, requiring another 24-hour period of 30 cfs flows for reinstallation. However, it is recognized that given the uncertainty in forecasting hydrometeorological conditions, that rare instances may occur which do not allow for 24-hour notification prior to increasing releases from Black Butte Dam. In these instances the communication and coordination of releases will be increased.

2. Black Butte Project

The Corps retains ownership of the Black Butte Project facilities except for the Orland South Canal Diversion Intake. Black Butte Dam flood control operations are determined by the Corps. Reclamation determines irrigation releases during the irrigation season which typically occurs from March to November, but can occur during any month of the year. Operations of the facilities are coordinated between the Corps and Reclamation as established under P.L. 91-502 (1970). Although Black Butte Dam is owned by the Corps, authorizing legislation did not identify an agency responsible for maintaining the channel capacity of Stony Creek below Black Butte Dam.

The Corps' operations of Black Butte Dam and Lake are governed by the Stony Creek Water Control Manual which includes a Water Control Plan and a Flood Control Diagram for Black Butte Lake. These documents provide guidance on when and how to make flood control releases from Black Butte Dam. The Corps proposes to continue operating Black Butte Dam in accordance with the Water Control Plan and Flood Control Diagram as it has since 1963. The Corps is in the process of rewriting the Water Control Manual; the Water Control Plan and Flood Control Diagram are not being changed except to reformat as required by regulation to indicate the reduction in total storage that has occurred due to sedimentation and to reflect a shift in the Water Control Diagram forward 15 days (from September 1-June 15 to September 15-July 1). Corps inspections or maintenance of the outlet works or powerplant facilities will require some outlet gates to be closed, however, a minimum of 30 cfs flow will be maintained during these outages by keeping at least two gates open. Annual and 5-year inspections typically will occur during mid-November.

a. *Flood Control Diagram*

Since 1962 the Corps, Sacramento District, has operated the Black Butte Project for flood control in accordance with the Flood Control Diagram of the Water Control Manual.

Flood control reservation in Black Butte Lake increases uniformly from 0 acre-feet on September 15 to a maximum reservation of 136,200 acre-feet (gross pool) by December 15. A minimum reservation of 106,400 acre-feet is required from November 25 to February 6, Conditional flood control reservation is up to a maximum of 136,200 acre-feet from December 15 to April 5, decreasing again to zero on June 30. The required reservation is determined by use of a ground wetness index during this period.

The maximum scheduled flood control release from Black Butte Dam is 15,000 cfs depending on a release schedule that correlates peak inflow for a specific event and the percentage of the flood control storage reserve in use. The controlled capacity through the outlet works is 22,800 cfs. The rated spillway capacity (uncontrolled weir) for the dam is 76,600 cfs. Flood control operations by the Corps begin when the storage in Black Butte Lake exceeds the flood control space required at any particular time as determined by the Flood Control Diagram.

According to the Flood Control Diagram, “required gross flood control reservation in Black Butte Lake may be reduced by creditable flood control space known to exist in East Park and Stony Gorge Reservoirs. The flood control requirement in Black Butte Lake is equal to the gross flood control reservation minus the total creditable transfer space.”

b. *Operations Forecasting*

The California-Nevada River Forecast Center (CNRFC) provides the Corps with both 6-hour full natural flow forecasts for the Black Butte Project and 6-day Quantitative Precipitation Forecasts (QPF). Respectively, these forecasts extend 60 and 72 hours into the future. Even though the Corps’ Water Control Plan does not currently require using forecasted data to operate the projects, these forecasts are used in Corps flood control models and to operate the Black Butte project. It is the Corps’s intention to formally incorporate forecasting into the Water Control Plan in the near future.

c. *Reclamation Operations*

Reclamation directs Black Butte Project operations for water conservation storage and to supply water for irrigation during the non-flood control season. The only space allocation made in Black Butte Lake for CVP operations is a 20,000 acre-feet minimum pool storage for recreation and fisheries purposes. Any rainfall and natural inflows into Black Butte Lake that are in excess of what the Orland Project uses are stored as CVP water. Available CVP water has been defined by Reclamation as excess water during the non-flood period projected to be available for use based on storage as of June 1 of each year, accounting for required water rights. Factors of evaporative losses, minimum releases, minimum pools, and conditions of the permit are accounted for in the determination of available water. The average annual yield after all accounting is approximately 56,000 to 59,000 acre-feet.

Reclamation proposes to continue water management of the three reservoirs in coordination with the OUWUA and the TCCA when the flood season is over, and to coordinate irrigation deliveries to the TCCA during the periods of April 1 through May 15 and September 15 through October 29 when water is needed, and if there is allowable storage of CVP water in the three reservoirs. Irrigation deliveries will not exceed 38,293 acre-feet annually according to the SWRCB permit #13776 issued April1, 1996. Reclamation will continue to coordinate irrigation deliveries with the OUWUA meeting Orland Project demands when water is available.

If Black Butte Lake is not encroached, Reclamation uses ramping rates of 30 percent per hour or 50 cfs, whichever is greater, to prevent overtopping when the lake is full and to provide water deliveries in a timely fashion.

104,657 acre-feet of water is needed to meet the exchange agreement requirements, maximum irrigation demands and current minimum instream flows below Black Butte Dam. This 104,657 acre-foot amount includes:
20,000 acre-feet of minimum pool in Black Butte Lake,
12,500 acre-feet of minimum pool in East Park and Stony Gorge reservoirs,
16,364 acre-feet of the 30 cfs minimum instream flow below Black Butte Dam from April-December,
15,715 evaporation losses from April-December,
1,785 acre-feet of additional 10 cfs minimum instream flow during rediversion below the TCC (90 days maximum), and
38,293 acre-feet of CVP water (maximum) to the TCCA for irrigation deliveries.

The Orland Project also maintains a right to divert up to 279 cfs of natural inflow into Black Butte Lake from the upper basin. These requirements in Black Butte Lake for water allocation and water exchanges can stay in effect in a dry year. Water indices such as the Sacramento Valley Water Year Hydrologic Index (based on carryover storage and rainfall in Shasta Lake) are useful but not reliable in forecasting conditions on Stony Creek and, because conditions change monthly, weekly and sometimes daily in the Stony Creek watershed, forecasting has not been used by Reclamation water managers. Factors such as late storms and high inflow after April 1 can drastically change allocations which are reassessed on a daily basis. Reclamation manages all water exchanges to maximize water conservation in the upstream reservoirs in preparation for potential future drought conditions. Should conditions occur such that more than 104,657 acre-feet are present, or expected to run off into Black Butte Lake on or after April 1, and the upstream reservoirs are full, Reclamation could release greater instream flows for fishery benefits so long as such releases do not affect the Orland Project's right to divert up to 279 cfs of daily inflow.

When basin conditions are dry and storage at Black Butte is low, operational options dictate using some or all of the upstream storage using the 1964 exchange agreement. Only 12, 500 AF would be exchanged for maintaining minimum pools in East Park (5,000 AF) and Stony Gorge (7,500 AF). East Park, being the most difficult to fill, would be the last to be used. Operations would use Stony Gorge storage first, drawing it down to 25,000 AF, and then drawing down East Park to 23,000 AF. If demands dictate, Stony Gorge would be drawn down to the minimum pool of 7,500 AF. If demands continue, East Park could be drawn down to the minimum pool of 5,000 AF.

d. *CVP Integration*

The Black Butte Project was financially and operationally integrated with the other storage features of the CVP in 1970 (P.L. 91-502, 84 Stat. 1097). As a result, Black Butte Lake now provides the maximum practicable amount of storage for conservation of irrigation water without impairment of the flood control functions. Water conserved in Black Butte Lake is authorized to be used for irrigation purposes and to meet such domestic, municipal, and industrial demands as may occur. The estimated conservation yield of Black Butte Lake was 59,000 acre-feet. On the average, it was estimated that 10,600 acre-feet of water would be made available for use in the watershed area above Black Butte Lake and an additional 48,600 acre-feet average annual yield would be available below the dam.

Releases are determined by the needs of the downstream water users during the irrigation season through Reclamation, and by flood control parameters during the flood control season through the Corps. The major downstream water users are the OUWUA authorized through the Orland Project and the CVP contractor districts served through the CVP facilities operated by the Tehama Colusa Canal Authority (TCCA).

e. *Tehama Colusa Canal/Constant Head Orifice*

The TCC was constructed as part of the CVP facilities in 1965 for the distribution of water diverted from the Sacramento River at RBDD. The TCC and the Corning Canal, which are integral parts of the TCCA canal system, both receive their primary water supply from RBDD, and are operated and maintained by the TCCA under a long term contract with Reclamation. The TCC extends from RBDD for 111 miles through Tehama, Glenn, and Colusa Counties with its terminus in Yolo County. The originating capacity of the TCC at RBDD is 2,530 cfs, reducing to 1,700 cfs at the downstream end.

The TCC, which intersects with lower Stony Creek approximately 30 miles below RBDD, siphons water under Stony Creek. At this crossing, the CHO was constructed in 1974 to divert water from the TCC into the creek for fishery enhancement purposes, but this diversion was discontinued in 1975 when a plan to restore Stony Creek's winter-run, fall-run and steelhead spawning habitat was abandoned due to the high cost of stream channel and gravel rehabilitation as well as problems such as land acquisition and access.

Since 1993, the CHO has been used in reverse to divert stored CVP water released from Black Butte Lake into the TCC when RBDD is not operating. Daily diversions at the CHO have averaged approximately 180 cfs when taken, between 1993 and 2000. Although never rated for a maximum capacity, the CHO diversions have at times been as high as 685 cfs. Rediversion operations involve the construction of a gravel berm upstream of the TCC/CHO to direct water into the canal. The berm construction/rediversion operations have been conducted under informal consultations with NMFS since 1993. Bypass culverts are installed to allow a minimum of 40 cfs down Stony Creek during rediversion, as required by the State Water Resources Control Board (SWRCB) permit. Reclamation proposes to continue annual rediversions of CVP stored water from Black Butte Lake, as described above, until a long-term solution to fish passage and water delivery limitations at RBDD is reached.

f. *State Water Resources Control Board Permit*

According to SWRCB permit #13776, the TCCA can only receive CVP water during the operation season of April 1 through May 15 and September 15 through October 29, for an annual maximum of 38,293 acre-feet. Other flow constraints include (1) maintaining a continuous bypass flow of not less than 40 cfs immediately downstream of the CHO when rediverting water, (2) ramping stream flows down at a rate of no more than 30 percent per hour or 50 cfs, whichever is greater, and (3) providing a fish distribution flow of not less than 100 cfs for a period of 24 hours prior to rediversion. The intended purpose of this distribution flow is to flush juvenile fish out of the area above the CHO so that they will not become entrained into the diversion.

g. *Coordinated Management*

In addition to the operating objectives of the 1971 MOU between Reclamation, the Corps, OUWUA and DFG, and the 1964 Exchange Agreement between Reclamation and the OUWUA for water transfer between East Park, Stony Gorge, and Black Butte Lakes, Reclamation manages water releases from Black Butte Lake cooperatively with the Corps when releases are needed during the flood control season. Reclamation's Willows office and the Corps' water management staff communicate daily during the flood control season regarding inflows, predicted precipitation, storage, demand, and other operation issues. When Black Butte Lake water is no longer released for flood control, any water remaining in the lake is considered CVP water.

h. *Miscellaneous Diversions in the Upper Watershed*

In 2005 Reclamation executed the renewal of five binding agreement water contracts in the Black Butte Unit of the Sacramento River Division and entered into Section 7 consultation for the long-term (40 year) renewal. The water contractors were: Stony Creek Water District for a diversion of 2,920 acre-feet, Stonyford for a diversion of 40 acre-feet, Whitney Construction for a diversion of 25 acre-feet, 4-E Water District for a diversion of 20 acre-feet, and the U.S. Forest Service for a diversion of 55 acre-feet, for a the total amount of 3,060 acre-feet of water. The contracts expire in 2010, 2020, or 2024. Reclamation initiated consultation on the effects of renewal of these contracts with NMFS on April 16, 2004. In a letter dated January 10, 2005, NMFS provided a determination that the effects of these contract renewals were analyzed and covered under previous biological opinions. A February, 2005 memorandum from the U.S. Fish and Wildlife Service provided a "not likely to adversely affect listed species or critical habitat" determination.

The Elk Creek Community Services District, another diverter on upper Stony Creek, chose not to enter into a Binding Agreement with Reclamation pursuant to §3404(c)(3) of the CVPIA, and therefore did not participate in the 2005 long-term water service contract renewal process. The District's existing long-term water service contract expires on August 20, 2007. The Region is unable to execute a long-term renewal contract (LTRC) pursuant to §3404(c) of the Central Valley Project Improvement Act (Title XXXIV PL102-575, 106 Stat. 4706) (CVPIA) with the District until the U.S. Fish & Wildlife Service and NOAA Fisheries complete Section 7 consultations under the ESA regarding the revised CVP Operations Criteria and Plan (OCAP). An interim renewal contract (IRC) will be necessary to provide continued delivery of a supplemental supply of CVP water to the District pending completion of the CVP OCAP consultations. By law, the initial interim contract would be limited to 3 years, but it may be limited to 2.5 years to coincide with a termination date of the last day in February (similar to other contracts) of the applicable year, and lasting until the OCAP is completed. Subsequent renewals, if needed, would be for two years, and the long term contract, to be negotiated after the OCAP is completed, would be for 40 years. Both the IRC and the LTRC will incorporate the applicable provisions of the CVPIA and will be modeled after the form of the recently negotiated interim and long-term renewal contracts. This biological opinion does not analyze or authorize these water contracts under the ESA. Reclamation intends to pursue separate environmental documentation and section 7 consultation for these actions.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following Federally listed species (Evolutionarily Significant Units (ESU) or Distinct Population Segments (DPS)) and designated critical habitat occur in the action area below Black Butte Dam and may be affected by water management operations:

Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
endangered (June 28, 2005, 70 FR 37160)
Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
threatened (June 28, 2005, 70 FR 37160)
Central Valley spring-run Chinook salmon designated critical habitat
(September 2, 2005, 70 FR 52488)
Central Valley steelhead DPS (*Oncorhynchus mykiss*)
threatened (signed December 22, 2005)
Central Valley steelhead designated critical habitat
(September 2, 2005, 70 FR 52488)

The threatened southern DPS of North American green sturgeon (*Acipenser medirostris*) is not found in Stony Creek and therefore will not be affected by the proposed project.

A. Species and Critical Habitat Listing Status

Sacramento River winter-run Chinook salmon were originally listed as threatened in August 1989, under emergency provisions of the Endangered Species Act (ESA), and formally listed as threatened in November 1990 (55 FR 46515). The ESU consists of only one population that is confined to the upper Sacramento River in California's Central Valley. NMFS designated critical habitat for winter-run Chinook salmon on June 16, 1993 (58 FR 33212). They were reclassified as endangered on January 4, 1994 (59 FR 440), due to increased variability of run sizes, expected weak returns as a result of two small year classes in 1991 and 1993, and a 99 percent decline between 1966 and 1991. Critical habitat area was delineated as the Sacramento River from Keswick Dam, (river mile (RM) 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (Delta), including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge. Although juvenile winter-run Chinook salmon are known to use the lower portion of the action area for non-natal rearing, the area is not included as critical habitat for winter-run Chinook salmon.

Central Valley spring-run Chinook salmon were listed as threatened on September 16, 1999 (50 FR 50394). This ESU consists of spring-run Chinook salmon occurring in the Sacramento River basin. A final rule designating critical habitat for Central Valley spring-run Chinook salmon was published on September 2, 2005 (70 FR 52488). The rule became effective on January 2, 2006. The designation includes numerous streams and stream reaches throughout the Central Valley, including portions of lower Stony Creek from the mouth upstream to NDD.

Central Valley steelhead were listed as threatened under the ESA on March 19, 1998 (63 FR 13347). This DPS consists of steelhead populations in the Sacramento and San Joaquin River (inclusive of and downstream of the Merced River) basins in California's Central Valley. A final rule designating critical habitat for Central Valley steelhead was published on September 2, 2005 (70 FR 52488). The rule became effective on January 2, 2006. The designation includes numerous streams and stream reaches throughout the Central Valley, including lower Stony Creek from the mouth upstream to Black Butte Dam.

The critical habitat designations for Central Valley spring-run Chinook salmon and Central Valley steelhead identify the primary constituent elements (PCEs) of critical habitat which include those physical and biological features of the habitat that are essential to the conservation of the species. The PCEs of critical habitat for these species are made up of specific physical and biological components such as water of an appropriate quality and quantity, suitable spawning substrates, forage and food sources, and natural cover such as shade, submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. PCEs within lower Stony Creek include freshwater spawning sites, freshwater rearing sites and freshwater migration corridors. The condition of these PCEs in lower Stony Creek has been impacted by past human activities and will be described more fully below in the Environmental Baseline section of this document.

NMFS recently has completed an updated status review of 16 salmon ESUs, including Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon, and concluded the species' status should remain as previously listed (70 FR 37160). On January 5, 2006, NMFS published a final listing determination for 10 steelhead DPSs, including Central Valley steelhead. The new listing determination became effective on February 6, 2006 (71 FR 834), and concludes that Central Valley steelhead DPS will remain listed as threatened.

B. Species Life History and Population Dynamics

1. Chinook Salmon

a. *General Life History*

Chinook salmon exhibit two generalized freshwater life-history types (Healey 1991). "Stream-type" Chinook salmon enter freshwater months before spawning and reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon spawn soon after entering freshwater and migrate to the ocean as fry or parr within their first year. Spring-run Chinook salmon exhibit a stream-type life history. Adults enter freshwater in the spring, hold over summer, spawn in fall, and the juveniles typically spend a year or more in freshwater before emigrating. Winter-run Chinook salmon are somewhat anomalous in that they have characteristics of both stream- and ocean-type races (Healey 1991). Adults enter freshwater in winter or early spring, and delay spawning until spring or early summer (stream-type). However, juvenile winter-run Chinook salmon migrate to sea after only four to seven months of river life (ocean-type). Adequate instream flows and cool water temperatures are more critical for the survival of Chinook salmon exhibiting a stream-type life history due to over summering by adults and/or juveniles

Chinook salmon mature between two and six years of age (Myers *et al.* 1998). Freshwater entry and spawning timing generally are thought to be related to local water temperature and flow regimes (Miller and Brannon 1982). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and the actual time of spawning (Myers *et al.* 1998). Both spring-run and winter-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows also are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38 ºF to 56 ºF (Bell 1991, DFG 1998). Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate past Red Bluff Diversion Dam (RBDD) from mid-December through early August (NMFS 1997). The majority of the run passes RBDD from January through May, and peaks in mid-March (Hallock and Fisher 1985). The timing of migration may vary somewhat due to changes in river flows, dam operations, and water year type. Adult spring-run Chinook salmon enter the Delta from the Pacific Ocean beginning in January and enter natal streams from March to July (Myers *et al.* 1998). In Mill Creek, Van Woert (1964) noted that of 18,290 spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30. Typically, spring-run Chinook salmon utilize mid- to high elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature.

Spawning Chinook salmon require clean, loose gravel in swift, relatively shallow riffles or along the margins of deeper runs; suitable water temperatures, depths, and velocities for redd construction; and adequate oxygenation of incubating eggs. Chinook salmon spawning typically occurs in gravel beds that are located at the tails of holding pools (FWS 1995). The range of water depths and velocities in spawning beds that Chinook salmon find acceptable is very broad. Bell (1991) identifies the preferred water temperature for adult spring-run Chinook salmon migration as 38 ^{o}F to 56 ^{o}F. Boles (1988) recommends water temperatures below 65 ^{o}F for adult Chinook salmon migration, and Lindley *et al.* (2004) report that adult migration is blocked when temperatures reach 70 ^{o}F, and fish can become stressed as temperatures approach 70 ^{o}F. Reclamation reports that spring-run Chinook salmon holding over the summer prefer water temperatures below 60 ^{o}F, although salmon can tolerate temperatures up to 65 ^{o}F before they experience an increased susceptibility to disease. The upper preferred water temperature for spawning Chinook salmon is 55 ^{o}F to 57 ^{o}F (Chambers 1956, Reiser and Bjornn 1979). Winter-run Chinook salmon spawning occurs primarily from mid-April to mid-August, with the peak activity occurring in May and June in the Sacramento River reach between Keswick dam and RBDD (Vogel and Marine 1991). The majority of winter-run Chinook salmon spawners are three years old. Physical Habitat Simulation Model (PHABSIM) results (FWS 2003) indicate winter-run Chinook salmon suitable spawning velocities in the upper Sacramento River are between 1.54 feet per second (ft/s) and 4.10 ft/s, and suitable spawning substrates are between 1 and 5 inches in diameter. Initial habitat suitability curves (HSCs) show spawning suitability rapidly decreases for water depths greater than 3.13 feet (FWS 2003). Spring-run Chinook salmon spawning occurs between September and October, depending on water temperatures. Between 56 and 87 percent of adult spring-run Chinook salmon that enter the Sacramento River basin to spawn are 3 years old (Calkins *et al.* 1940, Fisher 1994). PHABSIM results indicate spring-run Chinook salmon suitable spawning velocities in Butte Creek are between 0.8 ft/s and 3.22 ft/s, and suitable spawning substrates are between 1 and 5 inches in diameter

(FWS 2004). The initial HSC showed suitability rapidly decreasing for depths greater than one foot, but this effect was most likely due to the low availability of deeper water in Butte Creek with suitable velocities and substrates rather than a selection by spring-run Chinook salmon of only shallow depths for spawning (FWS 2004).

The optimal water temperature for egg incubation is 44 ^{o}F to 54 ^{o}F (Rich 1997). Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel percolation, and poor water quality. Studies of Chinook salmon egg survival to hatching conducted by Shelton (1955) indicated 87 percent of fry emerged successfully from large gravel with adequate subgravel flow. The length of time required for eggs to develop and hatch is dependent on water temperature and is quite variable. Alderdice and Velsen (1978) found that the upper and lower temperatures resulting in 50 percent pre-hatch mortality were 61 EF and 37 EF, respectively, when the incubation temperature was constant.

Winter-run Chinook salmon fry begin to emerge from the gravel in late June to early July and continue emerging through October (Fisher 1994), generally at night. Spring-run Chinook salmon fry emerge from the gravel from November to March and spend about 3 to 15 months in freshwater habitats prior to emigrating to the ocean (Kjelson *et al.* 1981). Post-emergent fry disperse to the margins of their natal stream, seeking out shallow waters with slower currents, finer sediments, and bank cover such as overhanging and submerged vegetation, root wads, and fallen woody debris, and begin feeding on small insects and crustaceans.

When juvenile Chinook salmon reach a length of 50 to 75 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures. In the mainstems of larger rivers, juveniles tend to migrate along the margins and avoid the elevated water velocities found in the thalweg of the channel. When the channel of the river is greater than 9 to 10 feet in depth, juvenile salmon tend to inhabit the surface waters (Healey 1982). Stream flow and/or turbidity increases in the upper Sacramento River basin are thought to stimulate emigration. Emigration of juvenile winter-run Chinook salmon past RBDD may begin as early as mid-July, typically peaks in September, and can continue through March in dry years (Vogel and Marine 1991, NMFS 1997). From 1995 to 1999, all winter-run Chinook salmon outmigrating as fry passed RBDD by October, and all outmigrating pre-smolts and smolts passed RBDD by March (Martin *et al.* 2001). Spring-run Chinook salmon emigration is highly variable (DFG 1998). Some may begin outmigrating soon after emergence, whereas others over summer and emigrate as yearlings with the onset of intense fall storms (DFG 1998). The emigration period for spring-run Chinook salmon extends from November to early May, with up to 69 percent of young-of-the-year outmigrants passing through the lower Sacramento River and Delta during this period (DFG 1998).

Fry and parr may rear within riverine or estuarine habitats of the Sacramento River, Delta, and their tributaries. Spring-run Chinook salmon juveniles have been observed rearing in the lower part of non-natal tributaries and intermittent streams during the winter months (Maslin *et al.* 1997, Snider 2001). Within the Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels and sloughs (McDonald 1960, Dunford 1975). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson *et al.* 1982, Sommer *et al.* 2001, MacFarlane and Norton 2002).

Winter-run Chinook salmon fry remain in the San Francisco Bay estuary until they reach a fork length of about 118 mm (*i.e.*, 5 to 10 months of age) and then begin emigrating from the estuary to the open ocean as early as November and continue through May (Fisher 1994, Myers *et al.* 1998). Little is known about estuarine residence time of spring-run Chinook salmon. Juvenile Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay and grew little in length or weight until they reached the Gulf of the Farallones (McFarlane and Norton 2002). Based on the mainly ocean-type life history observed (*i.e.*, fall-run Chinook salmon), MacFarlane and Norton (2002) concluded that unlike populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependence and may benefit from expedited ocean entry. Spring-run Chinook yearlings are larger in size than fall-run Chinook and ready to smolt upon entering the Delta; therefore, they probably spend little time rearing in the Delta.

b. *Population Trend – Sacramento River Winter-run Chinook Salmon*

The distribution of winter-run Chinook salmon spawning and rearing historically was limited to the upper Sacramento River and tributaries, where spring-fed streams allowed for spawning, egg incubation, and rearing in cold water (Slater 1963, Yoshiyama *et al.* 1998). The headwaters of the McCloud, Pit, and Little Sacramento Rivers, and Hat and Battle Creeks, provided clean, loose gravel, cold, well-oxygenated water, and optimal flow in riffle habitats for spawning and incubation. These areas also provided the cold, productive waters necessary for egg and fry survival, and juvenile rearing over summer. Construction of Shasta Dam in 1943 and Keswick Dam in 1950 blocked access to all of these waters except Battle Creek, which is blocked by a weir at the Coleman National Fish Hatchery and other small hydroelectric facilities (Moyle *et al*. 1989, NMFS 1997). Approximately, 299 miles of tributary spawning habitat in the upper Sacramento River is now blocked. Yoshiyama *et al.* (1998) estimated that the Upper Sacramento River in 1938 had a “potential spawning capacity” of 14,303 redds. Most components of the winter-run Chinook salmon life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the habitat blockage in the upper Sacramento River.

Following the construction of Shasta Dam, the number of winter-run Chinook salmon initially declined but recovered during the 1960s. The initial recovery was followed by a steady decline, subsequent to the construction of RBDD, from 1969 through the late 1980s (FWS 1991). Since 1967, the estimated adult winter-run Chinook salmon population ranged from 117,808 in 1969, to 186 in 1994 (NMFS 1997). The population declined from an average of 86,000 adults in 1967 to 1969 to only 1,900 in 1987 to 1989, and continued to remain low, with an average of approximately 2,500 fish for the period from 1998 to 2000 (Table 1). Between the time Shasta Dam was built and the listing of winter-run Chinook salmon as endangered, major impacts to the population occurred from warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Delta, acid mine drainage from Iron Mountain Mine, and entrainment at a large number of unscreened or poorly-screened water diversions (NMFS 1997).

Population estimates from 2001 through 2004 show relatively consistent population levels with at least 4,000 more adults than any of the previous 15 years (Table 1). The 2005 run (15,829 fish) was the highest since the listing. Also, there is an increasing trend in the five-year moving average (491 from 1990-1994 to 9,483 from 2000-2005), and the five-year moving average of cohort replacement rates has increased and appears to have stabilized over the same period.

Table 1. Winter-run Chinook salmon population estimates from Red Bluff Diversion Dam counts, and corresponding cohort replacement rates for the years since 1986.

Year	Population Estimate (RBDD)	5-Year Moving Average Population Estimate	Cohort Replacement Rate	5-Year Moving Average of Cohort Replacement Rate
1986	2,596	-	-	-
1987	2,186	-	-	-
1988	2,885	-	-	-
1989	696	-	0.27	-
1990	430	1,759	0.20	-
1991	211	1,282	0.07	-
1992	1,240	1,092	1.78	-
1993	387	593	0.90	0.64
1994	186	491	0.88	0.77
1995	1,297	664	1.05	0.94
1996	1,337	889	3.45	1.61
1997	880	817	4.73	2.20
1998	3,002	1,340	2.31	2.49
1999	3,288	1,961	2.46	2.80
2000	1,352	1,972	1.54	2.90
2001	8,224	3,349	2.74	2.76
2002	7,441	4,661	2.26	2.26
2003	8,218	5,705	6.08	3.02
2004	7,701	6,587	0.94	2.71
2005	15,829	9,483	2.13	2.83

c. *Status - Sacramento River Winter-run Chinook Salmon*

Numerous factors have contributed to the decline of winter-run Chinook salmon through degradation of spawning, rearing, and migration habitats. The primary impacts include blockage of historical habitat by Shasta and Keswick Dams, warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Delta, heavy metal contamination from Iron Mountain Mine, high ocean harvest rates, and entrainment in a large number of unscreened or poorly screened water diversions. Secondary factors include smaller water manipulation facilities and dams, low recruitment of spawning gravel due to blockage behind upstream dams, loss of rearing habitat in the lower Sacramento River and Delta from levee construction, marshland reclamation, and interaction with and predation by introduced species (NMFS 1997).

Since the listing of winter-run Chinook salmon, several of the factors that led to the decline of the species have been addressed and improved through restoration and conservation actions. The impetus for initiating restoration actions stem primarily from the following: (1) ESA section 7 consultation reasonable and prudent alternatives on temperature, flow, and operations of the CVP and State Water Project; (2) SWRCB decisions requiring compliance with Sacramento River water temperature objectives which resulted in the installation of the Shasta Temperature Control Device in 1998; (3) a 1992 amendment to the authority of the CVP through the Central Valley Project Improvement Act (CVPIA) to give fish and wildlife equal priority with other CVP objectives; (4) fiscal support of habitat improvement projects from the CALFED Bay-Delta Program (*e.g.,* installation of a fish screen on the Glenn-Colusa Irrigation District diversion); (5) establishment of the CALFED Environmental Water Account (EWA); (6) Environmental Protection Agency (EPA) actions to control acid mine runoff from Iron Mountain Mine; and (7) ocean harvest restrictions implemented in 1995.

Due to these restoration and recovery efforts, water temperatures in the upper river have generally been maintained within an acceptable range for winter-run migration, incubation and rearing, suitable spawning gravel has been replenished through gravel augmentation programs below Keswick Dam, and migrational barriers have been reduced at RBDD and Anderson-Cottonwood Irrigation Dam (ACID).

The susceptibility of winter-run Chinook salmon to extinction remains linked to the elimination of access to their historical spawning grounds and the reduction of their population structure to a single, relatively small population. Recent trends in winter-run Chinook salmon abundance and cohort replacement are positive and may indicate some recovery since the listing. However, the population remains below the draft recovery goals established for the run (NMFS 1997). In general, the recovery criteria for winter-run Chinook salmon includes a mean annual spawning abundance over any 13 consecutive years to be 10,000 females and the geometric mean of the cohort replacement rate over those same years to be greater than 1.0.

d. *Population Trend – Central Valley Spring-run Chinook Salmon*

Historically, spring-run Chinook salmon were predominant throughout the Central Valley occupying the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit Rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and the 1940s (DFG 1998). Before construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River alone (Fry 1961). Following the completion of Friant Dam, the native population from the San Joaquin River and its tributaries (*i.e.*, the Stanislaus and Mokelumne Rivers) was extirpated. Spring-run Chinook salmon no longer exist in the American River due to the operation of Folsom Dam. Naturally spawning populations of Central Valley spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (DFG 1998).

On the Feather River, significant numbers of spring-run Chinook salmon, as identified by run timing, return to the Feather River Hatchery (FRH). In 2002, FRH reported 4,189 returning spring-run Chinook salmon, which is 22 percent below the 10-year average of 4,727 fish. However, coded-wire tag (CWT) information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run Chinook salmon populations in the Feather River due to hatchery practices. Because Chinook salmon are not temporally separated in the hatchery, spring-run Chinook and fall-run Chinook are spawned together, thus compromising the genetic integrity of the spring-run Chinook salmon. The number of naturally spawning spring-run Chinook salmon in the Feather River has been estimated only periodically since the 1960s, with estimates ranging from two fish in 1978 to 2,908 in 1964. The genetic integrity of this population is at question because there is significant temporal and spatial overlap between spawning populations of spring-run and fall-run Chinook salmon (Good *et al.* 2005). For the reasons discussed previously, Feather River spring-run Chinook population numbers are not included in the following discussion of ESU abundance.

Since 1969, the Central Valley spring-run Chinook salmon ESU (excluding Feather River fish) has displayed broad fluctuations in abundance ranging from 25,890 in 1982 to 1,403 in 1993 (DFG unpublished data). Even though the abundance of fish may increase from one year to the next, the overall average population trend has a negative slope during this time period. The average abundance for the ESU was 12,499 for the period of 1969 to 1979, 12,981 for the period of 1980 to 1990, and 6,542 for the period of 1991 to 2001. In 2003 and 2004, total run size for the ESU was 8,775 and 9,872 adults respectively, well above the 1991 to 2001 average.

Evaluating the ESU as a whole, however, masks significant changes that are occurring among metapopulations. For example, while the mainstem Sacramento River population has undergone a significant decline, the tributary populations have demonstrated a substantial increase. Average abundance of Sacramento River mainstem spring-run Chinook salmon recently has declined from a high of 12,107 for the period 1980 to 1990, to a low of 609 for the period 1991 to 2001, while the average abundance of Sacramento River tributary populations increased from a low of 1,227 to a high of 5,925 over the same periods. Although tributaries such as Mill and Deer Creeks have shown positive escapement trends since 1991, recent escapements to Butte Creek, including 20,259 in 1998, 9,605 in 2001, and 8,785 in 2002 are responsible for much of the increase in tributary abundance (DFG 2002, DFG unpublished data). The Butte Creek estimates however, do not include prespawning mortality. In the last several years as the Butte Creek population has increased, mortality of adult spawners has increased from 21 percent in 2002 to 60 percent in 2003 due to disease associated with high water temperatures and over-crowding. This trend may indicate that the population in Butte Creek may have reached its carrying capacity (Ward *et al.* 2003) or are near historical population levels.

The extent of spring-run Chinook salmon spawning in the mainstem of the upper Sacramento River is unclear due to overlapping spawning periods with fall-run Chinook salmon. During aerial redd counts very few redds (less than 15 per year) were observed during September (generally accepted as the primary spawning period for spring-run Chinook salmon) from 1989 to 1993, and none in 1994 (FWS 2003). Recently, the number of redds in September has varied from 29 to 105 during 2001 though 2003 depending on the number of survey flights (DFG, unpublished data). In 2002, based on RBDD ladder counts, 483 spring-run Chinook adults are estimated to have spawned in the mainstem Sacramento River (DFG 2004). In 2003, that estimate dipped to zero, and in 2004 the number of spring-run Chinook adults estimated to have spawned in the mainstem Sacramento River was 575 (DFG 2004).

e. *Status of Spring-run Chinook Salmon and Critical Habitat*

The initial factors that led to the decline of spring-run Chinook salmon were related to the loss of upstream habitat behind impassable dams. Since this initial loss of habitat, other factors have impacted spring-run Chinook salmon critical habitat, contributed to the instability of the population and affected the ESU's ability to recover. These factors include a combination of physical, biological, and management factors that have reduced the quantity and quality of critical habitat PCEs and directly reduced population numbers. Climatic variation, water management activities, hybridization with fall-run Chinook salmon, predation, and harvest have all impacted spring-run Chinook salmon critical habitat and population numbers (DFG 1998).

Since spring-run Chinook salmon adults generally hold over for several months in small tributaries before spawning they are extremely susceptible to the effects of low flows and high water temperatures. During the drought from 1986 to 1992, Central Valley spring-run Chinook salmon populations declined substantially (DFG 1998). Dry hydrologic conditions result in reduced flows and warm water temperatures which negatively impact adults, eggs, and juveniles. For adult spring-run Chinook salmon, reduced instream flows delay, or in some instances completely block access to holding and spawning habitats. Water management operations including reservoir releases and unscreened or poorly-screened diversions along spring-run Chinook salmon migration routes compound drought-related problems by further reducing river flows, warming river temperatures, and entraining juveniles.

Several actions have been taken to improve and increase the PCEs of critical habitat for spring-run Chinook salmon, including improved management of Central Valley water (*e.g.*, through use of CALFED EWA and CVPIA (b)(2) water accounts), implementing new and improved screen and ladder designs at major water diversions along the mainstem Sacramento River and tributaries, removal of several small dams on important spring-run Chinook salmon spawning streams, and changes in ocean and inland fishing regulations to minimize harvest. Although protective measures and critical habitat restoration likely have contributed to recent increases in spring-run Chinook salmon abundance, the ESU is still below levels observed from the 1960s through 1990. Threats from hatchery production (*i.e.*, competition for food between naturally spawned and hatchery fish, and run hybridization and homogenization), climatic variation, reduced stream flows, high water temperatures, predation, and large scale water diversions persist. Because the Central Valley spring-run Chinook salmon ESU is confined to relatively few remaining streams and continues to display broad fluctuations in abundance, the population is at a moderate risk of extinction.

2. <u>Steelhead</u>

a. *General Life History*

Based on their state of sexual maturity at the time of river entry and the duration of their spawning migration, steelhead can be divided into two life history types: stream-maturing and ocean-maturing. Stream-maturing steelhead enter freshwater in a sexually immature condition and require several months to mature and spawn, whereas ocean-maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two life history types are more commonly referred to by their season of freshwater entry (*i.e.* summer [stream-maturing] and winter [ocean-maturing] steelhead). Only winter steelhead are currently found in Central Valley rivers and streams (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940s (Interagency Ecological Program [IEP] Steelhead Project Work Team 1999). At present, summer steelhead are found only in North Coast drainages, mostly in tributaries of the Eel, Klamath, and Trinity River systems (McEwan and Jackson 1996).

Winter steelhead generally leave the ocean from August through April, and spawn between December and May (Busby *et al.* 1996). Timing of upstream migration is correlated with higher flow events, such as freshets or sand bar breaches, and the associated lower water temperatures. The preferred water temperature for adult steelhead migration is 46 ^{o}F to 52 ^{o}F (McEwan and Jackson 1996, Myrick 1998, Myrick and Cech 2000). Thermal stress may occur at temperatures beginning at 66 ^{o}F and mortality has been demonstrated at temperatures beginning at 70 ^{o}F. The preferred water temperature for steelhead spawning is 39 ^{o}F to 52 ^{o}F, and the preferred water temperature for steelhead egg incubation is 48 ^{o}F to 52 ^{o}F (McEwan and Jackson 1996, Myrick 1998, Myrick and Cech 2000). The minimum stream depth necessary for successful upstream migration is 13 cm (Thompson 1972). Preferred water velocity for upstream migration is in the range of 40-90 cm/s, with a maximum velocity, beyond which upstream migration is not likely to occur, of 240 cm/s (Thompson 1972, Smith 1973).

Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Nickleson *et al.* 1992, Busby *et al.* 1996). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapolov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Most steelhead spawning takes place from late December through April, with peaks from January though March (Hallock *et al.* 1961). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity, and may spawn in intermittent streams as well (Everest 1973, Barnhart 1986).

The length of the incubation period for steelhead eggs is dependent on water temperature, dissolved oxygen concentration, and substrate composition. In late spring and following yolk sac absorption, fry emerge from the gravel and actively begin feeding in shallow water along stream banks (Nickelson *et al.* 1992).

Steelhead rearing during the summer takes place primarily in higher velocity areas in pools, although young-of-the-year also are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small woody debris. Cover is an important habitat component for juvenile steelhead both as velocity refuge and as a means of avoiding predation (Shirvell 1990, Meehan and Bjornn 1991). Some older juveniles move downstream to rear in large tributaries and mainstem rivers (Nickelson *et al.* 1992). Juveniles feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn 1969), and emerging fry are sometimes preyed upon by older juveniles.

Steelhead generally spend two years in freshwater before emigrating downstream (Hallock *et al.* 1961, Hallock 1989). Rearing steelhead juveniles prefer water temperatures of 45 °F to 58 EF and have an upper lethal limit of 75 EF. Reiser and Bjornn (1979) recommended that dissolved oxygen concentrations remain at or near saturation levels with temporary reductions no lower than 5.0 mg/l for successful rearing of juvenile steelhead. During rearing, suspended and deposited fine sediments can directly affect salmonids by abrading and clogging gills, and indirectly cause reduced feeding, avoidance reactions, destruction of food supplies, reduced egg and alevin survival, and changed rearing habitat (Reiser and Bjornn 1979). Bell (1973) found that silt loads of less than 25 mg/l permit good rearing conditions for juvenile salmonids.

Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows. Emigrating Central Valley steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean. Some may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to their final emigration to the sea. Barnhart (1986) reported that steelhead smolts in California range in size from 140 to 210 mm (fork length). Hallock *et al.* (1961) found that juvenile steelhead in the

Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall.

b. *Population Trends – Central Valley Steelhead*

Steelhead historically were well distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al.* 1996). Steelhead were found from the upper Sacramento and Pit River systems (now inaccessible due to Shasta and Keswick Dams), south to the Kings and possibly the Kern River systems (now inaccessible due to extensive alteration from water diversion projects), and in both east- and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). The present distribution has been greatly reduced (McEwan and Jackson 1996). The California Advisory Committee on Salmon and Steelhead (1988) reported a reduction of steelhead habitat from 6,000 miles historically to 300 miles today. Historically, steelhead probably ascended Clear Creek past the French Gulch area, but access to the upper basin was blocked by Whiskeytown Dam in 1964 (Yoshiyama *et al.* 1996). Steelhead also occurred in the upper drainages of the Feather, American, Yuba, and Stanislaus Rivers which are now inaccessible (McEwan and Jackson 1996, Yoshiyama *et al.* 1996).

Historic Central Valley steelhead run size is difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s, the steelhead run size had declined to about 40,000 adults (McEwan 2001). Over the past 30 years, the naturally spawned steelhead populations in the upper Sacramento River have declined substantially. Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead in the Sacramento River, upstream of the Feather River, through the 1960s. Steelhead counts at RBDD declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996, McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations.

Nobriga and Cadrett (2003) compared CWT and untagged (wild) steelhead smolt catch ratios at Chipps Island trawl from 1998 to 2001 and estimated that about 100,000 to 300,000 steelhead juveniles are produced naturally each year in the Central Valley. In the draft *Updated Status Review of West Coast Salmon and Steelhead* (Good *et al*. 2005), the Biological Review Team (BRT) made the following conclusion based on the Chipps Island data:

> "If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960s".

The only consistent data available on steelhead numbers in the San Joaquin River basin come from DFG mid-water trawling samples collected on the lower San Joaquin River at Mossdale. These data indicate a decline in steelhead numbers in the early 1990s, which have remained low through 2002 (DFG 2003). In 2004, a total of 12 steelhead smolts were collected at Mossdale (DFG, unpublished data).

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks and the Yuba River. Populations may exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996).

Recent snorkel surveys (1999 to 2002) indicate that steelhead are present in Clear Creek (J. Newton, FWS, pers. comm. 2002, as reported in Good *et al*. 2005). Because of the large resident *O. mykiss* population in Clear Creek, steelhead spawner abundance has not been estimated.

Until recently, steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected small self-sustaining populations of steelhead in the Stanislaus, Mokelumne, Calaveras, and other streams previously thought to be void of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (Demko *et al.* 2000). It is possible that naturally spawning populations exist in many other streams but are undetected due to lack of monitoring programs (IEP Steelhead Project Work Team 1999).

c. *Status of Central Valley Steelhead and Critical Habitat*

Both the BRT (Good *et al*. 2005) and the Artificial Propagation Evaluation Workshop (69 FR 33102) concluded that the Central Valley steelhead DPS is "in danger of extinction." However, in the proposed status review NMFS concluded that the DPS in-total is "not in danger of extinction, but is likely to become endangered within the foreseeable future" citing benefits of restoration efforts and a yet-to-be funded monitoring program (69 FR 33102). Central Valley steelhead already have been extirpated from most of their historical range. Critical habitat concerns for steelhead focus on the widespread degradation, destruction, and blockage of freshwater habitat within the region, and impacts to PCEs are similar to those discussed for Chinook salmon above. Widespread hatchery steelhead production within this DPS also raises concerns about the potential ecological interactions between introduced stocks and native stocks. Because the Central Valley steelhead population has been fragmented into smaller isolated tributaries without any large source population and the remaining habitat continues to be degraded by water diversions and other land use practices, the population is at high risk of extinction.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat, and ecosystem within the action area (USFWS and NMFS 1998). The action area includes Stony Creek and its riparian corridor from East Park Reservoir downstream to the confluence with the Sacramento River. The main focus of this analysis centers on the area that is accessible to anadromous species and is designated as critical habitat for Central Valley steelhead, the lower 24.6 miles of Stony Creek between Black Butte Dam and the confluence with the Sacramento River. The lower 19.7 miles of this reach, from NDD to the confluence with the Sacramento River also is designated as critical habitat for Central Valley spring-run Chinook salmon.

Stony Creek is the second largest tributary of the Sacramento River on the west side of the Sacramento Valley, and drains approximately 741 square miles along the eastern slopes of the California Coastal Range. The Stony Creek watershed is characterized by cool, wet winters with high flows, and hot dry summers with low summer and fall flows, with an average precipitation of 15 inches in the lower watershed. Within the upper watershed, variable winter rains and snow (annual precipitation of 32 inches) provide inflow into three reservoirs which affect water releases to lower Stony Creek.

A. Status of the Listed Species within the Action Area

Although Chinook salmon and steelhead are known to occur in lower Stony Creek (Corwin and Grant 2004; Brown 1994; DFG 1983; Reavis 1983), information on recent spawning is greatly limited (Corwin and Grant 2004). The installation of the Glenn Colusa Irrigation District (GCID) siphon under Stony Creek in 1999 has opened up much of the lower creek to anadromous salmonid use over a much greater portion of the year. Prior to installation of the siphon, a gravel berm was constructed during each irrigation season from 1911-1999 at the GCID canal crossing of Stony Creek at CM 3.3, which created an intermittent barrier to both upstream and downstream salmonid migration (Mike Hughes, personal communication, 2007). In many years this berm was able to withstand winter flows and therefore blocked passage throughout the year. In those years that the berm was washed out by high winter flows, it was generally rebuilt early in the spring (March or April) to allow irrigation water delivery. Even with the removal of this intermittent barrier, the potential for recovery of salmonid populations within lower Stony Creek currently is limited by passage barriers and diversions such as the CHO gravel berm during the irrigation season (typically late March to mid May), the NDD, and Black Butte Dam, as well as frequent fluctuations in stream flows with extended periods of extremely low base flows, elevated water temperatures and limited spawning and rearing habitat.

1. <u>Central Valley Spring-run and Sacramento Winter-run Chinook Salmon</u>

Spring-run Chinook salmon are known to have historically spawned in the Stony Creek watershed (Yoshiyama *et al.* 1996). There is documentation of salmon spawning at the confluence of Stony Creek and Little Stony Creek, although habitat conditions in this reach would indicate that these were likely fall-run Chinook salmon. The spring-run are likely to have spawned further up in the watershed above 2,000 feet of elevation, as they do in other tributaries to the Sacramento River. Prior to the placement of irrigation dams, Stony Creek was considered "a very good salmon stream" (Clark 1929). By 1928 spring-run Chinook salmon were nonexistent on Stony Creek due to irrigation diversions that blocked migration to the upper watershed and kept the lower stream dry except during the rainy season (Clark 1929). There is no evidence or documentation of winter-run Chinook salmon spawning in Stony Creek.

The life history and spawning strategies of spring-run Chinook salmon require them to reach upstream cold-water habitats during the spring, summer and early fall seasons. The construction of the GCID diversion, Stony Gorge and Black Butte Dams blocked the spring run from accessing the cold water habitats of upper Stony Creek in order to complete their life cycle. This loss of access to cold water habitats has caused the complete extirpation of spawning populations of spring-run Chinook salmon from the Stony Creek watershed (Yoshiyama et al 1996). It is unlikely that any action short of the removal of these dams or construction of fish passage facilities on these dams could facilitate the return of a spawning population of spring-run Chinook salmon to the system.

Several sampling efforts conducted over the past 20 years have captured juvenile spring- and winter-run Chinook salmon and steelhead in Stony Creek, mostly near the confluence with the Sacramento River (Reavis 1983, Maslin and McKinney 1994, Brown 1994, Corwin and Grant 2004). In addition, juvenile Chinook salmon (undetermined ESU) have been collected as far upstream as CM 12.9 (DFG 1983). As stated above, habitat conditions in lower Stony Creek do not support spring- or winter-run Chinook salmon spawning and it is therefore assumed that all juveniles of these two ESUs found within Stony Creek represent non-natal rearing. However, fall-run Chinook salmon spawning has been documented in lower Stony Creek and newly hatched fall-run fry have been collected in the creek (Corwin and Grant 2004).

2. Central Valley Steelhead

There have been only limited efforts to determine the presence or extent of steelhead spawning in Stony Creek and those limited efforts have not detected any such spawning. Murphy (1946) conducted a survey of the upper reaches of Stony Creek and Grindstone Creek (a tributary to Stony Creek) in August of 1946, prior to the existence of Black Butte Dam, during which he documented abundant rainbow trout. The existence of rainbow trout (and possibly juvenile steelhead) in these areas during the late summer of a drought year indicates that the habitat was suitable to support steelhead on a year round basis. Although steelhead production has not been documented in Stony Creek, the suitability of the habitat coupled with the documentation of anadromous Chinook salmon accessing these areas upstream of present-day dams (Yoshiyama *et al.* 1996) is a strong indication that steelhead would have spawned in Stony Creek as well (McEwan 2001).

Corwin and Grant (2004) conducted limited spawning surveys in lower Stony Creek from 2001 through 2004, primarily looking for Chinook salmon spawners. No adult steelhead were detected during this study. However, the extent of these surveys was greatly limited by high turbidity and lack of access to most of the creek (due to denial of access to private lands). Therefore the researchers concluded that they could neither confirm nor discount the presence of steelhead spawning during that period (Reclamation 2004).

The same study (Corwin and Grant 2004) monitored for juvenile salmonids through fyke netting and beach seining on lower Stony Creek. Again, no natal steelhead were detected during the 4-year study period. However, the scope of sampling was limited both spatially (many areas of the creek could not be sampled due to lack of landowner permission) and temporally (sampling efforts were not persistent throughout the study period). While the failure to detect natal juvenile steelhead under this sampling regime is a strong indication that there was no significant steelhead production in Stony Creek during this period, the possibility of successful steelhead spawning can not be definitively excluded, as sampling efforts were intermittent and access to suitable monitoring sites was not granted by landowners (Reclamation 2004).

Other sampling efforts that have captured juvenile steelhead in Stony Creek (Maslin and McKinney 1994, Brown 1994) found only larger juveniles (>100 mm) in the lower reaches of the creek, and concluded that they were likely non-natal to Stony Creek.

B. Status of Critical Habitat within the Action Area

The PCEs of critical habitat for spring-run Chinook salmon and steelhead in Stony Creek have been severely impacted and degraded by human activities and manipulation of the creek. The PCEs that have been most heavily impacted include suitable migration corridors, spawning sediments, creek hydrology including timing and magnitude of flows, suitable water temperatures, and shaded riparian aquatic (SRA) habitat including large woody debris.

1. Migrational Barriers

Migration of anadromous salmonids into sections of the upper Stony Creek watershed was originally blocked by East Park Dam on Little Stony Creek, and the associated Rainbow Diversion Dam on Stony Creek, in 1910 and 1914 respectively. The GCID gravel berm near the mouth of Stony Creek also intermittently blocked migration from 1911-1999. In 1928, the construction of Stony Gorge Dam further prevented salmonid passage into the reach between Stony Gorge Dam and the previously built dams. Since 1963, anadromous salmonids have been restricted to the lower 24.6 miles of Stony Creek by the construction of Black Butte Dam.

NDD located at CM 19.7 is a weir structure spanning the entire creek. The concrete spillway creates a nearly vertical drop to the downstream water surface which has been determined to impede upstream adult passage under most flow conditions, and makes it impossible for juveniles to move upstream of the dam at any time (Corwin and Grant

2004). On top of this spillway, flashboards are typically put in place from March through October to allow water diversions into the North Canal. However, these flashboards have, at times, been in place during all months of the year dependent on water demands and weather patterns. When flashboards are in place they create a total barrier to upstream passage so that adult and juvenile salmonids are unable to access the area above NDD. In addition, any juveniles migrating downstream from above the dam during irrigation diversions would have a strong likelihood of entrainment into the North Canal as the majority of summer flows are diverted into the canal. NDD flashboards are typically in place during much of the fall-run Chinook salmon adult migration period and during the latter part of the fall-run Chinook salmon, and steelhead juvenile emigration periods.

Since 1993, a seasonal passage impediment has existed at the CHO (CM 13) during rediversion operations which may occur from April 1 through May 15 and September 15 through October 29. During CHO operations, a gravel barrier is placed across Stony Creek to facilitate the diversion of water into the TCC via the CHO. Although a minimum bypass flow of 40 cfs is maintained downstream of this seasonal berm during the operation of the CHO, this temporary barrier may impede both upstream and downstream passage of salmonids. As with NDD, any juveniles migrating downstream from above the diversion structure would have a strong likelihood of entrainment into the TCC as the majority of the water flowing downstream is diverted into the canal during the diversion period. Upstream passage may be prevented or delayed during the fall-run Chinook salmon adult immigration period and during the fall- and spring-run Chinook salmon, and steelhead juvenile emigration periods.

Prior to 1999, a gravel berm was constructed (or maintained) on the creek each spring at the GCID main canal (approximately 3 miles upstream of the confluence of Stony Creek and the Sacramento River) and left in place through the irrigation season (generally March through November). The berm created a barrier which prevented fish passage into and out of the creek during the irrigation season, and in years when the berm was not blown out by winter flows, it remained a barrier to fish passage throughout the year. In 1999, a siphon was placed under Stony Creek at this site, and there is no longer any structural barrier there.

2. Spawning Substrate

Black Butte Dam blocks the transport of all but the finest sediment from the upper basin into lower Stony Creek. Prior to construction of the dam, the channel was a high gradient, bedload dominated system with sharp fluctuations in discharge, where the channel carrying the main flow shifted periodically. Post-dam, the flood peaks have been attenuated, and spring runoff often is stored for planned releases. Channel width and sediment transport have been reduced in the upper reaches and significant channel realignment has occurred. The sources of most bedload and suspended sediment have been eliminated by Black Butte Dam. High volume releases can produce accelerated bank erosion below the dam, which is the primary source of coarse bedload recruitment into the lower creek.

Several spawning sediment analyses have been conducted on lower Stony Creek over the past 40 years. Puckett (1969) conducted a spawning habitat survey during the mid-1960s, shortly after the completion of Black Butte Dam, before the impacts of the dam on substrate composition and distribution would have been apparent. Puckett (1969) sampled within three half-mile reaches of lower Stony Creek. These sites were at the U.S. Geological Survey (USGS) gage near Hamilton City, one-half mile downstream of the Road P crossing near Orland, and two miles below Black Butte Dam. The results of this investigation determined that the average substrate particle size was too small in the two lower study areas, but was adequate for Chinook salmon spawning in the upper most location, above NDD. Again, this study was conducted shortly after the construction of Black Butte Dam, and it is likely that the substrate characteristics throughout lower Stony Creek have changed significantly in the ensuing 35 years of dam operations.

In the late 1990s, David Vogel (1998) conducted an investigation of spawning gravel substrate in lower Stony Creek. Vogel concentrated a large majority of his sampling effort (15 of 18 samples) within the upper two miles of the creek, directly below Black Butte Dam. The decision to concentrate on this area was apparently based on Puckett's finding that this area had contained the highest quality spawning substrate some 30 years prior. Vogel (1998) concluded that "nearly all samples possessed a level of fine particles (mostly sand) within the level of concern for salmonid reproduction".

The combination of high winter flushing flows and a lack of sediment recruitment has severely impacted the uppermost stretch of lower Stony Creek, below Black Butte Dam. While Puckett (1969) determined that this section of the creek had the highest quality of spawning gravels shortly after Black Butte Dam was constructed, recent analysis of this area revealed that most of the channel has become incised down to a bed of older resistant alluvium (existing conditions report) and some areas have become completely denuded of all gravels and sediments with only bed rock and hard pan clay remaining, leaving the area unusable as spawning habitat (personal observation, Mike Tucker, June 2006).

The most recent scientific analysis of spawning substrate in lower Stony Creek was conducted by Corwin and Grant (2004). These investigators collected samples from 8 locations between the mouth of Stony Creek and I-5 at CM 16.2 (see Table 2). There were no samples taken above the I-5 site (upper 8.4 miles of lower Stony Creek) in the area most heavily concentrated on by the previous two studies, again due to denial of access by private landowners.

Table 2. Sampling sites for 2004 sediment study.

Sediment Sample Site	Creek Mile
I-5	16.2
Road N – Upstream	14.2
Road N - Berm	14.1
Road N	14.1
Tehama Colusa Canal (TCC)	13.9

Creek Mile 8.4	8.4
Glen Colusa Canal (GCC)	3.9
Mouth	0.2

In an analysis provided as supplemental information to Corwin and Grant's initial report (Reclamation 2005a), the investigators used two second order equations taken from Tappel and Bjornn (1983) to describe the relationship between the particle size ratios found in the sediment samples taken from lower Stony Creek and the expected percent survival of Chinook salmon and steelhead that might be spawned in that gravel.

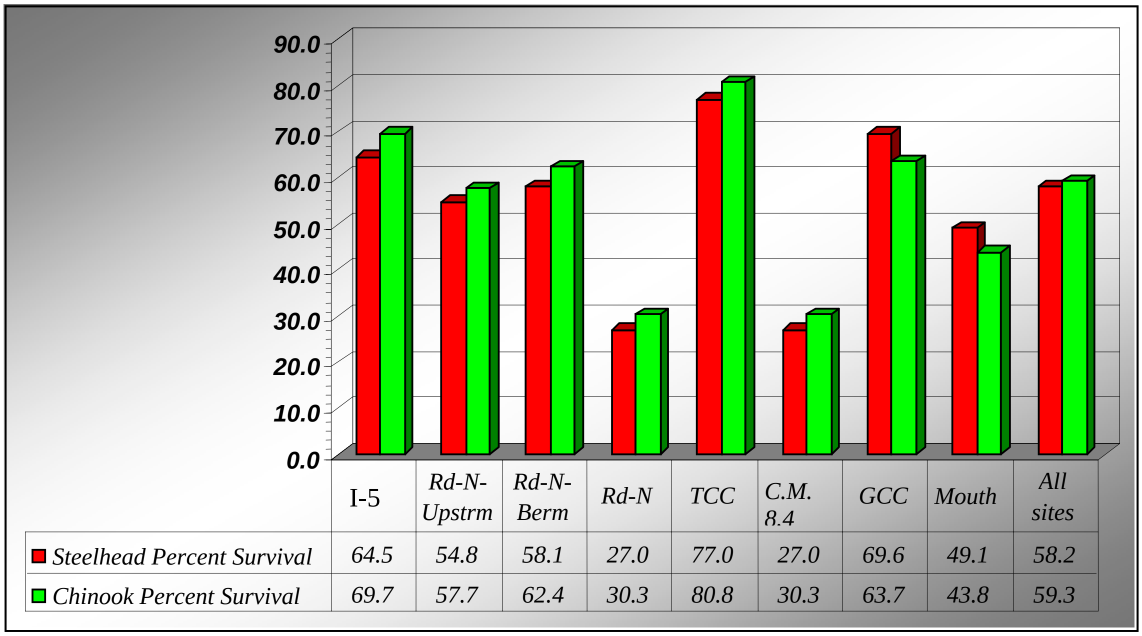

Figure 1. Predicted percent survival of salmonid embryos to emergence for lower Stony Creek substrate samples. Percent survival is based on two second-order equations developed by Tappel and Bjornn, 1983 (Figure taken from Reclamation 2005a)

As indicated by the graph in Figure 1, estimated percent survival to emergence was below 70 percent for all gravel samples except for the TCC sample which had a percent survival for steelhead and Chinook salmon of 77 percent and 81 percent, respectively. The mean percent survival among all sites for steelhead was 53 percent (Standard Deviation (SD) = 18.4) and ranged from 27 percent for gravel analyzed from Road N and CM 8.4 to 77 percent for the TCC gravel. The mean percent survival for Chinook salmon was found to be 55 percent (SD = 18.4) and ranged from a low of 30 percent for gravel from Road N to 80.8 percent for the TCC gravel. From this analysis the investigators concluded that the quality of gravel for salmonid spawning was fair to poor in the areas sampled (Reclamation 2005a). However, it is important to note that the capture of newly emergent Chinook salmon fry within these reaches proves that successful spawning, incubation, and emergence is occurring in these areas, although the actual percent survival of embryos to emergence is unknown at this time.

3. Hydrologic Conditions

Natural flow patterns within Stony Creek have been disturbed since 1910 with the construction of East Park Dam. Changes in the natural flow regime have altered the natural cycles by which juvenile and adult salmonids base their migrations. The dams have also decreased gravel and large woody debris recruitment to the lower creek. While storage of natural runoff can reduce flows in the lower creek during certain times of year, at other times dam releases can provide higher flows for longer periods of time than would occur under natural conditions. The existing streamflow conditions below Black Butte Dam are variable and highly dependent on flood control operations, diversions, seepage, and evaporation. Historic records indicate that before the construction of Black Butte Dam (1963), flows in the lower valley reach of Stony Creek diminished to zero or nearly zero in the late summer months of most years. This situation continues to occur today as minimum releases (30 cfs below NDD) can be diminished through evaporation, direct pumping, or absorption into the fluvial substrate of the valley floor before reaching the Sacramento River. In the spring, when Reclamation is diverting at the CHO, flows below NDD (the area currently accessible to anadromous salmonids) are generally higher and colder than they would otherwise be without the existence of Black Butte Dam. This situation may provide improved conditions for salmonids in the area above the CHO for this short period in the spring. However, the majority of these increased flows are diverted into the unscreened CHO, increasing the likelihood of entrainment of juvenile salmonids into the TCC

As a result of the 2002 BO, the Corps refined their flood control ramping rates and other water release protocols in order to improve habitat conditions for listed salmonids on lower Stony Creek. The current ramping rates followed during flood control operations are described below.

The rates of change for increasing flood releases from minimum flow to 1,000 cfs are as follows[1]:

1. When storage encroaches 0 percent to 25 percent of the required flood control space, releases will be increased by no more than 250 cfs/hour.

2. When storage encroaches 25 percent to 50 percent of the required flood control space, releases will be increased by no more than 500 cfs/hour.

3. When storage encroaches 50 percent or more of the required flood control space, releases will be increased by no more than 1,000 cfs/hour.

When flood releases are above 1,000 cfs, releases shall be increased by no more than 1,000 cfs/hour. Exceptions to this requirement shall be allowed to insure the structural integrity of the Corps' facilities[2] and in emergency situations, to protect human lives and property from flood damages.

The rate of change for decreasing releases are as follows[1]:

1. When flood release is 15,000 cfs to 5,000 cfs, releases will be decreased by no more than 500 cfs/hour.

2. When flood release is 5,000 cfs to 500 cfs, releases will be decreased by no more than 250 cfs/hour.

3. When flood release is 500 cfs to 100 cfs, releases will be decreased by no more than 250 cfs/day at a rate not greater than 30 cfs/hr.

4. When flood release is at or below 100 cfs, releases will be decreased in approximately 10 cfs/hour increments.

[1]All releases are expected to be within +/- 5 percent of those targeted.

[2]Operating experience has shown that when upward release changes are required within the range of 4,000 cfs to 6,500 cfs (depending on reservoir storage) the gates should be operated in such a way as to force a hydraulic jump below the outlet portal by temporarily increasing the release by approximately 2,000 cfs. Once the hydraulic jump is established, the 1,000 cfs per hour (or less) rate of release would resume.

The Corps has also initiated alternative flood release protocols during the last 5 to 7 percent of floodwater encroachment in Black Butte Lake. These new protocols are intended to provide more reliable and suitable conditions for successful spawning and survival of anadromous salmonids in lower Stony Creek. The basic strategy of these newly adopted release protocols has been to cut releases to between 100 and 200 cfs when the decreasing encroachment level reaches 5 to 7 percent (instead of maintaining higher releases until the reservoir is no longer encroached), with the intent of maintaining minimum releases of 100 cfs or greater for as long as possible during flood control operations while avoiding impacts to the Corps' flood control abilities below Black Butte Dam. These new release protocols have been generally successful in maintaining minimum flows of 100 to 200 cfs during the winter and spring flood control periods since late 2003 when the protocols were initiated.

Reclamation conducted an analysis of water use and water availability on lower Stony Creek in 2004 (Reclamation 2004) to investigate the potential effects on the available water supply from implementing minimum instream flow requirements of 100 and 150 cfs during the cold water periods (*i.e.*, generally November through May). A water resources model was required to address the system impacts of increasing minimum flows. As a result, CALSIM was selected as the model to evaluate potential long-term impacts on reservoir storage and water supply deliveries. Based on 80 years of available data, the study period analyzed was Water Years1921 through 2000.

The model described OUWUA's average contract demands of 104.9 TAF and TCCA's maximum demands of 38.3 TAF which can only be met by the available water supply within the basin. To estimate the water available through the peak irrigation season, April through September, allocations were determined by the following method and are supported by historical deliveries (1966-98):

1. The sum of the end of March storage in the three reservoirs;
2. Plus an estimate of the April-September unimpaired flow, above what OUWUA is diverting;
3. Minus a minimum system carryover storage target of 32.5 TAF; and,
4. Minus contingencies including 25% of an initial allocation estimate to account for channel recharge to the aquifer and an estimate for irrigation season evaporation.

Reservoir operating criteria were also identified. Reservoir storage-discharge relationships and current area-capacity-elevation tables were incorporated in the model. In addition, each reservoir is operated under the following set of priorities (in order), when possible:

1. Comply with current flood control and/or dam safety requirements;
2. Meet current minimum flow requirements;
3. Stabilize Black Butte Lake or Stony Gorge Reservoir in alternate years for in-lake fishery enhancement by limiting drawdown during the crappie (*Pomoxis* spp.) spawning season; and,
4. Satisfy contractual water supply demands to the OUWUA and the TCCA. Water in excess of these demands remains in storage.

Results of this analysis indicated that implementation of increased minimum flow releases would provide instream benefits for fish when temperatures are suitable, but that in dryer years, would result in lower reservoir system storage, thereby reducing water availability needed for irrigation. The model used the Sacramento Valley Water Year Hydrologic Index to compare hydrological trends in Stony Creek in response to alternative operations, since a hydrologic classification of Stony Creek does not exist

The analysis indicated that 100 percent of Orland Project agricultural demands could be met under the increased 100 cfs minimum flow during all “wet”, “above normal”, and all but two (out of 14) “below normal” year types (as defined under the Sacramento Valley Water Year Hydrologic Classifications) which occurred in 65 percent of years over the 80-year period of analysis. However, as OUWUA has rights to 100% of the water stored in East Park and Stony Gorge Reservoirs, only flood releases and CVP water stored in Black Butte Lake were considered available to meet the proposed minimum flows in Reclamation’s analysis.

The likelihood of meeting full agricultural demands was significantly reduced during most “dry” and almost all “critical” year types. Unfortunately, it is impossible to predict in November, through reservoir storage or long range forecasting, the type of hydrologic classification that will develop as the water year progresses.

Due to the unpredictability of spring reservoir storage and hydrological conditions in the Stony Creek basin, Reclamation conducted an additional cursory analysis which found that if more than 104,657 acre-feet are present, or expected to run off into Black Butte

Lake on or after April 1, in years when the upstream reservoirs are also full on April 1, Reclamation could release greater instream flows for fishery benefits without impacting agricultural deliveries or minimum pool requirements.

4. Water Temperature

Lower Stony Creek water temperatures are directly influenced by ambient air temperature, solar radiation, shading, channel geometry, volume of water being released down the creek, the water temperatures of Black Butte Lake releases, and, to a lesser degree, the other upstream reservoirs. Releases made from Black Butte Lake are made from the outlet located at the bottom of the lake, ensuring the coldest temperatures possible. Thermal monitoring within Black Butte Lake has indicated that, while there is a slight to moderate thermal stratification during the late spring and summer months (April-September), by the early fall at lowest pool elevations, temperatures within the reservoir can be relatively uniform, generally in the mid-60s °F (Corps 1987). Based on analysis of daily mean temperatures from four monitoring locations on lower Stony Creek from July 1995 to December 1997, temperatures remained fairly consistent from year to year during the winter months. Also, stream temperatures were not significantly different with regard to location during the winter months but increased as much as 18 °F in a downstream direction between CM 24 and CM 7 during the summer months (*i.e.*, May to August).

Mean daily water temperatures at the Black Butte gage (CM 24) in October from 1979 through 1994 (65.8 °F) were just below the maximum threshold of temperature tolerances for prespawning Chinook salmon (66 °F) reported by Ward and Kier (1999). During 1979 through 1994, water temperatures from November through March remained within the optimal range for adult migration, spawning, egg incubation and juvenile rearing for Chinook salmon and steelhead of 38 °F to 56 °F (Bell 1986, McEwan and Jackson 1996). Stream temperatures then remained within the optimal range (<65 °F) for fry/juvenile Chinook and steelhead rearing through at least April and sometimes to mid-June (Reclamation and Corps 2001).

The Black Butte gage is at the upstream portion of lower Stony Creek and is not always reflective of downstream temperatures during the spring, summer, and early fall. Temperature monitoring during 2002 and 2003 showed that water temperatures increased rapidly during May and were higher in a downstream direction (Corwin and Grant 2004). The sampling also demonstrated that any steelhead fry attempting to migrate out of the creek during those years would have encountered lethal conditions in lower Stony Creek by early June.

The multi-agency technical team examining the feasibility of restoring steelhead to the Upper Yuba River watershed formulated recommended water temperatures based on optimal, suboptimal, and chronic to acute stress for steelhead life stages (Table 3).

Table 3_. Recommended temperatures for steelhead in the Upper Yuba River basin (adapted from Stillwater Sciences 2006).

Steelhead Life Stage	Temperature		
	Optimal[1]	Suboptimal[2]	Chronic to Acute Stress[3]
Upstream migration/adult residence	< 52°F	52-70°F	>70°F
Spawning	<52°F	52-55°F	>55°F
Egg incubation	<52°F	52-55°F	>55°F
Fry & juvenile rearing and outmigration	<65°F	65-68°F	>68°F

[1] Feeding and growth occur; growth dependent on food availability. No sublethal or lethal effects.
[2] No direct mortality, but may result in a higher probability of diminished success (i.e., sublethal effects), especially at high end of range.
[3] Chronic exposure at the low end of the range results in sublethal effects, including reduced growth, reduced competitive ability, behavioral alterations, and increased susceptibility to disease. At higher temperatures in this zone, short-term exposure (minutes to days) results in death.

Using these criteria, water temperatures in Stony Creek at the NDD are suboptimal for steelhead rearing by mid- to late-May and reach chronic to acutely stressful conditions by mid-June. Lower-most Stony Creek becomes lethal to steelhead fry by early June and all of lower Stony Creek becomes lethal during the summer based on sampling in 2002 and 2003 (Corwin and Grant 2004).

5. <u>Riparian Vegetation</u>

The overall habitat quality of the riparian plant communities observed for lower Stony Creek is low with respect to species composition, extent and level of reestablishment, and stand maintenance (Harvey and Associates 2006). There are some small pockets of moderate to high-quality riparian habitat mostly above CM 15, above the TCC, and in the lowermost 2 miles. Interpretation of 1992 aerial photographs shows scattered patches of shrubs, typically well removed from the active channel. Much of the riparian habitat is severely infested with invasive species such as giant reed and salt cedar. To provide maximum contribution to steelhead PCEs, the riparian vegetation would have to be adjacent to the wetted channel to provide shade, cover, habitat complexity, and food sources (terrestrial insects).

Giant reed and salt cedar have displaced native riparian vegetation and have become well established along much of lower Stony Creek. These species can often out-compete native vegetation for a variety of reasons, including their superior ability to colonize disturbed areas (Reclamation 1998). The presence of these species diminishes the overall habitat quality of the stream corridor as they do not provide the erosion resistance of native riparian species and do not contribute large woody material to the stream channel.

Giant reed most likely first appeared in lower Stony Creek sometime shortly before 1950. Although it was largely absent in 1950 according to aerial photography, a few individuals were apparent between CM 14.5 and CM 15.0 (Reclamation 1998). The most substantial stands within lower Stony Creek also occurred in this area in 1992 according to aerial photographs. In approximately 1965, shortly after the installation of Black Butte Dam, giant reed began expanding at an increased rate. For example, from 1968 to 1995, giant reed increased in area from 2 to 17 acres between CM 14.5 and CM 15 (Reclamation 1998). Giant reed was well established along most of lower Stony Creek from CM 0 to approximately CM 17 with substantial stands present between CM 10.5 and CM 16 in 1998 (Reclamation 1998). By 2005, giant reed existed as far upstream as CM 22 (Harvey and Associates 2006). It has established in dense thickets, especially in disturbed areas, such as gravel mining sites. Giant reed has also displaced native vegetation along unstable channel reaches since stem and root fragments easily flow downstream and rapidly establish in open substrate.

Along with giant reed, salt cedar is replacing native vegetation along the lower Stony Creek stream corridor and reducing overall riparian habitat quality (Reclamation 1998). According to 1992 aerial photographs, the invasion of both salt cedar and giant reed along lower Stony Creek was most prevalent downstream of the I-5 bridge (CM 16). Like giant reed, salt cedar likely also spread at an increased rate along the corridor after the construction of the Black Butte Dam since salt cedar tends to colonize more rapidly in streams impacted by flow regulations (Reclamation 1998).

B. Factors Affecting Species and Critical Habitat within the Action Area

1. Migrational Barriers

The construction and operation of migrational barriers described in the previous section (East Park, Stony Gorge, Black Butte, and North Diversion Dams, and the TCC and GCID irrigation diversions) has greatly impacted listed salmonids and their critical habitat within Stony Creek. By blocking migration to the upper reaches of Stony Creek, these dams have caused the complete extirpation of all spawning populations of spring-run Chinook salmon, and have severely diminished the potential for steelhead to spawn and survive in Stony Creek. One of the primary constituent elements of critical habitat for spring-run Chinook salmon and steelhead is suitable migration corridors. By blocking migration to the upper reaches of Stony Creek, these dams have completely destroyed the suitability of this PCE in lower Stony Creek, as it can no longer act as a migration corridor to the spawning habitat in the upper watershed.

2. Substrate/Spawning Habitat

The lack of quality spawning substrates described above has reduced the spawning potential for steelhead and Chinook salmon in lower Stony Creek. Many stretches of the upper reach, below Black Butte Dam, are completely devoid of suitable spawning gravels and the high proportion of sand and other small sediments in the lower sections of the creek is likely to cause pre-emergent mortality in a high percentage of the eggs that are deposited in the creek.

3. Hydrologic Conditions

Low spring and summer flows on lower Stony Creek contribute to warm water temperatures and cause the entire creek to be uninhabitable by salmonids. Even as water temperatures cool in the fall, the flow releases are often maintained at such low levels that no flowing water makes it to the Sacramento River, precluding any fish from migrating into the creek to spawn. During the winter and spring flood control season rapid fluctuations and high peak flows can mobilize creek sediments, causing redds to be washed away or be buried under deposits from upstream. Extreme high flow events of greater than 10,000 cfs or 15,000 cfs occurred in 38 and 17 percent, respectively, of the 24 years of record examined (1965 – 1988). While recent adjustments to the Corps' flood management operations have reduced the severity of these impacts, there is still the potential for these operational flow changes to result in the death of eggs and pre-emergent fry. This circumstance is particularly evident for steelhead which spawn January – March, the principal high-flow period.

4. Water Temperature

Due to high summer water temperatures in lower Stony Creek, spring-run Chinook salmon can not complete their full life cycles in the creek, as both require cooler summer temperatures for adult holding and/or spawning and egg incubation. With regards to steelhead, current water temperature conditions in lower Stony Creek are at best marginal, but generally provide the necessary temperatures to allow successful steelhead reproduction in most years. Water temperatures are optimal (<55 °F) throughout the primary steelhead spawning period (December through March) although temperatures can rise quickly in the spring, leaving the potential for late spawned redds and fry to be lost to lethal temperature conditions. Summertime water temperatures are also well above the lethal level for steelhead, precluding the possibility for juveniles to rear in Stony Creek over the summer. Instead, they would be forced to migrate downstream to the mouth of the creek and into the Sacramento River, where temperatures generally remain suitable for steelhead rearing throughout the year. This type of behavior has been documented in other intermittent tributaries to larger rivers. Everest (1973) found that steelhead spawned in January and February in Sam's and Kane Creeks (intermittent tributaries to the Rogue River in southern Oregon) emerged in April and May, and migrated downstream into the Rogue River as water temperatures surpassed 70 °C, often only a few days before the creeks became intermittent. Similar life history strategies are evident in numerous intermittent tributaries in the upper Sacramento River in the Redding area, where steelhead spawn in the small tributaries and their offspring migrate out to the Sacramento River in the spring before the tributaries go dry. Despite the occurrence of marginally suitable water temperatures for steelhead reproduction, recent monitoring has not detected any successful steelhead reproduction in Stony Creek. High water temperatures are considered to be a significant factor in this lack of a healthy steelhead population in the creek (Reclamation 2001).

5. Riparian Habitat/Instream Structural Diversity

The sparse riparian vegetation and high proportion of invasive giant reed and salt cedar along lower Stony Creek reduce the quality of the critical habitat for rearing salmonids. The lack of dense overhead cover and shade increases water temperatures, reduces the input of food from terrestrial insects and reduces the ability of juvenile salmonids to find shelter from predators. The lack of large woody debris in the creek further impacts the PCE's for rearing and migrating by reducing the instream structural diversity necessary for juvenile feeding and sheltering. The lack of deeply rooted vegetation along the stream banks also allows for accelerated erosion and sediment influx into the stream.

6. Mining

Since 1977, DFG has not allowed instream pit mining in Stony Creek. However, mid-channel gravel-bar skimming remains the typical mining technique used in lower Stony Creek, and excavation below the level of seasonally replenished aggregate has occurred in the area east and west of the Highway 32 bridge (Glenn County 1997). The mines in this area had permitted extraction rates of 300,000-750,000 CY/y in 1990. These rates are 2 to 6 times the natural pre-dam sediment supply from the upper watershed, and 11 to 29 times the current sediment supply provided by upstream bank erosion (Swanson and Kondolf 1991). These tremendous extraction rates have directly lowered the channel bed within the boundaries of the gravel mines and induced channel incision immediately upstream and downstream. Kondolf and Swanson (1993) state: "Even if extraction were to cease today, the channel will continue to adjust to this catastrophic removal of sediment, probably for decades." In areas where gravel mining activities have created a disturbance threshold that exceeds the maintenance and regeneration capabilities of the native riparian vegetation, invasive weeds such as the Giant reed have become established.

These instream gravel mining activities directly impact salmonids and redds by elevating turbidity levels within and downstream of the extraction zones, and by direct disturbance of fish and eggs present within the extraction zone during instream work. Instream gravel mining also depletes the supply of suitable spawning substrates within the creek, an element that is severely limiting in lower Stony Creek.

7. Bank Stabilization/Agricultural and Residential Land Use

Bank stabilization and riprapping associated with land use activities such as agriculture and home building have altered streambank and channel morphology on lower Stony Creek. These practices have led to reductions in downstream recruitment of gravel and large woody debris which has reduced the quality and quantity of the PCEs of spawning and rearing habitat. It is suspected that groundwater pumping may lower the water table which causes Stony Creek water to absorb into the surrounding alluvium and prolongs the period of time that the creek remains disconnected from the Sacramento River during dry periods. However, groundwater hydrographs show that groundwater levels in, and near, the Orland Project actually rise as evidenced by spring and fall groundwater measurements (www.ca.water.gov). DWR hydrographs also show an increase in groundwater levels in proximity to the TCC and in related service areas since the mid-1980's. In addition, small unscreened water diversions for agriculture use result in direct entrainment of emigrating salmonids.

8. Species Interactions

In addition to salmonids, lower Stony Creek supports a wide variety of native non-salmonid migratory and resident species, and numerous introduced non-salmonid species. These species may compete with Chinook salmon and steelhead for food and/or suitable habitat, and several may prey upon salmonid fry and juveniles. Population estimates of these species and potential for adverse impacts to salmonids are unknown at this time. Adult Sacramento pikeminnow are known to be abundant in Stony Creek during the spring (the species' spawning period) and are known to prey on salmonid fry. Table 4 shows all fish species reported from various past studies of Stony Creek. The table gives the species names, status as to being exotic or native to the creek, and the area in which they were found.

Table 4
Fish Species Reported In The Stony Creek Watershed

Common Name	Scientific Name	Native / Exotic (N/E)	Above Black Butte Dam	Below Black Butte Dam	Source
Chinook Salmon	*Oncorhynchus tshawytscha*	N		X	a,c,d
Steelhead Trout	*Oncorhynchus mykiss mykiss*	N		X	d
Rainbow Trout	*Oncorhynchus mykiss*	N	X		a,b,c
Sacramento Sucker	*Catostomus occidentalis*	N		X	a,b
Common Carp	*Cyprinus carpio*	E	X	X	a,b,c
Sacramento Squawfish	*Ptychocheilus grandis*	N		X	a,b
California Roach	*Hesperoleucus symmetricus*	N		X	a.b
Speckled Dace	*Rhinichthys osculus*	N		X	a,b
Brown Bullhead	*Ameiurus nebulosus*	E		X	a
Mosquito fish	*Gambusia affinis*	E		X	a,b
Largemouth Bass	*Micropterus salmoides*	E	X	X	a,b,c
Green Sunfish	*Lepomis cyanellus*	E	X	X	a,b,c
Bluegill Sunfish	*Lepomis macrochirus*	E	X	X	a,b,c
Threespine Stickleback	*Gasterosteus aculeatus*	N		X	a,b

Bigscale Logperch	*Percina macrolepida*	E		X	b
Riffle Sculpin	*Cottus gulosus*	N		X	b
Prickley Sculpin	*Cottus asper*	N		X	b
Hitch	*Lavinia exilicauda*	N		X	b
Golden Shiner	*Notemigonus crysoleucas*	E		X	b
Hardhead	*Mylopharodon conocephalus*	N	X	X	b,c
White Crappie	*Pomoxis annularis*	E	X	X	b,c
Black Crappie	*Pomoxis nigromaculatus*	E	X		c
Striped Bass	*Morone saxatilis*	E	X		c
Smallmouth Bass	*Micropterus dolomieu*	E	X	X	b,c
Channel Catfish	*Ictalurus punctatus*	E	X	X	b,c
White Catfish	*Ameiurus catus*	E	X	X	b,c
Black Bullhead	*Ameiurus melas*	E		X	b
Tule Perch	*Hysterocarpus traski*	N		X	b
Warmouth	*Lepomis gulosus*	E		X	b
Threadfin Shad	*Dorosoma petenese*	E	X	X	b,c
Redear Sunfish	*Lepomis microlophus*	E	X		c
Lamprey	*Lampetra spp.*	N		X	b

Sources:
a. Puckett, 1969
b. M. Brown, 1995
c. DFG (unpublished files Region II)
d. Maslin and McKinney, 1994

C. Likelihood of Species Survival and Recovery in the Action Area

Under baseline conditions, there is zero likelihood of survival and/or recovery of naturally reproducing populations of winter-run Chinook salmon and spring-run Chinook salmon in lower Stony Creek. There is no evidence indicating that winter-run Chinook salmon ever spawned and reproduced in Stony Creek, and it is likely that winter-run use of the creek has always been, as it is today, as opportunistic non-natal rearing habitat.

Spring-run Chinook salmon have been cut off from their historic holding and spawning habitat by the dams on Stony Creek. This blockage of the historic migratory corridor makes it impossible for spring-run Chinook salmon to reproduce in Stony Creek. Spring-run Chinook salmon are now limited to using the creek as non-natal rearing habitat during those periods when water temperatures are suitable and the creek has a flowing connection to the Sacramento River.

The majority, if not all, of the historic steelhead spawning habitat in Stony Creek has also been cut off by Black Butte Dam. Recent monitoring has not detected any adult or natal juvenile steelhead in lower Stony Creek, and there is no evidence to indicate that steelhead have used the creek as spawning habitat in recent years. However, habitat conditions during the winter spawning and incubation period remain marginally suitable for steelhead reproduction, and it is possible that with the GCID barrier removed from the mouth of the creek since 1999, and ongoing habitat restoration under way, steelhead could eventually recolonize the lower creek and establish a spawning population.

V. EFFECTS OF THE ACTION

For purposes of this analysis, water temperature and flow evaluations in lower Stony Creek are based on official records for the period 1979-1998 (Reclamation 1998, Reclamation and Corps 2001). Project operations and environmental conditions (*i.e.* instream flows, release schedules, water temperatures, etc.) have not changed significantly since this period. This data set is the most recent complete and comprehensive data available and constitutes the best scientific and commercial information available.

A. Approach to the Assessment

1. Information Available for the Assessment

To conduct this assessment, NMFS examined an extensive amount of evidence and information from a variety of sources. Detailed background information on the status of these species and the potential effects of this project on these species has been taken from a number of documents including project-specific environmental reports, peer reviewed scientific journals, primary reference materials, government and non-government reports, project meetings and personal communications.

2. Assumptions Underlying this Assessment

In the absence of definitive data or conclusive evidence, NMFS will make a logical series of assumptions to overcome the limits of the available information. These assumptions will be made using sound scientific reasoning that can be logically derived from the available data. The progression of the reasoning will be stated for each assumption, and supporting evidence will be sited.

This biological opinion does not rely on the regulatory definition of “destruction or adverse modification” of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. NMFS will evaluate destruction or adverse modification of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species.

Because the proposed project is essentially the continuation of water management operations as they have occurred in the recent past, the habitat conditions and the effects of the project that have been observed in the recent past (baseline conditions) are at times described in this section and used as a reasonable estimation of the habitat conditions that can be expected to result from the future effects of the proposed project (effects of the action).

B. Reservoirs Above Black Butte Dam

Under current (and future) operational procedures, storage in East Park and Stony Gorge Reservoirs is maintained as close to the maximum allowable storage levels as possible, unless irrigation demands necessitate releases. The 1964 Exchange Agreement allows Orland Project water held in the upper reservoirs to be exchanged with CVP water within Black Butte Lake. Releases of Orland Project water are then made from Black Butte Lake storage instead of from the upper reservoirs. Water left in the upper reservoir early in the season is available for release to the irrigation system later in the summer or early fall.

In the last 16 years (1991 through 2006), East Park Reservoir has been maintained close to the maximum storage for 13 of 16 years and has consistently re-filled in the winter/spring following the draw-down years. Stony Gorge Reservoir has been drawn down to some extent each fall, but only 6 of those 16 years saw significant draw downs below 32,000 acre-feet of storage (California Data Exchange Center, provisional data).

In years following these rare significant drawdowns, the upper reservoirs refill during the winter months, capturing runoff that would otherwise flow downstream to the lower basin. By capturing this runoff, the refilling of the upper reservoirs delays the filling of Black Butte Lake and may prolong the period of minimum flow releases into lower Stony Creek and therefore extend the period when lower Stony Creek remains dry at its mouth and is hydrologically disconnected from the Sacramento River. When Stony Creek flows fail to reach the Sacramento River this prevents adult steelhead from entering the creek to spawn. The lack of access to Stony Creek in the fall and early winter also prevents fall-run Chinook salmon from spawning in the creek which eliminates an important source of nutrition (*i.e.*, salmon eggs and invertebrates that feed on salmon carcasses) for adult and juvenile steelhead and juvenile winter- and spring-run Chinook salmon. The loss of this important source of nutrients can reduce fitness levels and survival rates of juvenile salmonids rearing in Stony Creek.

C. Black Butte Dam and Lake

The construction of Black Butte Dam on the main stem of Stony Creek in 1963 blocked access by anadromous salmonids to the remainder of their historic spawning habitat within the Stony Creek watershed, including all tributaries to Stony Creek, above Black Butte Dam. The only reach left accessible to these fish is the lower 24.6 miles of creek which runs along the valley floor between the base of Black Butte Dam and the confluence with the Sacramento River. Historical conditions within this reach provided very poor if any suitable habitat for salmonid spawning and rearing. High temperatures and low flows created lethal conditions during most summer and early fall months, while high flashy flows carrying heavy sediment loads likely made winter conditions less than optimal for spawning. While the controlled release of stored water from the bottom of Black Butte Lake has likely provided some improvements to habitat conditions such as cooler water later into the spring, more consistent flows and less severe flood conditions, there are still many obstacles to the re-establishment of successful steelhead spawning populations in Stony Creek. These same obstacles prevent the establishment of a significant fall-run Chinook salmon population in Stony Creek, which in turn prevents the influx of important marine based nutrients to the system, impacting the fitness and survival of listed salmonids rearing in Stony Creek.

Black Butte Dam impacts the PCE's of critical habitat in Stony Creek by altering the timing and magnitude of flows as well as sediment transport to lower Stony Creek. Prior to construction of the dam, the channel was a high-gradient, bedload-dominated system with sharp fluctuations in discharge, where the channel carrying the main flow shifted periodically. Post-dam, the flood peaks have been attenuated, and storm runoff is stored for planned releases. Channel width and sediment transport have been reduced in the upper reaches and significant channel realignment has occurred. The sources of most bedload and suspended sediments have been eliminated by the dam. High volume flood control releases can produce accelerated bank erosion, which is the only source for recruitment of coarse bedload within this lower reach. Long-term impacts to PCEs associated with reservoir operations include the decreased recruitment of steelhead and fall-run Chinook spawning gravels, reduced recruitment of woody debris, and encroachment of non-endemic vegetation into spawning and rearing areas resulting in reduced habitat quality (NMFS 1996).

1. <u>Temperature</u>

Lower Stony Creek stream temperatures are directly influenced by ambient air temperature, solar radiation, shading, channel geometry, the temperature and volume of water released from Black Butte Lake. Releases made from Black Butte Lake are made from an outlet located at the bottom of the reservoir, ensuring the coldest temperatures possible. Black Butte Lake often stays relatively shallow during the summer months. Vertical temperature profiles indicate that the lake remains thermally unstable or weakly stratified and is easily mixed vertically by winds and diurnal heating and cooling. The waters are warm throughout the depths during the summer (Corps 1987). Reclamation's analysis of daily mean temperatures from four monitoring locations on lower Stony Creek from July 1995 to December 1997, indicate that winter temperatures are fairly consistent from year to year. Generally, stream temperatures begin to increase in the spring and exceed optimal rearing temperatures (>66 °F) between late April and August. Stream temperatures begin decreasing in September, generally reaching optimal spawning temperatures again in November.

Water temperatures warming up early in the spring can have several adverse effects on listed juvenile salmonids rearing in lower Stony Creek. Elevated temperatures can increase susceptibility to diseases, reduce growth rates and increase mortality in salmonids rearing in the creek. High water temperatures can also force juveniles out of the creek into the Sacramento River where rearing habitat is less appropriate for small salmonids than in smaller creeks.

When warm water temperatures are maintained into the fall they can prevent fall-run Chinook salmon from spawning in the creek, thereby eliminating an important source of nutrients for rearing juveniles.

2. Flood Control Operations

The recently revised ramping criteria for flood control releases from Black Butte Lake are described in the Environmental Baseline section of this document. While these revised criteria provide more gradual flow fluctuations during flood control operations than did the old criteria, the flashy nature of Stony Creek still creates situations where it is necessary for releases from Black Butte Dam to increase and decrease rapidly to prevent catastrophic flooding and insure the safety and structural integrity of Black Butte Dam. Stranding of Chinook salmon and steelhead may occur when water levels drop quickly and fish are either left totally exposed in dewatered areas or isolated in wetted areas that are no longer connected to the creek. Incubating eggs are even more susceptible to stranding due to their immobility and the tendency of salmonids to build their redds in shallow riffles. If no additional high flow events follow within a short period of time, isolated fish and eggs are likely to be lost to predation, lethal water temperatures, or desiccation.

The recently revised criteria for management of the bottom 5 to 7 percent of the flood pool in Black Butte Lake (described in the Environmental Baseline section of this document) generally has been successful in maintaining minimum flows of 100 to 200 cfs during the winter and spring flood control periods since late 2003 when the operating agreement was initiated. While no scientific studies have been conducted to analyze the effectiveness of these minimum flows in maintaining suitable steelhead spawning habitat PCEs, they have been found to maintain a flowing connection to the Sacramento River, provide suitable water temperatures for both spawning and rearing, and create a general bank-full condition that maintains connectivity throughout the lower creek, which reduces the potential for stranding and allows free movement through the area (Richard Corwin, Reclamation, pers. comm., May 2005). This recent success in maintaining 100 to 200 cfs minimum flows has occurred during relatively wet years and it is not yet known how successful these new protocols will be in maintaining adequate flows in drier years.

3. Black Butte Dam Powerplant

The Black Butte Dam Powerplant is operated opportunistically to take advantage of releases which are otherwise required for flood control or diversions. Flows releases are not controlled or regulated for hydropower generation. The intake for the powerplant takes water from the base of the dam and therefore provides the coldest water available from the reservoir. The powerplant uses only the force of the water to turn the turbines and generate hydropower, and water that is used is subsequently released to lower Stony Creek below Black Butte Dam. Temperature measurements taken at the powerplant tailwaters before release downstream indicate the powerplant does not significantly increase water temperatures downstream. Due to the eventual return of all water used at the powerplant to the creek and the method of power generation, powerplant operations do not affect the amount of flow released into lower Stony Creek from Black Butte Dam and have a negligible effect on the temperatures of flow releases. Therefore, powerplant operations are not likely to impact salmonids in lower Stony Creek.

D. South Diversion Intake and South Canal

The South Diversion Intake and South Canal divert water from an area directly below Black Butte Dam where there is no access for anadromous fish and therefore, no opportunity for listed fish to become entrained in the diversion facility.

South Canal diversions result solely from irrigation demand on the Orland Project south side operations. The Exchange Agreement requires Orland Project irrigation deliveries be provided from Black Butte storage, if available, which allows the upper reservoirs to maintain higher storage while reducing impacts on overall annual system storage since Black Butte flood control procedures require the annual evacuation of Black Butte Reservoir prior to the flood control season (late fall). However, the diversion of this stored water precludes its release into lower Stony Creek where it could otherwise improve the PCEs of critical habitat and improve survival of listed salmonids. If water was not released from Black Butte reservoir for Oreland Project diversions, there would be a greater volume of water left in Black Butte reservoir available for release down Stony Creek in the late fall when the Corps evacuates the reservoir for flood control purposes. Release of higher volumes of water during the late fall period would open up Stony Creek to the Sacramento River, improve habitat conditions in the creek, and allow earlier access to the creek for steelhead and fall-run Chinook salmon. Additionally, in some years, lower reservoir storage may result in higher release temperatures during late spring which could adversely affect listed salmonids incubating or rearing (natal or non-natal) within lower Stony Creek. Elevated temperatures can increase susceptibility to diseases, reduce growth rates and increase mortality in salmonids rearing in the creek. High water temperatures can also force juveniles out of the creek into the Sacramento River where rearing habitat is less appropriate for small salmonids than in smaller creeks. Due to a lack of temperature and habitat modeling for this system, the magnitude of potential impacts to habitat quality resulting from the diversion of this water has not been determined.

E. Northside Diversion Dam and North Canal

North Canal diversions will typically occur during the months of March to November although diversions may occur in any month of the year dependent on water demands and weather patterns. Maximum diversion rates are limited to 130 cfs and there is generally a minimum 30 cfs bypass to lower Stony Creek.

As with the South Diversion, diversions occurring at the North Diversion Dam result from irrigation demand on Orland Project north side operations. The Exchange Agreement requires Orland Project irrigation deliveries be provided from Black Butte storage, if available, which allows the upper reservoirs to maintain higher storage while reducing impacts on overall annual system storage since Black Butte flood control procedures require the annual evacuation of Black Butte Reservoir prior to the flood control season (late fall).

The release of water for diversion at NDD provides relatively high, stable flows in the upper reach of lower Stony Creek, but the diversion of this water at NDD prevents its continuation down the creek where it could otherwise improve the flow and temperature based PCEs of critical habitat. If water was not released from Black Butte reservoir for Oreland Project diversions, there would be a greater volume of water left in Black Butte reservoir available for release down Stony Creek in the late fall when the Corps evacuates the reservoir for flood control purposes. Release of higher volumes of water during the late fall period would open up Stony Creek to the Sacramento River, improve habitat conditions in the creek, and allow earlier access to the creek for steelhead and fall-run Chinook salmon. Additionally, in some years, lower reservoir storage may result in higher release temperatures during late spring which could affect salmonids incubating or rearing (natal or non-natal) within lower Stony Creek. Elevated temperatures can increase susceptibility to diseases, reduce growth rates and increase mortality in salmonids rearing in the creek. High water temperatures can also force juveniles out of the creek and into the Sacramento River where rearing habitat is less appropriate for small salmonids than in smaller creeks. Due to a lack of temperature and habitat modeling for this system, the magnitude of potential impacts to habitat quality resulting from the diversion of this water has not been determined.

1. <u>Adult Migration, Spawning, and Egg Incubation</u>

In most years, November is the month when water temperatures in Stony Creek cool to the level of preferred temperatures for migrating steelhead adults. Upstream migration and spawning is limited to the reach of Stony Creek below Black Butte Dam due to the impassable nature of this facility. In most years, diversions at NDD have ceased by mid-November, prior to the initiation of the steelhead spawning migration in the Central Valley, and do not resume until late March, after the upstream migration period has ended (DFG 1993). During periods of non-diversion at NDD, the flashboards are removed from the crest of the dam and a large drum gate on the east side of the dam is often raised to allow creek flows to pass through this section of the dam.

A recent barrier analysis conducted by Reclamation (Corwin 2003) found that upstream passage at NDD is completely blocked during periods when the flash boards are installed and that even when the flash boards are removed (*i.e.*, typically from November through March, when most adult Central Valley steelhead migrate), the dam is impassable to average length steelhead at all flow levels. Only steelhead 640 mm and over, or the upper 10 percent of steelhead measured at RBDD should be able to jump over the lowest measured crest height, measured at 4,744 cfs. It also was concluded that steelhead measuring 785 mm and above or 0.4 percent of steelhead measured at RBDD would be capable of jumping the dam at any flow levels examined. This study also found that average sized Chinook salmon from the Sacramento River would be capable of passing NDD at all flows above 1,400 cfs and possibly even lower flows down to 165 cfs (Corwin 2003). While the ability to pass NDD would not be expected to benefit winter- or spring-run Chinook salmon, the ability of fall-run Chinook salmon to pass NDD would allow the influx of important nutrients to the system which could benefit rearing juveniles of all runs of Chinook salmon and steelhead in lower Stony Creek. There has been no monitoring for adult salmonids above NDD and juvenile monitoring in the North Diversion Canal during the irrigation season has not detected any juvenile salmonids.

Installation and removal of NDD flashboards requires that releases from Black Butte be brought to 30 cfs for 24 hours prior to, and for the 4 to 5 hours during, the manipulation of the boards. Installation typically occurs in March when irrigation demands begin (average monthly releases from Black Butte Lake range from approximately 90 cfs to 1,750 cfs) and removal typically occurs in November when irrigation demands subside (average monthly releases from Black Butte Lake range from 33 cfs to 224 cfs). Flow fluctuations during installation and removal of the flashboards have the potential to impede passage, strand adult and juvenile fish and dewater sections of spawning gravel containing incubating eggs and newly hatched fry. Depending on weather conditions at the time of flashboard installation and removal, the required low flow level may temporarily increase water temperatures in the creek. Stranding, dewatering, and water temperature increases are expected to result in physiological stress and possibly mortality of individuals exposed to these conditions. Once the flashboards are in place, NDD becomes a total barrier to upstream passage.

2. Fry, Juveniles, and Smolts

If any adult steelhead are able to traverse NDD and successfully spawn in the reach above the dam, the operation of NDD and North Canal is likely to adversely affect juveniles hatched above the structure. Throughout much of the irrigation season the majority of the water (70 to 80 percent) coming down lower Stony Creek is diverted into the unscreened North Canal. Therefore, downstream migrants which attempt to pass NDD after diversions have begun will have a good chance of being diverted into North Canal where they would not survive.

Steelhead spawned and reared above NDD would have to disperse out of Stony Creek as young-of-the-year instead of smolts since lethal summer temperatures (>75 °F occurring as early as June and continuing to October) make it impossible for a year-round population of steelhead juveniles to survive above NDD. Dispersal triggered by temperatures increasing above 65 °F may occur from late April to mid-June. Since the North Canal typically is operated during this time, steelhead migrating downstream from above NDD would likely to be entrained into the North Canal. Juvenile spring-run and winter-run Chinook salmon are not expected to rear above NDD and would not be subjected to entrainment into North Canal.

Reclamation conducted a monitoring program in the North Canal from 2001 through 2004 in which they operated a fyke net in the upper end of the canal during the early summer diversion period (generally April through June) of each year (Corwin and Grant 2004). The fyke net sampled approximately 15 percent of the total flow in the canal during the sampling period and captured nearly 6,000 fish. None of these fish were salmonids. Continued monitoring through 2006 has likewise failed to detect any salmonids in the North Canal (Reclamation 2006). This data, along with the poor passage conditions at NDD and the poor quality of spawning habitat in the creek above NDD all indicate that there is no successful salmonid spawning occurring above NDD, primarily due to the adverse impacts of the proposed project.

F. Constant Head Orifice Rediversion

The CHO is operated based on demands from April 1 through May 15 and from September 15 through October 29, up to a maximum of 38,293 acre-feet per year. Diversions at the CHO may result in reductions of Black Butte Lake storage. The diversion of this stored water provides increased flows down Stony Creek to the CHO but precludes its continuation down the creek below the CHO where it would otherwise be available to manage for improved salmonid critical habitat PCEs. Additionally, in some years, lower reservoir storage may result in higher release temperatures during late spring through early fall which potentially would affect salmonids incubating or rearing (natal or non-natal) within lower Stony Creek. Due to a lack of temperature and habitat modeling for this system, the magnitude of potential impacts to habitat quality resulting from the diversion of this water has not been determined.

1. Adult Migration, Spawning, and Incubation

CHO operations in the spring can occur during the tail end of the upstream spawning migration period of steelhead. However, very few steelhead are anticipated to be migrating at this time into Stony Creek since April is the very end of the spawning period for steelhead (DFG 1993) and fish are likely to have migrated to their spawning grounds earlier in the spring. Additionally, if any steelhead were to spawn in lower Stony Creek in April or May, their eggs would not be likely to survive as water temperatures in this area generally rise above the level that is lethal to incubating steelhead eggs (58 °F) by mid-April (Reclamation and Corps 2001). Therefore, the operation of the CHO is not likely to adversely affect adult Central Valley steelhead migration and spawning.

2. Fry, Juveniles, and Smolts

Steelhead juveniles spawned and reared in lower Stony Creek likely would disperse out of the creek as young-of-the-year instead of age 1+ because high water temperatures make it impossible for juveniles to survive through the summer in lower Stony Creek. Dispersal may be triggered by increasing water temperatures which can exceed 65 °F beginning as early as late April. Since the unscreened CHO may be operated during this time, any steelhead migrating downstream from above the CHO prior to May 15 may be entrained into the TCC and would not be expected to survive. In addition, any non-natal rearing winter- and spring-run Chinook salmon and steelhead juveniles located above the CHO likely would disperse out of the creek according to these same temperature triggers and be subject to the same adverse effects. In order to minimize downstream passage problems at the CHO, culverts are placed within the temporary berm to facilitate passage. Also, adverse effects to juveniles are reduced through implementing conditions of the SWRCB permit (*e.g.*, maintaining bypass flows of 40 cfs below the CHO, slowly ramping down flows, and providing a fish distribution flow of 100 cfs prior to rediversion).

Reclamation conducted monitoring of entrainment into the TCC at the CHO in the springs of 2001, 2002, 2004, and 2005 (Corwin and Grant 2004, Reclamation 2005b, Reclamation 2006). No CHO diversions occurred in 2003 or 2006. The first year of sampling (2001) was basically a pilot year in which sampling strategies and protocols were tested and refined. A single fyke net was deployed for approximately 96 hours over a 15-day period. Only five fish and no salmonids were captured in 2001. In 2002 and 2004, two fyke nets were deployed side-by-side throughout most of the diversion period and several thousand fish, mostly Sacramento suckers (*Catostomus occidentalis),* were captured each year. In 2002, a total of 43 juvenile Chinook salmon were captured in the 2 fyke nets, and the expanded estimate of the total number of Chinook salmon entrained into the TCC that year was 328. In 2004, a total of 20 juvenile Chinook salmon were captured in the 2 fyke nets, and the expanded estimate of the total number of Chinook salmon entrained into the TCC that year was 92. In 2005 there was only a short, four-day diversion period (April 22 – 25). The fyke nets were deployed for a total of 69 hours sampling a total of approximately 175 acre feet of water. Only two fish were captured during this sampling effort, neither of which were salmonids. No steelhead were captured during any of the sampling in the TCC.

It is impossible to positively identify which ESU a wild Chinook salmon belongs to without genetic analysis. However, a length criteria analysis developed for juvenile Chinook salmon on the Sacramento River (Green 1992) indicates that all of the salmon captured (43 individuals) in 2002 were in the fall-and late fall-run Chinook salmon category. This same length criteria analysis indicates that in 2004, approximately 65 percent of the Chinook salmon captured were in the fall- and late fall-run category (resulting in an expanded estimate of 60 individuals entrained), and 35 percent were in the spring-run category (resulting in an expanded estimate of 31 individuals entrained). It should also be noted that the length-at-date criteria model for the Sacramento River (Green 1992) is not necessarily a good indicator for determining ESU classifications of Chinook salmon in tributaries of the Sacramento River. Moore (1997) found that Chinook salmon in Blue Tent Creek grew faster and had a higher condition factor than those in the mainstem Sacramento River, and Maslin *et al.* (1997) stated, "Individuals of the correct size to be members of each of the four Sacramento Chinook races were observed (in Sacramento River tributaries) but rapid growth makes race assignment based on size questionable."

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Non-Federal actions that may affect lower Stony Creek include agricultural practices, water withdrawals/diversions, gravel mining, and State or privately sponsored habitat restoration and bank stabilization activities.

A. Agricultural Practices

Agricultural practices in the lower Stony Creek watershed are expected to continue into the future at similar acreages and crop types as are found today. Agriculture is the dominant land use in the area with a variety of crops and practices employed. The dominant perennial crops include both permanent pastures and orchards, and annual crops including wheat, hay, field corn, sugar beets, beans, and Sudan grass. A substantial area within the lower watershed is also used for grazing. Most of the grazed land occurs between Black Butte Dam and the TCC (Reclamation 1998).

Grazing along Stony Creek could increase erosion, reduce riparian vegetation and increase the nutrient load into the creek. The application of chemicals and fertilizers to crops along the creek also could increase the level of contaminants entering the creek. Agricultural water use will also impact the condition of PCEs on lower Stony Creek. Groundwater pumping can lower the water table and cause Stony Creek water to absorb into the surrounding alluvium which could prolong the period of time that the creek remains disconnected from the Sacramento River during dry periods, however Orland Project surface irrigation has been shown increases groundwater levels in the project area.

B. Gravel Mining

As of 1998, six instream gravel extraction operations existed along lower Stony Creek, occupying a total of 1,179 acres, and several new gravel mining operations are proposed for development along lower Stony Creek in the near future (Reclamation 1998). According to the draft Stony Creek Watershed Assessment Existing Conditions Report (Harvey and Associates 2006), gravel extraction rates for these mining operations were not publicly available because the data were considered proprietary. However, Swanson and Kondolf (1991) compiled the permitted extractions for the mines active on Stony Creek at the time of their study. The mining operations immediately upstream and downstream from Hwy 32 had combined permitted extraction rates of 300,000-750,000 CY/y in 1990. These rates are 2 to 6 times the natural pre-dam sediment input from the upper watershed, and 11 to 29 times the sediment supply currently provided by upstream bank erosion. Kondolf and Swanson (1993) state: “Even if extraction were to cease today, the channel will continue to adjust to this catastrophic removal of sediment, probably for decades.” Gravel mining activities are expected to continue to directly impact salmonids and critical habitat by elevating turbidity levels within and downstream of the extraction zones, and by direct disturbance of any fish and eggs present within the extraction zone during instream work. Instream gravel mining will also continue to deplete the supply of suitable spawning substrates within the creek. These spawning gravels are a PCE of critical habitat that is severely limiting in lower Stony Creek, and their continued extraction, with no significant replenishment, will eventually make the creek completely unsuitable for salmonid spawning. Assuming the above mentioned rates of extraction will continue into the future, it is likely that the associated adverse impacts to critical habitat will continue and likely intensify.

C. Invasive Weed Control and Bank Stabilization

In 2000 the Glenn County Planning Department conducted a scoping process to determine the goals for the lower Stony Creek watershed. The goals that landowners identified were invasive species eradication, reduction of erosion, and modification of the release schedule from Black Butte Dam, also to reduce erosion. The Glenn County Resource Conservation District (GCRCD) is in the process of acquiring and coordinating funding, technical assistance, and permits in order to address the issues and concerns identified by the lower Stony Creek landowners.

Currently, the GCRCD proposes to provide technical, funding, and permitting assistance to private landowners on lower Stony Creek to implement the Lower Stony Creek Non-Native Invasive Species Eradication Project. The purpose of the project is to facilitate the eradication of Giant Reed (*Arundo donax)* and Salt Cedar (*Tamarix)*, revegetate the creek banks with native plants, install vegetative and structural bank stabilization features, and coordinate the permitting process. The GCRCD proposes to coordinate projects on private land using standardized and accepted methods and practices of weed management and bank stabilization in such a way that will not endanger, but improve, public and private natural resources and the environment. The GCRCD will then monitor project effectiveness and completeness using a Quality Assurance Project Plan developed by the GCRCD in conjunction with a technical advisory committee.

This project is likely to create some long-term benefits to salmonids and critical habitat PCEs in lower Stony Creek by improving riparian habitat and reducing fine sediment influx into the creek. There also are likely to be some short-term adverse impacts from instream construction of bank stabilization features and pesticide inflow from weed control. There is likely to be a long-term reduction in spawning gravel recruitment into the creek as lateral bank erosion, which is currently the only source of recruitment of new gravels into the creek, will be reduced.

VII. INTEGRATION AND SYNTHESIS

The greatest adverse effect associated with Stony Creek water management operations is the complete blockage of access by anadromous species to their historical spawning and rearing habitat above Black Butte Dam. Because this historic habitat is no longer accessible, Chinook salmon and steelhead are relegated to a small reach of the creek containing only marginal habitat that was not historically used to any great extent by these species. This makes these fish particularly vulnerable to the adverse effects of water management operations of the Corps and Reclamation. These Federal agencies, through the storage, release, and rediversion of flows, control the quantity and quality of the small amount of remaining habitat on Stony Creek.

The alteration of the natural hydrologic cycle due to upstream dam operations on Stony Creek has the potential to adversely affect all life stages of steelhead, as well as non-natal juvenile spring-run and winter-run Chinook salmon. Reservoir operations resulting in large scale flow fluctuations could cause adverse effects such as redd scouring or juvenile stranding. Extended periods of low flow releases can result in increased temperatures and reduced habitat availability.

NDD is a significant barrier to anadromous salmonids, and if any adults manage to pass above the dam and successfully spawn, entrainment of juveniles may occur within the North Canal (though no such passage or entrainment has been detected in 4 years of monitoring (Corwin and Grant 2004)). Juvenile steelhead, spring-run and winter-run Chinook salmon rearing in Stony Creek may also be entrained in the CHO Diversion. The diversion of water out of Stony Creek for consumptive purposes reduces flows below those diversions which can result in increased water temperatures and reduced quality and quantity of critical habitat.

The blockage of spawning gravels by Black Butte Dam, along with gravel extraction at the many mining operations along the creek have created a severe shortage of suitable spawning habitat in lower Stony Creek, with the upper end deeply incised down to bare rock and hardpan, and the lower end heavily dominated by fine sediments that can smother salmonid redds and reduce reproductive success. The continuation of these problems along with a new drive to stabilize the banks of the creek and thus eliminate the last source of gravel recruitment into the creek (*i.e.*, lateral erosion which recaptures old gravel deposits from the historic floodplain) will eventually make the creek completely devoid of suitable spawning habitat.

Impacts on Species Survival and Potential for Recovery

In examining the potential impacts of Stony Creek water management operations on the survival and potential for recovery of listed salmonids, one must determine whether or not those impacts are likely to reduce the numbers, reproduction, or distribution of these fish in such a way that their likelihood of recovery and survival within the action area is appreciably diminished, and if so, how those local reductions are likely to affect the overall populations throughout the Central Valley.

1. <u>Winter- and Spring-run Chinook Salmon</u>

With regards to winter-run and spring-run Chinook salmon, it is clear that project impacts on Stony Creek are unlikely to affect either reproduction or distribution of these ESUs as there are no spawning populations of either ESU in Stony Creek. The fact that non-natal juvenile winter-and spring-run Chinook salmon have been documented rearing in Stony Creek means that certain impacts of the water management operations such as sustained low flows, flow fluctuations, and unscreened water diversions could cause a reduction in the numbers of fish that use Stony Creek as rearing habitat. However, the majority of juvenile salmon collected in Stony Creek have been found within the lower two miles of the creek (Maslin and McKinney 1994, Corwin and Grant 2004) where they are not exposed to water diversions and they are likely to have the ability to escape to the Sacramento River when conditions in Stony Creek become unfavorable. Therefore, it is likely that very few of the fish that use Stony Creek as a rearing area actually are harmed or killed by the adverse effects associated with water management operations.

In estimating the effect of the loss of a small proportion of Stony Creek juveniles on the broader Central Valley populations of these ESUs, it is important to note that the poor habitat conditions found in Stony Creek (fluctuating flows, high temperatures, low instream habitat diversity, and poor SRA habitat) make it unlikely that this creek is used as non-natal rearing habitat by a significant proportion of the juvenile populations of these ESUs. On the other hand, were the creek managed in a more favorable manner to improve rearing conditions for juvenile salmonids, this large tributary with a long stretch of accessible, low-gradient habitat could serve as high-quality rearing habitat for a larger number of juvenile winter- and spring-run Chinook salmon. Under current conditions, the injury and death of the small number of juvenile Chinook salmon impacted by Federal water management operations is unlikely to result in detectable reductions in the number, reproduction, or distribution of winter- and spring-run Chinook salmon given the large fluctuations in juvenile survival rates experienced by the populations annually. As a result, NMFS finds that it is not reasonable to expect that these juvenile losses will reduce the likelihood of survival and recovery of the Sacramento River winter-run Chinook salmon or the Central Valley spring-run Chinook salmon.

2. <u>Central Valley steelhead</u>

Although steelhead spawning has not been documented in Stony Creek in recent years, there is access to marginally suitable spawning habitat for steelhead in the creek, and it is reasonable to assume that water management operations can and will have an effect on steelhead numbers, reproduction and distribution within Stony Creek. The severity of the adverse impacts produced by current operations will vary from year to year and season to season dependent on hydrologic conditions, irrigation demands and flood control requirements. It is likely that in years when operations produce extreme flow fluctuations, blockage or delay in migration, extended low-flow periods, and other such impacts, steelhead numbers, reproductive success, and distribution will be reduced. If these severe conditions occur on a regular basis, the likelihood of survival and recovery of any local steelhead population would be appreciably reduced.

The determination that the proposed project has the potential to appreciably reduce the likelihood of survival and recovery of the local steelhead population in lower Stony Creek requires that we must next determine the importance of this population to the viability of the overall Central Valley DPS. This importance can be measured by the level of contribution that the Stony Creek population makes to the numbers, genetic diversity, and resilience of the greater DPS.

It is likely that prior to the permanent removal of the GCID crossing, favorable conditions for steelhead spawning and fry survival only occurred on an occasional basis and it is unlikely that a significant sustained population could have been established. The longstanding access problem caused by the GCID canal crossing, along with all of the other effects of current water management operations on Stony Creek make it very unlikely that any current population of steelhead on Stony Creek is large enough or genetically distinct enough to contribute significantly to the Central Valley DPS. Based on the likely low value of the Stony Creek population to the overall diversity and resilience of the Central Valley steelhead DPS, NMFS finds that it is not reasonable to expect that reductions in the likelihood of survival and recovery of the local population will result in reductions in the likelihood of survival and recovery of the DPS.

3. Critical Habitat

Habitat conditions in lower Stony Creek below Black Butte Dam always have been marginal in terms of the ability to support spawning populations of Chinook salmon and steelhead. The location on the valley floor and natural hydrologic conditions created an environment that was likely too hot and dry to serve as anything other than a migratory corridor for these fish to access the more suitable habitat found in the upper reaches of the watershed. The controlled release of relatively cool water out of Black Butte Dam has improved the potential for this reach to serve as spawning and rearing habitat, although that improvement is relatively limited and the habitat remains marginal.

While the proposed water management operations to be conducted on lower Stony Creek do not allow the accessible habitat within the creek to meet the full potential to support and conserve listed salmonids, the small amount of habitat available in lower Stony Creek and the incremental level of degradation likely to result from future operations do not appear to significantly degrade the functions for which the habitat is currently being used (primarily as non-natal rearing habitat during cold water periods). Proposed operations are expected to maintain the currently medium conservation value (NMFS 2005) of the habitat and are not expected to diminish the current levels or types of habitat use by salmonids. As a result, NMFS expects that the proposed operations are not likely to diminish the value of critical habitat in lower Stony Creek for the survival and recovery of spring-run Chinook salmon and steelhead, or diminish the value of critical habitat within the overall designation. Lower Stony Creek water management operations are not expected to impact critical habitat for Sacramento River winter-run Chinook salmon, which has not been designated within the creek.

VIII. CONCLUSION

After reviewing the current status of endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened Central Valley steelhead, and critical habitat for Central Valley spring-run Chinook salmon and Central Valley steelhead, the environmental baseline for the action area, the effects of proposed lower Stony Creek water operations, and all other cumulative effects, it is NMFS' biological opinion that lower Stony Creek water operations are not likely to jeopardize the continued existence of these species, and are not likely to destroy or adversely modify designated critical habitat for Central Valley spring-run Chinook salmon and Central Valley steelhead.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by Reclamation and the Corps (the Agencies) so that they become binding conditions of any permits issued or project descriptions, as appropriate, for the exemption in section 7(o)(2) to apply. The Agencies have a continuing duty to regulate the activities covered by this incidental take statement. If the Agencies fail to assume and implement the terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Agencies must report the progress of the action and its impact on the species to NMFS as specified in this incidental take statement (50 C.F.R. §402.14(i)(3)).

A. Amount or Extent of Take

There are several aspects of the proposed action which have the potential to take listed species. The actual numbers of individuals likely to be taken can be estimated for certain aspects of the project while for others it cannot. With regards to the entrainment of fish into the irrigation canals, data is available from which to derive an estimate of take likely to occur from these activities. Data collected during Reclamation's studies and sampling efforts in lower Stony Creek (Corwin and Grant 2004, Reclamation 2005) has been analyzed to create an estimate of the level of entrainment that might occur due to future irrigation diversions on lower Stony Creek.

Although biologists who conducted the fish monitoring study are of the opinion that all Chinook salmon caught near the CHO were most likely members of the fall-run ESU, it is impossible to positively determine which ESU the juvenile Chinook salmon captured or entrained in Stony Creek might belong to. Therefore, a conservative approach will be taken in assuming that all entrained juvenile Chinook salmon are listed species (*i.e.*, either Central Valley spring-run or Sacramento River winter-run Chinook salmon) to insure that adequate accounting of potential take is provided should future ESU identification reveal that some or all these fish are in fact members of the listed ESUs. The highest estimate of Chinook salmon entrainment occurred in 2002 with 328 Chinook salmon entrained. Although Reclamation's monitoring efforts have not detected entrainment of Central Valley steelhead at the TCC diversion or the North Diversion, a small amount of steelhead take will be assumed to insure that any potential future take of steelhead will be accounted for, and thereby avoid jeopardizing Reclamation's future operation of these facilities due to "unauthorized take". Therefore we will assume that the maximum level of take expected at the agricultural diversions on Stony Creek will be 328 juvenile winter-run and/or spring-run Chinook salmon and 20 juvenile steelhead.

The entrainment monitoring and salvage system that is currently being used on the TCC diversion is assumed to capture a large proportion of the fish entrained into the diversion (wing-nets on the fyke traps now span the entire canal and are operated throughout the diversion period; conditions permitting). Every effort is made to insure that all fish captured in these traps are kept in good condition and are released back into the creek, below the diversion, following data collection. Through analysis of past capture and mortality rates, debris loads in the fike traps, and frequent fluctuations in diversion flows at the CHO, Reclamation has estimated that the level of lethal take for salmonids captured within the fyke traps will be approximately 49 fish during each annual monitoring/salvage period.

There are several other aspects of the proposed water management operations which can cause the incidental take of listed species through extreme flow fluctuations, insufficient releases which do not maintain suitable habitat conditions within lower Stony Creek, and the installation, operation and maintenance of diversion structures. The take associated with these activities is likely to occur in the form of dewatered redds, scoured redds, delayed or blocked migration due to low flows and/or structural impediments (diversion structures), isolation and stranding of fish due to flow fluctuations, and reduced survival and fecundity due to unfavorable habitat conditions. It is impossible to estimate the number of listed fish likely to be taken as a result of these impacts due to many unpredictable variables such as population size and timing of use by the various life stages of the listed species in Stony Creek and weather conditions/precipitation levels which will influence the frequency, timing, and magnitude of flow fluctuations as well as water temperatures and habitat availability and quality.

Because of the unpredictable nature of the annual level of take likely to be caused by these aspects of Stony Creek water management operations, NMFS has designated specific project related ecological surrogates to represent the extent of take anticipated to be caused by Stony Creek water management operations, so that we will be able to monitor those surrogates to determine the level of take that is occurring. The three most appropriate ecological surrogates for the extent of take caused by Stony Creek water management operations are: 1) the timing and duration of rediversion activities at the TCC; 2) the minimum bypass flows that will be maintained below specific diversion points on Stony Creek; and 3) the flood control/ramping rate operations that will be implemented by the Corps.

1. Ecological Surrogates

- The analysis of the effects of the proposed project anticipates that the diversion structure for the TCC will not be installed prior to April 1 of each year and a minimum 40 cfs bypass flow will be maintained at all times while the diversion structure is in place. Additionally, a fish distribution flow of not less than 100 cfs will be released below NDD for a period of 24 hours prior to the commencement of spring time diversions at the TCC.

- The analysis of the effects of the proposed project anticipates that a minimum of 30 cfs flow will be maintained below the lowest point of diversion not withstanding the above 40cfs requirement below the active TCC diversion.

- The analysis of the effects of the proposed project anticipates that the Corps will follow the flood control/ramping rate guidelines described on pages 33 and 34 of this document.

If these ecological surrogates are not met and maintained, the proposed project will be considered to have exceeded anticipated take levels, triggering the need to reinitiate consultation on the project.

B. Effect of the Take

In this biological opinion, NMFS has determined that the level of anticipated take is not likely to jeopardize the continued existence of listed Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead or result in the destruction or adverse modification of critical habitat.

C. Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Sacramento winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead:

1. Reclamation shall seek to minimize the impacts to listed species associated with the diversion of water from Stony Creek by continuing to capture and count salmonids that may become entrained into the CHO, and release them below the CHO.

2. The Corps shall implement flood release protocols to minimize the adverse effects of low flows and flow fluctuations on incubating eggs as well as juvenile and adult anadromous salmonids in Stony Creek.

3. The Corps shall develop and implement a long-term gravel augmentation program to improve the quality and quantity of salmonid spawning habitat throughout lower Stony Creek.

4. Reclamation and the Corps shall meet with NMFS each spring to determine minimum instream flows in lower Stony Creek during the spring cold-water period. The provision of increased minimum instream flows will be determined using water storage levels in the three reservoirs and projected inflow into Black Butte Reservoir on or after April 1 of each year.

D. Terms and Conditions

Reclamation and the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures listed above. These terms and conditions are non-discretionary.

1. Reclamation shall seek to minimize the impacts to listed species associated with the diversion of water from Stony Creek by continuing to capture and count salmonids that may become entrained into the CHO, and to release them below the CHO.

    A) Reclamation shall continue to implement the fish monitoring/salvage operations at the CHO during all periods that water is being diverted into the TCC during the spring diversion season (April 1-May 15). The trapping facilities shall be designed so as to sample the entire flow of the diversion by extending wing nets from the edges of the traps out to the banks of the channel. This can safely be done with flows up to 200 cfs. Wing nets or similar devices should also be employed between the two traps to insure that fish are not able to pass between the traps without being captured. When flows are above 200 cfs, Reclamation shall sample as much of the flow as can be safely sampled, with a minimum of 40% of the channel being sampled.

    B) Reclamation shall provide an annual report on the number, species, and disposition of all salmonids captured during the monitoring/salvage operations at the CHO. This report shall be provided within four months of the completion of monitoring/salvage operations each year. Take may not exceed 328 Chinook salmon and 20 steelhead. Lethal take for salmonids may not exceed 49 individuals during the annual monitoring/salvage operations.

The above mentioned report required by term and condition 1-B shall be submitted to:

Office Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3604

2. The Corps shall implement flood release protocols to minimize the adverse effects of flow fluctuations on incubating eggs as well as juvenile and adult anadromous salmonids in Stony Creek.

A) The Corps shall implement, to the extent possible, the ramping rate criteria provided in Table 5 for flood releases[1] from Black Butte Lake when storage elevations are encroached into the prescribed flood control space required at any particular time as determined from the updated Flood Control Diagram.

The rates of change for increasing flood releases of minimum flow to 1,000 cfs shall be as follows:

i. When storage encroaches 0 percent to 25 percent of the required flood control space, releases will be increased by no more than 250 cfs/hour.

ii. When storage encroaches 25 percent to 50 percent of the required flood control space, releases will be increased by no more than 500 cfs/hour.

iii. When storage encroaches 50 percent or more of the required flood control space, releases will be increased by no more than 1,000 cfs/hour.

When flood releases are above 1,000 cfs, releases shall be increased by no more than 1,000 cfs/hour. Exceptions to this requirement shall be allowed to insure the

[1] *All releases are expected to be within +/ - 5 percent of those targeted.*

structural integrity of the Corps' facilities and in emergency situations, to protect human lives and property from downstream flood damages.

The rate of change for decreasing releases shall be as follows:

i When flood release is 15,000 cfs to 5,000 cfs, releases will be decreased by no more than 500 cfs/hour.

ii When flood release is 5,000 cfs to 500 cfs, releases will be decreased by no more than 250 cfs/hour.

iii. When flood release is 500 cfs to 100 cfs, releases will be decreased by no more than 250 cfs/day at a rate not greater than 30 cfs/hr.

iv. When flood release is at or below 100 cfs, releases will be decreased in approximately 10 cfs/hour increments.

Table 5. Corps Ramping Rates[1]

When Increasing Flood Releases from Minimum Flow to 1,000 cfs:	
0 % to 25 % encroachment	250 cfs/hr or less
25 % to 50 % encroachment	500 cfs/hr. or less
Above 50 % encroachment	1,000 cfs/hr or less
When Increasing Flood Releases Above 1,000 cfs[2]:	
Any encroachment	1,000 cfs/hr. or less
When Decreasing Flood Releases:	
Flood releases 15,000 to 5,000 cfs	500 cfs/hr. or less
Flood releases 5,000 to 500 cfs	250 cfs/hr. or less
Flood releases 500 to 100 cfs	250 cfs/day at a rate not greater than 30 cfs/hr
Flood releases 100 cfs or less	10 cfs/hr

[1]All releases are expected to be within + /- 5 of percent those targeted.

[2]Operating experience has shown that when upward release changes are required within the range of 4,000 cfs to 6,500 cfs (depending on reservoir storage) the gates should be operated in such a way as to force a hydraulic jump below the outlet portal by temporarily increasing the release by approximately 2,000 cfs. Once the hydraulic jump is established, the 1,000 cfs per hour (or less) rate of release would resume.

B) The Corps shall continue to implement the recently developed flood release protocols for the last 5 to 7 percent of floodwater encroachment in Black Butte Lake. The intent is to release this last increment of flood water in a manner that will maintain minimum releases of 100 cfs or greater for as long as possible during flood control operations. On an annual basis in the fall of each year, the Corps, NMFS, and Reclamation shall meet to develop guidelines for release patterns for the upcoming winter with the intent of providing consistently suitable conditions for successful spawning and survival of anadromous salmonids. Those alternative release patterns shall not impair the Corps' flood control abilities through Black Butte Dam. In the event that flood releases are being made when irrigation water is requested, the total release from Black Butte Dam will be irrigation demands plus the desired instream flow needed for promoting successful spawning and survival of anadromous salmonids.

3. The Corps shall develop and implement a long-term gravel augmentation program to improve the quality and quantity of salmonid spawning habitat throughout lower Stony Creek.

   A) The Corps shall work with NMFS and other willing partners (GCRCD, Reclamation, local gravel mine operators, *etc*.) to develop and implement a spawning gravel augmentation program whereby an appropriate amount of suitably sized, clean spawning gravel will be placed into the upper end of lower Stony Creek on a regular basis to improve spawning habitat in those parts of the creek that have been deprived of adequate gravel recruitment due to the existence of Black Butte Dam. Implementation of this program shall commence within five (5) years of the issuance of this biological opinion

4. Reclamation and the Corps shall meet with NMFS each spring to determine minimum instream flows in lower Stony Creek during the spring cold-water period. The provision of increased minimum instream flows will be determined using water storage levels in the three reservoirs and projected inflow into Black Butte Reservoir on or after April 1 of each year.

   A) NMFS will initiate communications in early March of each year to establish early storage and inflow conditions and to set a meeting between Reclamation, the Corps and NMFS where the agencies will determine minimum instream flows in lower Stony Creek during the spring cold-water period.

   In those years when storage in Black Butte Lake is expected to exceed 104,654 acre feet on or after April 1, and the upstream reservoirs are full (Stony Gorge with 50,300 acre-feet, and East Park with 51,000 acre-feet), Reclamation shall increase minimum flows as much as possible with the intent of maintaining these flow levels throughout the cold-water period (see below). The target instream flow level shall be maintained below the lowest active diversion (or from Black Butte Dam if no diversions are occurring) during those periods when Reclamation has control over Black

Butte releases (non-flood control periods). These minimum flow releases will be determined by consensus between NMFS, Reclamation, and the Corps using water storage levels and anticipated inflow to the three reservoirs on or after April 1 of each year as a guideline.

When implemented, the increased minimum instream flow will be maintained as long as possible or through May 31 of that year, or until average daily water temperatures at the release point for Black Butte Dam reach 70 °F for three consecutive days, whichever occurs first, or until the time when the total system storage is less than 32.5 TAF (sum of minimum pool storage in the three reservoirs).

Failure by either agency to implement the project as described in this BO or to implement the terms and conditions set forth in this incidental take statement may cause the level of incidental take anticipated in this BO to be exceeded. If such a situation arises, the Agencies must immediately notify NMFS to provide an explanation for the deviation from the proposed project description or non adherence to the terms and conditions and review with NMFS the need for reinitiation of consultation.

X. 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. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Reclamation and the Corps should support and promote habitat restoration activities on lower Stony Creek, including the local landowner based efforts to restore healthy riparian habitat along the lower creek.

2. To improve habitat conditions and allow earlier access to Stony Creek for upstream migrating salmonids, Reclamation should use excess pumping capacity at the Red Bluff Pumping Plant (RBPP) to provide flows into the TCC which would be released into Stony Creek through the CHO in the fall. These releases should be a minimum of 75 cfs (the standard capacity of a single pump at the RBPP), should begin when water temperatures in the canal cool down to the point where they would provide suitable and attractive habitat for salmonids attempting to enter Stony Creek (below 68 °F), and should continue until natural instream flows in Stony Creek reach 100 cfs at the CHO.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

XI. REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the proposed lower Stony Creek Water Management Operations Plan. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take authorized in the accompanying 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 in this opinion; (3) the action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

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Enclosure 2

Magnuson-Stevens Fishery Conservation and Management Act (MSA)

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS[1]
U.S. Bureau of Reclamation and U.S. Army Corps of Engineers Lower Stony Creek Water Management Operations

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The geographic extent of freshwater essential fish habitat (EFH) for the Pacific salmon fishery includes waters currently or historically accessible to salmon within specific U.S. Geological Survey hydrologic units (Pacific Fishery Management Council 1999). EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH, "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

The associated biological opinion (Enclosure 1) thoroughly addresses the species of Chinook salmon listed both under the Endangered Species Act (ESA) as well as the MSA which potentially will be affected by the proposed action. These include Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley spring-run Chinook salmon (*O. tshawytscha*). Therefore, this EFH consultation will concentrate primarily on the Central Valley fall/late fall-run Chinook salmon (*O. tshawytscha*) which is covered under the MSA, although not listed under the ESA.

The Sacramento, Feather, Yuba, American, Cosumnes, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin Rivers, and many of their tributaries, support wild populations of Central Valley fall-/late fall-run (herein "fall-run") Chinook salmon. However, 40 to 50 percent of spawning and rearing habitats once used by these fish have been lost or degraded. Fall-run Chinook salmon once were found throughout the Sacramento and San Joaquin River drainages, but have suffered declines since the mid-

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[1]The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) set forth new mandates for NOAA's National Marine Fisheries Service (NMFS) and Federal action agencies to protect important marine and anadromous fish habitat. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NMFS regarding potential adverse effects of their actions on EFH, and respond in writing to NMFS "EFH Conservation Recommendations." The Pacific Fisheries Management Council has identified essential fish habitat (EFH) for the Pacific salmon fishery in Amendment 14 to the Pacific Coast Salmon Fishery Management Plan.

1900s as a result of several factors, including commercial fishing, blockage of spawning and rearing habitat, water flow fluctuations, unsuitable water temperatures, loss of fish in overflow basins, loss of genetic fitness and habitat competition due to straying hatchery fish, and a reduction in habitat quality.

Chinook salmon in the Sacramento/San Joaquin basin are genetically and physically distinguishable from coastal forms (Clark 1929). Additionally, San Joaquin River populations tend to mature at an earlier age and spawn later in the year than Sacramento River populations. These differences could have been phenotypic responses to the generally warmer temperature and lower flow conditions found in the San Joaquin River basin relative to the Sacramento River basin. There is no apparent difference in the distribution of marine coded wire tag (CWT) recoveries from Sacramento and San Joaquin River hatchery populations, nor are there genetic differences between Sacramento and San Joaquin River fall-run populations (based on DNA and allozyme analysis) of a similar magnitude to that used in distinguishing other Evolutionarily Significant Units (ESUs). This apparent lack of distinguishing life-history and genetic characteristics may be due, in part, to large-scale transfers of Sacramento River fall-run Chinook salmon into the San Joaquin River basin.

The historical abundance of fall-run Chinook salmon is poorly documented (Myers *et al.* 1998) and complete estimates are not available until 1953 (U.S. Fish and Wildlife Service [FWS] 1995). From the late 1930s to the late 1950s estimates for mainstem Sacramento River fall-run fish were obtained from spawning surveys and ladder counts at the Anderson-Cottonwood Irrigation Dam. Although surveys were not consistent or complete, they did yield population estimates for fall-run Chinook salmon in the Sacramento River ranging from 102,000 to 513,000 fish (Yoshiyama *et al.* 1998). Average escapement from 1953 to 1966 was 179,000 fish and from 1967 to 1991 was 77,000 (FWS 1995). From 1992 to 1997 the estimated fall-run population in the Sacramento River has ranged from 107,300 to 381,000 fish (Yoshiyama *et al.* 1998). Over the last 6 years average escapement of fall-run spawners in the mainstem Sacramento River has been above 190,000; however, 20 to 40 percent of these natural spawners have been of hatchery origin. The increase in salmon runs in the Sacramento River since 1990 may be attributable to several factors including, increased water supplies following the 1987-1992 drought, stricter ocean harvest regulations, and fisheries restoration actions throughout the Central Valley. However, it is unclear if natural populations are self-sustaining or if the appearance of a healthy population is due to high hatchery production. Concern remains over impacts from high hatchery production and harvest levels, although ocean and freshwater harvest rates have been recently reduced.

Although little information has been documented on fall/late-fall run Chinook salmon spawning in Stony Creek since the construction of Black Butte Dam, there has been sporadic documentation of spawning and juvenile rearing within the creek. Spawning surveys conducted by the California Department of Fish and Game (DFG) in the winter of 1981-82 estimated 384 adult fall-run Chinook salmon spawning in Stony Creek (Reavis 1983). A survey conducted by DFG during the fall and winter of 2000-01 documented successful Chinook salmon spawning in Stony Creek during a very dry year. Although no adult salmon were actually seen during this highly limited survey, redds were located and newly emergent fry were collected at several locations throughout the lower 15 miles of the creek (Charles Brown, DFG, pers. comm., March 5, 2001).

Corwin and Grant (2004) conducted limited surveys for adult Chinook salmon and redds during the fall-run spawning season from 2001 through 2004. While high stream flows and a lack of private land access limited these surveys to a very small area of the creek over short periods of time, the investigators found proof (in the form of live fish, carcasses, and/or redds) of adult escapement and spawning in each year of the study. In 2003, a groundwater monitoring study conducted by the California Department of Water Resources provided sufficient flows in lower Stony Creek to allow surface flows to reach the confluence of the Sacramento River during the early part of the fall-run Chinook salmon migration period. That fall's surveys showed the highest level of spawning activity of the 4-year study, with 27 live adults, 13 carcasses, and 18 redds documented before an increase in flows on December 10, 2003, made it impossible to conduct further surveys for the rest of the winter. The capture of newly-hatched fry Chinook salmon (30 to 40 mm fork-length) in each year of the study provided further evidence of consistently successful Chinook salmon spawning in lower Stony Creek during the study period (Corwin and Grant 2004).

A. Life History and Habitat Requirements

Central Valley fall-run Chinook salmon are "ocean-type," entering the Sacramento River from July through December, and spawning from October through January. Peak spawning occurs in October and November (Reynolds *et al.* 1993). Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths up to 15 feet. Preferred spawning substrate is clean loose gravel. Gravels are unsuitable for spawning when cemented with clay or fines, or when sediments settle out onto redds reducing intergravel percolation (NMFS 1997).

Egg incubation occurs from October through March, and juvenile rearing and smolt emigration occurs from January through June (Reynolds *et al.* 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and estuary (Kjelson *et al.* 1982). The remainder of fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, tributary streams are used as rearing habitat. These non-natal rearing areas are highly productive micro-habitats providing abundant food and cover for juvenile Chinook salmon to grow to the smolt stage. Smolts are juvenile salmonids that are undergoing a physiological transformation that allows them to enter saltwater. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean.

In contrast, the majority of fry carried downstream soon after emergence are believed to reside in the Delta and estuary for several months before entering the ocean (Healey 1980, 1982; Kjelson *et al.* 1982). Principal foods of Chinook salmon while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as *Daphnia*, flies, gnats, mosquitoes or copepods (Kjelson *et al.* 1982), stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates. All outmigrant Central Valley fall-run Chinook salmon depend on passage through the Sacramento-San Joaquin Delta for access to the ocean. They remain off the California coast during their ocean residence and migration.

II. DESCRIPTION OF THE PROPOSED ACTION

The proposed action is described in the *Description of the Proposed Action* section of the associated biological opinion (Enclosure 1) for the endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead ESUs.

III. EFFECTS OF THE ACTION

The greatest adverse effect on fall-run Chinook salmon EFH associated with Stony Creek water management operations is the complete blockage of access to a large portion their historical spawning and rearing habitat above Black Butte Dam. Because this historic habitat is no longer accessible, Chinook salmon are relegated to a small reach of the creek containing only marginal habitat. This makes these fish particularly vulnerable to the water management operations of the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation (Reclamation). These Federal agencies, through the storage and release of flows, control the quantity and quality of the small amount of remaining habitat on Stony Creek. The alteration of the natural hydrologic cycle due to upstream dam operations on Stony Creek has the potential to adversely affect all life stages of fall-run Chinook salmon. The storage of fall and early winter rains in upstream reservoirs prevents the flows of lower Stony Creek from reaching the Sacramento River until December of most years, thereby excluding the vast majority of adult fall-run Chinook salmon from entering Stony Creek to spawn. Reservoir operations resulting in large scale flow fluctuations can cause adverse effects such as redd scouring or juvenile stranding. Extended periods of low flow releases can result in increased temperatures and reduced habitat availability.

Diversion of irrigation water into the Tehama Colusa Canal (TCC) through the constant head orifice (CHO) at Stony Creek is another major impact to EFH, and causes direct entrainment and loss of juvenile fall-run Chinook salmon. The diversion of water out of Stony Creek for consumptive purposes also reduces flows below those diversions which results in increased water temperatures and reduced quality and quantity of essential habitat.

As discussed above, EFH protections apply to all ESUs of Pacific Chinook salmon, so the adverse effects that impact the habitat occupied by winter- and spring-run Chinook salmon juveniles are also considered adverse effects on EFH. Those effects are thoroughly detailed in the biological opinion for the proposed project (Enclosure 1).

IV. CONCLUSION

Upon review of the effects of lower Stony Creek water management operations, NMFS believes that some project activities will adversely affect EFH of Pacific salmon protected under the MSA.

V. EFH CONSERVATION RECOMMENDATIONS

As the habitat requirements of Central Valley fall-run Chinook salmon within the action area are similar to those of the Federally-listed species addressed in the attached biological opinion, NMFS recommends that the ESA reasonable and prudent measures and conservation recommendations included in the biological opinion prepared for the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead ESUs, be adopted as EFH conservation recommendations.

Additionally, the following conservation recommendation should be implemented to improve migrational, holding, and spawning habitat for Chinook salmon within the action area.

- To improve habitat conditions and allow earlier access to Stony Creek for upstream migrating Chinook salmon, Reclamation should use available pumping capacity at the Red Bluff Pumping Plant to provide flows into the TCC which would be released into Stony Creek through the CHO in the fall. These releases should be a minimum of 75 cfs (the standard capacity of a single pump at the RBPP), should begin when water temperatures in the canal cool down to the point where they would provide suitable and attractive habitat for salmonids attempting to enter Stony Creek (below 68 °F), and should continue until natural instream flows in Stony Creek reach 100 cfs at the CHO.

VI. ACTION AGENCY STATUTORY REQUIREMENTS

Section 305(b)(4)(B) of the MSA and Federal regulations (50 CFR § 600.920) to implement the EFH provisions of the MSA require Federal action agencies to provide a detailed written response to NMFS, within 30 days of its receipt, responding to the EFH conservation recommendations. The response must include a description of measures adopted by the Agency for avoiding, mitigating, or offsetting the impact of the project on Pacific salmon EFH. In the case of a response that is inconsistent with NMFS' recommendations, the Agency must explain their reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(j)).

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