United States Department of the Interior

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In Reply Refer To:
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To: Area Manager, Bureau of Reclamation, Mid-Pacific Region, Bay-Delta Office, Sacramento, California

From: Regional Director, U.S. Fish and Wildlife Service, Pacific Southwest Regional Office, Sacramento, California

Subject: Proposed Change to Action 4 of the 2008 Biological Opinion for the Coordinated Long-Term Operation of the Central Valley Water Project and State Water Project

This memorandum is in response to the Bureau of Reclamation's (Reclamation) September 7, 2017 memorandum requesting reinitiation of consultation with the U.S. Fish and Wildlife Service (Service) on the effects of a proposed change to implementation of the 2008 Biological Opinion for the Coordinated Long-Term Operation of the Central Valley Water Project and State Water Project (2008 BiOp). Specifically, Reclamation proposes a one month (October 2017) modification to the requirements outlined in Component 3, Action 4 (Action 4) of the Reasonable and Prudent Alternative (RPA) from the 2008 BiOp (proposed action). This proposed action is part of Reclamation and DWR's implementation of the Fall X2 adaptive management program. At issue are effects of this proposed action on the threatened delta smelt (*Hypomesus transpacificus*) and its designated critical habitat. This request is separate from the ongoing reinitiated consultation on the 2008 BiOp as a whole.

In reviewing this project, the Service has relied upon: (1) Reclamation's September 7, 2017 memorandum and the attached *Public Water Agency 2017 Fall X2 Adaptive Management Plan Proposal* (Proposal) which includes an analysis of the effects of the proposed action; (2) Reclamation's emails modifying the proposed action; (3) the Service's 2008 BiOp including Action 4 and its adaptive management provisions; and and (4) other information available to the Service.

This document amends the 2008 BiOp to address effects of the one month proposed action on delta smelt and its designated critical habitat within the limited context of the adaptive management provisions of Action 4. Unless otherwise noted, all of the information and requirements in the 2008 BiOp remain in place.

Consultation History

July 12, 2017	Special Collaborative Science and Adaptive Management Process (CSAMP) Policy Group Meeting: Fall X2 discussion
July 19- August 3, 2017	Coordination meetings with Reclamation, California Department of Fish and Wildlife (CDFW), the Service, California Department of Water Resources (DWR), and Public Water Agencies (PWAs)
August 14, 2017	Draft proposal provided to Delta Smelt Scoping Team (DSST), and Collaborative Adaptive Management Team (CAMT)
August 14 - August 25, 2017	DSST Review
August 18, 2017	The Service provided comments to Reclamation, PWAs and their consultants from ICF International
August 28, 2017	CSAMP Meeting: Discussion of Proposal
September 7, 2017	Request for Reinitiation received from Reclamation
September 26, 2017	Emails received from Reclamation (D. Murillo, D. Mooney) confirming modification of Fall X2 proposed action.

Regulatory Context

The objective of Action 4 is to improve fall habitat for delta smelt through increasing Delta outflow during fall (2008 BiOp p. 282). The location of the Low Salinity Zone (LSZ) where juvenile delta smelt rear is indexed by X2 (2008 BiOp p. 147). X2 is scaled as the distance in kilometers (km) from the Golden Gate Bridge (Jassby et al. 1995) where salinity is two parts per thousand (2008 BiOp p. 149). The 2008 BiOp states that Action 4 is accomplished by managing X2 through increasing Delta outflow during fall when the preceding water year is wetter than normal (2008 BiOp p. 369). During September and October in years when the preceding precipitation and runoff period was wet or above normal, Reclamation and DWR shall provide sufficient Delta outflow to maintain monthly average X2 no greater (more eastward) than 74 km in wet water years and 81 km in above normal water years (2008 BiOp p. 282).

RPA Action 4 addresses the effects to critical habitat from the coordinated operations of the CVP and SWP, which were found to have reduced habitat quality and quantity by altering the extent and location of the LSZ (2008 BiOp p. 243). At all times of year, the location of X2 influences both the area and quality of habitat available for delta smelt to successfully complete their life cycle (2008 BiOp p. 191). In general, delta smelt habitat quality and surface area are greater when X2 is located in Suisun Bay. Both habitat quality and quantity diminish the more frequently and further the LSZ moves upstream, toward the confluence of the Sacramento and San Joaquin rivers.

RPA Action 4 is structured as an adaptive management action and the requirements of the Action are subject to adaptive management. The discussion of Action 4 provides that the Service will review new scientific information and make changes to the action when the best available information warrants a change. Additionally, the Service will review implementation of the action and the effectiveness of the adaptive management program ten years from the signing of the 2008 BiOp.

2011 Implementation

Since the issuance of the 2008 BiOp, only WY 2011 was classified as a wet year in the Sacramento Valley. Despite a court mandated modification to the implementation of Action 4 for 2011, the daily average X2 values from DAYFLOW for September and October 2011 were 75 km and 74 km, respectively (pers. comm. D. Hilts). Therefore, the implementation criteria of Action 4 were functionally met in 2011. There have been no years classified as above normal in this period.

The delta smelt Fall Midwater Trawl (FMWT) abundance index increased more than tenfold in 2011 over its prior year value (http://www.dfg.ca.gov/delta/data/fmwt/indices.asp). Reclamation in cooperation with the Interagency Ecological Program (IEP) implemented the fall low salinity habitat (FLaSH) investigations in the fall of 2011 to explore hypotheses about the role of low-salinity habitat to the biology of delta smelt (Brown et al. 2014). Ultimately, directed 2011 FLaSH studies were considered largely inconclusive because many of the key predictions either could not be evaluated with the available data (e.g., primary production), or the necessary data were not collected (e.g., fecundity estimates). Abiotic habitat did increase in 2011 as predicted from Reclamation's 2011 Fall X2 Adaptive Management Program (AMP), but other variables such as zooplankton abundance were too variable to draw a conclusion and delta smelt growth rate comparisons remain incomplete as of 2017.

Similar to the approach taken in the FLaSH investigations, the IEP's Management Analysis and Synthesis Team's (MAST) updated conceptual model was used to generate hypotheses about the factors that may have contributed throughout 2011 to that year's increase in delta smelt abundance (IEP MAST 2015 p. 109). The authors of the MAST report surmised that the increase in abundance of delta smelt could be attributed to favorable habitat in all life stages, including the subadult stage, which benefited from "good food availability and from favorable habitat conditions in the large, westward LSZ" (IEP MAST 2015 p. 144). Both the FLaSH and MAST reports indicated that there were limitations to the application of the data to testing every component of the multifactor delta smelt conceptual models.

Proposed Action

In Reclamation's initial request for reinitiation, Reclamation and DWR proposed to operate their facilities in 2017 to achieve an average X2 location no greater (more eastward) than 81 km in October. Reclamation later modified their proposal to operate to maintain an average X2 location of no more eastward than 80 km. Operations for September and November would remain unchanged from those described for RPA Action 4 in the 2008 BiOp. For September, the monthly average X2 will be maintained at no more eastward than 74 km.

The proposed action also includes modification to the operation of the Delta Cross Channel (DCC) gates. This modification is being analyzed as part of a request by CDFW to reduce straying of returning fall-run Chinook salmon that were released directly into the Delta in 2014 to increase the survival of the young smolts during drought conditions. The DCC gate operations have been modeled in relation to the proposed X2 operations. The effects of the potential modified DCC gate operations on X2 are addressed as bookends and are included in the operational modeling. The specific DCC action was part of a separate request, but the operation is included here for purposes of analyzing effects.

In addition to the fall X2 action and DCC operation, a number of habitat actions will be either implemented in 2017, or studied for their potential to be implemented in 2018 or 2019. Supplementation of the available food supply in the Sacramento River is proposed to occur in fall 2017, and could also be implemented in 2018. This action would be similar to the action that occurred in 2016, when flood-up and drain practices on rice fields were modified to test the potential for food production by draining rice fields earlier and more frequently to export zooplankton to the Sacramento River. Participating landowners drained their fields to the Sacramento River and refilled these fields every 3-4 weeks, thus generating and delivering floodplain fish food to the river ecosystem.

In 2016, DWR also successfully implemented a food augmentation project called the North Delta Foodweb Adaptive Management Project (foodweb project), an action included in the Delta Smelt Resiliency Strategy, which elevated levels of primary production in the north Delta where some delta smelt were rearing. Unfortunately construction activity on the Wallace Weir salmon passage improvement project in the Yolo Bypass this summer has precluded implementation of the foodweb project in 2017, but DWR intends to implement the foodweb project again in summer and/or fall of 2018.

Additional actions to benefit the food supply and other components of delta smelt habitat are being proposed for further study and potential implementation in 2018 or 2019, including:

- Suisun Marsh Salinity Control Gate reoperation: Opening and closing the Suisun Marsh Salinity Control gates so that a greater portion of Suisun Marsh is low salinity habitat may increase delta smelt occupancy of large marsh channels where feeding success was recently observed to be higher than in Suisun Bay.

- Napa River flow augmentation: Provide increased flows on the Napa River in the fall to increase low salinity delta smelt habitat near tidal marshes in the Napa River, where high salinity typically precludes delta smelt use during the fall.

- Sacramento River Deepwater Ship Channel lock reoperation: Opening the locks at West Sacramento to move the relatively high primary production in the Ship Channel downstream into areas where a greater portion of delta smelt occur.

Monitoring will be undertaken in fall 2017 to test the support for the conceptual models linking delta smelt growth and survival to food availability and other habitat opportunities that change with the location of the LSZ. In addition to the long-term monitoring program that has been in

place for decades, the Service and Reclamation are conducting Enhanced Delta Smelt Monitoring (EDSM) combined with additional paired sampling of zooplankton and water quality to assess a broad variety of habitat features. Outside of the EDSM study area, additional habitat monitoring is proposed for the Napa River. This fall 2017 monitoring effort will be synthesized in 2018 to inform the ongoing CSAMP discussions described below, as well as discussions about modified operations of the Suisun Marsh Salinity Control Gates, and potential operational changes in Napa River.

The 2017 monitoring program includes the following:

- EDSM by the Service and Reclamation;
- Habitat monitoring, contracted through the State Water Contractors (SWC);
- Suisun Marsh and Montezuma Slough monitoring funded by DWR that will be used to inform the potential for Suisun Marsh Salinity Control Gate operations in 2018, per the Delta Smelt Resiliency Strategy;
- Napa River monitoring funded by the State and Federal Contractors Water Agency (SFCWA) to better understand habitat conditions of that low salinity zone;
- Synthesis of information by the IEP to be included in the RPA Action 4 10-year review and in reporting on 2017 research.

Special Circumstances

The damage that occurred at Oroville Dam in early 2017 requires operations that differ significantly from a typical wet year. In the interest of public safety, reservoir levels were substantially lowered while the dam and its spillway were being repaired. The Federal Energy Regulatory Commission has required that DWR keep levels as low as feasible through November 1, 2017. According to Reclamation's memo, this has impacted the water supply in Oroville to the point that the current and projected levels of water in storage nearly mimic those of drought years. Additionally, late spring and summer hydrologic conditions were drier in 2017 than in 2011, the only previous year since the Service's current BiOp has been in place in which X2 averaged near 74 km for September and October.

Ongoing Collaboration and Monitoring Opportunities

Parties to the 2008 BiOp litigation created the CSAMP to provide a forum to address scientific disagreements and uncertainties surrounding the 2008 BiOp and 2009 NMFS Biological Opinion. The Water Infrastructure Improvements for the Nation Act requires Federal agencies to regularly solicit input from the CSAMP in any consultation or reconsultation on the coordinated operations of the Central Valley Project and the State Water Project. This forum has provided an opportunity for participants to formulate science and management questions and to seek answers to these questions by funding agreed-upon studies. Results of the first of these studies have been completed and more are expected to be completed in the next year.

The efficacy of the Fall X2 action is one element of the RPA that has long been the subject of disagreement. A robust discussion around Fall X2 and outflow in other seasons for other species needs continues in CSAMP. A CSAMP-funded study re-analyzing the data set used by the Service to develop the Fall X2 action in the 2008 BiOp is scheduled to be completed in 2018.

Early in 2017 it was recognized that we might gain insight into species response to increased outflow by studying the effects of elevated outflow expected to occur in summer and fall of 2017 due to the wet hydrology. This study anticipated taking advantage of long- standing sampling efforts and the EDSM effort, as well as supplemental monitoring designed to augment the monitoring already in place. While the supplemental monitoring took some time to initiate, fish tissues have been collected since August and supplemental habitat monitoring began in September. Reclamation has made a substantial investment in this monitoring, both through EDSM and the supplemental monitoring described above. In addition, the PWAs estimate that approximately $800,000 will go towards supporting the monitoring efforts described above and in the Proposal. We believe these substantial investments in monitoring will yield new information which can help us develop tools to better determine the effects of actions such as the one proposed, as well as allow us to better understand the effects of management actions that can be taken to support delta smelt in the future.

The relevance of the collaborative nature of the current process cannot be understated. We now have several partners at the CSAMP table willing to make substantial investments to further our understanding of key management questions related to the protection of delta smelt and other species. We are confident that this effort will lead to more robust understanding of delta smelt and the actions that can be taken to protect them, while reducing the number of uncertainties around management of the Bay-Delta.

Effects of the Proposed Action

The Proposal includes an operational forecast for X2 for September-November, 2017. This forecast included projections for X2 with full implementation of the 2008 BiOp (i.e., average X2 = 74 km in September and October) and the proposed action (i.e., average X2 = 74 km in September and average X2 = 81 km in October), for DWR's estimate of an 80% confidence interval of the range in fall hydrology, bracketed within 'wet' and 'dry' bounds. For October 2017, X2 under the proposed action was modeled to range between 72 km and 81 km, depending on the hydrologic assumption used. Whereas the mean X2 in September was close to 74 km for all four scenarios examined, mean X2 in October was projected to be just over 73 km for full implementation of the 2008 BiOp, compared to around 78 km for the proposed action (See Table 1 in the Proposal). Therefore, the Proposal indicates there is a very good chance that X2 this October could be further downstream than 81 km, but the effects analysis in the Proposal includes the 81 km upper bound to conservatively describe the largest proposed change in X2.

Effects to Delta Smelt

Reclamation has concluded that the proposed action will not adversely affect delta smelt. The effects analysis in the Proposal provided by Reclamation revisited the 2008 BiOp stock-recruitment-X2 relationship, adopting a different stock-recruit formulation, and extending the

time series with several additional years of data. The effects analysis in the Proposal found that the fall X2 environment-recruitment correlation does not reliably increase the ability to predict recruitment of the juvenile life stage (Summer Townet index [STN]) from the previous year's subadult life stage (FMWT index). Reclamation noted that this finding does not invalidate work by others hypothesizing how fall X2 predicts the quality and quantity of delta smelt habitat (Feyrer et al. 2007; Feyrer et al. 2011); however, the analysis in the Proposal and work by others (MacNally et al. 2010; Thomson et al. 2010; Miller et al. 2012) have failed to detect a significant long-term population-level response to changes in habitat associated with fall X2.

The Service does not believe that the Proposal's stock-recruit analysis is useful to determine effects to delta smelt from this short-term action. The reason is that too much time passes between the component samples of a FMWT index and the component samples of a STN index to expect to see a persistent effect of Fall X2 (even when it is averaged over longer time periods than the proposed action). More than six months elapses between these sampling programs, during which time surviving adults mature, spawn, and die and the next generation of young delta smelt hatches into the plankton, passes through the larval stages, and metamorphoses into a new generation of juvenile fish. It has long been considered unreasonable to expect a statistical analysis to find a clear driver of the variation in fish recruitment that persists over long periods of time (Myers 1998). Consistent with this general fisheries science hypothesis, conceptual models of delta smelt's population trends have long invoked the hypothesis that multiple factors interact to affect recruitment (Bennett and Moyle 1996; Sommer et al. 2007; IEP 2015). Statistical assessments have generally provided quantitative evidence for some version of a multi-factor recruitment hypothesis (Bennett 2005; MacNally et al. 2010; Thomson et al. 2010; Maunder and Deriso 2011; Miller et al. 2012). The same is true of a recent individual-based life cycle model (Rose et al. 2013a, b).

While Reclamation has determined there will be no effect to Delta Smelt from the proposed action, we conclude there may be some effect to Delta Smelt related to the effects to Critical Habitat discussed below. The Effects Analysis in the Proposal demonstrates substantially greater effects when X2 is at 81km as compared to an X2 location of the forecasted 78 km X2 position in a wetter scenario and 79 km X2 position in a drier scenario. We believe there is corresponding reduction in the likelihood of effects to Delta Smelt when the effects to Critical Habitat are reduced however based on existing methods we are unable to quantify these effects.

Because the action proposed is short term in nature, we conclude that effects caused by the short term eastward increase in X2 position is unlikely to be detectible given the longer time scales used to inform existing data sets and analyses. It is possible that the EDSM and supplemental Reclamation sampling may provide more conclusive evidence of effects this year and if these studies do, that information will be synthesized next year and considered in future adaptive fall actions. But, at this time, tools to determine effects of this short term action are not available.

Effects to Delta Smelt Critical Habitat

Based on the effects analysis in the Proposal, Reclamation concluded that the proposed action is likely to adversely affect delta smelt critical habitat. The analysis presents information on the effects to both habitat area and habitat quality. It also provides a retrospective analysis of

seasonal patterns of historical X2 locations, and presents analyses on food density, water clarity and water temperature in the LSZ.

As stated in the effects analysis in the Proposal, in terms of habitat area, the proposed action is expected to reduce the average area of the LSZ by 37% in October, from 8,408 hectares (ha) when X2 is located at 74 km, to 5,313 ha when X2 is located at 81 km. If the average X2 location remained at 78 km this October, the estimated area of the LSZ is 7,959 ha which would represent less than a 7% reduction in habitat area compared to X2 located at 74 km.

The proposed action is expected to result in lower habitat suitability, as demonstrated by a decrease in the abiotic habitat index described by Feyrer et al. (2011). When X2 is located at 74 km and 81 km, the abiotic habitat index estimates are 7261 and 4835, respectively. This represents a reduction in suitability of approximately 33%. If the average location of X2 remained at 78 km this October, the predicted abiotic habitat index value would be 6099, which would represent a 16% reduction compared to X2 located at 74 km. The effects analysis in the Proposal also included habitat suitability estimates based on the newer 3-Dhydrodynamics-based station index (SI_H) (Bever et al. 2016). Based on the SI_H-X2 relationship, an X2 of 74 km in September would give an SI_H of 0.39 if turbidity is low and 0.62 if turbidity is high. An X2 of 81 km in October would give SI_H of 0.26 if turbidity is low and 0.42 if turbidity is high. Thus, under both low and high turbidity assumptions, X2 of 81 km would represent approximately 32-33% lower SI_H than if X2 were at 74 km this October. The SI_H values at low and high turbidity for X2 at 78 km are 0.35 and 0.54, respectively.

The findings presented in the analysis of effects in the Proposal to habitat area and habitat quality are consistent with the position of the 2008 BiOp that a westward and variable location of fall habitat provides increased habitat area and distributes the species into more diverse geographic areas reducing the potential risk of future entrainment loss, contaminants and predation (2008 BiOp p. 373). The effects analysis in the Proposal uses the UNTRIM model to provide 3D depictions of salinity and other habitat parameters laid over the geography of the estuary moving X2 from 74 km to 81 km and each kilometer in between. This model was not available at the time the 2008 BiOp was prepared.

Like the results of Feyrer et al. (2011), use of the UNTRIM model demonstrates that effects from moving X2 eastward are not linear and the effect of the eastward movement varies by kilometer. The largest single-kilometer inflection point demonstrated in the model is between 80 and 81 kilometers. At 80 km, parts of Grizzly Bay near Suisun Marsh and all of Montezuma Slough remain at salinities favored by delta smelt 100% of the time. When X2 moves to 81 km, the amount of time that salinity remains less than 6 parts per thousand (ppt) in Grizzly Bay and portions of Montezuma Slough drops to approximately 20%.

The *Status of Delta Smelt* section of the effects analysis in the Proposal provided by Reclamation outlines that both the STN survey and EDSM in 2017 indicate a large proportion of the juvenile delta smelt population is occurring within, or close to, the LSZ. Therefore, modification of Action 4 could affect the critical habitat currently being occupied by a significant proportion of the population, by reducing the area of the LSZ and its overlap with areas of relatively high

turbidity and low current speed. The proportion of the population that could be affected could change if delta smelt move upstream to the northern Delta prior to the proposed action.

As described above, Reclamation's proposed action is to maintain an average X2 no more eastward than 80 km for the month of October. The analysis provides a forecasted average monthly location of 78-79 km, depending on modeled hydrology, and exceeds 80 km only in the drier hydrology for a short period during the month. Given the large inflection point demonstrated by the UNTRIM model between 80 and 81 km, and the other habitat analyses that show disproportionately lesser effects at the forecasted X2 locations, we encourage Reclamation and DWR to hold the October X2 location westward of 80 km as much as possible to limit the habitat changes that were modeled to occur when X2 reaches 81 km.

DCC Gate Operation

Modification of DCC Gate will not result in any measurable effect to outflow during the September to November time period. The Service is supportive of the need for closure this fall.

Conclusion

Reclamation has requested a one month deviation from Action 4 for 2017 to be considered as an adaptive management action under Action 4. Reclamation's proposal highlights the extraordinary circumstances of this year, including the modified operation at Oroville, proposes additional activities with biological and scientific value, and proposes a significantly enhanced and supplemental monitoring. Additionally, this adaptive management action will help inform ongoing collaborative discussions in CSAMP and the Reinitiation of Consultation on Long Term Operations of the CVP and SWP.

This memo amends the 2008 BiOp to allow for Reclamation to operate its facilities to achieve an average X2 location no greater (more eastward) than 80 km in October, 2017. We appreciate Reclamation's concurrence to amend its original proposal to hold the average X2 location no more eastward than 80 km. Given the adverse effects to critical habitat demonstrated by the analysis in the Proposal, we encourage Reclamation and DWR to hold X2 westward of 80 km as much as possible to avoid the more substantial effects realized when the location moves eastward.

cc:

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