Summary of Differences between the California WaterFix Biological Assessment and the Partial Draft Biological Opinions and Possible Resolutions

DWR has reviewed the CWF Partial Draft Biological Opinions (Draft BiOps) sections provided by NMFS and USFWS on 12/23/2016. It is clear that the collaboration between DWR, Reclamation, NMFS, and FWS during the development of the Biological Assessment (BA) submitted in July 2016, has resulted in generally consistent understanding of the effects of the California WaterFix. However, there are a few key differences, as summarized below. For each of these differences, we also describe our understanding of how they may be resolved in subsequent versions of the BiOps. Also enclosed is a memo from ICF with a detailed description of the differences noted, which may be useful to the Independent Science Panel during their review of the Partial Draft BiOps.

Topics Related to the NMFS Partial Draft Biological Opinion

- **Construction Effects**: NMFS' assessment of construction effects placed greater emphasis than the BA on potential adverse effects from acoustic stress (focused on pile driving), increased predation risk (particularly from interim in-water structures), and physical impacts to fish (particularly from barge propeller injury and entrainment). These issues may be addressed through adjustments in construction approaches being developed through ongoing discussions with the design engineers and biologists, that will continue as design of the California WaterFix progresses.

- **Upstream Effects (real-time/seasonal operational adjustments):** The BA used flow and temperature models comparatively (i.e., NAA vs. PA) to determine effects of the PA, and compared any differences to two thresholds. Some of the upstream results that met criteria indicating an adverse effect of the PA were determined in the BA to have resulted from modeling artifacts or from failing to consider real time operations, but for most such cases NMFS identified the effect as adverse without discussing the role of real-time or seasonal management that would continue to occur as part of the CVP and SWP operations. This resulted in the BiOp identifying many more of the results as adverse effects. Through the development of the Draft and Final BiOp, NMFS, Reclamation, and DWR will coordinate to ensure real time operations are appropriately accounted for.

- **Upstream Effects (temperature analysis)**: NMFS's approach to evaluating effects of the PA for upstream water temperature effects somewhat differs from the BA, including: 1) that it treats the results of the water temperature modeling as absolute temperature estimates,

which is at odds with the caution in the BA that the modeling results not be treated as absolute, but rather be treated as relative values for comparing alternatives (see BA Appendix 5C, Section 5.C.5 “Appropriate Use of Model Results”, and 2) it does not seem to account for the fact that the water temperatures under both the PA and the NAA can be expected to exceed the water temperature thresholds less frequently following implementation of a revised RPA Action Suite 1, which NMFS is developing in consultation with Reclamation and other Federal and state agencies. The Draft and Final BiOp should make clear that the RPA revision process, committed to as part of the existing BiOp (2009), addresses the issues identified for the NAA and PA. Additionally, we would appreciate the Independent Science Panel’s review of the appropriateness of comparison of the temperature model results to known temperature thresholds.

- **Effects of North Delta Diversions**: NMFS made quantitative assumptions related to North Delta Diversion (NDD) entrainment/impingement that result in greater adverse effects than described in the BA, in part based on modeling results without consideration for commitments to real-time operations based on fish presence and reverse flow management. Through the development of the Draft and Final BiOp, NMFS, Reclamation, and DWR will coordinate to ensure real time operations are appropriately accounted for, including the initial operations ramp-up commitment (*CWF BA, Section 3.3.2.1 Operational Criteria for North Delta CVP/SWP Export Facilities, pp. 3-98-99*) and the further development of specific transitional criteria for adjustments to NDD operations, as detailed in the BA (*CWF BA Section 3.3.3.1 North Delta Diversion, pp. 3-107-110*).

Topics Related to the FWS Partial Draft Biological Opinion

- **Effects on Delta Smelt Critical Habitat**: USFWS included new analysis of changes in low salinity zone extent during the summer months that gave greater adverse effects of the PA compared to information presented in the BA; this is being addressed through a commitment to address Delta Smelt outflow issues through the reinitiation of consultation on the Coordinated Long-term Operations of the CVP and SWP and the update to the Bay-Delta Water Quality Control Plan.

Memorandum

To: Cindy Messer and Marcus Yee (DWR)

From: Marin Greenwood, Sophie Unger, Bill Mitchell, and Jennifer Pierre (ICF)

Date: January 12, 2017

Re: Review of California WaterFix (CWF) National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) Draft Partial Biological Opinion (BiOp) dated December 23, 2016

This memorandum summarizes the differences between the California WaterFix (CWF) Biolgical Assessment (July 2016) and the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) Draft Partial Biological Opinion (BiOp) dated December 23, 2016

Review of the NMFS Draft Partial Biological Opinion (Winter-Run and Spring-Run Chinook Salmon, Central Valley Steelhead, and Green Sturgeon)

The NMFS Draft BiOp sections draw on a mixture of information provided in the BA in addition to work undertaken solely during Draft BiOp development. The discussion below summarizes construction effects, upstream operations effects, and in-Delta operations effects, with an emphasis on highlighting differences from the information provided in the BA.

NMFS Construction Effects

2.5.1.1.1 Acoustic Stress

Although including more background discussion than the BA, the NMFS analysis of acoustic effects from pile driving is generally consistent with the analysis presented in the BA, although given the timing of upstream migration of adult steelhead 'NMFS therefore expects a substantial proportion of the adult CCV steelhead to be exposed to pile-driving activities at NDD intake locations' (p. 16 of <CWF Draft BO_section2.5.1.1_EffectsAnalysis_PartA_Construction_for peer review.pdf>). The same conclusion is reached for pile driving related to Clifton Court Forebay (CCF, p.29) and barge landings (p. 43); however, in the case of the barge landing at NDD intake 2[1], which NMFS assesses to have greatest potential for effect, the quantitative estimate provided by NMFS is 0.8–3% of the adult steelhead population (Table 3-23). Although

[1] Note, however, that a barge landing at intake 2 is no longer part of the PA (see discussion in the USFWS partial draft BiOp).

qualitatively noted as resulting in less exposure than NDD intake 2's barge landing, the exact same quantitative estimate of potential effect is given for the barge landings at Snodgrass Slough (Table 3-24) and Bouldin Island (Table 3-25). In contrast to pile driving at the other in-water locations, the analysis related to the Head of Old River (HOR) gate suggests less effect than other areas because the timing of work has less overlap with the return of steelhead to the San Joaquin River basin (p. 36).

In its analysis of acoustic stress associated with pile driving noise, NMFS does not consider potential reductions in exposure of adult and juvenile salmonids and green sturgeon related to migratory behavior, swimming speeds, or avoidance responses discussed in the BA.

NMFS included considerably more analysis of barge traffic noise effects (*2.5.1.1.1.2 Barge Traffic*) than the BA, although concluded that only a small proportion of NMFS-listed fishes would be affected.

In 2.5.1.1.1.1.1 *North Delta Intake Locations*,, Table 3-3 is incomplete and has a number of errors based on the acoustic data provided in the BA and the most recent submittal to NMFS (11/17/2016 email from David Buehler, ICF, to Jacqueline Pearson-Meyer, NMFS):

- 'Task Name' in first column should be 'Structure';
- First three rows should be labelled as pertaining to cofferdam sheet piles while the last three rows should be labelled as pertaining to foundation piles;
- 'Lateral Distance of Impact Across River' for foundation piles should be the same as for cofferdams;
- 'Upriver Distance' and 'Downriver Distance' for foundation piles should be 1,936 feet;
- 'Distance of Impact Across River' under 'Subinjurious Sound Levels' is mislabeled; it should be 'Distance to 150 dB RMS';
- 'Total River Distance' under 'Subinjurious Sound Levels' for cofferdam sheet piles presents distances in meters instead of feet.

Another correction that should be made to the pile driving information (and the effects analysis as necessary) in 2.5.1.1.1.1.1 *North Delta Intake Locations* is the reported distance between Intakes 2 and 3; the closest distance separating proposed pile driving activities at these two intakes (measured along the river axis) is approximately 1.4 miles, not 0.7 miles. The closest distance between pile driving activities at Intakes 3 and 5 is approximately 2.2 miles.2.5.1.1.2 Sediment Concentration and Turbidity Stress

The effects conclusions for sediment concentration and turbidity stress appear to be based on a qualitative scale that is different than that used for acoustic stress effects, and includes terms such as 'not adversely affect', 'a small proportion', 'a few', and 'some'; clarification of the relative magnitude of these terms would be useful and would be appropriate for inclusion in the

Analytical Approach. Table 2-1 in the *Analytical Approach* mentions high, medium, and low magnitude of effect, so it may be a case of making the effects analyses consistent with these definitions. In general the effects for sediment concentration and turbidity stress seem to be concluded to be less than those for acoustic stress.

2.5.1.1.3 Contaminant Exposure

Similar to the previous section, the discussion of contaminant exposure uses qualitative terms such as 'some' and 'a few' that would benefit from clarification as to their meaning.

2.5.1.1.4 Increased Temperature

Although the potential for increased water temperature because of removal of riparian vegetation was not discussed in the BA, NMFS reasonably concludes that listed fishes would not be affected because any changes would be difficult to detect.

2.5.1.1.5 Reduced Prey Availability

NMFS included an analysis for potential construction effects on prey availability, which was not discussed in the BA. Of the various PA activities discussed in the section, NMFS generally concludes no or limited adverse effects (with the possibility of short-term beneficial effects as prey become more available through disturbance). The exception is for barge traffic for green sturgeon, for which NMFS concludes on p. 110 that 'Juvenile and spawning adult green sturgeon, however, may be adversely affected by a reduced prey base over the long term.' The basis for this conclusion (as compared to salmonids) and extent of this adverse effect needs clarification.

2.5.1.1.6 Increased Predation Risk

Of the various potential impact mechanisms described in this section, NMFS' main emphasis on potential adverse effects related to predation is from in-water structures (*2.5.1.1.6.3 Interim In-Water Structures (Present During Construction)*), which was not discussed in depth in the BA. NMFS concludes that there would be adverse effects to listed fishes as follows:

- NDD: medium proportion of juvenile winter-run and spring-run Chinook salmon and steelhead; also adverse effects on juvenile green sturgeon (proportion not given);
- CCF: small proportion of juvenile salmonids and juvenile green sturgeon;
- HOR: small proportion of juvenile spring-run Chinook salmon and steelhead; also adverse effects on juvenile green sturgeon (proportion not given);

- Barge landings: small proportion of juvenile salmonids and a smaller (than salmonids) proportion of juvenile green sturgeon.

The 'medium proportion' affected at the NDD is of particular concern, and some clarification may be warranted for how this relates to or differs from the definitions of effects provided in the *Analytical Approach* (p. 15 of <CWF Draft BO_section2.1_Analytical Approach_for peer review.pdf>):

- High: Lethal effect due to stressor that has a broad effect on population at significant frequency.
- Medium: Effect between high and low definitions.
- Low: Generally sublethal effect, or lethal effect on a very small percentage of one population at a very infrequent interval.

There also appear to be inconsistencies or inaccuracies in the application of these terms. For example, 0.8 percent of juvenile fall-run Chinook salmon in June through October at the NDD project sites is characterized as a 'medium' proportion (2.5.1.1.6.1.1.1.1 *Chinook Salmon Exposure and Risk*, p.116). How these terms compare to other terms used in the document (e.g., "some") is unclear.

2.5.1.1.7 Physical Impacts to Fish

In the definition of 'physical impacts', NMFS includes impacts such as propeller strikes/entrainment, stranding/dewater capture and release, crushing by equipment or riprap placed in the water, and other mechanisms that overlap the earlier sections (e.g., disturbance because of pile driving). NMFS includes more quantitative detail on dredging entrainment potential than the BA, but regardless concludes that effects would be limited (*2.5.1.1.7.2 Dredging Entrainment*). NMFS also includes an extensive quantitative assessment of barge propeller effects (2.5.1.1.7.3 Barge Propeller Injury and Entrainment) that gives annual mortality estimates of several hundred (juvenile winter-run Chinook salmon and steelhead) to several thousand (juvenile spring-run Chinook salmon) fish (proportion not given); a qualitative estimate ('medium proportion') is provided for juvenile and adult green sturgeon. Other than these estimates, the discussion for physical impacts does not generally suggest potential for adverse effects to salmonids or green sturgeon beyond those considered in the BA.

NMFS Upstream Operations Effects

2.5.1.2.1 Increased Upstream Temperature

2.5.1.2.1.1 Winter-run Exposure and Risk

Spawning, Egg Incubation, Alevins: In the Draft BiOp, NMFS relies in part on the BA's water temperature threshold analysis and SALMOD model results, and draws conclusions from these results that are similar to those presented in the BA. However, NMFS additionally discusses a new egg mortality model developed by their Southwest Fisheries Science Center (SWFSC) and presents results of the model to estimate winter-run egg mortality under the PA and NAA alternatives. The results of the SWFSC model show little difference in mortality between the alternatives, which is in keeping with the results of the BA analyses.

Fry and Juvenile Rearing and Outmigration: The Draft BiOp relies, in part, on results of the BA's water temperature threshold analysis, but reaches a different conclusion about the effects. NMFS concludes that the results "indicate that an adverse effect to winter-run Chinook salmon juveniles is expected under the PA's thermal regime", while the BA states, at least for some locations, that "…there would be no biologically meaningful effect". The BA's conclusion is based on the following predefined criteria: (1) the difference in frequency of temperature threshold exceedance between NAA and PA was greater than 5%, and (2) the difference in average daily exceedance was greater than 0.5°F. These criteria were developed in consultation with NMFS, CDFW, DWR and Reclamation (see BA Appendix 5D, Section 5.D.2.1.2.2 *Water Temperature Threshold Analysis*). NMFS does not spell out the basis for their conclusion, but cites the results in Tables 5.D-68 through 5.D-73. Those tables give a number of examples of months and water year types with one or the other of the threshold criteria exceeded, but none with exceedance of both thresholds. It should be noted that the BA additionally concludes that the exceedances of the temperature threshold "…could have lethal or sublethal effects on juvenile emigrants….", but cites Section 5.4.2.3, *Summary of Upstream Effects*, which indicates that differences between the PA and the NAA in frequency of the threshold exceedances for rearing winter- and spring-run Chinook salmon are likely artifacts of the CalSim modeling that would not occur if real-time cold water management for the two alternatives used similar decision-making tools and criteria.

Adult Immigration and Holding: "juvenile emigration period" in the first sentence of paragraph 3 should read "adult emigration period". As described above for *Fry and Juvenile Rearing and Outmigration,* the Draft BiOp relies on results of the BA's water temperature threshold analysis, but the two documents reach different conclusions. For the specific river locations analyzed, the BA concludes that there would be "no biologically meaningful effects" because both criteria cited above were not met, but it also concludes "overall" that because "there would be more exceedances (5% or greater) in certain months and water year types under the PA", the PA could have lethal or sublethal effects on holding or immigrating adults. However, as described in the previous section, the BA also suggests the differences in exceedances between the two alternatives are likely modeling artifacts and would likely not occur in a real-time management context. The Draft BiOp, in contrast, provides the first portion of the BA's

summary conclusion, “Overall, the thresholds analysis in the BA indicates that there would be more exceedances (five percent or greater) in certain months and water year types under the PA, which could have lethal or sublethal effects on holding adults.”, without including the qualifying clause provided in the BA, “although this does not consider real-time operational management described in … that would be used to avoid and minimize any modeled effects”.

2.5.1.2.1.2 Spring-run Exposure and Risk

Spawning, Egg Incubation, Alevins: As described above for winter-run Chinook salmon, NMFS analyses in this section are largely consistent with those in the BA, but also include results of their new SWFSC egg mortality model. The Draft BiOp results show little difference in temperature threshold exceedances or temperature-related mortality (i.e., SALMOD results) between the alternatives, which is in keeping with the results of the BA. However, as noted above for the winter-run juvenile and adult sections, NMFS includes the BA’s conclusion that that there would be more exceedances in certain months and water year types under the PA, which could have lethal or sublethal effects, but does not include the BA’s qualification that the differences in model results between the alternatives in the frequency of threshold exceedances are likely artifacts of the CalSim modeling that would not occur in a real-time management context.

Fry and Juvenile Rearing and Outmigration: The analysis contained in this section is consistent with that presented in the BA. Notably, the conclusion in this section regarding results of the temperature threshold analysis includes the qualification from the BA about interpreting the results in the context of real-time operational management.

Adult Immigration and Holding: The Draft BiOp analysis contained in this section is consistent with that presented in the BA. Notably, the conclusion in this section regarding results of the temperature threshold analysis includes the qualification from the BA about interpreting the results in the context of real-time operational management. In addition, however, the Draft BiOp notes that the analysis presented does not consider NMFS’s revision to OCAP RPA Suite 1.2, although NMFS does not suggest that the conclusions regarding differences between the alternatives might be affected by the RPA revisions. It is not clear why NMFS included this comment in this section. The revised RPA targets early life stages of spring-run and winter-run more specifically than spring-run adult immigration and holding. Note that the BA addresses revision of RPA Action Suite 1.2 in Chapter 3, Section 3.1.4.5 *Annual/Seasonal Temperature Management Upstream of the Delta*, stating that “NMFS will work with Reclamation and other state and Federal agencies to adjust the RPA Action Suite 1.2.”

2.5.1.2.1.3 Steelhead Exposure and Risk

Spawning, egg incubation, and alevins: The first part of the Draft BiOp analysis in this section is almost identical to that in the BA, except that the BA, but not the Draft BiOp, ends its description of the temperature threshold analysis for each river location with the conclusion: "Therefore, it was concluded that there would be no biologically meaningful effect at [location]". Also, the BA, but not the Draft BiOp, includes a summary conclusion stating that there would be more exceedances in certain months and water year types under the PA, which could have lethal or sublethal effects. Instead, the Draft BiOp presents a detailed examination of the frequency of temperature threshold exceedances for the NAA and PA separately. This examination is introduced by noting:

> The water temperature exceedance plots are useful for assessing whether the PA is expected to make conditions warmer, colder, or have little impact relative to the NAA. The plots clearly show that the latter (little impact) is the case. What the plots do not show is how fish life stages, in this case CCV Steelhead eggs and alevins, will be affected by the thermal regimes present under both the PA and NAA scenarios…. These modeling results would indicate that although there is little difference in the number of water temperature exceedances between the PA and NAA scenarios, the actual water temperature conditions in the river are deleterious to spawning and egg/alevin incubation.

NMFS concludes the section as follows:

> NMFS finds that while the two scenarios are essentially equivalent in their effects on water temperature throughout the Keswick to Red Bluff river reaches, that both the PA and NAA operations during November and December, and later in March and April, will adversely affect incubating steelhead eggs and developing steelhead alevins in the gravel during November and December at the Keswick and Clear Creek locations and during March and April farther downstream from Balls Ferry to Red Bluff based on modeling information.

Thus, NMFS provides evaluations of the effects of both alternatives, based on the frequencies of their threshold exceedances, whereas the BA evaluates effects of the PA only, and only with respect to differences from the NAA. This is an important difference between these documents.

Kelt Emigration: The final sentence of the first paragraph of this section in the BA reads: "The largest increase in mean monthly water temperatures under the PA relative to NAA would be 1.0°F (1.4%), and would occur at Knights Landing in below normal water years during August". The Draft BiOp also provides this sentence, but correctly notes: "However this is outside the anticipated window when kelts are believed to be emigrating back down stream (February through May) and should not affect them". The Draft BiOp provides a similar correction at the end of the second paragraph. In other respects the

conclusions of the Draft BiOp for kelt emigration are largely consistent with those in the BA, i.e., the threshold analysis found no substantial differences between the PA and the NAA in threshold exceedances. However, the Draft BiOp additionally reports that no temperature thresholds were exceeded under either alternative at any of the locations during the kelt emigration period.

Juvenile Rearing: As described above for the section on Spawning, egg incubation, and alevins, the Draft BiOp is consistent with the BA in comparisons of the frequency and magnitude of water threshold temperature between the PA and the NAA, but extends the analysis to examine the frequency of threshold exceedances under the NAA and PA irrespective of differences between them. At all the river locations, the Draft BiOp concludes there would be adverse effects based on the threshold temperature criteria during part of the rearing period in certain water year types. The overall conclusion of the Draft BiOp's threshold analysis is that "environmental conditions as portrayed by riverine water temperatures associated with the PA and NAA operational scenarios will adversely affect juvenile rearing during the August through October period from Keswick Dam downstream to Red Bluff based on the modeling. In the farthest downstream reach modeled (Red Bluff), water temperatures under both the PA and NAA operational scenarios have the potential to adversely affect rearing steelhead in June and July as well". In contrast, the BA states or suggests, based on the criteria for evaluating the differences between the alternatives in the threshold exceedances, that "there would be no biologically meaningful effect" at any of the locations.

Smolt Emigration: As described above for the Juvenile Rearing section, the Draft BiOp is consistent with the BA in comparisons of the frequency and magnitude of water threshold temperature exceedances between the PA and the NAA, but extends the analysis to examine the frequency of threshold exceedances under the two alternatives irrespective of differences between them. The Draft BiOp concludes that the temperature threshold exceedances as represented by the modeling would not adversely affect smolt emigration during the peak period of migration, but that adverse effects are likely to occur outside of the peak period under both alternatives.
Adult immigration: As in the other steelhead sections, in this section the Draft BiOp is consistent with the BA in comparisons of threshold temperature exceedances between the alternatives, but extends the analysis to the frequency of exceedances for each alternative independently. Based on the latter analysis, the Draft BiOp concludes that elevated water temperatures under both the PA and NAA during September and August of critical years would adversely affect the fitness of immigrating adult steelhead from Red Bluff to Keswick. In contrast, the BA concludes that there would be no biologically meaningful effect of the PA on adult immigration and that, although there would be more exceedances (5% or greater) in certain months and water year types under the PA, which could have lethal or sublethal effects on immigrating adults, this result is likely to be a modeling artifact and does not consider the likely outcomes of real-time management.

Adult holding: The Draft BiOp and the BA analyses and conclusions differ for adult holding in essentially the same way as described above for adult immigration.

American River

Spawning, Eggs Incubation and Alevin: As described above for CCV steelhead in the Sacramento River, the Draft BiOp is consistent with the BA in comparisons of the frequency and magnitude of water temperature thresholds exceedances between the PA and the NAA, but extends the analysis to the frequency of threshold exceedances under the two alternatives irrespective of differences between them. The Draft BiOp concludes that the threshold temperature exceedances as represented by the modeling would adversely affect egg incubation and alevin development under both the PA and the NAA at both the Watt Avenue and the Hazel Avenue locations. The BA concludes, based on the threshold analysis of differences between the PA and NAA, that there would be no biologically meaningful water temperature-related effects at either location.

Kelt Emigration: The Draft BiOp and the BA analyses and conclusions differ for kelt emigration in the same way as described for the Spawning, Egg incubation, and Alevins section above.

Juvenile Rearing: The Draft BiOp and the BA analyses and conclusions differ for steelhead juvenile rearing and smoltification in the same way as described for the spawning, egg incubation, and alevin section above.

Smolt Emigration: The Draft BiOp and the BA analyses and conclusions differ for steelhead smolt emigration in the same way as described for the spawning, egg incubation, and alevin section above.

Adult immigration: The Draft BiOp and the BA analyses and conclusions differ for steelhead adult immigration in the same way as described for the spawning, egg incubation, and alevin section above.

Adult Holding: The Draft BiOp and the BA analyses and conclusions differ for steelhead adult holding in the same way as described for the spawning, egg incubation, and alevin section above.

2.5.1.2.1.4 Green Sturgeon Exposure and Risk

The Draft BiOp analysis for this section differs greatly from the analyses in the BA. The BA employs the same type of water temperature threshold analysis as described above for the salmonids, and concludes that for all green sturgeon life stages that “there would be more exceedances (5% or greater) in certain months and water year types under the PA [than the NAA], which could cause lethal or sublethal effects to … green sturgeon, although this does not consider real-time operational management.” In contrast,

the Draft BiOp simply gives temperature thresholds and development times from the literature for early life stages of green sturgeon and concludes that "Based on these temperature thresholds and requirements for the early life stages of this species, the predicted range of water temperatures in the upper Sacramento River following implementation of the PA is not expected to adversely affect the reproductive success, growth, or survival of sDPS green sturgeon."

2.5.1.2.1.5 Fall/Late fall-run Exposure and Risk

Although the heading of this section references late fall-run Chinook salmon as well as fall-run, the section in fact includes no water temperature analyses for late fall-run, nor does any other part of the Draft BiOp include water temperate analyses for late fall-run. The Essential Fish Habitat (EFH) assessment submitted in August 2016 with the BA does include such analyses.

2.5.1.2.1.5.1 Sacramento River

2.5.1.2.1.5.1 Fall-run Chinook Salmon

Spawning, egg incubation, and alevin: Some of the analyses in this section of the Draft BiOp differ substantially from those in the EFH assessment. Both reports begin with narrative summaries comparing temperature modeling results between the PA and the NAA and with temperature exceedance plots for the two alternatives for each water year type. However, the Draft BiOp includes the SWFSC's temperature dependent egg survival model as described above for the winter-run and spring-run spawning, egg incubation, and alevin sections. The results of the SWFSC model for fall-run, as presented in a figure, indicate high mortality for both alternatives with little difference between them, but, consistent with much of the rest of its temperature analyses, the Draft BiOp does not address changes of the PA from the NAA, but rather considers only that water temperatures under both the PA or the NAA would be so high as to adversely affect fall-run Chinook salmon egg incubation. This treatment follows NMFS's emphasis, as described above in the steelhead sections, of focusing on the PA effects in isolation, without considering their differences from the NAA effects. This is a major difference from the EFH assessment in the consideration of what constitutes effects of the PA. Following the SWFSC analysis, the Draft BiOp presents a summary of the temperature thresholds analysis results that are presented in the EFH assessment, which show little difference between the PA and the NAA, but then proceed to examine the frequency of threshold exceedances of the PA in isolation. The Draft BiOp also includes results of the SALMOD model in this section and, in keeping with the treatment of effects of the PA in isolation rather than as compared to the NAA, gives the SALMOD estimates for egg and alevin mortality due to water temperatures under the PA, with no discussion of how these estimates compare to those of the NAA. The Draft BiOp concludes this section as follows:

Results of the SWFSC egg mortality model, the water temperature thresholds analysis, and SALMOD all suggest that water temperatures under the PA are expected to have an adverse effect on fall-run Chinook salmon spawning, egg incubation, and alevin development.

In contrast, the EFH assessment concludes that any adverse effects of the PA on spawning, egg incubation, and alevins would be too small to detectable.

Fry, Juvenile rearing and Outmigration: This section of the Draft BiOp, as in the EFH assessment, begins by noting that results of the water temperature modeling give very similar results for the two alternatives. However, in keeping with the treatment of PA effects discussed in the previous section, the Draft BiOp presents results of the temperature thresholds analysis for the PA without including any presentation of the NAA results. The Draft BiOp states that these results indicate an adverse effect to fall-run is expected under the PA's thermal regime, whereas the EFH assessment, which evaluates the PA effects based on the differences from the NAA results, states that the threshold analysis indicates that any adverse effects would be undetectable.

Adult Immigration and Holding: Both reports begin this section with narrative summaries comparing temperature modeling results between the PA and the NAA and with temperature exceedance plots for the two alternatives for each water year type. The Draft BiOp states that these results show little difference in temperatures between the two alternatives. The Draft BiOp then discusses the temperature thresholds analysis results and notes that temperatures under the PA would exceed the thresholds infrequently except in critical water years. As for the section on Fry, Juvenile rearing and Outmigration, the results for the NAA are not given. The Draft BiOp concludes that the temperature thresholds analysis results indicate that for adult immigration adverse temperature-related effects of the PA would be limited to critical years and for adult holding they would occur in all water year types during July and August. In contrast, the EFH assessment, which compares the PA and NAA results, indicates that any adverse effects would be undetectable. Note that there are three misplaced tables in this section.

2.5.1.2.1.5.1 American River

Spawning, Egg incubation, and Alevin: The narrative description at the start of this section of the Draft BiOp, as in the Draft BiOp's Sacramento River fall-run water temperature sections discussed above (as well as the EFH assessment), summarizes differences in water temperatures between the PA the NAA and describes the differences as consistently small. The Draft BiOp then provides temperature exceedance tables for the river, without referring to them in the text. The Draft BiOp then discusses results of the temperature thresholds analysis in the EFH assessment and notes that differences between the PA and the NAA would be minimal. However, the Draft BiOp focuses primarily on the

frequency of the temperature thresholds under the PA, without regard to results for the NAA. The Draft BiOp, using detailed tables not included in the EFH assessment or the BA, shows that, during the peak spawning month of November, water temperatures under the PA would exceed the threshold more than 90% of the time, depending on water year type. In contrast, the EFH assessment, which compares the PA and NAA results, indicates that any adverse effects would be undetectable.

Fry, Juvenile rearing and Outmigration: The differences between the Draft BiOp and the EFH assessment for this section are essentially the same as those described above for the American River Spawning, Egg incubation, and Alevin section.

Adult Immigration: The differences between the Draft BiOp and the EFH assessment for this section are essentially the same as those described above for the American River Spawning, Egg incubation and Alevin and Fry, Juvenile rearing and Outmigration sections, with the exception that, in addition, this section includes a discussion of the differences in the results of the temperature thresholds analysis between the PA and the NAA and concludes that any adverse effects of the PA on adult fall-run immigration would be similar to those of the NAA. Based on the frequency of threshold exceedances of the PA alone, this section concludes with:

> The extended duration of exposure to water temperatures above the threshold is expected to increase the probability of pre-spawn mortality of adults and reduce in vitro egg viability, clearly resulting in adverse effects to fall-run Chinook salmon in the American River.

2.5.1.2.2 Redd Dewatering

2.5.1.2.2.1 Winter-run Exposure and Risk

The redd dewatering analyses and conclusions for winter-run are largely the same between the Draft BiOp and the BA, with both reports indicating greater redd dewatering under the PA than under the NAA. However, the BA, in Section 5.4.2.3 *Summary of Upstream Effects,* attributes the increased dewatering to lower CalSim Shasta releases in September and November under the PA relative to the NAA, and argues that actual future real-time management of the cold water pool would likely result in similar fall releases under the two alternatives, which would in turn result in no difference in redd dewatering between the alternatives. Another difference in the conclusions is that, based on results of the SALMOD model, the Draft BiOp reports that the percent change between the PA and the NAA in mortality caused by redd dewatering plus redd scour ranges from a 9% decrease in below normal years to a 5% increase in wet year types. However, it is unclear where these results come from because they are different than those given in the SALMOD results table (see Table 5.4-34 of the BA). Furthermore, the Draft BiOp follows this conclusion with a table that, according to the table title, reports winter-run

mortality predicted by SALMOD for all water year types of July through October. This table is not mentioned in the text. Finally, this section ends with an evaluation of the degree of certainty of the conclusions regarding the redd dewatering stressor, and its level of magnitude as a stressor on the winter-run population. The BA includes no such evaluation for redd dewatering as a stressor.

2.5.1.2.2.2 Spring-run Exposure and Risk

The redd dewatering analyses and conclusions for spring-run are largely the same between the Draft BiOp and the BA, with both reports indicating greater redd dewatering under the PA than under the NAA. However, the BA, in Section 5.4.2.3 *Summary of Upstream Effects,* attributes the increased dewatering to lower CalSim Shasta releases in September and November under the PA relative to the NAA, and argues that actual future real-time management of the cold water pool would likely result in similar fall releases under the two alternatives, and resulting, therefore, in no difference in redd dewatering between the alternatives. Another difference in the conclusions is that this section ends with an evaluation of the degree of certainty of the conclusions regarding the redd dewatering stressor, and its level of magnitude as a stressor on the spring-run population. The BA includes no such evaluation for redd dewatering as a stressor.

2.5.1.2.2.3 Steelhead Exposure and Risk

2.5.1.2.2.3.1 Sacramento River

The redd dewatering analyses and conclusions for Sacramento River steelhead are largely the same between the Draft BiOp and the BA, with both reports indicating lower redd dewatering under the PA than under the NAA. Note that there is an error in the first paragraph following the exceedance curves in this section. The second sentenced states that “the percent of redds dewatered range up to a 58 percent increase.” The “58 percent” should be “158 percent”, as given in the table that follows this paragraph.

2.5.1.2.2.3.2 American River

The redd dewatering analyses and conclusions for American River steelhead are largely the same between the Draft BiOp and the BA, with both reports indicating greater redd dewatering under the PA than under the NAA. In both reports, most of this difference is attributed to a CalSim modeling artifact.

2.5.1.2.2.4 Green sturgeon Exposure and Risk

The Draft BiOp included a section on redd dewatering for green sturgeon, but the BA did not include such a section. However, their conclusions in the documents regarding redd dewatering are equivalent: the Draft BiOp concluded that "Because green sturgeon spawn in deep pools, they are not vulnerable to redd dewatering as a result of flow management", and the BA, in Section 5.4.2.1.3.4.1 *Spawning and Egg Incubation* concluded that "Overall, the changes in flow [resulting from the PA] are expected to have no effect on green sturgeon spawning or egg incubation."

2.5.1.2.2.5 Fall/Late Fall-run Species Exposure and Risk

2.5.1.2.2.5.1 Sacramento River

2.5.1.2.2.5.1.1 Fall-run Chinook Salmon

The redd dewatering analyses and conclusions for Sacramento River steelhead are largely the same between the Draft BiOp and the BA, with both documents reporting minor differences in the redd dewatering results between the PA than the NAA in November and October. The main difference between the reports is that, based on the results for the PA, independent of those for the NAA, the Draft BiOp concludes that redd dewatering under the PA is a "high magnitude stressor to fall-run…in wet years and a medium stressor under relatively dry conditions." Note that the final sentence of the paragraph immediately preceding the table with the redd dewatering tables has an error. The cited ranges of values, "15 to 36 percent" and "three to five percent", combine values for the NAA and PA alternatives.

2.5.1.2.2.5.1.2 Late Fall-run Chinook Salmon

The differences between the Draft BiOp and the EFH assessment for this section are essentially the same as those described above for redd dewatering in the Fall-run Chinook Salmon section.

2.5.1.2.2.3.2 American River

The redd dewatering analyses and conclusions for American River fall-run are largely the same between the Draft BiOp and the EFH assessment, with both reports indicating greater redd dewatering under the NAA than under the PA. However, the Draft BiOp provides an additional analysis based on assumptions that a 25% reduction in flow would result in at least some redd dewatering and a 50% reduction would result in extensive dewatering. Without defining "some dewatering" and "extensive dewatering", NMFS based the assumptions, in part, on the relationship between redd dewatering and flow for fall-run Chinook salmon on the Sacramento River with the ACID Dam boards out (Table 5.D-57 in the Appendix 5D of the BA). Results based on these assumptions show that extensive dewatering would occur under the PA in 8% of wet years and 16% of critical years.

2.5.1.2.3 Redd Scour

2.5.1.2.3.1 Winter-run Exposure and Risk

There are few differences between the Draft BiOp and the BA in the analyses and conclusions for this section. The biggest difference is that the BA provides only a summary table of flow threshold exceedance frequencies, while the Draft BiOp gives this table as well as the flow data for the individual years in which the flow thresholds are exceeded.

2.5.1.2.3.2 Spring-run Exposure and Risk

There is little difference between the Draft BiOp and the BA in the analyses and conclusions regarding redd scour for spring-run.

2.5.1.2.3.3 Steelhead Exposure and Risk

2.5.1.2.3.3.1 Sacramento River

There is little difference between the Draft BiOp and the BA in the analyses and conclusions regarding redd scour for Sacramento River CCV steelhead.

2.5.1.2.3.3.2 American River

There is little difference between the Draft BiOp and the BA in the analyses and conclusions regarding redd scour for American River CCV steelhead.

2.5.1.2.3.4 Green Sturgeon Exposure and Risk

The Draft BiOp included a section on redd scour for green sturgeon, but the BA did not include such a section. However, their conclusions regarding redd scour are equivalent: the Draft BiOp concluded that "green sturgeon would experience little to no impacts from scour of their spawning areas", and the BA, in Section 5.4.2.1.3.4.1 *Spawning and Egg Incubation* concluded that "Overall, the changes in flow [resulting from the PA] are expected to have no effect on green sturgeon spawning or egg incubation."

2.5.1.2.3.5 Fall/Late fall-run Exposure and Risk

2.5.1.2.3.5.1 Sacramento River

2.5.1.2.3.5.1.1 Fall-run Chinook Salmon

There is little difference between the Draft BiOp and the EFH assessment in the analyses and conclusions regarding redd scour for Sacramento River fall-run, although the Draft BiOp concludes, based on results for the PA without regard to the NAA results, that redd scour is expected to adversely affect fall-run.

2.5.1.2.3.5.1.2 Late Fall-run Chinook Salmon

There is essentially no difference between the Draft BiOp and the EFH assessment in the analyses and conclusions regarding redd scour for Sacramento River late fall-run.

2.5.1.2.3.5.2 American River

In this section, the Draft BiOp describes the methods used for the redd scour analysis but provides no results or conclusions.

2.5.1.2.4 Stranding

The BA and EFH assessment provide no assessments of the effects of the PA on stranding of juvenile salmonids by flow reductions because, as explained in the Introduction to Section 5.D.2.3 *Rearing Flow Methods* of Appendix 5D, and in Section 5.4.2.1.3.1.2.1 *Flow-related Effects* of the BA, juvenile stranding generally results from reductions in flow that occur over short periods of time, and the CalSim modeling used to evaluate flow in the effects analysis has a monthly time step, which is too long for any meaningful analysis of juvenile stranding. Both the BA and Appendix 5D do include discussions of the impacts of stranding without regard to the alternatives, and note that NMFS's ramping rate restrictions at Keswick and Nimbus Dam would be the same for the PA as for the NAA, which reduces the chance that there would be any differences in stranding rate. NMFS, in the Draft BiOp, reiterates these conclusions, but also provides a discussion of stranding risks for each of the salmonid species and green sturgeon in Sections 2.5.1.2.4.1 through 2.5.1.2.5, although for green sturgeon the Draft BiOp simply states that stranding is not a potential stressor except on the seasonally inundated Yolo Bypass. Although both the Draft BiOp and the BA conclude that there is insufficient information to evaluate potential effects of the PA on stranding, the last paragraph in NMFS's discussion on stranding of juvenile steelhead in the American River reads:

> Modeled reservoir releases on the American River from Nimbus Dam indicate that there is a tendency for greater reductions in flow under the PA in certain months and water year types than

> under the NAA scenario. This has the potential to enhance the vulnerability to stranding of steelhead in the lower American River due to the PA.

NMFS does not provide any evidence for this statement and does not indicate which months and water year types have greater flow reductions under the PA.

NMFS In-Delta Operations Effects

2.5.1.2.5 North Delta Diversion Intake Screen Impingement and Entrainment

Entrainment: NMFS estimates that the maximum fork length for entrained juvenile Chinook salmon would be 29 mm based on a head width of 3 mm (p. 2 of <CWF Draft BO_section2.5.1.2_EffectsAnalysis_PartC_Operations Delta_for peer review.pdf>), although they did not explicitly describe how the 29-mm length was calculated. Subsequently (p. 5), they conclude that entrainment at the NDD would affect 0.5% of the juvenile population, based on 50% of individuals being exposed to a 1% entrainment rate—it is unclear how the 1% entrainment rate is derived, given that the percentage of the population small enough to be entrained is not provided in the NMFS analysis.
Impingement: NMFS used conservatively high injury (2.5%) and mortality (3.7%) rates for vertical bar fish screens from Columbia River dam studies, as provided in the literature review by ICF. This contrasted with the information provided in the BA, which noted that very low levels of impingement-related mortality had been observed in lab studies (Swanson et al. 2004). NMFS' assumptions for entrainment and impingement result in proportional take estimates of ~5–10% of juveniles, depending on the assumed percentage of fish passing near the NDD; the magnitude of these estimates is of concern.

2.5.1.2.6 Increased Predation Risk

Whereas the BA offered some quantitative perspective on the potential predation rates at the NDD and other in-water structures, the Draft BiOp sections provide only a qualitative discussion and acknowledge the importance of research and monitoring. The discussion for the HOR gate generally concludes that the gate will exacerbate the existing predation problem; acknowledgement of the potential beneficial effects of the HOR gate is limited (and is provided in the operations section).

2.5.1.2.7 Reduced In-Delta Flows

2.5.1.2.7.1 Travel Time and 2.5.1.2.7.2 Outmigration Routing

These analyses relies on the BA's detailed assessment of DSM2-HYDRO outputs, as well as new analysis by Perry et al. (Perry et al. CWF fish routing report 05Jul2016.pdf). The analyses are generally consistent with those presented in the BA, with NMFS' interpretation of results being important. In particular, the discussion on p. 31 notes (emphasis added): 'Another way to describe differences under Level 1 operations compared to Level 2 and 3 is that *Level 1 needs the least real time management and comes closest to meeting the prescribed Bypass criteria as actually written. Until a real time flow reversal monitoring plan is in place and tested the most conservative protection would be to remain at Level 1 during winter-run's historic migration window, November through April. Under the proposed action real time monitoring is designed to maximize exports by moving to Level 2 and Level 3 diversion amounts when listed fish are not detected in monitoring sites*. Therefore, it is important that a monitoring system is adequate to detect low abundance species if presence is a trigger for operational changes. Statistical analysis on what kind of robust monitoring detection system would be needed to detect movement of individual winter-run into and out of the Delta should be pursued. *Using several detection methods such as, flow as a surrogate, historical presence/absence as well as real time sampling would provide a more thorough real time management program to ensure protection during the entire winter-run rearing and out-migration period.*' NMFS' conclusion on p.32 is not inconsistent with the BA in stating 'the reduction in flow and related increase in travel time in the North Delta would adversely affect a high proportion of outmigrating winter-run Chinook salmon'. It is notable that although NMFS acknowledges the importance of real-time management for minimizing adverse effects, there is no acknowledgement of the potential effects of the proposed nonphysical barrier for reducing entry into Georgiana Slough.

2.5.1.2.7.3 South Delta Salvage and Entrainment

The analysis contained in this section is consistent with that presented in the BA; there are no notable differences.

2.5.1.2.7.4 Delta Survival

The analysis in this section includes the BA's Delta Passage Model (DPM) and a new analysis based on Perry (2017; <Summary of methods for Cal WaterFix survival analysis (21Dec2016).pdf>). Although NMFS notes that the Perry (2017) method supersedes the analysis based on Perry (2010) that was presented in the BA, the former actually is considerably more advanced than the latter. Indeed, the Perry (2017) analysis is more akin to the DPM in considering survival through multiple pathways explicitly; the main difference is that the DPM uses flow covariates specific to each reach within the model and includes migration through the Yolo Bypass, whereas Perry (2017) has reach-specific survival based only on flows

downstream of the NDD and does not include the Yolo Bypass. The Perry (2017) method would benefit from clarification regarding whether additional covariates were explored to improve model fit (e.g., south Delta exports for survival in reach 8) and how well the model predicts the empirical data (e.g., from area under receiver operator characteristic function). Additionally, the method should include an indication of the variability around the mean estimates, e.g., 95% credible intervals for the middle and bottom panels of the plot on p.60.

Presentation of results from the Perry (2017) method also would benefit from inclusion of relative percentage change in survival in order to compare to DPM results, and because the emphasis of differences in scenarios should always be on relative changes. Without the relative percentage change being described, it is challenging to ascertain how the results compare to those presented in the BA. For the DPM results, NMFS (p. 59) stated: 'Overall, the absolute mean reduction in survival is 1% to 2% for the PA, resulting in a relative survival reduction of 2-7% depending on water year type (Table 5.4-13). This is a notable survival reduction for an endangered species, especially if it occurs on a frequent (e.g., annual) basis.' The median absolute percentage survival reduction for the Perry (2017) method was 0.7–4% in December–June, which suggests that these differences would also be considered notable by NMFS.

2.5.1.2.7.5 Life Cycle Models

The draft BiOp section for life cycle models discusses IOS results from the BA with relatively little interpretation and no consideration of model uncertainty, which was discussed in the BA. There is no discussion of the OBAN life cycle model results from the BA.

NMFS conducted analysis with the Sacramento River Winter-run Chinook Salmon Life Cycle Model (WRLCM), with appropriate emphasis placed on the relative comparison of scenarios as opposed to absolute predictions. Detailed methods were not provided for review, but it is notable that NMFS explored several variations of scenarios to account for differences in initial abundance, hydrology (i.e., rearrangement of the 1922–2003 sequence so that drought occurs later), and NDD mortality (Table 1, from p.81).

CWF Alternative (PA, NAA) Comparison	Initial Abundance	Hydrology	NDD near - field mortality	Rationale
Scenario 1	10,000	Standard	5%	original scenario run
Scenario 1A	20,000	Standard	5%	explore resiliency of larger population
Scenario 1B	10,000	Revised	5%	test more favorable starting hydrology sequence
Scenario 2	5,000	Revised	5%	explore smaller population under revised hydrology
Scenario 2A	5,000	Revised	0%	explore smaller population, revised hydrology and no near field mortality
Scenario 2B	5,000	Revised	3%	explore smaller population, revised hydrology and 3% near field mortality.

Table 1. Description of modeling scenarios analyzed.

The results from the WRLCM suggested that even for the scenario with the least difference between NAA and PA, spawner abundance generally would be considerably less under the PA, even accounting for parameter uncertainty (Figure 1, from p. 83). This difference was driven by changes in survival in the lower Sacramento River rather than in the Delta, although the spatial location of these and the other reaches of the model were not explicitly provided. Explanations of differences focused only on smolts, with no discussion of how PA operations affected fry rearing habitat; presumably the latter was also of importance. The WRLCM represents through-Delta survival with enhanced particle tracking modeling (ePTM). A 2015 review of ePTM noted (p.37 of Anderson et al. 2015): 'The current model is not useful for making water operations decisions because of the poor fit to data, biologically implausibility of some model coefficients, the immeasurability of other model coefficients and questionable interpretation of the relationship between fish movement and survival. Nonetheless, the Panel strongly encourages the continued development, calibration and validation of the model and believes that it eventually can be useful for assisting in real-time decisions on river/Delta operations.'

It would be useful to summarize how the current ePTM used in the draft CWF BiOp addresses these shortcomings and, if appropriate, to provide comparison with the estimates of through-Delta survival from the Perry (2017) method. This seems particularly important because the ePTM absolute estimates of survival are very low compared to the estimates from Perry (2017) and it is important to provide context for how the ePTM estimates were derived.

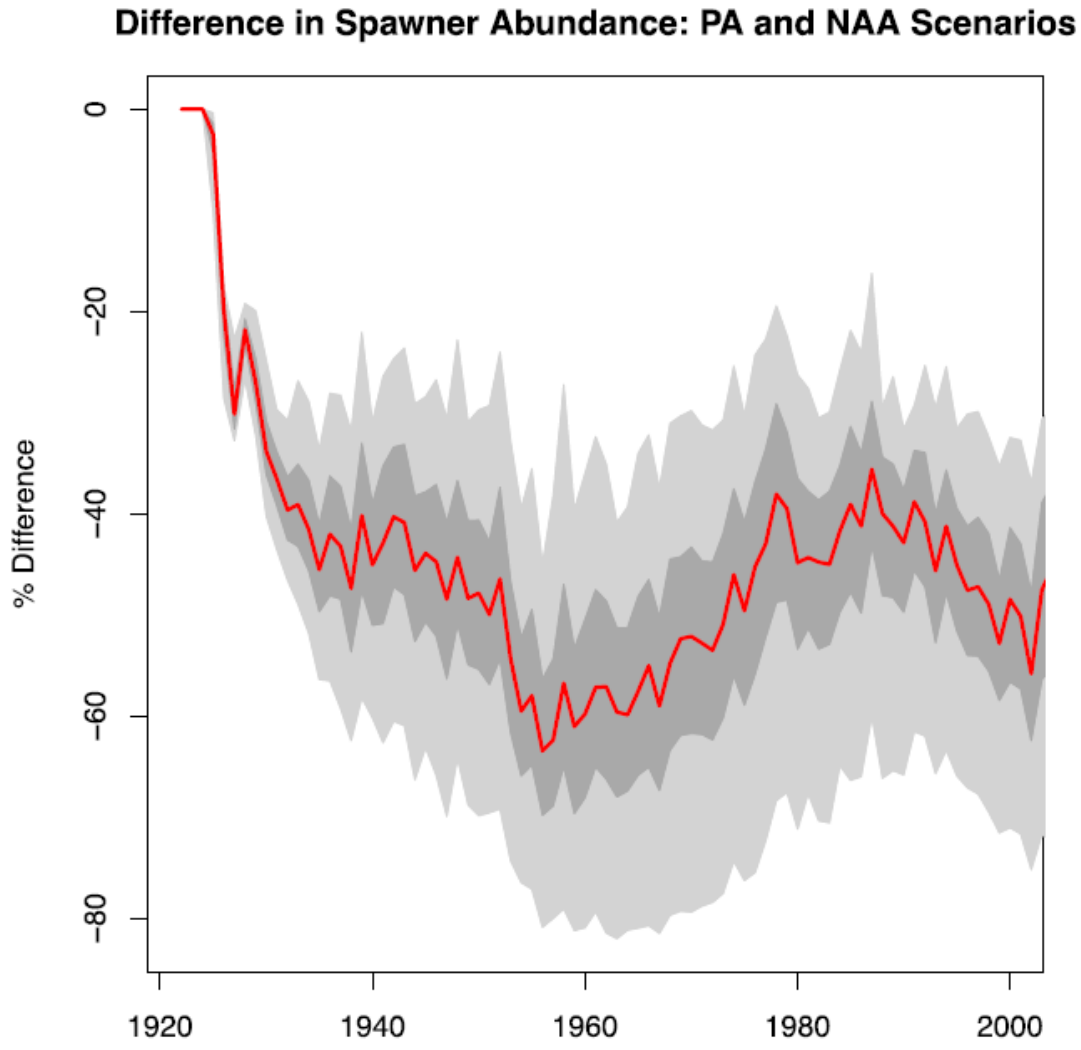

Figure 1. Difference in Scenario 2A abundance (PA – NAA)/NAA X 100% rate for 1000 paired runs of the LCM incorporating parameter uncertainty and ocean variability (NDD = 0, Initial = 5,000, hydrology altered). Median (red line), 50% interval (dark grey) and 95% interval (light gray) are depicted.

NMFS Critical Habitat (*2.5.2 Effects of the Action to Critical Habitat*)

The draft critical habitat analysis draws on the effects analysis described in *2.5.1 Effects of the Action to Species*, with additional qualitative discussion. The draft summary of effects concludes that winter-run Chinook salmon critical habitat will be highly impacted by the PA, whereas spring-run Chinook, Central Valley steelhead, and green sturgeon will be moderately impacted by the PA. The draft analysis does not indicate what these qualitative terms mean. The greater effect to winter-run Chinook salmon relative to the other species is judged based in part on the species' main critical habitat being on the Sacramento River alone, for which NMFS considers there to be the potential for negative effects in the Delta as well as in upstream areas, while the

other species have additional critical habitat in streams not expected to be affected by the PA. The conclusions in this section regarding upstream impacts on critical habitat of all three species are inconsistent with the conclusions in Section 5.4.2.1.5 *Effects of the Action on Designated and Proposed Critical Habitat* in the BA. The BA states that adverse effects, if any, of the PA on critical habitat of all four species in both the Sacramento and American Rivers, would be small to negligible. As detailed above in comparing the conclusions regarding effects of the PA on upstream habitat found in the Draft BiOp with those found in the BA, there are many similarities, but also some important differences. The differences primarily stem from two differences in the treatment of modeling results:

- In the BA, most differences in results between the PA and the NAA that exceed predefined thresholds indicating a potential impact were attributed to CalSim modeling artifacts or the inability to include real-time operations management effects, and were thereby discounted, whereas in the Draft BiOp results that indicated potential impacts were treated as modeling artifacts in only a couple of instances.
- The Draft BiOp, but not the BA (including the EFH), identified many of the water temperature results for steelhead and fall-run Chinook salmon as indicating a potential impact of the PA because they exceeded threshold temperatures, irrespective of the results for the NAA. The BA consistently evaluated effects of the PA with respect to differences from the NAA.

Review of the USFWS Draft Partial Biological Opinion (Delta Smelt)

The USFWS partial draft BiOp in large part draws on the CWF BA for its effects analyses, which are described in Section 9.2.2 *Effects to Delta Smelt from the Proposed Action*. The two main exceptions (listed in order of importance) are:

1. Changes in Delta outflow, captured primarily in the *Salinity* section of 9.2.2.2.8 *Effects to Habitat* (starting p. 238) and the *PCE 4 – Salinity* section of *9.2.3.3.3 Rearing Habitat* (starting p. 268)
    a. The main analysis focuses on the % of years in which X2 is greater than 84 km, which is taken to be an indicator of the low salinity zone being entirely upstream of Suisun Bay: this showed that the low salinity zone is consistently predicted to move upstream of current conditions (meaning the NAA) in July–September, e.g., August X2 greater than 84 km in 94% of modeled years for PA compared to 71% under NAA
    b. In contrast, the BA assessed the % of years in which X2 is within Suisun Bay (≤ 74.1 km), based on an interpretation of the language contained in the USFWS definition of critical habitat for the species: there was no difference between PA and NAA in July–November

c. Note that per Brown et al. (2014: Figure 13), X2 of *≥ 85 km* would actually be the cutoff for the low salinity zone being upstream of Suisun Bay, although examining the CalSim data for exceedance of this specific value probably would be unlikely to change the USFWS conclusion
d. It would be helpful to calculate the acreage difference in low salinity zone habitat in order to inform what the differences in X2 mean
e. In addition, USFWS used DSM2-QUAL data for assessing changes in salinity in Montezuma Slough, and found general increases in the % of years for which salinity was greater than the preferred range (0.5–6 ppt) under the PA
    i. This analysis would benefit from explicitly stating which conversion between electrical conductivity (EC) and salinity was used, as the DSM2-QUAL modeling is based on EC
    ii. In addition, the analysis appears to rely on summary tables in the BA (e.g., Table 5.B.5-27), when continuous exceedance plots are also available (e.g., Figure 5.B.5-28-7) and would be informative to provide finer resolution to the differences

2. Operations of the Freeport Intake Facility (*9.2.2.2.7.2 Freeport Intake Facility*, p. 237)
    a. Although this facility was not considered in the BA, the partial draft BiOp concludes that entrainment would be similar between NAA and PA

Table 9.2.3-1 provides a concise summary of effects to critical habitat by life stage. This emphasizes the USFWS's position with respect to the potential for restricted access to spawning habitat upstream of the NDD (as acknowledged to be a possibility in the BA, with proposed mitigation that USFWS acknowledges) and lower outflow affecting rearing habitat in the low salinity zone.

Table 9.2.3-1. Effects of the PA on critical habitat by life stage. (Type of effect indicated by cell color: yellow (neutral), and red (negative), brown (mixed effects), grey (not applicable)).

Life stage	*PCE 1: Physical habitat*	*PCE 2: Water [quality]*	*PCE 3: River flow*	*PCE 4: Salinity [LSZ]*
Migrating adults	Restricted access to the Sacramento River above the NDD	No substantive effect.	Improved SJR flows during winter migration improved spawning cues and improved flows reduce entrainment risk. Disruption of migration flows past NDD.	No change in effect.
Spawning adults	Partial to full migration barrier along Sacramento River, small habitat loss from barge landings and HORG; mitigation will reduce effects.	No substantive effect.		No change in effect.
Dispersing larvae and juveniles		No substantive effect.	Improved SJR flows during spring/early summer larval transport out of SJR. Disruption of transport flows past the NDD.	No change in effect.
Rearing larvae and juveniles	No substantive effect on water depths.	Elevated selenium load from SJR, small potential increase in *Microcystis* bloom intensity, potential for elevated zooplankton production; small effect on estuary turbidity.	Lower outflow will increase salinity and limit extent/suitability of western parts of critical habitat and move the LSZ upstream.	Lower outflow will increase salinity and limit extent/suitability of western parts of critical habitat and move the LSZ upstream.

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