Memorandum

TO: Maria Rea

FROM: Steve Lindley

CC: Cathy Marcinkevage, Rachel Johnson

DATE: 15 April 2019

SUBJECT: Review of ROC LTO Analytical Approach (received 19 March)

I reviewed an early draft of Section 2.1 of the ROC LTO Biological Opinion (file CWF_2.1_An_App_ROC_Markup_V4.docx, provided on 19 March 2019), which lays out the analytical approach used to determine how the Proposed Action (PA) described in the ROC LTO Biological Assessment would affected listed species and their critical habitat. My review was done with three questions in mind:

- Is the analytical approach based on a clear conceptual framework?
- Is the analytical approach likely to capture the important effects of the PA and can it synthesize them to support a jeopardy or adverse effect determination?
- Is it clear how the results of the analysis will be translated into the jeopardy or adverse effect determination?

The proposed analytical approach is well supported by a solid conceptual framework, based on best available science, including McElhany et al.'s 2001 Viable Salmonid Population framework, the Central Valley Technical Recovery Team's viability assessment framework for Central Valley salmonids (Lindley et al 2007), conceptual models developed by interagency science teams (DRERIP and MAST models), and for winter-run Chinook salmon, a variety of life-stage-specific models and a full life cycle model developed for quantitative assessments of water project operations and habitat modification impacts (Hendrix et al 2014). The conceptual models for conducting the analysis laid out in Figures 2-1 and 2-2 clearly illustrate how various information and data sources link together with analyses to connect the description of the PA to the jeopardy and adverse modification determinations. We recommend that the section include further description of the process to identify the environmental stressors, and offer that the existing DRERIP and MAST models could contribute to that.

I also feel that the analytical framework will produce a comprehensive view of the impacts of the PA on listed species. In the case of winter Chinook, where a full life cycle model is available that captures many if not all of the potential impacts, it will be possible to make a quantitative statement on the magnitude of impacts on VSP parameters of the PA relative to the environmental baseline. For other species, the assessments will be limited to a more qualitative assessment (i.e., the PA is expected to improve/degrade conditions slightly/substantially) based on expert judgement of the balance of evidence.

Finally, Table 2.2 shows clearly how the assessment of the effects and the weight of evidence for them will be used to determine whether there is an adverse effect or jeopardy. This is commendable, but I would note that step E, while conceptually straightforward, will require care in implementation. The difficulty arises from the nonlinearity of extinction risk as a function of its drivers, which include population size, population growth rate at low population size, and the variability of population growth. Over a range of values for these parameters associated with highly viable populations, extinction risk is insensitive to modest changes in the parameters. As the baseline condition of the population declines, at some point small changes in parameter values can drastically change the viability of the population, such that even fairly small changes in individual fitness can significantly reduce viability. The problem is that we don't know where most populations are in this parameter space, especially along the productivity dimension (this is why it is a good idea to use population models for relative comparisons rather than for absolute extinction risk estimation). I recommend that the analysis embrace the use of the principle of institutionalized caution, as defined in the analytical approach document, providing deference to the species in considering the uncertainty of the results and deciding whether a predicted negative change in individual fitness will reduce the viability of the population.

With regard to step F, the viability of a species can be sensitive to changes in the viability of a single population when the viability of other populations are low, or there are few or no other populations. Conversely, the viability of a species may be practically insensitive to loss of one population when there are many other reasonably viable populations. We generally have a much better idea of whether the species is in a condition where changes in the viability of one of its populations is likely to have an impact on species viability. Therefore this step is more straightforward with respect to implementation and determination of the effect on viability of the species.