MEMO

Date: 26 January 2014

From: Steve Cramer – Cramer Fish Science (Fisheries Consultant to Applicant)
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To: FERC Project No. 12496 – Lassen Lodge Hydroelectric Project

Re: FERC requested Sedimentation and Water Temperature Model Study plans confirmation

The project team has reviewed the NMFS Jan. 21, 2015 comments on the Sedimentation and Water Temperature Model Study plans and offers the following comments for consideration by FERC before issuing final confirmation of the Lassen Lodge Hydroelectric Project (LLHP) Sedimentation and Water Temperature Model Study plans:

The project team has carefully considered the comments that NMFS has offered both in written form and verbal discussions on each element of the Lassen Lodge Hydro Project. Our fundamental approach for this project has been to develop a suite of analytical approaches designed to provide reliable and efficient estimation of LLHP effects on stream habitat and aquatic organisms in South Fork Battle Creek. The physical setting of the LLHP project area is best described as a remarkably steep, boulder-filled stream channel, residing within a narrow canyon. Given this uncommon physical setting, the short time lines for completing the licensing process (for the project to be economically viable by being able to take advantage of time limited Federal Tax Credits and associated California CPUC RPS driven PPA), and the desire to make use of the best available data, we have found that analytical tools best suited for these three modeling efforts in process - sediment transport, stream temperature, and fish production – are distinct from one another. The customized approaches we recommend should provide predictions of similar reliability to those of traditional tools, such as HEC-RAS. Ultimately, models are basically tools to inform decision-makers in assessing potential impacts and balancing uses, and that is the approach followed herein.

The plans we describe here to address the concerns expressed by NMFS for temperature and fish modeling will also produce data to test whether the models are delivering suitable accuracy in their predictions. Because NMFS has no additional comments in addition to those already provided on the Sediment Transport Model Plan, that analysis is only briefly discussed.

Water Temperature

The WT3 model, although unfamiliar to NMFS, has several advantages over a more traditional HEC-RES model for water temperature. While HEC-RAS is a proven, robust, industry standard model for analyzing one-dimensional steady and unsteady flow, sediment transport and bed

computations, the model is relatively new to the water temperature analysis realm. Few HEC-RAS water temperature applications have been completed to date (e.g., Stonewall and Buccola 2015, Abadie 2013, Dhakal *et. al.* 2012, Drake *et. al.* 2010). Our project team is familiar with HEC-RAS, as well as the HEC-RAS temperature modeling approach and believes that this is an invaluable addition to the modeling community and a useful tool. However, implementing this model for the short project reach where data collection is challenging, and bed conduction and riparian/topographic shading are potentially important attributes, would be a difficult, expensive, and resource intensive application. Further, review of the available literature suggests that there is no guarantee that the use of such HEC-RAS model results would be an improvement over the scientifically sound W3T approach. While simpler in some ways, the steady flow, W3T model incorporates a full heat budget, as well as bed conduction, and topographic and riparian shade, attributes that are currently under consideration for inclusion in the HEC-RAS temperature model.

Regarding model resolution, W3T was developed under a Natural Resources Conservation Service Conservation Innovation Grant to assess flow transactions to assess temperature changes associated with small changes in flow. The model has been applied to several flow transactions that range from less than 1 cfs to over 20 cfs. While we have not fully completed the development of the project specific model for LLHP and tested it through all potential conditions, the team believes that the W3T approach will provide sufficient resolution to address questions associated with the LLHP project. Additionally, the other resource agencies involved with the project have either approved the use of the WT3 method (SWRCB and CDFW) or have provided no comments for modification (USFWS) in response to consultation.

As summarized in the memo of the Jan. 13 and 14, 2015 teleconferences between NMFS, Tetra Tech and Watercourse Engineering, due to the unfamiliarity of the WT3 by the NMFS review team, the Applicant's consulting team has offered to walk through the WT3 modeling calibration with NMFS to familiarize them with the use of the WT3 model and the South Fork Battle Creek application. And, in gaining familiarity with the use of this tool, the parties will have another tool in their toolbox for the potential use to study conditions such as presented in this proposed project.

Fisheries Modeling

Both NMFS and CDFW expressed concern at the January 8, 2015 meeting that the approach reported in the FLA to model the capacity for fish production as a function of flow might have unacceptable error due to two assumptions. The first of these assumptions was that changes in depth, width, and velocity as flows increased could be reliably estimated based on the ratio of those dimensions at one low flow to one high flow. In particular, the accuracy of dimensions at the high flow were of concern, because they were estimated from discernable markings on the side of the channel. The second assumption was that variation in channel dimensions might vary widely within a channel unit and not be well represented by the dimensions measured at one "representative" cross section in a channel unit.

The applicant's consulting team is planning additional studies to re-survey transects within the bypass reach that will enable testing of whether the assumptions under concern are reliable. In order to test whether the ratio of channel dimensions at one low and one high flow is reliable, channel dimensions will be re-surveyed in a subsample of channel units in the bypass reach. These measurements will be completed at a minimum of one additional flow in the range of 30 to 100 cfs (the previous survey was completed at 13cfs). If results of the one re-survey are unconvincing, a second re-survey would be planned. In response to NMFS stated concerns that only one cross-section was measured in each of the 54 channel units below Angel Falls, the additional studies to be proposed by the consulting team will measure three (3) cross-sections per channel unit to evaluate variance in channel dimensions within units, and compare it to variance in dimensions between units (e.g. pools, riffles, rapids). Our project team selected the approach described in the FLA based on their judgment from site reconnaissance that variance between units was greater than within units. For that reason, the original sampling approach was expected to provide greater statistical reliability than the traditional approach of measuring multiple transects within a subsample of units, and then assigning those results to the unmeasured majority of units. The new re-survey will test whether variances are greater within or between channel units, and whether change in channel dimensions between different flows under 100 cfs is reliably estimated using the active channel dimensions as described in the FLA.

Units to be re-surveyed will be selected for safe access and to represent a range of channel dimensions. The canyon of South Fork Battle Creek is very steep in the 1.7 mile reach between Angel Falls (RM 22.3) and the powerhouse/tailrace (RM 20.6), and safe access to and across the channel during winter is very limited. Portions of the creek that have been accessed by walking up the creek bed for the survey at13cfs cannot be safely accessed by walking up the creek bed at the desired flow range for the re-survey (30- 100 cfs) Safe access down to the creek from the road on the south side of the canyon, and along the stream banks on the south side is also very limited by steep terrain. There is no access from the north bank of the stream in any part of this reach.

Sediment Transport Study

The study approach to sediment transport has been consulted on with USFWS, approved as submitted and modified for comments by CDFW and the SWRCB, and commented on by NMFS. The Applicant has agreed to incorporate NMFS comments in the final Sediment Transport Repot. The fieldwork for the HEC-RAS modeling to support the Sediment Transport Study was undertaken in October 2014 in the areas of the project diversion/intake and powerhouse/tailrace areas. That work was specifically scheduled to be completed ahead of the larger late fall, winter and spring flows that would limit access to safely do this work until after the ramp-down of 2015 spring/early summer flows. Thus, necessary field data needed to complete the sediment transport study have already been obtained.

Citations

Abadie, B, 2013. Columbia River Treaty 2014/2024 Review: Iteration #2, Results Water Temperature Modeling HEC-RAS/WQ. SRT Meeting – February 28. (http://www.crt2014-2024review.gov/Files/HEC-Ras_WT_Results_SRT_28Feb2013.pdf).

Dhakal, A.S., E. Buckland, and S. McBain. 2012. Draft Technical Memorandum Overview of Methods, Models, and Results to Develop Unimpaired, Impaired, and Future Flow and temperature Estimates along Lower Alameda Creek for Hydrologic Years 1996-2009. Prepared for the Alameda Creek Fisheries Workgroup – Flows Subcommittee. April 24.

Drake, J. A. Bradford, and D. Joy. 2010. "Application of HEC-RAS 4.0 temperature model to estimate groundwater contributions to Swan Creek, Ontario, Canada." *Journal of Hydrology*. Volume 389, Issues 3–4, pp. 390–398.

Stonewall, A.J., and Buccola, N.L., 2015, Development of a HEC-RAS temperature model for the North Santiam River, northwestern Oregon: U.S. Geological Survey Open-File Report 2015-1006, 26 p., http://dx.doi.org/10.3133/ofr20151006.