Enclosure E
FWS-3
Large Woody Material and Sediment Transport Study
Submitted by U.S. Fish and Wildlife Service
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Introduction

The Service is requesting that the Licensee conduct a Large Woody Material (LWM) and Sediment Transport Study on the lower Bear River from Camp Far West Dam to the confluence with the Feather River as well as the Camp Far West Reservoir and Project area upstream of the reservoir.

The purpose of this study is to evaluate the effects of the Camp Far West Project (Project) on fluvial processes of the Bear River, which includes the amount and size of coarse substrate material and LWM that can be utilized by anadromous fish during their freshwater life stages in the Bear River, both upstream of the Project reservoir and downstream from the diversion dam to the confluence with the Feather River. A river's character and morphologic function are strongly influenced by the amount and timing of sediment and water provided to them, and any change to this continuum provokes a change in the river and the associated physical and biological processes it supports (Reid and Dunne 2003). Dams can affect channel morphology by trapping sediment, altering the frequency, timing and magnitude of peak flows, and by intercepting LWM (Grant et al. 2003). LWM plays an important role in streams by shaping channel morphology, storing sediment and organic matter, and providing nutrients and habitat for all life-stages of anadromous fish.

Camp Far West Dam, Reservoir, and associated diversion dam interrupt the downstream continuum of sediment and LWM transport by trapping upstream inputs of sediment and LWM. Project operations alter the timing, magnitude, and duration of peak flows, which are the flows responsible for transporting sediment and LWM as well as shaping channel morphology. Operation and maintenance of the Project therefore has the potential to affect fluvial processes, channel form, and associated anadromous fish habitat. This study seeks to quantify the magnitude of the Project's impacts on sediment and LWM supply and the resultant effects on anadromous salmonids.

Study Goals and Objectives

This study has two primary goals: (1) assess the potential geomorphic effect of reducing sediment and LWM supply to, and altering sediment transport capacity within, the lower Bear River, and (2) provide information required to assess potential anadromous fish habitat impacts of any changes to geomorphic processes in the lower Bear River resulting from Project facilities or operations.

Study goals will be met by completing the following specific objectives:

- Quantify miles of riparian habitat inundated by the Project reservoir
- Quantify LWM frequency and volume trapped on an annual basis by the Project reservoir.
- Quantify fine and course sediment volumes trapped on an annual basis by the Project reservoir.
- Survey the volume of mobile, coarse sediment and fine sediment stored in the active channel of the Lower Bear River.
- Survey the frequency and volume of LWM stored in the bankfull channel

The information collected will help the Licensee, the Service, and other relicensing participants to identify and implement measures to protect, mitigate, and/or minimize direct, indirect, and cumulative impacts to anadromous fish; enhance native anadromous fish resources, including related rearing and feeding, migration, spawning, riparian and benthic macro invertebrate habitats; protect anadromous fish from adverse fish hatchery operations and predation, and ensure coordination within and outside of the Project to minimize risk to anadromous fishes.

Resource Agency Management Goals
The USFWS has an active interest in the Bear River because we have been planning and implementing restoration actions in Dry Creek under the CVPIA Anadromous Fish Restoration Program (AFRP). Dry Creek is tributary to the Bear River, downstream of the Project, and it flows through the Spenceville Wildlife area and Beale Air Force Base. To address the decline of Chinook salmon and steelhead trout populations in California, the CVPIA calls for doubling of Chinook salmon (*Oncorhynchus tshawytscha*) runs. The studies and restoration actions that we are implementing are for both steelhead trout (*O. mykiss*) and Chinook salmon, and we are currently working on a habitat model for Dry Creek that will contribute to our understanding of the effect of the Project on salmonid restoration actions in Dry Creek. We are also funding a habitat analysis on Dry Creek and analyzing the restoration potential of enhanced fish passage on Dry Creek. These actions are consistent with the AFRP 2001 *Final Restoration Plan for the Anadromous Fish Restoration Program*, which is filed with the Commission.

The Project and its associated structures currently block upstream migration of anadromous salmonids and can alter the timing, duration, magnitude, and water temperature of the lower Bear River where the anadromous species and critical habitat occur. Low flows and high temperatures may result in a physical and thermal barrier to Dry Creek, preventing salmonid migration to and from AFRP restoration actions on Dry Creek.

The specific information obtained during this study will assist the Service, Licensee, and other Project relicensing participants in determining how Project operations and maintenance activities affect LWM and sediment in the lower Bear River. The results of this study and other Project relicensing studies will assist the Service, Licensee, and other Project relicensing participants in the collaborative development of Project Mitigation & Enhancement (PM&E) measures for LWM and sediment for the new FERC license.

Relevant Public Interest Considerations
The Service is a resource agency.

Existing Information and Need for Additional Information
Although the PAD indicated that SSWD completed habitat surveys, including identifying LWM, it does not include information on study methodology including information regarding selection of habitat sites and survey methodologies and how LWM was classified or surveyed. The Instream flow study proposed by South Sutter Water District (SSWD) contains a plan to collect LWM using similar guidelines. However, the instream flow study surveys two study sites. This is an insufficient number to characterize the entire lower Bear River. The operation of the Project reservoir affects the entire Bear River, and has done so since its construction in 1925. A complete study of the lower Bear River is required to accurately quantify the Project's past and current effect on sediment and LWM.

The Service does not have adequate information without the proposed study to determine the current Project affects to LWM and sediment in the lower Bear River.

Project Nexus

The primary Project facilities include the: (1) Camp Far West Dam and spillway; (2) Camp Far West Reservoir (impoundment); (3) 6.8 MW capacity Camp Far West powerhouse; (4) powerhouse afterbay; and (5) recreational facilities.

The Project contributes to Direct, Indirect, and Cumulative effects on the quantity of water in the lower Bear River and the amount of LWM and sediment that can pass through the Project dam. Operations and maintenance of the Project directly impacts the LWM and sediment in the lower Bear River.

Scientific studies evaluating the relationship between flows and how Project operations affect LWM and sediment in the lower Bear River must be conducted to provide federal and state resource agencies necessary information to develop license conditions, protection, mitigation, and enhancement measures that will protect the resources of this watershed and that are consistent with federal and state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by a project (§10(a)(2) of the Federal Power Act, 16 U.S.C. section 803(a)(2)(A)). Information from this specific new study would inform all parties of the Project's particular effects on LWM and sediment transport and provide information to enable all parties to evaluate whether beneficial uses of the lower Bear River are being protected.

Description of Study Methods and Analysis

Study Area

The study area includes the Bear River between water diversion pool/Project afterbay and the confluence with the Feather River as well as the Project reservoir and upstream to the Project boundary.

General Concepts

The following general concepts apply to this study:

- Personal safety is an important consideration of each fieldwork team. If Licensees determine the information cannot be collected in a safe manner, Licensees will notify FERC and the Service as soon as possible via email to discuss alternative approaches to perform the study.

- Licensee shall make a good faith effort to obtain permission to access private property where needed well in advance of performance of the study. If access is not granted or river access is not feasible or safe, Licensees will notify FERC and the Service as soon as possible via email to determine if the Service can assist in gaining access or to discuss alternative approaches to perform the study.

- Field crews may make minor modifications to the study proposal in the field to accommodate actual field conditions and unforeseen problems. If modifications are made,

Licensees will provide a detailed description of the conditions that led to the decision to modify the study to FERC and the Service as soon as possible via email.

- Licensees' performance of the study does not presume Licensees are responsible in whole or in part for resource management measures that may arise from that study.

Study Methods

The Licensee will:

- Quantify the amount of riparian habitat lost during construction of the original Camp Far West Dam and Diversion Dam. The Service recommends the Licensee utilize the methods described in the NMFS August 25, 2016 comment letter on the PAD.
- Measure or estimate the LWM that enters Camp Far West Reservoir and is not transported downstream to the lower Bear River. Any LWM that is supplied from the upper watershed to Camp Far West Reservoir is likely lost to downstream reaches where fluvially transported LWM would typically deposit in the lower gradient, less confined reaches and provide key habitat for anadromous fish. Although the PAD mentions that little to no LWM is found in the reservoir, no quantitative analysis is presented. Therefore, the frequency and volume of LWM trapped in Camp Far West Reservoir should be quantified using any aerial photographs as well as annual surveys throughout the licensing period. The annual surveys throughout the licensing period should document the length and diameter of LWM trapped in the reservoir, as this information is not likely to be available through historical data. Potential impacts of other land use activities, such as timber harvest, salvage logging, and road construction and upstream Dam construction that can alter LWM supply should also be assessed.
- Quantify fine and course sediment volumes trapped on an annual basis by the Camp Far West Reservoir.
- Survey the volume of mobile, coarse sediment and fine sediment stored in the active channel of the Lower Bear River.
- Conduct habitat mapping and characterization along the remaining length of the lower Bear River downstream of the Project Diversion Dam, starting with the reaches directly below the diversion dam downstream to the Pleasant Grove Rd. crossing and continuing as needed downstream. During the habitat surveys, qualitative information should be collected on sediment and LWM volume following the protocols included in the NMFS August 25, 2016 comment letter on the PAD.
- Quantify the frequency and volume of LWM stored in the lower Bear River and compare to available historical data to assess trends over time. The Service recommends using the parameters indicated in the NMFS August 25, 2016 comment letter on the PAD for inventorying LWM and identifying key pieces.

The Licensee will summarize and distribute results from this study to the Service and other interested Project relicensing participants no later than 3 months from the end of the data collection. Licensee will discuss the results from the survey at a Relicensing Project meeting within one month of issuance of the study report.

Consistency of Methodology with Generally Accepted Scientific Practices

The methodologies presented by the NMFS in their PAD comment letter include in each element references to specific methodologies consistent with generally accepted practices in the relevant

scientific community. This study is also consistent with the goals, objectives, and methods applied in recent FERC hydroelectric relicensing studies in California (e.g. McCloud-Pit Project FERC No. 2106 and South Feather Power Project FERC No. 2088 [SFWPA 2007] where sediment budget frameworks were used to assess Project effects to geomorphic processes by analyzing the mass balance between sediment supply and transport), and uses well recognized scientific methodologies and protocols from the NMFS, the Service, and CDFW.

Considerations of Level of Effort

As addressed above, existing information is not sufficient for developing protection, mitigation, and enhancement measures because the existing information does not specifically evaluate LWM and sediment transport and how Project operations and maintenance may affect their transport to the lower Bear River.

References Cited

Grant, G. E., J. C. Schmidt, and S. L. Lewis. 2003. A geological framework for interpreting downstream effects of dams on rivers. Pages 209-225 in J. E. O'Connor and G. E. Grant, editors. A peculiar river: geology, geomorphology, and hydrology of the Deschutes River, Oregon. Water Science and Application Series No. 7. American Geophysical Union, Washington, D. C.

Reid, L. M.; Dunne, T. 2003. Sediment budgets as an organizing framework in fluvial geomorphology. Ch. 16. In: Kondolf, G. M.; Piegay, H. (eds.). Tools in fluvial geomorphology. John Wiley & Sons