

STUDY DESCRIPTION FA-S2
FISH ENTRAINMENT RISK ASSESSMENT

Revised August 11, 2014

STUDY GOAL AND OBJECTIVE

The Bucks Creek Project (Project) Pre-Application Document (PAD) (November 2013) reviewed the existing, relevant, and reasonably available information associated with fish and aquatic resources and identified the following issues:

- FA-1 Condition of fisheries in Project reservoirs
- FA-2 Potential effect of entrainment at Project diversions and intakes on fish populations
- FA-3 Condition of Benthic Macroinvertebrate Communities in Project creeks
- FA-4 Effects of Project operations on common amphibian and aquatic reptile species
- FA-5 Effects of the Project on instream habitat in Project-affected streams
- FA-6 Potential spread of invasive mussels to Project reservoirs

Information required to address issues FA-1, FA-3, and FA-4 will be collected in studies FA-S1, FA-S3, and RTE-S1, respectively. The Licensees included information needed to address FA-5 and FA-6 within the PAD (see Sections 5.3.3–5.3.5 and 5.3.9, respectively), and anticipate no additional information will be necessary to assess the extent to which the Project affects instream habitat in Project-affected streams, or the potential spread of invasive mussels to Project reservoirs.

The goal of this study is to develop the essential additional information necessary to supplement the existing information to address issue FA-2.

To address the potential effect of entrainment at Project diversions and intakes on fish populations (issue FA-2), existing documents and drawings describing the physical conditions and operations of the (1) Bucks Lake intake structure for Lower Bucks Lake and (2) Bucks Creek Powerhouse intake structure (in Grizzly Forebay) will be located and examined. The information to be examined will include intake depth, intake dimensions, maximum intake diversion rates, and any existing information on approach velocities. A risk assessment of these two unscreened intake structures will be conducted to assess potential for fish entrainment into these Project facilities. The assessment will utilize fish population data to estimate the swimming speeds of fishes expected to occur near the Project intake structures. The swim speeds will be compared to the calculated intake approach velocities to assess the risk of entrainment and potential effects to the existing fish populations.

Additionally, the Licensees will sample the outlet to the Milk Ranch Creek Conduit if fish are captured in the perennial tributaries to the Milk Ranch Conduit (see FA-S5, *Stream Fish*

Population Study). The conduit empties into Lower Bucks Lake through an elevated pipe at the north end of the dam.

EXISTING INFORMATION

Entrainment studies of the Grizzly Powerhouse intake (which is screened) and Milk Ranch Conduit (which does not require screening [FERC 1993]) were completed as part of the Grizzly Development amendment (see PAD Section 5.3.6).

Project facility specifications document that the existing valve intake at Bucks Lake Dam and the Bucks Creek Powerhouse intake (within Grizzly Forebay) are both low elevation (i.e., deep) unscreened facilities. Fish entrainment is not believed to be an issue at these facilities due to the depth of the intakes (over 60 feet); however, an entrainment risk assessment has not been conducted.

No specific information currently exists related to fish population distribution around the intake structures, or entrainment through Project powerhouses. However, existing fisheries information for Bucks Lake is available (see PAD Section 5.3.2).

NEXUS BETWEEN PROJECT AND RESOURCE TO BE STUDIED AND HOW THE RESULTS WILL BE USED

Entrainment of fish at diversion structures and intakes can impact fish populations. The risk of entrainment is influenced by the depth of the intake, intake design, flow approach velocities, and other factors. The Project releases or diverts water at two unscreened impoundments capable of entraining fish; water is released from Bucks Lake into Lower Bucks Lake (via direct release), and diverted from Grizzly Forebay into Bucks Creek Powerhouse (via the Grizzly Forebay Tunnel). Project intakes would pose a risk of entrainment if fish occur near the intakes and the size and species of those fish have swim speeds below the average water velocities moving through the trash racks and into the intakes. Entrainment of fish at Project intakes has the potential to affect fish populations at Project reservoirs, since entrained fish cannot return to the reservoir.

The information obtained from this study will be used by the Licensees and resource agencies in combination with existing information to evaluate the effects of the Project's water diversions and impoundments on the local fish communities, and will be used to evaluate various management options when balancing resource uses.

STUDY AREA AND SITES

The study area includes ~~two~~ three unscreened Project intakes:

- Bucks Lake valve intake into Lower Bucks Lake
- Bucks Creek Powerhouse intake within Grizzly Forebay
- Milk Ranch Creek Conduit from Three Lakes

METHODS

Risk Assessment

The Licensees propose to assess the risk of entrainment by (1) using information on fish presence, vertical distribution, and size of fish in the vicinity of Project intakes (using information reported in the PAD Section 5.3.2, or to be collected as part of FA-S1 [*Reservoir Fish Species Composition*]), and (2) analyzing estimates of intake velocities relative to the swimming ability of the fish likely to be present.

The potential for entrainment at Project diversions will be analyzed using existing fishery data from Bucks Lake (See PAD Section 5.3.2) and data from Study FA-S1. Gill nets placed in the vicinity of intake structures at varying depths in Grizzly Forebay (Figure 1) will provide information of the vertical distribution of fishes relative to the depth of the intake structure. The vertical distribution of fishes will then be used to determine the likelihood of individual fish life stages being present near the intake structure. Approach velocities will be calculated for each diversion intake. The vulnerability of entrainment will then be assessed for each species and species life stage present based on the species distribution, fish size, and fish swimming ability relative to the intake approach velocities.

Incidental observations of species of interest will be documented on field data sheets or specific incidental species observation forms, and compiled into a single database of incidental observations that can be used as a reference for other studies and analyses.

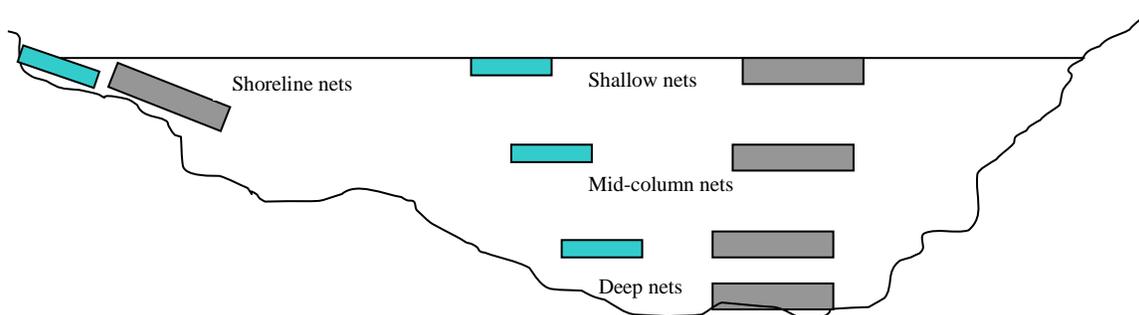


Figure 1 Conceptual net Placement near Intake Structures in Grizzly Forebay (Juvenile Nets in Blue, Adult Nets in Gray)

Milk Ranch Conduit Assessment

If fish are captured in the perennial tributaries to the Milk Ranch Conduit (see FA-S5, *Stream Fish Population Study*), the Milk Ranch Creek Conduit will be sampled for entrained fish at the elevated outlet pipe. Water exiting the conduit will be sampled using an appropriate net system, or similar device, where it empties into Lower Bucks Lake at the north end of the dam. The net will be set in place for one 48-hr sample period in each of three seasons (late spring, summer, early fall), and checked roughly every 12 hours at dawn and dusk to discriminate the time period when fish were captured (i.e., daytime versus nighttime). Captured fish will be held in a submerged enclosure at the base of the net. Fish data collected will include species identification, total length (TL, mm), fork length (FL, mm), weight (g), and notes on general condition. Fish will be released into the reservoir following processing.

To minimize the potential to spread of invasive species (e.g., New Zealand Mud Snail [NZMS], quagga/zebra mussel, Chytrid fungus), appropriate decontamination protocols will be followed prior to each aquatic-based field effort or moving between watersheds. Procedures may include, but not be limited to, freezing or soaking with a commercial 409 cleaner all field gear (including waders, boots, wetsuits) to kill NZMS, spraying equipment with a bleach and water solution to prevent spread of quagga/zebra mussel, and inspecting all field equipment (including boats).

ANALYSIS

Risk Assessment

The general location of intake structures relative to water depth and proximity to the shoreline will be described and compared to the expected distribution of fish species and life stages in the two reservoirs. An assessment of historical reservoir elevations will be included.

The Licensees will develop the relationship values associated with swim speeds, fish body length, and water chemistry, in collaboration with Project relicensing participants. Generally, a range of fish swim speeds will be calculated for fishes near the vicinity of the intakes using general sustained and burst speeds from Alexander (1967) and Clay (1961) in combination with the range of fish lengths measured in each study reservoir (from existing information identified in the PAD Section 5.3.2 and from FA-S1). A general rule of thumb is that a fish can sustain a speed equal to about four fish-lengths per second for long periods, and a speed of about ten fish-lengths per second for short bursts (Alexander 1967, Clay 1961). For example, a 3-in. fish (total length) would be capable of a sustained speed of about 1 foot per second (fps) and a burst speed of about 2.5 fps, while a 6-in. fish could sustain a speed of 2 fps and a burst speed of 5 fps.

The approach velocities at the intakes will be calculated based on historical diversion/release rates at each of the intake structures and the size of the intake opening. Finally, fish maximum swim speeds will be compared to intake velocities at a range of distances from the intake to assess the vulnerability of entrainment for each species and species life stage present.

Milk Ranch Conduit Assessment

In the event fish were documented in perennial tributaries to the Milk Ranch Conduit, fish data from the Milk Ranch Conduit outfall will be entered into an Excel spreadsheet for reduction, tabulation, and summary. Analyses will include quantifying and describing fish composition by life stage and by time period when fish were captured (i.e., daytime versus nighttime). Length-frequency histograms will be developed for all fish species observed. Fish data from the conduit will be compared to data from the stream and reservoir fish surveys, collected as part of FA-S1 and FA-S5 (Reservoir Fish Species Composition, and Stream Fish Population Study, respectively).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The analysis of entrainment is consistent with the approach used in other FERC relicensing projects in California. The risk analysis has been conducted on recent FERC relicensing projects including, the Sacramento Municipal Utility District's Upper American River Project, South Feather Water and Power Agency's South Feather Power Project, and PG&E's Spring-Gap Stanislaus, Chili Bar, and McCloud-Pit hydroelectric projects. Direct measurement of fish at an

outfall structure is a standard method for assessing fish entrainment/passage where conditions allow.

PRODUCTS

A summary of the information and findings will be included in the Application for New License, Exhibit E. A stand-alone Technical Memo will be produced with the methods and results of the study. Licensees will provide relevant data as appendices to the Technical Memo, and in electronic format upon request. Study results will be provided to the Relicensing Participants as soon as possible after the data are collected, tabulated, summarized, and checked for quality (i.e., Quality Assurance/Quality Control). The Licensee intends to have study results, to the degree complete, available in sufficient time to allow collaborative development of possible PM&E measures for inclusion in its Draft License Application. Study products may include a presentation to resource agency personnel and other relicensing participants. Any standard GIS shapefiles produced will be provided upon request; any custom formats or ancillary GIS data manipulation will be the responsibility of the party receiving the data.

RELATIONSHIP TO OTHER STUDIES

Data from this study will be combined with other studies for analysis, including studies FA-S1 (*Reservoir Fish Species Composition*), FA-S5 (*Stream Fish Population Study*), and WR-S2 (*Water Quality Assessment*).

SCHEDULE

The evaluation of entrainment at Project intakes will begin in fall 2014 with the collection of infrastructure information (i.e., construction diagrams) and calculation of approach velocities. The Milk Ranch Conduit outfall survey will be conducted in late spring, mid-summer, and early fall 2015, concurrent with the reservoir fish surveys and other field activities. Analysis of the ~~reservoir~~-fish population and water quality data will occur in fall 2015, following the reservoir fish, stream fish, and water quality surveys (FA-S1, FA-S5, and WR-S2, respectively). The study is scheduled to be completed by summer 2016.

LEVEL OF EFFORT AND COST

The preliminary estimated cost (2014 dollars) for the study subtotaled by major tasks is as follows:

Office Work	\$	<u>148,000</u>
Field Work	\$	<u>9,000</u>
Analysis.....	\$	<u>811,000</u>
Products.....	\$	16,000
Total (2014 dollars).....	\$	<u>5033,000</u>

REFERENCES

Alexander, R.M. 1967. Functional Design in Fishes. Hutchinson and Company, London.

Clay, C.H. 1961. Design of fishways and other fish facilities. Department of Fisheries of Canada, Ottawa. Cat. No. Fs 31-1961/1.

FERC (Federal Energy Regulatory Commission). 1993. Order approving recommendations for fish control and protection for Bucks Creek Project No. 619. (FERC Accession Number 19930901-3042). September 1.