Black Canyon Hydroelectric Project
FERC Project No. P-14110
Proposed Fisheries Study Plan
September 2012

Prepared for
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Table of Contents

List of Tables

1 INTRODUCTION

Black Canyon Hydro, LLC, (BCH) ultimately plans to file an application for an original license for the Black Canyon Hydroelectric Project (Project), FERC Project Number P-14110, and associated facilities on the North Fork Snoqualmie River (North Fork), approximately 4 miles northeast of North Bend in King County, Washington. The Project has a proposed generation capacity of 25 megawatts (MW) and would be located entirely on private lands.

The Project would consist of the following new facilities: 1) a 8-foot-high, 162.4-foot-long inflatable rubber diversion with associated fish passage and intake structures; (2) a variable pooling area behind the diversion with a normal water surface elevation of 971 feet above mean sea level and a maximum pooling of 2.83 acres; (3) a power conduit tunnel consisting of an approximately 450-foot-deep vertical tunnel into an approximately 8,300-foot-long, 12-foot-diameter horizontal tunnel and penstock connecting to; (4) a 60-foot-long, 100-foot-wide metal powerhouse with two Francis turbine units, one rated at 16 MW and the other rated at 9 MW; (5) a 200-foot-long, 24-foot-wide tailrace; (6) a 4.2-mile-long, 115-kilovolt overhead transmission line that transmits project power to the regional grid (transmission line would be an overbuild of an existing transmission line with only approximately 0.65 miles of new transmission); (7) a 0.75-mile-long and a 0.5-mile-long extension of two existing logging roads that lead to the project facilities; and (8) appurtenant facilities (switchyard, maintenance building, etc.).

The project would operate in run-of-river mode. The combined maximum hydraulic capacity of the two project turbines would be 900 cubic feet per second (cfs). The project would divert water from a 2.6-mile-section of the North Fork Snoqualmie River.

BCH filed a Notice of Intent (NOI) and the associated Pre-Application Document (PAD) to commence the FERC Integrated Licensing Process on March 27, 2012. In response to the subsequent study requests filed by FERC staff and other stakeholders and as detailed in 18 CFR 5.11, BCH is required to submit relevant resource study plans. This includes a study of fisheries within the Project reach which follows the requirements of 18 CFR 5.11(b)-(e).

2 STUDY DESCRIPTION AND OBJECTIVES

In accordance with 18 CFR §5.11(d)(1), this section describes the goals and objectives of the study and the information to be obtained.

The Fisheries Study is intended to document existing (baseline) conditions so that managers can decide what level of protection is required to preserve the ecological integrity of the North Fork. This study will interact with and inform other studies to determine the nature and degree of project impacts, and appropriate design and management measures that will avoid or mitigate undesirable project impacts. The specific objectives of the Fisheries Study are to estimate both relative and total abundance, age structure (based on length frequency distributions), diversity, spatial distribution (at local and reach scales), and habitat use by trout and other fishes in the 2.6-mi long Project (impact) reach, the 0.5-mi long (control) reaches immediately up- and downstream of the bypass reach.

Significantly, the specific objectives of this Fisheries Study will include many of the same elements as the Snoqualmie River Game Fish Enhancement Plan (Plan). The Plan was a comprehensive inventory and ecological study of the fishery resources in the upper Snoqualmie River watershed (although time constraints forced the field survey to avoid "Black Canyon"). The Plan was required as a FERC license requirement in 2004 when the Snoqualmie Falls Hydroelectric Project was relicensed. It was a four year study of the watershed developed in consultation with the Washington Department of Fish and Wildlife (WDFW), who then carried out the fisheries study from January 2008 to November 2011. The Plan included a range of primary fishery research topics including: habitat surveys and mapping, background environmental data monitoring, trout reproductive life history, age and growth studies, density and relative abundance, creel census, species distribution, trout movement, habitat enhancement, and public education.

Because data collection techniques used in BCH's Fisheries Study will be similar to those used to sample fish and habitat in other areas of the upper Snoqualmie River watershed, data collected in the two research efforts will be directly comparable and add greater certainty to study results. This comparison will help managers determine the uniqueness, sensitivity, and likely response of fish populations in the study area to changes in streamflow, sediment and wood load, water quality, fish passage (hydraulic) conditions, and other variables that may result from the construction and operation of the proposed project. It will also help pinpoint specific measures that can be implemented to avoid, reduce, or mitigate impacts that may be caused by the project.

3 STUDY AREA

The geographic area in which the Fisheries Study will be conducted includes the approximately 2.6-mile long Project (diversion) reach of the North Fork Snoqualmie River, and 0.5-mile sections of river immediately up- and downstream of the bypass reach (control reaches). The Project reach extends from the proposed intake structure (RM 5.1) downstream to the point where water will be discharged back into the river via the powerhouse tailrace channel (RM 2.5). Fish populations in the 0.5-mile sections of river above and below the Project reach will also be sampled and compared to fish populations sampled in the Project reach at the same time.

Since the Project will not alter the timing, frequency, or magnitude of flows downstream of the tailrace return, the potential for adverse effects on fish populations in downstream areas is expected to be minimal. Similarly, the Project will not alter flows upstream of the maximum pooling extent behind the diversion. This reality combined with the extensive, recent study completed by the WDFW of the greater watershed has shaped the proposed study area.

4 RESOURCE MANAGEMENT GOALS

In accordance with 18 CFR §5.11(d)(2), this section describes resources management goals of agencies or Indian tribes with jurisdiction over the resources to be studied.

Sections 4(e) and 10(a) of the FPA require that the Commission give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. As a result, describing the effects of project construction and operation on aquatic habitat is necessary to fulfill the Commission's responsibilities under NEPA. Ensuring that potential environmental measures associated with aquatic resources are analyzed is relevant to the Commission's public interest determination.

Additionally, the Northwest Power and Conservation Council has designated sections of the North Fork that includes the proposed Project reach as a "Protected Area." Portions of the North Fork have also been recommended to Congress by the US Forest Service (USFS) for inclusion in the national Wild and Scenic River system based on its outstanding recreation value and resident trout fishery (USFS 1990). The National Park Service has reviewed documents related to the Project and has offered guidance and comments to FERC regarding relevant resource management goals (NPS 2012).

Finally, the Washington State Department of Ecology (Ecology) recommends minimum instream flows for streams and rivers included in the Snohomish River Basin Instream Resources Protection Program (IRPP). These minimum instream flows are intended protect a range of instream values and prevent the over-appropriation of water for out-of-stream uses. The IRPP established minimum instream flows for the North Fork, as measured at USGS Gage 12143000, downstream of the Project tailrace, for specified dates during the year.

5 EXISTING INFORMATION

In accordance with 18 CFR §5.11(d)(3), this section describes existing information on fisheries at the Project, and the need for additional information.

5.1 Existing Fish Surveys

Fish populations and habitat in the Snoqualmie River Basin have been surveyed on several occasions over the past several decades; some of which have been summarized in the BCH Pre-Application Document (BCH 2012). Previous fish surveys by Ott Water Engineers and R.W. Beck and Associates in 1984 and 1985, respectively, indicated that rainbow trout and cutthroat trout were both present in the Project reach in relatively low densities (R.W. Beck and Associates 1985). From 2008-2010, the upper Snoqualmie River, including the mainstem North Fork and several of its tributaries, were surveyed by WDFW biologists as part of Puget Sound Energy's relicensing of the Snoqualmie Falls Hydroelectric Project (FERC No. 2493). The results of the survey included information on fish species composition, abundance, distribution, age, and life history data (WDFW 2011). Due to time and safety constraints, the WDFW survey did not include the Project reach; however, surveys completed upstream and downstream of Black Canyon confirmed that rainbow trout are the most abundant species of salmonids in the vicinity of the project (Thompson et al. 2011).

In August 2012, BCH began initial fisheries research to characterize fish populations and habitat in the study area. Using the same methods applied earlier by WDFW (Thompson et al. 2011) researchers, BCH biologists inventoried fish populations and habitat in the Project reach, and in up- and downstream control reaches.

5.2 Fish Habitat vs. Flow Simulations

In 1985, R.W. Beck and Associates conducted an instream flow study within the Project reach of the North Fork (R.W. Beck and Associates 1985). Weyerhaeuser was exploring

the feasibility of constructing a hydroelectric facility on the North Fork that was similar to the project being proposed by BCH. The purpose of the 1985 instream flow study was to simulate changes in habitat availability as a function of flow using the Instream Flow Incremental Methodology (IFIM; Milhous et al. 1984). IFIM is an instream flow decision-making tool that includes hydraulic (PHABSIM) and habitat (HABTAT) modeling components. In the 1985 study, water depth, water velocity, and substrate composition were measured at three flows (range 32 – 800 cfs) at 1 to 2 ft intervals along 14 transects within two study reaches in the Project reach. The study reaches were located near the upstream and downstream ends of the proposed Project reach, and sampled all but the steepest, most turbulent areas of the channel.

The IFG4 hydraulic simulation model was used to predict water depth and velocity at each sampling point for a range of flows. Habitat preference curves developed for different life stages of rainbow trout, which the researchers thought were the dominant fish species in the study area, were applied to the hydraulic output to quantify the amount and spatial distribution of weighted useable area (WUA, an index of habitat availability) for a range of flows within the two study reaches. The resulting WUA versus stream discharge curves were used to identify flows at which habitat was maximized for each life stage of both species. A habitat optimization matrix was constructed for each month of the year that defined the amount of WUA present for each life stage at flows 50, 60, 70, 80, and 90 percent monthly exceedence flows, which were calculated from historical streamflow records.

The 1985 IFIM study found that flows at which spawning and adult rainbow trout habitat was maximized (300 cfs and 225 cfs, respectively) were higher than those that maximized juvenile and fry rainbow trout habitat (l70 cfs and 50 cfs), when averaged across the two study sites. The WUA estimates and flow exceedence information were used to generate several instream flow scenarios for the North Fork, taking into consideration the timing and habitat requirements of different rainbow trout life stages.

5.3 Additional Information Needed

The additional information being gathered in this study plan is updated information on the timing and relative abundance of different fish species and other aquatic species in the North Fork. This information will be obtained through a literature review and the surveys proposed in this Fisheries Study Plan.

6 NEXUS TO PROJECT

In accordance with 18 CFR §5.11(d)(4), this section describes any nexus between Project operations and fisheries.

Small, run-of-the-river hydropower facilities that divert water from rivers and streams to generate power may alter the volume and timing of water flowing down the Project reach. This may have effects on fish and other aquatic organisms residing in that river reach. For example, previous studies have demonstrated that dams or weirs associated with small hydro systems can block or delay the migration or localized movements of fish. Poor design, insufficient flow, and lack of maintenance can reduce its effectiveness. Water diversion can also adversely affect fish in downstream areas by disrupting the downstream transport of sediment, wood, and other material to those areas (Kibler 2012). This Fisheries Study will provide data on both relative and total abundance, age structure, diversity, spatial distribution, and habitat use by trout and other fishes. Understanding what fish are present in the study area is necessary to inform other studies such as Instream Flows and Fish Passage and ultimately design a project that minimizes environmental impacts.

7 METHODS

In accordance with 18 CFR §5.11(d)(1) and §5.11(d)(5), this section provides a detailed description of the proposed study methodology, including data collection and analysis techniques, or objectively quantified information, sampling strategy, and a schedule including data collection and analysis techniques, or objectively quantified information, sampling strategy, and a schedule including appropriate field season(s) and the duration (see "Schedule" heading below for schedule).

The Fisheries Study is comprised of the following tasks:

7.1 Literature Review

As discussed above under the "Existing Information" section, there is a significant number of existing fisheries studies providing similar types of information that this Fisheries Study will gather. These resources will need to be reviewed, and existing data compiled, to allow for comparison and integration of results following the completion of the field surveys outlined in this study plan.

7.2 Investigate fish, fish habitat, and other aquatic resources in the study area.

Snorkeling will be used to quantitatively sample fish populations in the bypass and control reaches. A modified Hankin-Reeves (Hankin and Reeves 1988) visual estimation census will be performed in late summer of 2012 in the bypass/impact and non-bypass/control reaches within the study area. The approach entails systematic counts of fish by snorkelers within habitat units stratified by habitat unit type (pools, riffles, glides, and cascades; etc.) (Thompson et al. 2011).

Snorkeling was selected as the preferred sampling method for several reasons:

- It was the method used by Thompson et al. (2011) to sample other areas of the upper Snoqualmie Basin.
- It enables quantitative sampling of key attributes of individual fish, fish populations, fish communities, and distribution and use of associated habitats
- When stratified sampling is used, a relatively large number of habitat units can be sampled, thereby reducing errors in expansions of counts due to variation in fish densities between the sampled units.
- It is less time-consuming than most other techniques.
- Statistical techniques for analyzing and describing snorkeling data are well-developed
- It enables rapid collection of a large amount of data at relatively low cost
- It is well suited to sampling habitats with high water clarity
- It permits ready identification and enumeration of fish; salmonids in particular, due to their territorial nature.
- It is less likely to disturb the observed fish than do other sampling methods.
- It is particularly well-suited to remote, difficult-to-access locations like Black Canyon.

At least two highly experienced snorkelers and one highly experienced shore based data record/safety monitor will survey each habitat unit along the entire length of the study area. Survey will be conducted either in an upstream or downstream direction based on field reconnaissance. One snorkeler will wear a temperature logger while snorkeling to assess potential effects of water temperature on fish counts during the survey, and to profile longitudinal trends in temperature through the canyon. All survey crew members will be required to have previous experience in river safety, rope and extraction systems, and river snorkeling because the extremely confined and high gradient nature of the canyon may present some challenging circumstances.

When necessary, additional safety measures practiced during reconnaissance and surveys will include:

- Use of climbing harnesses, belay devices, pulleys, prusiks, etc. and high tensile strength static line for access, survey, and emergency extraction purposes
- Use of whitewater helmets, and elbow and knee pads while snorkeling
- Snorkeler harnesses attached to high tensile strength static rescue line toprohibit entrapment or recirculation and to limit extent of downstream drift while counting fish underwater
- Well-anchored static rope "grab line" set up at the base of each habitat unit where severe downstream hazards exist.

After conducting reconnaissance into the canyon, additional safety measures not identified here may be implemented for surveys.

Using fish count and habitat survey methods described by Thompson et al. (2011), snorkelers in drysuits will count all observed fish by species and length class, and habitat dimensions, substrate size composition, and large woody debris abundance (LWD) will be visually estimated. The number of snorkelers conducting the survey will be adjusted so that the entire wetted width of the North Fork channel will be covered. However, snorkelers will not count fish or estimate depth in habitat units where hazards or excessive turbulence prohibit accurate counts or measurements. Natural fish passage limitations or potential barriers and other geomorphic features will be documented and pictures will be taken throughout the surveys.

Density estimates will be obtained for units representing different habitat types in the impact and control study reaches. Following Hankin and Reeves (1988), electrofishing-based estimates will also be obtained for a subset of habitat units of each type, and used to calibrate visual counts obtained by snorkeling. The proportional area of the wetted stream surface area comprising different habitat types will be estimated, and visual counts will be expanded by habitat type to obtain absolute abundance estimates for the associated reach. This will result in an estimate of total fish abundance by species and size class in the study reaches.

Although the Project reach contains a diversity of fast water habitats, it exhibits a high degree of uniformity over its length in terms of flows, channel morphology, gradient, habitat composition, sediment characteristics, and abundance of large woody debris. Assuming that the uniform distribution of fish habitat is indicative of a uniform

distribution of fish, it may not be necessary to divide the Project reach into different strata in order to obtain a whole-reach abundance estimate. This assumption will be verified once habitat surveys have been completed and the variation in channel characteristics has been analyzed.

Fish populations will be sampled in areas located well outside the physical footprint of the project facilities. Project reach sampling will be conducted in the reaches where resident fish populations and habitat was sampled by R/W. Beck and Associates (1985) as part of an instream flow study. Hydraulic data collected in that study will be used to calibrate a refined hydraulic simulation model, which when combined with habitat preference curves for target species and life stages, will be used to predict habitat availability as a function of flow in the Project reach (see the Instream Flows Study Plan for more detail).

7.3 Technical Report

A final technical report will be submitted that details the results and implication of this study.

Specific products of the field survey include:

- Delineation of Habitats: Habitat unit types, including pools, riffles, glides, and cascades (Thompson et al. 2011), will be delineated and quantified throughout the canyon.
- Continuous Habitat Dimension Profiles: Longitudinal patterns in mean and maximum depths, wetted and active channel widths, dominant and subdominant substrates sizes, and LWD counts will be plotted with data collected recently by Thompson et al. (2011).
- Habitat Use by Fish: Habitat use will be assessed by unit type and statistical comparisons will be made. Scatter plots of fish counts by habitat type and reach will be smoothed and combined with data obtained previously in other North Fork Snoqualmie River segments by WDFW (2011). Habitat type frequency and dimensions will also be compared with previously collected data.
- Continuous Fish Abundance Profiles: Fish counts by species and functional size group will be plotted with data collected recently by Thompson et al. (2011).
- Fish Abundance and Age Structure Estimates: Mean fish density calculated from snorkeled units will be applied to non-surveyed units to estimate the total number of fish inhabiting the canyon.

- Results Comparison: additional fish and habitat surveys will be conducted upstream and downstream of the Project reach. These will serve as replicate surveys for comparison with results in Thompson et al. (2011), and those reported in historical studies of the North Fork Snoqualmie River.

8 PROGRESS REPORTING

In accordance with 18 CFR §5.11(b)(3), this section describes provisions for periodic progress reports, including the manner and extent to which information will be shared; and the time allotted for technical review of the analysis and results.

Study reports will be submitted as required by the FERC Integrated Licensing Process (ILP). The most recent schedule, issued by FERC in Appendix B of Scoping Document 1, includes a number of opportunities for progress reports, exchange of analysis and results between stakeholders, and information sharing. After proposed study plans are filed with FERC there will be a study plan meeting and comment period before a revised study plan is filed and a comment period passes. Once studies begin, the ILP also has deadlines for an Initial Study Report to be submitted, an Initial Study Report Meeting, and an Initial Study Report Meeting Summary. However, this schedule is subject to change by FERC staff and should not necessarily be relied upon. It is BCH's understanding that any changes to the ILP plan and schedule will be noticed by FERC staff.

9 SCHEDULE

In accordance with 18 CFR §5.11(b)(2), the schedule for conducting the study is provided in Table 1 below.

Field work will be conducted during July through October, 2012 and 2013 as necessary, as long as flow and visibility conditions permit. The schedule for conducting the Fisheries Study tasks is provided in Table 1 below. A draft Fisheries Study Report that describes the objectives, methods, results, and implications of this study will be written in the winter of 2012 and spring of 2013. A follow-up meeting can be held with the agencies, tribes, and other stakeholders to discuss the report if there is interest. Following revision of the draft report, a final report will be submitted to the stakeholders no later than January 31, 2014.

Table 1. Resource Study Schedule

Component	Completion Date*

Literature Review	February – March 2013
Sample fish populations and associated habitat in the study area.	August 2012 – August 2013
Compare data on fish populations and habitat in the bypass reach with data collected in other areas of the North Fork.	September 2012 – November 2013
Prepare Initial and Final Study Reports.	December 2013 – March 2014

*Dates based on schedule created and presented by FERC in Scoping Document 1 and subject to change.

10 LEVEL OF EFFORT AND COST

In accordance with 18 CFR §5.11(d)(6), the anticipated level of effort and cost are provided in Table 2 below.

The estimated cost of this work is approximately $42,500.

Table 2. Level of Effort and Cost

Task	Labor and Expenses
Literature Review	$3,000
Sample fish populations and associated habitat in the study area.	$30,000
Compare data on fish populations and habitat in the bypass reach with data collected in other areas of the North Fork.	$3,500
Prepare Initial and Final Study Reports.	$6,000
Total	$42,500

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12 APPENDIX A: Fisheries Study Area