Black Canyon Hydroelectric Project
FERC Project No. P-14110
Draft – Adaptive Management Plan
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1 EXECUTIVE SUMMARY

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, King County, Washington. As required by the Integrated Licensing Process of FERC, BCH conducted several studies to evaluate a wide range of potential impacts associated with the Project. BCH will incorporate the information provided by these studies into ongoing Project design and operations planning. While the studies will provide key information to guide these efforts, some uncertainty inevitably exists about potential Project impacts and the effectiveness of Project elements in adequately reducing Project impacts. To account for this uncertainty, monitoring of Project effects and a process for revising or adaptively managing Project operations can be implemented to enable the Project to achieve its ecological goals.

This first draft of an Adaptive Management Plan describes the monitoring and decision-making process that will be implemented to evaluate whether the Project is having unintended impacts and how to revise Project operations to address the impacts. The document is structured around the Management Goals that have been identified for the Project:

- Manage Project operations to minimize entrainment of fish species in the Project intake and stranding of fish in the diversion return channel.
- Avoid or minimize changes to sediment transport past the Project intake.
- Avoid or minimize changes to large woody debris (LWD) past the Project intake.
- Manage Project operations to avoid or minimize effects on habitats for resident fish, with a focus on rainbow trout and cutthroat trout.
- Manage Project operations to avoid changes in water level that potentially strand fish in the Project Reach or downstream of the tailrace.
- Manage Project operations to avoid or minimize negative effects, or enhance flow-dependent recreational opportunities in the Project Reach.

For each of these Management Goals, the monitoring elements to be implemented are briefly described, including the specific type of monitoring, the monitoring location(s), the timing, and the evaluation process. Through comments received to this draft Adaptive Management Plan and additional discussions, more specificity will be added to all steps of the framework.

2 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 generating capacity of 25-megawatts (MW) and would be located predominantly on private lands. The combined maximum hydraulic capacity of the four project turbines would be 900 cubic feet per second (cfs). The run-of-river Project would divert water from an approximately 2.7-mile-section of the North Fork.

As required by the Integrated Licensing Process of FERC, BCH conducted several studies to evaluate a wide range of potential impacts associated with the Project. BCH will incorporate the information provided by these studies into ongoing Project design and operations planning. BCH conducted an environmental flows study within the segment of the North Fork that would be affected by the proposed Project. This portion of the river, which extends from approximately river mile (RM) 5.3 to RM 2.6, is referred to as the Project Reach. This document presents the study results as part of the overall program of studies evaluating how flow-dependent resources may be affected by the Project operations and informing how Project goals can be achieved.

3 PROJECT DESIGN

3.1 Intake

The following description of intake features reflects an evolution in Project design since the filing of the Pre-Application Document (PAD) through scoping, stakeholder comment, and study results. As a result of completing relevant studies, two possible design alternatives have been developed for the intake. These Alternatives are called Alternative C and D. Both alternatives involve bulk water screening located at approximately RM 5.3, on the same river bend and point-bar as Alternative A. Alternative C uses a vertical plate screening system, and Alternative D uses a horizontal plate screening system.

Both alternatives would have a (1) control sill to control the normal water surface elevation and maintain a consistent river bed elevation for a side channel bulk-water intake. The control sill would consist of a concrete weir with boulders inset on the surface over top of a sheet pile cutoff wall to capture hyporheic flow. The sill would be at the newly established grade of the river bed and would allow uninterrupted flow through a natural looking re-profiled river as a roughened channel series of step pools, riffles, and boulder weirs. (2) An intake structure with a coarse trashrack, jib crane, and radial gate with sluiceway located on the east bank of the river. Diverted water would be conveyed through; (3) an open channel to a; (4) head gate control structure and into a; (5)

fish and debris screening structure. (6) Fish and debris would be screened and bypassed back into the river. Screened water would then flow through a power conduit to the underground powerhouse. (7) Access to the intake site would use an existing logging road and approximately 400 feet of new roadway extending to the intake site.

3.2 Powerhouse

The powerhouse location would be located underground beneath the selected intake site. This would include a (1) 450-feet tall, 30-foot diameter vertical shaft to allow space for the power penstock(s), elevator, stairs, ducting, mechanical, and electrical chases. Screened water from the intake screen system would be delivered down a (2) vertical power penstock(s) to the powerhouse. The powerhouse would (3) use four Pelton Turbines each rated at 6.25-MW, as well as appurtenant facilities. The (4) powerhouse substation and (5) elevator building would be located near the intake structure.

3.3 Tailrace

The tailrace will be an approximately (1) 8,600 foot long 12 foot diameter tunnel, and is anticipated to be constructed primarily in bedrock. The tailrace water return to the North Fork would be located at approximately the same location as proposed in the PAD at approximately river mile 2.6.

3.4 Transmission

Transmission would consist of a 34.5-kilovolt (kV) underground transmission line and overhead transmission that transmits project power to the regional grid. The transmission line would be sited predominantly on an existing power line corridor. The transmission line would originate at the powerhouse substation located at the intake site at RM 5.3. Subsurface transmission would follow the vertical shaft to the underground powerhouse, and down the 1.6 mile long tunnel. After exiting the tunnel the transmission would travel underground 1.0 miles on new and existing roads then 4.2 miles as 34.5- kV overhead transmission line predominantly following an existing power line corridor to the point of interconnection. The point of interconnection is located at an existing overhead transmission line near the intersection of 396th Drive SE and SE Reinig Road approximately 0.4 miles from the City of Snoqualmie. A new switch and substation would be added at the point of interconnection to transform voltage from 34.5-kV to 115-kV.

4 DESCRIPTION OF ADAPTIVE MANAGEMENT

Adaptive management is a structured framework that provides the process to use new information gained during implementation to revise Project operations, as necessary, to better achieve ecological Management Goals. In this way, adaptive management provides a process to monitor ecological responses to Project operations, evaluate whether unintended impacts are occurring, and adapt operations to address those impacts.

The development of the Project design and operations is based on the best information available, including information from other hydroelectric projects and river systems, as well as the data collected in the various studies conducted specifically for the Project. By applying this information, the potential impacts of the Project can be mitigated; however, due to the complexities of river systems, some uncertainty inevitably exists that the potential effects can be avoided or minimized as planned. By including adaptive management in the Project planning, a strategy for collecting more information to assess Project performance will be developed and incorporated into a decision-making process for making changes to the Project, as necessary.

Effective adaptive management plans clearly identify elements to be monitored, how they will be monitored, how the data will be evaluated, and the process by which decisions will be made for adjusting the Project to improve ecological performance. Figure 1 shows the steps involved with the planning, implementation, evaluation, and adjustment of Project operations. Adaptive management is an iterative process such that the cycle of monitoring, evaluation, and planning to adapt Project operations begins again after any earlier adjustments are implemented.

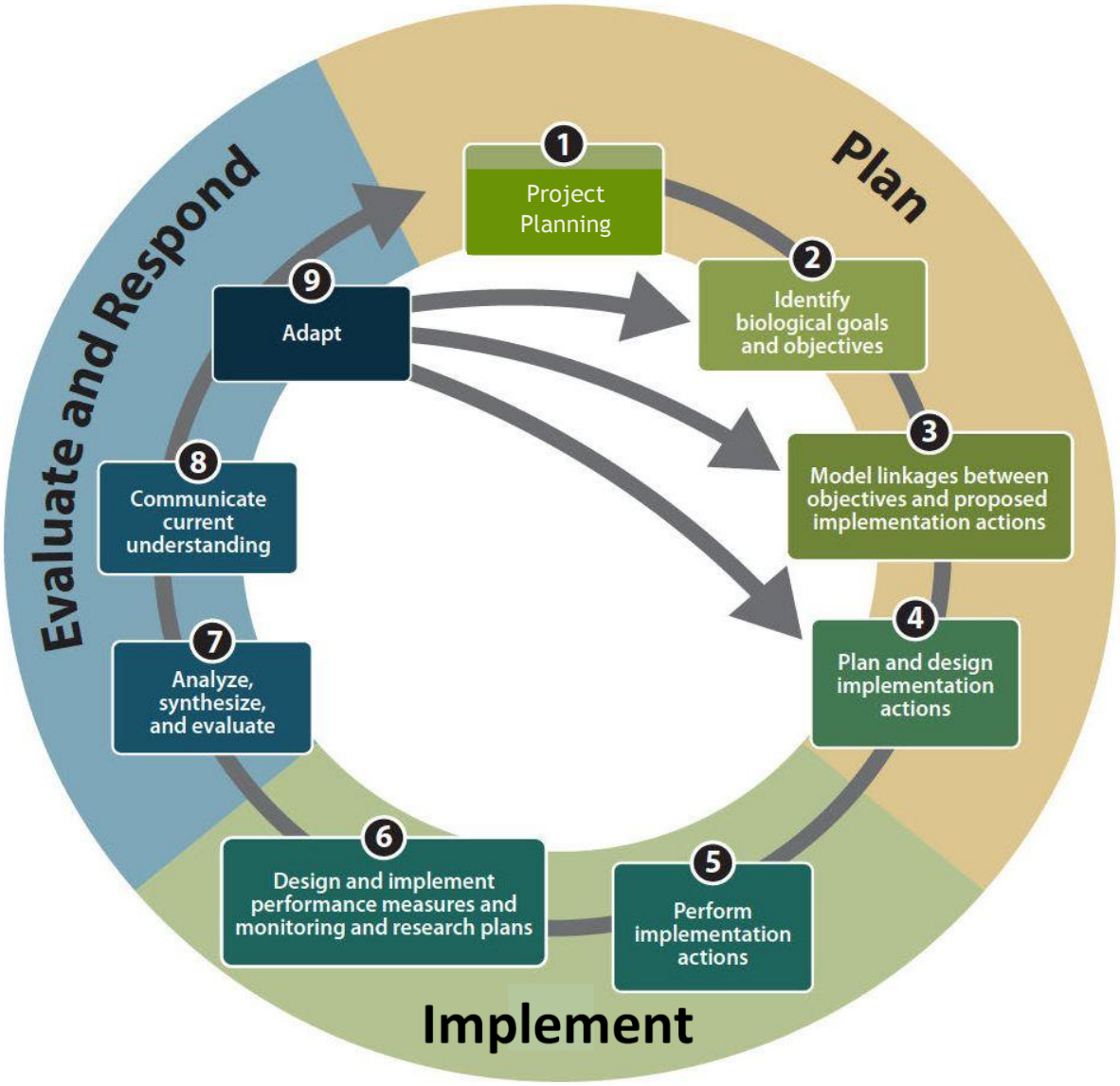

Figure 1. Steps in Adaptive Management

(revised from Delta Stewardship Council 2013)

5 MANAGEMENT GOALS

A draft Environmental Flows Management Plan has been prepared for the Project (BCH 2013). The Environmental Flows Management Plan identifies Management Goals to guide Project design and operational planning. The draft Management Goals have been updated below. The primary goal of the Project is to balance production of sustainable hydropower with conservation of ecological functions and recreational opportunities within the Project Reach. The following Management Goals for flow-dependent resources are identified that can be affected by Project structures or operations:

- Manage Project operations to minimize entrainment of fish species in the Project intake and stranding of fish in the diversion return channel.
- Avoid or minimize changes to sediment transport past the Project intake.
- Avoid or minimize changes to large woody debris (LWD) past the Project intake.
- Manage Project operations to avoid or minimize effects on habitats for resident fish, with a focus on rainbow trout and cutthroat trout.
- Manage Project operations to avoid changes in water level that potentially strand fish in the Project Reach or downstream of the tailrace.
- Manage Project operations to avoid or minimize negative effects, or enhance flow-dependent recreational opportunities in the Project Reach.

6 MONITORING AND EVALUATION OF MANAGEMENT GOALS

The Management Goals for the Project include consideration of ecological conditions from the upper end of the Project where flows are diverted, through the Project Reach, and downstream of the tailrace where full flow volumes occur in the river regardless of Project operations. The Management Goals focus on ecological processes, habitat availability, prey production, fish population structure, and the potential for physical injury to fish.

The fish species that are the target of these Management Goals are primarily rainbow trout and cutthroat trout because there are natural barriers below and in the Project Reach that restrict other fish from accessing these areas. Sculpin species are in the Project Reach. Sculpin are small, bottom oriented fish that use habitats differently than the trout species. Sculpin require aquatic habitat with interstitial spaces between substrates and clean moving water that delivers insect and zooplankton prey. It is believed that actions protective of the trout species will also be protective of sculpin. Downstream of the

Project Reach, mountain whitefish are present and are considered in Management Goals related to that portion of the river.

To evaluate the Project's performance in achieving the Management Goals, a monitoring program will be implemented. This section identifies the monitoring activities that will be conducted and how the data will be analyzed to assess whether the Project is achieving each goal. If necessary, the data will also be used to develop adjustments to improve Project performance.

In this draft, only the draft monitoring elements are identified. As the development of this plan proceeds, detail will be added to more fully describe each monitoring element, including how, when, and where data will be collected, as well as the evaluation approach to be used to determine if adjustments to Project operations are necessary to meet the Management Goals. When completed, the Adaptive Management Plan will serve as a monitoring handbook that can be referenced throughout the Project period.

6.1 Management Goal 1: Project design and operations will minimize entrainment of fish species in the Project intake and stranding of fish in the diversion return channel.

6.1.1 Potential Issue

Water diverted at the Project intake includes water that will flow into the Project facilities to generate power and water that will be redirected back to the Project Reach to safely return fish to the Project Reach. The Project intake will include screens to restrict fish entrainment into the facility. The Project intake and screen will be designed to provide suitable conditions to allow fish to be redirected unharmed to return to the river. Screen design and water velocities at the screens will meet appropriate standards to minimize impacts to fish. Project operation techniques to keep the fish screens clear of debris could potentially harm fish in the immediate vicinity.

6.1.2 Monitoring Elements

- Water velocities at screen – approach (perpendicular to screen) and sweeping (parallel to screen) – will be monitored to ensure suitable conditions are provided to minimize impacts to fish. The data will be compared to applicable criteria from Washington Department of Fish and Wildlife and National Marine Fisheries Service to determine actual velocities encountered over range of flows and range of maintenance cleaning conditions.
    - Monitoring Data Collected: water velocity using portable meter (e.g., Swoffer)
    - Location: at Project intake screens

- Timing: during Year 1 post-initiation of Project operations
- Evaluation: comparison of water velocities relative to screening criteria

- Flow conditions in return channel to Project Reach will be monitored to assess risk of fish stranding over range of flows as the volume of water diverted varies.
  - Monitoring Data Collected: water stage and channel profile
  - Location: in return channel downstream of screens
  - Timing: during Year 1 post-initiation of Project operations
  - Evaluation: determine if return flow rates across the range of diversion flow conditions (i.e., between 40 cfs to 900 cfs) are sufficient for fish to safely return to main river channel

6.2 Management Goal 2: Avoid or minimize changes to sediment transport past the Project intake.

6.2.1 Potential Issue

The water diversion intake and changes to the water flow regime through the Project Reach can alter sediment transport into and through the Project Reach. Stream sediments are an integral component of habitat formation and habitat complexity in river systems. The sediment supply and transport conditions in the river will affect the availability of: (1) suitable spawning habitat with appropriately sized substrates, (2) refuge from predators by providing areas to move under or between, (3) substrate for the production of prey items on which many fish commonly forage, and (4) access to refuge from high-energy areas.

6.2.2 Monitoring

- Monitor sediment accumulation and transport in vicinity of Project intake to assess how Project design and operations affect the delivery of substrates to all areas downstream of the intake.
  - Monitoring Data Collected: channel profiles and visual assessment of substrate sizes at cross-sections
  - Location: cross-section locations in immediate vicinity upstream of Project intake
  - Timing: during Year 1 post-initiation of Project operations

- Evaluation: assessment of whether Project intake structures delay sediment movement into Project Reach and apparent length of delay

- Monitor spawning gravel availability in wetted area of Project Reach during Project operations.
    - Monitoring Data Collected: spawning gravel availability and cross-section data to establish stage-discharge relationship
    - Location: same study sites as in Aquatic Resources Study (BCH 2014) (two study sites in Project Reach)
    - Timing: annually for 5 years post-initiation of Project operation
    - Evaluation: assessment of spawning gravel availability in wetted areas during Project operation

6.3 Management Goal 3: Avoid or minimize changes to large woody debris (LWD) transport past the Project intake.

6.3.1 Potential Issue

The water diversion intake and changes to the water flow regime through the Project Reach can limit the transport of LWD into the Project Reach. LWD is beneficial for fish habitat because it: (1) increases habitat complexity by altering river hydraulics resulting in the creation of pools and gravel bars (Beechie and Sibley 1997), (2) provides shelter where fish can avoid predation, (3) provides a substrate for the production of macroinvertebrates on which many fish forage (Johnson et al. 2003), and (4) provides refuge from extreme flows, thereby reducing the energy that fish must expend to swim and hold in the river (Harvey et al. 1999).

6.3.2 Monitoring

- Monitor LWD transport past Project intake.
    - Monitoring Data Collected: counts of LWD pieces
    - Location: at Project intake structures
    - Timing: during Year 1 post-initiation of Project operations
    - Evaluation: assessment of whether LWD pieces accumulate at the Project intake structures

6.4 Management Goal 4: Manage Project operations to avoid or minimize effects on habitats in the Project Reach for resident fish, with a focus on rainbow trout and cutthroat trout.

6.4.1 Potential Issue

By diverting flow from the 2.7-mile-long Project Reach of the river and into the power generation facility, the Project may alter fish habitat. Fish utilize different areas depending on the habitat conditions that are affected by instream flows, including water depth, velocity, and substrate. Different species and life stages tend to preferentially utilize specific depth and velocity ranges related in part to their swimming capabilities and other ecological considerations (e.g., risk of predation). Project operations will alter instream flows which can increase or decrease the availability of habitat in terms of both the amount of time suitable conditions are available and the quantity of suitable habitat available. Since the Project will be operated as a run-of-the-river facility, natural flows will be available in all parts of the river, except the Project Reach. Therefore, potential effects on habitat due to instream flows will be limited to the Project Reach. Project operations will be managed to avoid or minimize detrimental effects on habitat availability.

6.4.2 Monitoring

- Monitor flows in the Project Reach to ensure minimum flows are maintained.
    - Monitoring Data Collected: continuous flow monitoring
    - Location: BCH will maintain a stream gage at the intake site and at Ernie's Grove downstream of the tailrace.
    - Timing: top of reach gaging will be conducted continuously throughout Project operation; bottom of reach gaging will be conducted continuously during first 5 years of Project operation
    - Evaluation: determine if minimum flows are provided in Project Reach
- Monitor water temperatures in the Project Reach to ensure no excessive warming.
    - Monitoring Data Collected: continuous water temperature monitoring
    - Location: BCH will maintain a stream gage at the intake site and at Ernie's Grove downstream of the tailrace. Water temperature will be recorded at these two stream gages.

- Timing: top of reach gaging will be conducted continuously throughout Project operation; bottom of reach gaging will be conducted continuously during first 5 years of Project operation

- Evaluation: determine if water temperatures increase in Project Reach or downstream related to Project operations

- Monitor fish community upstream, downstream, and in Project Reach to assess changes in fish population size and distribution patterns relative to fish size as indication of changes in fish displacement/movement through Project Reach.

    - Monitoring Data Collected: snorkel surveys of fish in Project Reach, including collection of habitat utilization data (depth, velocity, and substrate)

    - Location: same study sites as in Aquatic Resources Study (BCH 2014) (two study sites in Project Reach, upstream reference, and downstream reference)

    - Timing: summer sampling in Years 1 through 5following initiation of Project operation

    - Evaluation: assess if there are changes in population size and composition and, if so, determine whether changes are due to natural variation or due to Project operation.

6.5 Management Goal 5: Manage Project operations to avoid changes in water level that potentially strand fish in the Project Reach or downstream of the tailrace.

6.5.1 Potential Issue

Ramping rate is the rate of change in river stage or flow that results from the diversion or release of water due to project operations. As flows in the river change and the quantities of water diverted for power generation are adjusted, there is the potential for fish to be stranded as habitats along the water's edge become separate from flowing water. The potential for fish stranding is related to the rate at which flows recede and thus the opportunity for fish to move from areas that are receiving less flow. Smaller fish are more vulnerable to stranding than larger fish. For example, salmonids less than 40 to 50 mm long are more vulnerable to stranding than larger juveniles because the smaller fish are weaker swimmers and are more likely to occur along the shallow margins of rivers (Hunter 1992). River channel configuration, channel substrate type, time of day (related to fish movements between day and night), and flow level before down-ramping flow rates are additional factors determining the potential for fish stranding.

Since the Project will be operated as a run-of-the-river facility, natural flows will be available in all parts of the river, except the Project Reach. Project ramping also affects water levels downstream of the tailrace because the travel time of water through the Project facilities is shorter than for water moving through the Project Reach. Therefore, as diversion rates for power generation are adjusted, there will be short-term acceleration or lags in the delivery of water downstream of the tailrace.

6.5.2 Monitoring

- Monitor water levels and fish movements during project ramping in the Project Reach and downstream of tailrace.
    - Monitoring Data Collected: water surface elevation changes during down-ramping, wetted area connectivity during/after down-ramping, visual observation of fish presence in margin habitats potentially affected by down-ramping
    - Location: same study sites as in Aquatic Resources Study (BCH 2014) (two study sites in Project Reach, and downstream reference)
    - Timing: during Year 1 post-initiation of Project Operations
    - Evaluation: determine if down-ramping isolates habitats and potentially strands fish
- Monitor redd dewatering in Project Reach.
    - Monitoring Data Collected: spawner surveys and cross-section data to establish stage-discharge relationship
    - Location: same study sites as in Aquatic Resources Study (BCH 2014) (two study sites in Project Reach) in Project Reach
    - Timing: spring sampling in first 5 years following initiation of Project operation
    - Evaluation: assess whether redds are created in areas not wetted by Project minimum flows

6.6 Management Goal 6: Manage Project operations to avoid or minimize negative effects, or enhance flow-dependent recreational opportunities in the Project Reach.

6.6.1 Potential Issue

Angling for resident trout and whitewater boating are the primary flow-dependent uses of the Project Reach. Anglers prefer lower stream flows than whitewater boaters and therefore the period when these two recreational groups are present in Black Canyon does not overlap. Project operation may increase the number of fishing days when flows are reduced to a level preferred by anglers. Likewise, during fall, winter, and spring high-flow periods, Project operations may increase the number of days when flows are within the optimum levels for whitewater boating.

6.6.2 Monitoring

…to be determined…

7 ADAPTIVE MANAGEMENT OF MANAGEMENT GOALS

The decision-making processes involved in adaptive management need to be spelled out so there is a common understanding of how new information gained from monitored will be shared and applied in decisions leading to changes in Project operations. This section will describe the decision-making process. This will include identifying what entities are involved, how decisions will be made, and the timing of decisions and implementation.

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