Thompson Falls Hydroelectric Project
FERC Project No. 1869

Fishway Operation and Maintenance Plan

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List of Abbreviations and Acronyms

>	greater than
Agencies	United States Fish and Wildlife Service, United States Forest Service, Montana Fish, Wildlife, and Parks
AWS	Auxiliary Water Supply
°C	degrees Celsius
cfs	cubic feet per second
CSKT	Confederated Salish and Kootenai Tribes
FERC	Federal Energy Regulatory Commission
fish passage facility	Thompson Falls Upstream Fish Passage Facility
fishway	Thompson Falls Upstream Fish Passage Facility
FOMP	Fishway Operations and Management Plan
FWP	Montana Fish, Wildlife and Parks
FWS	U.S. Fish and Wildlife Service
HVJ	high velocity jet
Licensee	NorthWestern Energy
ladder	Thompson Falls Upstream Fish Passage Facility
NMFS	National Marine Fisheries Service
NorthWestern	NorthWestern Energy
PIT	passive integrated transponder
Project	Thompson Falls Hydroelectric Project
Thompson Falls Project	Thompson Falls Hydroelectric Project
TDG	Total Dissolved Gas
U.S.	United States

1. Introduction

The Thompson Falls Hydroelectric Project (Thompson Falls Project or Project) is located on the Clark Fork River in Sanders County, Montana. Non-federal hydropower projects in the United States (U.S.), including the Thompson Falls Project, are regulated by the Federal Energy Regulatory Commission (FERC) under the authority of the Federal Power Act. The Project's current FERC license expires December 31, 2025. As required by the Federal Power Act and FERC's regulations, on July 1, 2020, NorthWestern Energy (NorthWestern, Licensee) filed a Notice of Intent to relicense the Thompson Falls Project using FERC's Integrated Licensing Process. Concurrently, NorthWestern filed a Pre-Application Document. Northwestern submitted a Final Application for a new license to FERC on December 29, 2023.

On December 17, 2024, NorthWestern filed a Fishway Operations Assessment Plan, which described operational protocols and studies NorthWestern plans to improve upstream fish passage efficiency at the Thompson Falls fish passage facility. Implementation of the 2024 Fishway Operations Assessment Plan will extend for the remainder of the existing FERC License term (through December 31, 2025), including any subsequent annual license issued by FERC.

This Fishway Operations and Management Plan (FOMP) will guide fishway operations during the new license term for the Project.

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2. Upstream Fish Passage Facility

The Thompson Falls upstream fish passage facility (fishway or ladder) was designed in general accordance with the National Marine Fisheries Service (NMFS) Anadromous Salmonid Passage Facility Design Manual (NMFS, 2008), which was used by the U.S. Fish and Wildlife Service (FWS) in the design of Bull Trout upstream passage facility. The fishway design incorporates a series of 48 pools, each 6 feet long by 5 feet wide by 4 feet deep. At the time of the design there was considerable uncertainty regarding timing, efficiency, and effectiveness with which Bull Trout use of the fish fishway would occur (FWS, 2008).

Hydraulically, the fishway was designed to induce a 1-foot drop in the hydraulic grade line for each of the 48 pools to allow passage of a diverse population of fish over the Thompson Falls Main Channel Dam. Each pool is separated by an aluminum weir plate with a sliding weir gate leaf. The weir plate has a square orifice (1'-tall x 1' 2"-wide) at the bottom center of the plate and a 2-foot-wide weir notch cut into the top of the plate. Because the fishway was a pioneering structure in Bull Trout passage, it was designed with flexibility to allow operations of the fishway in one of two modes, identified as "orifice" or "notch" modes. The fishway was not designed for operating with a combination of the two modes. Raising the central sliding weir gate allows pool-to-pool flow through the bottom orifice (orifice mode). Lowering the weir gate allows pool-to-pool flow through the top weir (notch mode) (Figure 2-1). The upper pools (46-48) operate solely in orifice mode to reduce the effects of the forebay water level on the fishway hydraulics.

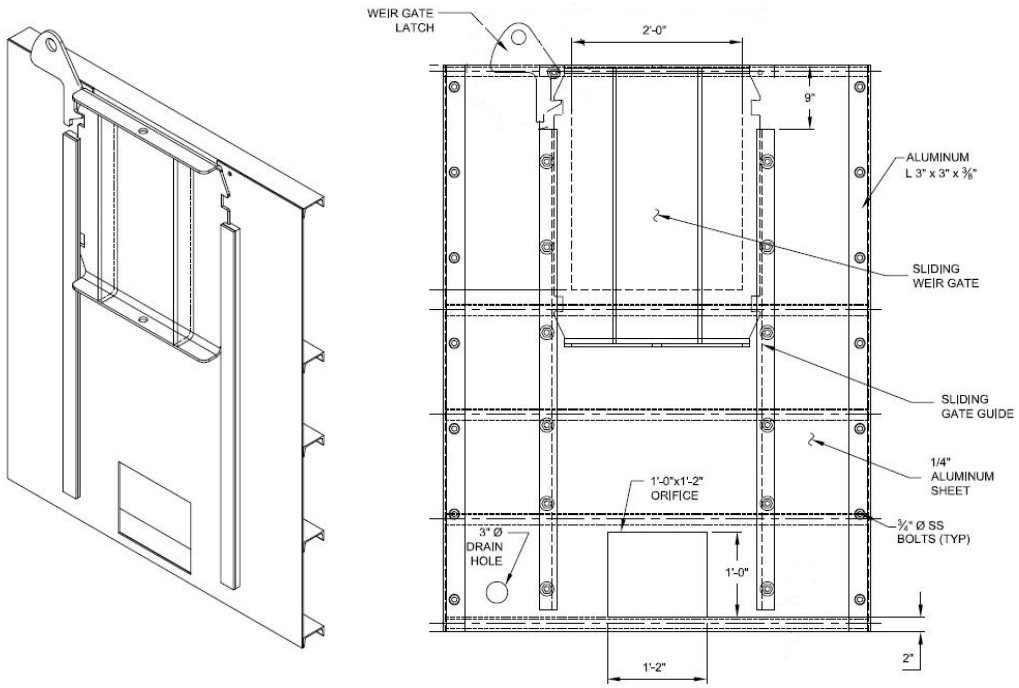

Figure 2-1: Isometric and front view of aluminum weir plates. By lowering the sliding weir gate down to cover the bottom orifice, the fishway is operated in notch mode.

By design, the fish fishway has four distinct areas, as follows (Figure 2-2):

- Fish Fishway Entrance – Pool 1
- Lower Fishway Pools – Pools 2-7
- Middle Fishway Pools – Pools 8-44
- Exit Control Section – Pools 45-48

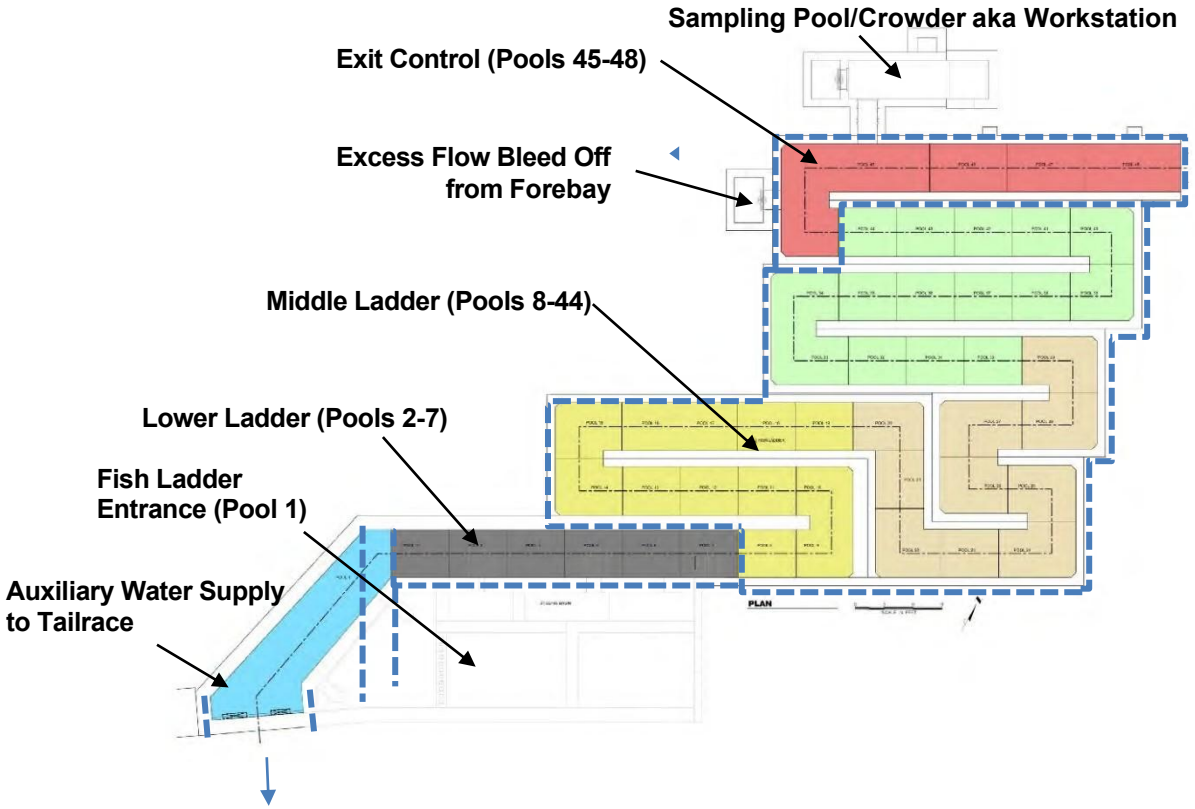

Figure 2-2: Thompson Falls Fish Fishway Flow Areas.

2.1 Fish Entrance

The fishway entrance includes two entrance ports through which fish can enter the fishway entrance pool (Pool 1): one is a gated 24”-wide by 36”-high low-tailwater entrance, designed to operate during non-spill periods; the other is a gated 30”- by 48”-high-flow entrance, designed to operate during spill (Figure 2-3).

Entrance attraction flow into the tailrace is a combination of fishway pool-to-pool flow (nominal 6 cubic feet per second (cfs)) and auxiliary water flow (maximum 54 cfs).

An adjacent high-velocity jet (HVJ) provides an additional means to increase attraction flow by 20 cfs.

Auxiliary water supply (AWS) flow is introduced into Pool 1 through a wall diffuser, with a maximum uniform velocity of 1 foot per second.

The entrance pool is configured to enable fish to readily find the fishway pool-to-pool flow during the low-flow, non-spill period. During spill, auxiliary water flow is added in Pools 3, 5, and 7, successively.

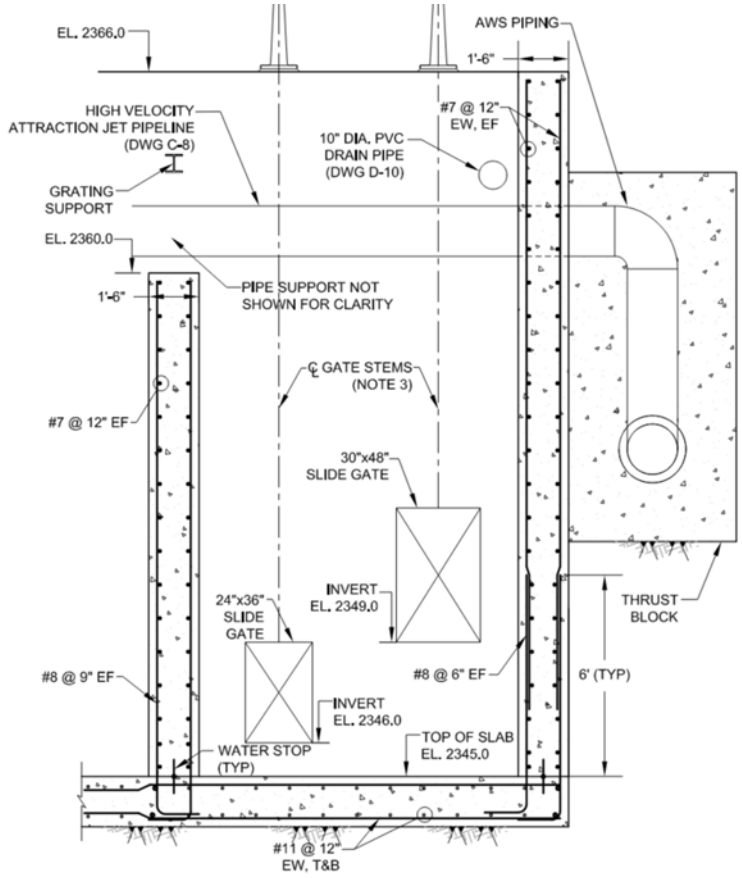

Figure 2-3 Ladder Entrance Configuration

2.2 Lower Fishway (Pools 2-7)

The fishway is designed to operate within design criteria between the low design tailwater El. 2248 feet and the high design tailwater El. 2259 feet.

Floor diffusers in Pools 3, 5, and 7 provide added auxiliary water successively to Pool 3, then Pool 5, then to Pool 7 as tailwater rises in 2-foot increments above low design tailwater. The purpose is to maintain fish attraction velocities/flow magnitudes over inundated weirs 2-7 during higher tailwater periods.

The auxiliary water add-in system is designed for notch-operation-only in these lower pools and will not add auxiliary flow if these pools are operated in orifice mode.

The design was intended to operate Pools 2-7 in the notch setting, regardless of whether Pools 8-45 are operated in notch or orifice mode. This was the case from 2011 through 2018 operating seasons. In 2019, Pools 2-7 were switched to orifice for a short period of time.

2.3 Middle Fishway Pools (8-44)

The middle fishway is designed to operate as a pool-type fishway with a 1-foot pool-to-pool differential at a fishway flow rate of 6 cfs.

For pool-type fish ladders, design intent is to provide pool volume to fully dissipate energy from incoming flow. An energy dissipation criterion (NMFS, 2008 updated in NMFS, 2011) dictates required volume, for an appropriate turbulence level in each pool.

Aluminum prefabricated weirs were designed to enable changing from notch to/from orifice operating mode, by lowering/raising a gate leaf in each weir. Orifice and weir sizes were both selected to provide a 1-foot drop in the hydraulic grade line along the ladder, based on assumed notch and orifice coefficients.

The lower fishway flow is determined by the water surface elevation in Pool 45, whether operation is in notch or orifice mode.

No additional auxiliary water is added or removed between Pool 8 and Pool 45.

2.4 Exit Control Section (Pools 45-48)

Three orifice pools (Pools 45-48), are designed with a drop of approximately 1 foot between pools. The pool 45 design has an elevation target of El. 2393 feet. Flow to the fishway pools below Pool 45 equals the difference in total inflows and bleed-off outflows from Pool 45.

Orifices between Pools 45-48 are designed to modulate minor flow changes due to minor forebay pool fluctuations.

Excessive flow into Pool 45 from the forebay is bled off at a screened overflow weir, with a backset porosity control plate used to set the Pool 45 water surface.

Additional flow may be added through the trap holding pool to Pool 45.

2.5 Attraction Flows

The AWS adds attraction water to the lower ladder, by discharging through one of the fishway entrances into the tailrace to attract fish to the ladder. Auxiliary flow enters from the forebay through the coarse trash rack and auxiliary water traveling screen, then passes through the 36-inch by 36-inch isolation gate, G-2, immediately downstream of the traveling water screen. The 30-inch-diameter flow control valve CV-2 throttles AWS discharge quantity, and routes flow into a stilling pool. Energy is dissipated in this stilling pool, before flow passes through a set of vertical baffles, a porosity plate, and add-in diffuser panel into the entrance pool. Flow passing through the Pool 1 add-in diffuser has reduced levels of residual turbulence and passes uniformly through the wetted diffuser surface area.

At the Main Channel Dam Spillway, spill occurs once streamflows exceed 23,000 cfs. At low design tailwater (non-spill), AWS flow is added to Pool 1 only. At low spill levels (less than 5,000 cfs), the secondary AWS stilling basin (between the vertical baffles and porosity plate) is designed to be 1 foot higher than the Pool 1 water surface tailwater, which is the purpose of the porosity plate. In turn, the Pool 1 water surface is to be 1 foot higher than tailwater. The 1-foot drops between these three points remain as tailwater, Pool 1, and the secondary AWS stilling basin water surfaces rise and progressively inundate the lower fishway pools. When Weir 2/3 (between Pools 2 and 3) becomes inundated, a portion of AWS flow passively overtops the first chimney, and through the Pool 3 floor diffuser. As tailwater continues to rise in 2-foot increments, chimneys for Pools 5 and 7 are also overtopped, passively sending some AWS flow to those pools. The purpose of AWS floor diffusers in Pools 3, 5, and 7 is to create a perceivable attraction flow over inundated lower fishway weirs at progressively higher tailwater elevations.

Pool 1 discharge is designed to pass 26 cfs through entrance gate EG-1 during non-spill, with an AWS discharge of 20 cfs augmenting the 6 cfs fishway flow. During spill, Pool 1 discharge increases to 60 cfs through EG-2, with 54 cfs AWS discharge augmenting the 6 cfs fishway flow. Depending on tailwater elevation, a portion of the AWS will overtop one or more chimneys, and pass floor diffusers in Pools 3, 5, and 7. Each floor diffuser will pass approximately 5 cfs.

Another 20 cfs can be discharged directly into the tailrace in the form of an HVJ. Its purpose is to improve fish attraction to the ladder, as needed. This is accomplished by fully opening Gate G-1. The HVJ is designed to discharge 20 cfs through control valve CV-1. The jet discharges through a 14-inch diameter orifice, which produces a discharge jet velocity of approximately 19 feet per second into the tailrace. The HVJ was designed to operate during spill. The HVJ will be operated at Northwestern's discretion.

Other attraction alternatives during non-spill periods include opening of an adjacent spillway panel(s) near the fishway entrance. Between 2013 and 2023, a partial panel near the fishway entrance has been opened providing an additional 100 to 125 cfs (estimate) attraction flow (B. Mabbott, NorthWestern, personal communication, January 25, 2018). NorthWestern evaluated this additional spill relative to the effects on upstream passage attraction to the fishway for Target Species. The results are not conclusive. Therefore, NorthWestern will continue to include the use of additional spill for fish attraction as an option if the fishway evaluation program detailed in the Fisheries and Aquatic PM&E Plan.

3. Standard Operating Procedures

3.1 Seasonal Operations

NorthWestern will operate the fishway annually from approximately March – October. Fishway operation is impacted by freezing conditions at the site and high spring flows. The facility was designed to be operated up to 48,000 cfs total discharge, yet through testing the fish passage facility can be operated to 65,000 cfs. Closing of the fish passage facility will occur within this flow range (48,000 - 65,000 cfs) and NorthWestern will notify Montana Fish, Wildlife, and Parks (FWP), FWS, the U.S. Forest Service (collectively, Agencies) and the Confederated Salish and Kootenai Tribes (CSKT) within 5 days of closing the fishway and within 5 days of reopening the fishway after high flows.

3.2 Flexible Generation

During the new license term, NorthWestern proposes to draw down the Project reservoir to 2.5 feet below full pool for the purpose of flexible power generation. Currently, the Project fishway facility does not allow for adequate flow when the reservoir is drawn down more than 2.0 feet below full pool. NorthWestern will design and implement an engineered solution that will provide adequate flows into the fishway prior to drawing down the project reservoir between 2.0-2.5 feet below full pool during the fish passage facility operating season.

3.3 Spillway Operations

During spill operations (streamflows exceed 23,000 cfs), the Main Channel Dam Spillway tailrace becomes highly turbulent, and tailwater elevation rises quickly. After several years of study, a spillway operations schedule was finalized in 2010 which was intended to enhance fish attraction to the right abutment of the Main Channel Dam, promote adult upstream fish passage, and minimize entrainment of Total Dissolved Gas (TDG) (PPL Montana, 2010). The 2010 spill schedule has been implemented by the Licensee since that time.

On May 23, 2024, NorthWestern filed an updated TDG Control Plan with FERC which incorporates TDG and fish passage data collected from 2019-2023 (NorthWestern 2024). The 2024 TDG Control Plan outlines the plan of spill operations under the new license. The TDG Control Plan was developed in consultation with the Montana Department of Environmental Quality and satisfies Administrative Rules of Montana 17.30.636 (1), which provides that “owners and operators of water impoundments that cause conditions harmful to prescribed beneficial uses of state water shall demonstrate to the satisfaction of the department that continued operations will be done in the best practicable manner to minimize harmful effects.” The updated spill operations sequence mimics the operations and intent of the 2010 TDG Control Plan to promote fish passage while reducing TDG but incorporates the infrastructure of the four radial gates and their contribution to downstream TDG.

At lower total Project flows, when the fish passage facility is operating, the spill operations sequence is designed to optimize upstream fish passage efficiency. This may include removing one panel or a combination of panels to attract fish to the fishway. Similar to the 2010 TDG Control Plan, spill panels will then be removed from the side of the dam opposite of the fishway to maintain reduced river velocities near the fishway. Only one radial gate, Radial Gate #1, is planned to be used in the open position at this point in the sequence so that lower river velocities through the natural falls area can be maintained.

The maximum design capacity of the fishway is 48,500 cfs, so when total Project flow exceeds this value, spill operations will be designed to minimize TDG concentrations downstream. Consistent with the updated TDG Control Plan, NorthWestern will remove the remaining spill panels on the Main Channel Dam prior to utilizing Radial Gate #3 fully, which occurs at approximately 72,391 cfs. The radial gate study showed that operating Radial Gates #1 and #3 together at total Project flows above 65,000 cfs entrained the least amount of TDG downstream (NorthWestern 2024).

3.4 Fish Passage Priority Species

Upstream fish passage priorities (target species), in order, are: 1) Bull Trout, 2) native species, and 3) Rainbow and Brown Trout. Those species not to be passed upstream will be determined annually through NorthWestern acquiring a Fish Collection Permit from FWP. Currently Walleye, Smallmouth Bass, Brook Trout, Brook x Bull hybrids, Lake Trout, and Northern Pike are not passed upstream.

3.5 Workstation Protocol

NorthWestern will ensure the fishway is sufficiently staffed to be operated and maintained throughout the seasonal operating period. Workstation protocol includes implementing the following parameters:

- Daily checks (except weekends and holidays)
- Time of checks should be approximately 9:00 AM
- All personal protective equipment will be worn, and appropriate safety rules followed
- A measured dose of approved anesthetizing agent for fish (*refer to* Fish Handling Protocols Section 3.6.1, for temperature thresholds)
- Fish will be released immediately upstream of the dam, or immediately downstream as appropriate
- Data input will be synced daily for upload to NorthWestern's database

- Fish metrics recorded at the ladder
    - All fish species tagged at the fishway will be weighed, measured, and recorded.
    - Species not tagged will be counted and recorded
- Species rarely occurring at the fishway (e.g., Peamouth, Kokanee, Largemouth Bass, etc.) will be weighed, measured, and recorded.

3.6 Fish Data Collection

NorthWestern will manage and retain information collected at the upstream fish passage facility. This includes fishway operations, total fish counts, and any fish metrics collected. NorthWestern will prepare an annual report summarizing upstream passage activities and results and file the annual report with FERC. The contents and review process for the annual report are described in more detail below in Section 6.

Fish metrics collected for salmonids will include the species identification, length, and weight, and tag identification, as appropriate. Fish metrics collected for non-salmonids will include, at a minimum, the species identification and number of fish.

During summer, water temperatures often reach or exceed 23°C. In extreme warm temperatures the fishway may be checked more frequently or closed to reduce fish stress and the probability of mortality. NorthWestern will confer with FWP on actions that are taken due to high water temperatures and fish safety. The annual report will include any deviations taken to protect fish health due to warm summer temperatures.

3.6.1 Fish Handling Protocol

NorthWestern and personnel handling fish at the fish passage facility or handling fish during studies associated with the evaluation of fish passage will follow State of Montana collection permit guidelines. Fish handling guidelines and tagging protocols specific to the upstream fish passage facility are included in Table 3-1.

Table 3-1. Fish tagging and genetic sampling protocol at Thompson Falls workstation.

Species	PIT tag	Adipose clip	Floy tag	Genetic sample	Comments
Bull Trout	X			X	Continue tagging when temperatures are > 20℃
Brown Trout	X	X	X		Discontinue anesthetizing, tagging, and measuring when temperatures >20℃
Rainbow Trout	X	X	X		
Westslope Cutthroat Trout	X	X	X		
Mountain Whitefish	X	X			
Northern Pikeminnow					
Largescale Sucker					

3.6.2 Tagging and Marking Fish Protocol

NorthWestern has established a protocol for marking and/or tagging salmonid and non-salmonid species that are captured after ascending the fishway, captured downstream of the Project, or captured upstream of the Project. Tagging data will be collected and used per the Thompson Falls Fisheries and Aquatic Resources Protection, Mitigation, and Enhancement (PM&E) Plan (NorthWestern 2025).

All Bull Trout, Westslope Cutthroat Trout, Rainbow Trout, Brown Trout, and Mountain Whitefish captured in the fishway will be tagged with a passive integrated transponder (PIT) tag when water temperatures are less than 20°C. The PIT tag will be a full duplex configuration inserted in the dorsal sinus cavity. It is possible that fish previously tagged for other studies will have PIT tags inserted in different locations. Therefore, fish will be fully scanned for PIT tags at all possible tagging locations.

At the ladder, PIT tag data will be collected through an automated system. Antennas are located at the entrances (lower and upper), pools 7 and 8, and pool 45 (referred to as the holding pool). A receiver will automatically record PIT tag identification numbers via antenna. The installed antennas can detect a TX1411SST PIT tag at a distance of 20 inches from the antenna surface with consistent detection at 18 inches. The automated PIT tag recording system at the fishway will run when the fishway is in operation. During the winter the automated PIT tag recording system will be turned off. The automated system will allow detection of tagged fish when they enter the fishway and then again when they reach the top of the fishway.

Genetic testing will be conducted for Bull Trout that ascend the fishway and for Bull Trout that are otherwise captured in the Project boundary. At a minimum, genetic assignment to tributary of origin and sex of fish will be analyzed. Data gathered from the genetic analysis will be summarized in the annual report filed with FERC.

4. Fishway Maintenance and Inspection Schedule

Fishway maintenance includes a series of regularly scheduled duties where inspections and cleaning occur. Routine operations and maintenance include the following:

- Inspect and remove debris from trash racks and screens during fishway checks as needed.
- Record water levels through existing staff gages, or other means, and keep records of daily readings.
- Lubricate chains and other moving parts as necessary during fishway startup.
- Annually inspect cables, pumps, electrical components, and other parts.
- When possible, perform required or identified maintenance during times of the year fishway is not operating.

5. Protocols for Changes to Fishway Operations Due to Planned or Unplanned Circumstances

NorthWestern's priority is to reduce stress on target species and ensure they pass upstream efficiently. In response to unforeseen circumstances that may cause stress such as high water temperature or large numbers of fish, NorthWestern may implement minor modifications to fishway operations. These modifications could include, but are not limited to, more frequent checks, modifying fish tagging protocols, or other measures that improve fish safety and health at the fishway.

During the fishway operating season, NorthWestern will notify the Agencies and CSKT of fishway maintenance or repairs that require closure of the fishway for more than five consecutive days. The annual report filed with FERC will include information on the repairs, the amount of time the fishway was not functional, and a summary of minor modifications to fishway operations described above.

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6. Reporting and Updating the FOMP

6.1 Reporting

Annually, by March 31 of each year, NorthWestern will file a report with FERC that includes a summary of fishway operations during the prior calendar year (January 1 to December 31), including the following: 1) fishway operations season and configurations, (2) Clark Fork River discharge conditions through the fishway operation season, 3) any repairs or modifications to the fishway, 4) any deviations from normal fishway operations due to planned or unplanned circumstances, 5) fish capture results, 6) fish tagging at the fishway, 7) tag detections on tributary PIT arrays, and 8) angler recaptures of fish that previously ascended and were floy tagged at the fishway. NorthWestern will prepare the report for review and comment by the Agencies and CSKT, allowing at least 30 days for comments on the draft, before filing the final report with FERC.

6.2 Updates to Fishway Operations and Management Plan

Through the term of the License this FOMP may be updated based on permanent changes to fishway operations as a result of Tier 1 and Tier 2 evaluations described in section 5.1.2 of the PM&E Plan (NorthWestern 2025). These permanent fishway changes will be developed in consultation with the Agencies and CSKT and submitted to FERC for approval, as provided in the PM&E Plan. Should implementation of the PM&E Plan result in permanent modifications to the fishway operational parameters described in this FOMP, NorthWestern will update the FOMP accordingly. NorthWestern will prepare the updated FOMP for review and comment by the Agencies and CSKT, allowing at least 30 days to provide comments and recommendations on the draft FOMP before filing the final FOMP with FERC for approval. When filing the final FOMP with FERC, NorthWestern will include its reasons, based on Project-specific information, if it does not adopt a recommendation submitted by an Agency or CSKT.

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7. Literature Cited

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U.S. Fish and Wildlife Service (FWS. 2008). Biological Opinion for Thompson Falls Hydroelectric Project. Bull Trout Consultation. Federal Energy Regulatory Commission Docket No. 1869-048-Montana. PPL Montana, LLC, Licenses. Prepared by FWS Montana Ecological Services Field Office, Helena.