NorthWestern Energy
Delivering a Bright Future

NWE-THF-3564

Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

March 22, 2018

Re: NorthWestern Energy Files 2017 Annual Activity, Fish Passage and Bull Trout Take Report for the Thompson Falls Hydroelectric Project (1869)

Dear Secretary Bose:

Herein attached, per Item D of Commission Order dated February 12, 2009, is NorthWestern Energy's 2017 Annual Activities, Fish Passage and Bull Trout Take Report for the Thompson Falls Project completed in consultation with the U.S. Fish and Wildlife Service (USFWS), Montana Fish, Wildlife and Parks, Montana Department of Environmental Quality and Confederated Salish and Kootenai Tribes. The USFWS signature of approval (under their Section 7 Terms and Conditions Authority) for this report and filing with the Commission is included on page 2.

Sincerely,

Mary Gail Sullivan
Manager Environmental Permitting and Compliance

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The USFWS has reviewed and by signature below, approves this Thompson Falls Project 2017 Annual Activity, Fish Passage and Bull Trout Take Report filing with the Commission.

Ben Conard
Name

Office Supervisor
U.S. Fish and Wildlife Service (position)

3/21/2018
Date

2017 Annual Report
Fish Passage Project
Thompson Falls Hydroelectric Project
FERC Project Number 1869

Submitted to:
Federal Energy Regulatory Commission
Washington, D.C.

Submitted by:
NorthWestern Energy Corporation
Butte, Montana

In Collaboration With:
Montana Fish Wildlife and Parks
Thompson Falls, Montana

U.S. Fish and Wildlife Service
Kalispell, Montana

Montana Department of Environmental Quality
Helena, Montana

Confederated Salish and Kootenai Tribes of the Flathead Nation
Pablo, Montana

With Assistance From:
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Portland, Oregon

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Missoula, Montana

March 2018

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List of Acronyms

%	percent
AMFA	adaptive management funding account
AWS	auxiliary water system
BO	Biological Opinion
BULL	Bull Trout
BL BH	Black Bullhead
°C	degrees Celsius
cfs	Cubic feet per second
Ck	creek
Commission	Federal Energy Regulatory Commission
CPUE	catch per unit effort
CSKT	Confederated Salish and Kootenai Tribes of the Flathead Nation
EB	Brook Trout
EF	electrofishing
Evaluation Plan	10-year Fish Passage Facility Evaluation Plan, Phase 2 Action Plan, 2011-2020
FERC	Federal Energy Regulatory Commission
ft	feet
FDX	full-duplex
FWP	Montana Fish, Wildlife and Parks
FWS or Service	U.S. Fish and Wildlife Service
GBT	gas bubble trauma
g	gram
HDX	half-duplex
HVJ	high-velocity jet
hrs	hours
kg	kilogram
km	kilometer
L	length
ladder	Thompson Falls Upstream Fish Passage Facility
LCFR	Lower Clark Fork River
Licensee	NorthWestern Energy Corporation
LL	Brown Trout
LT	Lake Trout
LMB	Largemouth Bass
LS SU	Largescale Sucker
LN DC	Longnose Dace
LN SU	Longnose Sucker
LWF	Lake Whitefish
MOU	Memorandum of Understanding
mbar	millibar

mm	millimeter
mmHg	millimeter of mercury
MDEQ	Montana Department of Environmental Quality
MWF	Mountain Whitefish
Msl	mean sea level
N	number
NP	Northern Pike
NPMN	Northern Pikeminnow
NorthWestern	NorthWestern Energy Corporation
PEA	Peamouth
PIT	passive integrated transponder
PPL Montana	PPL Montana, LLC
Project	Thompson Falls Hydroelectric Project
PUMP	Pumpkinseed
RB	Rainbow Trout
RBxWCT	Rainbow x Westslope Cutthroat Trout hybrid
RS SH	Redside Shiner
SMB	Smallmouth Bass
SOP	Operational and Procedural Manual
TAC	Technical Advisory Committee
TCs	Terms and Conditions
TDG	total dissolved gas
TFalls	Thompson Falls
TRiver	Thompson River
USGS	U.S. Geological Survey
WE	Walleye
Wt	weight
WCT	Westslope Cutthroat Trout
WF	West Fork
YP	Yellow Perch

Executive Summary

NorthWestern Energy Corporation (NorthWestern) is owner and operator of the Thompson Falls Hydroelectric Project (No. 1869) (Project), located on the Clark Fork River near Thompson Falls, Montana. The current Federal Energy Regulatory Commission (FERC or Commission) License was issued to the Montana Power Company in 1979 (purchased by PPL Montana in 1999 and subsequently purchased by NorthWestern in 2014) and is scheduled to expire on December 31, 2025.

In 1998, the Bull Trout (*Salvelinus confluentus*) was federally-listed under the Endangered Species Act as a threatened species (Federal Register, 1998). Critical habitat was designated in 2005 and revised in 2010 (Federal Register 2005, 2010). The Licensee for Project 1869 conducted 5 years of studies (2003 start) and filed a Biological Evaluation with the Commission on April 7, 2008 discussing the effects of the Project on Bull Trout and proposed conservation measures.

The 2008 Biological Evaluation was adopted as the Commission's Final Biological Assessment and submitted to the U.S. Fish and Wildlife Service (FWS or Service) on May 1, 2008. On November 4, 2008 the FWS filed with the Commission a Biological Opinion (BO) (FWS, 2008) and an associated Incidental Take Statement, which includes reasonable and prudent measures, Terms and Conditions (TCs) and conservation recommendations to minimize incidental take of Bull Trout. On February 12, 2009 the Commission issued an Order Approving Construction and Operation of Fish Passage Facilities for the Project (FERC, 2009). This Order included the reasonable and prudent measures, TCs, and conservation recommendations from the BO. The Commission agreed with the FWS's conclusion that the Project is currently adversely affecting Bull Trout and Licensee's proposed conservation measures will reduce, but not eliminate, adverse impacts of the Project.

The 2009 Order requires the Licensee to file with the Commission, by April 1 of each year through the remainder of the License, the annual report referenced in Term 7a of the FWS's TCs (FERC, 2009). In addition to the requirements stipulated in Term 7a, the annual report is required to address the Licensee's compliance with the FWS's TCs.

This report is intended to fulfill the annual reporting requirement, as specified in Term 7a of the BO, the requirements of the FERC Order (FERC, 2009), and summarizes the Licensee's 2017 activities (Sections 2.0 – 8.0); compliance with the FWS's TCs of the BO (Section 9.0); and proposed activities in 2018 (Section 10.0).

Baseline Fisheries Studies

Baseline fisheries data collection includes spring electrofishing in the Thompson Reservoir; fall electrofishing in the Clark Fork River above the islands and between Paradise to Plains, Montana; and fall gillnetting in the Thompson Reservoir. The baseline fisheries surveys were set up with the intention of monitoring the impact of salmonids passed upstream of Thompson Falls Dam.

Between 2011 and 2016, over 2,082 uniquely-tagged salmonids were released upstream of the Thompson Falls Dam. During the same time, between zero and 11 ladder-tagged fish were captured during annual baseline surveys resulting in 24-tagged salmonids recaptured after their release upstream of the dam.

In 2016, the Technical Advisory Committee (TAC) agreed to modify the frequency of the baseline surveys starting in 2017. Gillnetting efforts continue annually each autumn, while spring and fall electrofishing occur every other year, with the next sample event scheduled for 2018.

In October 2017, NorthWestern with the assistance from Montana Fish, Wildlife and Parks (FWP) completed the fall gillnetting in the Thompson Falls Reservoir. A total of 188 fish were sampled with the majority represented by Black Bullhead and Northern Pike. None of the fish had any previous markings or tags indicating they had been passed upstream at the Thompson Falls fish ladder. A summary of the results compared to previous sample years are presented in Section 2.1.

Upstream Fish Passage Evaluation

In 2017, the Thompson Falls upstream fish passage (fish ladder), completed its seventh season in operation. The ladder commenced 2017 operation on March 22 and was winterized on October 31. In June, the ladder was closed for 14 days (June 2 – 15) due to high spring flows (exceeding 80,000 cfs) and sedimentation in the ladder. The ladder operated in notch mode for the entire 2017 season.

Spring streamflows were higher than average, exceeding 30,000 cfs in March and April. The peak streamflow for 2017 was approximately 82,100 cfs on June 3. During the 224-day season in 2017, maximum daily water temperatures in the ladder exceeded 21 degrees Celsius (ºC) for 57 days with a maximum water temperature of 24.3 ºC recorded on August 3.

A total of 530 fish (305 salmonids, 225 non-salmonids) ascended the ladder in 2017. This was the lowest number of non-salmonids, specifically native non-salmonids, recorded at the ladder since 2011. Peak movement of both salmonids and non-salmonids ascending the ladder occurred in July when water temperatures were warmest and streamflows declined and were near baseflow (approximately 10,000 cfs). In contrast to previous years, there were no Mountain Whitefish detected entering the ladder or in the holding pool in 2017. No walleye, lake trout, or brook trout x bull trout hybrids (species not authorized by FWP for upstream release) were recorded at the ladder in 2017.

The total fish count included one Bull Trout that ascended the ladder on September 18 and was released upstream. A PIT tag was inserted in the Bull Trout prior to release upstream. The same Bull Trout was later detected in the mainstem of the Thompson River (via remote array) on October 23, 2017.

A total of eight mortalities were recorded at the ladder, including one Rainbow Trout and six Brown Trout on July 9, and one Westslope Cutthroat Trout on October 31. All mortalities

appeared to be related to mechanical issues at the ladder, which were fixed. Excluding the eight mortalities, the remaining 522 fish recorded at the ladder were released upstream.

In 2017, 331 fish were PIT-tagged at the ladder prior to release upstream, including 270 salmonids, 53 Northern Pikeminnow, and eight Largescale Sucker. A total of 35 fish (16 LL; 9 RB; 2 WCT; 8 SMB) that were initially tagged at the ladder were recorded returning and ascending to the top of the ladder. Of the 27 tagged salmonids collected in 2017, 17 were initially tagged at the ladder in 2016, while the remaining fish were tagged prior to 2016.

The time needed to ascend the ladder can only be assessed for PIT-tagged fish that enter the ladder and are detected in the lower pool and holding pool. The ascent time is the duration of time it takes a fish to move from the lower pool upstream to the top (holding pool). In 2017 ascent times were recorded for 35 salmonids (LL; RB; WCT). No PIT-tagged non-salmonids ascended the ladder in 2017. The median ascent time for 35 salmonids in 2017 operating in notch mode was 1.4 hours compared to the median time of 2.0 hours for the same species (n=191) between 2013 and 2016 while operating in orifice mode. Ascent time for salmonids was quicker in notch mode compared to orifice, but fewer salmonids were observed entering or ascending the ladder and a lower percentage of the salmonids that entered the ladder in notch mode ascended to the holding pool compared to orifice mode.

Remote PIT-tag detection data from the ladder (lower pools and the holding pool) in 2016 while operating in orifice mode and 2017 while operating in notch mode were evaluated. Results indicate a higher proportion of salmonids entering the ladder ascended to the holding pool (68%) while in orifice mode compared to notch mode (51%). Additionally, a larger number of fish and a greater variety of species entered, as well as ascended, the ladder in orifice mode than in notch mode.

Fallback is defined as a fish that ascends the ladder, receives a PIT, Floy, or other unique identification tag, is released upstream, and then is later recaptured either downstream of the Thompson Falls Dam or at the ladder again that same year. There were two “fallback” fish, one Westslope Cutthroat Trout and one Brown Trout identified in 2017. Both fish were detected re-entering the ladder, but neither ascended to the holding pool. The Westslope Cutthroat Trout returned within 30 days and either passed through the turbine or over the spillway during this downstream journey. The Brown Trout returned to the ladder in 70 days and likely passed through the turbine during its downstream journey. Overall fallback data indicate a low percentage of salmonids fallback annually and the “fallback” fish are surviving downstream passage, either through the turbines or over the spillway, returning to the ladder (sometimes multiple times a year), and continuing to move upstream into the Thompson River or other locations.

In 2017, there were 297 PIT-tagged salmonids released upstream of Thompson Falls Dam (270 newly PIT-tagged fish in 2017 and 27 returning PIT-tagged fish), In addition, there were 61 non-salmonids PIT-tagged prior to release upstream. None of the non-salmonids were detected in the Thompson River after release upstream. Approximately 117 (33%) individual PIT-tagged salmonids were detected in the Thompson River in 2017. Detections of salmonids in the Thompson

River after being released upstream of Thompson Falls Dam included the one Bull Trout recorded at the ladder in 2017, approximately 44 percent of the Brown Trout, 25 percent of the Rainbow Trout, and 38 percent of the Westslope Cutthroat Trout. The proportion of PIT-tagged salmonids released upstream of Thompson Falls Dam and later detected in the same year in the mainstream Thompson River has remained consistent with 39 percent of salmonids in 2015 and 33 percent of the salmonids in 2016, mostly Rainbow Trout and Brown Trout. Many of these fish move from the Thompson Falls Dam to the Thompson River within 1 day with the median time ranging from 2 days (2015) to 7 days (2014).

In 2017, most of the ladder-fish were detected entering the Thompson River in July as was the case in 2016. In 2015, the peak detection of fish entering the Thompson River occurred in late-June and was likely attributed to lower water levels and warmer-than-usual water temperatures in the Clark Fork River. Over the last 3 years, peak flows have occurred earlier in the spring (March and April) compared to most years when the peak flows in the Thompson River occur in May. In future years, fish movement patterns in the Thompson River may shift under "normal" peak flow occurrences. NorthWestern will continue to monitor ladder-fish movement in the Thompson River in 2018.

Bull Trout Incidental "Take"

In 2017, the Licensee collected one Bull Trout at the Thompson Falls fish ladder, which was released live upstream of the dam. This Bull Trout was recorded on September 18 measuring 408 mm and 522 grams (g). The water temperature in the ladder was approximately 15.1 ºC) and Clark Fork River (at the U.S. Geological Survey [USGS] gage station near Plains) was flowing at approximately 8,100 cfs. A PIT tag (# 989001006029199) was implanted prior to its release. A genetic sample (#118-084) was also taken and submitted to Abernathy Lab for analysis, results remain pending at the time of this report.

Baseline electrofishing surveys in the Thompson Falls Reservoir and upstream in the Clark Fork River (above islands reach and Paradise-to-Plains reach) were not completed in 2017. This is scheduled for alternating years, with the next survey to be implemented in 2018. NorthWestern and FWP did electrofish downstream of Thompson Falls Dam in spring of 2017; however, no Bull Trout were recorded.

Since operations at the ladder began in 2011, 16 Bull Trout (*representing 15 individuals*) have ascended the ladder. This includes one Bull Trout that ascended the ladder twice. During the second ascent (2012), the Bull Trout jumped out of a pool and died. This is the only documented Project-related mortality. A cover was initially installed over the holding pool that was later replaced with a screen installed around the railing above the holding pool to mitigate the potential for this to occur in the future.

Since 2011, NorthWestern has recorded 32 individual Bull Trout in the Project area. Sampling has included collecting Bull Trout via electrofishing efforts upstream and downstream of Thompson

Falls Dam, as well as Bull Trout recorded at the ladder. Sampling efforts in the Thompson River drainage are not included in this report because these data are collected and reported by FWP.

Avista Bull Trout Passage and Monitoring

The number of Bull Trout transported by Avista has been documented in each annual report for the Thompson Falls Project since 2009. From 2009 through 2017, Avista captured 99 Bull Trout that were genetically assigned to Region 4 (upstream of Thompson Falls Dam) and transported 70 Bull Trout to Region 4 with an average of approximately eight Bull Trout transported annually to Region 4.

In 2017, Avista captured 48 unique Bull Trout (≥345 mm) downstream of the Cabinet Gorge Hydroelectric Project and transported 36 of the Bull Trout upstream and released them in either the Cabinet Gorge Reservoir (number [n]=6), Noxon Reservoir (n=25), or upstream of Thompson Falls Dam (n=5).

Of the five Bull Trout transported upstream of Thompson Falls Dam, one Bull Trout was released near St. Regis, one Bull Trout was released in the Thompson Falls Reservoir at the Cherry Creek boat ramp, located downstream of the confluence with the Thompson River, and three Bull Trout were released in the Thompson River at the ACM bridge (upstream of the remote mainstem arrays). The three Bull Trout transported by Avista and released in the Thompson River (upstream of the remote array station) were detected upstream of the release location in Fishtrap Creek and later detected downstream of the release location in the mainstem Thompson River in September and/or October 2017.

Total Dissolved Gas (TDG) Monitoring

In 2017, the spring snowpack was much higher in the Lower Clark Fork basin than in recent years. In April 2017, the volume runoff forecast in the Lower Clark Fork basin was approximately 117 percent of normal, below the threshold of 125 percent identified for any additional total dissolved gas (TDG) monitoring. The last TDG monitoring was completed in 2014 (an average water year). Although the 125 percent threshold was not met in April 2017, NorthWestern decided to deploy instruments to monitor TDG in 2017.

TDG in 2017 was lowest above the Project, highest at the first measurement site below the Project (at the High Bridge), and intermediate at the most downstream site at the Birdland Bay Bridge. TDG levels declined downstream of the High Bridge due to mixing with river flow coming through the powerhouse and, potentially, some degassing as the river moves downstream.

TDG upstream of the Project peaked at approximately 109 percent of saturation during 2017. TDG levels at the High Bridge approached 122 percent of saturation, and TDG at the Birdland Bay Bridge site was approximately 118 percent of saturation in 2017. These readings were not as high as in some previous years, such as 2011, when peak discharge exceeded 100,000 cfs and peak TDG was correspondingly higher.

Gas bubble trauma (GBT) was not monitored downstream of Thompson Falls Dam in 2017. No GBT was noted in fish examined at the fish ladder during the spill period.

TAC-Funded Projects

In 2013, the Licensee renewed the Memorandum of Understanding (MOU, 2013) for a 7-year term (January 1, 2014 – December 31, 2020). The MOU was approved and signed by FWS, FWP, CSKT, and the Licensee. The Licensee will provide $100,000 annually for 7 years and allow a maximum of $250,000 to accrue in the account from unspent or transferred annual TAC funds. The Adaptive Management Funding Account (AMFA) is designated for implementation of downstream passage minimization measures in addition to Project License required studies, monitoring activities, reports, upstream fish passage minimization measures, gas abatement monitoring, predator control measures, and other means to reducing impacts on Bull Trout caused by operation of the Project.

In 2017, the Licensee, through the TAC, approved funding for Bull Trout protection, mitigation, or enhancement either in whole or in partnership to the following projects:

- Koch Property Acquisition ($60,000)
- Rattlesnake Dam Removal, Phase 1 ($20,000)
- Thompson River Watershed Coordinator ($16,500)
- Bull Trout Genetics Analysis ($10,000)
- Miscellaneous Contingency Funding ($10,000)

NorthWestern will continue to coordinate with TAC members throughout the year and any proposal(s) submitted during the year will be distributed to the TAC members for review and approval. Projects approved and funded in 2018 will be summarized in next year's annual report.

1.0 Introduction

1.1 Background

NorthWestern Energy Corporation (NorthWestern) is owner and operator of the Thompson Falls Hydroelectric Project (No. 1869) (Project), located on the Clark Fork River near Thompson Falls, Montana. The current Federal Energy Regulatory Commission (FERC or Commission) License was issued to Montana Power Company in 1979 (purchased by PPL Montana in 1999 and subsequently purchased by NorthWestern in 2014) and is scheduled to expire on December 31, 2025.

In 1998, the Bull Trout (*Salvelinus confluentus*) was federally-listed under the Endangered Species Act as a threatened species (Federal Register, 1998). Critical habitat was designated in 2005 and revised in 2010 (Federal Register, 2005, 2010). The U.S. Fish and Wildlife Service (FWS or Service) proposed a revision to the Critical Habitat Designation on January 13, 2010. The Final Critical Habitat Designation Rule for Bull Trout was submitted by FWS on September 30, 2010 and was effective as of November 17, 2010. The Project area is within the designated critical habitat for Bull Trout. Because Bull Trout are present within the Project area, a draft Biological Evaluation was prepared for the Project and submitted to FWS and FERC in 2003.

After 5 years of studies (2003-present), the Licensee filed a new Biological Evaluation with the Commission, discussing the effects of the Project on Bull Trout and proposed conservation measures with the Commission on April 7, 2008. The Biological Evaluation identified several factors directly related to Project operation that negatively impact Bull Trout in the Clark Fork River. Inhibition of upstream migration and subsequent access to spawning habitat by the Project was identified as a major concern. Consequently, the Licensee proposed to install a full-height fishway at the Project and filed 90-percent drawings for the structure on April 7, 2008. The filing also contained a Memorandum of Understanding (MOU) signed by the Licensee, the Confederated Salish and Kootenai Tribes of the Flathead Nation (CSKT), Montana Fish, Wildlife and Parks (FWP), and FWS (MOU, 2008). On November 11, 2013, the Licensee filed the renewed MOU with the Commission. The renewed MOU was developed in consultation with CSKT, FWP, and FWS and is effective from January 1, 2014 through December 31, 2020 (MOU, 2013). The MOU provides terms and conditions regarding the collaboration between the Licensee and the FWS, FWP, and CSKT and the implementation of minimization measures for Bull Trout.

In 2008, the Commission concluded that the Project is adversely affecting Bull Trout and the proposed conservation measures will reduce, but not eliminate, the Project's adverse effects on Bull Trout. The 2008 Biological Evaluation was adopted as the Commission's Final Biological Assessment and submitted to FWS on May 1, 2008.

1.2 Biological Opinion

On November 4, 2008 the FWS filed with the Commission a Biological Opinion (BO) and associated Incidental Take Statement, which includes reasonable and prudent measures and Terms and Conditions (TCs) to minimize incidental take of Bull Trout. The FWS concluded in its BO that the Project is currently adversely affecting Bull Trout and the Licensee's proposed conservation measures will reduce, but not eliminate, adverse impacts of the Project (FWS, 2008).

1.3 FERC Order Approving Construction and Operation

On February 12, 2009 the Commission issued an Order Approving Construction and Operation of Fish Passage Facilities for the Thompson Falls Project (FERC, 2009). This Order included the reasonable and prudent measures, TCs, and conservation recommendations from the FWS's BO (2008).

The FERC Order (February 12, 2009) requires the Licensee to file with the Commission for approval, after development and approval by the FWS and the Thompson Falls Technical Advisory Committee (TAC), study and operational plans referenced in the FWS's TCs 1 through 7. For the Commission to ensure compliance with the FWS's TCs, the Licensee is required to file with the Commission, by April 1 of each year through the remainder of the License, the annual report referenced in Term 7a of the FWS's TCs (*see* Section 9.7.1 for details).

1.4 Phase 2 Evaluation Period (2011-2020)

For the Thompson Falls Project, Phase 2 (2011-2020) is the evaluation period of the Thompson Falls Upstream Fish Passage Facility. As stated in the FWS BO (2008), Phase 2 will, "evaluate the efficiency of the upstream passage facility. The goal will be to assess how effective the ladder is at passing bull trout, the potential length of any delay, the amount of fallback, and the optimal operational procedures to achieve the highest efficiency."

The February 2009 FERC Order required the Licensee develop an upstream fish passage evaluation plan. In cooperation with the TAC and approval by FWS, the *10-year Fish Passage Facility Evaluation Plan, Phase 2 Action Plan, 2011-2020* (Evaluation Plan) (PPL Montana, 2010) was submitted to the Commission in 2010. FERC issued an Order on June 9, 2011 approving the Licensee's Action Plan.

The Evaluation Plan, outlines the Licensee's strategy for evaluating the effectiveness of fish ladder through various studies to be conducted to assess the ability of Bull Trout and other fish to locate the ladder entrance and ascend the ladder.

The Evaluation Plan identified the following objectives:

- Assess the effectiveness of the upstream fish ladder to pass Bull Trout

- Determine the optimal operational procedures to achieve the highest efficiency for upstream bull trout passage
- Assess the potential length of delay for upstream bull trout passage and devise strategies to minimize that delay
- Assess the amount of "fallback"

Effectiveness of the fish ladder will be a qualitative assessment and evaluated based on the annual fish passage, including enumeration of fish using the facility, species using the facility, range and average length and weight of species using the facility, and the timing of movement passage by species (PPL Montana, 2010). Effectiveness of the ladder operations to provide fish passage will be evaluated based on the weir mode studies and optimal attractant flow (NorthWestern Energy, 2017). These studies will also provide data to allow the Licensee to fine-tune the operation of the ladder to optimize fish passage with the ultimate goal of volitional fish passage.

As stated in the Evaluation Plan, results will be included in the Annual Report filed April 1 to FERC each year, as well as the 10-year (2011-2020) comprehensive report scheduled for completion by December 31, 2020. The annual reports provide information which facilitates development of ladder operational protocols to optimize upstream fish passage of Bull Trout and other migratory species. The Evaluation Plan identifies the Annual Report will include, at a minimum, a summary of the following information:

- Total number of fish and species ascending the ladder
- Total number of fish and species passed to Thompson Falls Reservoir
- Most active period(s) for fish and various species ascending the ladder
- Results from the weir vs. orifice study and attraction flow studies
- Total number of fallback
- Bull trout genetic sampling and tributary assignment

1.5 FERC Compliance and Annual Reporting

This annual report is intended to fulfill the annual reporting requirement, as specified in Term 7a of the BO and the requirements of the FERC Order. This report summarizes the Licensee's 2017 activities in Sections 2.0 through 8.0; NorthWestern's compliance with the FWS's TCs of the BO (Section 9.0); and NorthWestern's proposed activities in 2018 (Section 10.0).

2.0 Baseline Fisheries Studies

The baseline fisheries surveys were set up with the intention of monitoring the impact of salmonids passed upstream of Thompson Falls Dam. Baseline fisheries data collection includes fall gillnetting in the Thompson Falls Reservoir, electrofishing the Thompson Falls Reservoir (upper and lower sections) in the spring, and electrofishing two reaches in the Clark Fork River (above the islands and between Paradise and Plains, Montana) in the fall. Gillnetting in the Thompson Falls Reservoir has occurred annually each October, since 2004. Monitoring via electrofishing began in 2010. This report only includes a summary of the 2017 gillnetting efforts since no electrofishing sampling was scheduled for 2017.

The objective for these sampling efforts is to establish baseline information on species composition and relative abundance within and upstream of the Thompson Falls Reservoir. This information helps track annual and long-term changes to the fish community, which is especially important with the full-height fish ladder at the Project that commenced operations in spring 2011. The ladder is one monitoring tool that gives managers the ability to track potential system-wide changes with fish passing into the Thompson Falls Reservoir from downstream.

Between 2011 and 2016, over 2,000 uniquely-tagged salmonids were released upstream of the Thompson Falls Dam. During the same time, between zero and 11 ladder-tagged fish were captured during annual baseline surveys resulting in 24-tagged salmonids recaptured after their release upstream of the dam.

In 2016 the Technical Advisory Committee (TAC) agreed to modify the frequency of the baseline surveys starting in 2017. Gillnet sampling continues to be annual, but electrofishing occurs every other year, with the next sample event scheduled for 2018.

Fish recorded through the baseline fisheries data and upstream fish passage results are listed in Table 2-1 along with each species abbreviation, common name, and scientific name. Tables and figures in this report refer to the species abbreviation provided in Table 2-1.

Table 2-1: Summary of abbreviations for fish identification, species common name, and scientific name.

Fish Abbreviation	Common Name	Scientific Name
BL BH	Black Bullhead	*Ameiurus melas*
BULL	Bull Trout	*Salvelinus confluentus*
EB	Brook Trout	*Salvelinus fontinalis*
LL	Brown Trout	*Salmo trutta*
LMB	Largemouth Bass	*Micropterus salmoides*
LN DC	Longnose Dace	*Rhinichthys cataractae*
LN SU	Longnose Sucker	*Catostomus castostomus*
LS SU	Largescale Sucker	*Catostomus macrocheilus*

Fish Abbreviation	Common Name	Scientific Name
LT	Lake Trout	*Salvelinus namaycush*
L WF	Lake Whitefish	*Coregonus clupeaformis*
MWF	Mountain Whitefish	*Prosopium williamsoni*
NP	Northern Pike	*Esox lucius*
N PMN	Northern Pikeminnow	*Ptychocheilus oregonensis*
PEA	Peamouth	*Mylocheilus caurinus*
PUMP	Pumpkinseed	*Lepomis gibbosus*
RB	Rainbow Trout	*Oncorhynchus mykiss*
RBxWCT	Rainbow x Westslope Cutthroat Trout hybrid	*Oncorhynchus clarkii lewisi and Oncorhynchus mykiss*
RS SH	Redside Shiner	*Richardsonius balteatus*
SMB	Smallmouth Bass	*Micropterus dolomieu*
WCT	Westslope Cutthroat Trout	*Oncorhynchus clarkii lewisi*
WE	Walleye	*Sander vitreus*
YP	Yellow Perch	*Perca flavescens*
YL BL	Yellow Bullhead	*Ameiurus natalis*

2.1 Autumn Gillnetting

The established gillnet sampling sites in the Thompson Falls Reservoir are shown in Figure 2-1. Nylon multifilament experimental sinking gillnets, 38 meters (125 feet) long and 1.8 meters (6 feet) deep, with five separate 7.6-meter (25-foot) panels consisting of 1.9-cm (0.75-inch), 2.5-cm (1-inch), 3.2-cm (1.25-inch), 3.8-cm (1.5-inch), and 5.1-cm (2-inch) square mesh are deployed (Table 2-2).

The 2016 Annual Report (NorthWestern, 2017) contained an error. There were 130 fish captured gillnetting in 2016, not 116 fish as reported. Data from net #10 (8 NP; 3 YP; 2 PUMP; 1 NPMN) was not included in the 2016 Annual Report. A recalculation to include the results from net #10 changes the total fish caught per net in 2016 to 13 fish per net and the average fish per net between 2004 and 2016 to 8.4 fish per net. The species composition in 2016 remained unchanged.

In 2017, nets were set on October 11 between 1:50 and 3:11 PM and pulled approximately 18.7 to 19.1 hours later between 8:40 and 10:12 AM on October 12. The mean catch per net, by species, during the annual gillnetting efforts from 2004 to 2017 is displayed in Table 2-3.

Table 2-2: Summary of gillnetting in Thompson Falls Reservoir from 2004-2017.

Year	# Gillnets	Date Net Set	Date Net Pulled	Total # of Fish Captured	# of Species
2004	6	10/13	10/14	48	8
2005	10	10/13	10/14	79	7
2006	10	10/12	10/13	116	7
2007	10	10/11	10/12	122	9
2008	10	10/8	10/9	59	7
2009	10	10/19	10/20	55	6
2010	10	10/14	10/15	50	9
2011	10	10/5	10/6	33	9
2012	10	10/12	10/13	53	7
2013	10	10/22	10/23	40	6
2014	10	10/15	10/16	62	8
2015	10	10/13	10/14	231	9
2016	10	10/12	10/13	130	6
2017	**10**	**10/11**	**10/12**	**188**	**8**

Table 2-3: Catch per net, by species, during annual October gillnetting series on Thompson Falls Reservoir in 2017 and the average, minimum, and maximum catch per net between 2004 and 2016. A dash indicates no (zero) fish of that species was captured.

Species	2017	2004-2016		
		Avg	Min	Max
BL BH	**11.2**	3.3	-	14.1
LL	**-**	0.0	-	0.2
LMB	**-**	0.1	-	0.3
LN SU	**0.1**	0.1	-	0.5
LS SU	**0.5**	0.8	0.6	1.3
NP	**4.2**	2.4	1.0	4.6
N PMN	**0.9**	0.4	-	1.0
PEA	**-**	0.0	-	0.1
PUMP	**-**	0.3	-	1.8
RB	**-**	0.1	-	0.4
SMB	**0.4**	0.2	-	0.5
WCT	**0.1**	0.0	-	0.2
YP	**1.4**	0.8	0.1	1.8
YL BL	**-**	0.0	-	0.1
Total	**18.8**	8.4	3.3	23.1

In 2017, 188 fish representing eight species were captured during gillnetting efforts. One salmonid, a Westslope Cutthroat Trout was recorded in 2017. No fish recorded in 2017 had any previous markings or tags indicating they had been passed upstream at the Thompson Falls fish ladder. The total catch rate in 2017 was 18.8 fish per net, mostly attributed to Black Bullhead (n=112) and

Northern Pike (n=42). The total number of fish captured in 2017 was more than twice the average for gillnetting efforts completed between 2004 and 2016 (8.4 fish per net). The total number of fish captured since sampling began in 2004 has varied between 33 fish (2011) to 231 fish (2015). Catch rates (number of fish per net) has varied from a low of 3.3 fish per net in 2011 to a high of 23.1 fish per net in 2015 (Figure 2-2).

Additional summary information for annual fall gillnetting efforts between 2005 and 2017 is available in FWP's 2017 report, Thompson Falls Reservoir Gillnetting: 2005-2017 (Terrazas and Kreiner, 2017).

Figure 2-1: Summary of all fish species caught per net during the annual autumn gillnetting in the Thompson Falls Reservoir between 2004 and 2017.

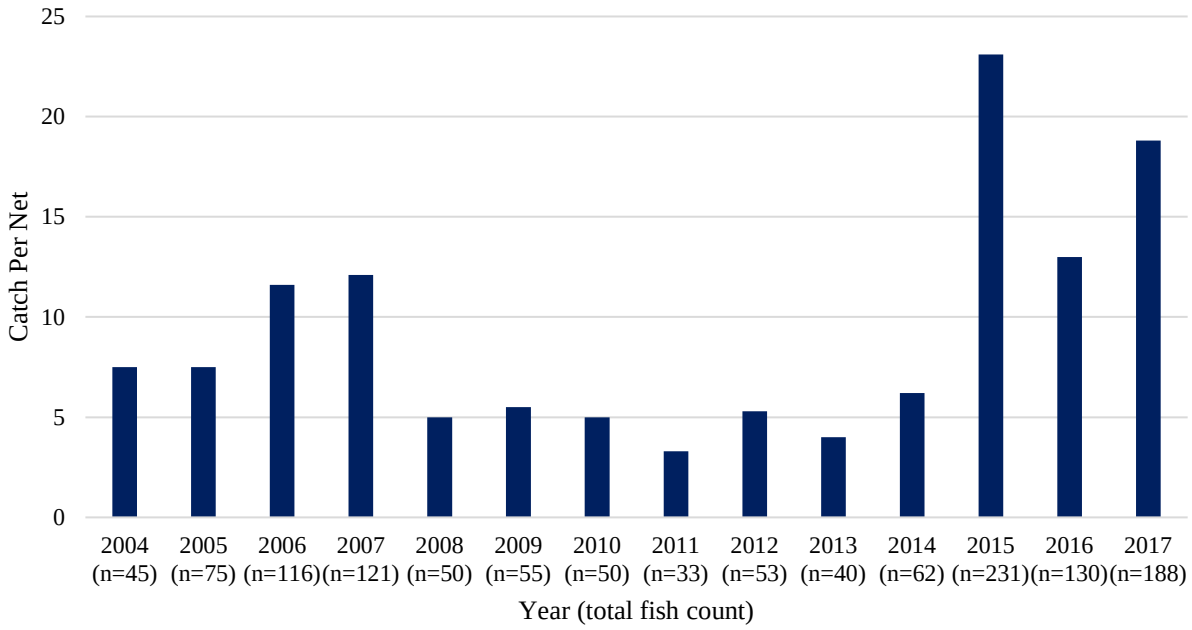
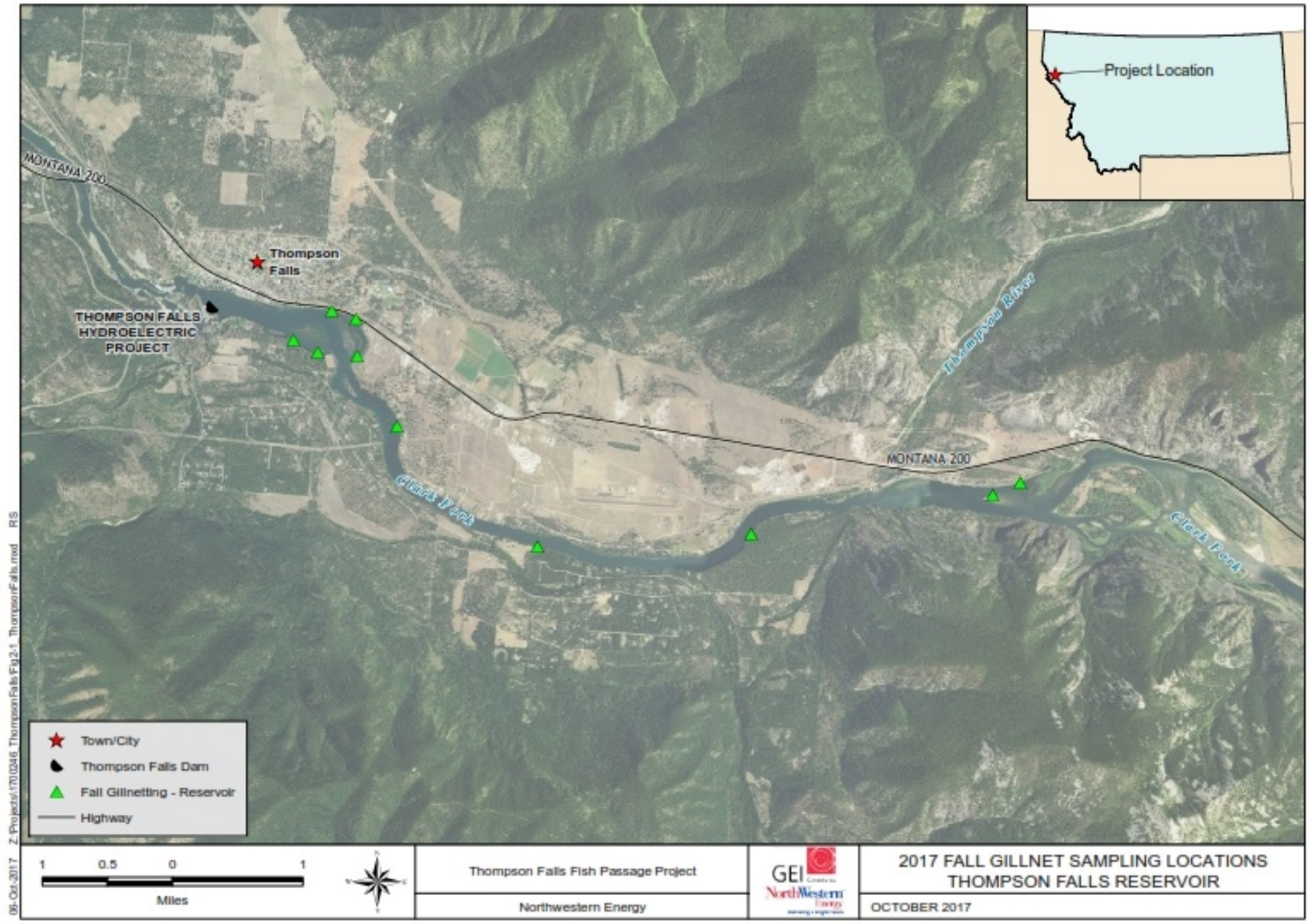


Figure 2-2: Gillnet Sampling Locations in Thompson Falls Reservoir, October 2017.



3.0 2017 Upstream Fish Passage Evaluation

Following construction, Phase 2 for the Thompson Falls Project includes the 10-year (2011-2020) evaluation period of the Thompson Falls Upstream Fish Passage Facility. As stated in the FWS BO (2008), Phase 2 will "…evaluate the efficiency of the upstream passage facility. The goal will be to assess how effective the ladder is at passing bull trout, the potential length of any delay, the amount of fallback, and the optimal operational procedures to achieve the highest efficiency."

In 2010, the Licensee submitted the *10-year Fish Passage Facility Evaluation Plan, Phase 2 Action Plan, 2011-2020* (Evaluation Plan) (PPL Montana, 2010) that was subsequently approved by FERC on June 9, 2011. The Evaluation Plan outlines the seasonal ladder operations, fish tagging and marking protocols, genetic testing for Bull Trout, and the data the Licensee will collect annually at the ladder. The following data are collected annually to evaluate fish passage effectiveness per the Evaluation Plan (PPL Montana, 2010) and in compliance with the FWS Biological Opinion (2008):

- Ladder operations
- Clark Fork River hydrology
- Stream temperatures in the ladder
- Total number of fish and species ascending the ladder and passed upstream
- Fish metrics (length, weight)
- Number of fish returning to the ladder
- Number of "fallback" fish after release upstream of the Thompson Falls Dam
- Timing/duration for fish to ascend the ladder
- Timing/movement patterns of ladder fish moving upstream into the Thompson River
- Weir operations (notch vs. orifice)
- Attractant flow

These data are collected at the ladder to 1) qualitatively evaluate the effectiveness of upstream fish passage at the ladder, 2) evaluate operational procedures (e.g., weir mode and attractant flow), 3) assess the potential for delay, and 4) assess fallback (PPL Montana, 2010).

The Thompson Falls upstream fish passage facility (ladder) became operational in 2011 and has operated for seven seasons (2011-2017). The following sections summarize the total number of fish recorded ascending the ladder between 2011 and 2017, including the number of species, the average and range of length and weights for each species, the number of fish returning to the ladder, the number of "fallback" in 2017, the duration of time it took fish to ascend the ladder, and the timing of the movement and passage of each species.

3.1 2017 Ladder Operations

Since the ladder commenced operations in 2011, the operational season most often starts in mid-March and extends into October, and once extending into early November (in 2015). The operational season depends on weather conditions and when air temperatures are above freezing to allow for equipment to operate properly. In 2017, the operational season lasted 224 days, beginning March 21 and ending October 31.

Ladder closures during the season are generally a result of maintenance issues or high spring streamflows that deposit debris and sediment in the ladder. Since 2011, only one season (2016) did not experience any ladder closures (Table 3-1). The 2017 season represented a more normal water year and streamflows exceeded 80,000 cfs resulting in closure of the ladder for 14 consecutive days (June 2-15). As in previous years, the holding pool at the top of the ladder was typically checked daily (in the morning), except for weekends and holidays (no ladder check), for fish.

In 2011 and 2012, the ladder was operated in alternating weir mode (orifice and notch). In 2013, 2014, and 2015, the ladder was operated in orifice mode for the duration of each season. In 2016, the ladder primarily operated in orifice mode except for 2 weeks in July when operated in notch mode. In 2016, the weir mode was alternated weekly between notch and orifice for a 4-week period (June 30–July 28) when water temperatures exceeded 19 ºC, before returning to orifice mode for the remainder of the year (NorthWestern Energy, 2017). In 2017, the ladder was operated in notch mode for the entire season.

A summary of when the ladder was operating annually between 2011 and 2017, the number of days in each season, the number of days the ladder was closed each season, the number of days the ladder was checked for fish each season, the percentage of the season when the ladder was open that the ladder was checked, the percentage of ladder checks when no fish were recorded, and the annual weir operations is provided in Table 3-1.

Table 3-1: Summary of when the ladder was in operation, 2011-2017.

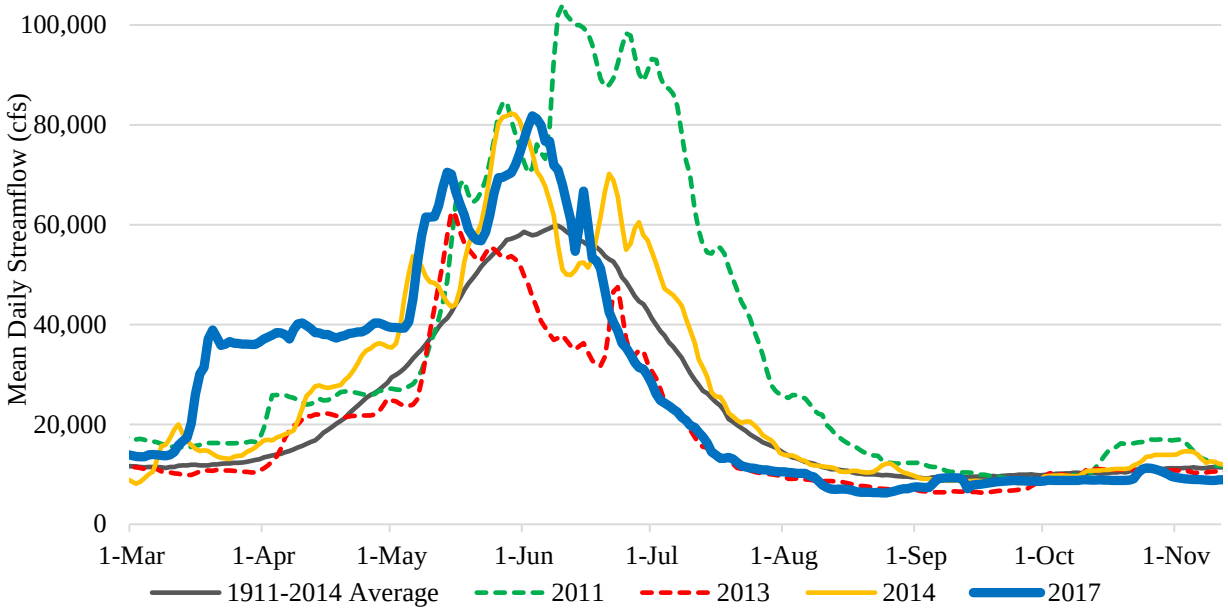
Year	Ladder Season (date opened and closed)	Days in Season	# of Days Ladder Closed During Season	# of Days Ladder was Checked	% of Season When Ladder Operating, Ladder is Checked	% of Ladder Checks with No Fish	Weir Mode (notch and/or orifice)
2011	Mar 17–Oct 17	215	84	114	87%	31%	Alternating Notch and Orifice Mode
2012	Mar 13–Oct 15	216	22	164	85%	43%	
2013	Mar 13–Oct 15	217	14	147	72%	29%	Orifice Mode Only
2014	Mar 28–Oct 21	208	16	132	69%	25%	
2015	Mar 16–Nov 9	238	8	141	61%	10%	
2016	Mar 13–Oct 31	231	None	144	62%	9%	Mostly Orifice Mode Except for 2 weeks in Notch Mode (June 30–July 6 and July 13–20)
2017	**Mar 21–Oct 31**	**224**	**14 (June 2-15)**	**131**	**62%**	**43%**	**Notch Mode Only**

3.2 Clark Fork River Conditions

Mean daily streamflow data are collected by the USGS gage station #12389000 on the Clark Fork River near Plains, Montana (approximately 30 miles upstream of Thompson Falls Dam). The annual hydrograph in the lower Clark Fork River has varied greatly since ladder operations commenced in 2011. The area has experienced higher than average streamflows in 2011, lower than average streamflows in 2013, 2015, and 2016, and closer to average streamflows in 2012, 2014, and 2017. The long-term (1911-2014) average peak streamflow is approximately 60,000 cfs and occurs between the end of May and early June. Peak streamflows between 2011 and 2017 vary, occurring as early as May 15 in 2013 and as late as June 20 in 2012. Actual peak flows at Thompson Falls Dam are likely higher than measurements at the USGS station near Plains with the contribution of other sources such as tributaries (e.g., Thompson River) and groundwater.

Figure 3-1 illustrates the streamflow variability observed over time, with the high streamflows in 2011, the below average streamflows in 2013, the normal streamflows observed in 2014, and the long-term average (1911-2014) compared to the mean daily streamflows in 2017. Hydrographs for each year of ladder operation are available in the respective annual reports.

Figure 3-1: Mean daily streamflow from March 1 through November 1 in the lower Clark Fork River measured at the USGS gage #12389000 near Plains, Montana in 2017 compared to a high-water year (2011), low-water year in 2013, normal-water year in 2014, and the 1911-2014 average.



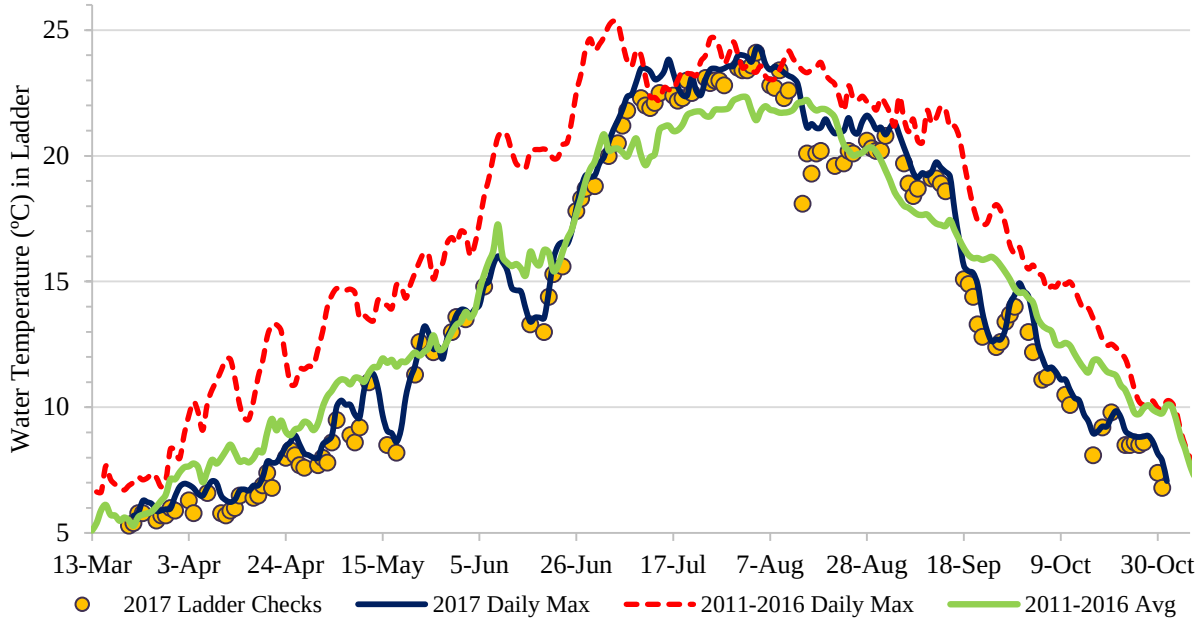
In the lower Clark Fork River basin, snowpack in 2017 was slightly above average and spring precipitation in March was at a record-high in the Thompson Falls area. As a result, streamflows in mid-March increased quickly and were sustained through April, near 40,000 cfs, before snow melt occurred in May. On June 3, streamflows peaked at 82,100 cfs. Peak flows in 2017 were

similar to peak flows in 2014 (Figure 3-1); however, with the dry and hot summer conditions, streamflows declined more quickly in 2017. In July 2017, streamflows declined quickly and conditions were more like 2013 (Figure 3-1).

During each operating season, water temperatures in the ladder were recorded through a combination of a single measurement (coinciding with each ladder check) and continuously recording thermographs. Each year water temperatures (in °C) are recorded in the upper most pool (pool 48) in the ladder and air temperatures are recorded at the work station located at the top of the ladder. Thermographs were set to record air and water temperature on a timed interval. In 2017, air and water temperatures were collected hourly. In previous years, during operational interruptions and maintenance activities resulting in period(s) of ladder closure, water temperature data was not available when water was not flowing in the ladder. In 2012, there was a technical issue with the continuous recording thermographs in pool 48, resulting in air and water temperature readings being taken during each ladder check at the workstation only.

In 2017, the loggers recording the air and water (in pool 48 and the reservoir) temperatures collected data between March 17 and October 31, 2017. The water temperature recorded during each ladder check and daily maximum water temperature collected in 2017 compared to the daily maximum and daily average water temperatures collected between 2011 and 2016 is shown in Figure 3-2.

Figure 3-2: Summary of water temperatures recorded during each ladder check and maximum daily water temperatures in 2017 compared to the 2011-2016 daily maximum and average water temperatures collected at the Thompson Falls Fish Ladder (pool 48).



A summary of the peak streamflow (per USGS gage #12389000) and maximum daily water temperatures recorded in the ladder between 2011 and 2017 is provided in Table 3-2. The annual

peak streamflow has varied from 36,600 to 104,000 cfs and the maximum daily temperature has varied from 22.2 to 25.4 ºC. The warmest water year and lowest peak flow both occurred in 2015. The coolest water year and highest peak flow both occurred in 2011.

Table 3-2: Summary of the annual peak streamflow in the Clark Fork River (USGS gage #12389000) near Plains and maximum daily temperature recorded in the ladder, 2011-2017.

Year	Peak Streamflow	Peak Streamflow Date	Max Daily Water Temperature (ºC)
2011	104,000	June 10	22.2*
2012	75,300	June 20	22.8
2013	63,700	May 15	24.7
2014	82,800	May 29	23.6
2015	36,600	June 11	25.4
2016	44,100	May 27	24.5
2017	82,100	June 3	24.3

***2011 temperature data not available for most of June, July, and August due to ladder closure.**

3.3 Bull Trout Ascending the Ladder

Between one and five Bull Trout have been recorded annually at the ladder (Table 3-3). A comprehensive summary of Bull Trout documented at the ladder and Licensee's sampling record of Bull Trout in the Project area is provided in Section 5.0.

3.4 Fish Count

Between 2011 and 2017, 30,845 fish have been recorded at the ladder representing 14 species plus three hybrids (Table 3-3). In 2017, 530 fish representing seven species plus two hybrids were recorded at the ladder including one Bull Trout. Unlike previous years, no Mountain Whitefish were recorded at the ladder in 2017.

Fish counts have varied from a low of 530 fish in 2017 to a high of 11,647 fish in 2015. Annual variability in river conditions and ladder operations (*refer to* Section 3.2) likely contribute to the irregularity observed in the annual fish count. The total number of fish captured by species annually, in weir mode, and general river conditions based on streamflows and water temperatures (average, above average, below average) is summarized in Table 3-3.

Since operations began in 2011, Lake Trout and Walleye have never been authorized by FWP for release upstream of Thompson Falls Dam. In 2016, the Licensee, in consultation with FWP, ceased release of Brook Trout and/or Brook Trout x Bull Trout hybrids upstream of Thompson Falls Dam. In 2017, no Lake Trout, Walleye, or Brook Trout x Bull Trout hybrids were recorded entering or ascending the ladder.

Table 3-3: Summary of all fish species recorded at the ladder annually, as well as weir mode (notch or orifice), and river conditions between 2011 and 2017.

Year	2011	2012	2013	2014	2015	2016*	2017
Weir Mode	Weir Modes Alternate Weekly		Orifice only (*except in 2016, 2 weeks in notch mode)				Notch only
River conditions	Above Avg	Avg	Below Avg	Avg	Below Avg	Below Avg	Avg
Species							
BULL	2	2	5	1	2	3	**1**
EBxBULL	-	-	-	-	-	1	**-**
EB	-	-	-	1	2	1	**-**
RB	164	208	213	187	281	366	**181**
RBxWCT	9	7	13	12	4	5	**1**
WCT	21	21	48	36	37	36	**14**
LL	28	42	111	81	184	204	**108**
LS SU	418	1,403	3,041	2,802	6,327	2,270	**34**
LN SU	10	0	2	1	26	6	**-**
MWF	17	24	2	254	54	8	**-**
NPMN	1,000	926	387	1,003	3,356	707	**66**
PEA	-	-	-	-	120	2	**-**
PEAxNPMN	-	-	-	-	2	13	**2**
SMB	135	34	8	1,356	1,244	1,007	**123**
LMB	-	-	-	-	-	1	**-**
LT	1	1	-	1	6	-	**-**
WE	-	-	-	-	2	-	**-**
Native Fish	**1,468**	**2,376**	**3,485**	**4,097**	**9,924**	**3,045**	**117**
TOTAL	**1,805**	**2,668**	**3,830**	**5,735**	**11,647**	**4,630**	**530**

Over the last 7 years of ladder operations, 30,687 fish (2,973 salmonids and 27,722 non-salmonids) were released upstream of Thompson Falls Dam and 158 fish (112 non-salmonids, 46 salmonids) were not released upstream (Table 3-4). Of the 46 salmonids not released upstream, 10 fish (9 LT; 1 EBxBULL) were not authorized to be released upstream and the remaining 36 salmonids were recorded as mortalities at the ladder (15 RB; 17 LL; 2 MWF; 1 WCT; 1 BULL). Over half of the mortalities (79 non-salmonids, 3 salmonids) documented at the ladder in the last 7 years occurred during the first season of operation. The mortalities recorded in 2011 were primarily related to inexperience in operating the mechanical equipment during the first season of operation. Mechanical-related mortalities have declined substantially in subsequent years. In 2017, eight mortalities were recorded at the ladder, including six Brown Trout and one Rainbow Trout on July 9 and one Westslope Cutthroat Trout on October 31. The mortalities on July 9 appeared to be related to mechanical issues with the vertical crowder. The mortality on October 31 resulted from human error.

In 2017, 522 fish were released upstream; with 358 fish (68%) were released upstream with PIT tags (331 newly PIT-tagged and 27 returning PIT-tagged fish). About 33 percent of the 297 PIT-

tagged salmonids released upstream in 2017 were detected in the Thompson River in 2017 (*refer to* Section 4.2). An annual summary of the total fish count at the ladder, the number of fish released upstream, and the number of fish PIT-tagged at the ladder is provided in Table 3-4.

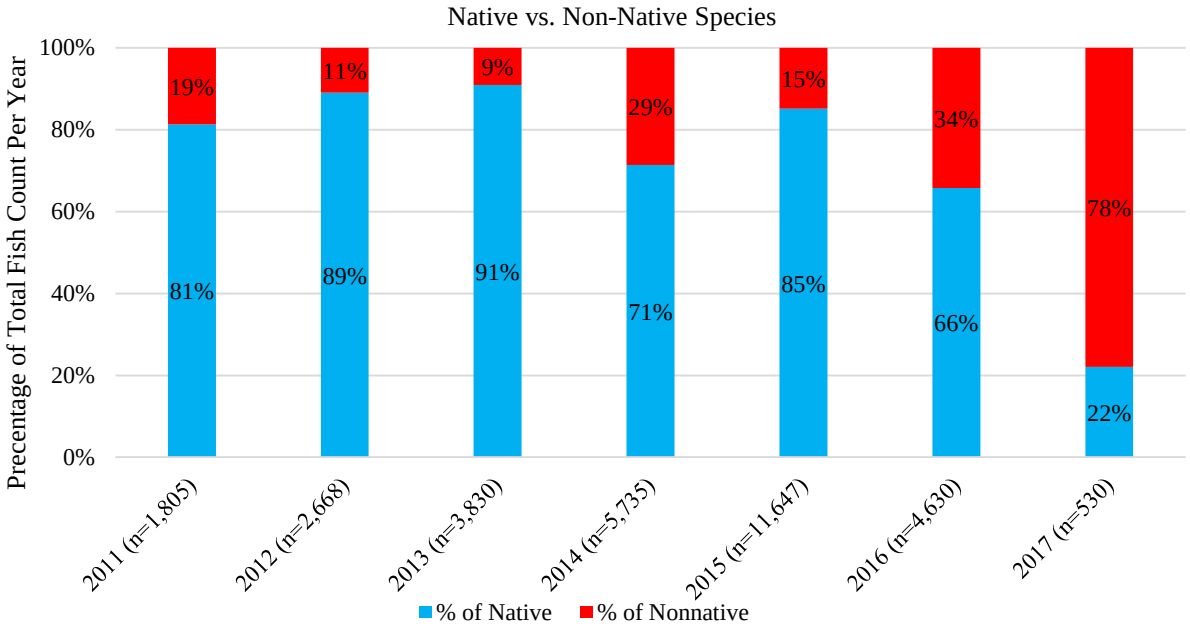
Table 3-4: Summary of the annual totals between 2011 and 2017 for the number of fish recorded at the ladder, total number of salmonids and non-salmonids at the ladder, the total number of PIT tags implanted in salmonids and non-salmonids per year, and the number of fish released upstream.

Year	Total Fish Count	Total Salmonids Count	Total Non-Salmonids Count	Salmonids with New PIT Tags	Non-Salmonids with New PIT Tags	Number of Fish Released Upstream
2011	1,805	242	1563	216	9	1,723
2012	2,668	305	2363	256	-	2,660
2013	3,830	392	3438	344	-	3,818
2014	5,735	573	5162	258	-	5,733
2015	11,647	570	11077	483	-	11,620
2016	4,630	624	4006	525	-	4,611
2017	**530**	**305**	**225**	**270**	**61**	**522**
TOTAL	**30,845**	**3,011**	**27,834**	**2,352**	**70**	**30,687**

3.5 Species Composition

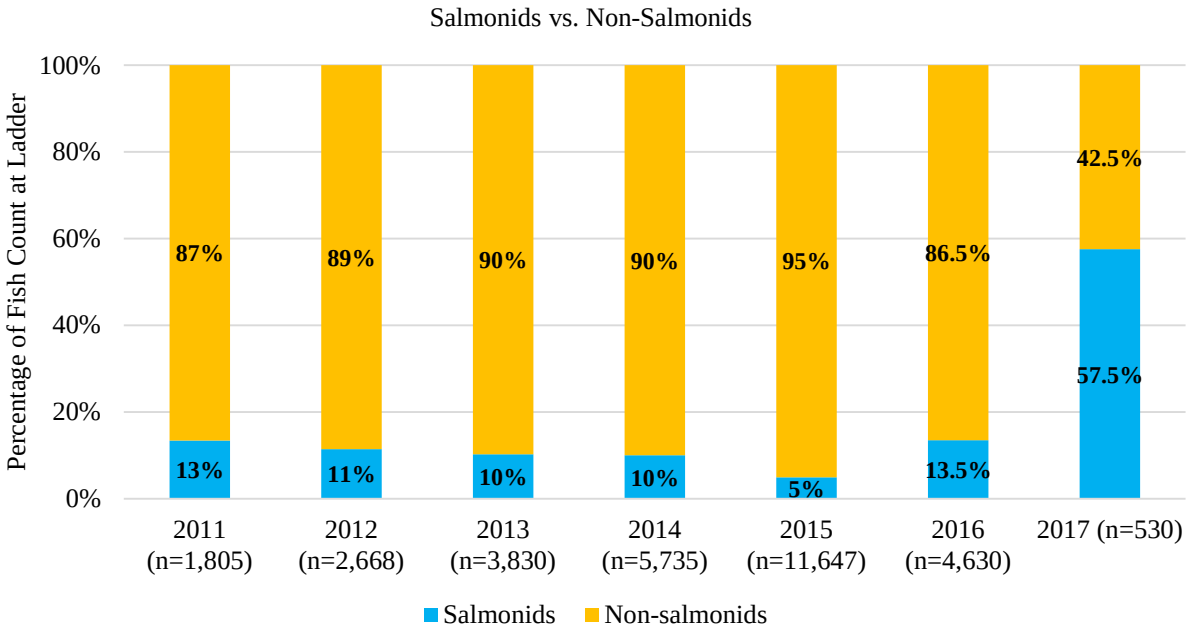
Approximately 80 percent of the fish recorded at the ladder since 2011 were represented by native species (BULL, WCT, MWF, LS SU, LN SU, NPMN, PEA, NPMN, NPMNxPEA). Between 2011 and 2016, native species represented between 66 and 91 percent of the fish count annually at the ladder (Figure 3-3). In 2017, the percentage of native species declined to 22 percent (Figure 3-3). River conditions in 2017 were considered average and comparable to previous years such as 2012 and 2014.

Figure 3-3: Composition of native versus non-native species that ascended the Thompson Falls fish ladder annually, 2011-2017.



In 2017, salmonids represented over half of the fish documented at the ladder, which was a large increase from previous years when salmonids generally represented 5 to 13 percent of the total fish count (Figure 3-4). Weir operations in notch mode for the entire 2017 season were likely the cause of this shift in species composition.

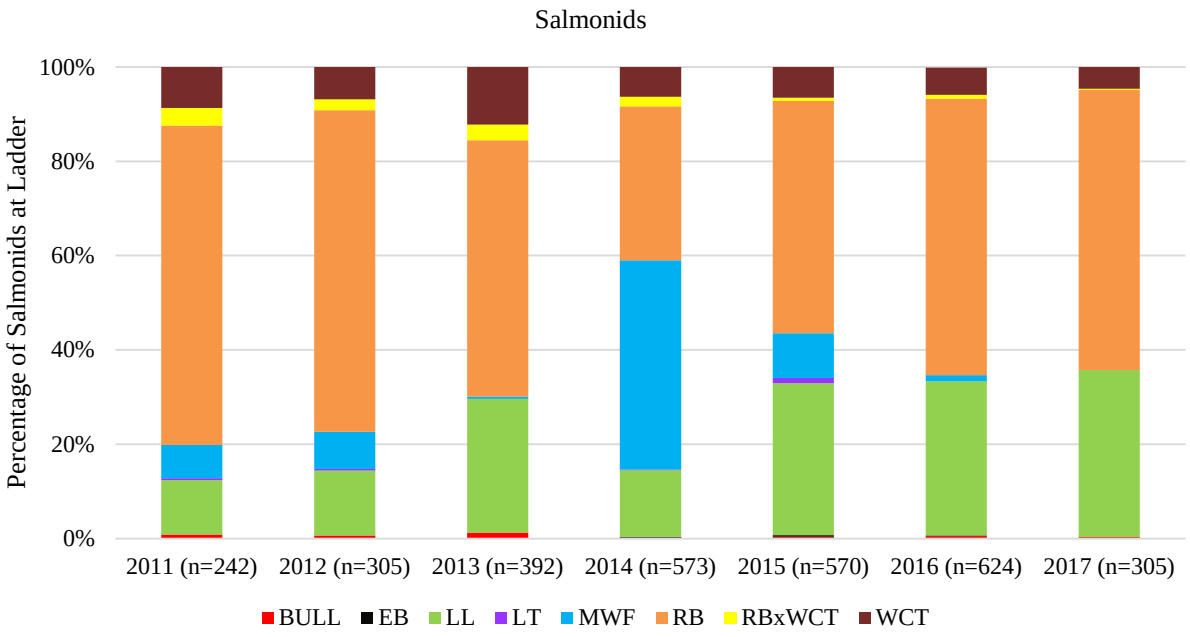
Figure 3-4: Composition of salmonid versus non-salmonids species that ascended the Thompson Falls fish ladder annually, 2011-2017.



Although the proportion of salmonids species in 2017 was higher than previous years, the total number of salmonids (n=305) was lower compared to the 4 previous years (2013-2016) when the ladder was primarily operated in orifice mode. Salmonid totals in 2017 were more similar to 2011 (n=242) and 2012 (n=305) numbers when ladder operations alternated the weir mode (orifice and notch) weekly.

The species composition of salmonids remained similar to previous years except for the notable absence of Mountain Whitefish in 2017 (Figure 3-5). Rainbow and Brown Trout continue to be the most common salmonid observed at the ladder annually. The percentage of Westslope Cutthroat Trout is relatively consistent each year with the lowest total count occurring in 2017 while operating in notch mode and the highest numbers per year occurring between 2013 and 2016 when the ladder operated in orifice mode (*refer to* Table 3-3). Bull Trout continue to ascend the ladder annually varying from 1 to 5 fish per year. The number of Bull Trout documented at the ladder are too low to determine any trend or correlation, but continued annual ascent is a positive result.

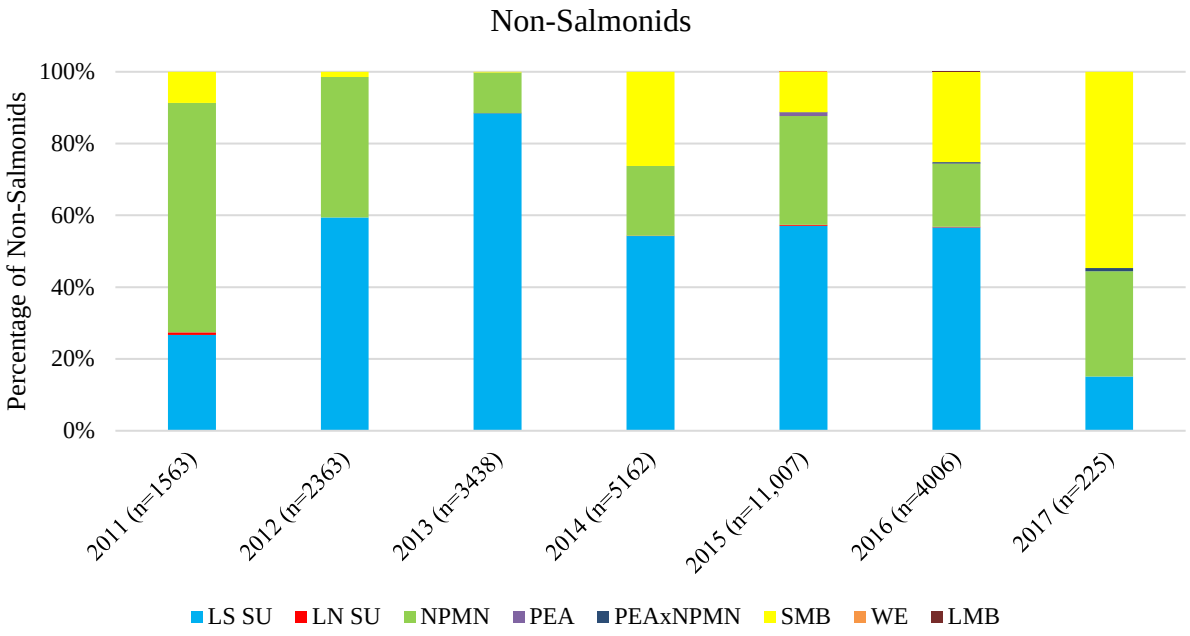
Figure 3-5: Composition of salmonid species that ascended the Thompson Falls fish ladder annually, 2011-2017.



Non-salmonid species composition in 2017 compared to previous years shifted with the lowest percentage of Largescale Sucker and Northern Pikeminnow recorded since 2011 (Figure 3-6). The total number of non-salmonids recorded at the ladder in 2017 was 225, which was the lowest count since operations began (*refer to* Table 3-4). In 2017, non-salmonids represented in order of abundance (from high to low) included Smallmouth Bass, Northern Pikeminnow, Largescale Sucker, and Peamouth x Northern Pikeminnow hybrid (*refer to* Table 3-3). Although Smallmouth Bass was the most abundant non-salmonid in 2017, their numbers were about one-tenth of their annual totals in 2014, 2015, and 2016 when ladder operations were in orifice mode and more

similar to 2012 totals when weir mode alternated weekly. The variability in the annual number of Smallmouth Bass appears to be related to weir mode operations with more Smallmouth Bass generally observed at the ladder during orifice mode apart from the 2013 results (*see* Table 3-3). In 2013, the ladder operated in orifice mode and only eight Smallmouth Bass were documented at the ladder, the lowest number of Smallmouth Bass recorded since operations began in 2011. FWP data indicate that the paucity of Smallmouth Bass in 2013 was related to a low recruitment class resulting from the high flows in 2011 (FWP, unpublished data).

Figure 3-6: Composition of non-salmonid species that ascended the Thompson Falls fish ladder annually, 2011-2017.



3.6 Fish Metrics

Fish measurement protocols at the ladder have been consistent since 2011, with the goal of measuring all salmonids ascending the ladder for total length in millimeters (mm) and weight in grams (g). Non-salmonids are also measured for total length and weight, with sub-samples applied when large groups of non-salmonids enter the ladder at once.

For the last seven seasons (2011-2017), length and weight measurements were documented for approximately 36 percent of the 30,845 fish recorded at the ladder. Between 2011 and 2017, the size of salmonids (2,987 fish measured) recorded at the ladder range from a minimum of 107 mm to a maximum of 785 mm. The size of non-salmonids (8,355 fish measured) recorded at the ladder range from a minimum of 82 mm to a maximum of 610 mm. In 2017, the size of fish recorded at the ladder varied from 90 to 584 mm, with the average salmonid size by species varying between 272 to 408 mm and the average non-salmonid size by species varying between 246 and 425 mm. A summary of the 2017 mean and range of length and weight measurements collected for each fish species is provided in Table 3-5.

Table 3-5: Summary of the mean and range of lengths (mm) and weights (g) for each fish species recorded at the ladder in 2017.

Species	Count	Mean Length (mm)	Length (mm) Range	Mean Weight (g)	Weight (g) Range
BULL	1	408	-	522	-
RB	181	380	165-538	591	42-1518
RBxWCT	1	272	-	182	-
WCT	14	377	269-478	554	212-1094
LL	108	386	156-584	600	38-1740
LS SU	34	425	303-493	801	320-1326
N PMN	66	341	123-488	360	12-1172
PEA x NPMN	2	316	295-338	280	212-348
SMB	122	246	90-430	187	23-1060

The average length and weight for species measured between 2011 and 2016 compared to species recorded and measured in 2017 is shown in Figures 3-7 and 3-8, respectively. Species not present in 2017 include Brook Trout, Brook Trout x Bull Trout hybrid, Mountain Whitefish, Lake Trout, Longnose Sucker, Peamouth, Largemouth Bass, and Walleye. *Refer to* the 2016 Annual Report (NorthWestern Energy, 2017) regarding size measurements for all species recorded at the ladder between 2011 and 2016.

Figure 3-7: Average length and standard deviation for species measured at the ladder between 2011 and 2016 compared to 2017. Graph does not include species not allowed to be released upstream (LT, WE, EB, EBxBULL)

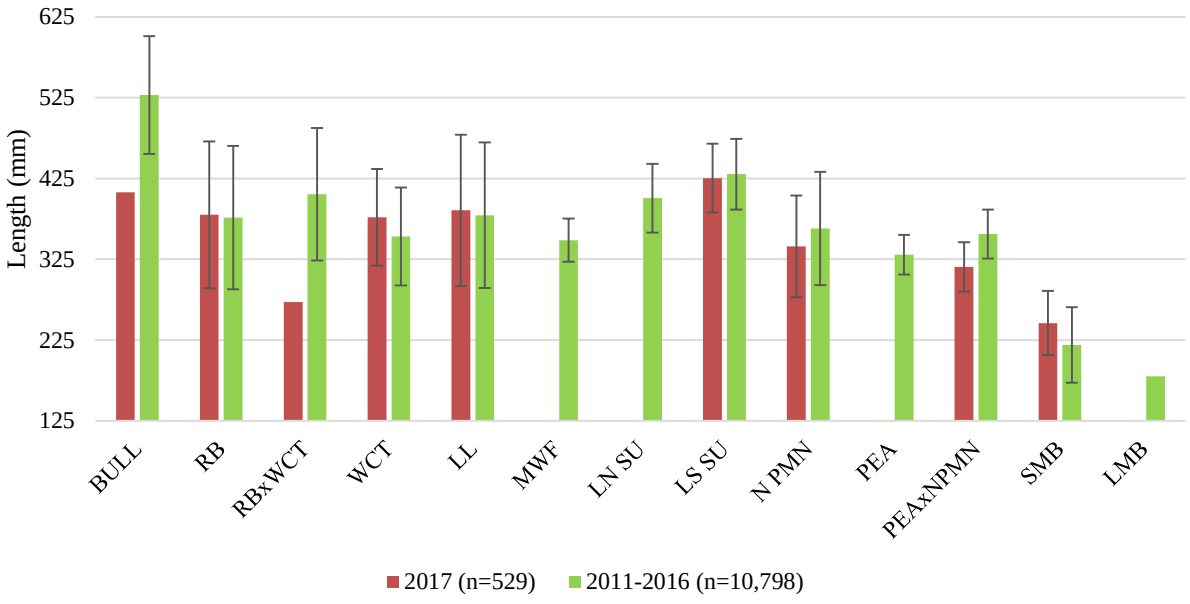
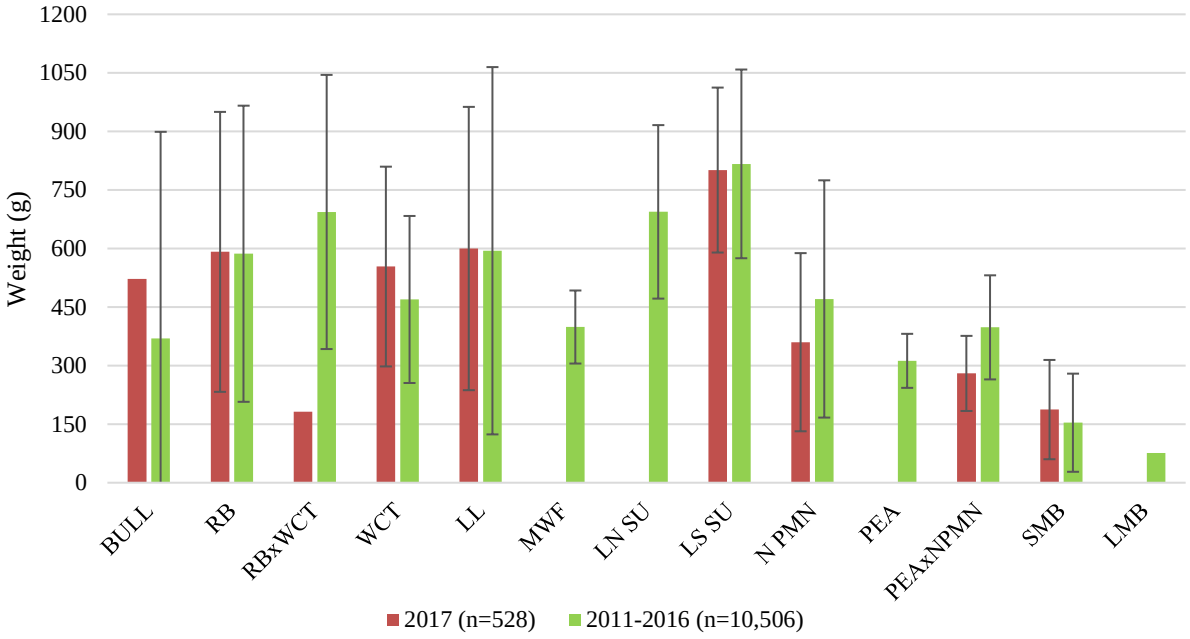


Figure 3-8: Average weight and standard deviation for species measured at the ladder between 2011 and 2016 compared to 2017. Graph does not include species not allowed to be released upstream (LT, WE, EB, EBxBULL)



3.7 Movement Patterns

In the Evaluation Plan, one component of evaluating fish passage effectiveness includes an analysis of each species timing of movement and upstream passage (PPL Montana, 2010). Figures of species movement patterns at the ladder in past years (2011-2016) compared to 2017 are presented in Appendix A. The data of individual species show how some species like Rainbow and Brown Trout are observed throughout the operational season with peak presence in June/July and other species such as Mountain Whitefish, Largescale Sucker, Peamouth, and Smallmouth Bass show a preference to specific times of year that may coincide with other factors such as streamflow and/or water temperature. The movement patterns of individual species show fish movement at the ladder is unlikely to be solely related to migration for spawning, but may also be related to other factors such as food availability, predator-prey relationships, seasonal refugia, etc.

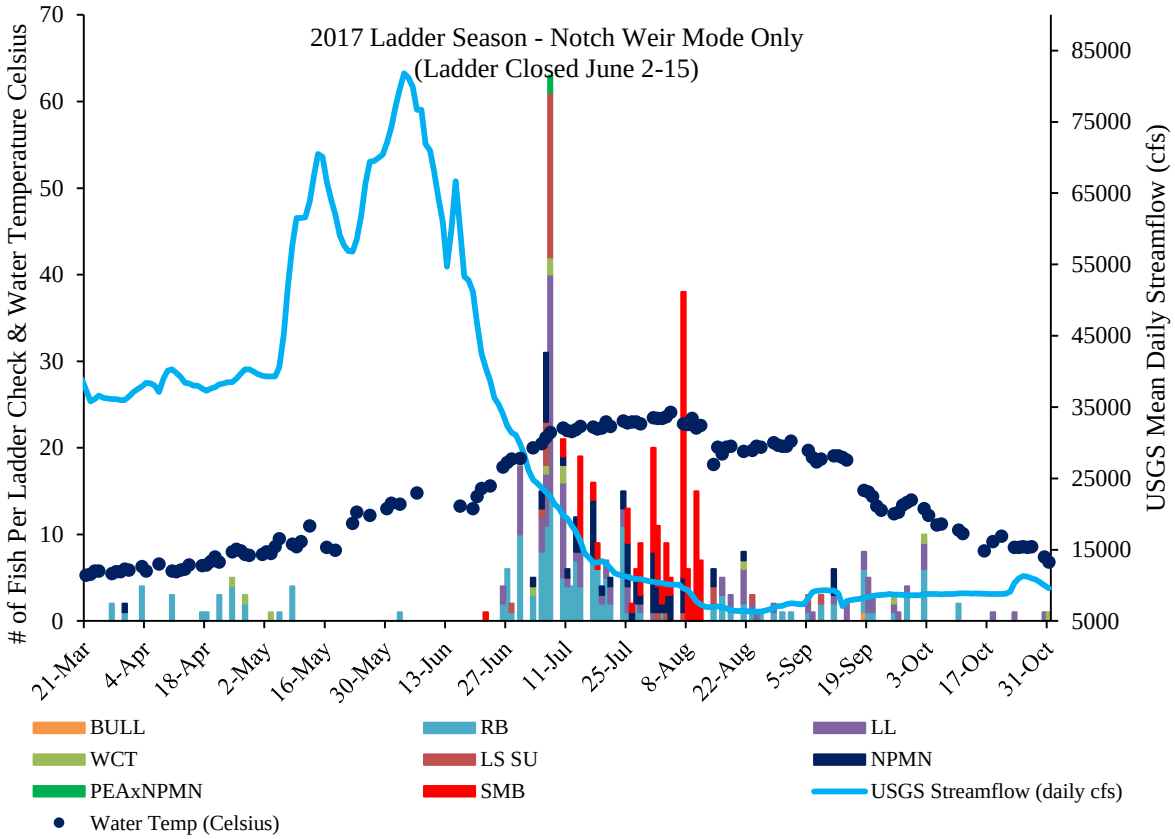
Fish movement is likely influenced by a myriad of elements such as, but not limited to, thermal regime, hydrologic regime, life history cycle, attractant flow at the ladder, ladder operations (e.g., closures or weir mode), and/or other physical or biological factors. Although there are several potential factors working in concert to influence fish movement and behavior, streamflow and water temperature are the primary elements discussed in the following sections. Weir mode appears to be a factor (as previously mentioned); the weir mode analysis of comparable hydrologic years is provided below, in Section 3.12.

The following sections group fish movement patterns into categories of salmonids and non-salmonids and seasonal movement patterns observed as they related to streamflow and/or water temperature.

3.7.1 Seasonal Movement Patterns

Over the last 7 years (2011-2017) of ladder operations, seasonal trends in fish movement at the ladder are apparent even with the annual variability in the number of fish observed at the ladder and physical river conditions (streamflow and water temperatures). Salmonids and non-salmonids recorded at the ladder between 2011 and 2017 display distinct and different movement strategies (*refer to* Appendix A for detailed figures for each species). Salmonids have ascended the ladder in all months of operation and peak in early summer (June/July) while non-salmonids are most common in warmer water months and less common in the spring and fall months when water temperatures are cooler. In 2017, the number of fish at the ladder peaked in early July with the declining limb of the hydrograph and water temperatures exceeding 20 ºC (Figure 3-9). The number of salmonids peaked in early July while the number of non-salmonids peaked in early August.

Figure 3-9. Fish, by species recorded at the ladder in 2017, including mean daily streamflow (USGS gage near Plains, Montana) and water temperature data collected in pool 48 in the ladder.



Seasonal movement patterns, based on the percentage of salmonids and non-salmonids recorded at the ladder each month, in 2017 compared to previous years are shown in Figures 3-10 and 3-11, respectively. Salmonids consistently ascend the ladder in all months of operation (2011-2017), but peak movement occurs in July. This was true in 2017 and in previous years (Figure 3-10). The key difference between 2017 data and previous years (2011-2016) was the lack of fish recorded at the ladder in the spring (March through May) and fall (September and October) months in 2017. As previously mentioned, some potential causes for the lower numbers of fish in the spring and fall 2017 may be related to the weir operation in notch mode in 2017 in contrast to previous years, as well as river conditions. Bull Trout passage at the ladder in 2017 (1 Bull Trout) was within the range of previous years (1 to 5 Bull Trout per year), but the timing of movement was different than previous years. In 2017, the Bull Trout ascended the ladder in mid-September. Most Bull Trout ladder ascents have occurred in the spring (except for one Bull Trout in August 2013) (*refer to* Section 5.2 for details). In spring 2017, streamflows were much higher than previous years and kept water temperatures cool. In fall 2017, water temperatures dropped quickly compared to previous years and fewer fish were recorded at the ladder and Mountain Whitefish were absent.

Non-salmonids are most often observed in the ladder between the months of May and August (Figure 3-11). The peak movement into the ladder for non-salmonids appears to be related to water temperatures. The presence of non-salmonids in May and June occurred during years when streamflows were lower than normal and water temperatures were above 11 ºC. In 2017, streamflows were higher in the spring and the spring freshet was over 80,000 cfs in early June; thus peak movement for non-salmonids in 2017 occurred in July and August when streamflows had declined and water temperatures had warmed. Also, the species composition of non-salmonids changed from predominantly Largescale Sucker and Northern Pikeminnow in previous years (2011-2016) to predominantly Smallmouth Bass in 2017. This shift in species composition may also have contributed to shift of the peak movement to July and August in 2017 compared to previous years. Smallmouth Bass appear to prefer a warmer stream temperature than some of the native non-salmonids. Weir operations in 2017 (notch mode) is likely a key cause to the shift in non-salmonid species composition and resulting shift in peak movement pattern.

Figure 3-10. Percentage of salmonids per month in 2017 (top graph) and 2011-2016 (bottom graph).

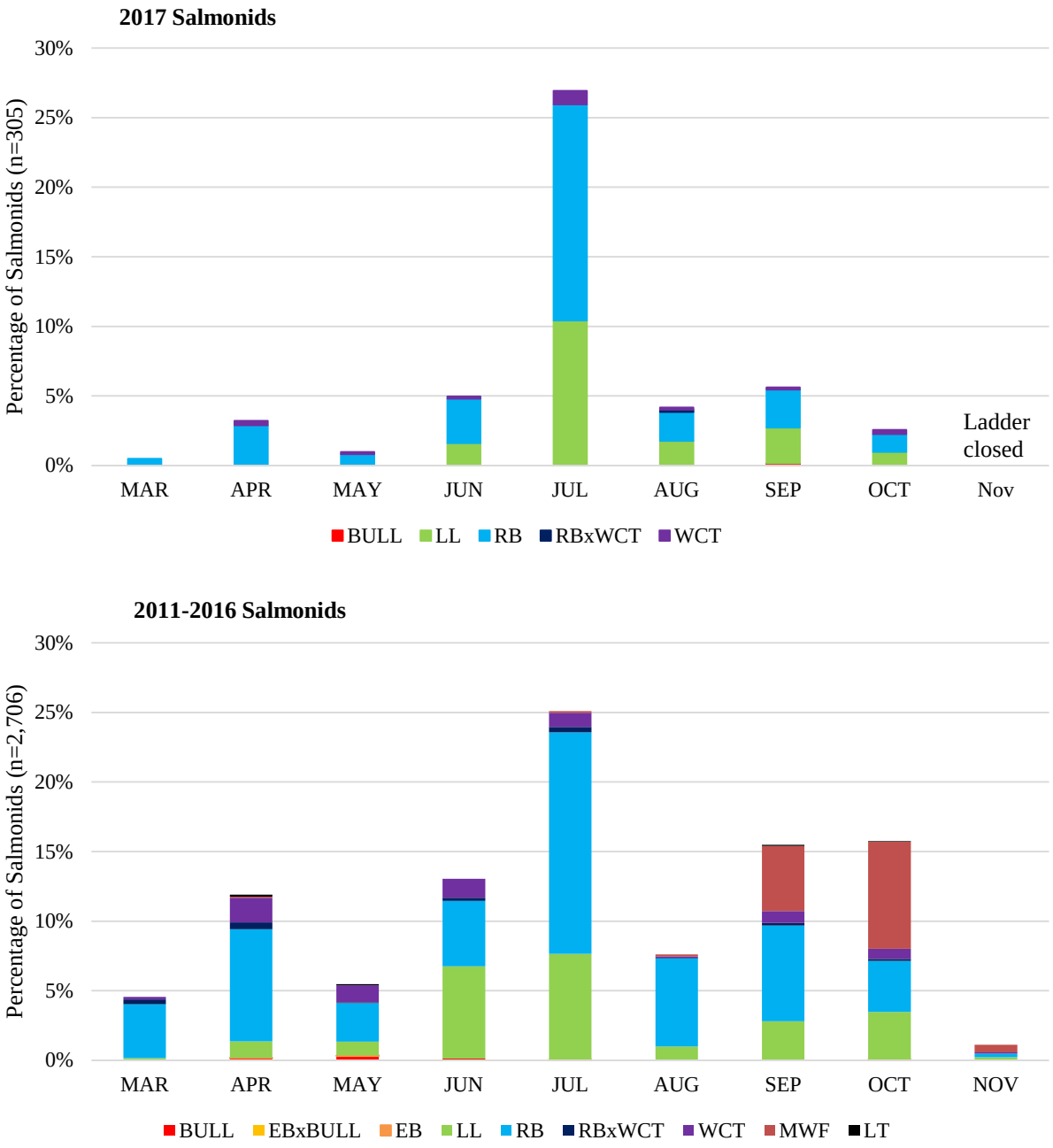
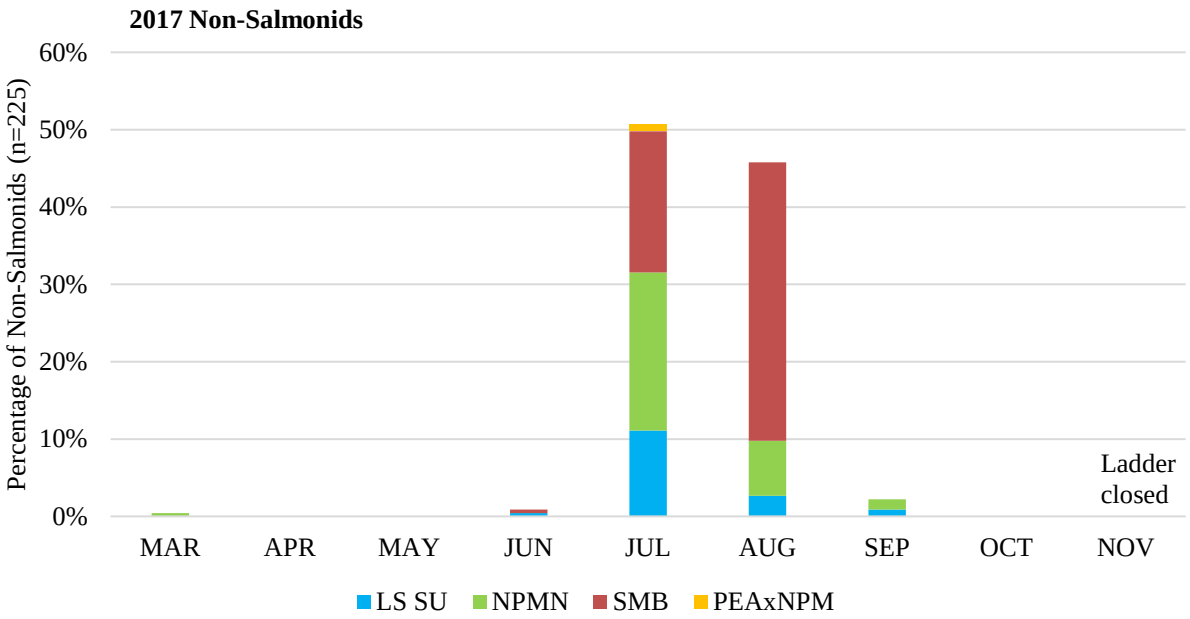
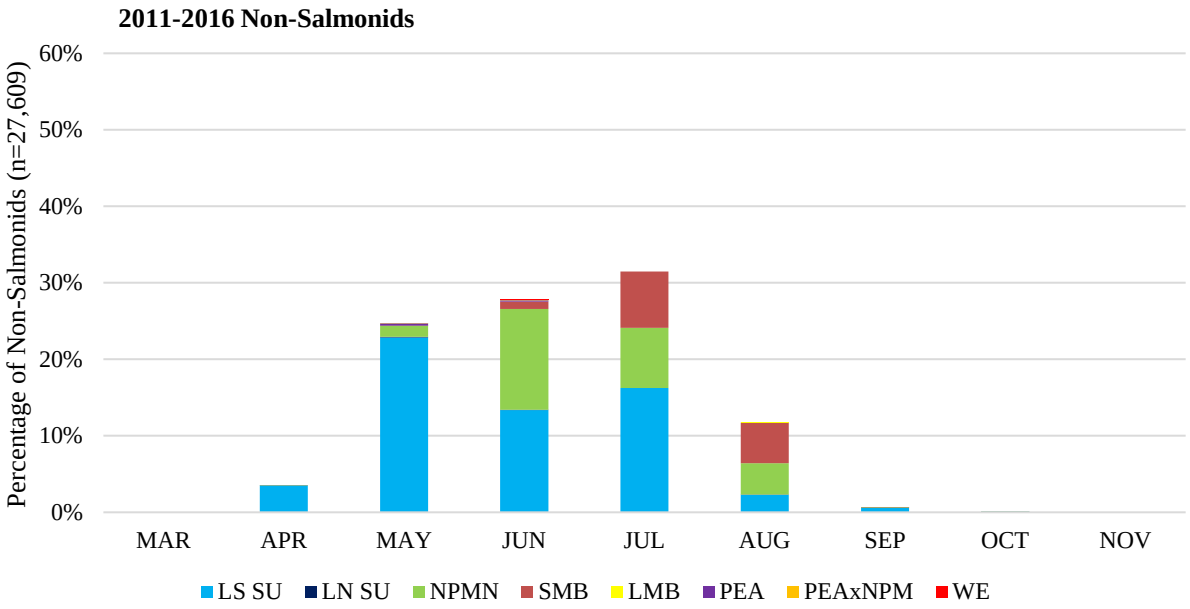


Figure 3-11. Percentage of non-salmonids per month in 2017 (top graph) and 2011-2016 (bottom graph).





3.7.2 Seasonal Movements and Weir Operations

Fish movement to the ladder and weir mode were evaluated for salmonids and non-salmonids. The analysis excludes 2011 data because the ladder was closed for nearly 2.5 months (late May–late August). Fish movement in November is limited to 9 days of ladder operations in 2015. Figures 3-12 and 3-13 show the monthly percentage of the total salmonids and non-salmonids,

respectively per season(s) when operating in alternating weir modes (2012), operating in orifice mode (2013-2016), and operating in notch mode (2017).

Figure 3-12: Percentage of salmonids recorded monthly per respective season at the ladder in 2012 (alternating weir mode weekly), cumulatively between 2013-2016 (orifice mode), and in 2017 (notch mode).

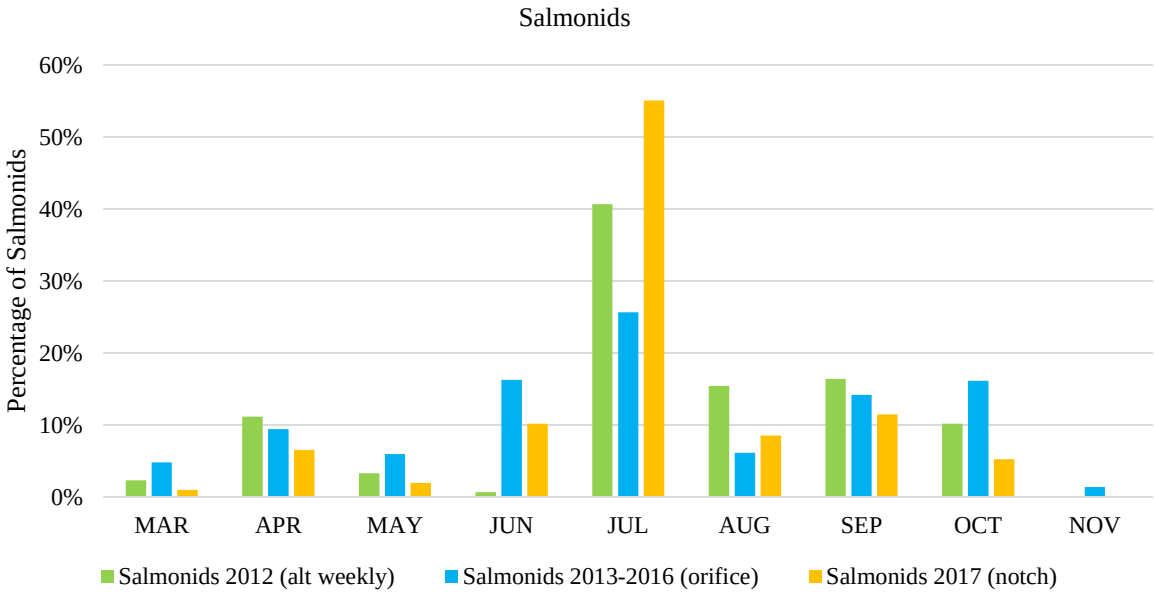
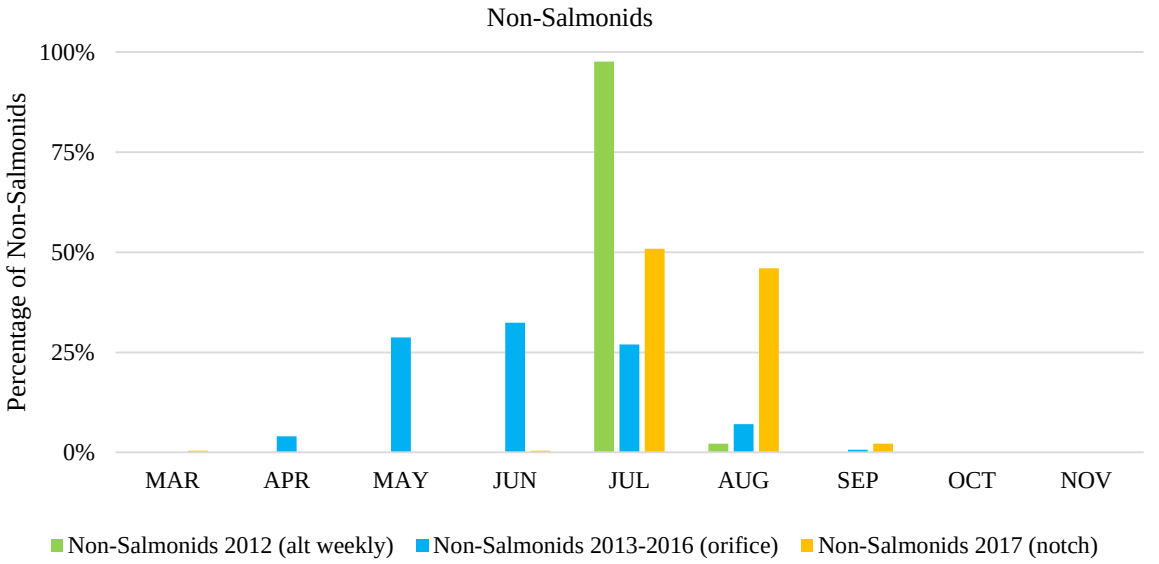


Figure 3-13: Percentage of non-salmonids recorded monthly per respective season at the ladder in 2012 (alternating weir mode weekly), cumulatively between 2013-2016 (orifice mode), and in 2017 (notch mode).



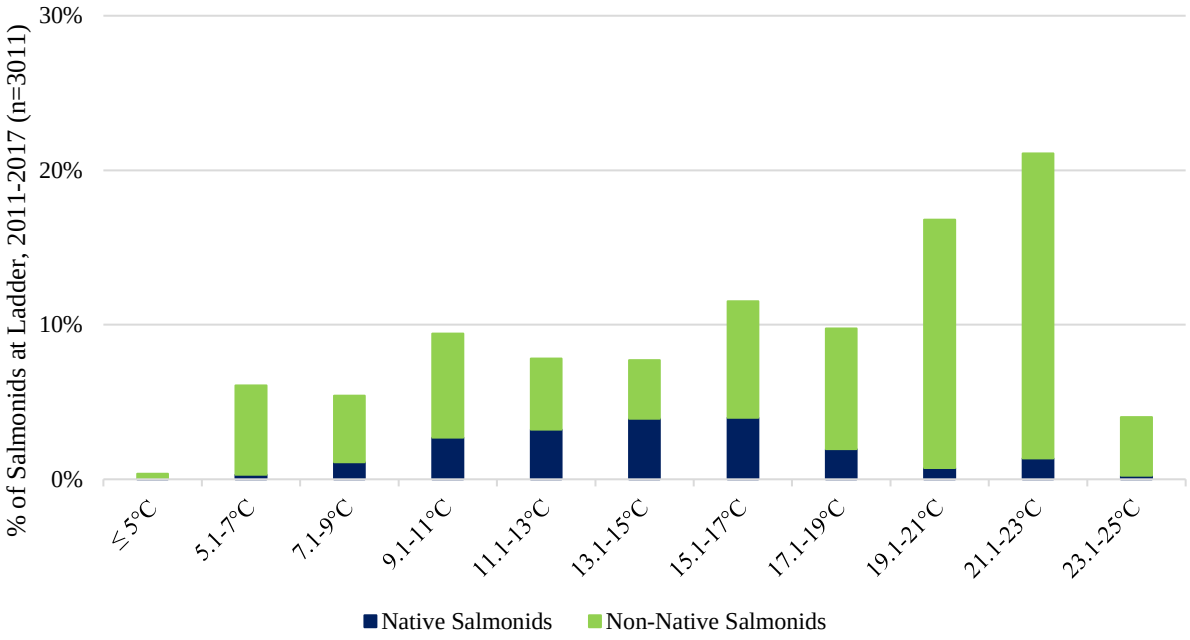
In the ladder, peak movements for salmonids appear similar in either weir mode (notch or orifice) with peak movements generally occurring in June or July and coinciding with the descending limb of the hydrograph (Figure 3-12). Peak movements in the ladder for non-salmonids also appear to

occur in the summer months (Figure 3-13), but shift depending on water temperatures and species composition. Although the number of fish ascending the ladder may be influenced by the weir operating mode, the timing of occurrence of salmonids and non-salmonids at the ladder does not seem to be influenced by weir mode, but more by river conditions.

3.7.3 Seasonal Movement Patterns and Water Temperatures

This section evaluates 2011 through 2017 movement patterns in the ladder for salmonids and non-salmonids, as well as native and non-native species within each group, based water temperature measurements (Figures 3-14 and 3-15, respectively). Water temperature measurements reflect temperatures recorded in the ladder, pool 48, during each ladder check. Water temperatures are set in 2-degree increments and range from less than or equal to 5 to 25 ºC.

Figure 3-14. Percentage of salmonids (native and nonnative) recorded at the ladder at various water temperatures, 2011-2017.

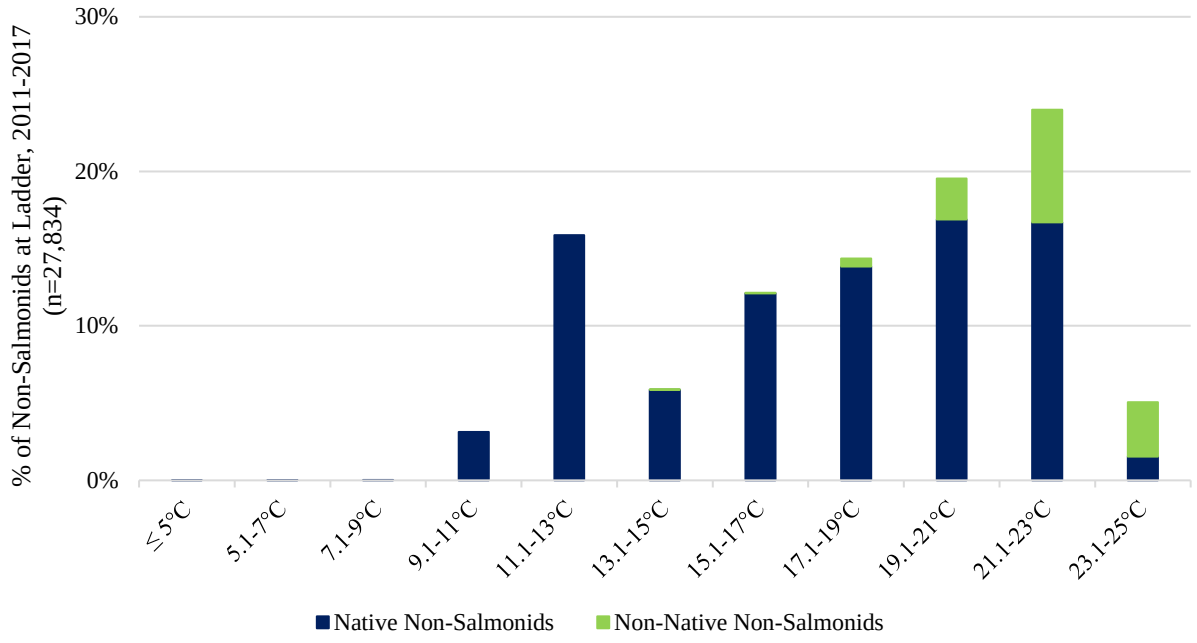


When water temperatures ranged from less than 5 ºC to just under 25 ºC (Figure 3-14), salmonids (n=3,011) were recorded at the ladder, while non-native salmonids (n=2,423) were observed at all water temperatures, and were most common between 19.1 and 23 ºC. Non-native salmonids are primarily represented by Rainbow Trout (n=1,600) and Brown Trout (n=758). Native salmonids (n=588) were more common at lower water temperatures, 9.1 to 19 ºC. Native salmonids are largely Mountain Whitefish (n=359) and Westslope Cutthroat Trout (n=213). Bull Trout are also native, but sample numbers are low (n=16). The occurrence of native salmonids was fewest when water temperatures were below 7.1 ºC or above 23.1 ºC. The occurrence of non-native salmonids was lowest when temperatures were below 5 ºC or above 23.1 ºC. Cooler water temperatures are generally associated with spring flows and the ascending limb of the hydrograph, as well as late fall temperatures prior to when the ladder is shut down. Warmer temperatures are generally

associated with the descending limb of the hydrograph, as well as summer months and early fall. The overall peak movement of salmonids during warmer water temperatures coincides with the peak movement of salmonids in the summer (June/July) during the descending limb of the hydrograph.

Non-salmonids (n=27,834) were also recorded at the ladder at all water temperature intervals, but overall appear to prefer warmer water temperatures compared to salmonids (Figure 3-15). Non-native non-salmonids (n=3,910) were only documented at the ladder when water temperatures were greater than 13 ºC. Native non-salmonids (n=23,924) were present at all water temperatures but preferred water temperatures above 9 ºC and below 23 ºC. As with salmonids, non-salmonid occurrence declined substantially when water temperatures exceeded 23 ºC. Non-native non-salmonids are primarily represented by Smallmouth Bass (n=3,907). Native non-salmonids are mostly represented by Largescale Sucker (n=16,295) and Northern Pikeminnow (n=7,445). The warmer water temperatures (19-23 ºC) and higher abundance of non-salmonids coincides the declining limb of the hydrograph and with peak movement of non-salmonids during the summer (June-August).

Figure 3-15. Percentage of non-salmonids (native and nonnative) recorded at the ladder at various water temperatures, 2011-2017.

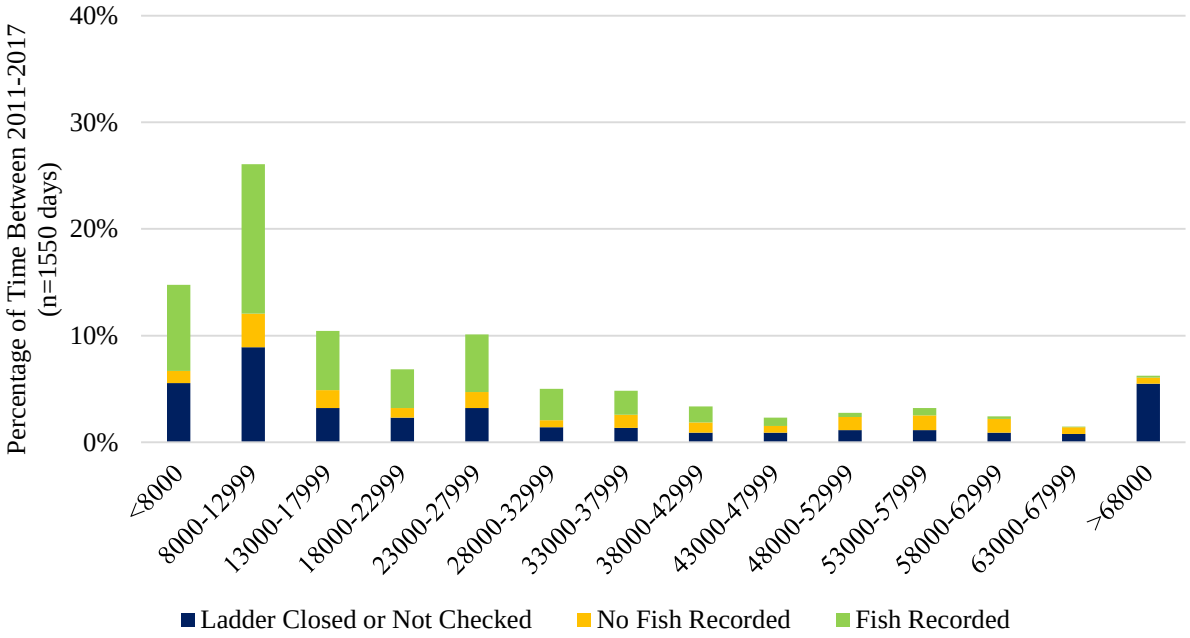


3.7.4 Streamflow

This section evaluates 2011 through 2017 movement patterns in the ladder for salmonids and non-salmonids, based on mean daily streamflow measurements taken at the USGS gage near Plains. Details regarding fish data collected at the ladder in conjunction with the streamflows over the last seven seasons is also provided. Streamflows intervals are in 5,000 cfs increments ranging from flows less than 8,000 cfs to flows exceeding 68,000 cfs.

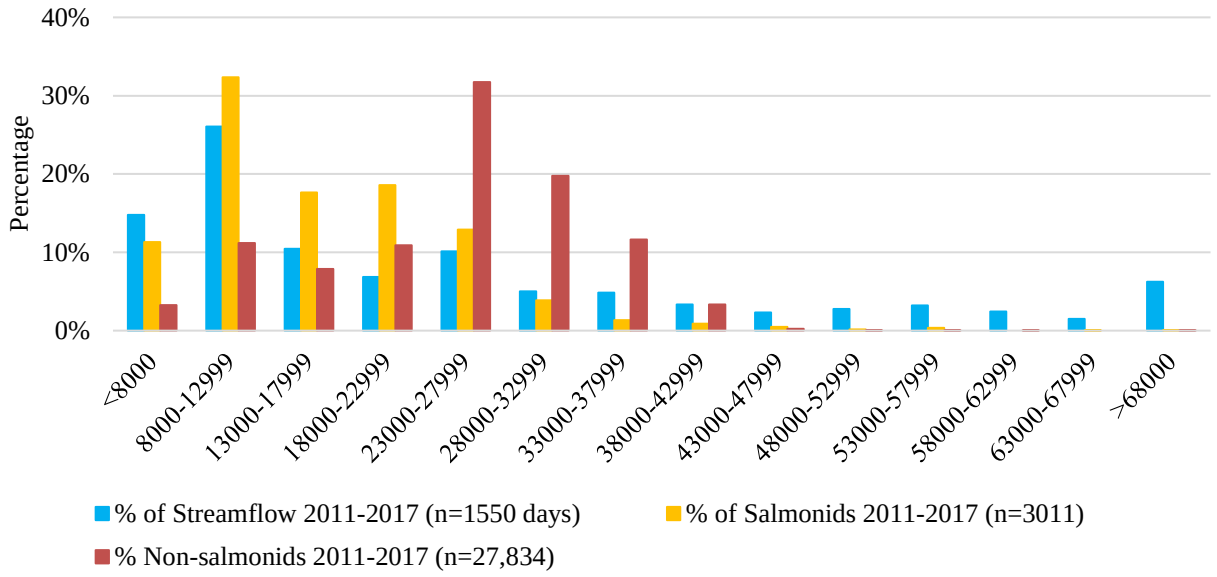
Between 2011 and 2017 there were approximately 1,550 operational days and 974 daily ladder checks completed. Days with no data (n=576) represent days the ladder was not checked or was closed. The natural variability in annual streamflows and design limits of the ladder under higher streamflows results in some flow intervals disproportionately represented over time. For example, annual streamflows do not always reach or exceed 68,000 cfs (e.g., 2013, 2015, 2016). Additionally, at higher flows, the ladder operates less frequently and is more likely to be shut down. The percentage of streamflows occurring each season since 2011 is shown in Figure 3-16. Each bar in Figure 3-16 is delineated into three categories, including the percentage of time the ladder was closed or not checked; the percentage of time no fish was recorded during a ladder check; and the percentage of time fish were recorded during a ladder check at the specified streamflow interval.

Figure 3-16. Percentage of streamflows, including percentage of time the ladder was closed/not checked, fish were not present, or fish were present during a ladder check at each streamflow interval, over 7 ladder seasons, 2011-2017.



The majority of ladder checks (83%) and fish recorded at the ladder (96% of 30,845 fish) occurred when flows were less than 38,000 cfs. Approximately 78 percent of the streamflows over the last 7 years of operations were less than 38,000 cfs (Figure 3-16). Just over half (51%) of the streamflows were less than 18,000 cfs and 22 percent of streamflows were greater than 38,000 cfs. Therefore, when evaluating salmonid and non-salmonid occurrence at the ladder under various streamflows, it is not surprising to find most fish were recorded at the ladder when streamflows were less than 38,000 cfs. The unexpected result was the distinct difference in the proportion of salmonids compared to non-salmonids at various streamflow intervals less than 38,000 cfs (Figure 3-17).

Figure 3-17. Percentage of streamflow occurrence and percentage of salmonids and non-salmonids recorded at the ladder at various streamflows, 2011-2017.



Although salmonids were recorded during all streamflow intervals except 58,000 to 62,999 cfs, they were more common (69%) at flows between 8,000 and 27,999 cfs with their peak presence at flows between 8,000 and 12,999 cfs (Figure 3-17). However, variability among salmonids species exist. About 90 percent of Mountain Whitefish were recorded at streamflows between 8,000 and 12,999 cfs, while over half of the Bull Trout were recorded at streamflows between 23,000 and 32,999 cfs, and other salmonids (RB; WCT; LL) were more evenly distributed between streamflow intervals 8,000 and 27,999 cfs. These lower streamflows generally coincide with the declining limb of the hydrograph, warmer water temperatures, and peak movements of salmonids observed in the summer.

Non-salmonids were most common (74%) at higher streamflows compared to salmonids, ranging from 18,000 to 37,999 cfs with a peak presence at flows between 23,000 and 32,999 cfs (Figure 3-17). Again, differences were observed among the non-salmonids species; Smallmouth Bass (53%) were more common between 8,000 and 12,999 cfs, Largescale Sucker (42%) and Peamouth (98%) were more common between 23,000 and 27,999 cfs, and Northern Pikeminnow were more even distributed, ranging between 15 and 22 percent, at each flow interval between 13,000 and 37,999 cfs.

3.8 Ladder Design Limitations and Fish Passage

The fish ladder was designed to pass fish with streamflows up to 48,000 cfs. Since the ladder was operational in 2011, streamflows have exceeded this threshold annually except for the 2015 and 2016 seasons.

In 2017, there were 44 days when streamflows (measured at the USGS gaging station near Plains) exceeded 48,000 cfs between May 7 and June 19. Fish were recorded at the ladder during two of the 15 ladder checks during this period. On May 8, four Rainbow Trout were recorded at the ladder when streamflows were approximately 57,800 cfs. On June 2, the day the ladder was shut down due to high flows, one Rainbow Trout (214mm, 150g) was recorded with streamflows approximately 79,700 cfs, the highest mean daily streamflow recorded concurrent with a fish ascent at the ladder. Due to high flows, the ladder was closed after the morning check on June 2 and then re-opened on June 16.

Between 2011 and 2017, the ladder was checked 106 times when streamflows exceeded 48,000 cfs. Fish were recorded during 28 of the ladder checks (26% of the time), with 50 fish representing six species, including two Bull Trout. Ladder checks were completed with streamflows varying between 48,000 and 95,700 cfs. The highest mean daily streamflow measured concurrent with a Bull Trout recorded at the ladder was 51,600 cfs in 2012.

Table 3-6 provides a summary of the number ladder checks that occurred annually when streamflows exceeded 48,000 cfs, the number of fish and species recorded during these higher flow periods, and the time of year when these flows were recorded.

Table 3-6: Summary of ladder checks and the number of fish (and species) recorded when streamflows exceeded 48,000 cfs at the USGS gage #12389000 during ladder operations, 2011-2014, 2017. Streamflows did not exceed 48,000 cfs in 2015 or 2016.

	2011	2012	2013	2014	2017
USGS Peak Streamflow (cfs)	104,000	75,300	63,700	82,800	**82,100**
Number of Ladder Checks when Flows >48,000 cfs	14	34	16	27	**15**
# of Ladder Checks with Flows > 48,000 cfs with Fish Recorded in Ladder	4	8	6	8	**2**
Species Recorded (Total Number)	3 RB, 3 LS SU, 3 NPMN (9)	2 BULL, 9 RB, 1 WCT, 1 LS SU (13)	12 LS SU, 1 NPMN (13)	1 RB, 1 LL, 4 WCT, 4 LS SU (10)	**5 RB (5)**
Range of Flows (>48,000cfs) with Fish Recorded at Ladder	55,900-69,000	49,600-63,300	52,200-61,800	50,300-58,300	**57,800 & 79,700**
Max Streamflow During Ladder Check	95,700	74,800	62,600	66,700	**79,700**
Total # of Fish Recorded at Ladder	**1,805**	**2,668**	**3,830**	**5,735**	**525**

3.9 Fish Tagging History

Since 2011, 4,239 fish have been uniquely-tagged (3,112 PIT and 1,127 Floy tags) either at the fish ladder or immediately downstream of Thompson Falls Dam. Prior to 2017, only non-salmonids and primarily Smallmouth Bass received Floy tags at the ladder. Starting on July 11, 2017, Northern Pikeminnow and Largescale Sucker were implanted with a PIT tag and a blank Floy tag (to indicate the fish should be checked for a PIT tag) at the ladder prior to release upstream. In 2017, there were 53 Northern Pikeminnow and eight Largescale Sucker tagged and released upstream. PIT tagging of Northern Pikeminnow and Largescale Sucker at the ladder is proposed to continue in 2018.

On September 20, 2017, in addition to a PIT-tag, salmonids recorded at the ladder also received uniquely numbered-Floy tag. The Floy-tag allows FWP to evaluate angling exploitation. A total of 25 salmonids (13 RB; 10 LL; 2 WCT) were implanted with a Floy tag in 2017. One Floy-tagged Rainbow Trout was reported by an angler in the lower Flathead River, nearly 80 miles upstream of the dam in the Flathead River. FWP proposes to continue Floy-tagging salmonids at the ladder in 2018. Note that for the tagging totals (Table 3-7) a salmonid is accounted for only one time (in the PIT tag total) even if it received a Floy tag.

3.9.1 Fish Tagged at the Ladder

Since 2011, 3,530 individual fish (2,422 PIT and 1,108 Floy tags) were uniquely-tagged at the ladder (Table 3-7). These uniquely-tagged fish represent 10 species and one salmonid hybrid. Tagging efforts have resulted in uniquely tagging (PIT or Floy) about 91 percent of the salmonids and about 4 percent of the non-salmonids recorded at the ladder and released upstream.

The annual number of fish receiving PIT-tags at the ladder has varied from 225 fish in 2011 to 525 fish in 2016. Floy-tagging efforts were more variable over the years (zero in 2016 to 974 in 2015). Most Floy-tags were implanted in Smallmouth Bass (Table 3-7).

In 2017, 331 fish were PIT-tagged at the ladder (270 salmonids and 61 non-salmonids). Non-salmonids, specifically Northern Pikeminnow (n=53) and Largescale Sucker (n=8) were PIT tagged at the ladder in 2017 in an effort to evaluate movement (e.g. upstream into the Thompson River), fallback, passage efficiency, and duration to ascend the ladder. None of the PIT-tagged non-salmonids were detected as fallback, few tagged non-salmonids entered the ladder, and no tagged non-salmonids ascended the ladder. In addition, none of the PIT-tagged Northern Pikeminnow or Largescale Sucker released upstream of the dam in 2017 were detected in the Thompson River.

Table 3-7: Summary of the number of fish, by species, with unique PIT or Floy tag implanted annually in fish at the Thompson Falls fish ladder prior to release upstream between 2011 and 2017.

Species	Tag Type	2011	2012	2013	2014	2015	2016	2017
BULL	PIT	2	-	4	1	2	3	**1**
EB	PIT				1	2	1	**-**
LL	PIT	27	40	97	67	153	169	**86**
RB	PIT	141	189	186	144	238	310	**171**
RBxWCT	PIT	9	7	12	11	1	4	**1**
WCT	PIT	20	20	45	34	33	32	**11**
MWF	PIT	17				54	6	**-**
N PMN	PIT	2						**53**
N PMN	FLOY	1						**-**
LN SU	PIT	1						**-**
LS SU	PIT	6						**8**
SMB	FLOY	73	30	7	23	974	-	**-**
Subtotal	**PIT**	**225**	**256**	**344**	**258**	**483**	**525**	**331**
Subtotal	**FLOY**	**74**	**30**	**7**	**23**	**974**	**-**	**-**
TOTAL	**All Tags**	**299**	**286**	**351**	**281**	**1,457**	**525**	**331**

A summary of the number of ladder ascents by fish initially tagged (PIT and Floy) at the ladder is provided in Table 3-8. Nearly 10 percent (235 individuals) of the 2,422 PIT-tagged fish were documented at the ladder work station at least twice. Of the 1,108 Floy-tagged fish, 72 fish have returned to the ladder at least twice. Two fish (1 LL; 1 SMB) have each ascended the ladder five times, the maximum number of ladder ascents recorded for an individual fish to date.

In 2017, 35 of the 530-fish recorded at the ladder were returning after being previously tagged at the ladder. These returning fish included eight Smallmouth Bass initially Floy-tagged in 2015 and 27 PIT-tagged salmonids (16 LL; 9 RB; 2 WCT) returning to the ladder. These returning fish represented nearly 15 percent of Brown Trout, 14 percent of Westslope Cutthroat Trout, 6.5 percent of Smallmouth Bass, and about 5 percent of Rainbow Trout recorded at the ladder in 2017.

Of the 27 returning salmonids, 17 fish initially ascended the ladder in 2016; five fish in 2015; two fish in 2014; and three fish in 2013. Of the returning salmonids, 70 percent (14 LL; 5 RB; 1 WCT) were detected in the mainstem of the Thompson River following release upstream of Thompson Falls Dam in 2017. For a majority of these fish, they were documented entering the Thompson River in previous year(s).

Table 3-8: Summary of the number of ladder ascents (fish ascend ladder and are released upstream) for 307 returning fish (all initially PIT or Floy-tagged at the ladder), by species between 2011 and 2017.

Species	Total Number of Fish Initially Tagged at Ladder 2011-2017	Total Number of Individual Fish Detected at Ladder Multiple Times	Frequency of Ladder Ascents			
			2x	3x	4x	5x
BULL	13	1	1	-	-	-
EB	4	-				
LL	639	68	57	8	2	1
RB	1379	144	120	18	6	-
RBxWCT	45	6	6	-	-	-
MWF	77	3	3	-	-	-
WCT	195	12	9	2	-	-
LS SU	14	1	1	-	-	-
LN SU	1	-				
NPMN	56	-				
SMB	1107	72	68	2	1	1
TOTAL	**3530**	**307**	**266**	**30**	**9**	**2**

On an annual basis, between 3 and 10 percent of the salmonids PIT-tagged in a given year, return to the ladder the following year (Table 3-9). For example, in 2016, there were 525 newly PIT-tagged salmonids released upstream of the ladder and 3 percent (8 RB; 7 LL; 2 WCT) returned to the ladder in 2017. The relatively low return of 2016-tagged fish in 2017 may be related to operating the ladder in notch mode. Data collected from the remote tag arrays in the ladder indicate a larger percentage of previously PIT-tagged fish entering the ladder in 2017 did not ascend the ladder compared to 2016 when the ladder was operating in orifice mode. These data are presented and discussed in more detail in Section 3-11.

Table 3-9: Summary of the number of salmonids PIT-tagged each year and the percentage of the PIT-tagged salmonids recorded at the ladder the following year, 2011-2017.

Year	# of Salmonids PIT-tagged at Ladder	% of PIT-Tagged Salmonids Recorded in Ladder the Following Year
2011	216	3%
2012	256	7%
2013	344	9%
2014	258	10%
2015	483	10%
2016	525	3%
2017	270	To be calculated in 2018

3.9.2 Fish Tagged Below the Dam

In 2011, 2012, 2014, and 2017, the Licensee and FWP electrofished downstream of Thompson Falls Dam and captured 2,369 fish. During these efforts, 709 fish (690 PIT and 19 Floy tags) representing 13 species and one hybrid, were uniquely PIT or Floy-tagged. In 2017, electrofishing efforts occurred over 3 days in April and on May 5 and resulted 147 fish sampled (104 fish PIT-tagged) representing seven species. A summary of the number of tagged fish by year and the number of those tagged fish recorded ascending the ladder between 2011 and 2017 is provided in Table 3-10. No tagging efforts below the dam were implemented in 2013, 2015, or 2016. No additional tagging efforts below the dam are proposed for 2018.

Table 3-10: Summary of tagged fish below Thompson Falls Dam in 2011, 2012, 2014, and 2017 and total number of tagged fish recorded ascended the ladder.

Species	Total Number of Tagged Fish by Year				# of Tagged Fish Ascend Ladder	% of Tagged Fish Ascend Ladder
	2011	2012	2014	2017		
BULL	3	1	2	**-**	1	17%
EB	-	1	-	**-**	-	-
LL	9	19	5	**9**	6	14%
RB	84	64	21	**6**	18	10%
RBxWCT	1	1	2	**-**	-	-
WCT	8	16	4	**2**	3	10%
MWF	22	59	2	**4**	1	1%
LWF	1	-	-	**-**	-	-
NPMN	-	7	-	**-**	-	-
LN SU	-	11	-	**26**	-	-
LS SU	78	164	-	**56**	5	2%
NP	3	12	-	**-**	-	-
SMB	3	2	-	**-**	-	-
WE	-	-	-	**1**	-	-
Total Tagged Fish	**212**	**357**	**36**	**104**	**34**	**5%**

Since 2011, 29 salmonids and 5 non-salmonids (5% of 709 tagged fish) ascended the ladder after being tagged downstream of Thompson Falls Dam (Table 3-10). This includes 16 of the 2011-tagged-fish, 13 of the 2012-tagged fish, three of the 2014-tagged fish, and two of the 2017-tagged fish. The movement of these fish from downstream of the dam to the ladder varies with some fish moving upstream and ascending the ladder in the same tagging year (7 fish in 2011; 8 fish in 2012; 1 fish in 2014; 2 fish in 2017), some fish ascending the following year after initial tagging, others ascends 2 or more years after tagging, and some fish making multiple ladder ascents over the years. These data indicate not all fish captured during electrofishing below the dam are motivated to move upstream immediately, and some may not be motivated to move upstream at all.

In 2017, three Brown Trout recorded downstream of the dam during spring electrofishing also ascended the ladder. Two Brown Trout were initially tagged in 2017 and the third Brown Trout was initially tagged below the dam in 2012 and recorded ascending the ladder in 2013, 2014, 2015, 2016, and 2017. There were three other fish (1 LL; 2 LS SU) tagged below the dam in 2017 that were only detected in the lower pools in the ladder and did not ascend the ladder. Less than 2 percent of the fish tagged below the dam in 2017 ascended the ladder in 2017.

3.10 Fallback

Fallback is defined as a fish that ascends the ladder, receives a PIT, Floy, or other unique identification tag, is released upstream, and then is later recaptured either downstream of the Thompson Falls Dam or at the ladder again that same year. The objective of evaluating "fallback" is to assess whether these fish are moving through the turbines or over the spillway and if there are operational modifications that could improve fish movement upstream after release into the Thompson Falls Reservoir.

The combined capacity of the generating units at the Project is approximately 23,000 cfs. When river inflows exceed this capacity or there is a generating load rejection, spill is initiated at the Main Dam spillway. Therefore, when streamflows are less than 23,000 cfs, it is assumed that all downstream fish passage is through the turbines. When streamflows are above 23,000 cfs, fish can pass downstream through the turbines or over the spillway.

Detecting a fallback is limited to when a fish returns to the ladder or when a fish is recaptured/detected during sampling efforts downstream of the Thompson Falls Dam. Therefore, the number of fallback fish reported represents a minimum value. Also, the duration between the time a fish is released upstream of the dam and when it moves downstream of the dam is an estimate since tags are not detected moving over the spillway or at the turbines.

In 2017, two fish were identified as fallback, including one Westslope Cutthroat Trout (#989001006029181) and one Brown Trout (#989001006029230). This equates to less than 1 percent of the 297 PIT-tagged salmonids recorded at the ladder and released upstream returning to the ladder in the same year.

Upon the return of the two fallback fish to the ladder in 2017, these fish were only detected entering the lower pools of the ladder (via remote PIT tag arrays) and did not ascend to the top. The Westslope Cutthroat Trout initially ascended the ladder on June 30 and was detected 30 days later (July 20) entering the ladder. It is unknown if this fish moved downstream over the spillway or through the turbines since flows varied from 46,700 to 13,100 cfs during the 30-day period. The Brown Trout initially ascended the ladder on August 16 and was later detected in the ladder on October 26 (approximately 71 days later). This fish most likely traveled downstream through the turbines since flows were below 23,000 cfs during this period.

In general, the percentage of PIT-tagged salmonids identified as fallback annually between 2011 and 2017 has varied from less than 1 percent in 2013 and 2017 to about 6 percent in 2011. The detection of salmonids downstream of Thompson Falls Dam within 30 days of being released upstream of the dam has varied from zero to 4.6 percent in 2011 (Table 3-11). Collectively, about 2 percent of the salmonids PIT-tagged at the ladder were identified as fallback and less than 1 percent of the PIT-tagged salmonids were re-detected within 30 days of release upstream.

Table 3-11: Summary of the annual fallback of salmonids, 2011-2017.

Salmonid Fallback	2011	2012	2013	2014	2015	2016	2017
Total Salmonid Fallback	13	2	4	8	6	19	**2**
Bull Trout Fallback				1		1	
# of PIT Tagged Salmonids	216	256	344	258	483	525	**270**
% of Tagged Salmonids Detected within 30 days of Release Upstream	4.6%	-	-	1.2%	0.4%	1.5%	**0.4%**

Annual fallback for non-salmonids is also low, however the data are limited with the primary analysis on Smallmouth Bass in 2015 (*refer to* NorthWestern Energy, 2016 and 2017 for more details). In 2017, there were 61 non-salmonids PIT-tagged (53 NPMN; 8 LS SU) and none were detected again following their release upstream of the dam.

Salmonid fallback data from 2014 through 2017 show 40 percent (14 out of 35 fallback fish) were detected in the Thompson River one or more times. Because the tag array in the Thompson River was not set up until September 2014, fallback data for 2011-2013 salmonids (n=19) were not included in this analysis. Some fallback fish (2014-2017) ascended the ladder multiple times and subsequently migrated into the Thompson River each time, while other fish that ascended the ladder and were released upstream remained upstream for multiple years based on multiple tag detections in the Thompson River.

Overall the data show salmonids are capable of surviving downstream passage, either through the turbines or over the spillway, returning to the ladder (sometimes multiple times a year), and continuing to move upstream into the Thompson River or other locations.

3.11 Upstream Passage Efficiency

The FWS (2017) defines passage efficiency as "A quantitative measure of the proportion of the population motivated to pass a barrier (i.e., motivated population) that successfully moves through the entire zone of passage; typically expressed as the product of attraction and passage efficiencies."

Attraction efficiency is a measure of the proportion of the (motivated) population that is successfully attracted to the fishway; typically measured as a percentage of the motivated

population that enters the fishway (FWS, 2017). A challenge at the Thompson Falls fish ladder is quantifying the "motivated" fish population. Spawning habitat exists both upstream and downstream of the dam, so there is no way to assess the desired destination of the fish in the Project area. In addition, many species utilize the fish ladder during seasons apparently unrelated to spawning migrations. For example, Rainbow Trout utilize the fish ladder during the summer and fall, as well as in the spring during their spawning season. For these reasons, a quantitative assessment of attraction efficiency may never be possible.

Passage efficiency is a measure of the proportion of fish entering the fishway that also successfully pass through the fishway; successful passage through the fishway is typically measured at the fishway exit; also referred to as "internal fishway efficiency" (FWS, 2017). At the Thompson Falls fish ladder, quantitative evaluations of internal fishway efficiency is assessed by monitoring the movement of PIT-tagged fish through the ladder. These evaluations include ladder ascent time and percentage of fish ascending the ladder after entry. These calculations require a tagged fish, most likely tagged at the ladder after its initial ascent, to enter the ladder again in order to be detected by the remote arrays in the ladder. In other words, this evaluation is based on data collected on non-naïve fish.

Three remote antennas (non-directional) were installed in the lower pools 7 and 8 and the holding pool (pool 45) of the ladder for detecting the presence of PIT-tagged fish. Fish detections in the ladder are used to evaluate the length of time fish take to ascend the ladder. These data have been collected annually since operations began in 2011.

3.11.1 Ladder Ascent Time

The remote antennas and detection data were used to calculate the length of time it took an individual fish to ascend the ladder between the lower pools 7/8 and the holding pool (pool 45). Not all fish detected in pool 45 were recorded at the ladder work station, indicating that some fish escaped the holding pool. Tagged fish detected in the ladder were either initially tagged at the ladder or via electrofishing surveys downstream of Thompson Falls Dam.

Over the last seven seasons, 314 ascent times have been recorded representing 145 Rainbow Trout, 99 Brown Trout, 39 Largescale Sucker, 16 Westslope Cutthroat Trout, seven Rainbow x Westslope hybrids, five Mountain Whitefish, two Bull Trout, and one unknown (no tagging history available for this fish). Ascent times have varied from 0.6 hour to 10 days. The median time for salmonids was 1.9 hours and 7.5 hours for Largescale Sucker over all seasons and operating weir modes.

In 2017, 35 ascent times were calculated representing three species, including 21 Brown Trout, 12 Rainbow Trout, and two Westslope Cutthroat Trout (Table 3-12). These fish spent between 0.6 hour to just over 1 day to ascend the ladder with the median time of 1.4 hours and average of 2.1 hours.

Table 3-12: Summary of each species including the number of fish detected entering the ladder and the median, minimum and maximum range of time (hours) spent ascending the ladder while operating in notch mode in 2017.

Species	Number of Fish	Median Time (hrs)	Min Time (hrs)	Max Time (hrs)
LL	21	1.2	0.6	4.0
RB	12	1.4	0.8	2.5
WCT	2	14.4	1.1	27.6
TOTAL	**35**	**1.4**	**0.6**	**27.6**

Fish ascents during different weir modes, orifice versus notch mode were also evaluated. Orifice ascent data from 2013, 2014, 2015, 2016 (except for 2 weeks in July while in notch mode) were compared to notch ascent data from 2 weeks in July 2016 and the 2017 season. Data from 2011 and 2012 were not included because weir modes alternated weekly in both seasons and the ladder was closed for about 2.5 months in 2011. Figure 3-18 illustrates the median, average, and minimum ascent times for Brown Trout, Westslope Cutthroat Trout, Rainbow Trout, and all salmonids recorded ascending in orifice mode (2013, 2014, 2015, 2016) and notch mode (2016, 2017).

As shown in Figure 3-18, the average time and median time for salmonid ascents in notch mode (1.9 and 1.3 hours, respectively) were less than in orifice mode (6.8 and 2.0 hours, respectively). In notch mode, there were fewer species documented entering or ascending the ladder (Table 3-13). Of the salmonids that ascended the ladder in notch mode, the range of ascent times for these fish varied less and the median and average ascent times were quicker.

Bull Trout data are not included in this comparison. However, in 2012 while the ladder was in orifice mode, two previously tagged Bull Trout ascended the ladder in 2.4 and 2.8 hours, respectively. These ascent times are within the range observed by other salmonids ascending in both weir modes. While Bull Trout have ascended the ladder in notch mode, no PIT-tagged Bull Trout have ascended the ladder in notch mode.

Figure 3-18. Summary of fish median (blue bars and label), average (green squares), and minimum (yellow circles) ascent times for salmonids recorded in both notch (2013-2016) and orifice mode (2016-2017), as well as comparison of all salmonids in notch versus orifice mode.

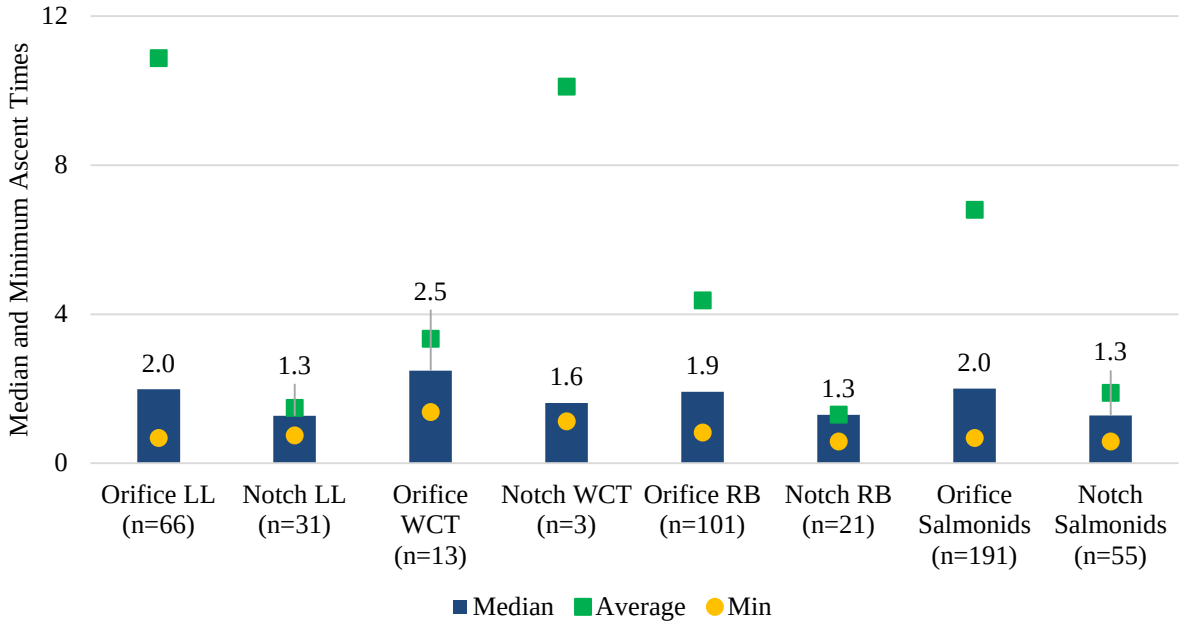


Table 3-13: Annual summary of the 274 salmonids and 39 Largescale Sucker detected via remote antennas in the ladder, including the median time (hours) spent ascending the ladder each year. The one unknown species (2.1 hrs ascent) is not included.

Year	Weir Mode	Salmonids			Largescale Sucker	
	Orifice or Notch	Fish Count	# of Species	Median Time (hrs)	Fish Count	Median Time (hrs)
2011	Weekly Alternating	16	2	3.6	1	3.6
2012	Weekly Alternating	12	4	2.3	4	6.6
2013	Orifice	42	3+hybrid	1.8	10	8.2
2014	Orifice	32	4+hybrid	1.6	-	-
2015	Orifice	49	3+hybrid	2.2	20	9.1
2016	Orifice (except 2 weeks in July)	68	4+hybrid	2.2	4	4.2
2016	Notch (2 weeks in July)	20	3	1.2	-	
2017	**Notch**	**35**	**3**	**1.4**	**-**	**-**
TOTAL	**All Seasons**	**274**	**5+hybrid**	**1.9**	**39**	**7.5**

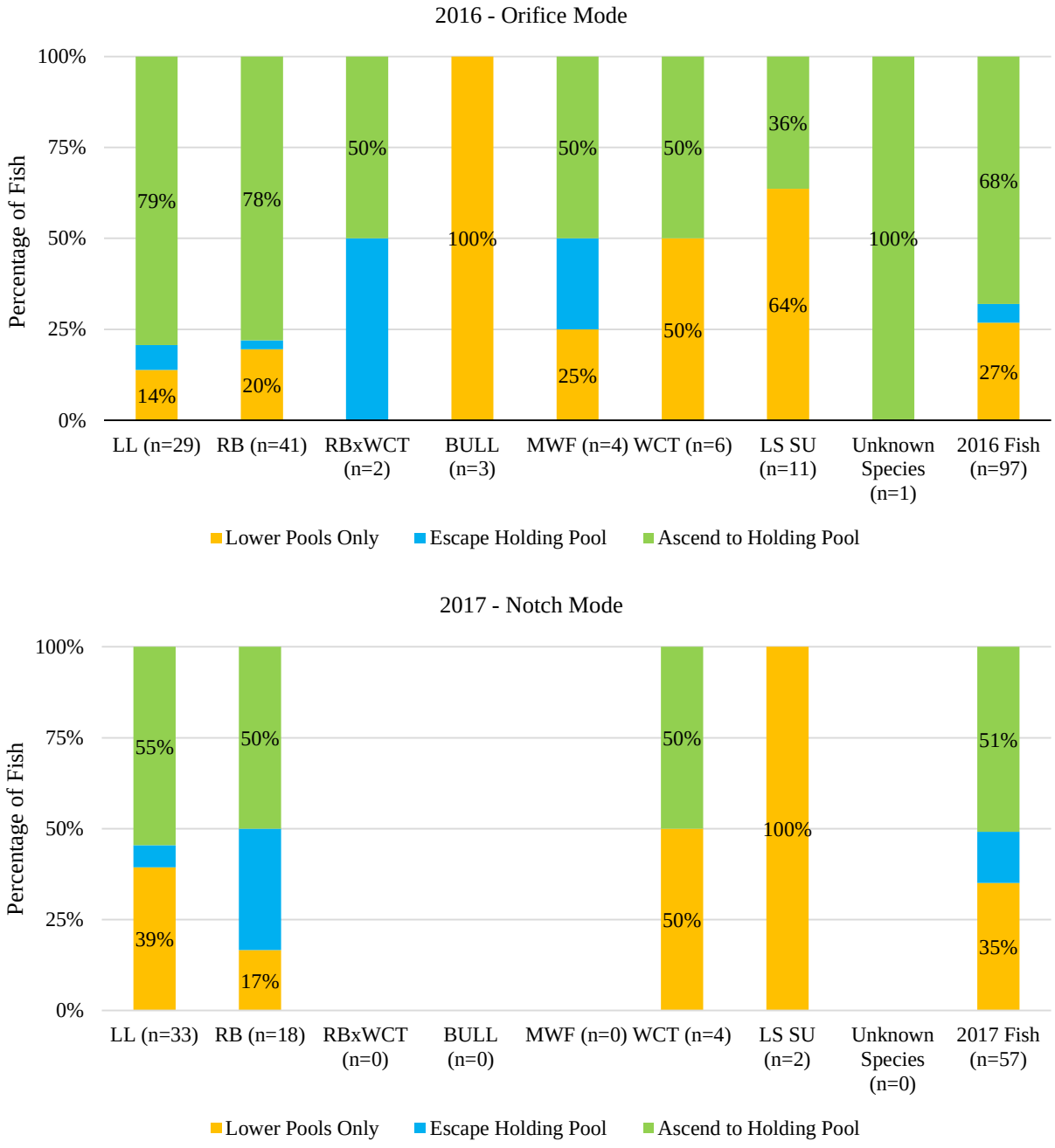
3.11.2 Ladder Efficiency – Fish Entering and Ascending

Remote arrays installed in the lower pools (pools 7/8) and the holding pool (the top of the ladder) of the ladder detect PIT-tagged fish that swim by. Efficiency of these remote arrays is not 100 percent, but is assumed to be very high. These arrays only collect data from fish with PIT tags and have collected data at the ladder since 2011. Between 2011 and 2015, it was estimated 23 percent of the 213 PIT-tagged fish detected entering the ladder were not recorded at the holding pool or work station (NorthWestern Energy, 2016). In 2016 and 2017, remote tag array data storage was improved and automated such that every tag-detection in pools 7/8 and the holding pool are saved in a cloud-database, thus all fish detections records at pools 7/8 and 45 were available for analysis.

In 2016 and 2017, data collected via the remote PIT-tag arrays, as well as fish recorded at the ladder work station, were used to investigate how many tagged fish entering the ladder were ascending to the top (the holding pool); how many fish ascending to the holding pool escaped the holding pool; and how many fish were only detected in the lower pools of the ladder (not ascending to the top). The results from 2016 (data collected in orifice mode) versus 2017 (notch mode) are discussed in this report. *Refer to* the 2016 annual report of a summary of all 2016 detection data (NorthWestern Energy, 2017).

In 2016, the ladder operated primarily in orifice mode except for 2 weeks in July. In 2017, the ladder operated in notch mode only. In 2016, 97 individual fish representing six species, one salmonid hybrid, and one unknown species (tagging history not available for this fish) were detected in the ladder. In 2017, 57 individual fish representing four species were detected in the ladder. The percentages of fish, by species and year, that entered the ladder and ascended to the holding pool, ascended and escaped the holding pool, and those fish that remained in the lower pools of the ladder and did not ascend are shown in Figure 3-19.

Figure 3-19. Percentage of individual fish detected in the ladder during orifice mode operations in 2016 (top graph) and notch mode operations in 2017 (bottom graph), including percentage of species remain in lower pools, ascend but escape the holding pool, and ascend to the holding pool (the top of the ladder).



Results from 2016 and 2017 show there were more species represented and more individual fish detected entering the ladder in orifice mode (2016) than in notch mode (2017). In 2017, there were no PIT-tagged Bull Trout, Mountain Whitefish, or Rainbow x Westslope Cutthroat Trout hybrid detected entering the ladder in contrast to 2016. A higher percentage of the fish ascended to the

holding pool in orifice mode (68%) in contrast to the notch mode (51%). Approximately 35 percent of the fish in 2017 remained in the lower pools compared to 27 percent in 2016. When comparing 2016 and 2017 data among Brown Trout, Rainbow Trout, Westslope Cutthroat Trout, and Largescale Sucker, all but Westslope Cutthroat Trout displayed higher percentages of fish ascending to the holding pool while in orifice mode than in notch mode. Westslope Cutthroat Trout had the same percentage of fish ascending to the holding pool in both modes (50%).

Although salmonids ascending the ladder in 2017 appear to reach the holding pool quicker in notch mode, a smaller proportion of salmonids entering the ladder in 2017 (53%) reached the holding pool compared to 2016 (73%) when ladder operations were in orifice mode. Based on the overall fish count at the ladder in 2017 in conjunction with the remote array data from the ladder, Largescale Sucker were not as successful ascending the ladder in notch versus orifice mode.

Overall, salmonids and a larger variety of species (as well as more native species) appear to prefer and ascend the ladder more easily in orifice versus notch mode.

3.12 Weir Mode Analysis

Ladder operations over the last seven seasons (2011-2017) are summarized in Section 3.1 of this report. Existing weir data includes 2 consecutive years (2011 and 2012) of alternating the weir mode (notch and orifice) weekly, 4 consecutive years (2013-2016) operating the entire season in orifice mode apart from 2 weeks in July 2016 when the weirs were switched to notch mode, and 1 complete season operating in notch mode (2017).

During the 2016 annual TAC meeting, FWP proposed additional testing in notch mode was needed to further evaluate ladder operations and efficiency of fish passage. The Licensee and TAC members (FWS, CSKT, and FWP) agreed to operate the ladder in notch mode in 2017. The results of the fish count for 2017 are presented in previous sections of this report. The following section compares fish passage results from 2014 (orifice mode) and 2017 (notch mode). These 2 years are considered similar and comparable in operating time, ladder checks, and river conditions. It is understood that no 2 years are exactly alike, but from the available data these are the most comparable years with opposing weir modes running during the entire season. As more data are gathered in 2018 with operations scheduled to be notch mode for the entire season, additional analysis will be completed and reported in the 2018 annual report.

3.12.1 Orifice Mode (2014) vs. Notch Mode (2017)

In 2014, the weir mode was set to orifice and in 2017, the weir mode was set to notch for the entire ladder season (mid-March–October). The operational season in 2014 (208 days) and 2017 (224 days) were similar in both years. The ladder was checked 132 times in 2014 and 131 times in 2017. The ladder was closed for 16 days (May 24–June 8) in 2014 and 14 days (June 2-15) in 2017. The peak streamflows were similar with a peak in 2014 of 82,800 cfs on May 29 and a peak in 2017 of 82,100 cfs on June 3. The maximum water temperature in 2014 was 23.6 ºC; in 2017 it was 24.3ºC.

River conditions for the 2014 and 2017 ladder seasons are shown in Figures 3-20 (streamflows) and 3-21 (water temperatures in the ladder). The 2 seasons provide an opportunity to evaluate potential operational influences (notch *vs.* orifice weir mode) on fish movement in the ladder during relatively average hydrologic years. Some differences in river conditions were observed between the 2 years including higher streamflows in the early spring 2017, an earlier decline in the hydrograph in 2017 (about 2.5 weeks earlier) compared to 2014 (Figure 3-20), warmer mean daily water temperatures during the summer 2017 compared to 2014, and cooler mean daily water temperatures in the fall 2017 compared to 2014 (Figure 3-21).

Figure 3-20: Mean daily streamflow in the Clark Fork River, near Plains between March 13 and October 31, 2014 and 2017.

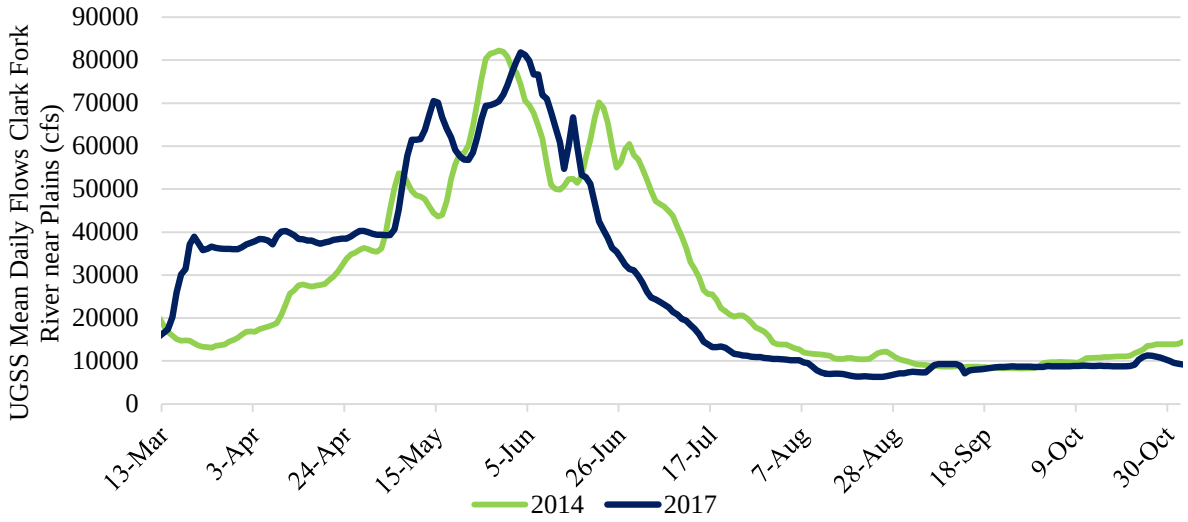
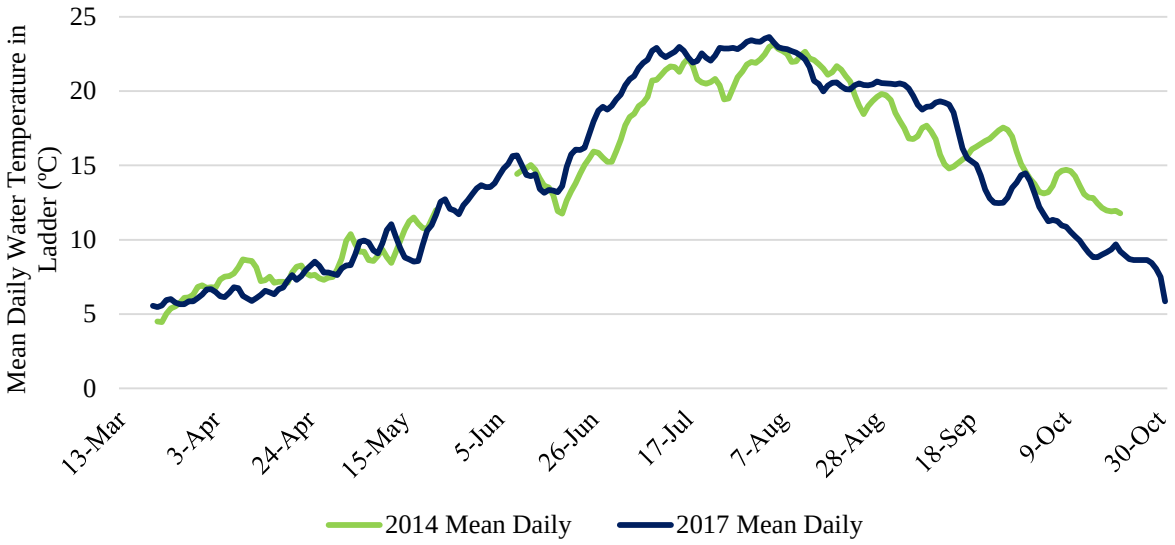


Figure 3-21: Mean daily water temperature in ladder (pool 48) between March 13 and October 31, 2014 and 2017.



Although the number of ladder checks were similar between the 2 years, there was a higher percentage of ladder checks in notch mode resulting in "no fish" recorded than in orifice mode. In orifice mode, about 25 percent of the ladder checks resulted in no fish and in notch mode, about 43 percent of the ladder checks resulted in no fish (*refer to* Table 3-1).

The number of salmonids and non-salmonids per ladder check in orifice mode (2014) and in notch mode (2017) are shown in Figure 3-22. The data show an order of magnitude more fish ascended the ladder (n=5,735) in orifice mode than in notch mode (n=530). In orifice mode, there were nearly double the number of salmonids (n=573) compared to notch mode (n=305) and about 29 times the number of non-salmonids in orifice mode (n=5,162) compared to notch (n=225). Additionally, a larger percentage of the fish recorded in orifice mode were native species (salmonids and non-salmonids) than in notch mode. The proportion of native fish was higher in orifice mode in 2014 than in notch mode in 2017 (*refer to* Figure 3-3). The increase in proportion of non-native fish in notch mode was mostly likely attributed to the low numbers of native Largescale Sucker and Northern Pikeminnow in 2017 (n=100) that were so abundant in 2014 (n=3,806).

Movement patterns in the ladder for salmonids and non-salmonids at various water temperatures showed similar trends for both years and weir modes (Figure 3-23). The majority of non-salmonids were recorded in the ladder when water temperatures were above 17 ºC with the majority observed at temperatures between 19.1 and 21 ºC in 2014 and between 21.1 and 23 ºC in 2017. This may reflect the warmer temperatures during the summer months in 2017 compared to 2014. Non-salmonids appear to ascend the ladder in 2014 and 2017 primarily during the summer months, which coincides with warmer water temperatures and the declining limb of the hydrograph.

The distribution of salmonids and non-salmonids during various streamflows in 2014 and 2017 is shown in Figure 3-24. The data show the majority of salmonids ascended the ladder during lower streamflows (less than 13,000 cfs) in 2014, which was attributed to the large number of Mountain Whitefish (n=254) that year (NorthWestern Energy, 2015). Mountain whitefish represented about 44 percent of the salmonids followed by Rainbow Trout (33%) in 2014. In 2017, about 25 percent of the salmonids were observed at flows between 8,000 to 12,999 cfs and another 23 percent between 18,000 and 22,999 cfs (Figure 3-24). In contrast to 2014, most salmonids in 2017 were Rainbow Trout (59%) and Brown Trout (35%). The difference in streamflow intervals and peak movement of salmonids in the ladder in 2014 and 2017 does not appear to be related to weir mode, but more likely related to the species-specific movement patterns and behavior. Mountain whitefish tend to ascend the ladder in the fall, Rainbow Trout show larger movements into the ladder in spring, summer, and fall, and Brown Trout show peak movements at the ladder during the summer (*refer to* Appendix A figures).

In 2014, the majority of non-salmonids were recorded at the ladder when flows were between 23,000 and 27,999 cfs. In 2017, the majority of non-salmonids were recorded at the ladder when streamflows were between 8,000 and 12,900 cfs. The data show the peak movement of non-

salmonids were recorded at the same time interval in 2014 and 2017 (*refer to* Figure 3-22, bottom graph), but in 2017 the hydrograph declined earlier than in 2014. Thus, the streamflows in 2017 were lower than in 2014. The rapid decline in the hydrograph in 2017 in the summer may also have attributed to the fact no non-salmonids were recorded at flows greater than 28,000 cfs in 2017. The difference in the streamflow intervals when most of the non-salmonids were observed in 2014 and 2017 is likely related to the different streamflows occurring in July and August each year and not related to a preference of streamflow by non-salmonids or a reflection of weir mode.

Figure 3-22: Number of salmonids (top graph) and of non-salmonids (bottom graph) recorded per ladder and mean daily streamflows (cfs) in 2014 and 2017. Fish per ladder check data in 2014 (orifice mode) and 2017 (notch mode) are stacked to show fish recorded during the same time frame.

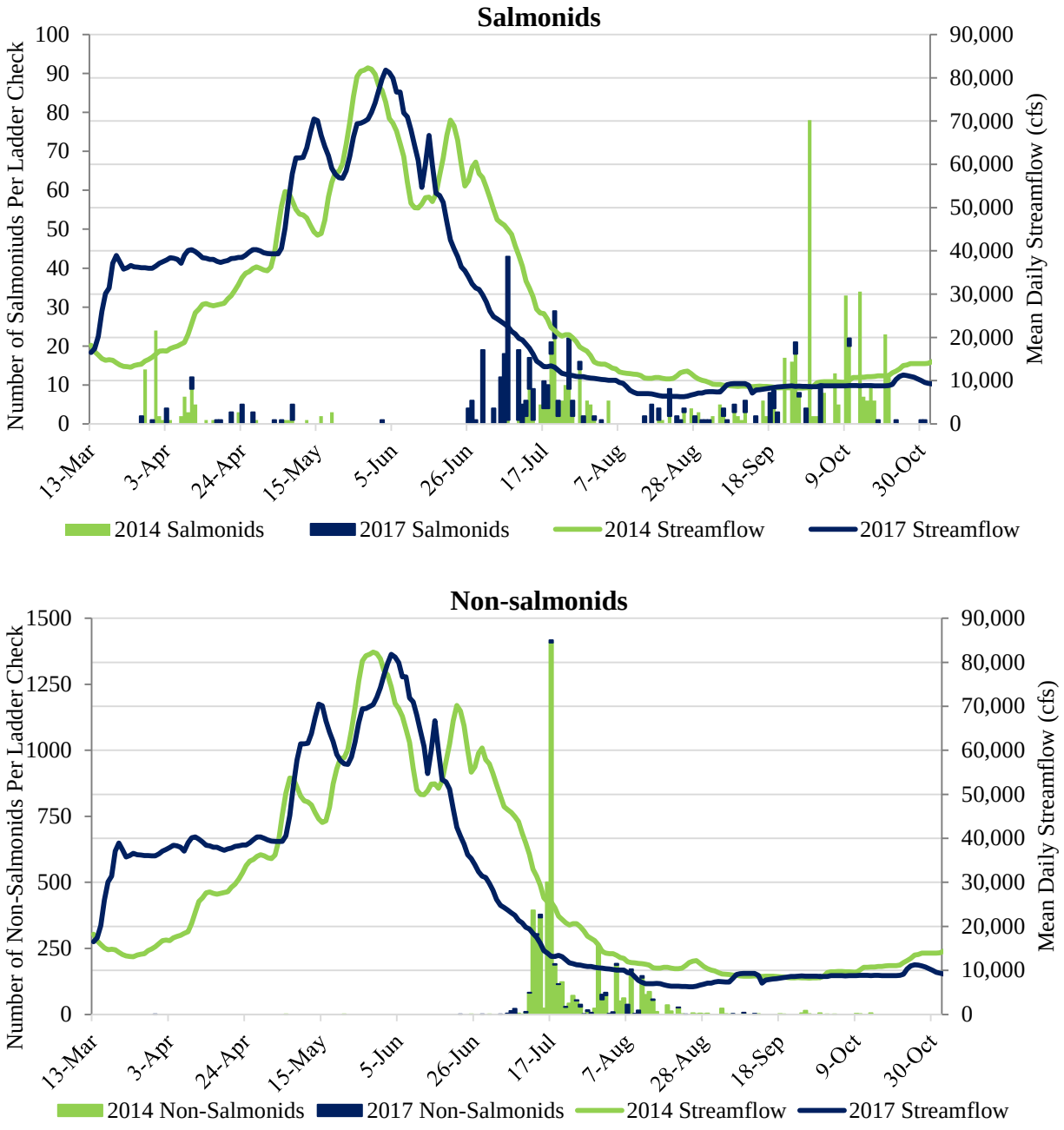


Figure 3-23: Percentage of salmonids and percentage of non-salmonids recorded at the ladder in 2014 during orifice mode (top graph) and in 2017 during notch mode (bottom graph) with various water temperatures in the ladder.

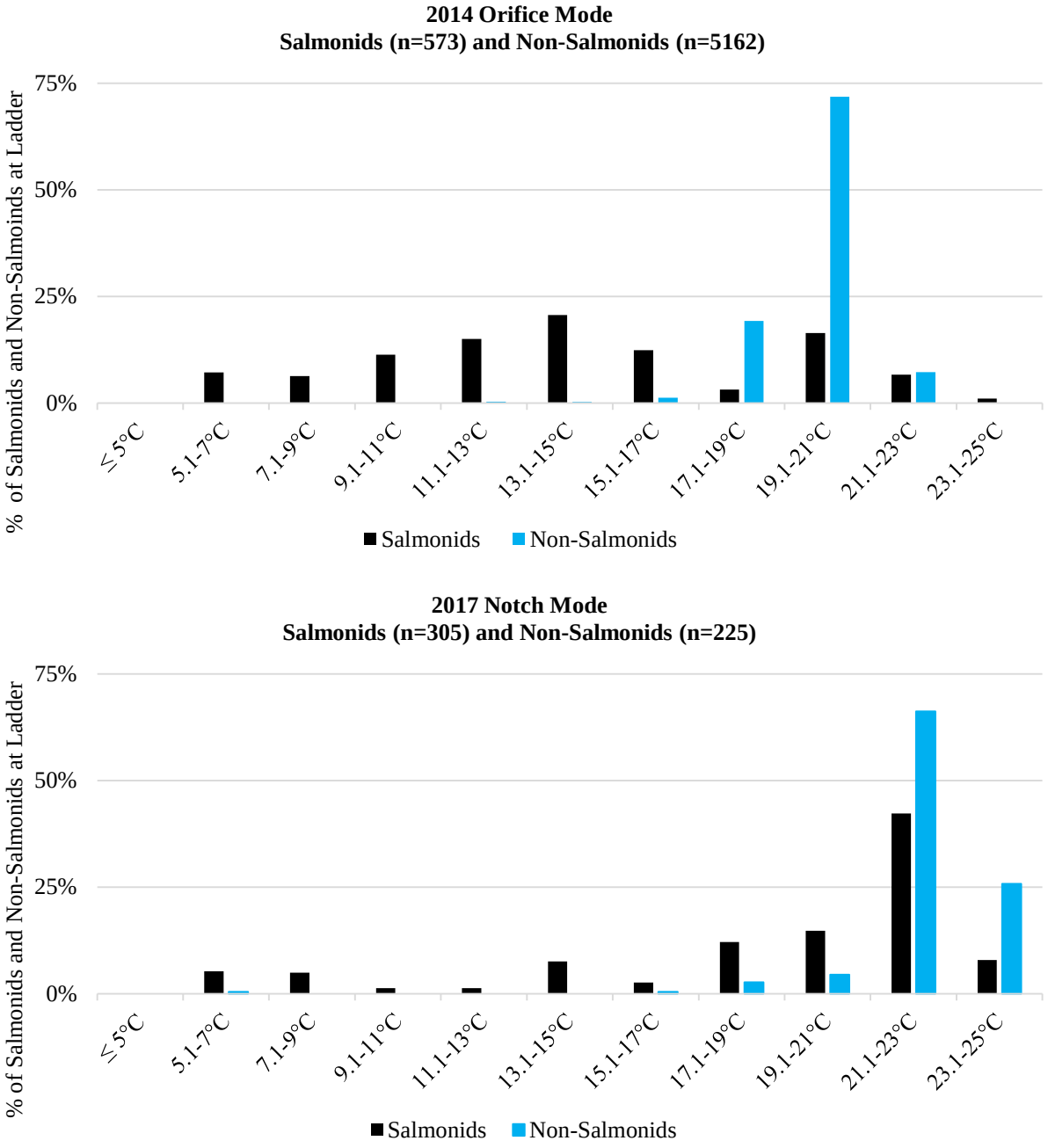
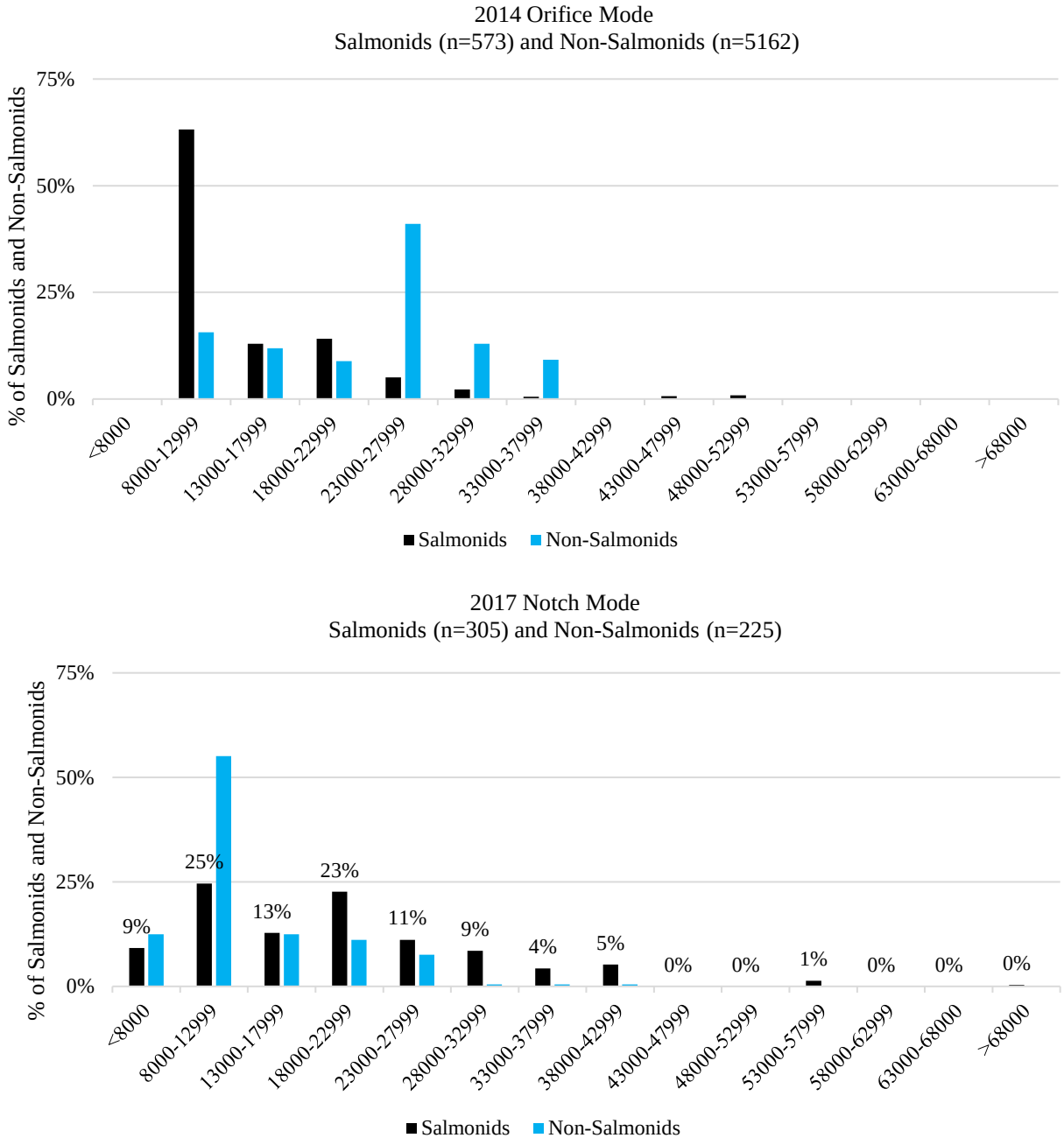


Figure 3-24: Percentage of salmonids and percentage of non-salmonids recorded at the ladder in 2014 during orifice mode (top graph) and in 2017 during notch mode (bottom graph) with various streamflows.



3.12.2 Chi-Square Test of Association – 2014 and 2017

The non-parametric Chi-Square test of association was used to evaluate whether there is an association between the successful ladder ascent of salmonid or non-salmonid (native or non-native) fish and the mode of operation (orifice or notch). Days the ladder was closed or not checked (in both years) were excluded from analysis. All days the ladder was checked (in both years) were included in the analysis. This test weighted the categorical fish variables (i.e., salmonid or non-salmonid, native or non-native) based on the successful ascent of fish in both 2014 and 2017 and tested the association with the categorical mode of operation variables. However, this test cannot provide inferences about causation. As noted above, the weir was operated only in orifice mode for 2014 and only in notch mode for 2017.

The weir mode significantly influenced the successful ladder ascents of fish whether grouped by salmonid or non-salmonid (Table 3-14) or by native versus non-native (Table 3-15; $p < 0.001$, both tests). Specifically, the Thompson Falls fish ladder facilitated the ascent of significantly more salmonids and non-salmonids during orifice mode than notch mode ($p < 0.05$, z-test on column outcomes), with non-salmonids accounting for most of the fish. Similarly, the fish ladder facilitated the ascents of significantly more native and non-native fish during orifice operation than notch operation ($p < 0.05$, z-test on column outcomes).

The Chi-Square analysis was also conducted excluding Mountain Whitefish from the data. The number of Mountain Whitefish in 2014 (n=254) was substantially higher than in other years of operation (2 to 54 MWF per year), so may have skewed the results for salmonid and native fish passage. Similar results occurred when the Chi-Square test excluded Mountain Whitefish ($p<0.001$, z-test on column outcomes). The Thompson Falls fish ladder facilitated the ascent of significantly more salmonids (not including Mountain Whitefish) and non-salmonids during orifice mode than notch mode, and significantly more native (not including Mountain Whitefish) and non-native fish during orifice operation than notch operation.

Table 3-14: Chi-Square test of association between weir mode operation and successful ladder ascents by salmonids or non-salmonids.

		Year		
		2014 (orifice)	2017 (notch)	Total
Non-Salmonids	Count	5162_a	225_b	5387
	Expected Count	4931.3	455.7	5387.0
Salmonids	Count	573_a	305_b	878
	Expected Count	803.7	74.3	878.0
Total	Count	5735	530	6265
	Expected Count	5735.0	530.0	6265.0

Each subscript letter denotes a subset of Year categories whose column proportions do not differ significantly from each other at the .05 level.

Table 3-15: Chi-Square test of association between weir mode operation and successful ascents by native or non-native fish.

		Year		
		2014 (orifice)	2017 (notch)	Total
Native Fish	Count	4097_a	117_b	4214
	Expected Count	3857.5	356.5	4214.0
Non-native Fish	Count	1638_a	413_b	2051
	Expected Count	1877.5	173.5	2051.0
Total	Count	5735	530	6265
	Expected Count	5735.0	530.0	6265.0

Each subscript letter denotes a subset of Year categories whose column proportions do not differ significantly from each other at the .05 level.

3.12.3 Summary

Results from the comparison of upstream fish passage at Thompson Falls Dam in orifice *versus* notch mode in 2014 and 2017, respectively, found the following:

- There was a higher percentage of ladder checks in notch mode resulting in "no fish" recorded than in orifice mode.
- The weir mode significantly influenced ladder ascents of fish. Statistically more fish (salmonids, non-salmonids, native, and non-native) ascended the ladder in orifice than in notch mode.
- A lower proportion of native fish (out of the total fish count) were recorded at the ladder in notch *vs.* orifice mode.
- Fewer fish and species were recorded at the ladder in notch mode *vs.* orifice mode.
- The timing of peak movements of fish in the ladder does not appear to be related to weir mode, but more likely related to the species-specific movement patterns and behavior.
- Bull Trout have ascended the ladder in both orifice mode (n=1 in 2014) and notch mode (n=1 in 2017). Sample size is too low to evaluate mode preference.

3.13 Attractant Flow

The auxiliary water system (AWS) routes water from the forebay to augment the ladder pool-to-pool flow and provides the majority of flow at the ladder entrance and into the tailrace to attract fish. Additionally, another 20 cfs can be discharged directly into the tailrace in the form of a high-velocity jet (also referred to as the HVJ or attractant flow). Its purpose is to improve fish attraction to the ladder, as needed. 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 is designed to operate during spill

(occurs when streamflow exceeds 23,000 cfs) but can also be operated during non-spill periods. Other attraction alternatives during non-spill include partially opening an adjacent spillway lift gate near to the ladder entrance to provide approximately 125 cfs (L. Mabbott, NorthWestern Energy, personal communication, January 25, 2018).

Observations of tailrace conditions downstream of the Thompson Falls Dam indicate that, during non-spill periods, additional flow are needed to allow fish to migrate upstream through the natural falls that are present downstream of the Main Channel Dam (L. Mabbott, NorthWestern Energy, personal communication, 2014). For this reason, both the AWS and the HVJ were operated throughout the non-spill season in 2017 (as has been implemented since 2012) to allow fish to reach the entrance to the ladder. In addition, starting in the autumn of 2014, half of one panel (panel #4 in the first bay), located closest to the fish ladder was modified to allow an estimated additional 125 cfs streamflow over the dam. The half panel remained opened during the 2015, 2016, and 2017 ladder seasons and NorthWestern proposes to continue this operating practice moving forward. The half panel reduces the issue of macrophytes occluding the traveling screen. The traveling screen protects and prevents large debris from entering the work station, the AWS, and the HVJ. If the traveling screen is occluded by macrophytic vegetation, flows may be reduced or even prevented from reaching the work station, the AWS, and the HVJ. The additional 125 cfs flow over the dam also appears to augment the attractant flow at the entrance of the ladder. NorthWestern proposes to continue to operate the attractant flow system in this manner in 2018 to ensure that there is sufficient flow downstream of the Project to allow fish to successfully transit the falls.

3.13.1 New Radial Gates at the Main Dam

In 2017, NorthWestern started construction on the installation of two new radial gates near the left abutment on the main channel dam, the opposite side of the existing fish passage facility. The new gates will be of similar size and configuration as the existing radial gates located in the center of the main dam. The radial gates will provide an automated system that can be managed remoted and will address safety concerns with respect to the manual efforts required to manage reservoir levels and debris build up. Each radial gate will allow a maximum of approximately 10,000 cfs to flow through. With the new gates installed, the capacity for spill will be nearly doubled with just over 40,000 cfs for all four gates. It is anticipated that the new radial gates will be operational in 2019.

NorthWestern does not propose any operational changes at the main channel dam in 2018 and will continue to implement the existing Total Dissolved Gas (TDG) Spill Plan developed in 2010 (PPL Montana, 2010). NorthWestern will also continue to monitor TDG in the area and potential impacts resulting from the use of the new radial gates.

4.0 Ladder Fish Upstream of Thompson Falls Dam

Since 2011, approximately 11.5 percent of the fish recorded at Thompson Falls fish ladder and released upstream of the dam (n=30,687) were uniquely-tagged at the ladder (2,422 PIT tags, 1,108 Floy tags). These fish are referred to as "ladder-fish". The detection of the uniquely-tagged fish after being released upstream of the dam is limited to baseline fisheries surveys, angler reports, and the remote PIT-tag arrays in the Thompson River drainage. A summary of tagged fish is provided in Section 3.9 in this report. This section summarizes baseline fisheries detections, angler detections and Thompson River detections.

4.1 Baseline Fisheries Surveys and Angler Reports of Ladder-Fish

Between 2011 and 2017, 58-tagged (PIT and Floy) ladder-fish were recaptured during baseline fisheries surveys or by anglers. Angler reporting has been associated with Floy-tagged fish only. Over 90 percent (54 fish) were recaptured upstream of Thompson Falls Dam.

Since 2011, a total of 1,107 Smallmouth Bass, initially tagged at the ladder, were released upstream of Thompson Falls Dam. The majority of the Smallmouth Bass were tagged in 2015 (n=974). Since 2015, anglers have reported to FWP capturing 33 Smallmouth Bass (10 in 2015; 18 in 2016; 5 in 2017). The majority (n=29) of these Smallmouth Bass were captured upstream of Thompson Falls Dam with at least five fish in the lower Flathead River, including two fish near Kerr Dam located approximately 100 miles upstream of Thompson Falls Dam.

In 2017, a Rainbow Trout (PIT Tag 989001006029565 and Floy tag), initially recorded at the ladder and released upstream of the dam on September 20, 2017 (476 mm, 982g), was captured 22 days later by an angler approximately 77 miles upstream near the Sloan Bridge in the lower Flathead River (M. Terrazas, FWP, personal communication, October 23, 2017).

The baseline fisheries surveys between 2011 and 2016 (no survey completed in 2017) resulted in 24 previously-tagged salmonids (20 Rainbow Trout; 3 Brown Trout; 1 Westslope Cutthroat Trout) recaptured (NorthWestern Energy, 2017). Of the 24 recaptured salmonids, eight ladder-fish were recaptured during spring electrofishing efforts (upper and lower Reservoir sections), 14 ladder-fish were recaptured during autumn electrofishing efforts (above islands or Paradise-to-Plains sections), and two ladder-fish were recaptured during autumn gillnetting (only in 2012). No Bull Trout recorded at the ladder or released upstream were recaptured during annual baseline fisheries surveys. Details of the 24 salmonids are provided in Table 2.10 in Section 2.4 of the *2016 Annual Report* (NorthWestern Energy, 2017).

4.2 Thompson River Drainage

A remote PIT-tag antenna array was installed in the mainstem of the Thompson River on September 26, 2014. The periods of operation and data collection were between September 26 and December 22, 2014; between February and December 2015; between January and December 2016; and between January and December 2017. Data collection from 2018 will be summarized and included in next year's annual report.

Although the array cannot detect directionality of fish, the entry of fish into the drainage can be assumed by cross-referencing the release date upstream of the ladder and the first detection recorded in the Thompson River. A fish detection represents the first record of an individual fish in the Thompson River and is assumed to indicate entry into the Thompson River drainage. During the initial evaluation of tag detection efficiency by the array in 2014, it was concluded that the array in the mainstem Thompson River detected both HDX and FDX PIT tags, but the detection range for a FDX tag was greater than the HDX tag (J. Glaid, Montana State University, personal communication, December 4, 2014). Although tag detection is high, there are still a few fish that go undetected thus evaluation of array detections provided in this section represent minimum values. Additionally, in 2017 between May 15 and September 26, antenna 5 (1 antenna out of 7 antennas) along the array located in the mainstem of the Thompson River was not functioning properly and not detecting fish. It is likely some fish passed through antenna 5 and were not recorded in 2017.

FWP and the Licensee also installed one PIT-tag array in Fishtrap Creek and West Fork Thompson River, both critical Bull Trout spawning tributaries in the Thompson River. These arrays have functioned sporadically since 2015 due to various technical challenges. FWP is leading the data collection effort in the tributaries and provides annual updates on the results of the fish detections in the two tributaries.

The following sections summarize ladder-fish detections at the mainstem Thompson River PIT-tag array to focus our understanding regarding how many ladder-fish are detected in the Thompson River and the timing of these movements into the drainage. Other detections from fish initially tagged in the Thompson River or transported by Avista into the Thompson River are not included in this section.

Note that after further review of the 2016 data, one revision was made, the addition of one Rainbow Trout detection for a new total of 222 new ladder-fish detections in 2016 at the Thompson River PIT-tag array. This update does not alter conclusions or general findings reported in the 2016 Annual Report. The revised 2016 data are included in the summary tables and figures and compared to 2017 data presented in this report.

4.2.1 Ladder-Fish Detected in the Thompson River

Over 650 ladder-fish have been detected in the mainstem Thompson River (via the remote array) since installation in 2014 (Table 4-1). These detections represent the first detection of a ladder-fish following its release upstream of Thompson Falls Dam. This equates to approximately 27 percent of the PIT-tagged fish released upstream of Thompson Falls Dam (since 2011) detected in the Thompson River.

Table 4-1: Summary of the number of individual ladder-fish detected in the Thompson River each year, 2014-2017.

	Year Fish Detected in the Thompson River				
Species	**2014**	**2015**	**2016**	**2017**	**Total**
BULL	-	2	1	**1**	**4**
EB	-	1	1	**-**	**2**
LL	27	103	88	**49**	**267**
RB	16	146	101	**61**	**324**
RBxWCT	-	3	3	**-**	**42**
MWF	-	1	5	**1**	**6**
WCT	1	16	20	**5**	**7**
LS SU		1	1	**-**	**2**
Unknown			2	**-**	**2**
Total	**44**	**273**	**222**	**117**	**656**

Although the remote-array in the Thompson River was not installed until late September 2014, there have been several fish detected in the Thompson River that were last recorded at the Thompson Falls fish ladder prior to 2014. Table 4-2 summarizes the last record (year) a fish was documented at the Thompson Falls fish ladder prior to detection in the Thompson River.

Table 4-2: Summary of the 656-fish detected in the Thompson River between 2014 and 2016 and the last record of the fish at the Thompson Falls fish ladder.

	Year Fish Last Detected at Thompson Falls Fish Ladder						
Species	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
BULL					2	1	**1**
EB					1	1	
LL		1	2	30	100	88	**46**
RB		11	12	42	108	106	**45**
WCT			2	5	14	16	**5**
RBxWCT			1	1	2	2	
MWF	1				5	1	
LS SU		1				1	
Unknown					1	1	
TOTAL	**1**	**13**	**17**	**78**	**233**	**217**	**97**

In 2017, there were 117 individual ladder-fish detected for the first time in the mainstem Thompson River. Ninety-seven of these fish ascended the ladder in 2017, including one Bull Trout, and were released upstream of Thompson Falls Dam, while 19 fish were last detected and recorded at the ladder in 2016 and one Mountain Whitefish in 2015. About 33 percent of the PIT-tagged salmonids released upstream of Thompson Falls Dam in 2017 (270 newly-tagged; 27 returning-tagged-fish) were detected in the Thompson River in 2017. A similar proportion of PIT-tagged salmonids released upstream of the Thompson Falls Dam in 2016 (33%) and 2015 (39%) were also detected in the Thompson River in the respective year (Table 4-3). Table 4-3 summarizes the number and percentage of PIT-tagged salmonids that were released upstream of Thompson Falls Dam and later detected in the Thompson River via the remote tag array in the same year. The total number of fish recorded at the ladder each year is provided in Section 3, Table 3-3.

Table 4-3: Summary of the PIT-tagged salmonids released upstream of Thompson Falls Dam in 2015, 2016, 2017 detected in the Thompson River in the same year as they were released. NA – not applicable

	# of Tagged Salmonids Released Upstream and Detected in the Thompson River in the Same Year			% of Tagged Salmonids Released Upstream of Dam and Detected in the Thompson River in the Same Year		
Species	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
BULL	2	1	1	100%	33%	100%
EB	1	1	-	50%	100%	-
LL	97	85	46	56%	44%	44%
RB	98	90	45	37%	25%	25%
RBxWCT	2	2	-	50%	40%	-
WCT	12	16	5	32%	46%	38%
MWF	-	1	NA	-	17%	NA
Total	**212**	**196**	**97**	**39%**	**33%**	**33%**

The majority of PIT-tagged ladder-fish are represented by Rainbow and Brown Trout, which consequently represent the largest proportion of ladder-fish detected in the Thompson River. On an annual basis (since 2015), between 25 and 37 percent of Rainbow Trout and between 44 and 56 percent of Brown Trout released upstream of Thompson Falls Dam are detected in the Thompson River in the same year (Table 4-3).

Westslope Cutthroat Trout numbers at the ladder are significantly lower than Rainbow and Brown Trout, ranging from 14 fish in 2017 to 48 fish in 2013. The percentage of Westslope Cutthroat Trout passed upstream of the dam annually and detected in the Thompson River in the same year ranges from 32 to 46 percent (Table 4-3). These data indicate the importance of Thompson River to Westslope Cutthroat Trout.

Although the tagging history of Mountain Whitefish annually at the dam was not as consistent as for other salmonids (*refer to* Table 3-7), detections of Mountain Whitefish in the Thompson River

in the same year after release upstream of the dam were much lower than other salmonids. In 2015, none of the tagged-Mountain Whitefish released upstream were detected in the Thompson River and in 2016, only 16 percent of the fish were detected. Overall, seven of the 77 tagged-Mountain Whitefish were detected in the Thompson River after release upstream (Table 4-2). Detection of these fish occurred between 119 and 1358 days following release. These data indicate Mountain Whitefish do not move immediately into the Thompson River following release upstream of the dam and may not be utilizing the Thompson River in the same way other salmonids (e.g., Rainbow Trout, Brown Trout, and Westslope Cutthroat Trout). In 2017, there were no Mountain Whitefish recorded at the ladder.

Although sample numbers are low for Bull Trout compared to other salmonids, the proportion of detections (via remote array or other sampling efforts) in the Thompson River after released upstream of the dam ranges from 33 to 100 percent moving into the Thompson River in the same year after release upstream of the dam.

PIT-tagging data of non-salmonids at the ladder are limited to a few fish prior to 2017. Between 2011 and 2017, two PIT-tagged Largescale Sucker were detected in the Thompson River. None of the Largescale Sucker or Northern Pikeminnow (n=61) PIT-tagged and released upstream of the ladder in 2017 were detected in the Thompson River in 2017.

4.2.2 Monthly Movement Patterns in the Thompson River

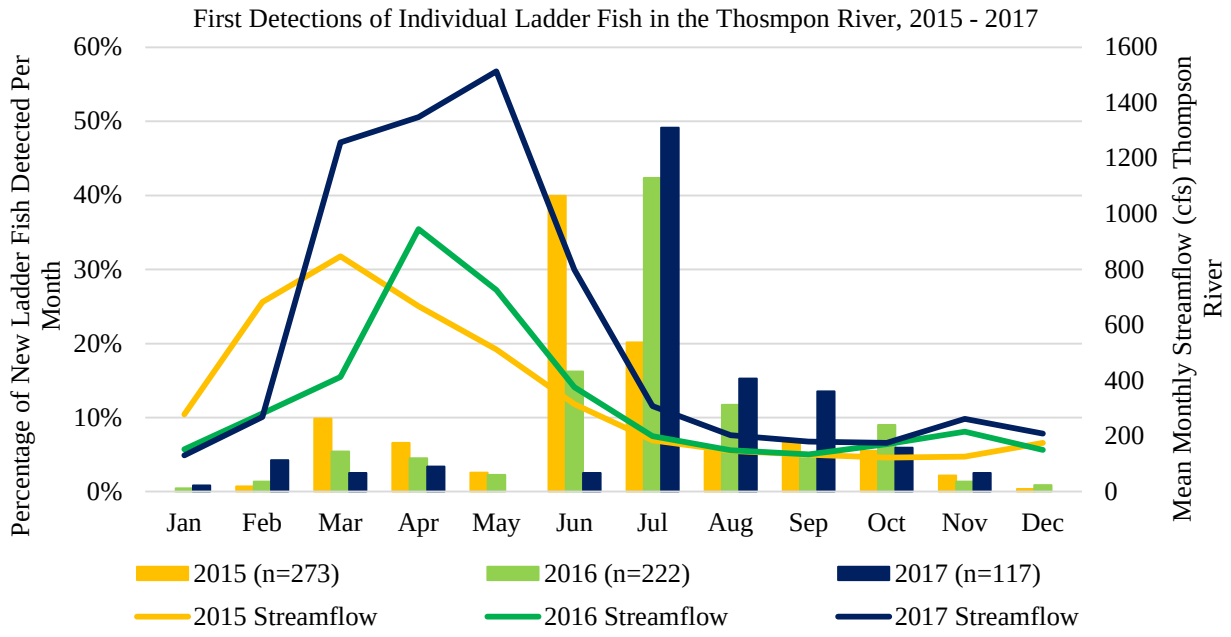
Hydrologic conditions have varied annually in the Thompson River. Over the last 3 years, peak streamflows in the Thompson River ranged from 1,440, in 2016 to 3,710 cfs in 2017 and occurred in March and April. Historically, the peak streamflow in the Thompson River generally occurs in May. During the first years the ladder was operating, between 2011 and 2014, peak streamflows in the Thompson River ranged between 2,280 and 4,590 cfs and occurred in May 2011, 2013, and 2014 and in late-April 2012 (USGS, 2017).

The monthly detections of ladder-fish in the Thompson River (for the first time after being released upstream of Thompson Falls Dam) and the mean monthly streamflow in the Thompson River (recorded at the USGS gage #12389500) for 2015, 2016, and 2017 are shown in Figure 4-1. Detailed graphs showing the mean daily streamflow and daily fish detections in the Thompson River for each year are available in Appendix A.

The highest proportion of salmonids entering the Thompson River in 2016 and 2017 occurred in July, while peak movement of salmonids in 2015 occurred in June (Figure 4-1). However, the peak movement in 2015 occurred during the last week in June concurrent with stream temperatures in the Clark Fork River that were higher than normal, nearing 25 ºC based on temperature data collected in the ladder (NorthWestern Energy, 2016). Stream temperatures in the Clark Fork River in 2016 and 2017 were not as warm in June as compared to 2015. The warmer than usual water

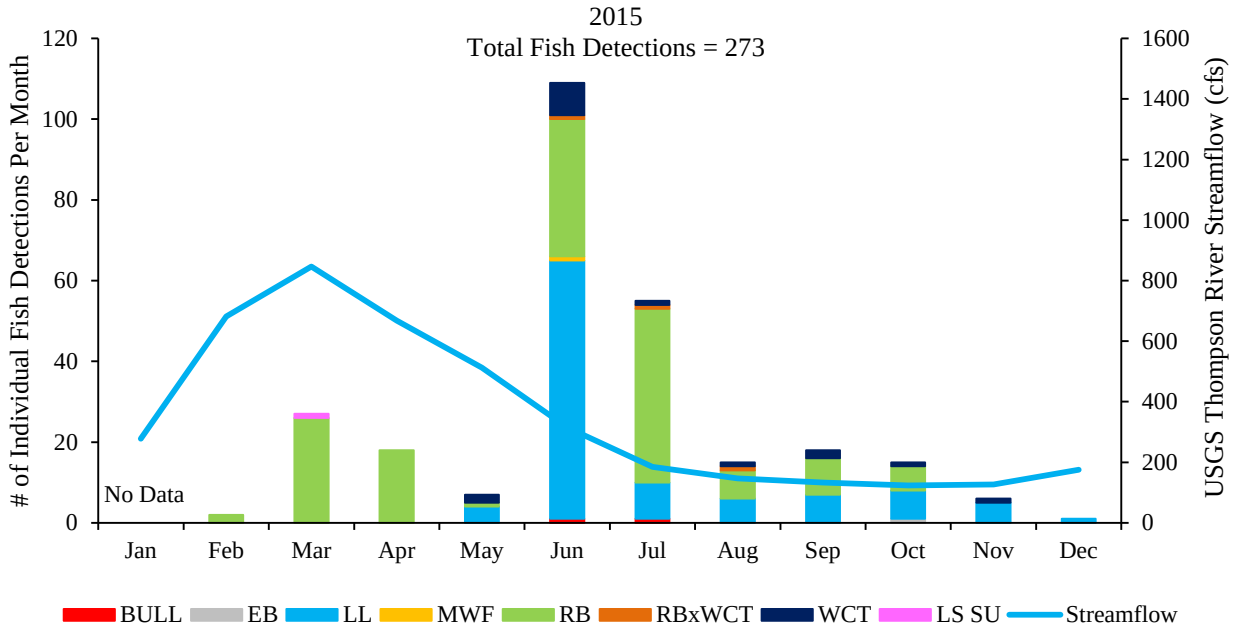
temperatures and early spring flows in the Thompson River may influence the fish movement patterns.

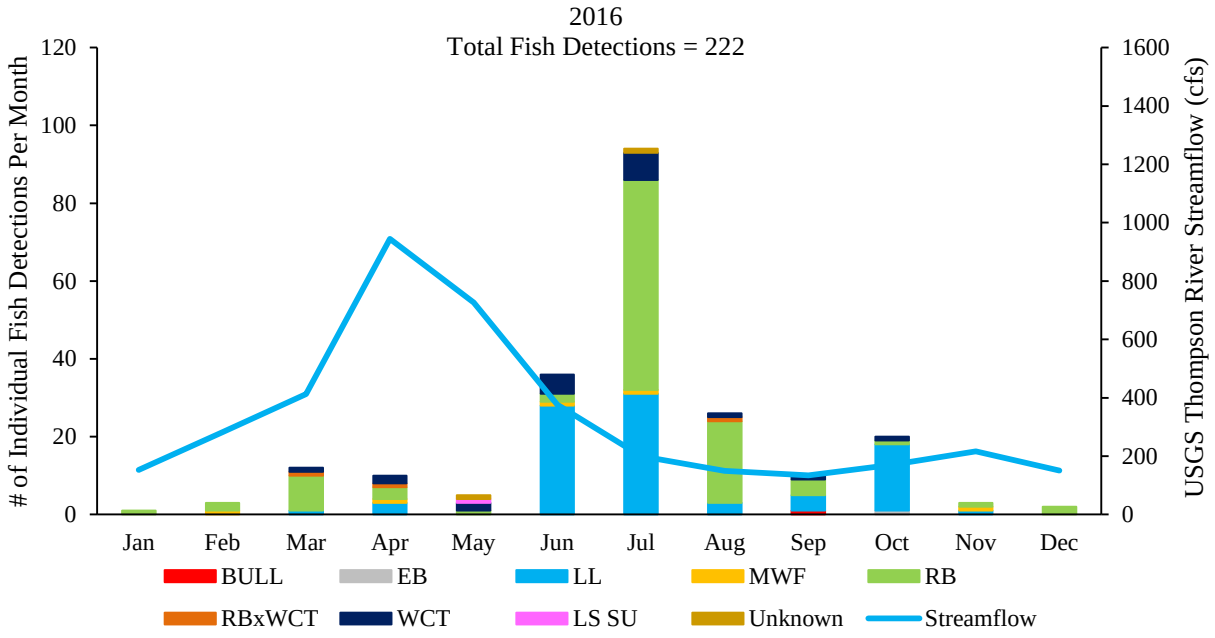
Figure 4-1: Monthly detections of ladder-fish in the Thompson River and monthly mean streamflows in the Thompson River in 2015, 2016, 2017.

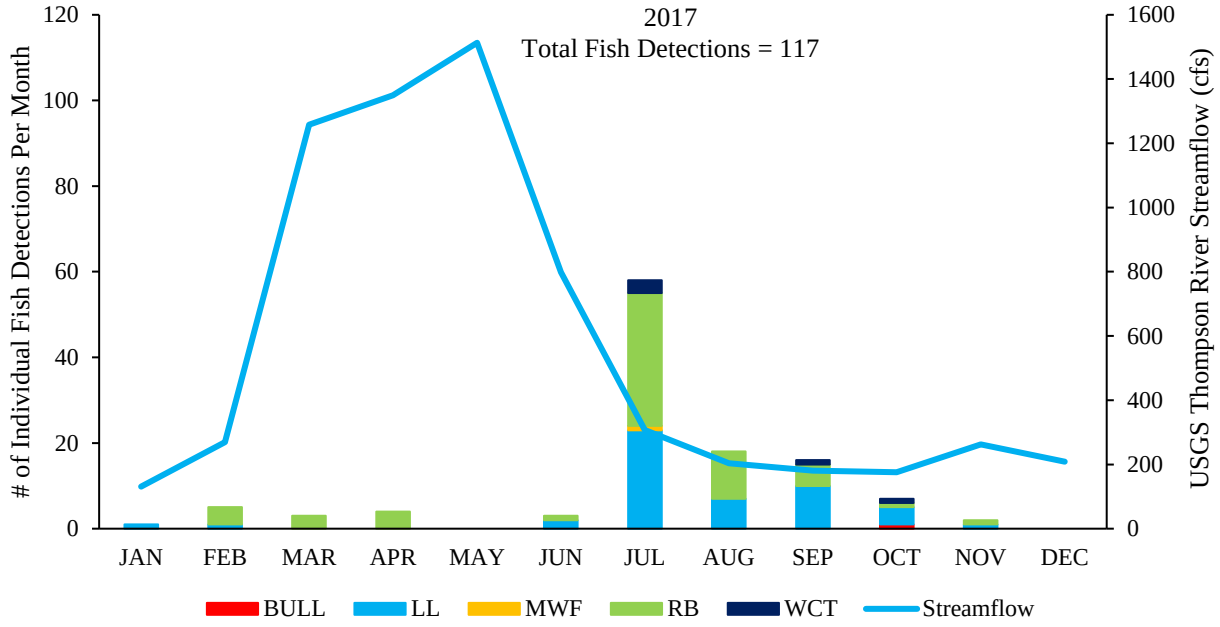


Although the general movement of fish in the Thompson River appears consistent over the last 3 years (Figure 4-2), the recent shift to earlier peak flows (March and April) in the Thompson River may be influencing movement patterns. It is also possible that river conditions in the mainstem Clark Fork River (e.g., water temperature) have a greater influence on fish entry into the Thompson River than the local hydrologic conditions in the Thompson River drainage. Additional monitoring under various hydrologic conditions will help evaluate and identify potential factors prompting salmonid movement into the Thompson River.

Figure 4-2: Monthly summary of the number of ladder-fish, by species first detected in the Thompson River and mean monthly streamflow in the Thompson River in 2015 (top), 2016 (middle) and 2017 (bottom).







4.2.3 Travel Time Between Thompson Falls Dam and the Thompson River

Travel time for fish released upstream of Thompson Falls Dam and to the Thompson River were estimated for 563 individual fish (Table 4-4). All 563 fish were released upstream of Thompson Falls Dam after the installation of the remote array in the Thompson River on September 26, 2014. It is assumed that the period between December 2014 and February 2015, when the remote array in the Thompson River was not in operation, is negligible in this analysis because the ladder was not in operation (no new fish were being released upstream) and fish movement is minimal during the winter months.

The minimum time for a fish to reach the Thompson River following release upstream of Thompson Falls Dam was approximately 5.5 hours. Approximately 30 percent of the 563 fish in Table 4-4 were detected in the Thompson River within 1-day following their release upstream of Thompson Falls Dam. Most of these fish making this 6-mile journey did so in June or July. In 2015, about 49 percent of the fish that traveled to the Thompson River within 1 day of release upstream of the dam completed the journey in June. In 2016 and 2017, fish traveling in 1 day to the Thompson River occurred most frequently in July (40% of fish traveling within 1 day in both years combined). In 2015, water temperatures in the Clark Fork River were much warmer in June compared to more typical conditions observed in 2016 and 2017 (warming that occurs in July). The higher occurrence of fish traveling within 1-day from Thompson Falls Dam to the Thompson River in June/July is likely correlated to the peak movement of PIT-tagged fish at the ladder and subsequent release upstream. Peak movements of salmonids up the ladder in 2015 occurred in June (28% of salmonids), while peak movements of salmonids up the ladder in 2016 and 2017 occurred in July (29% and 27%, respectively).

Table 4-4: The median, average, minimum, and maximum travel time for fish released upstream of Thompson Falls Dam (from September 26, 2014 through 2017) and their first detection in the Thompson River in 2014, 2015, 2016, 2017, and all 4 years combined.

Year Detected in T. River	Number of Fish	Duration (days) between Release Upstream of Dam and Detected in the Thompson River			
		Median	Average	Min	Max
2014	12	7	16	< 1 day	67
2015	217	2	23	< 1 day	277
2016	217	6	50	< 1 day	619
2017	**117**	**4**	**60**	**< 1 day**	**641**
All Years	**563**	**3.1**	**41**	**< 1 day**	**641**

4.2.1 Upstream and Downstream Movements

The previous sections summarized linear fish movement from Point A (fish ladder) to Point B (Thompson River) within the same year. However, riverine fishes such as salmonids are much more dynamic in their movement patterns. Unlike anadromous salmon, riverine fishes do not face imminent mortality following spawning and are not solely motivated to move upstream (or downstream in some cases) to spawn. With 3 years of Thompson River array data and 7 years of ladder data, some larger movements and patterns have been observed.

Some salmonids appear to be making a "loop" of upstream and downstream movements (between Thompson Falls Dam and the Thompson River) at varying intervals. A "loop" is defined as a fish that ascends the ladder and is released upstream of the dam, moves upstream into the Thompson River, and then exits the Thompson River drainage and moves downstream of Thompson Falls Dam (either through turbines or over the spillway, depending on the time of year) and returns to the ladder to repeat the journey upstream into the Thompson River. Several fish have made the "loop." In 2017, there were 15-salmonids (5 RB; 4 LL; 1 WCT) documented either returning to the Thompson River after being released upstream of Thompson Falls Dam for a second (n=10), third (n=4), or fourth (n=1) time. In 2016, there were 28 salmonids (15 RB; 12 LL; 1 WCT) returning to the Thompson River for the second time after being released upstream of the dam and one salmonid making a third trip.

4.2.2 Summary

Data collected at the ladder and in the Thompson River show upstream fish passage provides the potential benefit of multiple spawning contributions by an individual fish. The movement patterns observed from 656-ladder-fish released upstream of Thompson Falls Dam and later detected in the Thompson River (via the remote array) indicate some fish remain upstream of Thompson Falls Dam for multiple years following the release upstream of the fish ladder, while other individual fish repeat the cycle of ascending the fish ladder (annually or some other interval) before returning to the Thompson River.

5.0 Bull Trout Sampled in the Project Area

This section summarizes Bull Trout sampling in the Project Area, including Bull Trout documented at the ladder since 2011. Only Bull Trout initially tagged by NorthWestern in the Project area and subsequently recaptured/detected in the Thompson River are described in this section. Bull trout surveyed and/or sampled in the Thompson River, are related to FWP sampling efforts and are reported by FWP.

In 2017, one Bull Trout (#989001006029199) measuring 408mm and 522 grams was sampled by the Licensee. This individual fish was recorded at the fish ladder on September 18, 2017 and released upstream of the Thompson Falls Dam. This fish was detected once in the mainstem Thompson River via the remote PIT tag array approximately one month later October 23, 2017. NorthWestern did not implement spring or fall baseline electrofishing and no Bull Trout were captured during spring electrofishing efforts downstream of the Thompson Falls Dam or during fall gillnetting efforts in the Thompson Reservoir in 2017.

Bull Trout sampled via annual spring and fall baseline fisheries surveys upstream of Thompson Falls Dam, electrofishing surveys immediately downstream of Thompson Falls Dam, and enumeration of fish at the Thompson Falls fish ladder has resulted in 33 Bull Trout (representing 32 individuals) sampled by the Licensee since 2011.

A total of 16 Bull Trout (representing 15 individuals) ascended the Thompson Falls fish ladder, entered the holding pool, and were released upstream between 2011 and 2017. During the same period 10 Bull Trout were sampled during baseline fisheries surveys upstream of Thompson Falls Dam (6 Bull Trout during spring surveys; 4 Bull Trout during fall surveys), and 7 Bull Trout were recorded during electrofishing efforts immediately downstream of Thompson Falls Dam in 2011, 2012, and 2014. A summary of the 15 individual Bull Trout recorded at the ladder is provided in Table 5-1 and a summary of the other 17 individual Bull Trout sampled in the Project area (excluding the ladder) is provided in Table 5-2.

Since 2011, the Licensee only documented one Bull Trout mortality associated with the Project. In 2012, one Bull Trout returned to the ladder for a second ascent and jumped out of a pool and died (Table 5-1). Initially, a cover was placed over the holding pool which was later replaced with a screen installed around the railing above the holding pool to mitigate the potential for this to occur again.

Table 5-1: Summary of 15 individual Bull Trout that ascended the ladder, 2011-2017.

Date	Length (mm)	Weight (g)	PIT Tag	Water Temp (°C)	USGS #12389000 Mean Daily Streamflow (cfs)	Most likely population of Origin	Last Detection of Bull Trout (updated 12-13-2017)
4/13/2011	365	364	985121023302169	6.6	24,500	WF Thompson River (R4)	Released live upstream of TFalls Dam; no additional detections
4/26/2011 5/21/2012	547 563	1438 1404	985121023464730	7.8 11.1	25,900 56,100	Fishtrap (R4)	4/26/2011 first ascent; 5/21/2012 second ascent **Mortality** (jumped out of pool)
5/15/2012	510	1172	985121021877906 982000357016269	11.3	51,000	Meadow Ck (R4)	5/31/2011 first observed below TFalls Dam electrofishing; 5/15/2012 ascended TFalls Ladder and released live upstream of TFalls Dam; 7/7/2013–8/13/2013 detected downstream of TFalls Dam by Avista in Prospect Creek
4/30/2013	598	2306	982000357016065	8.9	25,100	Fish Ck (R4)	Released live upstream of TFalls Dam; no additional detections
5/6/2013	576	1694	982000357016109	10.6	24,000	Fishtrap (R4)	Released live upstream of TFalls Dam; 9/21/2014 detected downstream of TFalls Dam by Avista in Prospect Creek; 5/5 & 5/13/2015 detected in the lower pool in the Thompson Falls fish ladder
5/7/2013	478	978	982000357016155	11.3	25,000	Fishtrap (R4)	Released live upstream of TFalls Dam; no additional detections
6/7/2013	596	1926	Half-duplex (HDX) tag not recorded (Genetics 118-073)	15.5	38,100	Fishtrap (R4)	Released live upstream of TFalls Dam; no additional detections
8/9/2013	482	1058	982000357016151	22.3	8,680	Fishtrap (R4)	Released live upstream of TFalls Dam; no additional detections
5/16/2014	523	1264	982000357016169	10.8	44,000	Fish Ck (R4)	Released live upstream of TFalls Dam; 10/13/2014 recaptured during 2014 annual reservoir monitoring led by FWP in Noxon Reservoir on via gillnet **(Mortality)**
5/17/2015	519	1334	982000363519407	12.9	26,400	Fishtrap (R4)	Released live upstream of TFalls Dam; 6/2/2015 recaptured (543mm, 1348g) during 2015 FWP electrofishing in Big Hole Section of Thompson River and released live in Thompson River

Date	Length (mm)	Weight (g)	PIT Tag	Water Temp (°C)	USGS #12389000 Mean Daily Streamflow (cfs)	Most likely population of Origin	Last Detection of Bull Trout (updated 12-13-2017)
6/3/2015	520	1112	982000357016242 982000357016210	15.6	29,900	Fishtrap (R4)	Released live upstream of TFalls Dam; 7/15/2015 detected in West Fork Thompson River
4/18/2016	413	602	989001005372232	9.7	19,500	Fishtrap (R4)	4/18/2016 released live upstream of TFalls Dam; 10/2/2016 detected in the lower pool in the Thompson Falls fish ladder
5/18/2016	615	1934	989001005372387	13.4	29,500	NF Fish Ck (R4)	5/18/2016 released live upstream of TFalls Dam; 9/18-19, 9/21, 9/24, 9/26-18 (2016) detected in the Thompson River; 9/20/2017 detected in Graves Creek (entered and exited system on the same day)
6/6/2016	618	1950	989001005372405	17.0	32,000	NF Fish Ck (R4)	Released live upstream of TFalls Dam; no additional detections
9/18/2017	**408**	**422**	**989001006029199**	**15.1**	**8,270**	**118-084 (Pending)**	**9/18/2017 released live upstream of TFalls Dam; 10/23/2017 detected In Thompson River**

Table 5-2: Summary of 17 individual Bull Trout sampled during baseline fisheries surveys or electrofishing downstream of Thompson Falls Dam, 2011-2017. No Bull Trout sampled in 2017. NA – not any.

Initial Date Captured	Length (mm)	Weight (g)	PIT Tag #	Method & Location	Most Likely Population of Origin	Subsequent Detection Date(s)	Location(s)
5/31/2011	482	966	985121021877906	Spring EF Below TFalls Dam	Meadow Creek (R4)	5/15/2012 7/7/2013	TFalls Ladder Prospect Ck
5/31/2011	180	50	985121021907887	Spring EF Below TFalls Dam	Fishtrap Creek (R4)	NA	
5/31/2011	247	130	985121021914545	Spring EF Below TFalls Dam	Fishtrap Creek (R4)	NA	
4/10/2012	272	150	985121027393272	Spring EF Below TFalls Dam	Graves Creek (R3)	NA	
4/16/2012	222	76	985121027360192	Spring EF Lower Section – TFalls Reservoir	Fishtrap Creek (R4)	NA	
4/17/2012	260	140	985121027402995	Spring EF Upper Section – TFalls Reservoir	Fishtrap Creek (R4)	NA	
10/30/2012	472	800	982000357016135	Autumn EF Paradise – Plains	Monture Creek (R4)	NA	
10/30/2012	444	678	982000357016066	Autumn EF Paradise – Plains	Fish Creek (R4)	NA	
4/10/2013	260	108	982000357016097	Spring EF Upper Section – TFalls Reservoir	Fishtrap Creek (R4)	NA	
4/7/2014	520	1500	No PIT Tag (no genetics)	Spring EF Below TFalls Dam	NA	NA	
4/15/2014	577	1446	900226000035846	Spring EF Upper Section – TFalls Reservoir (initial tagging by Avista Below Cabinet Gorge Dam & transport to R4, 6/9/2013)	Fishtrap Creek (R4)	NA	
5/28/2014	567	1640	985121021203256 982000357016106	Spring EF Below TFalls Dam (initial tagging by Avista LCFR-ID and released to Vermilion River 6/2/2011 with radio tag 38 frequency 148.500)	Fishtrap Creek (R4)	9/18/2014	Prospect Ck

Initial Date Captured	Length (mm)	Weight (g)	PIT Tag #	Method & Location	Most Likely Population of Origin	Subsequent Detection Date(s)	Location(s)
6/3/2014	509	1224	982000357016241	Spring EF Below TFalls Dam	Fishtrap Creek (R4)	NA	
10/28/2014	315	260	982000357016111	Autumn EF Paradise – Plains	NF Jocko (R4)	NA	
4/13/2015	219	88	989001004067249	Spring EF Upper Section – TFalls Reservoir	Fishtrap Ck (R4)	NA	
10/20/2015	651	1966	900226000730577	CFR – Above Islands (initial tagging by Avista Below Cabinet Gorge Dam & transport R4 4/14/2015)	Fishtrap Ck (R4)	NA	
4/11/2016	247	124	989001005372235	Spring EF Upper Section – TFalls Reservoir	WF Thompson River (R4)	NA	

5.1 Bull Trout Genetic Assignments

Genetic samples of Bull Trout collected in association with the Project, were submitted to Abernathy Fish Technology Center Conservation Genetics Laboratory for analysis. The summary tables (Tables 5-1 and 5-2) include the respective genetic assignment for each Bull Trout sampled by the Licensee. Since the 2016 Annual Report (NorthWestern, 2017), one Bull Trout (#989001005372235) genetic sample was reanalyzed and the updated genetic assignment (now West Fork Thompson River, Region 4) is included in Table 5-2. The initial genetic assignment for this Bull Trout was the East Fork Bull River (Region 2). Historic data indicate FWP collected Bull Trout eggs in the Bull River in 1942 and 1944, Creston National fish hatchery incubated eyed eggs and stocked fingerlings in the Thompson River basin (Pratt and Huston 1993). This historical stocking event may explain the genetic assignment of this Bull Trout to Region 2 (Bull River drainage) even though the fish is known to originate in Region 4. Therefore, because the Bull Trout (#989001005372235) was sampled upstream of Thompson Falls Dam (Region 4) in the upper section of the Thompson Reservoir and had no history below Thompson Falls Dam, the sample was reanalyzed for genetic assignment. However, in the second analysis, Region 3 and 4 tributaries were included as potential streams of origin and the analysis resulted in a genetic assignment of Prospect Creek (Region 3) as the most likely population of origin and West Fork Thompson River (Region 4) as the second most likely population of origin (Adam et al. 2017). After further discussions with Avista and Abernathy regarding the origin of the individual Bull Trout in Region 4, the analysis was analyzed a third time and only included Region 4 tributaries with the genetic assignment result identifying West Fork Thompson River as the most likely population of origin (S. Bernall, Avista, personal communication, January 29, 2018; B. Adam, personal communication, January 29, 2018). The third and most recent analysis will be reflected in Abernathy's 2017 report anticipated to be finalized in 2018 (Adam et al. *in prep*).

Although the genetic assignment for the Bull Trout recorded at the ladder in 2017 remains pending at the time of this report, the other 14 individual samples from Bull Trout recorded at the ladder have been genetically assigned to Region 4 (upstream of the Thompson Falls Dam) with the majority (60%) genetically assigned to Fishtrap Creek (n=8) or West Fork Thompson River (n=1), both tributaries to the Thompson River (Table 5-1). Other Bull Trout were assigned to Fish Creek (n=3), North Fork Fish Creek (n=2), and Meadow Creek (n=1).

5.2 Bull Trout Ascending the Ladder

The primary objective for construction of the Thompson Falls upstream fish ladder was to address upstream fish passage for the federally-threatened Bull Trout. The ladder has proven to provide upstream passage to Bull Trout and during every year of operation (2011-2017), between one and five Bull Trout have ascended the ladder annually and been released upstream.

During the last 7 years of operations, 16 Bull Trout (representing 15 unique individuals) ascended the ladder. Fourteen individual Bull Trout were "new" fish and received PIT tags at the ladder

prior to being released upstream. One Bull Trout was initially tagged electrofishing downstream of Thompson Falls Dam approximately 1-year prior to its ascent of the ladder.

A total of 9 individual Bull Trout were detected at least once after being released upstream of Thompson Falls Dam (Table 5-1). Of the nine Bull Trout with subsequent detections, four Bull Trout were detected upstream in the Thompson River drainage, and one of these fish was also detected downstream of the Project in Graves Creek in 2017. Two Bull Trout were detected downstream of the Project in Prospect Creek and two fish were later recorded as mortalities (1 at the ladder; 1 downstream in Noxon Reservoir). Since the fish ladder has been in operation, one Bull Trout has ascended the ladder twice with the second ascent resulting in mortality after the fish jumped out of the holding pool, while two other Bull Trout have returned to the ladder (detected in the lower pools) but not ascended the ladder.

5.2.1 Bull Trout Data Collection

Bull trout data collected at the Thompson Falls fish ladder includes the number of Bull Trout entering the ladder that were previously PIT-tagged and detected by the remote arrays in the lower pools (pools 7/8) or in the holding pool (pool 45), or Bull Trout recorded at the work station that received a PIT-tag.

Streamflow and water temperature data are recorded for each corresponding day that a Bull Trout is detected entering the ladder or recorded at the work station after ascending the ladder. Streamflows reflect the mean daily streamflow measured at the USGS gage #12389000 (near Plains), but do not include contributions from tributary streams, including the Thompson River located between Plains and Thompson Falls Dam. Therefore, actual streamflows at the Project are likely higher. Water temperatures reflect the temperature data collected at the time the ladder was checked and does not reflect the daily maximum.

5.2.2 Bull Trout Movement Patterns at the Ladder

Most Bull Trout (14 of 16 ascents) ascended the ladder between April and June, while one Bull Trout was recorded ascending the ladder on August 9, 2013 and another Bull Trout was recorded ascending the ladder on September 18, 2017. Based on data collected between 2011 and 2017, the peak ladder use for Bull Trout (7 of 16 ascents) occurs in May. Bull trout were recorded during the month of May in the ladder when streamflows ranged from approximately 22,000 to 56,100 cfs and water temperatures ranged from 11.1 to 13.8 ºC. The only months Bull Trout have not been recorded ascending the ladder were March, July, October, and November. However, one Bull Trout was detected entering the ladder in October.

Since 2011 and throughout the entire operational season, Bull Trout were documented entering the ladder with streamflows ranging from 6,600 to 56,100 cfs (Figure 5-1) and water temperatures ranging from approximately 6.9 to 22.7 ºC (Figure 5-2). In 2017, the single Bull Trout recorded at the ladder on September 18 ascended when the water temperature was approximately 15.1 ºC and the streamflow approximately 8,100 cfs.

Figure 5-1: Clark Fork River streamflow (USGS gage #12389000) corresponding to when Bull Trout were detected either entering the lower pools and did not ascend (some Bull Trout display multiply entries) or ascended to the holding pool between 2011 and 2017.

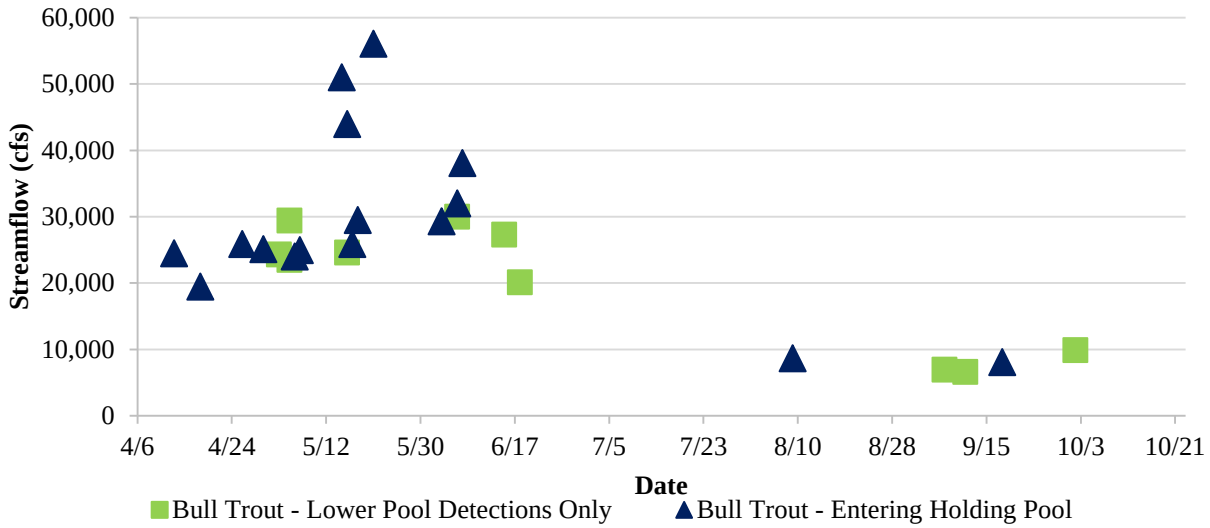
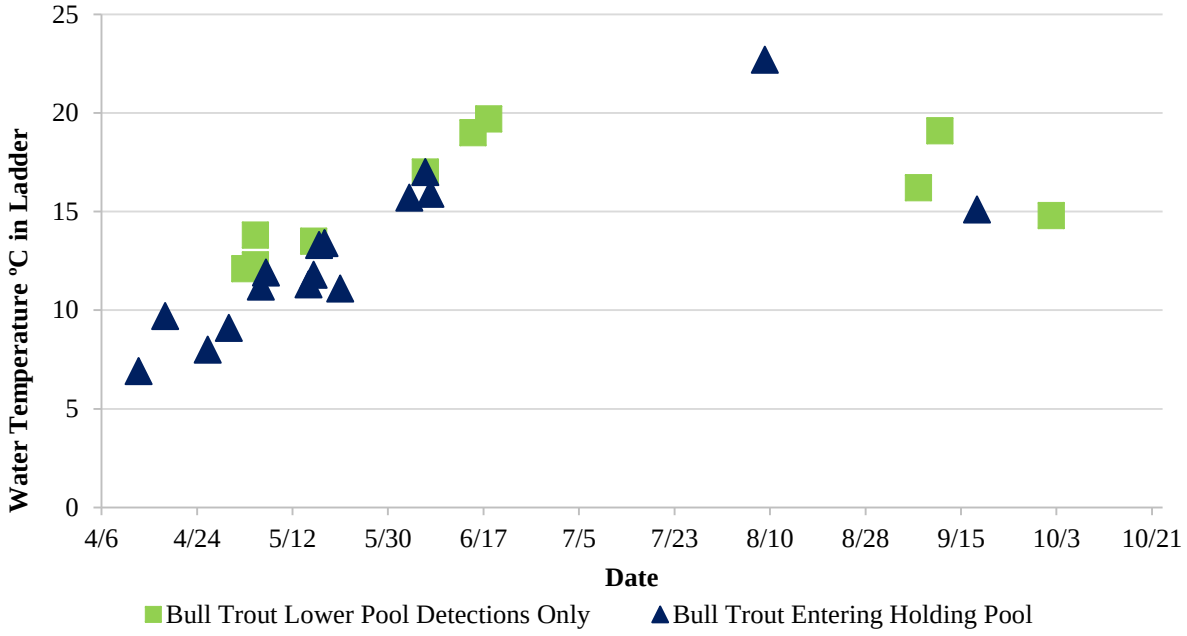


Figure 5-2: Water temperature in the ladder (based on single daily measurement) corresponding to the date when Bull Trout were detected either entering the lower pools and did not ascend (some Bull Trout display multiply entries) or ascended to the holding pool between 2011 and 2017.



Between 2011 and 2016, all 15 Bull Trout ascents and entry detections at the ladder occurred while the ladder operated in orifice mode. In 2011, one Bull Trout, presumably ascending the ladder, was captured in pool 23 during a mode switch from orifice to notch mode (H. Carlsmith, FWP, personal communication, August 20, 2017). The Bull Trout recorded in 2017 represented the first Bull Trout to ascend the ladder in September and ascend in notch mode. Prior to 2017, there were

no Bull Trout detections in the ladder during notch mode and only two Bull Trout detected entering the lower pools (in orifice mode and did not ascend) during the month of September.

In addition to the 16 Bull trout that ascended the ladder and were recorded at the work station and released upstream, 10 previously-tagged Bull Trout have been documented entering the ladder (via remote tag arrays) with two fish ascending and eight fish not ascending. In 2012 there were two previously PIT-tagged Bull Trout that entered and ascended the ladder. In 2015 and 2016, eight Bull Trout (5 in 2015; 3 in 2016) detected entering the lower pools of the ladder but did not ascend to the holding pool (Table 5-3). There were no detections of previously tagged Bull Trout entering the ladder in 2011, 2013, 2014, or 2017.

Table 5-3: Summary of the 8 Bull Trout detected in the Thompson Falls fish ladder via the remote antennas that did not ascend to the holding pool in 2015 and 2016, including the date(s) of detection, PIT tag identification, most likely population of origin, previous detection(s), other detections in ladder (if any), most recent length (mm).

Year	Detections in Lower Pools Only	PIT Tag (Genetic Assignment & Region)	Previous Detection(s)	Last Recorded L (mm)
2016	5-May 6-Jun	900226000570921 (WF Thompson R4)	10/3/2014 twin weir below CGD transported to WF Thompson	570
2016	7&8-Sep	985121025935363/ 900226000625227 (Graves Creek R3)	11/2/2010 juvenile in Graves Creek; 9/27/2013 LPO /gillnet; 9/17/2014 below CGD transported to Graves Creek	694
2016	2-Oct	989001005372232 (Fishtrap Creek R4)	4/18/2016 Thompson Fall Ladder (released upstream)	413
2015	3-May 8-May 16-May	900226000035613 (Thompson River R4)	8/28/2012 Prospect Creek Weir (Avista); 8/5 – 9/14/2013 detected sporadically on the lower Prospect Creek PIT tag array station (Avista)	585
2015	5-May 13-May	982000357016109 (Fishtrap Creek R4)	TFalls Ladder 5/6/2013; 9/21/2014 Prospect Creek (Avista)	576
2015	16-May 11-Sep	900226000116250 (Thompson River R4)	9/14/2013 Twin Creek ID weir, 9/18/2013 transported and released to WF Thompson River by Avista	616
2015	15-Jun	900226000730558 (Graves Creek R3)	4/30/2015 captured below CGD, released into Graves Creek on 5/6/2015 (Avista)	651
2015	18-Jun	985120019650279 900226000570831 (Rock Creek R2)	8/22/08 captured as juvenile in Prospect Creek and transported downstream to Idaho (by Avista); 8/28/13 captured below CGD, released in Prospect Creek by Avista; 9/13/13 captured in Prospect Creek weir; 7/28/14 captured below CGD and transported to Prospect Creek	718

Of the eight individual Bull Trout detected entering the ladder in 2015 and 2016 that did not ascend to the holding pool, two were initially tagged at the ladder (thus had ascended once prior) and were returning fish. The other six fish were previously captured downstream of Thompson Falls Dam by Avista personnel and were visiting the ladder for the first time. Many of the Bull Trout, only detected in the lower pools, entered the ladder multiple times at various intervals and some were detected multiple times in the same month while others visited in different months. A summary of the eight Bull Trout, including the dates they were detected in the ladder and detection history is provided in Table 5- 3.

5.3 Bull Trout Length Frequency and Length-Weight Relationship

In past reports, fish metrics have included a summary of length and weight measurements as well as growth estimates. Fish growth reflects the change in size (length and weight) per year extrapolated by calculating the difference in size between an initial capture and subsequent capture of the same fish. However, the growth rate calculations were difficult to interpret with the high variability related to the small sample sizes with some fish increasing in size and others declining in size, likely related to factors such as, but not limited to potential weight loss due to spawning or mortality.

Due to the small sample size of recaptured Bull Trout in the Project area, other metrics instead of a growth rate were evaluated. A summary of length and weight of Bull Trout recorded at the ladder between 2011 and 2017 is provided in Section 3.6. For this section, length frequency and length-weight relationship for Bull Trout sampled by the Licensee in the Project area between 2011 and 2017 were evaluated.

Between 2011 and 2017, the Licensee sampled 33 Bull Trout (representing 32 individuals, *refer to* Tables 5-1 and 5-2) in the Project area, including seven Bull Trout captured via electrofishing immediately below Thompson Falls Dam, 10 Bull Trout recorded upstream of Thompson Falls Dam (5 Bull Trout in the upper Reservoir section; 1 Bull Trout in the lower Reservoir section; 1 Bull Trout in the above islands section; 3 Bull Trout in the Paradise to Plains section), and 16 Bull Trout recorded at the fish ladder. The length frequency and length-weight relationship for the Bull Trout sampled in the Project area is illustrated in Figures 5-3 and 5-4 respectively.

Figure 5-3: Frequency distribution of the total lengths (mm) measured for 33 Bull Trout sampled in the ladder and electrofishing in the Thompson Falls Project area between 2011 and 2017.

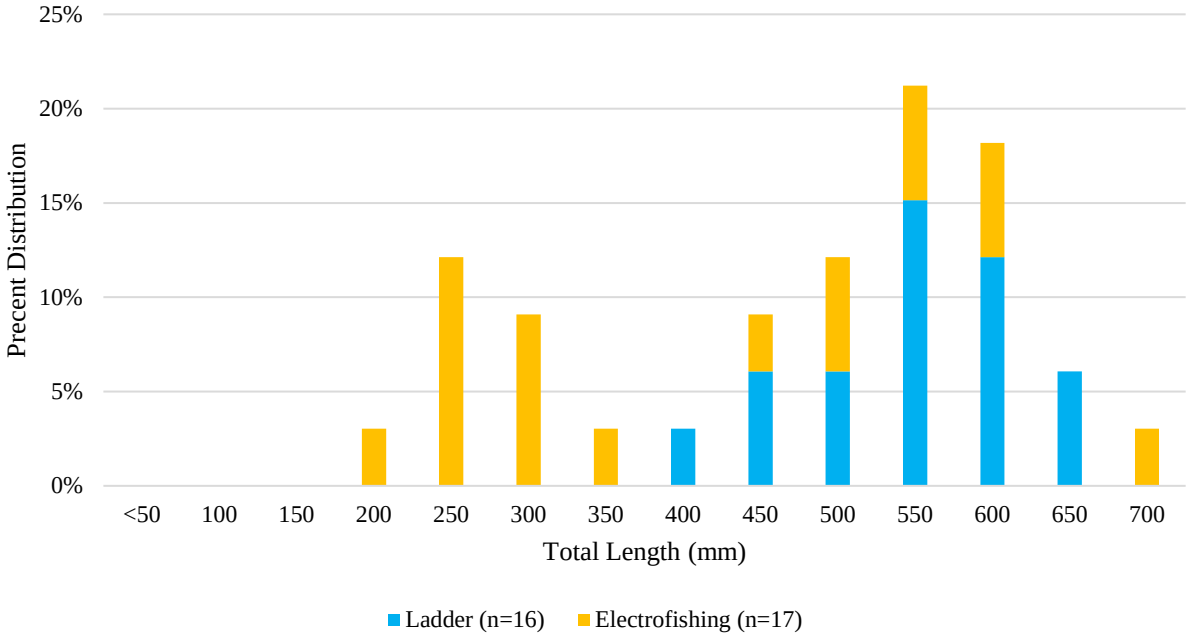
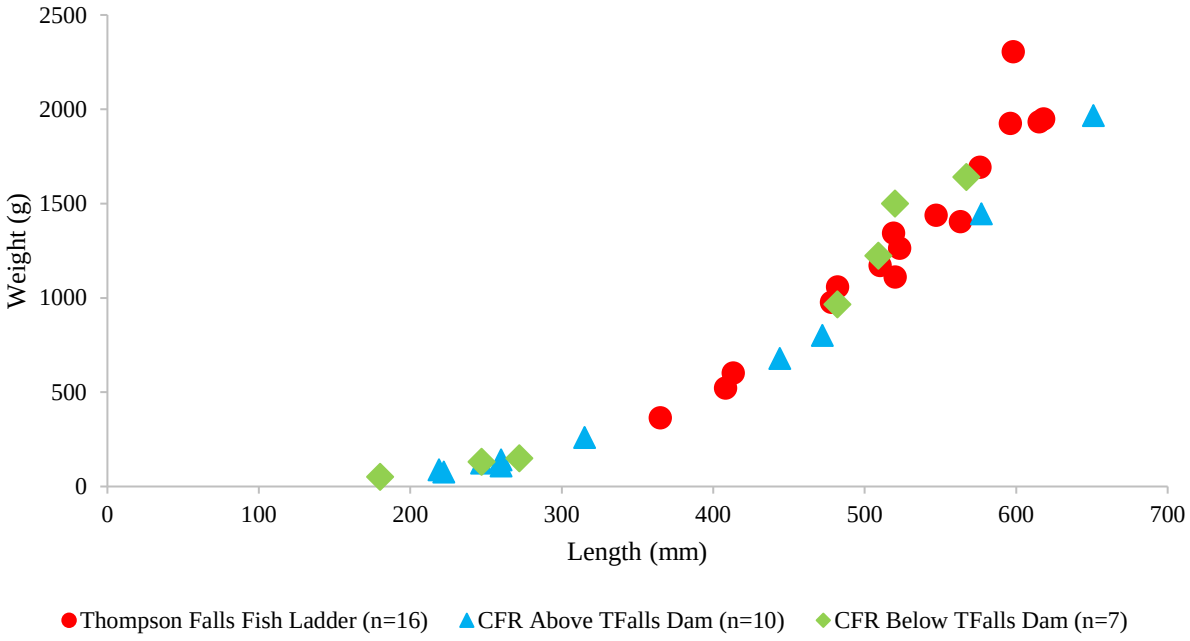


Figure 5-4: Weight (g) *vs.* length (mm) of Bull Trout data collected in the Project Area (n=33), including 16 Bull Trout at Thompson Falls fish ladder, 10 Bull Trout in the Clark Fork River (CFR) upstream of Thompson Falls Dam, and 7 Bull Trout in the CFR immediately downstream of Thompson Falls Dam between 2011 and 2017.



Bull trout recorded during electrofishing efforts in the Clark Fork River upstream and downstream of Thompson Falls Dam ranged in size from 180 mm to 651 mm in length, indicating these

sampling efforts captured both juvenile and adult Bull Trout. Bull trout recorded at the ladder ranged in size from 365 mm to 618 mm indicative of primarily adult Bull Trout. The distribution of sizes for bull trout sampled in the Project area show that both juvenile and adult Bull Trout are in the Project area, but primarily adult Bull Trout are ascending the ladder.

5.4 Juvenile and Sub-adult Bull Trout Out-Migration Study

The juvenile and sub-adult Bull Trout out-migration study was implemented in 2014 and 2015 by a Montana State University graduate student. The final Master's Thesis, *Subadult Bull Trout Out-migration in the Thompson River Drainage, Montana* (Glaid, 2017) is available on the Project website (http://thompsonfallsfishpassage.com/reference.html). Fisheries data collected in 2014 and 2015 from the Thompson River drainage was also summarized in the 2016 Technical Memo (New Wave Environmental Consulting and GEI Consultants), which is also available on the Project website.

Glaid's (2017) primary study objectives included 1) describe the out-migration timing, magnitude, and demographics of subadult Bull Trout in the Thompson River drainage; 2) identify abiotic parameters that influence fluvial and adfluvial out-migration of Bull Trout in the Thompson River drainage; and 3) assess movement characteristics of subadult Bull Trout in the mainstem Thompson River and Thompson Falls Reservoir.

Glaid's (2017) conclusions found few subadult Bull Trout emigrated from the tributaries into the mainstem Thompson River or from the tributaries to Thompson Falls Reservoir. A total of 754 Bull Trout were PIT tagged in 2014 and 2015 in West Fork Thompson River (n=246) and Fishtrap Creek (n=511). Glaid (2017) estimated 3.4 percent (n=26) of the Bull Trout were detected out-migrating to the Thompson Reservoir and approximately 22 percent (n=168) were detected out-migrating to the mainstem Thompson River. In 2017, the remote tag array in the mainstem Thompson River detected three Bull Trout initially tagged in 2015 in the Fishtrap Creek drainage (NorthWestern, unpublished data).

Glaid (2017) tracked 14 radio-tagged Bull Trout for 78 days between September 24 and December 22, 2015. None of the radio-tagged fish were documented leaving the Thompson River drainage and only one was recorded at the remote array station on the mainstem Thompson River. Radio-tagged bull trout from Fishtrap and West Fork Thompson River did not intermix and four of the radio-tagged fish were casualties of mink predation.

The majority of Bull Trout emigration from the tributaries occurred at night between 2000 and 0800 hrs (Glaid, 2017). Bull trout movement out of the tributaries peaked in October and out-migration of the Thompson River peaked in December. Size of bull trout tagged in the tributaries were not a strong predictor of out-migration and abiotic factors were weakly associated with out-migration.

The study found sub-adult Bull Trout spend prolonged periods in the mainstem Thompson River, and shows the importance of the mainstem Thompson River for overwintering habitat and

potentially prolonged residency (Glaid, 2017). The study also identified mink predation as potential risk to Bull Trout. Monitoring data show there was the lack of intermixing between Fishtrap and West Fork Thompson River sub-adult Bull Trout in the mainstem Thompson River and Glaid (2017) questioned if potential "habitat bottlenecks" are associated with predation and/or human-instigated habitat degradation.

6.0 Bull Trout Passage from Downstream Facilities

Avista continued their trap and haul upstream fish passage program in 2017. Bull trout captured downstream of Cabinet Gorge Hydroelectric Project were genetically tested using rapid response genetic identification methodology (Adams et al., *in prep*). The rapid response genetic testing provides population assignment within 24 hours after receipt of fish tissue samples. The analysis predicts, with varying degrees of confidence, the natal stream of origin of each Bull Trout. Bull trout are then either transported to their genetically assigned region of origin or released downstream of Cabinet Gorge Hydroelectric Project. Bull trout with a genetic assignment upstream of the Thompson Falls Hydroelectric Project are referred to as "Region 4" fish.

A summary of the total number of Bull Trout captured annually since 2009 below Cabinet Gorge Dam, genetically assigned to Region 4, and transported to Region 4 (Thompson River drainage or other locations) is provided in Table 6-1 (J. Johnson, Avista, personal communication, 2017). The number of individual Bull Trout recorded ascending the Thompson Falls fish ladder between 2011 and 2017 is also included in Table 6-1.

Table 6-1: Summary of Bull Trout captured by Avista below Cabinet Gorge Dam, genetically assigned to Region 4 (R4) and transported to Region 4, and Bull Trout ascending Thompson Falls fish ladder.

Year	# Below Cabinet Gorge Dam	# Genetically Assigned R4	# Transported to R4 (Between TFalls Dam and the Thompson River Drainage)	# Transported R4 Locations upstream of Thompson River	# of Bull Trout ascending TFalls Ladder
2017	48	6	4	1	1
2016	26	2	2	-	3
2015	54	11	7	2	2
2014	75	15	10	2	1
2013	47	12	7	1	5
2012	40	11	8	-	2
2011	64	18	4	1	2
2010	35	11	9	-	NA
2009	47	13	6	6	NA
Average	**48.4**	**11**	**6.3**	**1.4**	**2.4**
Total	**436**	**99**	**57**	**13**	**16**

Not all Bull Trout genetically assigned to Region 4 were transported to Region 4. For example, some Bull Trout were initially captured by Avista as juveniles in other regions (downstream of Region 4) and thus after being recaptured below Cabinet Gorge Dam were transported and released to their natal stream even if the genetic assignment was Region 4 (S. Bernall, Avista, personal

communication, 2017). In addition, if Bull Trout did not meet the minimum length requirement of ≥350 mm (with the exception of one fish in 2017 measuring 345 mm), they were not transported upstream.

In 2011, there were 11 Bull Trout assigned to Region 4, but these fish were transported and released in Region 3 (near the Vermilion River), approximately 22 river miles downstream of Thompson Falls Dam, to monitor and evaluate movement to the Thompson Falls fish ladder. Seven of the 11 Bull Trout were redetected in 2011, including five Bull Trout downstream of the release location (one fish detected near Marten Creek, two fish detected near or in Graves Creek, two fish detected downstream of Noxon Rapids Dam) and two Bull Trout upstream of the release location in/near Prospect Creek (located immediately downstream of Thompson Falls Dam). Four Bull Trout were never detected again after their release in Region 3. One of the Bull Trout detected in Prospect Creek was also detected downstream of Thompson Falls Dam when flows exceeded 70,000 cfs in early June 2011 at a time when the fish ladder was closed.

6.1 Avista's 2017 Upstream Fish Passage Program

In 2017, Avista captured 48 unique adult Bull Trout (≥ 345mm) downstream of the Cabinet Gorge Hydroelectric Project. Of the 48 Bull Trout, 36 fish were assigned to Montana tributaries and transported upstream of Cabinet Gorge Dam to either Region 2 (Cabinet Gorge Reservoir [n=6]); upstream to Region 3 (Noxon Reservoir [n=25]); or upstream to Region 4 (upstream of Thompson Falls Dam [n=5]) (J. Johnson, Avista, personal communication, November 7, 2017).

There were six Bull Trout genetically assigned to Region 4 however, one fish was initially captured as a juvenile in Graves Creek and thus was transported back to Graves Creek (Region 3). The five Bull Trout transported to Region 4 were released at the St. Regis Boat Ramp (n=1), Thompson River at ACM bridge (n=3), and the Thompson Reservoir at the Cherry Creek boat ramp (n=1).

A summary of Bull Trout captured downstream of Cabinet Gorge Dam between 2009 and 2017 and genetically assigned to Region 4 and transported to Region 4, and in some instances Region 3 is provided in Table 6-2. A summary of Avista's Upstream Fish Passage Program from 2017 is available in Bernall and Duffy (*in prep*.).

Table 6-2: Summary of the Bull Trout captured by Avista downstream of Cabinet Gorge Dam in 2017 as well as previous years (since 2009) assigned to Region 4 and released in Region 3 or 4 (S. Bernall, Avista, personal communication, 2016 and J. Johnson, Avista, personal communication 2017). Note: EF = electrofishing, LCFR = Lower Clark Fork River. Subsequent detections from radio telemetry and remote array stations. Thompson River Detection information available from 2014-2017

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
7/9/2017	**LCFR-ID Night EF**	**900226000626037**	**465**	**907.3**	**-**	**Graves Creek in hole below trap site; *juvenile transport from Graves Ck 10/15/14**	**West Fork Thompson River**	**-**
7/13/2017	**LCFR-ID Night EF**	**982000357016301**	**615**	**1984.7**	**7/14/2017**	**St. Regis boat ramp (river plume)**	**West Fork Fish Creek**	**-**
8/27/2017	**LCFR-ID Night EF**	**900228000078316**	**624**	**2778.6**	**8/30/2017**	**Thompson River @ ACM bridge**	**Fishtrap Creek**	**10/6 & 10/19/2017 (Fishtrap) 10/23/2017 (T.River)**
9/6/2017	**LCFR – ID Ladder**	**900228000078315**	**745**	**3799.3**	**9/11/2017**	**Thompson River @ ACM bridge**	**West Fork Thompson River**	**9/14 & 9/17/2017 (Fishtrap) 9/25-10/2/2017 (T.River)**
9/13/2017	**LCFR – ID Ladder**	**900228000078351**	**708**	**3345.6**	**9/15/2017**	**Thompson River @ ACM bridge**	**Fishtrap Creek**	**9/22 – 10/21/2017 (Fishtrap) 10/27/2017 (T.River)**
9/21/2017	**LCFR – ID Ladder**	**900228000078307**	**732**	**3941**	**9/26/2017**	**Cherry Creek boat ramp**	**Skalkaho Creek**	**-**
4/21/2016	LCFR-ID Night EF	900228000078378	592	2466	4/27/2016	Thompson Falls Reservoir @ Cherry Creek boat ramp	SF Little Joe Creek	-
5/26/2016	LCFR-ID Night EF	900228000078368	650	3629	6/2/2016	Thompson Falls Reservoir @ Cherry Creek boat ramp; detected in TRiver 6/4/2016	Fishtrap Creek	6/4/2016 (T.River), 10/10/2016 (Fishtrap)

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
4/14/2015	LCFR-ID Night EF	900226000730577	653	3062	4/17/2015	1 km downstream of Thompson River confluence	Fishtrap Creek	10/20/2015 (CFR Above Islands)
4/14/2015	LCFR-ID Night EF	900226000730599	558	2041	4/17/2015	1 km downstream of Thompson River confluence	Fishtrap Creek	5/22/2015 (T.River)
5/31/2015	LCFR-ID Night EF	900226000730509	604	2608	6/4/2015	Thompson River @ ACM road bridge 1 mile above mouth	West Fork Thompson River	-
6/11/2015	LCFR-ID Night EF	900226000592474	631	2863	6/17/2015	Thompson River @ ACM road bridge 1 mile above mouth	Fishtrap Creek	9/25/2015 (WFTR)
8/3/2015	LCFR-ID Night EF	900228000078399	557	1585	8/10/2015	Thompson River @ ACM road bridge 1 mile above mouth	Fishtrap Creek	8/11-8/19/2015 (T.River) 8/23/2015 (WFTR) 10/11/2015 (T.River)
8/6/2015	LCFR-ID Night EF	900226000570690	531	1446	8/10/2015	Thompson River @ ACM road bridge 1 mile above mouth	West Fork Thompson River	8/11-12/2015 (T.River) 8/24/2015 (WFTR) 9/17-19/2015 (T.River)
8/11/2015	LCFR-ID Night EF	982000357016301	616	2275	8/16/2015	St. Regis River (RM 0.25)	West Fork Fish Creek	-
8/11/2015	LCFR-ID Night EF	982000357016316	637	2551	8/16/2015	St. Regis River (RM 0.25)	North Fork Little Joe Creek	7/13/2017 LCFR-ID & Transport R4
8/27/2015	LCFR-ID Night EF	900228000078389	735	4082	8/31/2015	Thompson River @ ACM road bridge 1 mile above mouth	Fishtrap Creek	9/6/2015 (Fishtrap) 9/28/2015 (T.River)

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
4/20/2014	LCFR-ID Night EF	900226000501515	528	1304	4/23/2014	WF Thompson River	WF Thompson River	-
4/22/2014	LCFR-ID Night EF	900226000113597	572	2126	4/25/2014	St. Regis	Little Joe Creek	-
4/29/2014	LCFR-ID Night EF	900226000501522	525	1247	5/2/2014	WF Thompson River	WF Thompson River	-
5/11/2014	LCFR-ID Night EF	900226000035849	718	3629	5/14/2014	Clark Fork River near Paradise	South Fork Jocko River	-
6/15/2014	LCFR-ID Night EF	900226000501561	540	1360	6/18/2014	WF Thompson River	WF Thompson River	-
7/2/2014	LCFR-ID Night EF	985121011605005/ 900226000501514 (Initial tagging on 7-28-2010 in WF Thompson River 162mm)	648	2523	7/3/2014	WF Thompson River	WF Thompson River	-
7/13/2014	LCFR-ID Night EF	900226000592716	614	2211	7/16/2014	WF Thompson River	WF Thompson River	-
7/17/2014	LCFR-ID Night EF	900226000570596	532	1304	7/23/2014	WF Thompson River	WF Thompson River	6/5/2015 (T.River) 9/11/2015 (WFTR) 9/11/2015, 9/20-21/2015 & 5/25/2016 (T.River)
7/24/2014	LCFR-ID Night EF	900226000570799	566	1644	7/30/2014	Fishtrap Creek	Fishtrap Creek	6/7-6/18/2015 (T. River) 9/11/2015 (Fishtrap)

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
9/6/2014	LCFR – ID Ladder	900226000570258	684	2721	9/10/2014	Fishtrap Creek	Fishtrap Creek	-
9/24/2014	LCFR – ID Ladder	900226000626007	614	2324	9/26/2014	Fishtrap Creek	Fishtrap Creek	-
10/3/2014	LCFR – ID Twin Weir	900226000570921	570	1531	10/6/2014	WF Thompson River	WF Thompson River	10/11/2014 (T.River) 5/5/2016 & 6/6/2016 (TFalls Ladder lower pools)
6/9/2013	LCFR-ID Night EF	900226000035846	567	2211	6/12/2013	Just downstream of confluence of Fishtrap Creek & Thompson River	Fishtrap Creek	4/15/2014 (Upper Section TFalls Reservoir)
6/13/2013	LCFR-ID Night EF	900226000035886	607	2324	6/19/2013	Mouth of Fishtrap Creek	Fishtrap Creek	-
6/19/2013	Hook-n-line sampling	900226000035877	606	2154.8	6/26/2013	Fishtrap Creek 100 m above mouth	Fishtrap Creek	-
6/23/2013	LCFR-ID Night EF	900226000035863	651	2806	6/26/2013	WF Thompson River 1/4 mile above mouth	WF Thompson River	-
9/4/2013	LCFR-ID Ladder	900226000570790	554	1361	9/9/2013	WF Thompson River 1/4 mile above mouth	WF Thompson River	-
9/14/2013	LCFR-ID Weir	900226000116250	616	2466	9/18/2013	~ 0.1 mile up WF Thompson River	WF Thompson River	5/16/2015 (TFalls Ladder lower pools) 7/3/2015 & 9/9/2015 (Prospect) 9/11/2015 (TFalls Ladder lower pools) 6/30/2016 (Graves Ck)

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
9/26/2013	LCFR-ID Ladder	900226000570690	475	851	9/30/2013	WF Thompson River 1/4 mile above mouth	WF Thompson River	8/6/2015 (below CGD & transport R4) 8/11-12/2015 (T.River) 8/24/2015 (WFTR) 9/17-19/2015 (T.River)
9/27/2013	LCFR-ID Twin Creek Ladder	985121001925944/ 900226000570887	744	4082	9/28/2013	In Fishtrap by campsite upstream from lower bridge	Fishtrap Creek	-
4/26/2012	LCFR-ID Night EF	380180914261084 (initial tagging from 2/14/2012 LPO)	585	1928	5/2/2012	Fishtrap Creek	Fishtrap Creek	-
5/1/2012	LCFR-ID Night EF	900226000035832	616	2324	5/4/2012	Clark Fork River @ St. Regis boat ramp	Cedar Creek	-
5/13/2012	LCFR-ID Night EF	985121025905128, 900226000035851 (initial tagging 8/30/2011)	637	2154	5/14/2012	Fishtrap Creek	Fishtrap Creek	-
5/13/2012	LCFR-ID Night EF	900226000035807	520	1190	5/17/2012	Fishtrap Creek	Fishtrap Creek	-
5/13/2012	LCFR-ID Night EF	900226000035860	575	2211	5/17/2012	Fishtrap Creek	Fishtrap Creek	-
5/17/2012	LCFR-ID Night EF	985121021199577, 900226000035789 (initial tagging from 4/29/2010)	620	2580	5/18/2012	Fishtrap Creek	Fishtrap Creek	-
6/26/2012	LCFR-ID Night EF	900226000035803	815	6010	7/2/2012	Fishtrap Creek	Fishtrap Creek	-
6/28/2012	LCFR-ID Night EF	900226000035797	575	1870	7/5/2012	Thompson River below WF Thompson River	WF Thompson River	-

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
4/19/2011	LCFR-ID Night EF	985121021183536	586	2126	4/22/2011	Released upstream from Vermilion Bay (Region 3)	Meadow Creek	6/1 & 6/6/2011 (below TFalls Dam - ladder closed); 6/27-10/24/2011 (Prospect)
4/24/2011	LCFR-ID Night EF	985121021159735	627	2835	4/27/2011	Released upstream from Vermilion Bay (Region 3)	South Fork Jocko River	11/18/2011 (Marten Creek Rd)
5/17/2011	LCFR-ID Night EF	985121021199621	530	1360	5/25/2011	Released upstream from Vermilion Bay (Region 3)	WF Thompson River	6/21/2011 (below Noxon Dam); 12/6/2011 Rock Creek (Region 2)
5/22/2011	LCFR-ID Night EF	985121021152977	710	3856	5/20/2011	Released upstream from Vermilion Bay (Region 3)	Fishtrap Creek	6/25/2011 (below Noxon Dam); 10/26/2011 (below Cabinet Gorge Dam)
6/2/2011	LCFR-ID Night EF	985121021203256	500	1049	6/8/2011	Released upstream from Vermilion Bay (Region 3)	Fishtrap Creek	6/9-7/21/2011 (Prospect); 10/7 & 12/5/2011 (near Trout Ck); 5/28/2014 (below TFalls Dam); 9/18/2014 (Prospect)
6/5/2011	LCFR-ID Night EF	985121001919071	585	1814	6/8/2011	Released upstream from Vermilion Bay (Region 3)	Fishtrap Creek	7/18/2011 (Graves Creek) 8/1-12/19/2011 (downstream 8.5 miles – radio tag may be out of water)
6/19/2011	LCFR-ID Night EF	985121021146823	570	1729	6/23/2011	Released upstream from Vermilion Bay (Region 3)	Fishtrap Creek	-
6/21/2011	LCFR-ID Night EF	985121021183908	701	3685	6/24/2011	Released upstream from Vermilion Bay (Region 3)	Fishtrap Creek	-
6/21/2011	LCFR-ID Night EF	985121021184737	462	907	6/24/2011	Released upstream from Vermilion Bay (Region 3)	Fishtrap Creek	-

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
6/26/2011	LCFR-ID Night EF	985121021186461	470	907.3	6/29/2011	Released upstream from Vermilion Bay (Region 3)	Fishtrap Creek	-
7/3/2011	LCFR-ID Night EF	985120015892614 (initial capture 8/28/2008 EF Bull River)	513	1191	7/5/2011	Bull River old bridge site downstream of EFBR (Region 2)	Upper Rock Creek	-
7/5/2011	LCFR-ID Night EF	985121021157243	669	1948	7/8/2011	Released upstream from Vermilion Bay (Region 3)	Fishtrap Creek	9/13-10/31/2011 (Graves Creek)
7/24/2011	LCFR-ID Night EF	985120029222140	496	1190	7/25/2011	Graves Creek just upstream of USFS bridge (Region 3)	Rattlesnake Creek	-
7/28/2011	LCFR-ID Night EF	985121021156804	516	1021	8/3/2011	One-mile up Thompson River (Region 4)	Fishtrap Creek	-
8/30/2011	LCFR-ID Night EF	985121025905128	650	2892	9/2/2011	Fishtrap Creek, just up from mouth (Region 4)	Fishtrap Creek	5/13/2012 (below CGD & transport R4 Fishtrap)
9/21/2011	Twin Creek Weir	985121001907073	613	2268	9/22/2011	Just upstream of the mouth of Thompson River (Region 4)	Fishtrap Creek	-
9/22/2011	Twin Creek Weir	985121025914593	592	1701	9/26/2011	Just upstream of the mouth of Thompson River (Region 4)	Fishtrap Creek	-
9/22/2011	LCFR-ID Ladder	985121025758989	606	1871	9/26/2011	South Fork Jocko River, upstream of last diversion (Region 4)	South Fork Jocko River	-
6/25/2010	LCFR-ID Night EF	985121021187084	535	1587	6/30/2010	Thompson River (Region 4)	Fishtrap Creek	-

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
5/13/2010	LCFR-ID Night EF	985121016753895	621	2778	5/19/2010	Thompson River (Region 4)	Char Ck	-
5/5/2010	LCFR-ID Hook-n-line sampling	985121016700474	534	1247	5/12/2010	Thompson River (Region 4)	Fishtrap Creek	-
5/16/2010	LCFR-ID Night EF	985121015963939	643	2665	5/19/2010	Thompson River (Region 4)	Fishtrap Creek	-
4/29/2010	LCFR-ID Night EF	985121021199577 (radio tag 32 148.480)	547	1389	5/5/2010	Thompson River (Region 4)	Fishtrap Creek	5/17/2012 (below CGD & transport R4 Fishtrap)
7/6/2010	LCFR-ID Night EF	985121021185451	724	4366	7/13/2010	West Fork Thompson River (mouth)	Fishtrap Creek	-
7/25/2010	LCFR-ID Night EF	985121001907073 (initial tagging 8/27/2007)	598	2211.5	No Data	West Fork Thompson River (mouth)	Fishtrap Creek	9/21/2011 (below CGD & transport R4 Fishtrap)
8/18/2010	LCFR-ID Night EF	985121021156358	535	1190	8/20/2010	Thompson River (ACM road bridge)	WF Thompson River	-
8/31/2010	LCFR-ID Night EF	985121021141387	614	1842	9/3/2010	Thompson River (ACM road bridge)	WF Thompson River	-
5/26/2009	LCFR-ID Night EF	985121001907962	516	1361	5/29/2009	Thompson River	Fishtrap Creek	-
6/7/2009	LCFR-ID Night EF	985121001829048	580	1616	6/10/2009	Paradise MT-LCFR	Monture Creek	-
6/11/2009	LCFR-ID Hook-n-line sampling	985120029215361	710	3686	6/15/2009	Thompson River	Fishtrap Creek	-

Capture Date	Capture Method	PIT Tag Number	Length (mm)	Weight (g)	Release Date	Release Site	Most Likely Pop. of Origin	Subsequent Detections
6/11/2009	LCFR-ID Night EF	985121001869178	660	2722	6/15/2009	Thompson River	Fishtrap Creek	-
9/15/2009	LCFR-ID Fish Ladder	985121017314384	563	1815	9/18/2009	St. Regis	Cedar Creek	-
9/21/2009	LCFR-ID Fish Ladder	985121015961762	600	1845	9/23/2009	St. Regis	Fish Creek	-
9/21/2009	LCFR-ID Fish Ladder	985121017312262	610	2041	9/23/2009	St. Regis	Upper Rock Creek (R4)	-
9/21/2009	LCFR-ID Hook-n-line sampling	985121016754113	585	1701	9/23/2009	St. Regis	Rattlesnake Creek	-
9/22/2009	LCFR-ID Fish Ladder	985121015942027	646	2382	9/25/2009	Fishtrap Creek	Fishtrap Creek	-
9/22/2009	LCFR-ID Hook-n-line sampling	985121015639163	490	964	9/25/2009	Fishtrap Creek	WF Thompson River	-
9/23/2009	LCFR-ID Fish Ladder	985121001925944	592	2100	9/25/2009	Fishtrap Creek	Fishtrap Creek	9/27/2013 (below CGD & transport Fishtrap R4)
9/28/2009	LCFR-ID Fish Ladder	985121016755149	700	3289	9/30/2009	Clark Fork River ~ 400m below the mouth of St. Regis	Cedar Creek	-

7.0 Total Dissolved Gas Monitoring

In 2010, the *Total Dissolved Gas Control Plan* (PPL Montana, 2010a) (TDG Control Plan) for the Thompson Falls Hydroelectric Project (Project) was submitted to the Montana Department of Environmental Quality (MDEQ). With the TDG Control Plan, NorthWestern proposes to continue to collaborate with the MDEQ, Avista, FWP, and other entities with a long-term goal of reducing the overall systemic gas supersaturation levels in the Clark Fork River, occurring from a point downstream of the Project to below Albeni Falls Dam.

The Licensee has set up the following protocol for Total Dissolved Gas (TDG) monitoring:

- Consult with the TAC agencies regarding monitoring TDG depending on the snowpack report on April 1.
- If the April 1 forecast is for runoff at or above 125 percent of normal, the Licensee will monitor for TDG.
- If the April 1 forecast is for runoff below the 125 percent of normal, the Licensee will not monitor for TDG.
- The final decision to be made by the FWS and MDEQ in consultation with the Licensee.

In 2017, the spring snowpack was much higher in the Lower Clark Fork basin than in recent years. In April 2017, the volume runoff forecast in the Lower Clark Fork basin was approximately 117 percent of normal, below the threshold of 125 percent identified for additional TDG monitoring. The last TDG monitoring was completed in 2014 (an average water year). Although the 125 percent threshold was not met in April 2017, NorthWestern voluntarily choose to monitor TDG in 2017 because of the length of time that has passed since the last monitoring.

7.1 TDG Monitoring Methods

The Licensee has monitored TDG in the Clark Fork River in the Project area for 12 years during the period between 2003 and 2017. All field work and data gathering are conducted by the Licensee's personnel.

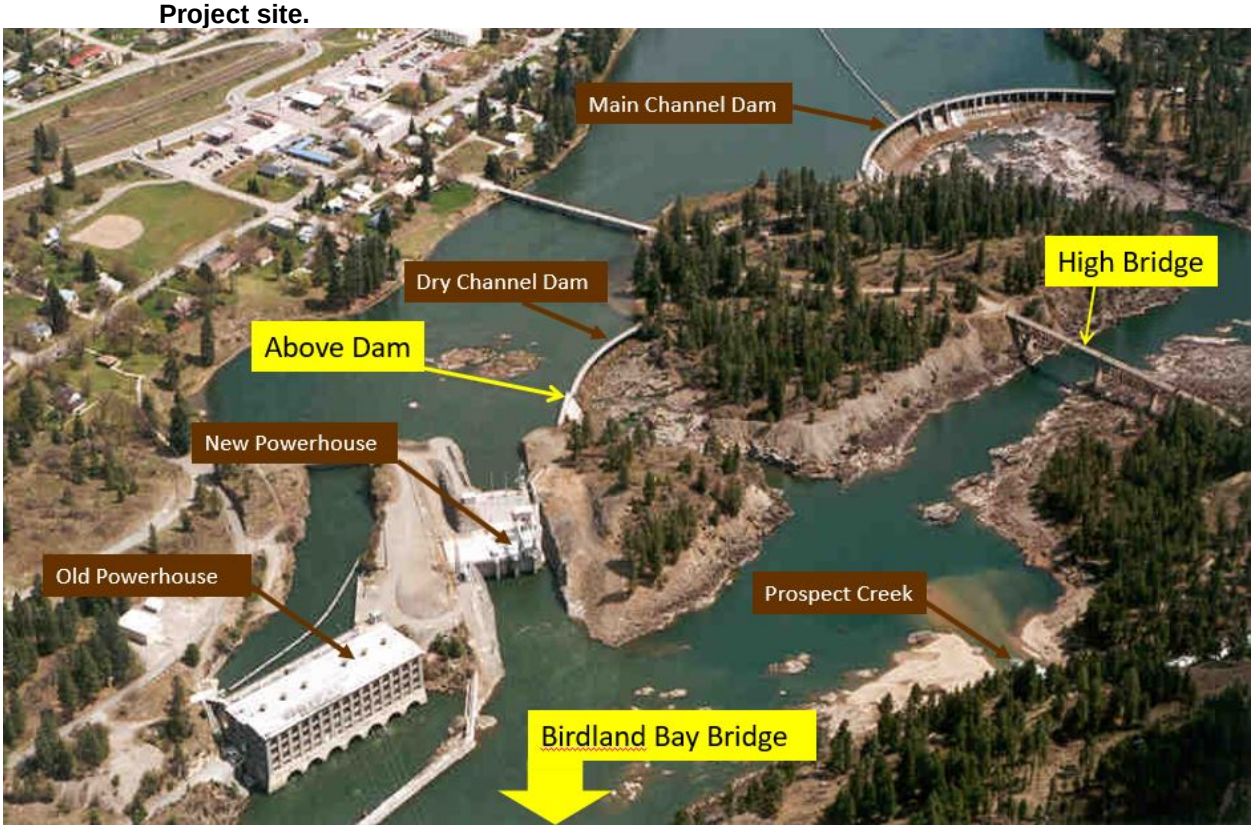
Hydrolab Series 4 and 5 DataSondes fitted with TDG sensors and are used to collect TDG data. DataSonde TDG sensors are calibrated by the manufacturer, Hydrolab, every 2 to 3 years. At the beginning of the year, TDG sensors are compared to each other for accuracy and calibrated within 1 millimeter of mercury (mmHg) of each other, if necessary. Sensor membranes are pressure tested to approximately 1,000 mmHg at the beginning of the spill season. Each membrane is used once during the spill season. The instruments are cleaned, batteries changed, and a new membrane installed every 2 to 2.5 weeks during the monitoring season. The instruments are then calibrated on site and then re-deployed.

TDG is monitored during the high flow season, typically from April until July, with exact dates varying slightly every year. In 2017, TDG was monitored from March 28 to July 14. Deployment periods for the DataSonde units were 3 to 4 weeks. Biological and sediment fowling is not a problem at the water temperatures found at the Project site over this length of time. All parameters including pH, specific conductivity, dissolved oxygen, and turbidity are calibrated at the beginning of each 4-week deployment period. During calibrations, sensors are cleaned, and batteries replaced. Time and date are checked. The stated accuracy of the TDG sensor is +/- 1.5 mmHg over a range of 400 to 1,400 mmHg.

Barometric pressure (BP) is measured by an Onset Computer Corp HOBO Microstation Barometric Pressure Smart Sensor with a stated error of +/- 1.5 millibar (mbar) = 1.1 mmHg at 25 ^{o}C and a maximum error of +/- 2.5 mbar = 0.9 mmHg over the temperature range -10 ^{o}C to +60 ^{o}C. The barometer is mounted approximately 2 meters above the floor of the Control Room in the old powerhouse. The elevation of the barometer is approximately 2,381.2 feet above mean sea level.

Monitoring sites have varied in some years, but in 2017 the sites monitored were 1) above dam, 2) High Bridge, and 3) Birdland Bay Bridge (Figure 7-1).

Figure 7-1: Monitoring locations for total dissolved gas at the Thompson Falls Hydroelectric Project site.



The High Bridge monitoring site captures information on TDG at a location that is downstream of the Main Dam spillway and the falls but is upstream where the Dry Channel Dam spill enters the river channel. The Birdland Bay Bridge monitoring site captures information on the level of TDG entering Noxon Rapids Reservoir. All three sensors suffered failures during some periods during the 2017 monitoring season. However, the data recovery is sufficiently complete to draw conclusions on TDG in the Clark Fork River during 2017.

In November 2014, there was a change in data tags linking the data entered at the facility to the NorthWestern Energy database. As a result, the database did not record the details of the spillway operation during the 2017 TDG data collection period.

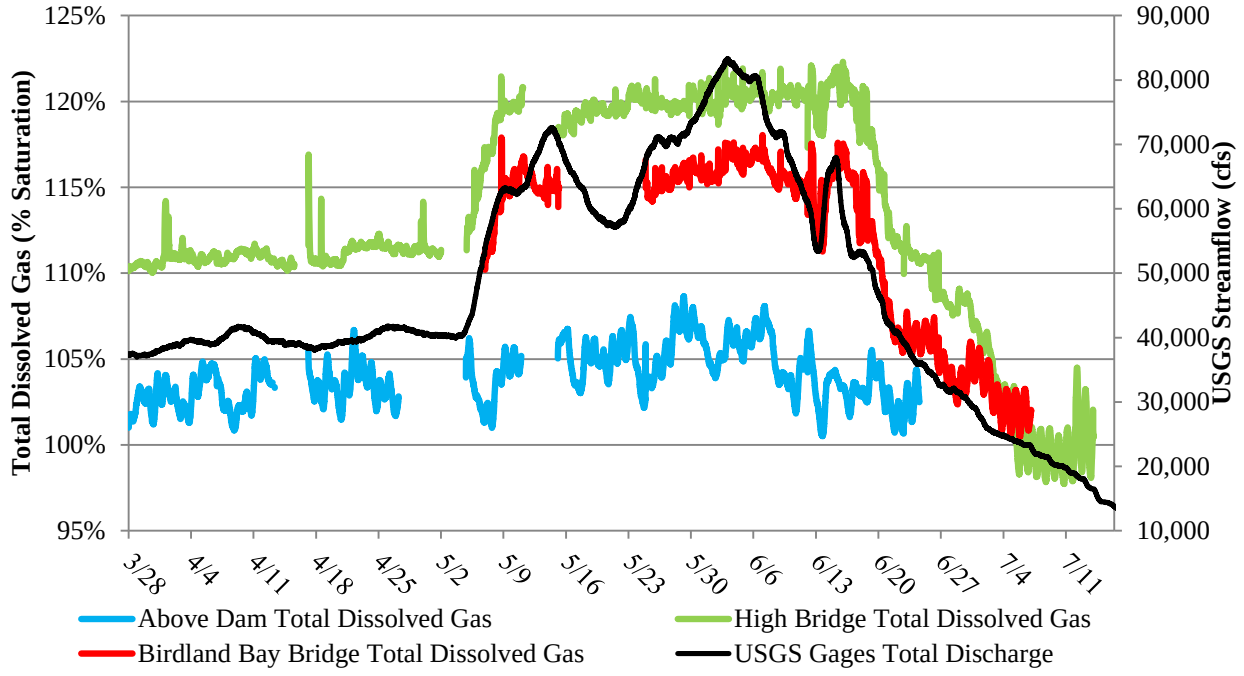
No electrofishing was conducted in the Thompson Falls tailrace during the 2017 spill period to monitor for potential gas bubble trauma (GBT) in fish. No GBT was noted in any of the fish monitored at the fish ladder during the spill period.

7.2 2017 TDG Monitoring Results

Peak discharge in the Clark Fork River in the Project area in 2017 was higher than the long-term average of 60,000 cfs (*refer to* Figure 3-1), reaching approximately 85,870 cfs on June 3, 2017, as measured by the Licensee at the powerhouse (peak flow measured by the USGS at Plains, was 82,100 cfs on that same day). Similar to past years, TDG in 2017 was lowest above the Project, highest at the first measurement site below the Project (at the High Bridge), and intermediate at the most downstream site at the Birdland Bay Bridge (Figure 7-2). TDG levels declined downstream of the High Bridge as a result of mixing with river flow coming through the powerhouse and, potentially, some degassing as the river moves downstream.

TDG upstream of the Project peaked at approximately 109 percent of saturation during 2017. TDG levels at the High Bridge approached 122 percent of saturation, and TDG at the Birdland Bay Bridge site was approximately 118 percent of saturation in 2017. These readings were not as high as in some previous years, such as 2011, when peak discharge exceeded 100,000 cfs and peak TDG was correspondingly higher.

Figure 7-2: Total Dissolved Gas (% of saturation) and discharge (cfs) as measured at the powerhouse in the Clark Fork River upstream and downstream of the Thompson Falls Hydropower Project in 2017.



In 2017, the mean TDG at discharge was within the range observed in previous years. Tables 7-1 and 7-2 describe maximum and mean TDG over a range of discharge for each year of the study. Maximum and mean TDG at the Birdland Bay Bridge was comparable to previous years.

Table 7-1: Maximum TDG recorded over a range of discharge at the Birdland Bay Bridge on the Clark Fork River, Montana. 2003-2017.

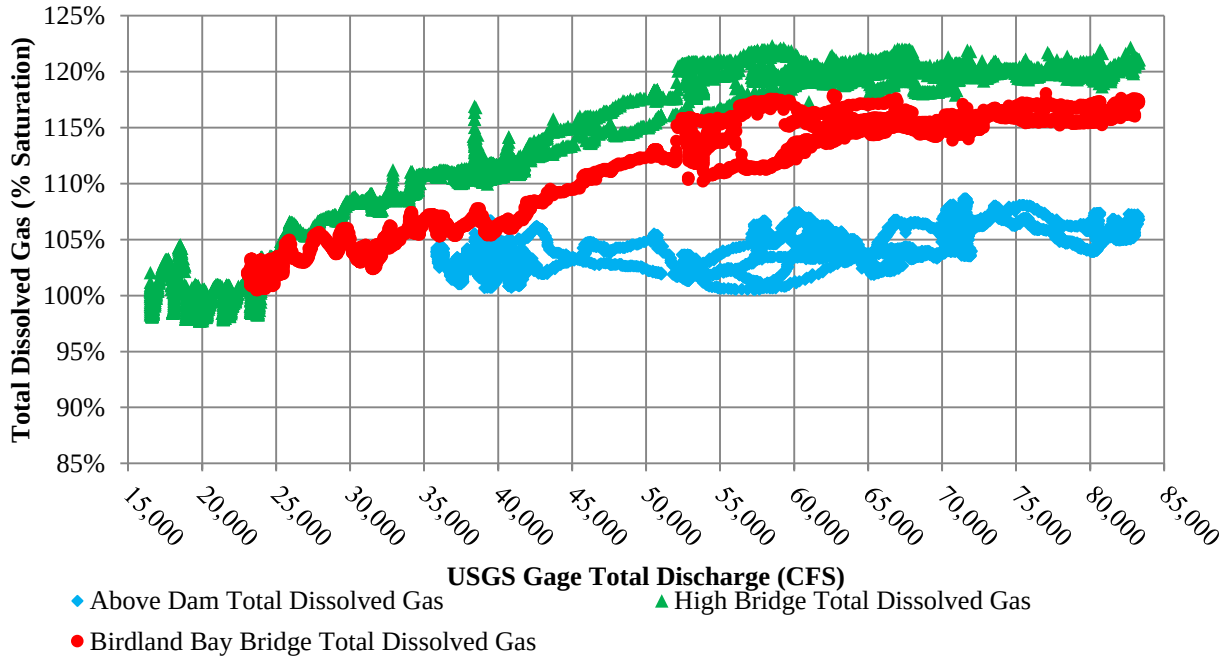
Total Flow (thousand cfs)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2017
>23, <30	111.5	109.6	107.6	106.7	105.6	113.1	109.5	106.0	107.6	103.6	104.1	106.0
>30, <40	112.6	109.2	112.7	111.1	108.3	114.8	108.9	111.3	108.3	107.7	107.0	107.8
>40, <50	111.1	108.9	113.3	115.0	112.8	115.3	112.9	113.8	109.0	111.3	111.3	112.3
>50, <60	113.9	N/A	114.4	116.7	N/A	119.5	114.6	113.2	112.4	116.3	115.3	117.5
>60, <70	114.0	N/A	115.1	117.0	N/A	118.2	113.1	N/A	116.4	116.0	116.9	117.9
>70, <80	114.1	N/A	114.0	117.0	N/A	116.6	N/A	N/A	116.9	115.8	117.4	118.0
>80, <90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	120.8	112.6	118.7	118.0
>90, <100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	122.3	N/A	N/A	N/A
>100, <110	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	121.8	N/A	N/A	N/A
>110, <120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	121.7	N/A	N/A	N/A

Table 7-2: Mean TDG recorded over a range of discharge at the Birdland Bay Bridge on the Clark Fork River, Montana, 2003-2017.

Total Flow (thousand cfs)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2017
>23, <30	102.1	103.5	103.6	103.6	102.5	102.2	102.6	102.0	102.9	102.3	102.7	103.0
>30, <40	104.7	105.0	107.1	106.7	105.2	105.6	105.2	106.6	105.8	104.4	104.7	105.2
>40, <50	109.5	107.5	110.4	110.6	109.0	110.6	109.2	110.9	108.1	108.8	108.6	108.7
>50, <60	111.0	N/A	112.7	114.3	N/A	114.9	113.0	111.6	111.0	111.2	111.5	113.9
>60, <70	112.9	N/A	114.1	115.7	N/A	116.0	113.1	N/A	113.5	113.0	114.8	115.2
>70, <80	113.2	N/A	114.0	115.7	N/A	115.9	N/A	N/A	116.0	112.7	115.4	115.6
>80, <90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	116.8	112.5	116.2	116.6
>90, <100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	119.7	N/A	N/A	N/A
>100, <110	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	120.6	N/A	N/A	N/A
>110, <120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	119.9	N/A	N/A	N/A

TDG downstream of the Project increases with increasing flow, up to about 60,000 cfs. At flows higher than 60,000 cfs, TDG downstream of the Project continues to increase, but a lower rate (Figure 7-3).

Figure 7-3: Total Dissolved Gas (% of saturation) and discharge (cfs) (as measured at the powerhouse), in the Clark Fork River in 2017.



The majority of research on TDG biological effects has occurred in the Columbia and Snake River with focus on anadromous salmon (Maynard 2008). Maynard's (2008) literature review found susceptibility varies among species and salmonids may not be the most susceptible group. Fish cannot detect changes in TDG like temperature, but some species appear to avoid it (Maynard 2008, Weitkamp et al. 2003). For every meter of depth, TDG saturation declines 10 percent, thus if TDG at the surface is 120 percent saturation, at 1 meter it is 110 percent saturation and at 2 meters it is as 100 percent saturation. NOAA (1995, 2000) suggest TDG supersaturation levels between 110 and 120 percent have minimal impacts on aquatic biota in river environments. McGrath et al. (2006) review of available research support these findings that short-term exposure to up to 120 percent TDG did not produce effects on juvenile or adult salmonids when compensating water depths are available.

Weitkamp et al. (2003, 2003a) studied resident fish in the lower Clark Fork River downstream of Noxon Rapids and Cabinet Gorge dams and their behavior and gas bubble disease (GBD) as it relates to TDG. The depths at which fish occupy the water column determines the biological effects to the fish under higher TDG levels. In general, TDG levels exceeding 120 percent may result in adverse biological impacts. Fish can avoid or minimize incidence and severity of GBD when TDG supersaturation exceeds 120 percent by spending time at sufficient depths or accessing tributaries (Weitkamp et al. 2003). There was a low occurrence of GBD in resident fish attributed to their

behavior and mobility to either occupy depths that compensate for high TDG level or move into tributaries to avoid high TDG level (Weitkamp et al. 2003a).

8.0 TAC Funding

8.1 2017 Funded Projects and Progress Reports

In 2017, the following projects initially approved for funding by the Thompson Falls TAC in 2016 were anticipated for implementation in 2017:

1. Cedar Creek Phase 2 Road Relocation and Large Woody Debris Enhancement Project ($30,000)
2. Beartrap Fork Culvert Removal Project ($11,000)
3. Rattlesnake Creek Fish Screen Project, Phase I ($13,125)
4. Watershed Coordinator for the Thompson River Drainage ($16,500)
5. Bull Trout Genetics Analysis ($10,000)

The Beartrap Fork Culvert Removal Project was not completed in 2017 and is now scheduled for implementation in 2018. The delay was due to wildfire activity and lack of resources available in 2017. Only one Bull Trout, recorded at the ladder in September, was sampled for genetics in 2017 and results are still pending.

Progress reports were provided by Trout Unlimited for the Cedar Creek Phase 2 and Rattlesnake Fish Screen Project and provided by the Lower Clark Fork Watershed Group with updates on the activities completed within the Thompson River drainage in 2017. All progress reports are available in Appendix B.

8.2 2018 Proposals Approved for TAC Funding

The Thompson Falls TAC annual meeting was held in Missoula on November 29, 2017. The TAC reviewed and discussed the proposals summarized in Table 8-1. All proposals submitted and discussed during the annual meeting were approved by the TAC. However, after further legal review, NorthWestern determined proposals for projects downstream of Thompson Falls Dam do not comply with FERC or FWS BO requirements and cannot be funded at this time. NorthWestern must submit a formal request to FERC with FWS and TAC approval, and subsequently receive FERC authorization, to modify the geographic region to receive TAC funding. Thompson Falls TAC agreed to move forward with the preparation of such a request that will only include Prospect Creek as a downstream location eligible for TAC funding. Thus, two projects (Crow Creek, and Prospect Creek PIT Tag) located in the Prospect Creek drainage, were not eligible for TAC funding at this time. Approved proposals for 2018 are available in Appendix C.

Table 8-1. Summary of 2018 proposals submitted to the TAC for review.

Agency/Entity Submitting Proposal	Proposal Description	TAC Funding Requested	TAC Funding Approved	TAC Vote
FWP (Knotek)	Koch In-holding Acquisition Lower Fish Creek	$60,000	$60,000	Approved unanimously by TAC via email Aug/Sep 2017
FWP (Kreiner)	Crow Creek Stream Reconstruction Design	$30,000	**project downstream of TFalls Dam not eligible for TAC funding**	
TU/FWP	Rattlesnake Dam Removal Project, Phase 1	$20,000	$20,000	Vote Yes by FWP, CSKT, NorthWestern. FWS abstain vote
NorthWestern/Avista	Prospect PIT Tag array	$20,000	**project downstream of TFalls Dam not eligible for TAC funding**	
Lower Clark Fork Watershed Group	3-years for Thompson River Coordinator	$49,500	$16,500	Vote Yes $16,500 for 2018 only (unanimous)
NorthWestern	BULL Genetics	$10,000	$10,000	Vote Yes (unanimous)
NorthWestern	Emergency Fund	$10,000	$10,000	Vote Yes (unanimous)
2018 TOTALs		**$214,500**	**$116,500**	
2017 TAC Approved Funding – Scheduled for 2018	**Beartrap Ck Culvert Replacement**		**$11,000**	
2018 Total Approved Budget			**$127,500**	

9.0 Compliance with the Biological Opinion

9.1 Compliance with Terms and Conditions of the BO

A summary of the FWS's BO Terms and Conditions (TCs) 1 through 7 is provided in Table 9-1. The table includes the BO's TC followed by a statement describing the Licensee's actions of compliance. The language in the BO (FWS, 2008) refers to PPL Montana, the Licensee at the time the BO was prepared. All references to PPL Montana and compliance requirements in the BO apply to NorthWestern. As of November 18, 2014, NorthWestern is the Licensee of the Thompson Falls Hydroelectric Project (FERC No. 1869) and is responsible for compliance with the TCs in the BO.

Table 9-1: Summary of FWS's Biological Opinion (2008) Terms and Conditions (TC) 1 through 7 and compliance status by the Licensee.

Term and Condition (TC)	TC Requirement from Biological Opinion (FWS 2008)	Compliance Status by Licensee
TC 1 - Upstream Passage		
TC 1(a)	During 2009 and 2010, PPL Montana will construct a fish passage facility (permanent fishway) to provide timely and efficient upstream passage at the right abutment of the main dam, as agreed to by the Service and through oversight of the TAC (as provided for in the interagency Thompson Falls MOU).	Activity is Complete
TC 1(b)	During construction and cleanup, PPL Montana will follow permit procedures as required by the Service, the State of Montana, and U.S. Army Corps of Engineers so that minimal impacts to downstream aquatic resources occur during construction.	Activity is Complete
TC 1(c)	PPL Montana will determine operational procedures for the passage facility and develop a written operation and procedure manual (SOP) by the end of 2010, with input from the TAC and approval by the Service, updated as needed.	Activity is Complete -The FERC approved the Licensee's Thompson Falls Fish Ladder – Fishway Operations Manual 1.0 (SOP) in an Order issued on June 17, 2011
TC 1(d)	For the remaining term of the license (expiring December 31, 2025), PPL Montana will ensure that operation of the fish passage facility is adequately funded and conducted in compliance with the approved SOP; including activities such as biological studies, transport of Bull Trout (as needed), and assessment of ladder efficiency.	NorthWestern will continue funding for the ladder and operate the facility in conformance with the approved SOP.
TC 1(e)	During the Phase 2 evaluation period (2010 through 2020), PPL Montana will provide adequate funding for genetic testing to determine the likely natal tributary of origin of all adult Bull Trout which ascend the fishway and enter the sample loop, as well as those otherwise captured at the base of Thompson Falls Hydroelectric Project. In order to positively identify natal origin of Bull Trout at the project, PPL Montana will institute a permanent fish tagging system for all Bull Trout handled during monitoring and for other fisheries investigation activities in the Project area.	The Licensee provides annual funding in support of genetic testing for Bull Trout in the vicinity of the Project.
TC 1(f)	During the Phase 2 evaluation period (2010 through 2020), PPL Montana will make a fish transport vehicle available, and provide staff to transport any adult Bull Trout that is captured at Thompson Falls Hydroelectric Project and determined by the SOP to require transport to upstream waters.	To date, fish transport via vehicle has not been requested or identified as a need. The Licensee will continue to evaluate this need and provide support as appropriate annually.

Term and Condition (TC)	TC Requirement from Biological Opinion (FWS 2008)	Compliance Status by Licensee
TC 1(g)	In consultation with the TAC, PPL Montana will prepare by January 1, 2011, for Service approval, an action plan for Phase 2 of the evaluation period (2010 through 2020) to evaluate efficiency of the upstream passage facility. The goal will be to assess how effective the ladder is at passing Bull Trout, the potential length of any delay, the amount of fallback, and the optimal operational procedures to achieve the highest efficiency. During this Phase 2 evaluation period (2010 through 2020) a routine feedback loop will be established and used, as agreed to by the Service, to fine tune operations and will be combined with a variety of experimental and evaluative studies. It may be necessary to conduct research on surrogate species (e.g., Rainbow Trout) at the discretion of the TAC, in order to facilitate certain of these evaluations. At a minimum, for the remaining term of the license (through 2025), PPL Montana will support a sampling method to annually estimate the total numbers of all species passing through the ladder and adequately characterize the timing of such movements.	The Licensee developed and submitted the FWS-approved *Fish Passage Evaluation Plan*, *Phase 2 Action Plan, 2011-2020* (PPL Montana, 2010) to FERC on October 14, 2010. FERC issued an Order approving the Evaluation Plan on June 9, 2011. Data collected annually at the ladder is summarized and reporting in the Annual Report that is approved by FWS prior to filing with the Commission each year.
TC 1(h)	During the entire Phase 2 evaluation period (2010-2020), the TAC, subject to approval of the Service and with PPL Montana support, will provide adequate oversight of scientific aspects, surveys, studies, and protocols associated with the fish passage aspects of the Project. At the end of the Phase 2 evaluation period (2010-2020), and upon completion and adequate distribution and consideration of a comprehensive 10-year report (due December 31, 2020), PPL Montana will convene a structured scientific review of the project, guided by the TAC. This scientific review will be completed by April 1, 2021 and will develop a set of recommendations to be submitted to the Service for evaluation, modification, and approval; including specific conclusions as to whether the fishway is functioning as intended and whether major operational or structural modifications of the fishway are needed. The review process will culminate, by December 31, 2021, in a revised operating plan for the fishway during the remainder of the existing term of the FERC license (2022 through 2025)	Annual data collection of fish passage results continues. The 10-year comprehensive report pursuant to TC 1(h) is scheduled to be addressed in 2020, followed by the TAC scientific review and revised operations plan for the remainder of the license in 2021.

Term and Condition (TC)	TC Requirement from Biological Opinion (FWS 2008)	Compliance Status by Licensee
TC 2 - Downstream Passage	PPL Montana will provide annual funding to the TAC, as approved by the Service and specified in the Thompson Falls MOU, to conduct offsite habitat restoration or acquisition in important upstream Bull Trout spawning and rearing tributaries. The purpose is to boost recruitment of juvenile Bull Trout. This funding is provided to partially mitigate for incidental take of Bull Trout caused by downstream passage through the turbines and spillways. The annual $100,000 contribution specified for the first term of the MOU (2009-2013) is subject to renegotiation during succeeding terms of the MOU to run from 2014-2020.	On November 11, 2013, the Licensee electronically filed the renewed 7-year (effective January 1, 2014 through December 31, 2020) MOU, dated September 20, 2013, for the Project to the Commission. The renewed MOU received approval from FWS, FWP, CSKT, and the Licensee and was filed in compliance with the FWS's BO TC2 and FERC Order issued on February 12, 2009. The adaptive management funding account (AMFA) started with $150,000 on January 1, 2014. The Licensee will provide $100,000 annually for 7 years and allow a maximum of $250,000 to accrue in the account from unspent or transferred annual TAC funds.
TC 3 - Gas Supersaturation		
TC 3 (a)	For the remainder of the license (through 2025), in consultation with the TAC and subject to Service approval, PPL Montana will develop and implement operational procedures to reduce or minimize the total dissolved gas production at Thompson Falls Dams during periods of spill. Future modifications to prescribed operations may be determined from ongoing evaluations, as necessary and determined appropriate by Montana Department of Environmental Quality (MDEQ).	The Licensee prepared a *Total Dissolved Gas Control Plan* (PPL Montana, 2010a) (TDG Control Plan) in collaboration with the TAC in October 2010 and submitted the TDG Control Plan to the MDEQ. The TDG Control Plan recommends continued monitoring of TDG at the Project, and also recommends a spillway operating plan for the Main Dam Spillway. The recommended spillway operating plan for the Main Dam Spillway has been implemented annually since 2011.
TC 3 (b)	For the remainder of the license (through 2025), in consultation with the TAC and subject to Service approval, PPL Montana will continue to collaborate with MDEQ, Avista, FWP, and other entities toward reducing the overall systemic gas supersaturation levels in the Clark Fork River, occurring from a point downstream of Thompson Falls Dam to below Albeni Falls Dam.	NorthWestern will continue to collaborate with the MDEQ, Avista, FWP, and other entities toward reducing the overall systemic gas supersaturation levels in the Clark Fork River.

Term and Condition (TC)	TC Requirement from Biological Opinion (FWS 2008)	Compliance Status by Licensee
TC 3 (c)	For the remainder of the license (through 2025), all Bull Trout detained through the sampling loop at the Thompson Falls Fish Ladder will routinely be examined for signs of gas bubble trauma; with results of such observations permanently recorded. Should GBT symptoms be discovered, then PPL Montana will consult the TAC on the need for immediate corrective actions and subsequently implement any new studies or potential operational changes (to the ladder or the dam) which may be required by the Service and MDEQ, in order to mitigate GBT concerns.	Past GBT monitoring (2008-2014) below Thompson Falls Dam has resulted in limited findings of fish with symptoms indicating GBT. Bull trout recorded at the ladder or downstream of the Thompson Falls Dam annually between 2011 and 2017 have not shown any external symptoms of GBT.
TC 4 - MOU and TAC	Upon completion of construction of the Thompson Falls Fish Ladder (currently scheduled for 2010) and concurrent with initiation of the Phase 2 review period (mid-2010 through 2020) PPL Montana will review the Thompson Falls MOU and collaborate with the signatory agencies as to the need to revise and restructure the MOU. Any such revision should be developed around the 2010-2020 Phase 2 evaluation period and may include appropriate changes to the TAC and its operation. Subsequent revision may occur again in 2021, or as needed based on adaptive principles and subject to approval of the Service and PPL Montana.	The current MOU expires on December 31, 2020 (Section 9.2.2). NorthWestern will coordinate with the TAC and FWS to revisit the terms of the MOU in 2020, prior to the expiration of the current agreement.
TC 5 - Thompson Falls Reservoir		
TC 5 (a)	During the first 5 years of the Phase 2 evaluation (2010 through 2015) PPL Montana, with TAC involvement and Service approval, will conduct a prioritized 5-year evaluation of factors contributing to the potential loss or enhancement of migratory Bull Trout passage through Thompson Falls Reservoir. Goals and objectives for this assessment and scientifically-based methodology will be developed through the TAC and approved by the Service no later than the end of 2010 and will focus at a minimum on better understanding temperature and water current gradients through the reservoir; travel time, residence time, and pathways that juvenile and subadult Bull Trout select in moving through the reservoir; and an assessment of impacts of predatory nonnative fish species on juvenile and subadult Bull Trout residing in or passing through the reservoir. The initial findings will be summarized and supported with scientifically based conclusions, no later than the end of 2015, with a goal of adaptively improving survival of juvenile Bull Trout in Thompson Falls Reservoir as they pass downstream or reside in the system. A second, more comprehensive summary of conclusions and recommendations regarding reservoir impacts will be submitted as part of the scientific review package by the end of 2020 (*see* TC1h).	In compliance with TC 5a, the Licensee collaborated with TAC members and prepared the 5-Year (2011-2015) Reservoir Monitoring Plan, which was approved by FWS and submitted to the FERC on June 17, 2010. FERC issued an Order approving the 5-Year Reservoir Monitoring Plan on February 9, 2011. NorthWestern implemented the reservoir monitoring plan and because of an ongoing study in 2014 and 2015 requested modifications to the initial filing requirements outlined in FWS' BO. Summary of 2014 and 2015 study has been posted on the Project website (Glaid, 2017). FERC authorized request to postpone recommendations until 2020 (FERC 2015).

Term and Condition (TC)	TC Requirement from Biological Opinion (FWS 2008)	Compliance Status by Licensee
TC 5 (b)	Based on the interim Thompson Falls Reservoir Assessment (a., above), a timely evaluation of the site-specific need for a nonnative species control program in Thompson Falls Reservoir will be conducted by PPL Montana, in collaboration with the TAC agencies (*see* TC7b., below), no later than the end of 2015, with final recommendations to be approved by the Service.	In 2014, the Licensee consulted with FWS and proposed to modify filing requirements specified in the FWS' BO TCs 5a, 5b, and 7b. A letter of concurrence from FWS, along with the proposed changes, was filed with the Commission on December 17, 2014. FERC issued a letter approving the proposed modifications on February 25, 2015. The approved modifications include: 1) removing the 5-year comprehensive summary of activities associated with the Reservoir Monitoring Plan (due in 2015) and combining the final report (due in 2020) required by TC 5a with reporting requirements in TC 5b; 2) postponing the reporting deadline for the nonnative species (in the Thompson Falls Reservoir) control recommendations in TC 5b to December 31, 2020; and 3) waive the 5-year interim reporting requirement under TC 7b while continuing annual reporting required by TC 7a until 2019. After the 2019 ladder season is complete, NorthWestern will be responsible for compiling conclusions and recommendations per TC 5a and 5b reporting requirements and compiling the findings from the annual reports (2011-2019) into one comprehensive report that will be filed with FWS and the Commission by December 31, 2020.
TC 6 - System-wide Monitoring		
TC 6(a)	For the remainder of the license (through 2025), PPL Montana will ensure that actions at the Thompson Falls Fish Ladder, including tagging, transport, and any tracking of fish movement, are adequately funded and fully coordinated with the Avista project and the management agencies FWP, CSKT, and the Service. This coordination will include routine communications through the TAC and may require participation in special meetings or discussions to ensure that there is a single seamless fish passage effort for the lower Clark Fork projects.	The Licensee collaborates with TAC members to proactively address the adaptive needs of the operations of the ladder each season, as well as holding annual TAC meetings where the Licensee provided an overview of findings at the ladder for the year and an open forum for the TAC and FWS to discuss any needs for changes in operations.

Term and Condition (TC)	TC Requirement from Biological Opinion (FWS 2008)	Compliance Status by Licensee
TC 6(b)	For the remainder of the license (through 2025) PPL Montana will contribute a proportional amount of funding to ensure that fish sampled at the Thompson Falls Fish Passage Facility are processed, analyzed, and integrated into annual updates of the system wide Clark Fork River genetic database.	The Licensee continues to provide annual funding available for bull trout genetic analysis.
TC 6(c)	In consultation with the TAC and with approval of the Service, for the remainder of the license (through 2025), PPL Montana will fund the technology required to track transmittered fish that pass the project as they move through the system. This may include an integrated PIT-Tag scanner at the fishway, mobile PIT-Tag scanning capabilities (wand[s] for use in the field), and radio implantation and tracking of Bull Trout that move through the sample loop in the ladder. Obligations for tracking transmittered fish by PPL Montana will include at a minimum the portions of the Lower Clark Fork Core Area upstream of Thompson Falls Dam (i.e., mainstem Clark Fork River from Thompson Falls Dam to the confluence of the Flathead River, including tributaries such as the Thompson River) Note: in the lower Flathead River, Jocko River, and other Flathead Reservation waters primary responsibility for tracking is assumed by the CSKT, but close coordination with the Tribes will be maintained by PPL Montana. Broader tracking needs upstream will be determined through cooperation with other entities in the basin (as in TC6a, above).	With the construction of the fish ladder, three remote antennas were installed on the weirs (pools) that detect HDX and FDX PIT-tagged fish. These remote antennas detect PIT tags as fish move through the ladder. A remote PIT-tag array was also installed on the mainstem of the Thompson River in 2014 and continues to be utilized to track PIT-tagged fish released upstream of Thompson Falls Dam. These data are compiled annually and summarized in the respective annual report. NorthWestern will continue to collaborate and coordinate with local biologists regarding the need to track fish movement.
TC 7 - Reporting		
TC 7(a)	Annually, by April 1 of each year for the remainder of the license (expires 2025), PPL Montana will prepare and submit to the Service for approval a report of the previous year's activities, fish passage totals, and next year's proposed activities and other fisheries monitoring that may result in intentional as well as incidental take of Bull Trout. The report will quantify the number of Bull Trout proposed to be incidentally taken by each activity and summarize the cumulative extent of incidental take from all previous year activities.	The Licensee has filed annually (since 2011) by April 1, a report summarizing previous year's activities, fish passage totals, and proposed activities for the following year. A summary of cumulative incidental take of Bull Trout since 2009 by the Licensee is provided in Table 9-2 in this report.
TC 7(b)	By December 31, 2015, after the first 5 years of the Phase 2 evaluation period (as described per TC1g., above), PPL Montana will present to the TAC and the Service a comprehensive written assessment of the first 5 years of fishway operation. This report is partially for the purpose of assessing the need for major mid-Phase 2 modifications to the facility and its operations as well as for consideration of the need for supporting additional Bull Trout passage or transport above the dam.	NorthWestern filed a letter, with FWS's support, to FERC on December 17, 2014 proposing TC 7b no longer be required because the comprehensive reporting has been continually provided in the annual reports. FERC approved this proposal on February 25, 2015. No major modifications to the facility were identified or proposed.

Term and Condition (TC)	TC Requirement from Biological Opinion (FWS 2008)	Compliance Status by Licensee
TC 7(c)	Annually, by April 1 of each year beginning in 2010 and for the remainder of the license (expires 2025), PPL Montana will archive electronic versions of all biological progress reports (described in TC 1 through TC 7 and dating back to 2005) generated through the Thompson Falls Project. PPL Montana will provide to TAC agencies at no cost, upon request, updated CDs or web-based access to those reports.	The Licensee has archived report (dating back to 2005) annually on the Project website: http://www.thompsonfallsfishpassage.com/reference.html
TC 7(d)	For the remainder of the license (expires 2025), upon locating dead, injured, or sick Bull Trout, or upon observing destruction of redds, notification must be made within 24 hours to the Service's Division of Law Enforcement Special Agent (Richard Branzell, P.O. Box 7488, Missoula, MT, 59807-7488; (406) 329-3000). Instructions for proper handling and disposition of such specimens will be issued by the Division of Law Enforcement. Dead, injured, or sick Bull Trout should also be reported to the Service's Kalispell Field Office (406-758-6882).	No incidents to report in 2017
TC 7(e)	For the remainder of the license (expires 2025), during project implementation the FERC or applicant shall promptly notify the Service of any emergency or unanticipated situations arising that may be detrimental for Bull Trout relative to the proposed activity.	No incidents to report in 2017

9.2 Bull Trout Incidental Take Summary 2009-2017

In compliance with FWS's BO TC 7a, this section provides a summary of the cumulative extent of incidental take from previous years' activities (2009-2017) in support of the upstream fish passage at the Project (Table 9-2). Between 2009 and 2017, 34 individual Bull Trout have been sampled by the Licensee in the Project area.

Since operations at the ladder commenced in 2011, 32 individual Bull Trout have been sampled annually by the Licensee in the Project area with approximately four to seven individual Bull Trout sampled annually. In 2017, the Licensee sampled one Bull Trout (1 at the Thompson Falls fish ladder), which were released live.

Since 2009, sampling has included collecting Bull Trout via electrofishing efforts upstream and downstream of Thompson Falls Dam as well as Bull Trout recorded at the Thompson Falls fish ladder. Since 2011, 16 Bull Trout, representing 15 individual fish were recorded at the Thompson Falls fish ladder. One Bull Trout ascended the ladder twice and during the second ascent in 2012, the Bull Trout jumped out of one of the pools and died. This mortality has been the only occurrence in the Project area and subsequently, a cover was placed over the holding pool to mitigate the potential for this to occur again. In 2014, the Bull Trout that ascended the ladder was released alive upstream of the dam, but was later captured downstream of Thompson Falls Dam and the Project area during the annual reservoir monitoring activities led by FWP in Noxon Reservoir. The Bull Trout was captured via gillnet on October 13, 2014 resulting in a mortality. Additional details regarding Bull Trout sampled by the Licensee between 2011 and 2017 are provided in Section 5.0.

Table 9-2: Cumulative incidental "take" of Bull Trout for the Thompson Falls Project area located in the Lower Clark Fork River drainage, since January 1, 2009. Note: 2017 fish are listed in bold; EF = electrofishing; L = length; Wt = weight.

Date	Method of Capture	Location	Action	Personnel	L (mm)	Wt (g)	PIT tag	Genetic Assignment	Condition at time of release
9/18/217	**Ladder**	**TFalls Dam**	**Fish Passage Studies**	**Licensee FWP**	**408**	**522**	989001006029199	**118-084**	**Alive**
6/6/16	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	618	1950	989001005372405	NF Fish Creek (R4)	Alive
5/18/16	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	615	1934	989001005372387	NF Fish Creek (R4)	Alive
4/18/16	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	413	602	989001005372232	Fishtrap (R4)	Alive
4/11/16	EFISH	Upper TFalls Reservoir (CFR)	Long-term Population Monitoring	Licensee FWP	247	124	989001005372235	Prospect Ck (R3)	Alive
10/20/15	EFISH	Clark Fork River, upstream of Island Complex	Long-term Population Monitoring	Licensee FWP	651	1966	900226000730577	Fishtrap Creek (R4)	Alive
6/3/15	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	520	1112	982000357016242 982000357016210	Fishtrap Creek (R4)	Alive
5/17/15	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	519	1334	982000363519407	Fishtrap Creek (R4)	Alive
4/13/15	EFISH	Upper TFalls Reservoir (CFR)	Long-term Population Monitoring	Licensee FWP	219	88	989001004067249	Fishtrap Creek (R4)	Alive
10/28/14	EFISH	Paradise-Plains	Long-term Population Monitoring	Licensee FWP	315	260	982000357016111	NF Jocko (R4)	Alive
6/3/14	EFISH	Below TFalls Dam	Fish Passage Studies	Licensee FWP	509	1224	982000357016241	Fishtrap Creek (R4)	Alive
5/28/14	EFISH	Below TFalls Dam	Fish Passage Studies	Licensee FWP	567	1640	985121021203256 982000357016106	Fishtrap Creek (R4)	Alive

Date	Method of Capture	Location	Action	Personnel	L (mm)	Wt (g)	PIT tag	Genetic Assignment	Condition at time of release
5/16/14	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	523	1264	982000357016169	Fish Creek (R4)	Alive (later captured via gillnet in Noxon Reservoir resulting in a mortality)
4/15/14	EFISH	Upper TFalls Reservoir (CFR)	Long-term Population Monitoring	Licensee FWP	577	1446	900226000035846	Fishtrap Creek (R4)	Alive
4/7/14	EFISH	Below TFalls Dam	Fish Passage Studies	Licensee FWP	520	1500	No tag implanted/ no genetic sample taken	NA	Alive
8/9/13	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	482	1058	982000357016151	Fishtrap Creek (R4)	Alive
6/7/13	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	596	1926	HDX tag not recorded (Genetics 118-073)	Fishtrap Creek (R4)	Alive
5/7/13	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	478	978	982000357016155	Fishtrap Creek (R4)	Alive
5/6/13	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	576	1694	982000357016109	Fishtrap Creek (R4)	Alive
4/30/13	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	598	2306	982000357016065	Fish Creek (R4)	Alive
4/10/13	EFISH	Upper TFalls Reservoir (CFR)	Long-term Population Monitoring	Licensee FWP	260	108	982000357016097	Fishtrap Creek (R4)	Alive
10/30/12	EFISH	Paradise-Plains	Long-term Population Monitoring	Licensee FWP	472	800	982000357016135	Monture Creek (R4)	Alive
10/30/12	EFISH	Paradise-Plains	Long-term Population Monitoring	Licensee FWP	444	678	982000357016066	Fish Creek (R4)	Alive
5/21/12	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	563	1404	985121023464730	Fishtrap Creek (R4)	Mortality (2012)

Date	Method of Capture	Location	Action	Personnel	L (mm)	Wt (g)	PIT tag	Genetic Assignment	Condition at time of release
4/26/11					547	1438			Alive (2011)
5/15/12	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	510	1172	985121021877906 982000357016269	Meadow Creek (R4)	Alive
4/17/12	EFISH	TFalls Reservoir (Upper Section)	Long-term Population Monitoring	Licensee FWP	260	140	985121027402995	Fishtrap Creek (R4)	Alive
4/16/12	EFISH	TFalls Reservoir (Lower Section)	Long-term Population Monitoring	Licensee FWP	222	76	985121027360192	Fishtrap Creek (R4)	Alive
4/10/12	EFISH	Below TFalls	Fish Passage Studies	Licensee FWP	272	150	985121027393272	Graves Creek (R3)	Alive
5/31/11	EFISH	Below TFalls	Fish Passage Studies	Licensee FWP	482	966	985121021877906	Meadow Creek (R4)	Alive
5/31/11	EFISH	Below TFalls	Fish Passage Studies	Licensee FWP	180	50	985121021907887	Fishtrap Creek (R4)	Alive
5/31/11	EFISH	Below TFalls	Fish Passage Studies	Licensee FWP	247	130	985121021914545	Fishtrap Creek (R4)	Alive
4/13/11	Ladder	TFalls Dam	Fish Passage Studies	Licensee FWP	365	364	985121023302169	Thompson River (R4)	Alive
10/12/10	EFISH	Clark Fork River, upstream of Island Complex	Long-term Population Monitoring	Licensee	325	240	N/A	SF Jocko River (R4)	Alive
5/1/09	Gillnet	TFalls Reservoir	Long-term Population Monitoring	Licensee	271	174	985121009494278	Fishtrap Creek (R4)	Alive

10.0 Proposed Activities for 2018

10.1 Baseline Fisheries Data Collection

NorthWestern and FWP reviewed baseline fisheries data and propose to continue autumn gillnetting surveys on an annual basis and alternate electrofishing (both spring and autumn surveys) every other year. Baseline electrofishing and fall gillnetting efforts are scheduled for 2018. In 2018, electrofishing efforts will include the Thompson Falls Reservoir (spring sampling), above the island complex (autumn sampling), and Paradise to Plains (autumn sampling). The sample locations and methods will remain unchanged. Gillnetting efforts in 2018 will be summarized in next year's annual report. Based on prior year's sampling in the Clark Fork River and Thompson Falls Reservoir, it is conservatively estimated that incidental take of Bull Trout for 2018 autumn gillnetting efforts will be no more than five Bull Trout. Any fish evaluations in the Thompson River drainage will be managed by FWP, thus any incidental take of Bull Trout will be reported by FWP.

10.2 Upstream Adult Fish Passage Studies

In 2018, NorthWestern will continue to implement 10-year *Fish Passage Facility Evaluation Plan, Phase 2 Action Plan, 2011-2020* (PPL Montana, 2010) (Evaluation Plan) that was developed and submitted to the FERC on October 18, 2010 and approved on June 9, 2011. NorthWestern will continue to collect biological and operational data during ladder operations in 2018. NorthWestern will summarize the following information, as available, for next year's annual report:

- Total number of fish and species ascending the ladder
- Total number of fish and species passed to Thompson Falls Reservoir
- Most active period(s) for fish and various species ascending the ladder
- Number of Bull Trout that fallback after passing the Thompson Falls Dam
- Bull trout genetic sampling and tributary assignment

As was implemented in 2017, NorthWestern proposes to check the ladder at a minimum of once a day when and if water temperatures reach or exceed 23 ºC. NorthWestern also proposes to operate the ladder in notch mode throughout the duration of the 2018 season.

Several studies outlined in the Evaluation Plan will occur over multiple years (2011-2020). A list of the studies and their respective schedule is provided in Table 10-1. Based on prior year's sampling in the Thompson Falls tailrace it is conservatively estimated that incidental take of Bull Trout during 2018 upstream adult fish passage studies will be no more than 10 Bull Trout.

Table 10-1: Summary of the objectives, studies, and reporting requirements for the Evaluation Plan (2011-2020). Annual activities are indicated by an "x." A dash (-) indicates no action will be taken for the year. TBD = "to be determined." (Table was modified from the *Evaluation Plan*, 2010.)

Objective	Study	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Effectiveness of the Ladder	Annual Fish Passage	x	x	x	x	x	x	x	x	x	x
	Annual Movement Patterns (timing)	x	x	x	x	x	x	x	x	x	x
	Bull Trout Genetic Testing	x	x	x	x	x	x	x	x	x	x
Operational Procedures for Effectiveness	Weir Modes Notch *vs.* Orifice	x	x	Orifice Mode Only			Orifice; then alternating modes 4 weeks when water > 19 °C	Notch Mode Only	Notch Mode Only	TBD	TBD
	Attractant Flow (AF) & Radio Telemetry (RT)	x (no RT)	x (no RT)	x (max AF, no RT)							
Length of Delay	Upstream Movement Patterns, Timing & Behavior (Delay)	x	x	x	x	x	x	x	x	x	x
Fallback	Fallback	x	x	x	x	x	x	x	x	x	x
Reporting Requirements	Annual Reporting (April 1 – FERC Submittal)	x	x	x	x	x	x	x	x	x	x
	5-year Fish Passage Evaluation Plan Report	Accomplished through Annual Reports – No Longer a Separate Requirement for 2015[1]					-	-	-	-	-
	10-year Fish Passage Evaluation Plan Report (Dec 31, 2020 – TAC/FWS Submittal)	-	-	-	-	-	-	-	-	-	x

[1] NorthWestern and FWS concur that the 5-year Fish Passage Evaluation Plan, per TC 7b and scheduled for submittal in 2015, was not necessary due to the comprehensive annual reporting. NorthWestern filed a letter to the Commission on December 17, 2014 summarizing the modifications that FWS and NorthWestern discussed and agreed to implement with regards to the upstream fish passage terms and conditions described in the BO. FERC issued a letter on February 25, 2015 approving the modifications.

10.2.1 Effectiveness of Upstream Fish Passage

Effectiveness of the ladder will continue to be evaluated based on annual upstream fish passage. For the Thompson Falls ladder, Bull Trout remain the primary target species for upstream fish passage. The biological data collected at the ladder's work station will be used to summarize overall upstream fish passage, including enumeration of fish using the facility; the species using the facility; range, average size, and weight of species using the facility; and the timing of movement and passage by each species.

The ladder was initially designed to operate with flows up to 48,000 cfs. Subsequently, the ladder has operated with streamflows exceeding 48,000 cfs in 5 of the 7 years (*see* Table 3-15) and recorded fish ascending the ladder at these higher flows. However, the ability to attract fish appears to decline when streamflows exceed 43,000 cfs (*refer to* Section 3.7.4). Ladder operation during higher spring flows is primarily dependent on debris and sediment loading. As in previous years, the ladder will be operated in 2018 during the spill season for as long as operationally practicable, and data collected on fish movements into the ladder through this range of flow.

Effectiveness of the operational procedures of the ladder to pass fish upstream continues to be evaluated based on studies of weir modes (notch *vs.* orifice) and attractant flows. The attractant flow study began in 2011. The Licensee originally proposed to use the first 3 years of ladder operations (2011-2013) to test variable attraction flows and learn operations. Based on observations in the first 2 years of study, the Licensee concluded that during non-spill time periods, the HVJ and AWS should be operated at maximum capacity to provide sufficient flow to allow fish to migrate upstream through the natural falls, which is present downstream of the Main Channel Dam. NorthWestern has continued this practice since 2013 and proposes to continue to use near maximum attractant flow during 2018 operations.

In 2011 and 2012, weir modes were alternated weekly throughout each season. Between 2013 and 2016, the weir mode was operated primarily in orifice except for 2 weeks in July 2016 when the weir mode was switched to notch as part of a short-term experiment (NorthWestern, 2017). In 2017, the weir mode was set in notch for the entire season. The results from alternating weir modes in 2011 and 2012 (PPL Montana 2012, 2013) and July 2016 (NorthWestern, 2017), operating in orifice only between 2013 and 2016 (NorthWestern, 2017), and operating in notch only in 2017 (this report) indicate fish ascend the ladder in both modes, but more fish and a greater variety of species, including more native non-salmonids are likely to pass in orifice mode.

The majority of Bull Trout recorded at the ladder ascended the ladder in orifice mode (15 Bull Trout in orifice *vs.* 1 Bull Trout in notch). When alternating weir modes in 2011 and 2012, all Bull Trout recorded at the ladder ascended in the orifice mode. The first and only Bull Trout ascent in notch mode occurred in 2017. The 2017 Bull Trout ascent was also the first documentation of a Bull Trout ascending in September. However, the effectiveness to pass Bull Trout in either mode is not conclusive due to the low sample size per year (1 to 5 fish per year ascend).

Following the review of 2017 upstream fish passage results, the TAC agreed to operate the ladder in notch mode in 2018 and 2019 to verify 2017 findings and test the notch mode under the natural streamflow and stream temperature variability for a better comparison to orifice operations (2013-2016). Following the 2019 season, operations would resume in orifice mode for 2020. The TAC will review results following the 2018 operational season and determine if any changes to the 3-year operation plan are warranted based on the results.

The operational plan to run the ladder in notch mode for 3 consecutive years (2017-2020) will allow for a complete evaluation of orifice *versus* notch mode under various river conditions (streamflows and temperature). It is understood that operating in notch mode will likely reduce the total number of native non-salmonid fish passage at the ladder. However, the TAC believes it is important to further evaluate fish passage under notch mode to see if undesirable fish, such as Walleye will ascend in notch mode and to evaluate the best operational strategy to assess effective Bull Trout and migratory fish species upstream passage per the FWS Biological Opinion (2008). Although even if Walleye do not ascend in notch mode over the next 3 years, this will not conclusively determine the potential.

10.2.2 Evaluation of Fish Movement Patterns, Timing, and Behavior

Fish movement patterns, timing, and behavior are evaluated through biological data collected at the ladder and Thompson River. The assessment of fish movement patterns, timing, and behavior will be conducted by monitoring fish PIT-tagged at the ladder and monitoring PIT tag detections via the remote array in the mainstem of the Thompson River. These studies will allow for an assessment of the length of time for Bull Trout to ascend the ladder and movement patterns. No radio telemetry studies have been identified by the TAC since operations began in 2011. No radio telemetry studies are proposed for 2018. In addition, no electrofishing or tagging of fish below Thompson Falls Dam is proposed for 2018.

Bull trout captured in 2018 downstream of Avista's Cabinet Gorge and Noxon Rapids dams that are genetically tested and assigned to Region 4 (upstream of Thompson Falls Hydroelectric Project) will be PIT-tagged (but will not be radio tagged) and released in Region 4; Region 3 fish will be released in Region 3, accordingly.

Any fish evaluations in the Thompson River drainage will be managed by FWP, and any incidental take of Bull Trout will be reported by FWP.

10.2.3 Evaluation of Fallback

The potential fallback of Bull Trout after ascending the ladder and moving into the Thompson Falls Reservoir will be evaluated on an annual basis. Bull trout are PIT tagged at the ladder prior to being released upstream. The remote arrays in the ladder will be used to monitor for previously PIT-tagged fish and to evaluate fallback.

10.3 Thompson Falls Reservoir Monitoring Plan

The Licensee was scheduled to submit a comprehensive report to FWS in 2015 to summarize data collected between 2010 and 2015, as well as provide recommendations for improving emigrating juvenile Bull Trout survivorship and evaluate the site-specific need for a nonnative species control program in the Thompson Falls Reservoir per the TCs 5a and 5b in the BO. However, the schedule for the summary report in 2015 and recommendations for any additional programs and/or efforts was modified. In 2014, the Licensee consulted with FWS and proposed to modify filing requirements specified in the FWS' BO TCs 5a, 5b, and 7b. A letter of concurrence from FWS along with the proposed changes, were filed with the Commission on December 17, 2014. FERC approved the proposed modifications in a letter dated February 25, 2015. The modifications include removing the comprehensive summary of activities associated with the 5-Year Reservoir Monitoring Plan (due at the end of 2015) because this requirement was achieved through the annual reports since 2011 and postponing the development of any recommendations, "for a nonnative species control program in the Thompson Falls Reservoir…" from the end of 2015 until December 31, 2020 (formal filing to the Commission) to allow for the completion and full review of the results from the 2014 to 2015 study evaluating out migration of juvenile Bull Trout from the Thompson River.

Glaid (2017) completed a detailed analysis of the results from the 2014 and 2015 field data collection and submitted his thesis to the TAC in 2017, which is also available on the Project website. The TAC will review the results and collaborate to identify recommendations, "for a nonnative species control program in the Thompson Falls Reservoir…" that will be included in the 10-year comprehensive report scheduled to be submitted by December 31, 2020 (formal filing to the Commission).

Any additional fish evaluations in the Thompson River drainage will be managed by FWP, thus any incidental take of Bull Trout will be reported by FWP.

10.4 Total Dissolved Gas Control Plan

In 2010, the *Total Dissolved Gas Control Plan* (PPL Montana, 2010a) (TDG Control Plan) for the Project was submitted to the MDEQ. With the TDG Control Plan, NorthWestern proposes to continue to collaborate with the MDEQ, Avista, FWP, and other entities with a long-term goal of reducing the overall systemic gas supersaturation levels in the Clark Fork River, occurring from a point downstream of the Project to below Albeni Falls Dam.

In 2018, NorthWestern will monitor TDG regardless of spring snowpack conditions. This monitoring will be useful for assessing the impact that the new radial gates have on TDG levels downstream of the Main Dam Spillway. No GBT monitoring in fish downstream of Thompson Falls Hydroelectric Project is proposed for 2018.

10.5 2018 TAC Funded Projects

TAC-approved proposals for 2018 are outlined in Table 8-1 in this report with approved proposals provided in Appendix C. The projects anticipated for implementation in 2018 include the following:

- Koch In-holding Acquisition Lower Fish Creek
- Rattlesnake Dam Removal Project, Phase 1
- Watershed Coordinator for Thompson River
- Beartrap Creek Culvert Replacement
- Bull Trout Genetics Analysis
- Emergency Contingency

11.0 Acknowledgements

This report was prepared by Kristi Webb, New Wave Environmental Consulting, and Ginger Gillin, GEI Consultants, Inc. for NorthWestern Energy. The report was developed in coordination with stakeholder groups representing NorthWestern Energy, FWP, FWS, CSKT, USFS, MDEQ, Avista, and Weyerhaeuser. We would like to thank everyone and their organizations for their time and dedication with regards to their collaborative efforts in monitoring and reporting findings in support of improving fish passage in the lower Clark Fork River. Previous annual reports prepared in support of the Thompson Falls Project are available on the Thompson Falls Project website at http://thompsonfallsfishpassage.com/. Please contact NorthWestern Energy in Butte, Montana for any data requests.

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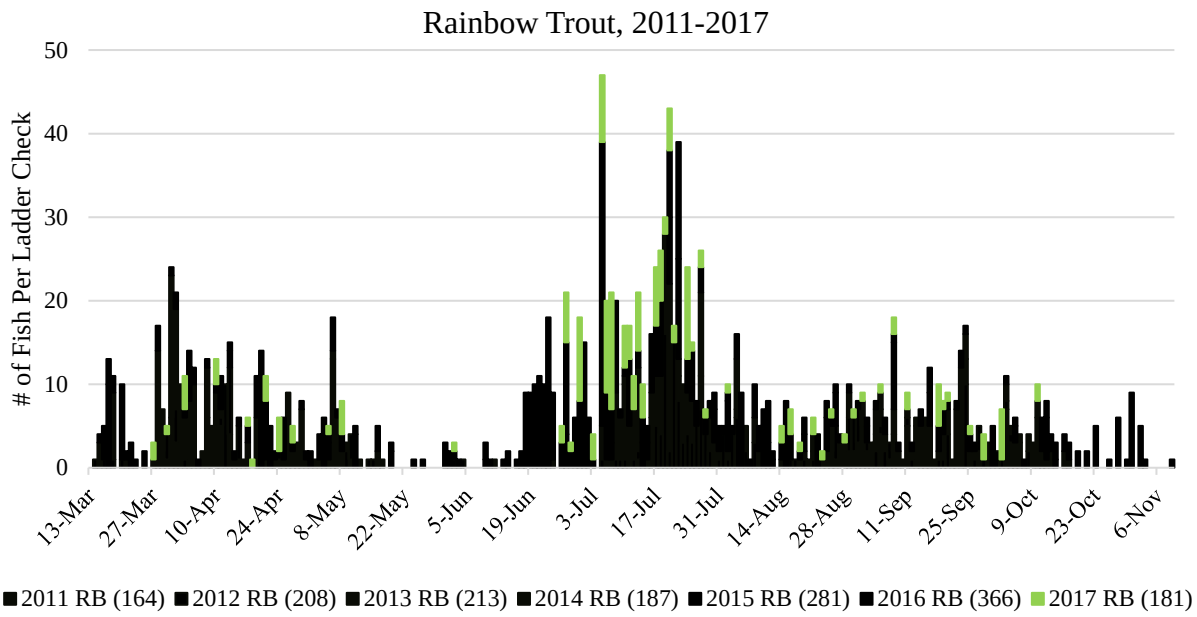
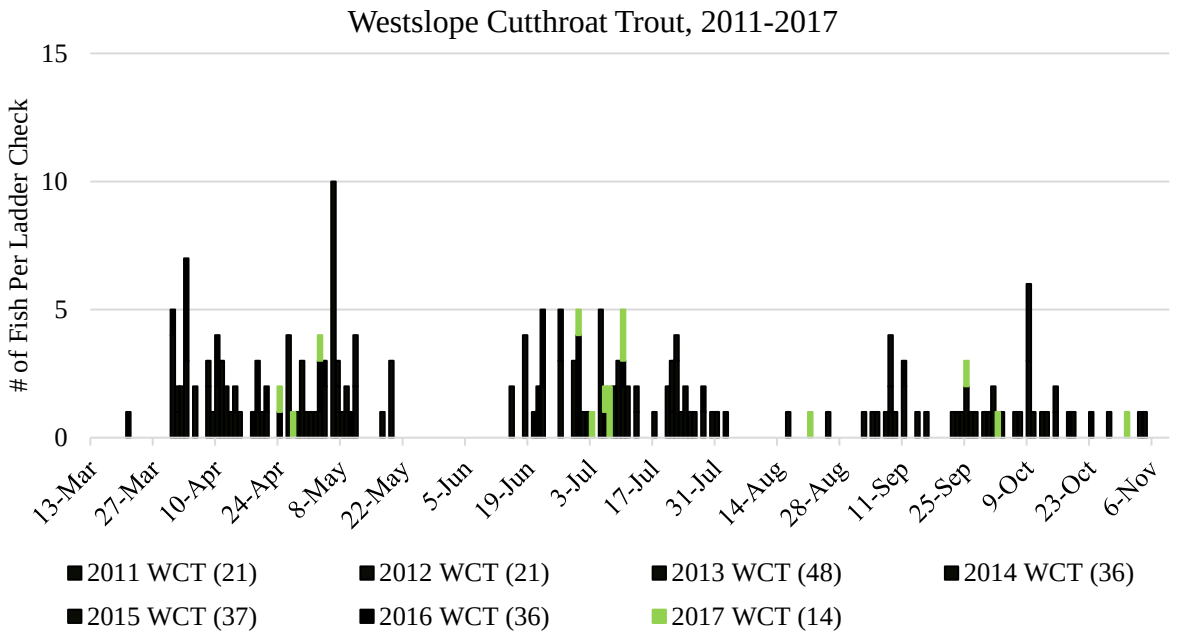
Appendix A – Figures of Movement Patterns, 2011-2017

The following figures are stacked bar graphs depicted the number of fish (by species) recorded at the fish ladder per ladder check each year. Not all fish were observed ascending the ladder annually. For example, Largemouth Bass was only recorded in 2016 and Walleye were only observed in 2015. The number of fish documented at the ladder each year is provided in parenthesis (#) within each graph. Data from 2011 through 2016 are the same color and 2017 is in green. These graphs were prepared to show the timing of when species were recorded at the ladder over time compared to 2017 data.

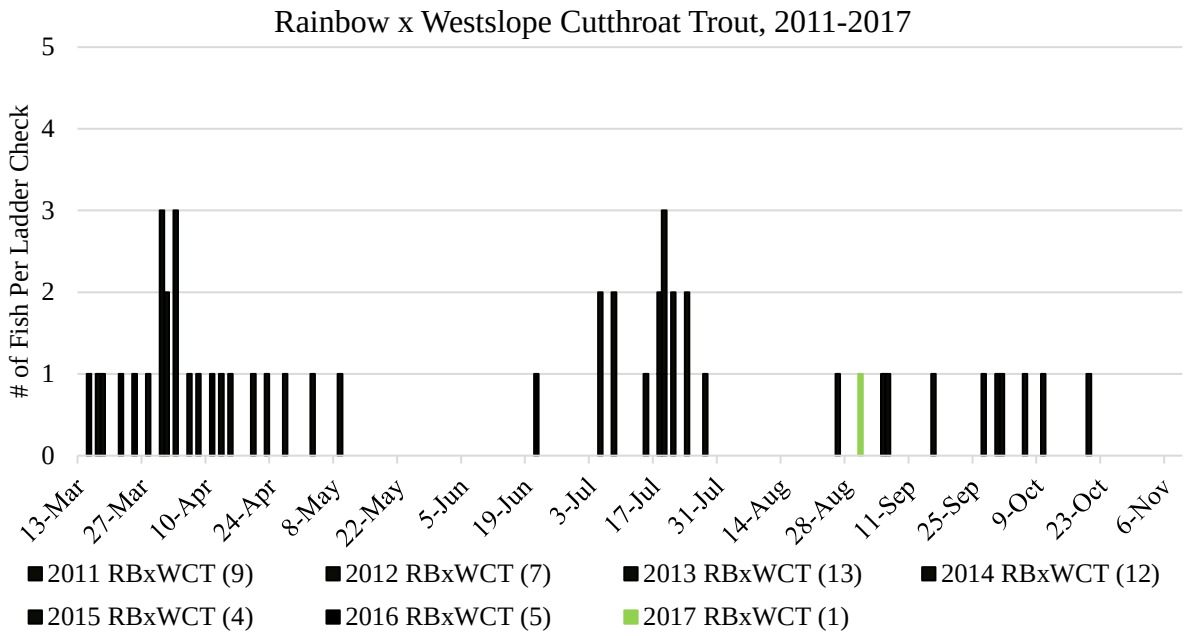
Rainbow Trout



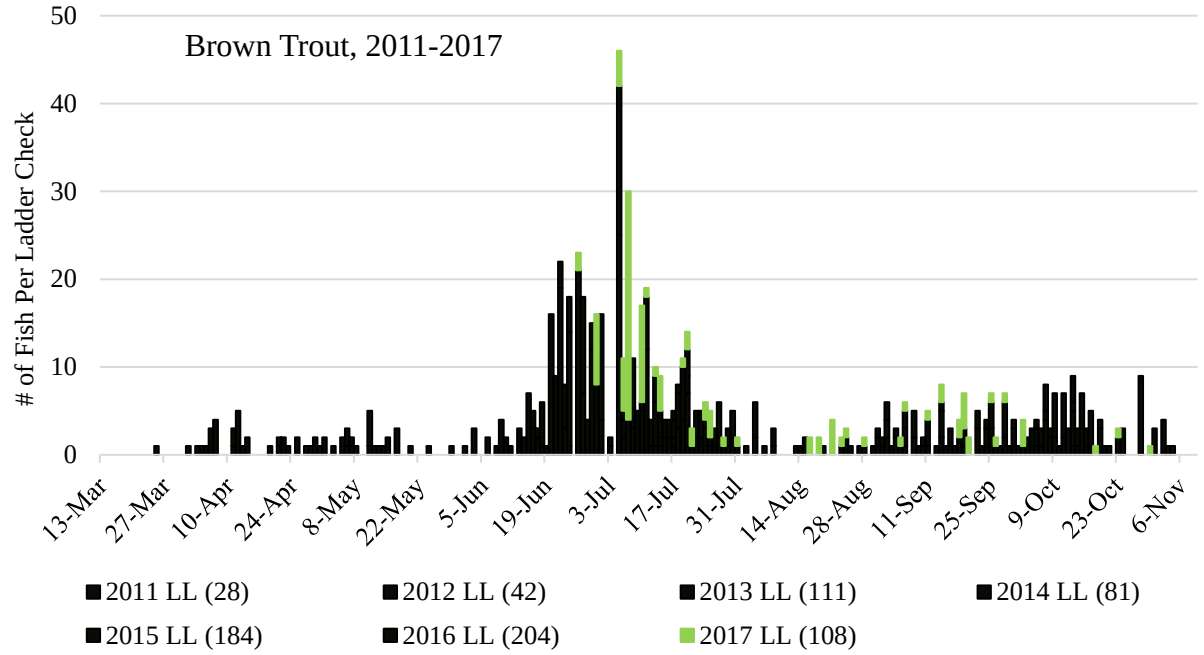
Westslope Cutthroat Trout



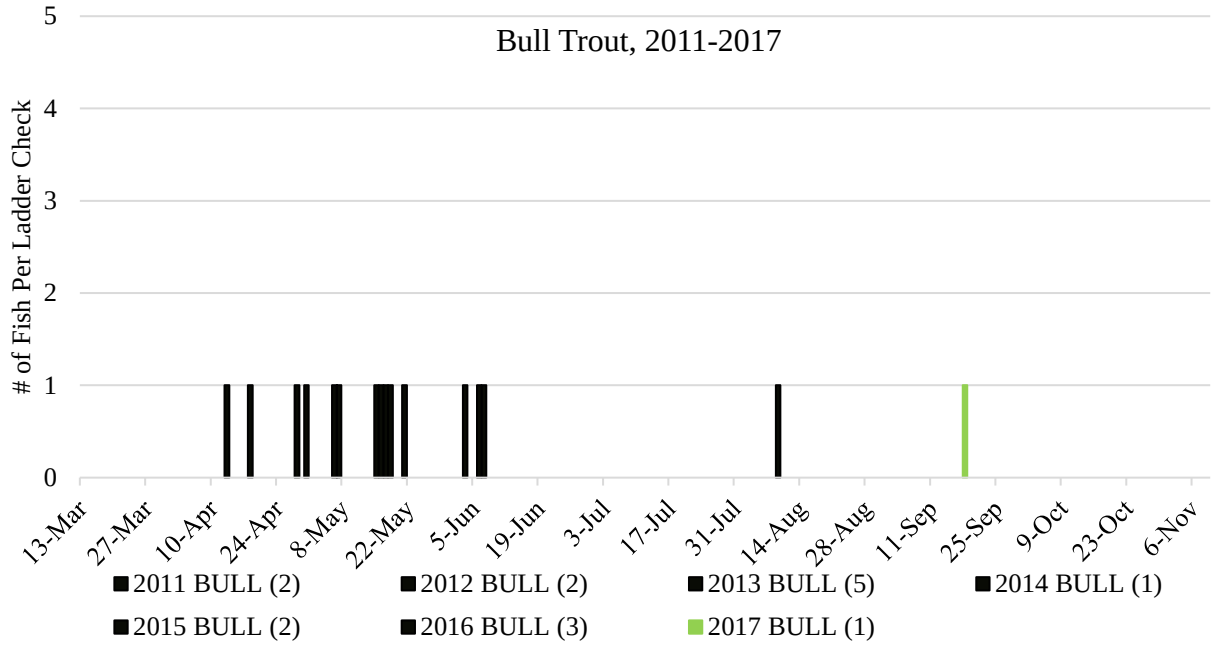
Rainbow x Westslope Cutthroat Trout



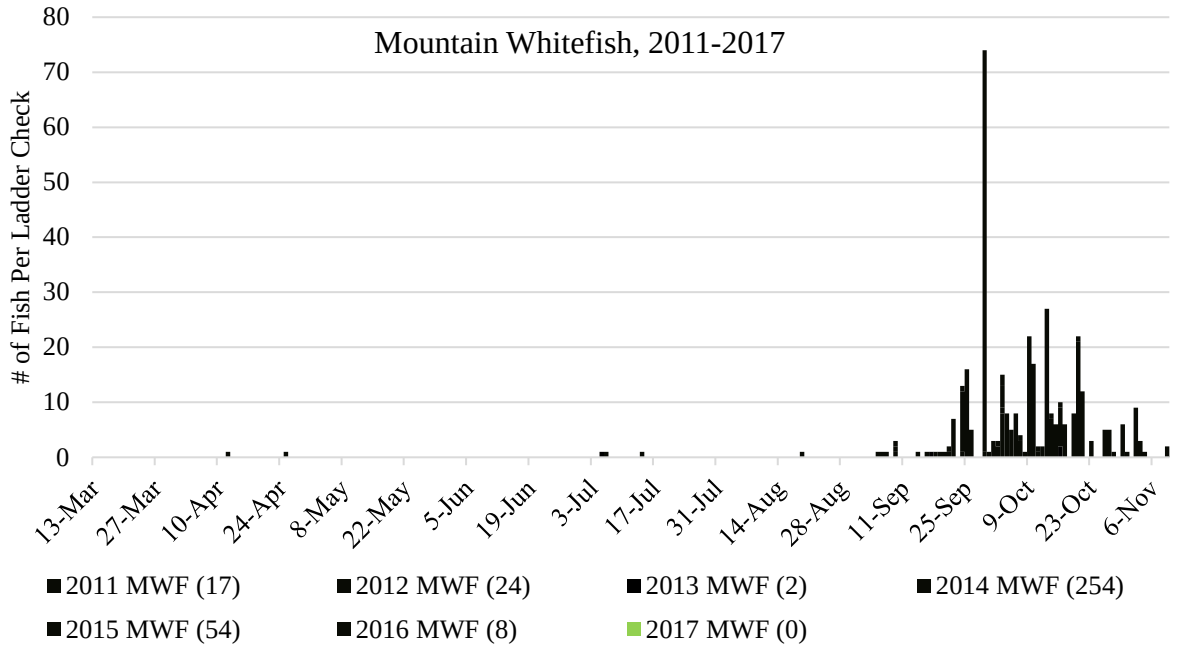
Brown Trout



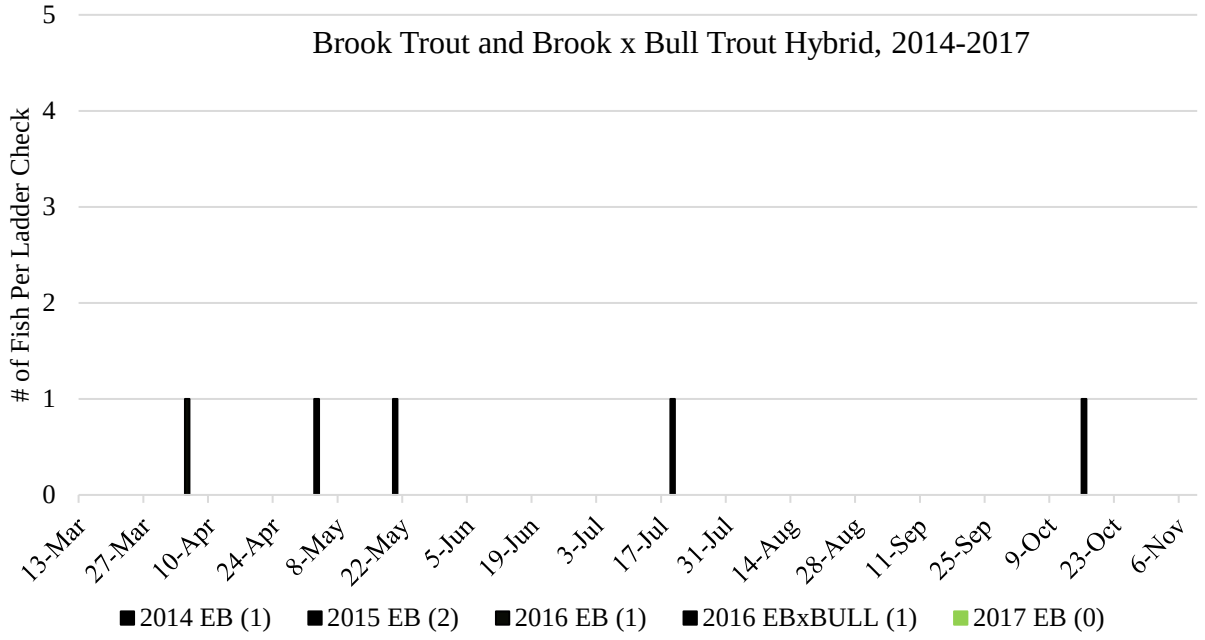
Bull Trout



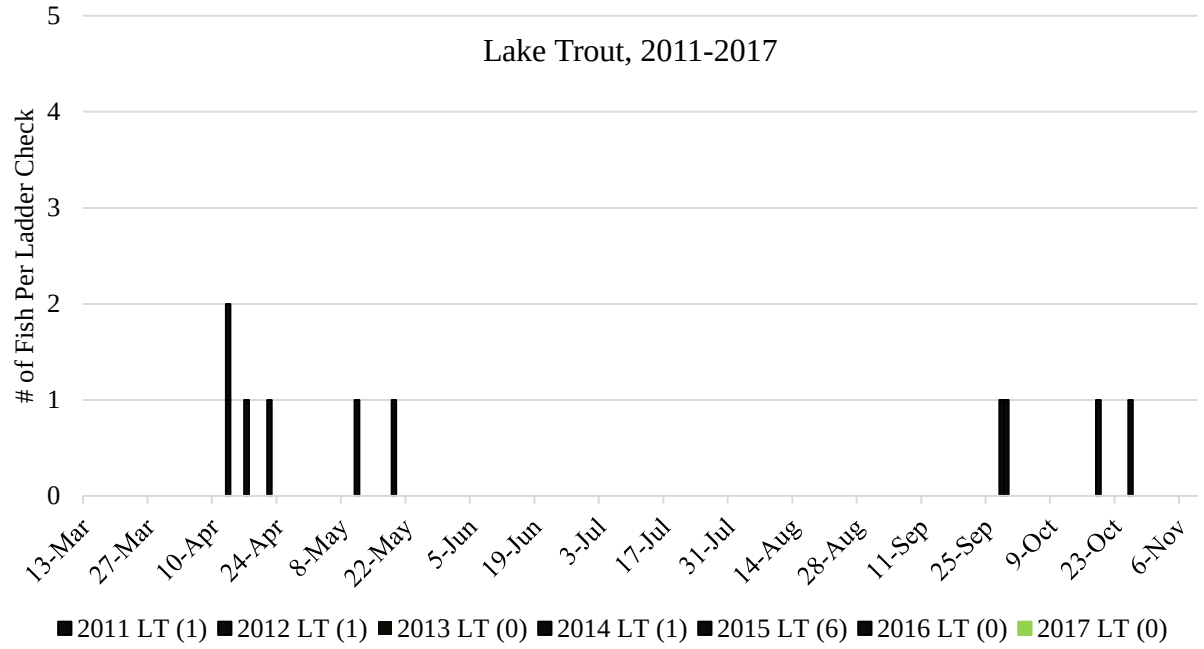
Mountain Whitefish



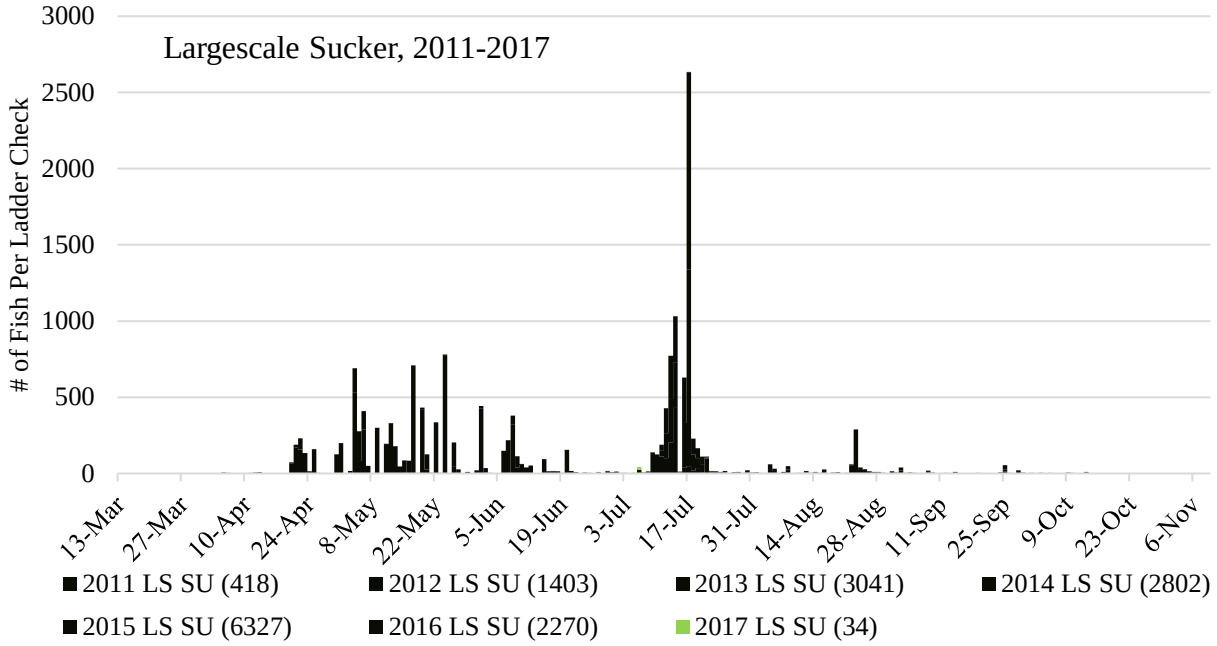
Brook Trout (and Brook x Bull Trout hybrid)



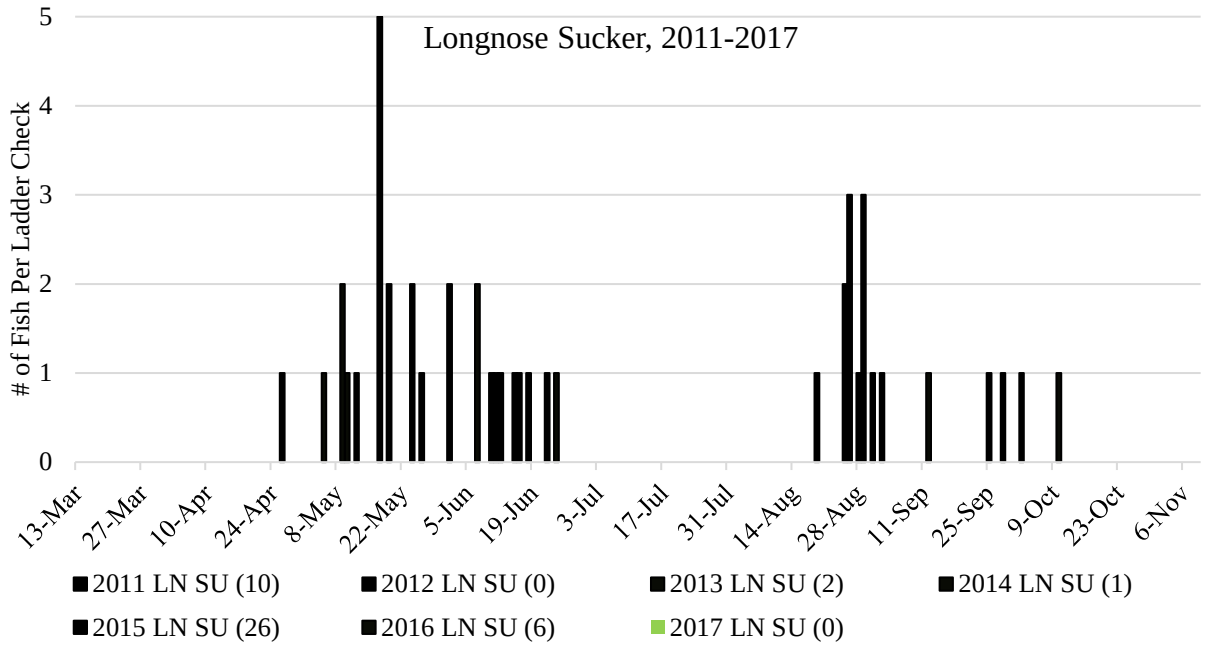
Lake Trout



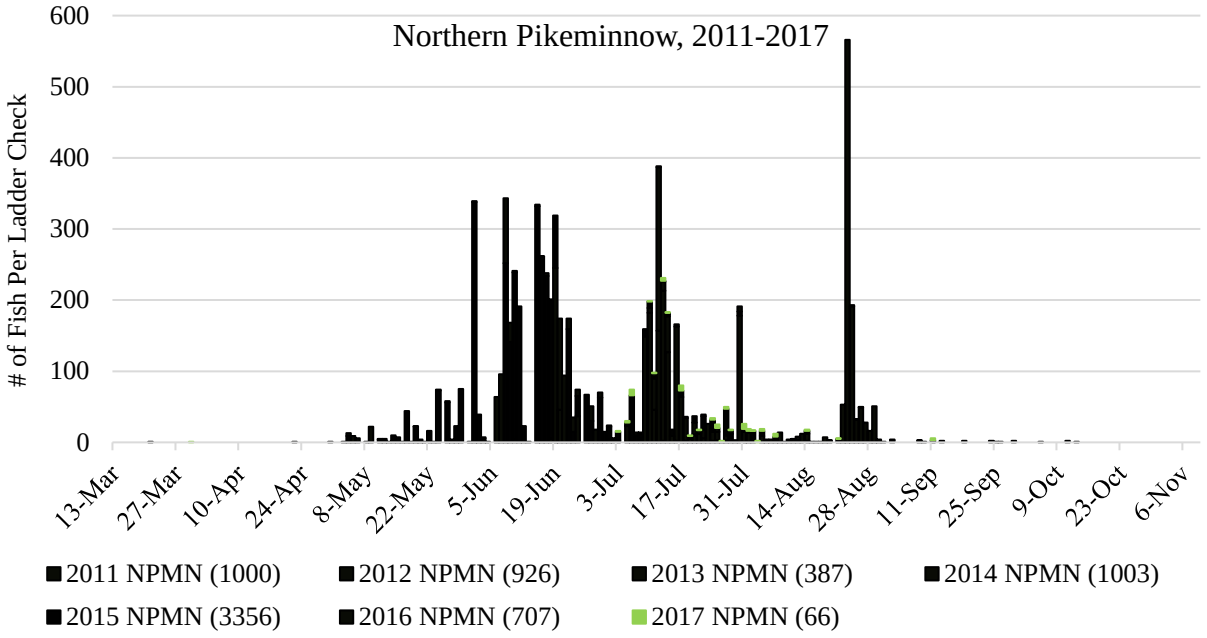
Largescale Sucker



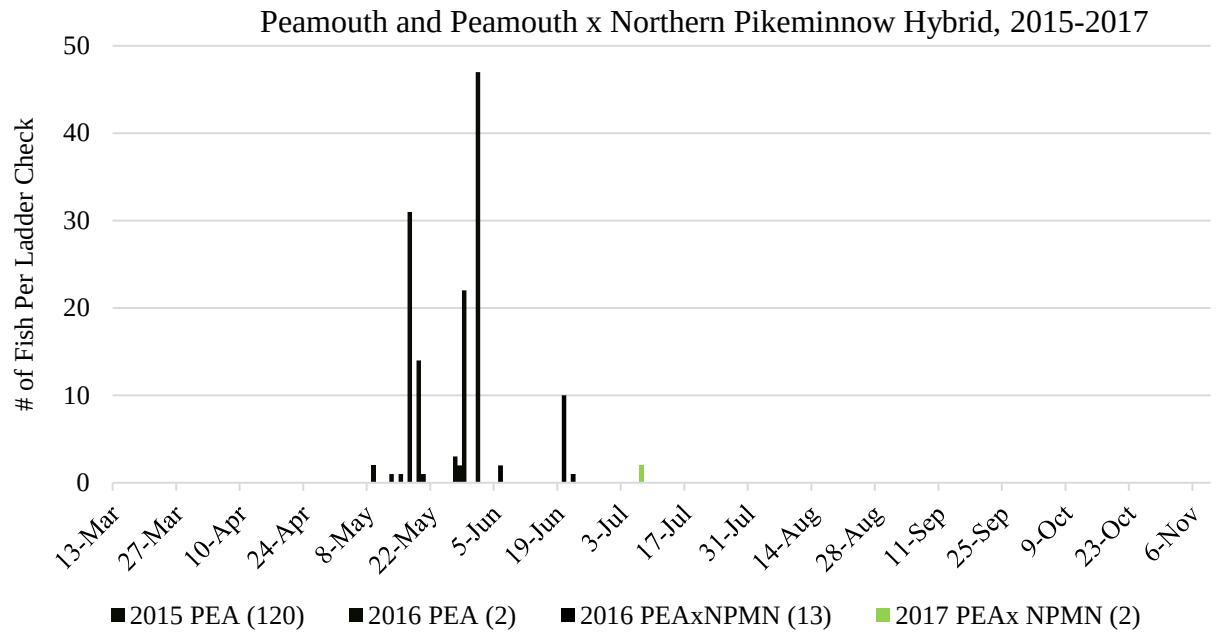
Longnose Sucker



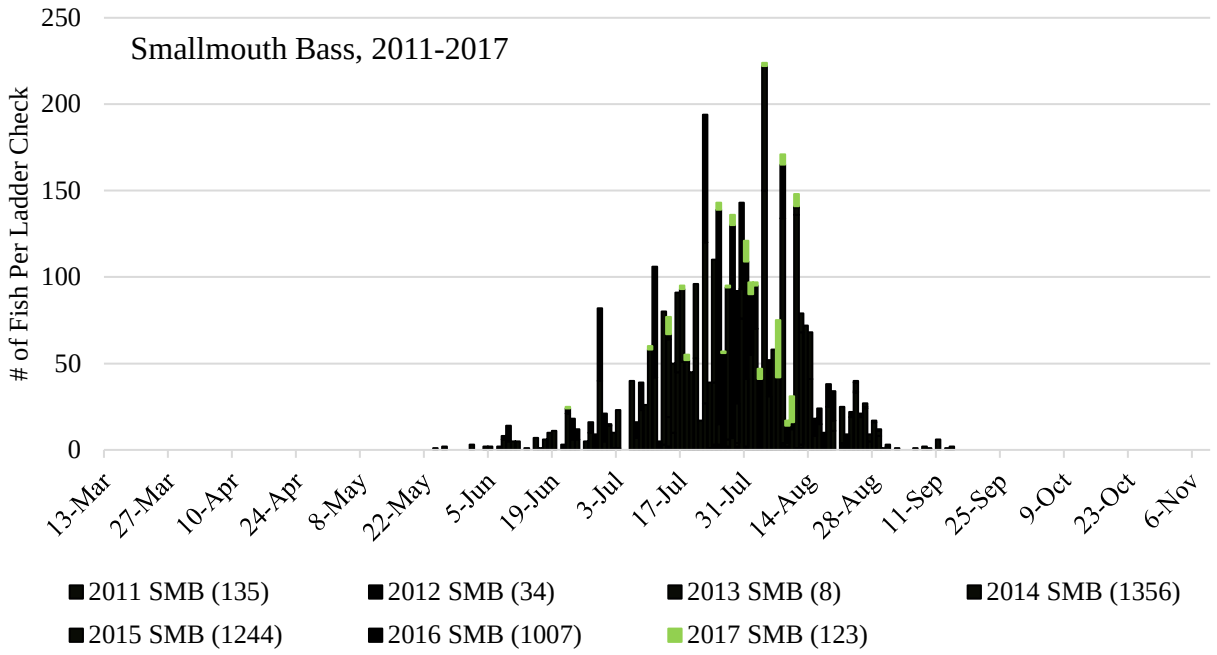
Northern Pikeminnow



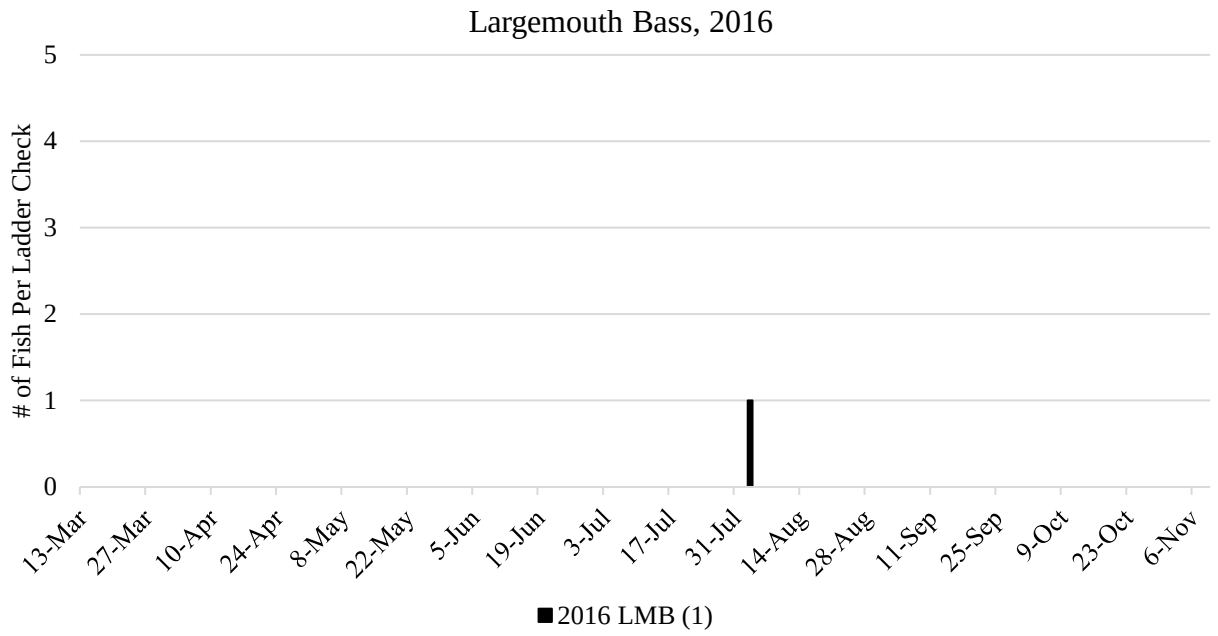
Peamouth and Peamouth x Northern Pikeminnow



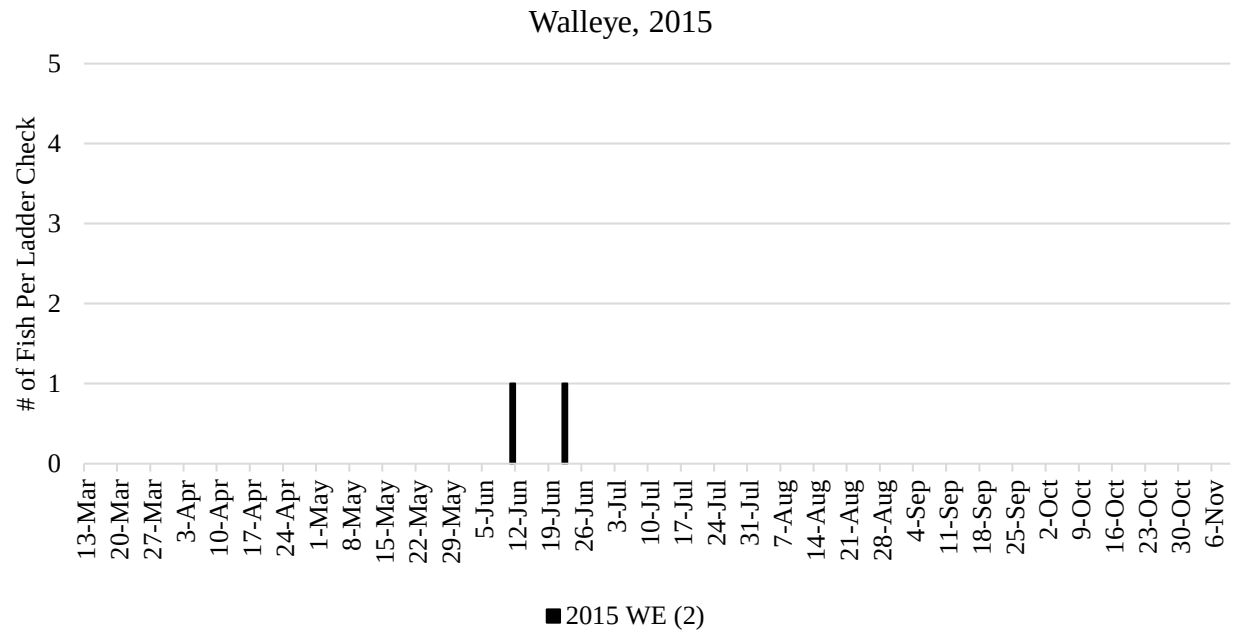
Smallmouth Bass



Largemouth Bass

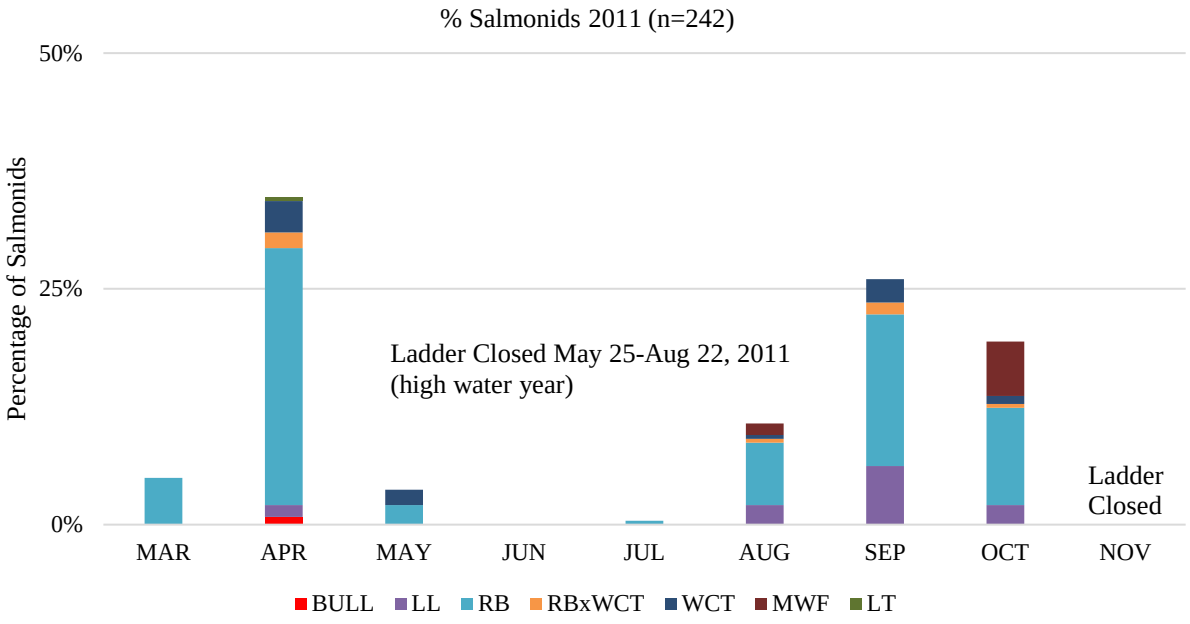


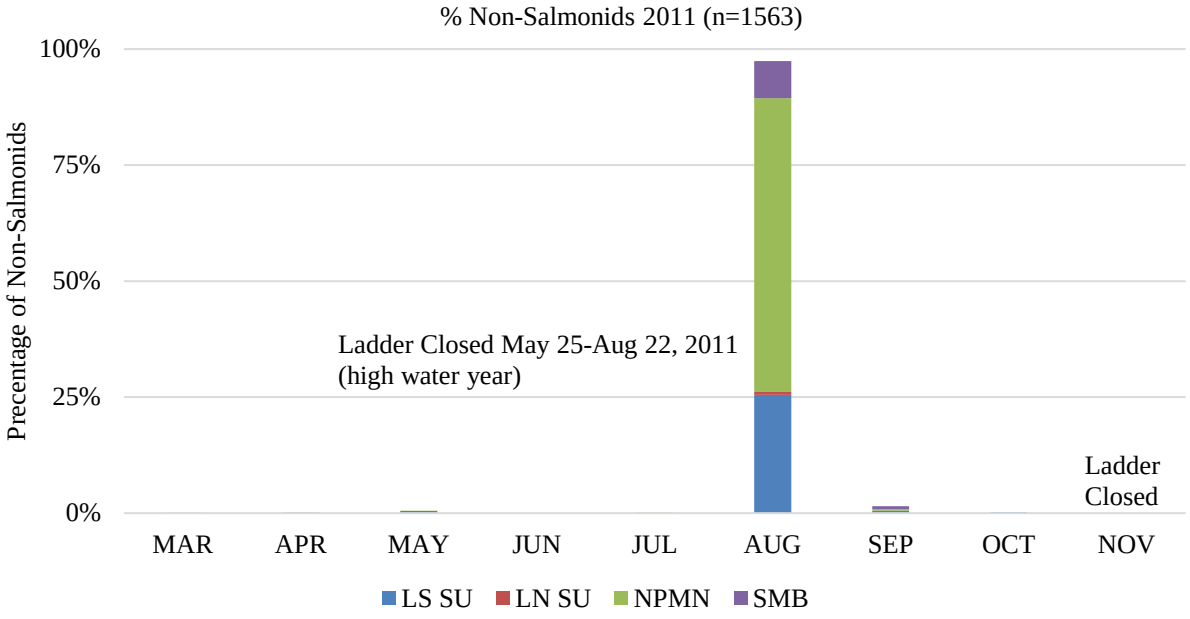
Walleye



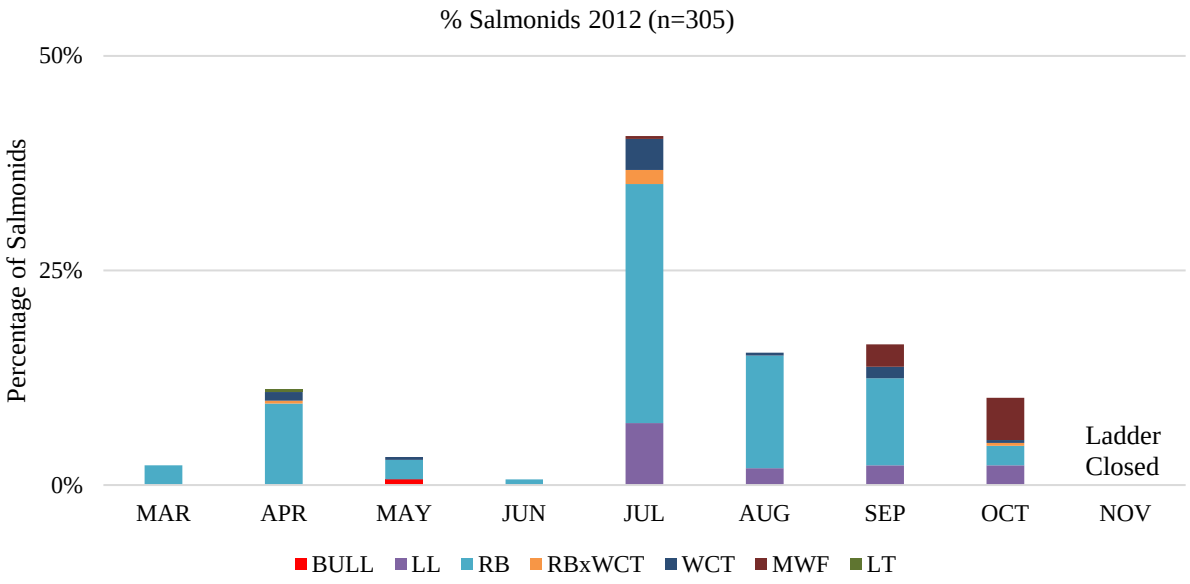
The following figures provide a monthly summary of the percentage of total salmonids and percentage of total non-salmonids, respectively, recorded at the ladder each operational season, 2011-2017.

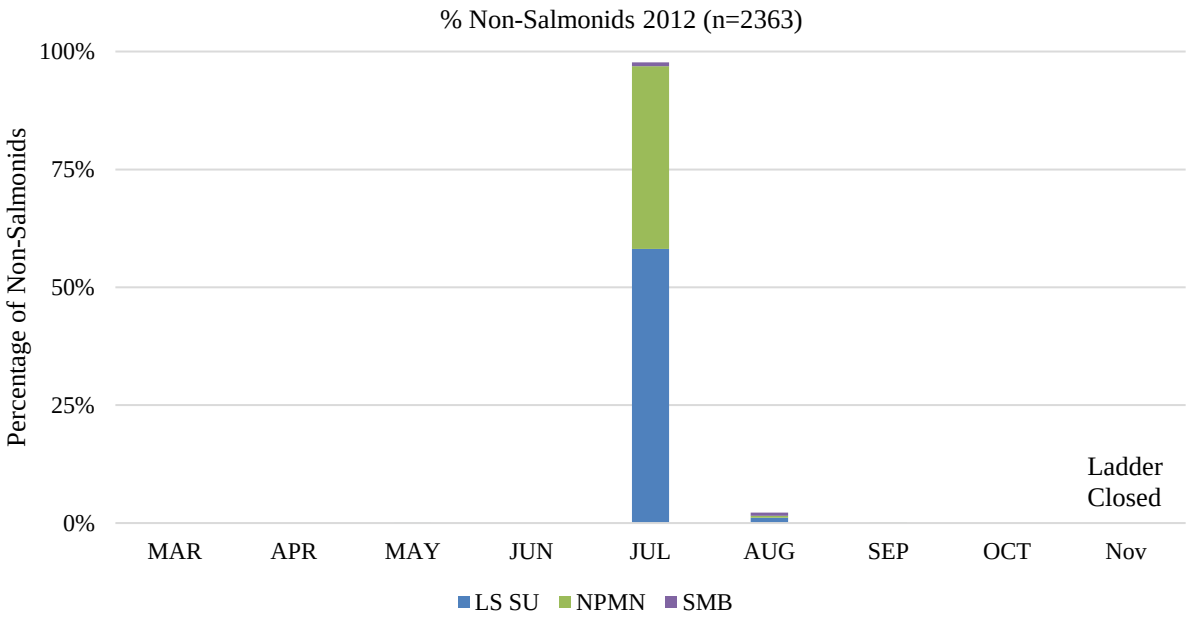
Seasonal Movements at the Ladder – 2011



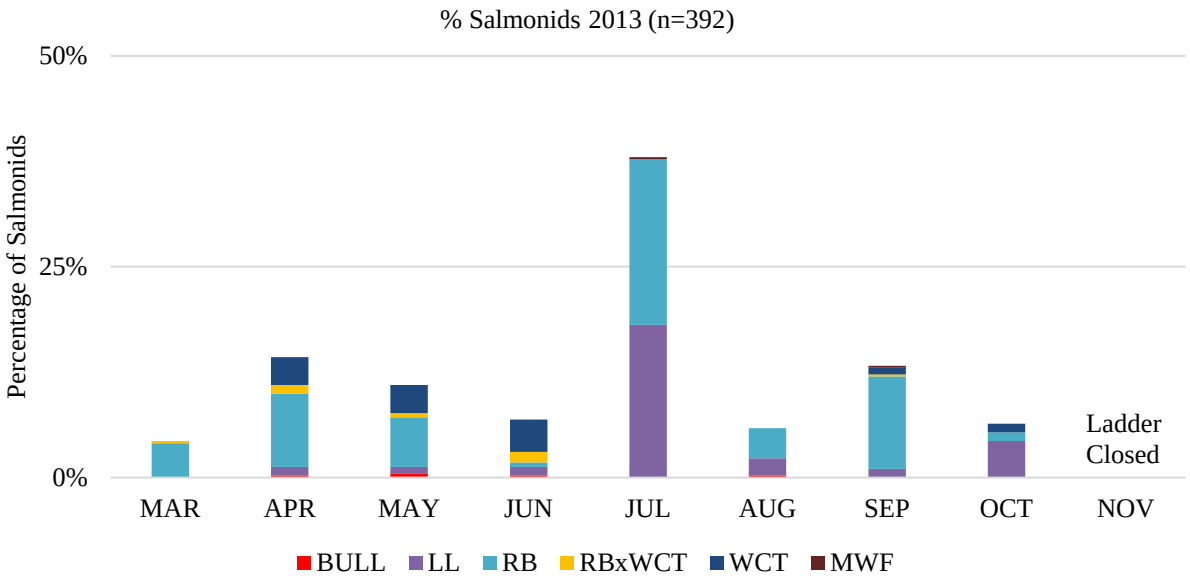


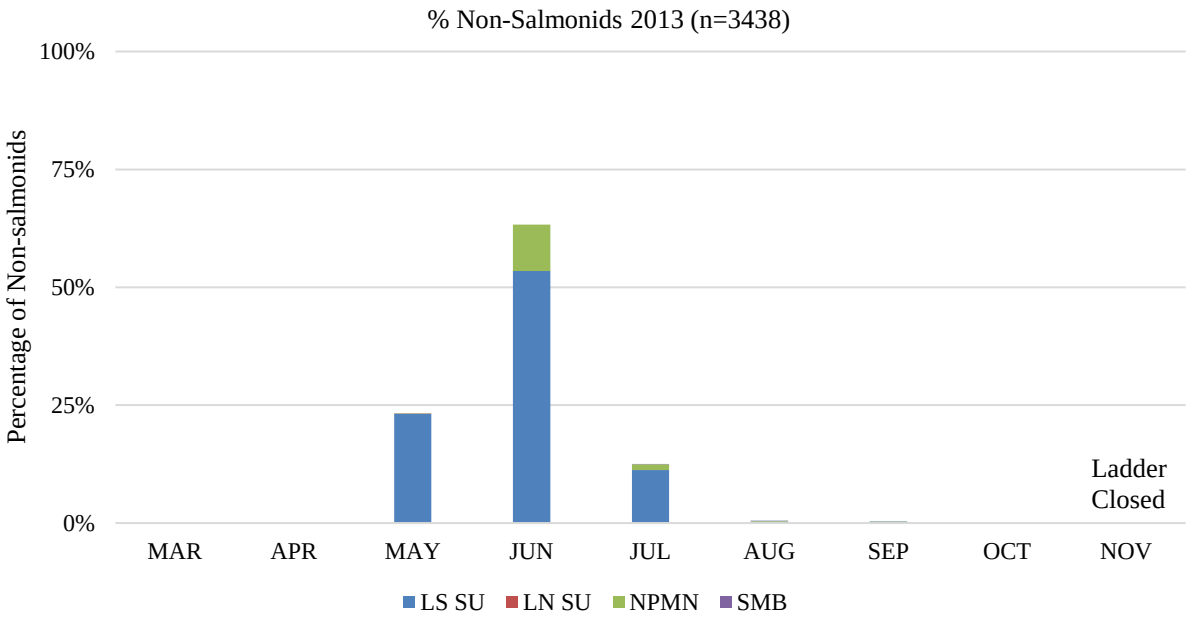
Seasonal Movements at the Ladder – 2012



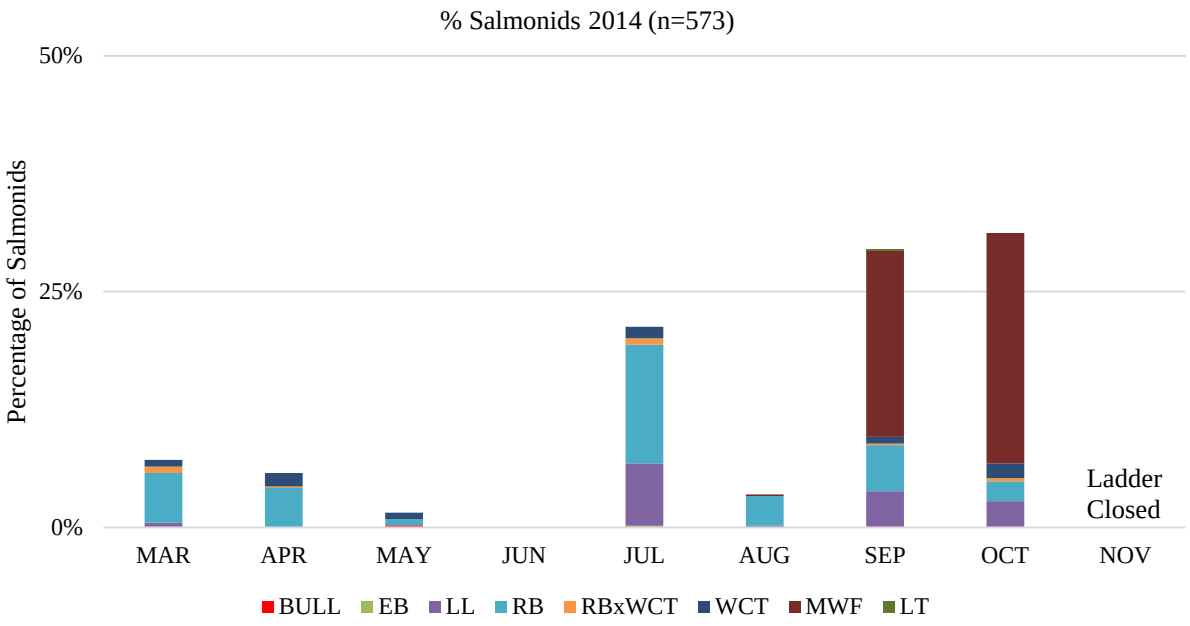


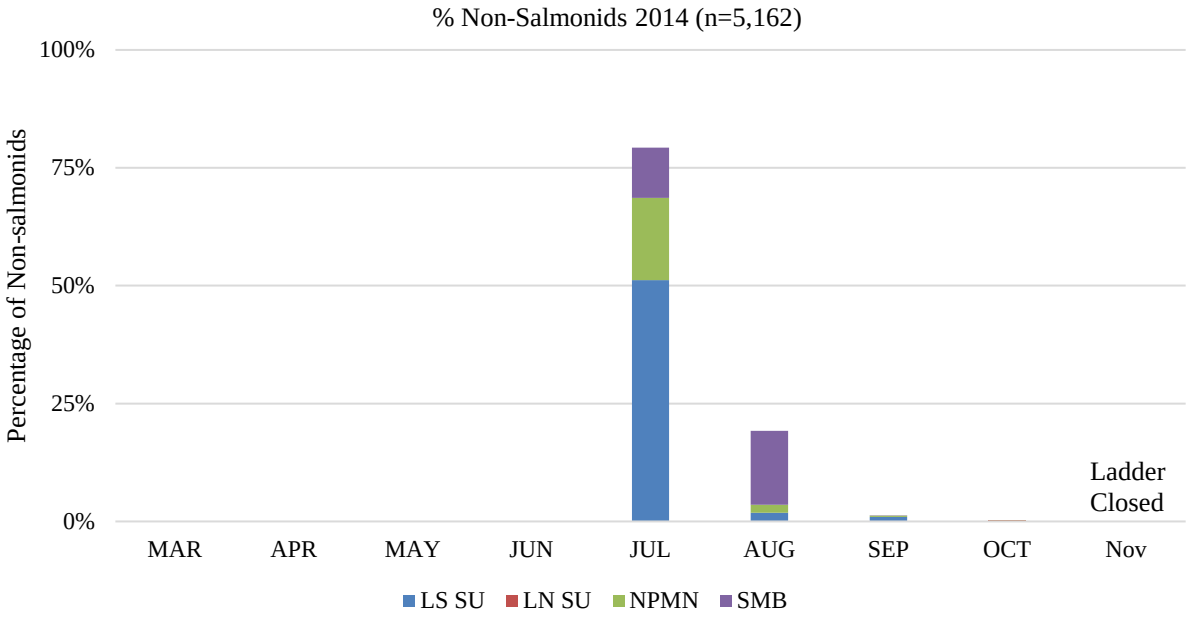
Seasonal Movements at the Ladder – 2013



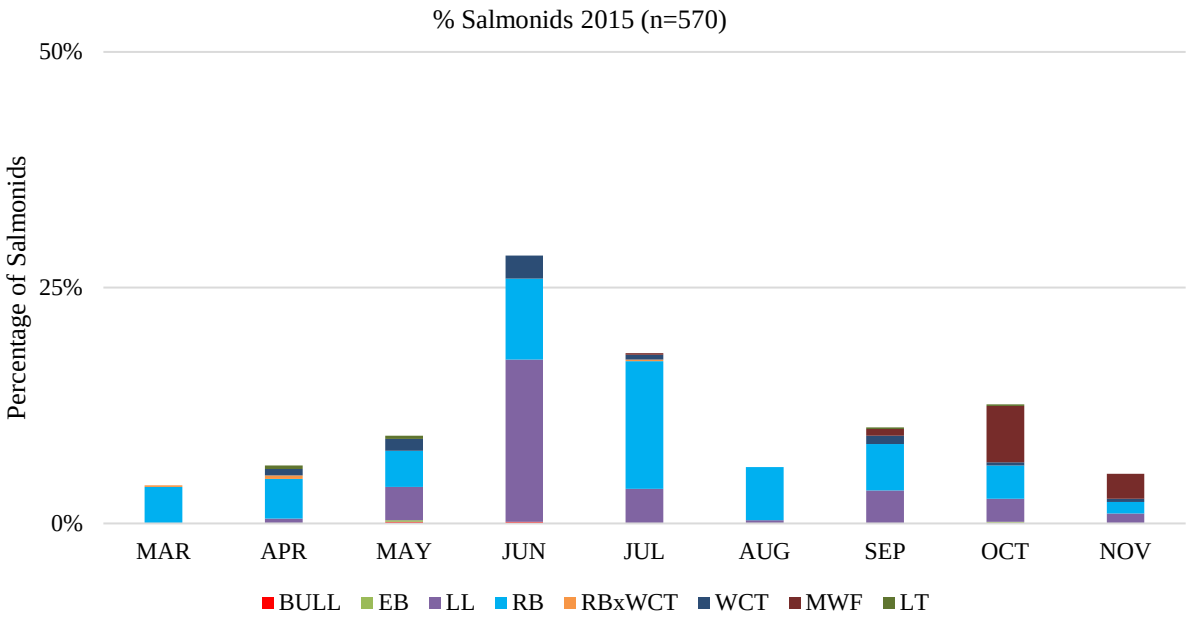


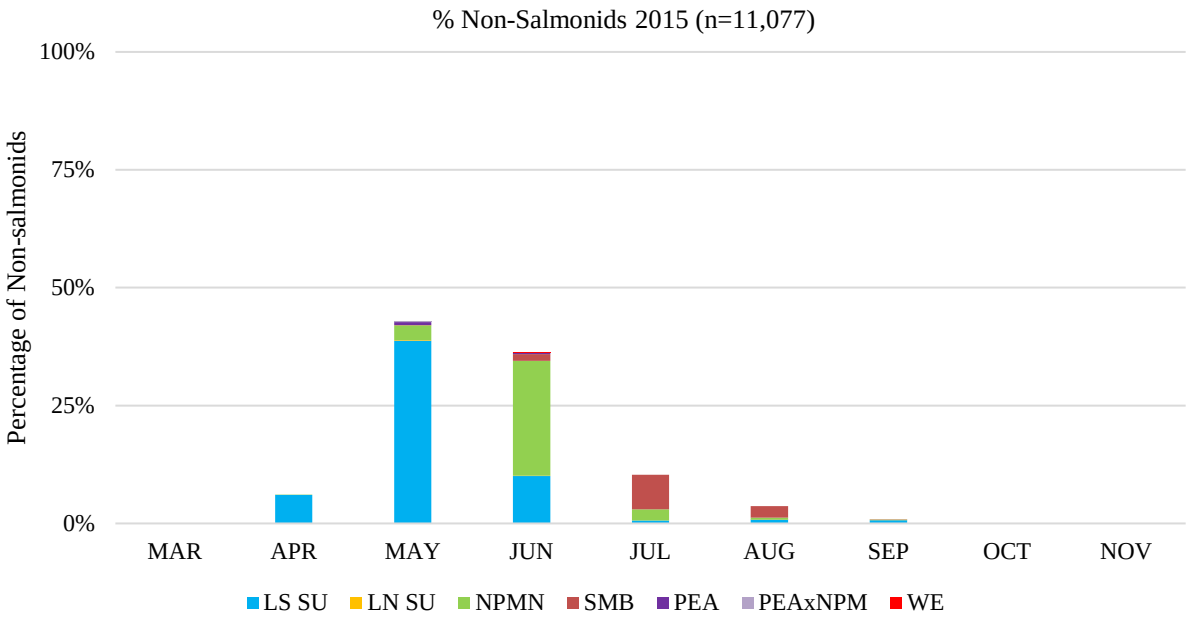
Seasonal Movements at the Ladder – 2014



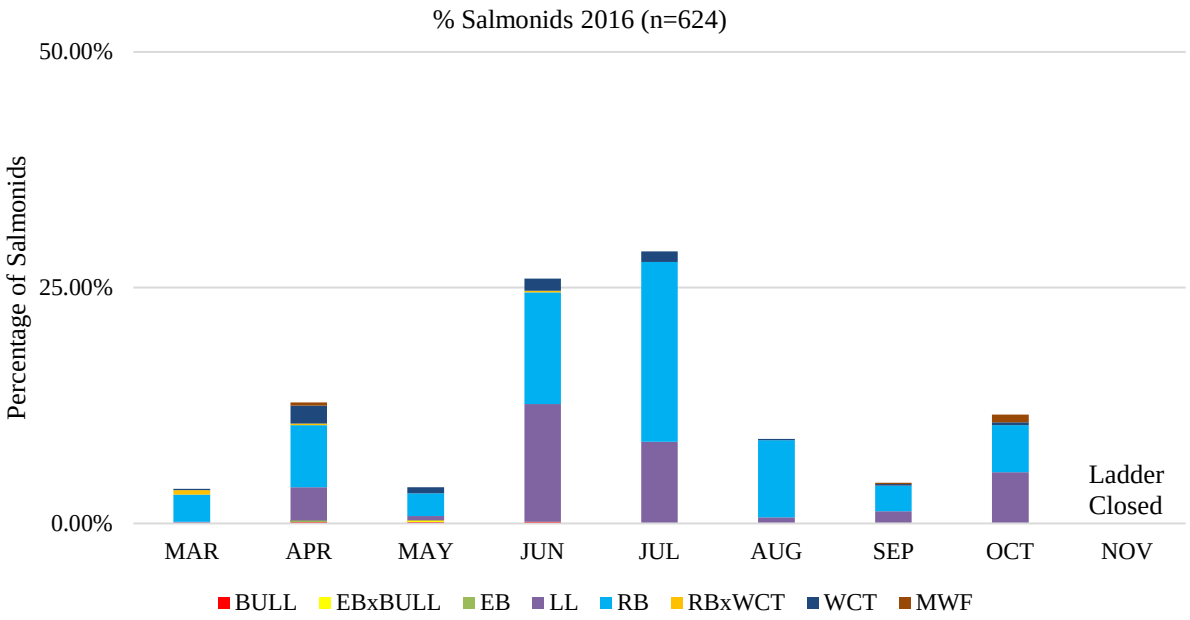


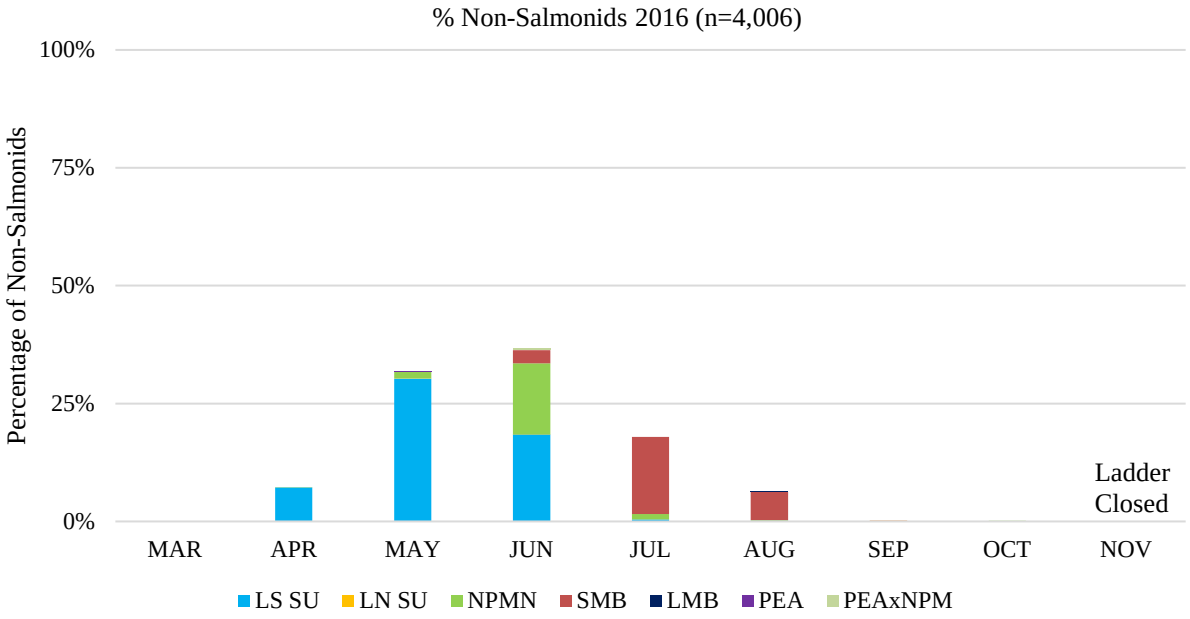
Seasonal Movements at the Ladder – 2015



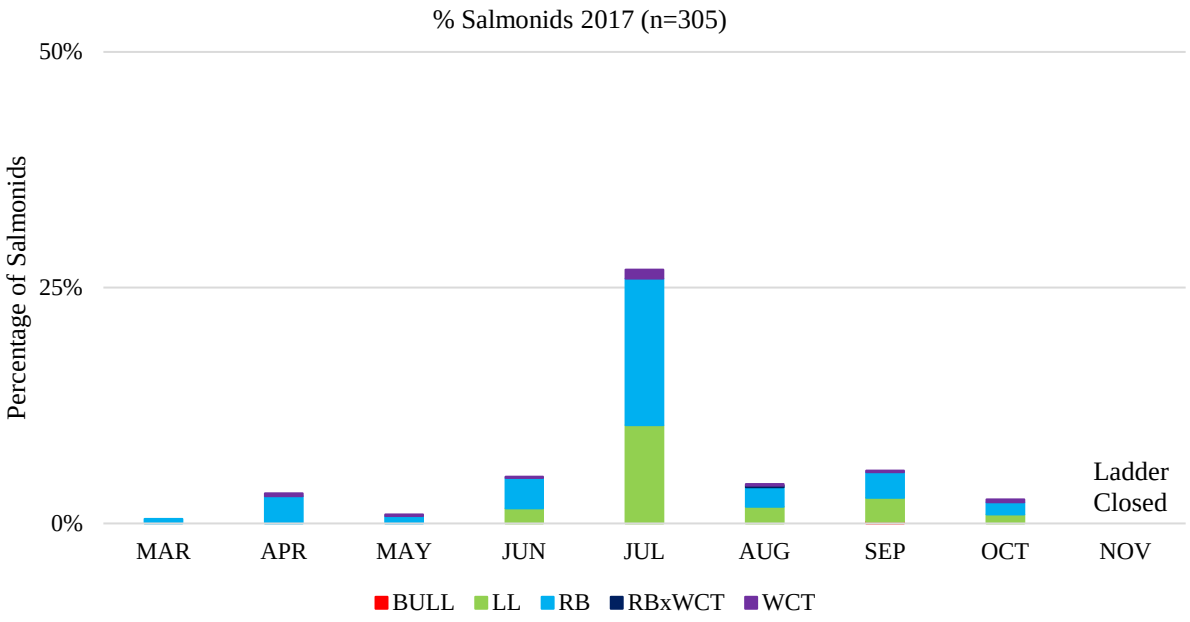


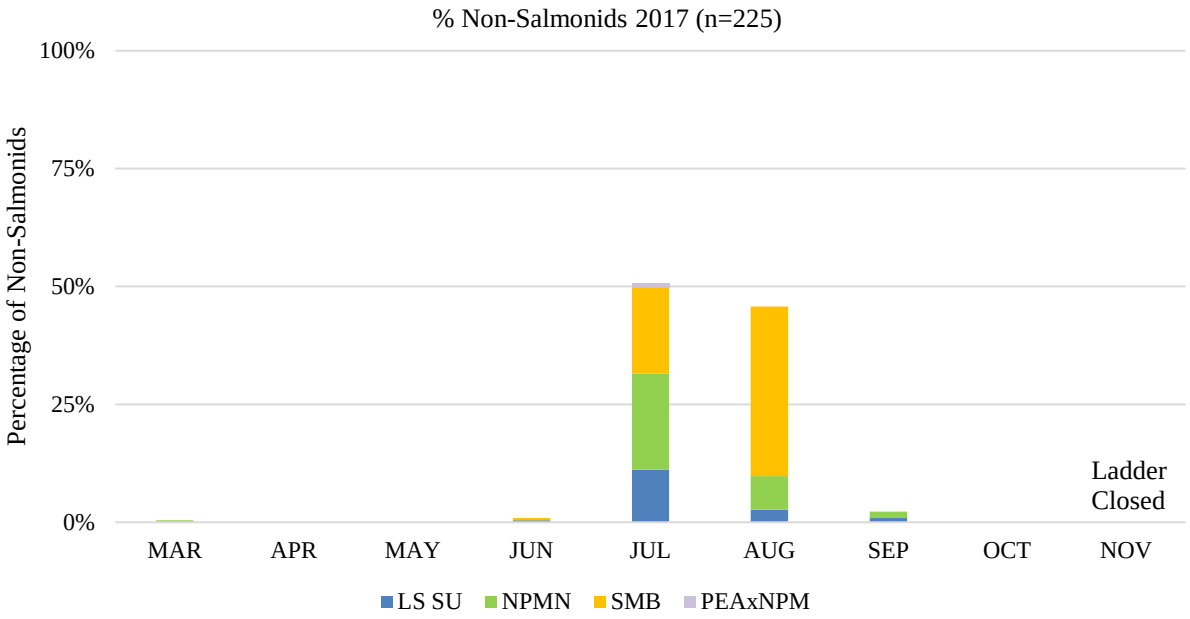
Seasonal Movements at the Ladder – 2016





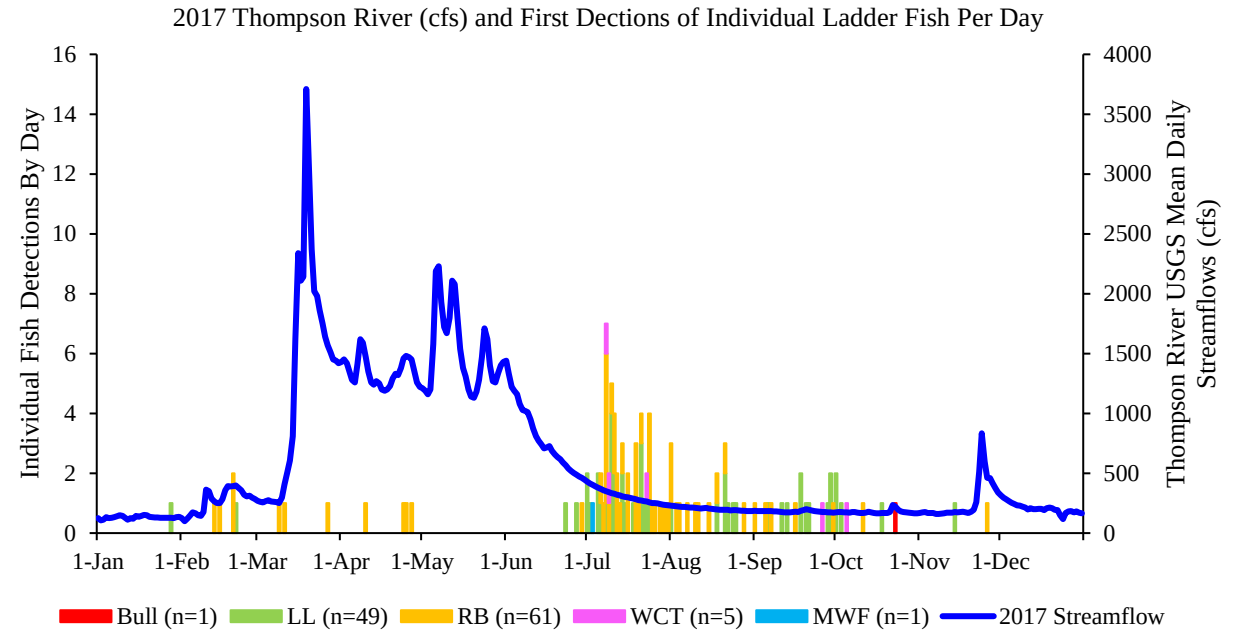
Seasonal Movements at the Ladder – 2017

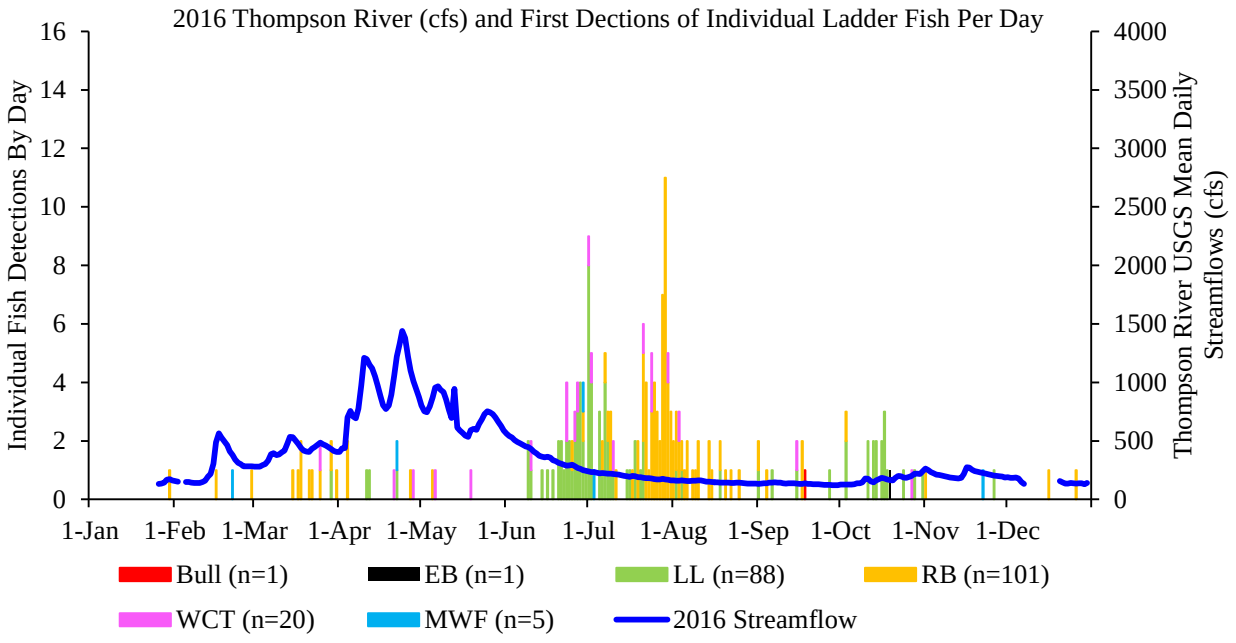


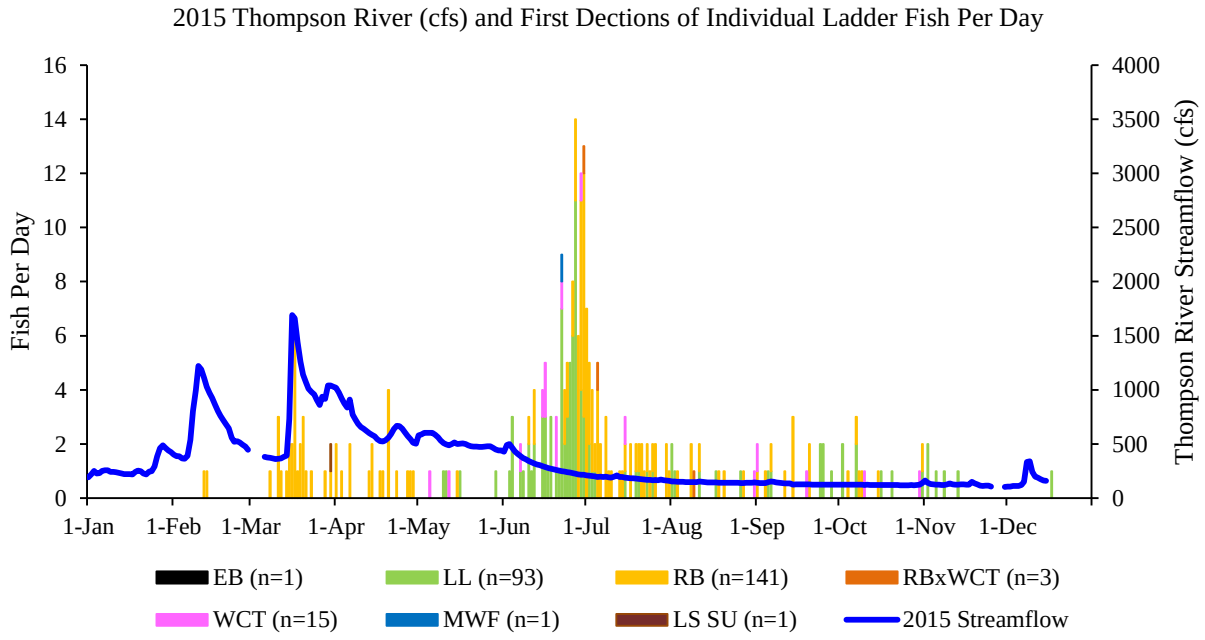


The following figures provide the annual hydrograph in the Thompson River (USGS Gage #12389500) and the first detections of individual fish, by species in 2017, 2016, and 2015. Data from 2014 was not included because the array was not installed or operating for the entire year.

Daily Fish Detections (ladder-fish) in the Thompson River, 2015-2017






2015 Thompson River (cfs) and First Dections of Individual Ladder Fish Per Day
Fish Per Day
Thompson River Streamflow (cfs)
0
2
4
6
8
10
12
14
16
0
500
1000
1500
2000
2500
3000
3500
4000
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
EB (n=1)
LL (n=93)
RB (n=141)
RBxWCT (n=3)
WCT (n=15)
MWF (n=1)
LS SU (n=1)
2015 Streamflow

Appendix B – 2017 Progress Reports

B.1 Thompson River Watershed Coordinator

This report was prepared and submitted by Brita Olson to the Thompson Falls TAC, January 8, 2018.

Project Sponsor: Lower Clark Fork Watershed Group (LCFWG)
PO Box 1329, Trout Creek, MT 59874

Project Contact(s): Brita Olson, LCFWG Coordinator
brita@lowerclarkforkwatershedgroup.org
(208) 304-3852

Ryan Kreiner, FWP Fisheries Biologist
rkreiner@mt.gov
(406) 827-9320

Project Location: Thompson River Drainage

Project Description:

Since May 2016, Northwestern has provided ongoing funding for the Lower Clark Fork Watershed Group (LCFWG), a 501(c)(3) non-profit that works to facilitate collaborative restoration in the tributaries of the lower Clark Fork River for the benefit of water quality, native fish and wildlife. The purpose of these funds is to develop on-the-ground restoration projects in the Thompson River drainage, by supporting a portion of the LCFWG Coordinator's wages. The role of the LCFWG in this process is to coordinate the many elements that must fall into place in order to carry out a quality, impactful project. This involves connecting with and gaining support of key stakeholders, developing landowner support and involvement, ensuring environmental compliance and permitting is in place, piecing together funding, implementing or contracting for the implementation of the project, and providing adequate monitoring and follow-through to ensure the long-term success of a project.

In 2016, the Coordinator's focus in the Thompson River drainage was connecting with stakeholders and developing relationships throughout drainage, laying crucial groundwork for future on-the-ground projects. In 2017, the focus of the LCFWG's efforts in the Thompson River drainage was the development of the Thompson River Watershed Restoration Plan. The LCFWG was able to leverage Northwestern commitment of funding for Thompson River coordination and obtain additional funding, which was used to support a part-time position with LCFWG, filled by Sarah Bowman (a former Big Sky Watershed Corps member who had worked on developing the Flathead-Stillwater Watershed Restoration Plan), to lead the development of the Thompson River Watershed Restoration Plan. Throughout 2017, Sarah worked in close partnership with Brita Olson

(LCFWG Coordinator) to gather input from stakeholders in the Thompson River drainage and develop a plan that both met the needs and priorities of those working in the drainage, and also met the federal requirements for a Watershed Restoration Plan. Having an approved WRP for a watershed is very valuable because it qualifies any tributaries included in it for Clean Water Act, Section 319 funding. Additionally, demonstrating that any project is a priority developed out of a collaborative planning process is attractive to many other funders.

The development of the Thompson River Watershed Restoration Plan was initiated in January 2017, and a kick-off stakeholder's meeting was held in February. At this meeting, key landowners and managers (including representatives from the Lolo National Forest, Montana Department of Natural Resources and Conservation, and Weyerhaeuser) discussed a strategy for developing a meaningful plan throughout the following year. Over the following months, Sarah Bowman and Brita Olson (along with other partners) drafted and edited the majority of the Thompson River Watershed Restoration Plan. In September, stakeholders reconvened to share progress on the plan and project ideas that had been developed. Over the fall, stakeholders continued to meet and contribute input for the plan, which Sarah and Brita worked to incorporate into the draft document. A draft Thompson River Watershed Restoration Plan was completed at the end of November 2017 and was sent out to stakeholders for review. The LCFWG will be taking comments on this document through January 15, 2018 and plan to update the plan with stakeholder comments by the end of January, send to Montana Department of Environmental Quality (DEQ) to review, and finalize a DEQ-approved Thompson River Watershed Restoration Plan by March 2018.

A key outcome of the Watershed Restoration Plan has been that it has provided the impetus for connecting key stakeholders in the drainage (who have collectively contributed roughly $10,000 in-kind towards the completion of the Thompson River Watershed Restoration Plan) and has helped create a context for future collaboration on watershed restoration projects. A few of the projects identified have already been incorporated into stakeholders workplans for the coming years. For example, one of the projects identified is further large woody debris enhancement in Fishtrap Creek. This has already been included in a suite of projects for which the Lolo National Forest is working on NEPA compliance, expected to be completed in 2018. Another task for 2018 will be to convene key landowners and Montana Fish, Wildlife, and Parks to identify specific projects, and begin developing designs. The LCFWG will continue following up on projects identified in the Watershed Restoration Plans, and work with stakeholders to move these projects closer to implementation.

Over the next few years, the LCFWG will take the lead on implementing the Thompson River Watershed Restoration Plan. Continued support from Northwestern will be instrumental in making this possible. The LCFWG will develop project ideas identified in the plan and move on-the-ground projects forward—completing activities such as connecting key stakeholders, identifying opportunities for collaboration, securing funding, obtaining permits, and hiring contractors. The LCFWG's work will also include key maintenance, monitoring, and follow-through post-implementation that is necessary for a project's success into the future. After the finalization of

the Thompson River Watershed Restoration Plan, the LCFWG will focus efforts in 2018 on planning, with the idea of project implementation in 2019 and 2020.

Funds from the LCFWG's Statement of Service #1, executed May 13, 2016, were fully expended. Remaining funds (after the close of 2016) totaling $7,589.76 were expended in 2017 on travel to the Montana Watershed Coordination Council's Annual Meeting ($340.98) and LCFWG staff time working in the Thompson River drainage, primarily developing the Thompson River Watershed Restoration Plan ($7,248.78).

Funds from the LCFWG's Statement of Service #2, executed March 30, 2017, were partially expended. In addition to funding staff time, mileage and equipment funds were spent on travel to stakeholder meetings for the development of the Thompson River Watershed Restoration Plan, and one nonprofit ArcGIS license. The remaining balance (as of December 31, 2017) by item, is as follows:

Expense	Opening balance	Spent to date	Remaining balance
Coordination (staff time)	$ 13,000.00	$ 4,063.80	$ 8,936.20
Mileage, equipment and operation expenses	$ 1,000.00	$ 282.34	$ 717.66
Education and training	$ 1,000.00	$ 0.00	$ 1,000.00
Total	$ 15,000.00	$ 4,346.14	$ 10,653.86

Northwestern funds (between the 2016 and 2017 contracts) expended in 2017 total $11,935.90.

Match funds expended in 2017 included $13,812.70 (from the Department of Natural Resources 223 program, Lolo National Forest, and Soil and Water Conservation Districts of Montana) for LCFWG staff time, $3,247.15 (from the Soil and Water Conservation Districts of Montana) for coordination and training expenses related to the development of the Thompson River Watershed Restoration Plan. Additional in-kind contributions from additional partners involved in the development of the Thompson River Watershed Restoration Plan throughout 2017 total $14,070.63. Cash and in-kind match contributing to LCFWG's work in the Thompson River drainage totals $31,130.48.

B.2 Rattlesnake Creek Fish Screen Project

Project Title: Rattlesnake Creek Fish Screen Project		
Sponsor: Trout Unlimited		
Contact Name: Rob Roberts	**Email:** rroberts@tu.org	
Address: 312 N. Higgins Ave, Suite 200 Missoula, MT 59802	**Phone:** 406-540-2944	**Fax:** 406-543-6080

Executive Summary

Trout Unlimited was awarded $13,125 by Northwestern Energy/TFalls Mitigation Fund in 2016 to complete topographic surveys on four irrigation ditches along Rattlesnake Creek, with the intent of developing design plans for irrigation diversion and fish screen upgrades. TU subsequently received matching funds from the Missoula Conservation District and The Westslope Chapter of Trout Unlimited for the survey and design effort.

After acquiring access from all landowners, TU and specialists from Great West Engineering visited the four irrigation diversion sites in order to take topographic surveys of the diversions, ditches, and associated land features. TU then met with multiple water users on each irrigation ditch to compile information about of water use, perceived maintenance and operation problems and other needs, as well as concerns or insights about improving the irrigation and fish screen structures.

Phase I of the Rattlesnake Creek Fish Screen Project is currently 100% completed. Based upon engineering constraints and landowner and water user feedback, Trout Unlimited completed conceptual designs for the Williams Ditch, Cobban Ditch, Hamilton Day, and Hollenbeck fish screen projects. The Williams Ditch project proceeded into the final design phase in the fall of 2016 and will be constructed in the spring of 2017. The Cobban Ditch project is scheduled to be constructed during the winter/spring of 2017/2018. The Hamilton-Day and Hollenbeck Ditch projects are scheduled to be completed by 2019 and 2020 respectively. The Quast Ditch has a functional fish screen, and the Hughes-Fredline Ditch was screened during a previous TU project.

Background

Rattlesnake Creek is one of the major sources of trout recruitment for the middle Clark Fork River, a 100-mile reach of river located between Missoula and St. Regis. Within the lower five miles of Rattlesnake Creek, there are six irrigation ditches that divert water and could potentially entrain migratory and/ or juvenile trout. Surveys and annual electrofishing (2000-2005) indicated that fish entrainment losses (including bull trout) were high in several of these diversions.

Four of the lower Rattlesnake Creek ditches were screened in the early 2000s by Montana FWP, the Lolo National Forest and partners. The Quast Ditch screen, a flat plate/paddle wheel design, has since been updated by the USFS and functions properly. In addition, a new diversion structure

and Coanda fish screen were installed by Trout Unlimited on the Hughes-Fredline Ditch in 2015. The three remaining screened diversions (Williams, Hamilton Day, and Cobban) still have original 'Brencail', manually cleaned, trough screens that were originally installed. These screens have reached the end of their intended 10-year functional life and no longer adequately prevent fish entrainment due to plugging and corrosion. The Hollenbeck Ditch has never been screened.

TU was partially funded by Northwestern Energy to complete topographic surveys on these remaining four irrigation ditches and develop conceptual designs for irrigation diversion and fish screen upgrades. Fish screen fabrication and project implementation was planned as a future phase of this effort.

Goals

The Rattlesnake Creek Fish Screen project was developed to protect native fish by ensuring safe upstream and downstream passage through the lower five miles of Rattlesnake Creek. Therefore, goals for the project include:

- Improve fish passage for all life stages
- Prevent entrainment of salmonids at irrigation diversion sites
- Allow for better control and lawful use of diverted water

Activities

The following activities and tasks have been completed since the inception of this project:

Task 1: Contact land owners and water users for permission to access the diversion sites

Task 1 Description: TU contacted individual land owners for each of the four Rattlesnake Creek diversions to acquire permitted access. In addition, TU met with the multiple water users for each irrigation diversion to collect information about the history of timing and quantity of water use, perceived maintenance and operation problems and other needs, concerns or insights about improving the irrigation and fish screen structures. Fish biologists from Montana Fish, Wildlife and Parks and the Lolo National Forest were also consulted during the development of these projects.

Task 2: Complete topographic survey of diversion sites

Task 2 Description: Trout Unlimited and engineers from Great West visited the four irrigation diversion sites in order to take topographic surveys of the diversions, ditches and associated land features. The topographic survey was translated into a site map for each location. By completing topographic surveys site, we are better able to asses our limiting factors for screen design and engineering.

Task 3: Produce conceptual designs for diversion structure and fish screen that delivers legally allocated water right and provides for instream fish passage at all flow levels

Task 3 Description: Trout Unlimited worked with Great West Engineering to produce conceptual designs for the Williams Ditch, Cobban Ditch, Hamilton-Day and Hollenbeck fish screen projects.

Task 4: Incorporate feedback from water users into final design

Task 4 Description: Trout Unlimited met multiple times with water users on the Williams Ditch project on-site to present conceptual design options and gather feedback from stakeholders. Information about water usage, annual maintenance needs, and future planned use is critical to designing irrigation infrastructure that will meet water users' needs and function in the long term to protect upstream and downstream fish passage. TU has been meeting with the lead water user and ditch operator on the Cobban Ditch for the past year and will be modifying the conceptual design for that project based upon their continual feedback during the spring of 2017. TU continues to work with water users on the Hamilton-Day ditch and Hollenbeck ditch during project development.

Task 5: Produce final designs and engineer's cost estimate

Task 5 Description: Trout Unlimited completed the final design for the Williams Ditch project in the fall of 2016. That project was constructed in the spring of 2017. The Cobban Ditch project is scheduled to be completed during the fall of 2017. The Hamilton-Day and Hollenbeck Ditch projects are scheduled to be completed in 2019 and 2020 respectively.

Task 6: Fundraising and permitting for project implementation

Task 6 Description: Trout Unlimited has completed installation for the Williams Ditch fish screen project and completed permitting and fundraising for the Cobban Ditch fish screen project. Permits were acquired from the Missoula Conservation District, Missoula County Floodplain Office, and Lolo National Forest. The Army Corps of Engineers submitted a letter of exemption from section 404 of the Clean Water Act. Funds for implementation were acquired from Montana Fish, Wildlife and Parks, The Trout and Salmon Foundation, Montana Trout Unlimited and The Westslope Chapter of Trout Unlimited.

Finances

The following budget represents the expenses for the project to date.

Item	NEW/TFalls Cost	Match	Other	Total
Direct Labor Topographic Survey Crew (4 sites X $2,000 per) Design Engineer (2 sites X $4,500 per)	$13,125	$13,500		$26,625
Travel and Living	-	-		
Material and Equipment	-	-		
Totals	$13,125	$13,500		$26,625

TU has expended the entirety of the $26,625 in the original budget. Matching funds for the topographic survey and project design effort were acquired from the Missoula Conservation District and from the Westslope Chapter of Trout Unlimited.

B.3 Cedar Creek Restoration

Cedar Creek Phase 2 Road Realignment and LWD Accomplishments 2017

The Cedar Creek road realignment and Large woody debris habitat improvement project was completed in November of 2017. Trout Unlimited worked with the Lolo National Forest to design, permit and implement the project. The project was completed on time and on budget by Haskins Excavating. Below are the project accomplishments:

Lineal feet of floodplain	600
Lineal feet of terrace	546
Square feet of floodplain	22,520
Square feet of terrace	5,600

7,250 cy of material removed off floodplain and terraces
725 10cy dump truck loads
55 whole trees used to construct instream habitat
4 wood structures within a 0.25-mile stream reach

Photograph 1: Aerial View of road before reclamation

Photograph 2: Before and after removal of historic waste rock used for road construction and mining.

Photograph 3: During construction.

Photograph 4: Post construction. Picture taken from behind vehicle in top photograph.

Photograph 5: Before and after road relocation. Note floodplain creation for high flows, canopy cover development and sediment filtering.

Photograph 6: Before and after road relocation section. Terrace creation for canopy cover and sediment filtering.

Appendix C – 2018 Proposals Approved by TAC

C.1 Fish Creek Land Acquisition

Proposal presented to the TAC during the 2016 Annual Meeting. Funds were approved by TAC via email in August 2017. Land p and spent in December 2017.

Project Title: Rattlesnake Creek Fish Screen Project, Phase I

Proposal Submitted by: Rob Roberts, Trout Unlimited
Ladd Knotek, Montana FWP

Location of Proposed Project: Rattlesnake Creek, Missoula County, Montana
Total Project Cost: $26,625

TAC Funds (Cost-Share) Requested: $13,125

I. Introduction

Rattlesnake Creek flows for 26 miles, beginning in the Rattlesnake Wilderness north of Missoula, Montana and ending at its confluence with the Clark Fork River. Rattlesnake Creek is one of the major sources of trout recruitment for the middle Clark Fork River, a 100-mile reach of river located between Missoula and the Flathead River confluence. It supports a significant population of migratory bull trout and is one of only six major tributaries in the area known to support fluvial spawning. The creek also supports populations of native westslope cutthroat trout, mountain whitefish and sculpin, as well as wild rainbow trout, brown trout, and brook trout.

Within the lower five miles of Rattlesnake Creek, there are six irrigation ditches that divert water and could potentially entrain migratory and/or juvenile trout (*see* attached map and photos). Initial surveys and annual electrofishing (2000-2005) indicated that fish entrainment losses (including bull trout) were high in several of these diversions.

Four of the lower Rattlesnake Creek ditches were screened in the early 2000s by Montana FWP, the Lolo National Forest and partners. The Quast Ditch screen, a flat plate/paddle wheel design, has since been updated by the USFS and functions properly. In addition, a new diversion structure and Coanda fish screen were installed by Trout Unlimited on the Fredline Ditch in 2015. The three remaining screened diversions (Williams, Hamilton Day and Cobban) still have the original 'Brencail', manually cleaned, trough screens that were originally installed. These screens have reached end of their intended 10-year functional life and no longer adequately prevent fish entrainment. The Hollenbeck Ditch has never been screened.

Recently, stakeholders in the Rattlesnake Creek watershed (Trout Unlimited, Montana FWP, Lolo National Forest, etc.) met to discuss future activities and priorities for fisheries and riparian restoration. Fish screen and fish passage enhancements were identified as priorities. Therefore, Trout Unlimited plans to work with water users on the Williams, Hamilton Day and Cobban

ditches to replace the outdated Brencail screens and possibly install a new fish screen on the Hollenbeck ditch. Phase I of this project will include a topographic survey of the four ditches and diversion structures, engineered screen designs and stakeholder negotiations.

This proposal requests partial 'seed' funds for survey and design on the four irrigation diversions that do not currently have functional fish screens. We anticipate installing flat plate, Coanda or other contemporary designs once the projects are fully developed. *These funds are critical as support for survey and design is a common bottleneck in implementing fisheries enhancement projects–most funding sources will only fund project implementation and many irrigators will not agree to projects unless they know what design would be installed.* Once project designs and irrigator consent are obtained, we will secure implementation funds from the numerous available funding sources.

II. Objectives

The Rattlesnake Creek Fish Screen project was developed to protect native fish by ensuring safe upstream and downstream passage through the lower five miles of Rattlesnake Creek. Therefore, objectives for the project include:

- Improve fish passage for all life stages
- Prevent entrainment of salmonids at irrigation diversion sites
- Allow better control and lawful use of diverted water

III. Methods

The Williams, Hamilton Day, Cobban and Hollenbeck ditches are small diversions that each deliver approximately 2 cfs (or less) and are generally managed by individual or small groups of water users that hold legal water rights. The following table details the water right for each diversion and observed flows during the irrigation diversion survey:

Ditch	Water Right (cfs)	Average Flow (cfs)	Max Flow (cfs)	Minimum Flow (cfs)
Williams Ditch	0.70	1.36	3.18	0.53
Hamilton-Day Ditch	1.00	1.51	1.75	1.28
Cobban Ditch	1.57	1.53	1.84	1.11
Hollenbeck Ditch	1.12	0.70	0.91	0.53

TU has already identified the water users with valid water rights for the four irrigation ditches. That table is attached as an appendix to this document. The land ownership for the four points of diversion are as follows:

- Williams Ditch – Lolo National Forest
- Hamilton Ditch – City of Missoula
- Cobban Ditch – City of Missoula

- Hollenbeck Ditch – Todd and Sabrina Donahue

Trout Unlimited anticipates the following steps in the planning and design of the diversion improvement and screen installation process:

- Contact land owners for permission to access the diversion sites
- Completed topographic survey of diversion sites
- Work with the qualified engineering firm to produce conceptual design for diversion structure and fish screen that delivers legally allocated water right and provides for instream fish passage at all flow levels
- Incorporate feedback from water users into final design
- Produce final design drawings and engineer's cost estimate
- Fundraising and permitting for project implementation

IV. Anticipated Schedule

The following is a timeline for activities for Rattlesnake Creek Fish Screen Project in the 2016 season:

Feb – March 2016: Landowner/water user coordination
April – May 2016: Topographic surveys
May – June 2016: Conceptual designs
May – June 2016: Final designs
June – August 2016: Fundraising for project implementation
Fall 2016- 2017 Project implementation

V. Personnel

Trout Unlimited will primarily be responsible for project development, contracting, grant reporting and project implementation. Montana FWP is involved in all aspects of planning as well as technical oversight. The following are the project staff for each organization that will be involved in the project:

Rob Roberts, Trout Unlimited – Rob is the project leader and primarily responsible for project planning and coordination with project partners. Rob is a full-time staff person for TU and has 15 years' experience working on mine reclamation and native fish habitat restoration in the Clark Fork River basin.

Casey Hackathorn, Trout Unlimited – Casey is the Upper Clark Fork coordinator for TU and has experience working on fish passage and fish screens on Harvey Creek, Silver Bow Creek, Browns Gulch, Cottonwood Creek and Rattlesnake Creek. Casey will also work on project planning and coordination for TU.

Ladd Knotek, Montana Fish, Wildlife and Parks – Ladd is the Montana FWP Region 2 Fisheries Biologist. Ladd is responsible for various aspects of fisheries and aquatic management

on Rattlesnake Creek, including long term monitoring, fishing regulations, and stream permitting.

Shane Hendrickson, Lolo NF – Shane is the Fish Biologist for the Lolo National Forest covering Ninemile, Missoula and Seeley Lake Ranger Districts. Shane will serve as the project contact for the Lolo National Forest and advise on technical issues.

VI. Budget for Phase I – Survey and Design

Item	PPL Cost	Match Cost	Total Cost
Direct Labor- Topographic Survey Crew (4 sites x $2,000 per) Design Engineer (4 sites x $4,500 per)	$12,500	$13,500 (Trout Unlimited)	$26,000
Direct Overhead-5%	$625	$ -	$625
Travel and Living	$ -	$ -	$ -
Material and Equipment	$ -	$ -	$ -
Totals	**$13,125**	**$13,500**	**$26,625**

Phase II will primarily involve installation of new screens and implementation of maintenance agreements with water users. Cost of Phase II is expected to be ~ $100,000, which will be requested from Future Fisheries Improvement Program and other funding sources.

VII. Deliverables

Deliverables resulting from this project will include the completion of final engineering drawings and cost estimates for the fabrication and installation of four fish screens and associated diversions on the Williams, Hamilton Day, Cobban and Hollenbeck ditches on lower Rattlesnake Creek. The success of the project will be monitored through long-term tracking of fish entrainment in the ditches as compared to historical FWP data.

VIII. Cultural Resources

This phase of the project does not involve any land-disturbing activity or the modification, renovation or removal of any building or structures. Cultural, permitting and other considerations will be incorporated into each project at the implementation phase.

C.2 Rattlesnake Dam Removal Project, Phase I

Project Title: Rattlesnake Dam Removal Project, Phase I

Proposal Submitted by: Rob Roberts, Trout Unlimited and Ladd Knotek, Montana FWP

Location of Proposed Project: Rattlesnake Creek, Missoula County, Montana

Total Project Cost: $100,000

TAC Funds (Cost-Share) Requested: $20,000

Introduction

Rattlesnake Creek is an 82 square-mile drainage that originates in the Rattlesnake Wilderness and joins the Clark Fork River in downtown Missoula, Montana. The watershed is designated as Bull Trout Critical Habitat and is considered a Tier II priority with respect to Thompson Falls Dam bull trout mitigation funds. This stream supports a robust trout community consisting of both native and wild trout populations. The Rattlesnake Creek corridor is a recreation hub for Missoulians and visitors, with a large network of mountain bike and hiking trails. Further, the confluence of Rattlesnake Creek and the Clark Fork was historically one of the largest and most important fish camps for the native Salish people.

Rattlesnake Creek Dam was constructed in 1901 to be the primary water source for Missoula by impounding more than 3 million gallons of water in an adjacent constructed reservoir. In the early 1980s, Rattlesnake Creek water became contaminated with giardia because of beaver populations in the middle reaches, which led to giardia outbreaks in the city's water system. As a result, in 1983 the Mountain Water Company stopped using the Rattlesnake Watershed system as the primary water supply and began maintaining it as the city's backup supply.

Since that time the Dam has served no water storage or delivery purpose (and is no longer even viable as a back-up municipal system) but has continued to impact fish migrations and river processes (e.g. floodplain connections, sediment transport). Although construction of a fish ladder at the site in 2003 helped to mitigate fish passage impacts, recent structural modifications at the dam have compromised benefits to some species (including bull trout). With the recent acquisition of the Dam and associated infrastructure by the City of Missoula (in June 2017), we now have a unique – and immediate – opportunity to decommission the obsolete municipal water system and remove the dam.

The City of Missoula, Trout Unlimited and Montana Fish, Wildlife and Parks are invested in restoring habitat for native fish and terrestrial wildlife, improving water quality in Rattlesnake Creek, reducing maintenance costs and providing additional scenic open space and recreational opportunities for the Missoula community. Therefore, the City, FWP and TU are working collaboratively to plan and implement a restoration project at the dam that will remove existing man-made infrastructure and fully re-naturalize the site. Following restoration of the site the land

will be managed as City Open Space in conjunction with the greater Rattlesnake Greenbelt system of Conservation Lands.

This proposal requests partial funding of Phase I of this project for survey and design activities. TU has secured $80,000 in matching funds for Phase I project costs. This data collection and preliminary design stage will take place through the spring of 2018. The final design phase will occur through the winter of 2018, and construction activities will begin in the summer of 2019. Thompson Falls Bull Trout Mitigation funds are critical in this phase of the project as they will both leverage extensive matching support and help to pay for the design phase (most funding sources will not fund survey and design aspects of a project, only implementation).

Objectives

The project will include the following elements and associated outcomes:

- **Objective 1:** Provide unobstructed upstream fish passage for native trout populations, including fluvial bull trout. Rattlesnake Creek is considered a Tier II priority for investment of Thompson Falls Dam Bull Trout Mitigation funds.
- **Objective 2:** Promote passage and habitat conditions that support all life stages of native fish and aquatic organisms. Incorporate habitat heterogeneity and connectivity for terrestrial wildlife on the site.
- **Objective 3:** Rehabilitate stream, floodplain and hillslope processes to approximate reference conditions
- **Objective 4:** Include future use of the site for public recreation into the dam removal design and construction process
- **Objective 5:** Reduce public safety hazards and/or eliminate potential liability hazards

Methods

Field data collection will be undertaken to support the conceptual design. This task includes LiDAR imagery, LiDAR control support, hydrologic analysis, infrastructure mapping and a reconnaissance-level geomorphic assessment.

As part of the alternatives analysis, a cost-benefit analysis will be performed with input from stakeholders to facilitate prioritization of alternatives. Evaluation criteria to be considered include ecological benefits, constraints, feasibility, risk management, social considerations, relative cost and overall ability to satisfy project goals. The conceptual restoration plan will describe design considerations including engineering and permitting needs to support final design. In addition, the plan will describe implementation considerations including phasing options, construction sequencing, construction methods, dewatering concepts, resource protection measures and contracting.

With input and assistance from TU, FWP and the City of Missoula, River Design Group and Morrison-Maierle, Inc will develop a conceptual plan for restoration of the site. The conceptual plan will include drawings, cost estimates and a design report. Drawings will include plan views, cross sections and three-dimensional renderings illustrating dam removal and site restoratio n

concepts. The conceptual design report will include the following information: Project background and objectives; Existing conditions and site assessment; Dam mitigation alternatives; Restoration alternatives; Analysis of alternatives; Design considerations; Implementation considerations; Construction cost estimates; and Data summary appendices

The conceptual design process will be used for public scoping efforts, which will be led by the City of Missoula Parks and Recreation Department. Pursuant to data collection and Phase I design efforts, addition data collection and design activities will be undertaken in 2018 for project permitting, final design and bid package development.

Anticipated Schedule

The following is a timeline for activities for the Rattlesnake Dam Removal Project:

- Site Infrastructure Data Collection – November/December 2017
- Data Processing and Analysis – December/January 2017
- Conceptual Plan Development – January/February 2018
- Conceptual Design Review Meeting – February 2018
- City/Public Scoping – February 2018
- Final Conceptual Design Plan – March 2018
- Final Public Scoping – April/May 2018
- Phase II Scope of Work Development – May/June 2018

Personnel

Trout Unlimited will primarily be responsible for project development, contracting, grant reporting and project implementation. Montana FWP is involved in all aspects of planning as well as technical oversight. The following are the project staff for each organization that will be involved in the project:

Rob Roberts, Trout Unlimited – Rob is the project leader and primarily responsible for project planning and coordination with project partners. Rob is a full-time staff person for TU and has 15 years' experience working on mine reclamation and native fish habitat restoration in the Clark Fork River basin.

Paul Parson, Trout Unlimited – Paul is a Civil Engineer with over 13 years of experience in water resources related projects, surveying and construction oversight. Paul specializes in floodplain analysis and modeling, erosion control, hydraulic and hydrologic models, stream simulation and stabilization.

Ladd Knotek, Montana Fish, Wildlife and Parks – Ladd is the Montana FWP Region 2 Fisheries Biologist. Ladd is responsible for various aspects of fisheries and aquatic management on Rattlesnake Creek, including long term monitoring, fishing regulations, and stream permitting.

Matt Daniels and John Muhlfeld, River Design Group – River Design Group, along with Morrison-Maierle, Inc were hired to provide data collection and technical support for project design.

Budget for Phase I –

Item	NorthWestern Energy Cost	Match Cost	Total Cost
Direct Labor-			
LiDAR Imagery	$ 0	$ 12,500	$ 12,500
Data Collection and Analysis	$ 5,000	$ 35,000	$ 40,000
Conceptual Design and Report	$ 14,000	$ 27,500	$ 41,500
Direct Overhead-5%	$ 1,000	$ 5,000	$ 6,000
Travel and Living	$ -	$ -	$ -
Material and Equipment	$ -	$ -	$ -
Totals	**$ 20,000**	**$ 80,000**	**$ 100,000**

Deliverables

Deliverables resulting from this Phase I of the Rattlesnake Dam Removal Project will include the following:

Data Collection and Analysis

- LiDAR coordination and analysis;
- Infrastructure and utility surveys and dam inspections to comply with Montana Dam Safety Act;
- Geomorphic investigations including channel morphology, substrate and site hydrology;
- Hydrologic analysis with particular attention to baseflow, fish passage flows and bankfull for
- channel forming flow determination;
- Historical aerial photograph analysis; and
- Identification of site constraints and limitations.

Conceptual Design

- Project background and objectives;
- Existing conditions and site assessment;
- Dam mitigation alternatives;
- Restoration alternatives;

- Analysis of alternatives;
- Design considerations;
- Implementation considerations;
- Construction cost estimates; and
- Data summary appendices.

Cultural Resources

This phase of the project does not involve any land-disturbing activity or the modification, renovation or removal of any building or structures. Cultural, permitting and other considerations will be incorporated into each project at the implementation phase, but we do not anticipate major cultural resource issues or impacts associated with this project.

C.3 Thompson River Watershed Coordinator

Project Title: Coordination in the Thompson River Drainage
Proposal Submitted by: Lower Clark Fork Watershed Group (LCFWG)
PO Box 1329, Trout Creek, MT 59874

Project Contact(s): Brita Olson, LCFWG Coordinator
brita@lowerclarkforkwatershedgroup.org
(208) 304-3852

Ryan Kreiner, FWP Fisheries Biologist
rkreiner@mt.gov
(406) 827-9320

Location of Proposed Project: Thompson River Drainage
Total Project Cost: $49,500, though additional match is expected
TAC Funds Requested: $49,500

I. Introduction.

The Lower Clark Fork Watershed Group (LCFWG) is a 501(c)(3) non-profit that works to facilitate collaborative restoration in the tributaries of the lower Clark Fork River for the benefit of water quality, native fish and wildlife. Since its formation in 2004, the LCFWG has been an active player in habitat restoration projects throughout the lower Clark Fork River area working with partners involved in local watershed conservation: local watershed councils, Green Mountain Conservation District, Montana Fish, Wildlife and Parks, Forest Service, Natural Resource Conservation Service, and Avista Corporation. In 2016, the LCFWG began working with NorthWestern Energy to identify stream restoration and enhancement opportunities in the Thompson River.

One aspect of the LCFWG's work is the production of planning documents. Over the course of 2016 and 2017, the LCFWG has been drafting the Thompson River Watershed Restoration Plan, compiling research from previous reports and collecting input from key collaborators and stakeholders within the Thompson River drainage. This plan will provide the groundwork for future projects throughout the drainage and has helped the LCFWG establish working relationships with key landowners and managers which will be crucial for successful project implementation. Additionally, an approved Watershed Restoration Plan will make streams in the drainage eligible for federal Nonpoint Source 319 grant funding, and also increase the competitiveness of Thompson River projects for other grant funds. A completed draft of the Thompson River Watershed Restoration Plan is expected in January 2017, with final approval of the document expected in March 2017.

This proposal requests continued support (over a three-year period 2018-2020) from the Thompson Falls TAC for coordination in the Thompson River drainage. If approved, this will assist LCFWG with operational costs associated with project planning, coordination, and other annual expenses related to habitat restoration projects in line with NorthWestern Energy's efforts to recover Bull Trout in the Thompson River.

II. Objectives.

a. Finalize Thompson River Watershed Restoration Plan.
b. Compile annual update and provide progress report on Watershed Restoration Plan implementation to Thompson River Watershed stakeholders.
c. Identify priority projects in Watershed Restoration Plan in line with Northwestern Energy's efforts to recover Bull Trout in the Thompson River to implement in 2019 and 2020.
d. In 2018, coordinate with key landowners and stakeholders to plan strategy for funding and implementation of projects in 2019 and 2020.
e. In 2019 and 2020, initiate on-the-ground project implementation.
f. In 2020, begin planning ahead for next steps and further project implementation.

III. Methods. Description of how the objectives will be accomplished.

Over the next 3 years, the LCFWG will take the lead on implementing the Thompson River Watershed Restoration Plan. Continued support from NorthWestern will be instrumental in making this possible. The LCFWG will develop project ideas identified in the plan and move on-the-ground projects forward—completing activities such as connecting key stakeholders, identifying opportunities for collaboration, securing funding, obtaining permits, and hiring contractors. The LCFWG's work will also include key maintenance, monitoring, and follow-through post-implementation that is necessary for a project's success into the future. After the finalization of the Thompson River Watershed Restoration Plan, the LCFWG will focus efforts in 2018 on planning, with the idea of project implementation in 2019 and 2020.

If approved, LCFWG staff would continue to dedicate an average of 40 hours/month to drainages within the Thompson Falls project area. This request would also fund mileage, equipment and operational expenses associated with this work in the Thompson River drainage (allowing the LCFWG to have an on-the-ground presence) and provide a small stipend for continuing education and pertinent training which will help increase the efficacy and impact of the LCFWG's work.

IV. Schedule.

January 2018 thru December 2020

V. Personnel.

The project leader will be the LCFWG Watershed Coordinator, Brita Olson. The Coordinator's hourly work on Thompson River projects in support of this proposal (on average 40 hours/month) will be funded through this proposal.

VI. Budget

LCFWG coordination in the Thompson River (3 years)	$39,000
LCFWG mileage, equipment and operational expenses (3 years)	$3,000
LCFWG education and training (3 years)	$3,000
LCFWG Administration (3 years)	$4,500
Total project cost	$49,500

Other funding (cost-share and partners):
Other funding in support of Thompson River projects is expected. This proposal is meant to be provide the "seed" money and additional impetus for obtaining additional funds, either for additional LCFWG staff time (if needed) or for project implementation funds. For example, over 2016 and 2017, the LCFWG was able to obtain additional cash support for the development of the Thompson River Watershed Restoration Plan totaling $17,300 (from the Soil and Water Conservation Districts of Montana, Department of Natural Resources and Conservation, and the Lolo National Forest), not including in-kind time ($9,164) provided by stakeholders to-date who have participated in the watershed planning process.

VI. Deliverables.

a. FINAL Thompson River Watershed Restoration Plan (March 2018)
b. Annual report (January 15, 2019)
c. Annual report (January 15, 2020)
d. Annual report (January 15, 2021)
e. Habitat restoration project implementation (2019 and 2020)

VII. Cultural Resources.

The activities to be funded by this proposal do not involve any land disturbing activity. A plan for meeting Cultural Resource Management requirements will be included in habitat restoration project-specific proposals.

C.4 Bull Trout Genetics

Project Title: Bull Trout Genetics
Date: November 2017
Project Sponsor (submitted by): NorthWestern Energy Brent Mabbott
Location of Proposed Project: Genetics of Bull Trout at Thompson Falls Dam and upstream
Total Project Cost: $10,000
TAC Funds (Cost-Share) Requested for Project: $10,000

I. Introduction; brief statement of project to be completed with pertinent background information. Genetic testing of Bull Trout is needed to determine the origin of specific Bull Trout and to also continue and update genetic testing of Bull trout populations in tributaries of the Clark Fork River above Thompson Falls Dam

II. Objectives; explicit statement(s) of what is intended to be accomplished. Use funding to test DNA of Bull Trout at Thompson Falls dam and upstream of the Dam.

III. Methods; description of how Project objectives will be accomplished. Testing using established contractor

IV. Schedule; when the Project work will begin and end. 2018

V. Personnel; who will do the work? Identify Project leader or principal investigator. Samples will be collected and submitted for testing by field personnel using established collection methods.

VI. Project budget must include amounts for the following: Direct Labor $10,000

VII. Deliverables; describe work product (reports, habitat restoration, etc.) which will result from this Project. How will "success" for this project be monitored or demonstrated? Sampling results will be reports in the annual report for Thompson Falls Dam fish work.

VIII. Cultural Resources. Cultural Resource Management (CRM) requirements for any activity related to this Project must be completed and documented to NorthWestern Energy as a condition of any TAC grant. TAC funds may not be used for any land-disturbing activity, or the modification, renovation, or removal of any buildings or structures until the CRM consultation process has been completed. Agency applicants must submit a copy of the proposed project to a designated Cultural Resource Specialist for their agency. Private parties or non-governmental organizations are encouraged to submit a copy of their proposed project to a CRM consultant they may have employed. Private parties and non-governmental organizations may also contact the NorthWestern Energy representative for further information or assistance. Applications submitted without this section completed, will be held by the TAC, without any action, until the information has been submitted. NA

Summarize here how you will complete requirements for Cultural Resource Management: NA

IX. Water Rights. For projects that involve development, restoration or enhancement of wetlands, please describe how the project will comply with the Montana DNRC's "Guidance for Landowners and Practitioners Engaged in Stream and Wetland Restoration Activities", issued by the Water Resources Division on 9March2016. NAS

Summarize here how you will comply with Montana water rights laws, policies and guidelines: NA

C.5 Emergency – Contingency Fund

Project Title: Emergency/contingency fund
Date: 12/1/2017
This fund will be used for, but not be limited to, emergency purchasing of equipment, scoping potential stream rehab proposals, and support of 2018 approved proposals.

During ongoing operations and proposal work there are times when this approved proposal would allow for immediate funding of equipment, stream restoration assessments or other conditions that may require immediate attention. This proposal will eliminate (within the $10,000 limit) the need for TAC approval of a new proposal for spending of TAC funds.

Project Sponsor (submitted by): Brent Mabbott
Location of Proposed Project: Within TAC approved proposal boundaries.
Total Project Cost: $10,000
TAC Funds (Cost-Share) Requested for Project: $10,000

I. Introduction; Contingency funding to be used in emergency situations
II. Objectives: To have TAC approved funding for emergency situations as noted above.
III. Methods: Funding will used for situations as noted above.
IV. Schedule; Used when needed during 2018
V. Personnel; Brent Mabbott will determine and report usage of funding.
VI. Project budget must include amounts for the following:
Materials…yes
Other Direct Expenses…yes
VII. Deliverables; describe work product (reports, habitat restoration, etc.) which will result from this Project. Spending will be reported at annual meeting.
VIII. Cultural Resources. Cultural Resource Management (CRM) requirements for any activity related to this Project must be completed and documented to NorthWestern Energy as a condition of any TAC grant. TAC funds may not be used for any land-disturbing activity, or the modification, renovation, or removal of any buildings or structures until the CRM consultation process has been completed. Agency applicants must submit a copy of the proposed project to a designated Cultural Resource Specialist for their agency. Private parties or non-governmental organizations are encouraged to submit a copy of their proposed project to a CRM consultant they may have employed. Private parties and non-governmental organizations may also contact the NorthWestern Energy representative for further information or assistance. Applications submitted without this section completed, will be held by the TAC, without any action, until the information has been submitted.
Generally NA but maybe used for this if needed.
Summarize here how you will complete requirements for Cultural Resource Management: NA
IX. Water Rights. For projects that involve development, restoration or enhancement of wetlands, please describe how the project will comply with the Montana DNRC's "Guidance for Landowners and Practitioners Engaged in Stream and Wetland Restoration Activities", issued by the Water Resources Division on 9March2016. NA
Summarize here how you will comply with Montana water rights laws, policies and guidelines: NA