



Keeyask Generation Project Aquatic Effects Monitoring Plan

Lake Whitefish Movement Monitoring Report

AEMP-2023-03



KEYYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2023-03

LAKE WHITEFISH ACOUSTIC TRACKING IN THE NELSON RIVER BETWEEN CLARK LAKE AND THE LIMESTONE GENERATING STATION, OCTOBER 2021 TO JULY 2022: YEAR 1 OPERATION

Prepared for

Manitoba Hydro

By

K.D. Small and C.L. Hrenchuk

June 2023



North/South Consultants Inc.
Aquatic Environment Specialists

83 Scurfield Blvd.
Winnipeg, Manitoba, R3Y 1G4
Website: www.nscons.ca

Tel.: (204) 284-3366
Fax: (204) 477-4173
E-mail: nscons@nscons.ca

This report should be cited as follows:

Small, K.D. and C.L. Hrenchuk. 2023. Lake Whitefish acoustic tracking in the Nelson River between Clark Lake and the Limestone Generating Station, October 2021 to July 2022: Year 1 Operation. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2023-03. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2023. xvi + 121 pp.

SUMMARY

Background

The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the Keeyask Generating Station (GS) on the environment. Besides measuring the accuracy of the predictions made and actual effects of the GS on the environment, monitoring results will provide information on how construction and operation of the GS will affect the environment and if more needs to be done to reduce harmful effects.

Construction of the Keeyask GS began in mid-July 2014 and instream work was completed in 2020. The reservoir was impounded with water levels being raised to full supply level between August 31 and September 5, 2020. Commissioning of the powerhouse turbines was initiated after impoundment. They were brought into service one at a time with the final of seven turbines completed on March 9, 2022.

The movements of Lake Whitefish over Birthday Rapids and Gull Rapids (now the site of the Keeyask GS) were monitored before the start of construction, but because different methods are being used to collect data under the Aquatic Effects Monitoring Plan (AEMP), the results of the two programs can't be compared. Pre-construction movement studies showed that Lake Whitefish were able to move upstream and downstream over both Gull Rapids and Birthday Rapids. Lake Whitefish also congregated in the area below Gull Rapids during the fall spawning season.

This report presents results of Lake Whitefish movement monitoring from October 2021 to July 2022 and provides a summary of data collected since the monitoring program was started in the fall of 2014. Monitoring fish movements is an important part of the overall plan to monitor the impacts of construction and operation of the Keeyask GS on fish. Lake Whitefish were identified as one of the key species to monitor because they are: of commercial and domestic importance; known to pass through Gull Rapids in either direction; and resilient enough to survive the acoustic tagging procedure.

Movements have been monitored for approximately six years during construction (October 2014 to September 2020), and for nearly two years after impoundment (September 23, 2020, to July 17, 2022). The reservoir was flooded in 2020 so changes to Lake Whitefish movements associated with impoundment may be seen. The Keeyask GS powerhouse was completed in March 2022 so there may also be some changes associated with GS operation on Lake Whitefish movements seen in Stephens Lake.

Why is the study being done?

Monitoring in the years after the GS was constructed and the reservoir was flooded is being done to answer three questions:

How often do Lake Whitefish move downstream through the Keeyask GS and when are the movements occurring?

This is important because if Lake Whitefish move downstream through the GS, they cannot move back upstream. If a large number move downstream, it could impact the upstream population.

What types of habitat are Lake Whitefish using in the Keeyask reservoir (i.e., are fish staying far upstream from the GS, or closer to it)?

Habitat conditions of the river, rapids, lakes, bays, and tributaries that make up the Keeyask reservoir have changed since impoundment. This may lead to Lake Whitefish using different areas of the reservoir.

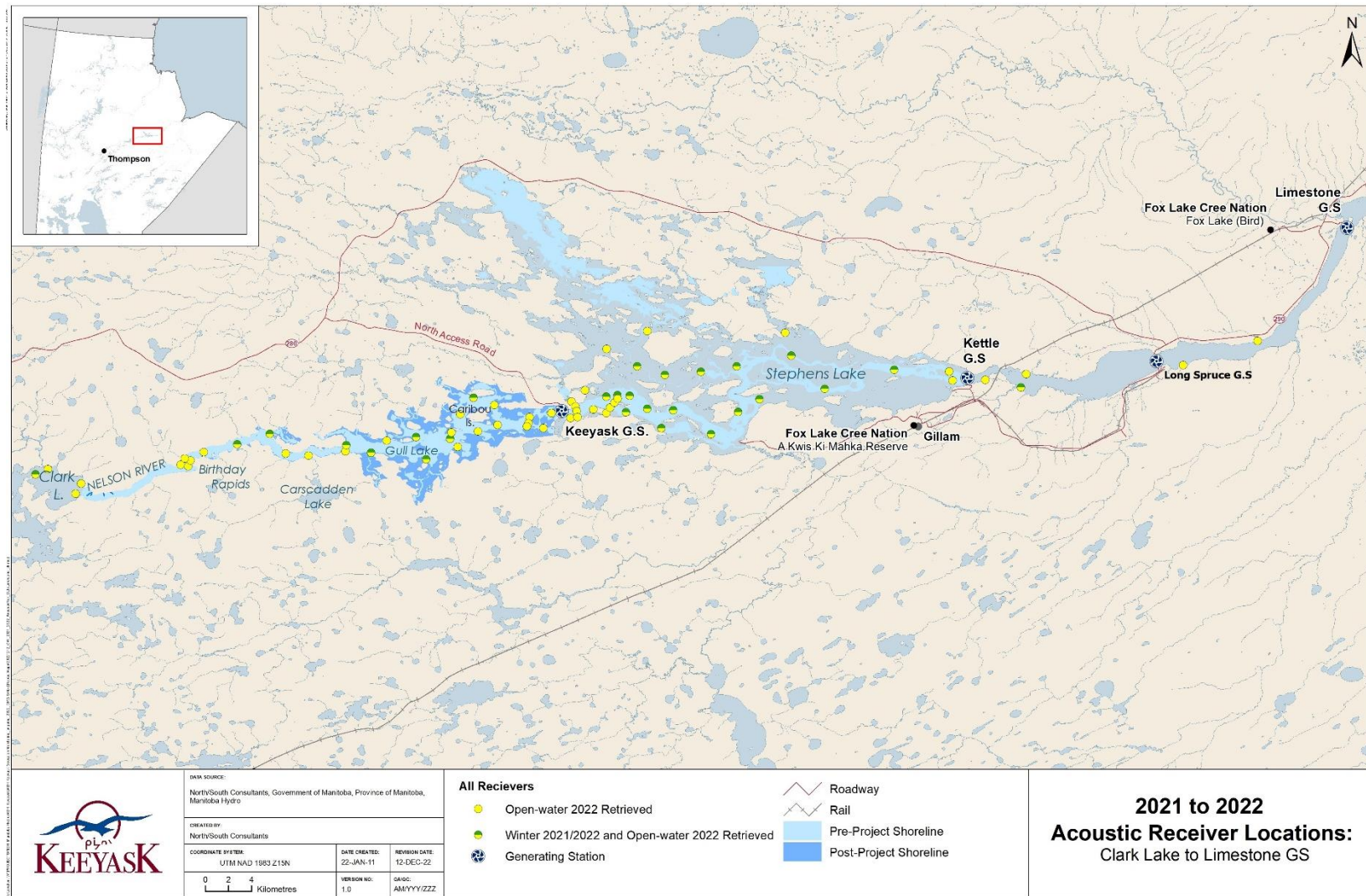
How many Lake Whitefish move upstream past Birthday and/or Long Rapids?

Lake Whitefish habitat in the reservoir has changed and so Lake Whitefish may move upstream and leave the Keeyask area.

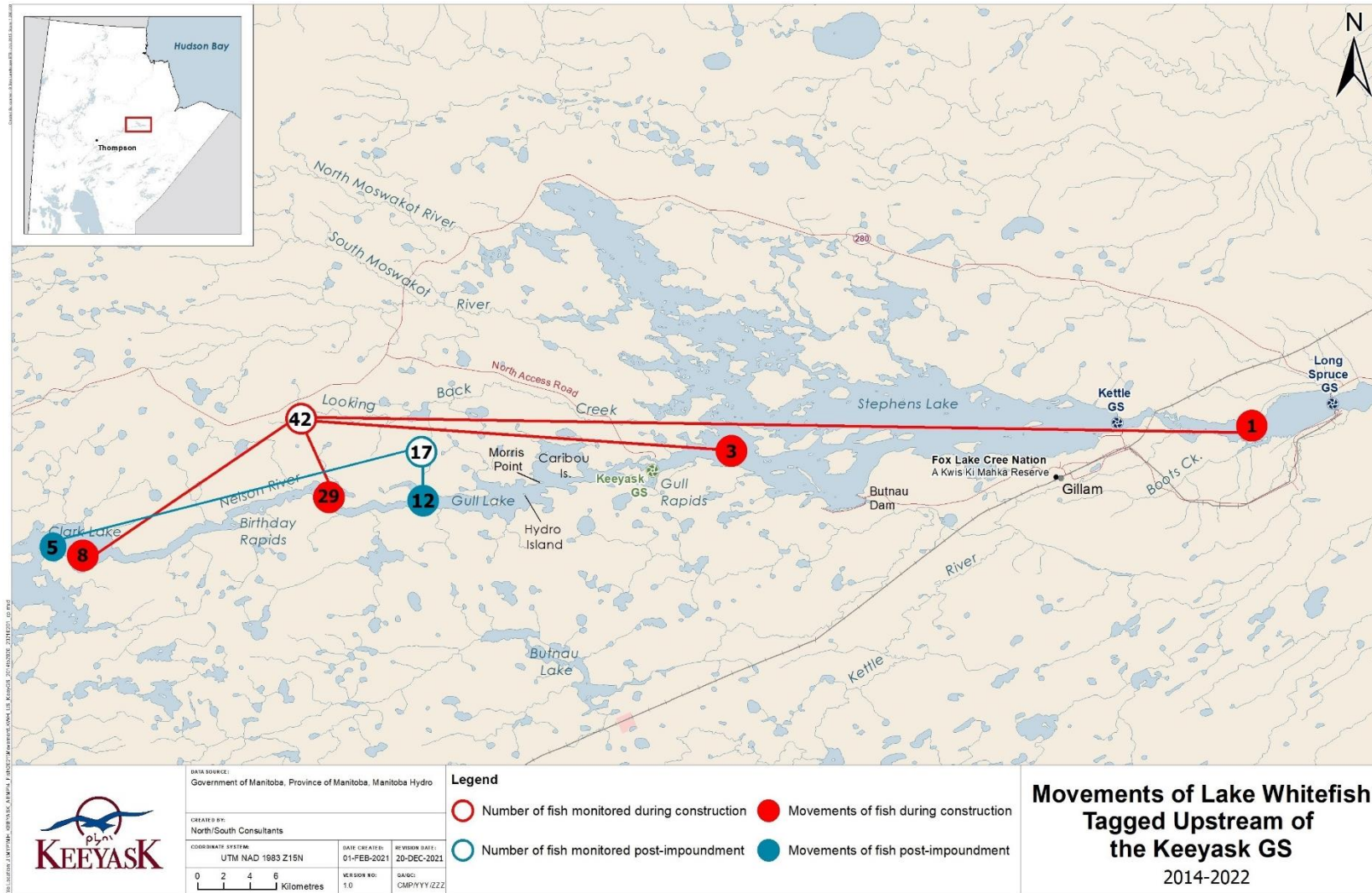
What was done?

Movements of Lake Whitefish were tracked using acoustic telemetry. This is a technique in which a tag (transmitter) is surgically implanted inside a fish. Each tag sends out a sound signal (called a “ping”) that is picked up by receivers that were placed along the Nelson River between Clark Lake and the Limestone Generating Station (see the study area map below). Each fish is given a transmitter that sends out a unique ping, and pings can be detected up to 1 kilometre (km) away from a receiver. By looking at the detections recorded by different receivers, the movement of each fish can be tracked. The tags are powered by batteries with a 4-year lifespan.

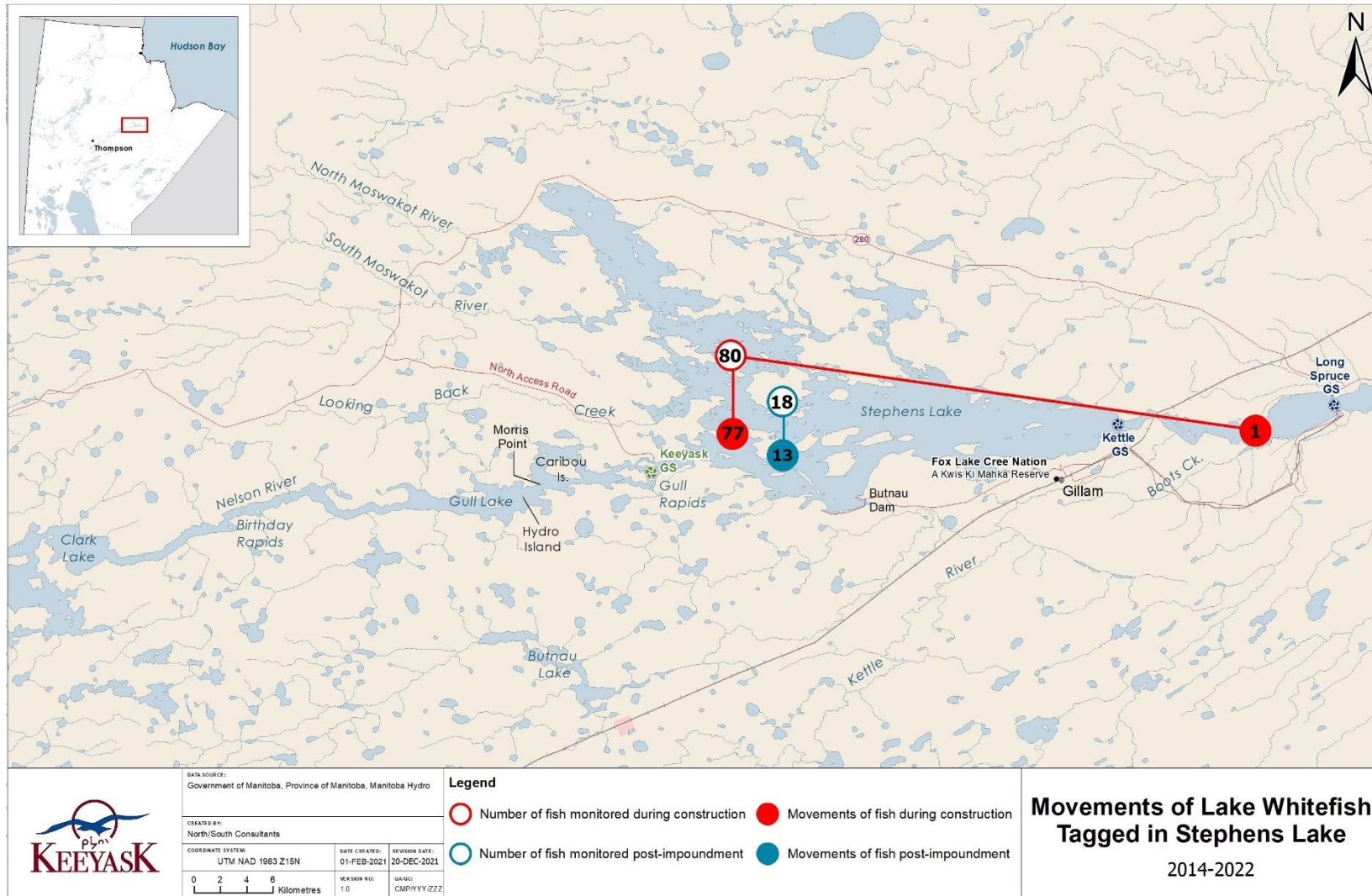
Sixty Lake Whitefish were tagged in 2014, 20 upstream and 40 downstream of the Keeyask GS. Because the batteries in these transmitters expired in winter 2017, 62 additional transmitters were implanted into Lake Whitefish in October 2017. This extended the tracking of Lake Whitefish movements until summer 2022.



Map showing the study area. The dots represent the locations of receivers in the river. The different colours represent receivers that were in the river at different times of the year.



Map showing how many Lake Whitefish moved upstream out of Gull Lake, stayed in Gull Lake, and moved into Stephens Lake during construction (red) and after reservoir impoundment (blue). Movements of fish due to tagging stress or mortality were not included. Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected.



Map showing how many Lake Whitefish moved upstream through Gull Rapids (before it was no longer possible in 2018), stayed in Stephens Lake, and moved downstream through the Kettle GS during construction (red) and after reservoir impoundment (blue). Movements due to tagging stress and mortality were not included. Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected.

What was found?

Results from eight years of tracking the movements of Lake Whitefish suggest that movement through the Keeyask GS is rare. Two fish (10% of tagged fish) tracked from 2014–2017 moved downstream through the Keeyask GS, and three (14% of tagged fish) made the same movement between 2017–2022, one of which was because of tagging stress or mortality. All downstream movements happened before reservoir impoundment. No whitefish moved upstream through Gull Rapids between 2014–2018, before the GS made these movements impossible. Movements into Clark Lake were observed both before and after reservoir impoundment at about the same rate. These movements have all been brief with fish returning to the Gull Lake portion of the reservoir. All movements of fish out of Gull and Stephens lakes since studies began are shown in the maps above.

Since the study started, whitefish tagged upstream of the Keeyask GS have consistently spent a large part of their time far upstream in the Keeyask reservoir during the open-water period and have not been observed using habitat directly upstream of the GS. Some of the detected fish made upstream movements out of Gull Lake to the base of Birthday Rapids in the fall. These upstream movements are believed to be for spawning.

Whitefish tagged in Stephens Lake have been more evenly spread throughout the lake. Many tagged whitefish have been located closer to the base of the Keeyask GS in the fall, likely because it is a spawning area. There are also some fish that move into the north arm of Stephens Lake outside of the receiver array and spend most of their time there. These fish move to the Keeyask GS in the fall to spawn.

What does it mean?

There has been no indication that Lake Whitefish movement patterns have changed as a result of the Keeyask Project. Lake Whitefish tagged upstream of the Keeyask GS have consistently spent most of their time in Gull Lake, moving to Birthday Rapids in the fall, most likely to spawn. Lake Whitefish in Stephens Lake use areas both closer to and farther from the GS. Some have consistently been detected within the northern portion of Stephens Lake, but they return to the GS to spawn. Movements downstream through the Keeyask GS have been rare since the study began in 2014 and no Lake Whitefish have moved downstream through the GS since reservoir impoundment. Similarly, there has been no observed increase in Lake Whitefish movements upstream into Clark Lake.

What will be done next?

Lake Whitefish movement monitoring started in 2014 to describe movements during the construction and early operation of the Keeyask Project. The goal of the study was to determine if habitat changes associated with construction of the GS would alter habitat use and coarse-scale movements. All acoustic tags expired in 2022 and new tags will not be applied. Movements of Lake Whitefish will continue to be monitored using Floy-tag mark-and-recapture. Spawn and fish community monitoring will continue which will tell us if Lake Whitefish continue to live and spawn in the Keeyask reservoir and Stephens Lake as they have since we started monitoring them in 2014.

ACKNOWLEDGEMENTS

We would like to thank Manitoba Hydro for the opportunity and resources to conduct this study.

Grant Connell, Leslie Flett, Patrick Connell, Tyler Kitchokeesik, and Terry Kitchokeesik of Tataskweyak Cree Nation are thanked for their local expertise and assistance in conducting the field work.

The collection of biological samples described in this report was authorized by Natural Resources and Northern Development, Fish and Wildlife Branch, under terms of the Scientific Collection Permit #41767128 (SCP 08-2022).

STUDY TEAM

Data Collection

Brenden Slongo

Brock Kramble

Claire Hrenchuk

Grant Connell

Jon Peake

Leslie Flett

Patrick Connell

Ryler Tonner

Scott Morrison

Tyler Kitchkeesik

Data Analysis, Report Preparation, and Report Review

Brett Funk

Chris Kullman

Claire Hrenchuk

Friederike Schneider-Vieira

Kendra Small

TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	STUDY SETTING.....	3
3.0	METHODS.....	6
3.1	ACOUSTIC TELEMETRY	6
3.1.1	Acoustic Transmitter Application	6
3.1.2	Acoustic Receivers.....	8
3.1.2.1	Winter 2021/2022.....	8
3.1.2.2	Open-water 2022.....	11
3.1.3	Data Analysis	15
4.0	RESULTS.....	18
4.1	2017-2022 RESULTS SUMMARY.....	18
4.1.1	Upstream of the Keeyask GS	18
4.1.2	Stephens Lake	19
4.2	WINTER 2021/2022.....	20
4.2.1	Upstream of the Keeyask GS	21
4.2.2	Stephens Lake	24
4.2.3	Long Spruce Reservoir.....	24
4.3	OPEN-WATER 2022	28
4.3.1	Upstream of the Keeyask GS	28
4.3.1.1	Proportional Distribution	31
4.3.1.2	Movement Patterns	32
4.3.2	Stephens Lake	32
4.3.2.1	Proportional Distribution	37
4.3.2.2	Movement Patterns	37
4.3.3	Long Spruce and Limestone Reservoirs.....	39
5.0	DISCUSSION	40



5.1 EVALUATION OF METHODOLOGY40

5.2 WINTER MOVEMENT40

5.3 OPEN-WATER MOVEMENT41

5.4 KEY QUESTIONS.....41

6.0 SUMMARY AND CONCLUSIONS 43

7.0 LITERATURE CITED 45



LIST OF TABLES

Table 1: Acoustic-tag and biological information for each Lake Whitefish tagged with an acoustic transmitter in the Nelson River upstream of the Keeyask GS, fall 2017.....6

Table 2: Acoustic-tag and biological information for each Lake Whitefish tagged with an acoustic transmitter in Stephens Lake, fall 2017.7

Table 3: Proportion of time spent in each river zone by Lake Whitefish implanted with acoustic transmitters upstream of the Keeyask GS during a portion of the 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16), 2018 (June 6 to October 10), 2019 (June 2 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to July 17) open-water periods.31

Table 4: Proportion of time spent in each river zone by Lake Whitefish implanted with acoustic transmitters in Stephens Lake during a portion of the 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16), 2018 (June 6 to October 10), 2019 (June 2 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to July 17) open-water periods.37

LIST OF FIGURES

Figure 1: Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Kettle GS between October 2021 and May 2022..... 16

Figure 2: Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake (Zone 1) and the Limestone GS (Zone 9) between May and October, 2022..... 17

Figure 3: Water temperature in the Nelson River mainstem from October 4, 2021, to October 16, 2022. 21

Figure 4: Detection ranges for individual Lake Whitefish (n = 22) tagged with acoustic transmitters upstream of the Keeyask GS during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods. 22

Figure 5: Relative number of detections at each acoustic receiver set between Clark Lake and the Keeyask GS during winter 2021/2022 (October 11, 2021 to May 15, 2022)..... 23

Figure 6: Detection ranges for individual Lake Whitefish (n = 40) tagged with acoustic transmitters in Stephens Lake during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods..... 25

Figure 7: Relative number of detections at each acoustic receiver set in Stephens Lake during winter 2021/2022 (October 11, 2021 to May 15, 2022). 27

Figure 8: Detection ranges for individual Lake Whitefish (n = 22) tagged with acoustic transmitters upstream of the Keeyask GS during the 2018 (May 1 to October 10), 2019 (May 1 to October 7), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to July 17) open-water periods. 29

Figure 9: Relative number of detections at each acoustic receiver set in the Nelson River between Clark Lake and the Keeyask GS during the 2022 open-water period (May 16 to July 17)..... 30

Figure 10: Map showing how many Lake Whitefish moved upstream to Clark Lake, stayed in the Keeyask reservoir, moved into Stephens Lake, and moved downstream through the Kettle GS during construction (red) and after reservoir impoundment (blue). 33



Figure 11: Detection ranges for individual Lake Whitefish (n = 40) tagged with acoustic transmitters in Stephens Lake during the 2018 (May 1 to October 10), 2019 (May 1 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to July 17) open-water periods.34

Figure 12: Relative number of detections at each acoustic receiver set in Stephens Lake during the 2022 open-water period (May 16 to July 17).36

Figure 13: Map showing how many Lake Whitefish moved upstream through Gull Rapids (before it was no longer possible in 2018), stayed in Stephens Lake, and moved downstream through the Kettle GS during construction (red) and after reservoir impoundment (blue).38

LIST OF MAPS

Map 1: Map of the Nelson River showing the site of the Keeyask Generating Station and the Lake Whitefish movement monitoring study setting.5

Map 2: Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between October 2021 and May 2022.9

Map 3: Locations of stationary receivers set in Stephens Lake from the Keeyask GS to Kettle GS between October 2021 to May 2022. 10

Map 4: Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between May and October 2022. 12

Map 5: Locations of stationary receivers set in Stephens Lake between May and October 2022. 13

Map 6: Locations of stationary receivers set between the Kettle and Limestone Generating Stations, May to October 2022. 14



LIST OF APPENDICES

Appendix 1: Detection Summaries for Lake Whitefish Tagged and Monitored in the Keyyask Study Area between 2017 and 2022.....49

Appendix 2: Location Summary for Individual Acoustic-Tagged Lake Whitefish in Gull Lake, October 2017 to October 2022.54

Appendix 3: Location Summary for Individual Acoustic-Tagged Lake Whitefish in Stephens Lake, October 2017 to October 2022.78



1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt (MW) hydroelectric generating station on the lower Nelson River in northern Manitoba. The GS is approximately 725 kilometres (km) northeast of Winnipeg, 35 km upstream of the existing Kettle Generating Station, 60 km east of the community of Split Lake, 180 km east-northeast of Thompson and 30 km west of Gillam. Construction of the GS began in July 2014 and the seven generating units were all in-service in March 2022.

The *Keeyask Generation Project: Response to EIS Guidelines*, completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the aquatic environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs, is provided in the *Keeyask Generation Project Environmental Impact Statement: Aquatic Environment Supporting Volume (AE SV)*. As part of the licensing process for the Project, an Aquatic Effects Monitoring Plan (AEMP) was developed detailing the monitoring activities of various components of the aquatic environment including the focus of this report, Lake Whitefish (*Coregonus clupeaformis*) movements, for the construction and operation phases of the Project.

Pre-construction (baseline) movements of Lake Whitefish were monitored from 2001 to 2005 (Barth *et al.* 2003; Murray *et al.* 2005; Murray and Barth 2007). Radio and acoustic telemetry studies focused specifically on detecting the upstream and downstream movements of fish over rapids in the study area (Birthday Rapids and Gull Rapids). Pre-construction movement data revealed that a proportion (28%) of Lake Whitefish did make movements both upstream and downstream over Gull or Birthday rapids. The pre-construction movement data also recorded Lake Whitefish congregating in the area below Gull Rapids during the fall, presumably for spawning. As pre-Project studies were not designed to record detailed movement patterns of Lake Whitefish in the Clark Lake to Stephens Lake reach as a whole, results are not directly comparable to the movement data being collected under the AEMP.

Since fall 2014, 122 adult Lake Whitefish were implanted with acoustic transmitters to assess the frequency of movement through Gull Rapids and to monitor the potential impact construction of the Keeyask GS may have on Lake Whitefish. Annual reports detailing the 2014 to 2021 results are provided in Hrenchuk and Barth (2015), Lavergne and Hrenchuk (2016), Burnett and Hrenchuk (2017), Lacho and Hrenchuk (2018), Lacho and Hrenchuk (2019), Hrenchuk (2020, 2021), and Small and Hrenchuk (2022).

This report provides results from October 2021 to July 2022, which is the seventh winter and eighth open-water period of monitoring conducted since construction of the Keeyask GS began in July 2014. This timeframe includes the transition period from construction to operation and tracking movements for the first year of full GS operation (October 11, 2021 to July 17, 2022).

Key questions identified in the AEMP relating to monitoring Lake Whitefish movements include:

- What is the frequency of downstream movement through the Keeyask GS and when are the movements occurring?

- What types of habitat are Lake Whitefish utilizing in the Keeyask reservoir (*i.e.*, are fish using the upper, middle, or lower end of the reservoir)?
- What proportion of the fish population moves from the Keeyask reservoir upstream past Birthday and/or Long rapids?

2.0 STUDY SETTING

The study area encompasses an approximately 110 km long reach of the Nelson River from Clark Lake to the upstream end of the Limestone Reservoir (Map 1). This section of river offers a diversity of physical habitat conditions, including a variety of substrate types, and variable water depths (range: 0–30 m) and velocities. Clark Lake is located immediately downstream of Split Lake, and approximately 42 km upstream of the Keeyask GS. Current is restricted to the main section of the lake, with off-current bays outside the main channel. The Assean River is the only major tributary to Clark Lake and flows into the north side. Downstream from the outlet of Clark Lake, the Nelson River narrows and water velocity increases for a 3 km stretch, known as Long Rapids. For the next 7 km, the river widens, and water velocity decreases. The area between Clark Lake and Birthday Rapids is referred to herein as the upper Keeyask reservoir.

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream Keeyask GS and marks the upstream end of major water level changes because of impoundment by the Keeyask GS. The drop in elevation from the upstream to downstream side of Birthday Rapids was approximately 2 m prior to impoundment but is now nearly level, albeit a fast-flowing section of river. The 14 km reach of the Nelson River between Birthday Rapids and Gull Lake was characterized as a large and somewhat uniform channel with medium to high water velocities and a few large bays. This area is now within the Keeyask reservoir, though flooding was limited to mainly shoreline areas, and is referred to herein as the middle Keeyask reservoir.

Prior to impoundment, Gull Lake was a widening of the Nelson River, with moderate to low water velocity beginning approximately 20 km upstream the Keeyask GS. Water levels on Gull Lake increased by several metres following impoundment and flooding along the shoreline and small tributaries entering this reach was extensive. Although this area is larger than prior to impoundment, the portion of the Keeyask reservoir is referred to herein as Gull Lake.

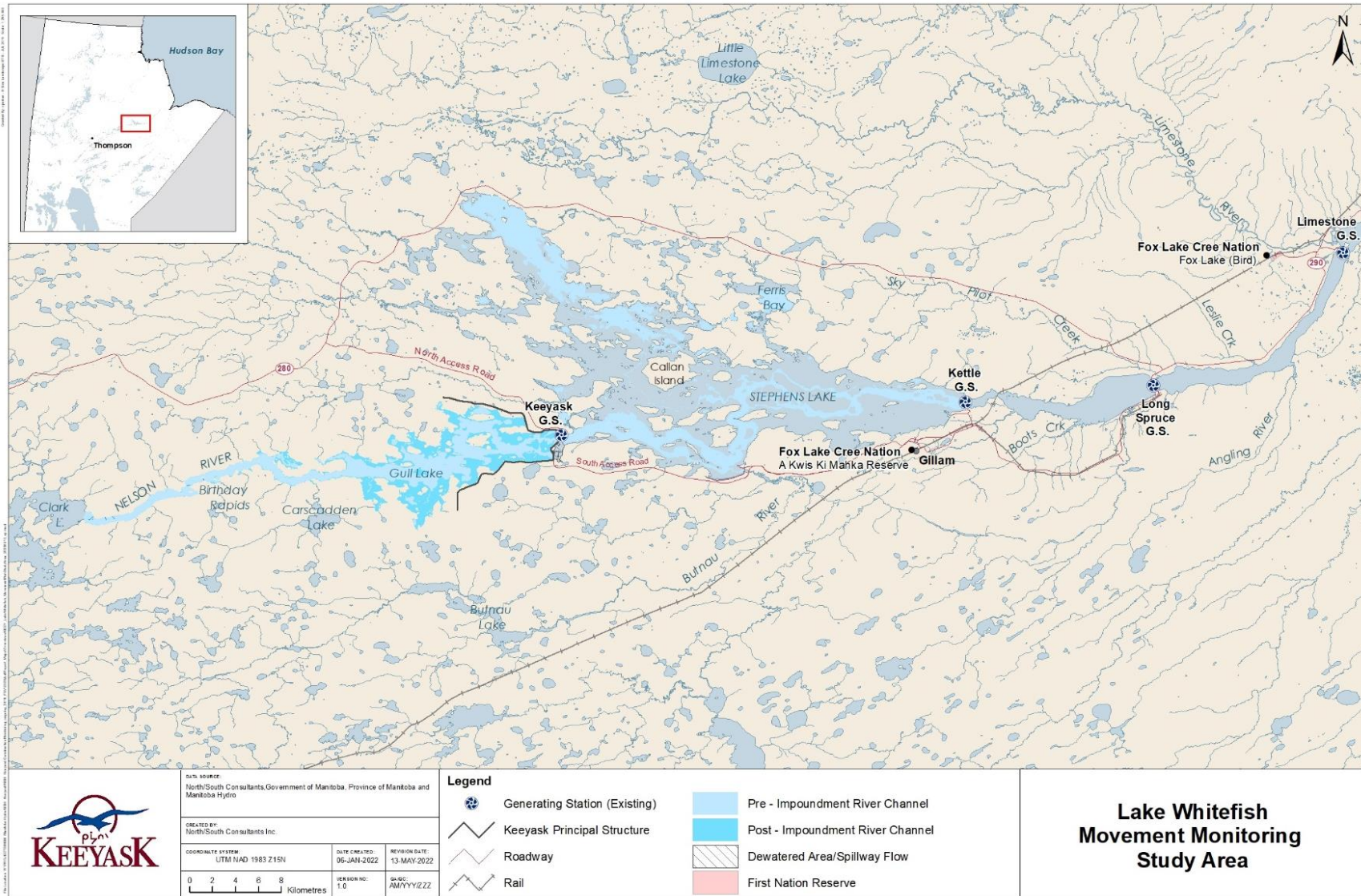
Just below the Keeyask GS, the Nelson River enters Stephens Lake. Stephens Lake was formed in 1971 by construction of the Kettle GS. Construction of the Keeyask GS has altered the flow distribution immediately downstream of the station.

Construction of the Kettle GS flooded Moose Nose Lake (north arm) and several other small lakes that previously drained into the Nelson River, as well as the old channels of the Nelson River that now lie within the southern portion of the lake. Major tributaries of Stephens Lake include the North and South Moswakot rivers that enter the north arm of the lake. Looking Back Creek is a second order stream that drains into the north arm of Stephens Lake. Kettle GS is located approximately 40 km downstream of the Keeyask GS.

The Long Spruce reservoir was formed in 1979 by the construction of the Long Spruce GS. It is a 16 km reach of the Nelson River extending from Long Spruce GS upstream to Kettle GS (Manitoba Hydro Public Affairs 1999). Kettle River and Boots Creek are the only major tributaries flowing into Long Spruce reservoir, with both tributaries entering the reservoir on the south shore.

The Limestone reservoir was formed in 1990 by the construction of the Limestone GS. It is a 23 km reach of the Nelson River extending from Limestone GS upstream to Long Spruce GS. Four

tributaries of the Nelson River enter the reservoir; Wilson Creek and Brooks Creek enter from the south, and Sky Pilot Creek and Leslie Creek enter from the north. Aquatic habitat within the reservoir ranges from a riverine environment in the upper reach, to more lacustrine conditions just upstream of the Limestone GS.



Map 1: Map of the Nelson River showing the site of the Keeyask Generating Station and the Lake Whitefish movement monitoring study setting.

3.0 METHODS

3.1 ACOUSTIC TELEMETRY

Acoustic telemetry involves tracking movements of fish surgically implanted with internal acoustic transmitters (tags). Each transmitter emits a unique signal, recognizable by stationary receivers. When tagged fish come into the detection range of a receiver (generally within 500 m to 1 km, depending on conditions), the transmitter code number, as well as the date and time, are stored in the receiver.

3.1.1 ACOUSTIC TRANSMITTER APPLICATION

Acoustic transmitters (Vemco V13-1x, estimated 1,141 day battery life) were applied to 60 fish in September and October, 2014; 20 upstream and 40 downstream of Gull Rapids (now the Keeyask GS). As the batteries in these tags were due to expire during winter 2017/2018, an additional 62 tags (V13-1x, estimated 1,737 day battery life) were applied to Lake Whitefish in October 2017; 22 upstream and 40 downstream of the Keeyask GS (Tables 1 and 2). Lake Whitefish tagged in 2014 and 2017 had fork lengths ranging from 372 to 565 mm.

Table 1: Acoustic-tag and biological information for each Lake Whitefish tagged with an acoustic transmitter in the Nelson River upstream of the Keeyask GS, fall 2017.

Acoustic Tag ID	Floy Tag #	Date Tagged	Tag Life (days)	Expiry Date	Fork Length (mm)	Weight (g)
31722	101750	07-Oct-17	1737	10-Jul-22	460	2275
31726	109695	12-Oct-17	1737	15-Jul-22	468	2575
31727	109696	12-Oct-17	1737	15-Jul-22	465	2075
31728	109688	14-Oct-17	1737	17-Jul-22	486	2550
31729	109689	14-Oct-17	1737	17-Jul-22	483	2350
31730	109690	14-Oct-17	1737	17-Jul-22	448	1850
31731	109691	14-Oct-17	1737	17-Jul-22	490	2500
31732	109697	12-Oct-17	1737	15-Jul-22	455	1750
31733	109692	14-Oct-17	1737	17-Jul-22	488	2725
31734	109693	14-Oct-17	1737	17-Jul-22	435	1925
31735	109694	12-Oct-17	1737	15-Jul-22	495	2250
31736	109698	12-Oct-17	1737	15-Jul-22	528	3425
31737	109699	12-Oct-17	1737	15-Jul-22	454	1500
31738	109700	11-Oct-17	1737	14-Jul-22	432	1425
31739	109654	11-Oct-17	1737	14-Jul-22	491	2475
31740	109652	11-Oct-17	1737	14-Jul-22	509	2950
31741	109653	11-Oct-17	1737	14-Jul-22	467	1725
31742	109655	11-Oct-17	1737	14-Jul-22	482	2525
31743	109656	11-Oct-17	1737	14-Jul-22	529	3050
31744	109657	11-Oct-17	1737	14-Jul-22	501	2350
31745	109658	11-Oct-17	1737	14-Jul-22	533	2675
31746	109659	11-Oct-17	1737	14-Jul-22	450	1500

Table 2: Acoustic-tag and biological information for each Lake Whitefish tagged with an acoustic transmitter in Stephens Lake, fall 2017.

Acoustic Tag ID	Floy Tag #	Date tagged	Tag life (days)	Expiry date	Fork length (mm)	Weight (g)
31698	101729	09-Oct-17	1737	12-Jul-22	476	1900
31699	101728	09-Oct-17	1737	12-Jul-22	423	1375
31700	101727	09-Oct-17	1737	12-Jul-22	446	2125
31701	101726	09-Oct-17	1737	12-Jul-22	524	2450
31702	101744	09-Oct-17	1737	12-Jul-22	406	1100
31703	101730	09-Oct-17	1737	12-Jul-22	525	2400
31704	101731	09-Oct-17	1737	12-Jul-22	504	2600
31705	101732	09-Oct-17	1737	12-Jul-22	495	2375
31706	101733	09-Oct-17	1737	12-Jul-22	522	2300
31707	101734	09-Oct-17	1737	12-Jul-22	456	1750
31708	101740	09-Oct-17	1737	12-Jul-22	455	1500
31709	101738	09-Oct-17	1737	12-Jul-22	480	2050
31710	101737	09-Oct-17	1737	12-Jul-22	426	1250
31711	101736	09-Oct-17	1737	12-Jul-22	494	2075
31712	101735	09-Oct-17	1737	12-Jul-22	413	1400
31713	101739	09-Oct-17	1737	12-Jul-22	519	2450
31714	101743	09-Oct-17	1737	12-Jul-22	455	1725
31715	101745	09-Oct-17	1737	12-Jul-22	490	2500
31716	101747	08-Oct-17	1737	11-Jul-22	417	1075
31717	101749	08-Oct-17	1737	11-Jul-22	504	2100
31718	101741	09-Oct-17	1737	12-Jul-22	486	2050
31719	101742	09-Oct-17	1737	12-Jul-22	505	2000
31720	101746	09-Oct-17	1737	12-Jul-22	512	2300
31721	101748	08-Oct-17	1737	11-Jul-22	519	2900
31723	109673	10-Oct-17	1737	13-Jul-22	511	2250
31724	109664	10-Oct-17	1737	13-Jul-22	494	2150
31725	109663	10-Oct-17	1737	13-Jul-22	447	1525
31747	109660	10-Oct-17	1737	13-Jul-22	490	2525
31748	109661	10-Oct-17	1737	13-Jul-22	410	1000
31749	109662	10-Oct-17	1737	13-Jul-22	422	1250
31750	109665	10-Oct-17	1737	13-Jul-22	499	2150
31751	109666	10-Oct-17	1737	13-Jul-22	540	2550
31752	109667	10-Oct-17	1737	13-Jul-22	537	2250
31753	109668	10-Oct-17	1737	13-Jul-22	468	2175
31754	109669	10-Oct-17	1737	13-Jul-22	471	1875
31755	109670	10-Oct-17	1737	13-Jul-22	512	2350
31756	109671	10-Oct-17	1737	13-Jul-22	496	1775
31757	109672	10-Oct-17	1737	13-Jul-22	516	2125
53761	109674	10-Oct-17	1737	13-Jul-22	502	1975
53762	109675	09-Oct-17	1737	12-Jul-22	508	2275

3.1.2 ACOUSTIC RECEIVERS

Since 2011, stationary acoustic receivers (VEMCO model VR2W) have been used to continuously monitor tagged adult Lake Sturgeon in the Nelson River between Clark Lake and the Long Spruce GS. In spring 2016, the receiver array was extended to the upper Limestone reservoir, with the placement of two receivers downstream of the Long Spruce GS. The intent of adding these receivers was to determine whether fish that had moved into the Long Spruce reservoir had continued to move downstream.

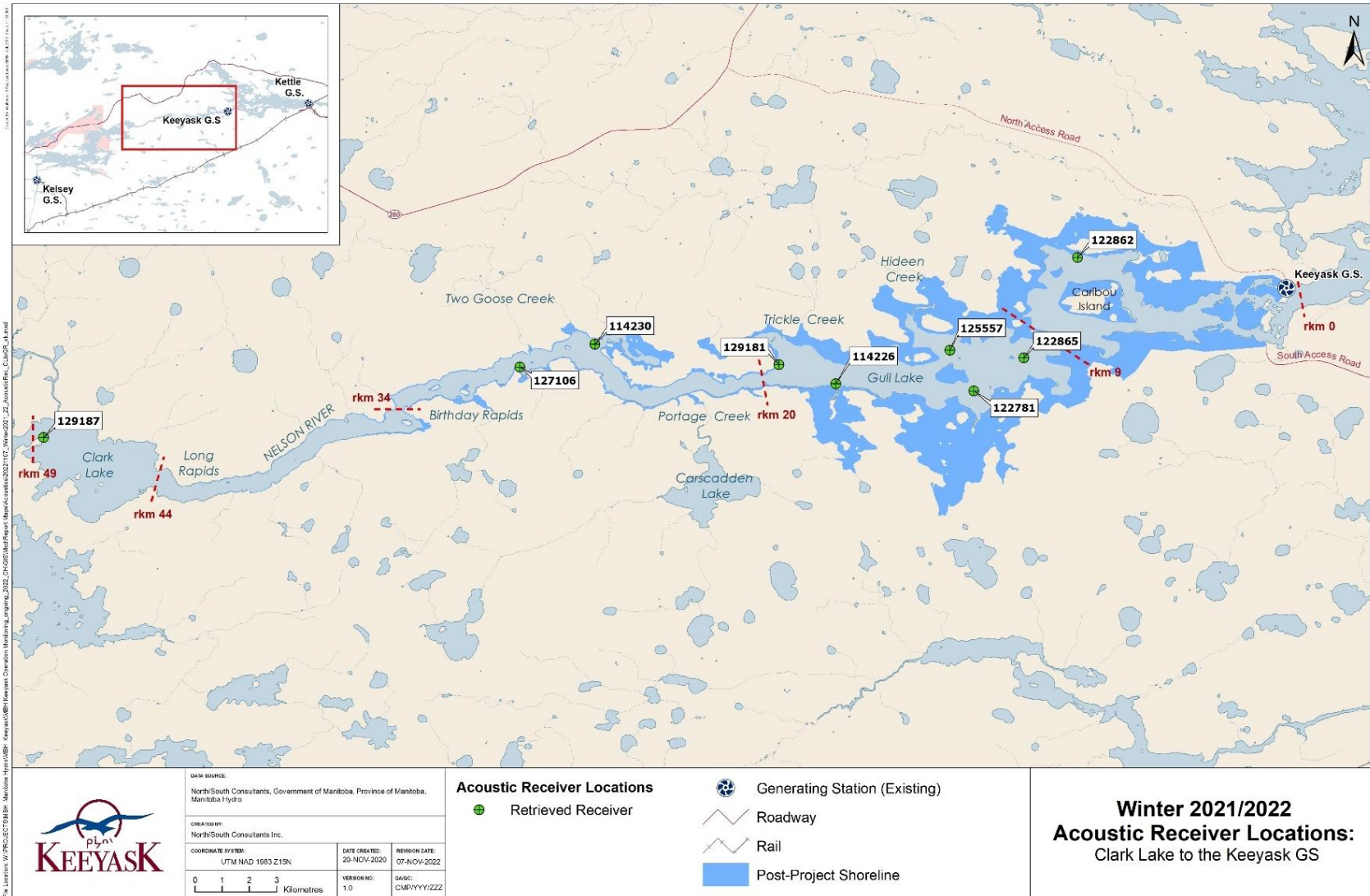
During the six years of the construction phase of the Project (beginning in July 2014), receivers were deployed at the same sites as those established during the pre-construction phase (2011–2013). During the open-water period, receivers were deployed in calm water with a flat bottom free of large debris to maximize detection range and spaced along the main river channel throughout the study area to maximize spatial coverage. In Stephens Lake, receivers were placed at locations within pre-flood river channels, based on the observation that Lake Sturgeon, which are also monitored, tend to stay within river channels, even in flooded environments. At constrictions within the river channel, a series of receivers were deployed to create “gates” with the intent of recording all fish that passed by the river cross-section (described in Section 3.1.2.2).

The retrieval of receivers deployed during winter has proven challenging and several were lost in previous winters, likely moved by ice (Hrenchuk and Barth 2013). Because it appears that receivers will only remain safe from ice if deployed in calm areas at depths greater than 10 m, the number of possible receiver locations during winter is limited, especially in areas upstream of the Keeyask GS.

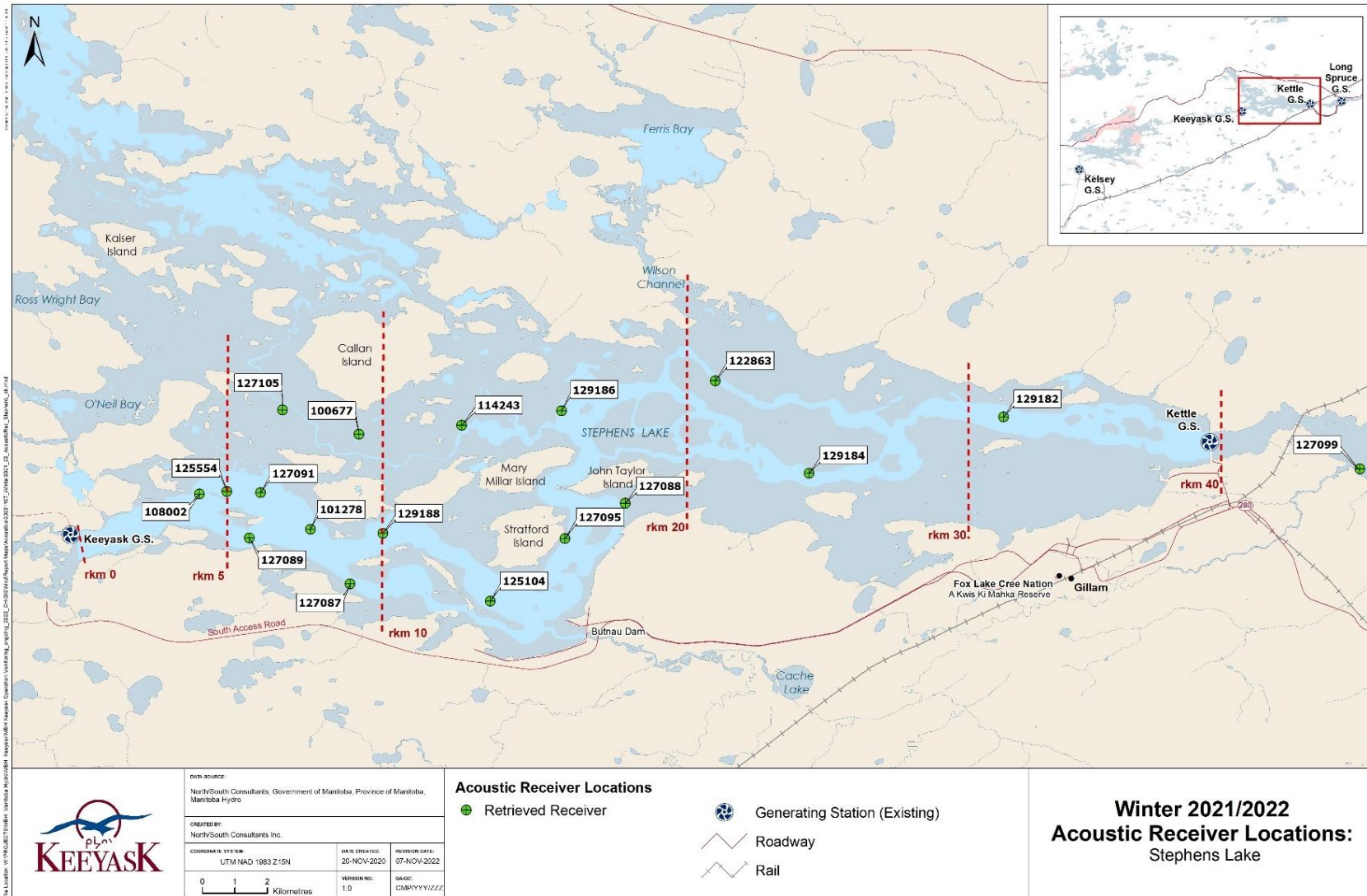
3.1.2.1 WINTER 2021/2022

The stationary acoustic receiver array for the winter 2021/2022 (October 11, 2021, to May 15, 2022) period consisted of 27 receivers. Nine were set upstream of the Keeyask GS, 17 throughout Stephens Lake, and one in the Long Spruce forebay (Maps 2 and 3). The 2021/2022 winter array was the same that was set during winter 2020/2021.

Water temperature within the Nelson River mainstem was recorded with a HOBO Water Temperature Pro data logger from October 10, 2021, to July 2022. Lake Whitefish spawn during fall when water temperatures are between 6 and 9°C, often forming pre-spawning aggregations (Green and Derksen 1987; Scott and Crossman 1998; Stewart and Watkinson 2004). Thus, data collected during this temperature range was considered as the “spawning period”.



Map 2: Locations of stationary receivers set in the Nelson River from Clark Lake to the Keyask GS between October 2021 and May 2022. River kilometer (rkm) distances are indicated with a dotted line. The former (pre impoundment) river channel is shown in light blue.



Map 3: Locations of stationary receivers set in Stephens Lake from the Keyask GS to Kettle GS between October 2021 to May 2022. River kilometer (rkm) distances are indicated with a dotted line. The former (pre-impoundment) river channel is shown in light blue.

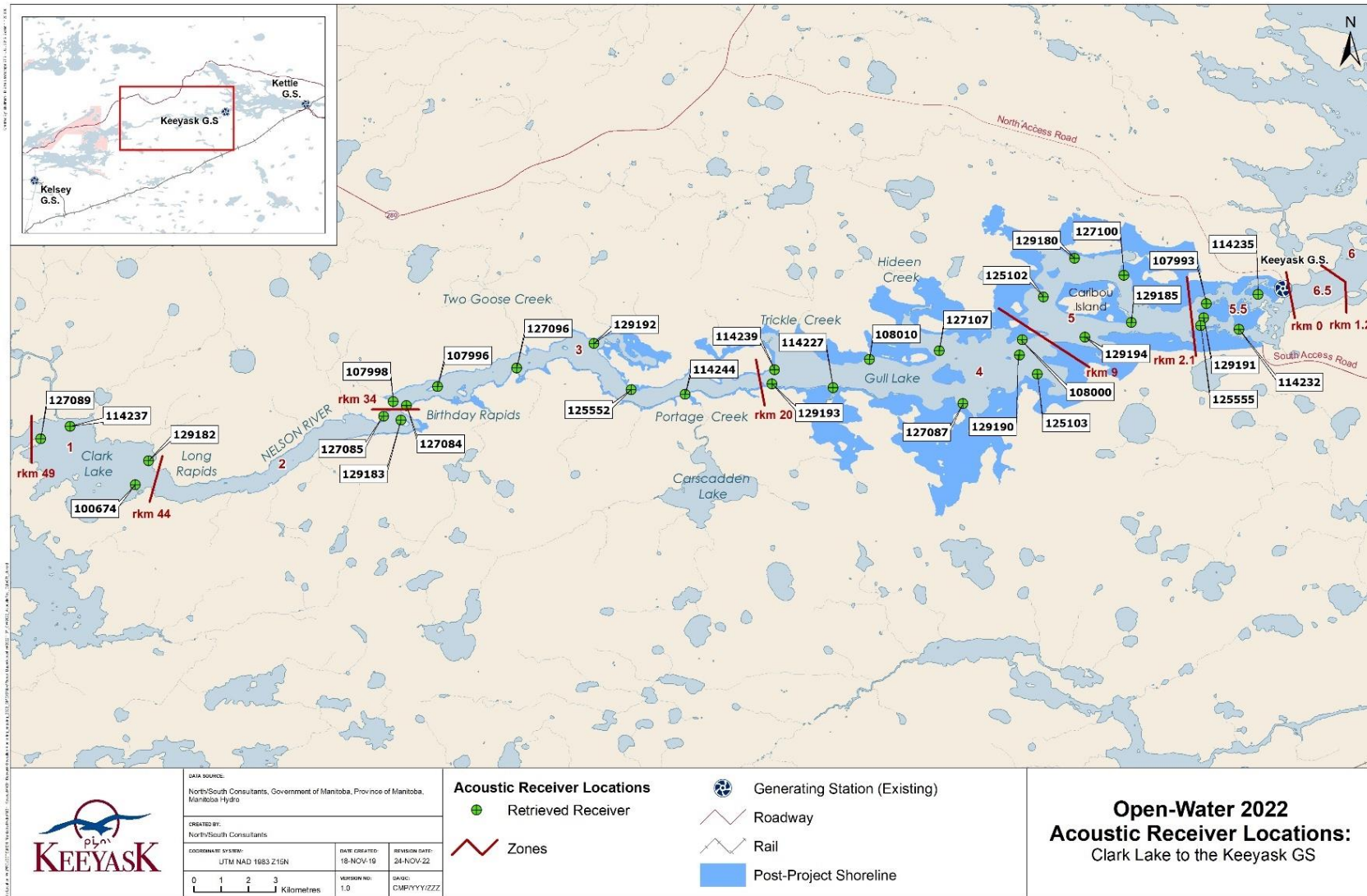
3.1.2.2 OPEN-WATER 2022

An array of 70 acoustic receivers was used during the 2022 open-water period (defined as May 16 to October 10, 2022). Thirty-two were set upstream of the Keeyask GS, 33 in Stephens Lake, three downstream of the Kettle GS, and two downstream of the Long Spruce GS (Maps 4–6). The 2022 open-water array differed slightly from the array used in 2021. Three receivers (#107993, #129191, and #125555; rkm -2.1) were set as a “gate” (described below) upstream of the GS to detect fish movements close to the station (Map 4). One (#114232; rkm -0.8) was set immediately upstream of the powerhouse and an additional (#114235; rkm -0.3) was set immediately upstream of the spillway). One receiver (#122779; rkm 1.2) was added in Stephens Lake to create a “gate” downstream of the GS (Map 5).

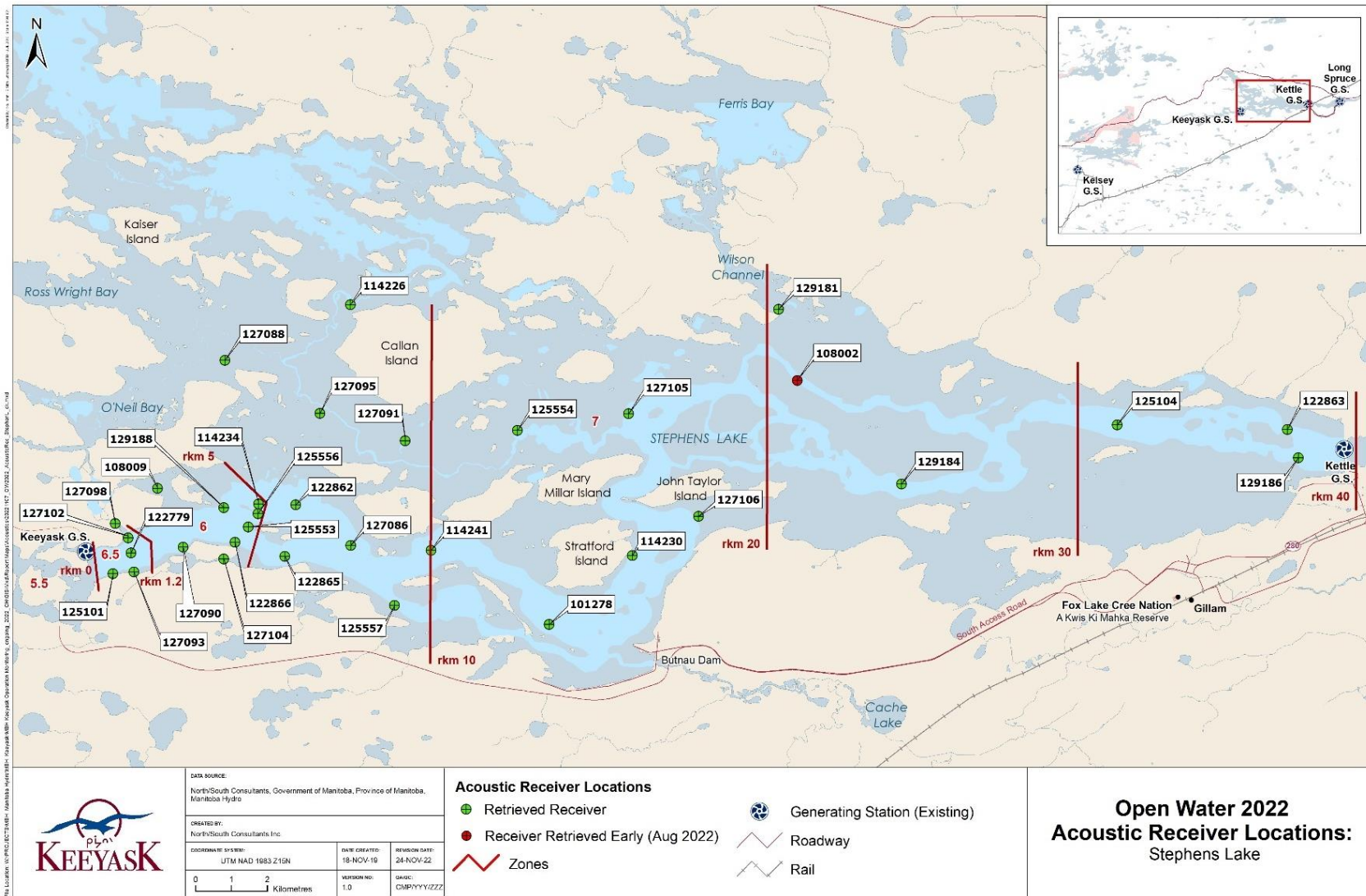
Similar to previous years, receiver “gates” were established in several key areas selected by river morphology (channel restrictions) and habitat characteristics (areas with low velocity adjacent to the main flow of the river). Receiver “gates” consisted of two or more acoustic receivers set parallel to flow to provide complete (or nearly complete) signal coverage of a river cross-section. Areas between the “gates” were referred to as river zones. Receiver gates provide confidence that movements past key points are being detected, which allows for extrapolation of coarse-scale positions (*i.e.*, which zone) during periods when fish remain undetected. When analyzing data, fish detected within a zone that subsequently go undetected for a period of time without passing through a gate, are assumed to be within the zone in which they were last detected.

Five gates were established between Clark Lake and the Keeyask GS (44.0, 34.0, 20.0, 9.0, and 2.1 rkms upstream of the GS), dividing the river into six zones (Zones 1, 2, 3, 4, 5, and 5.5; Map 4). Three were established in Stephens Lake (1.2, 4.5, and 40.0 rkms downstream of the GS), dividing the lake into three zones (Zones 6.5, 6, and 7; Map 5). The location of the “gates” has remained consistent since 2013 except for the two gates closest to the station which were added in 2022 to track movements of fish close to and through the GS.

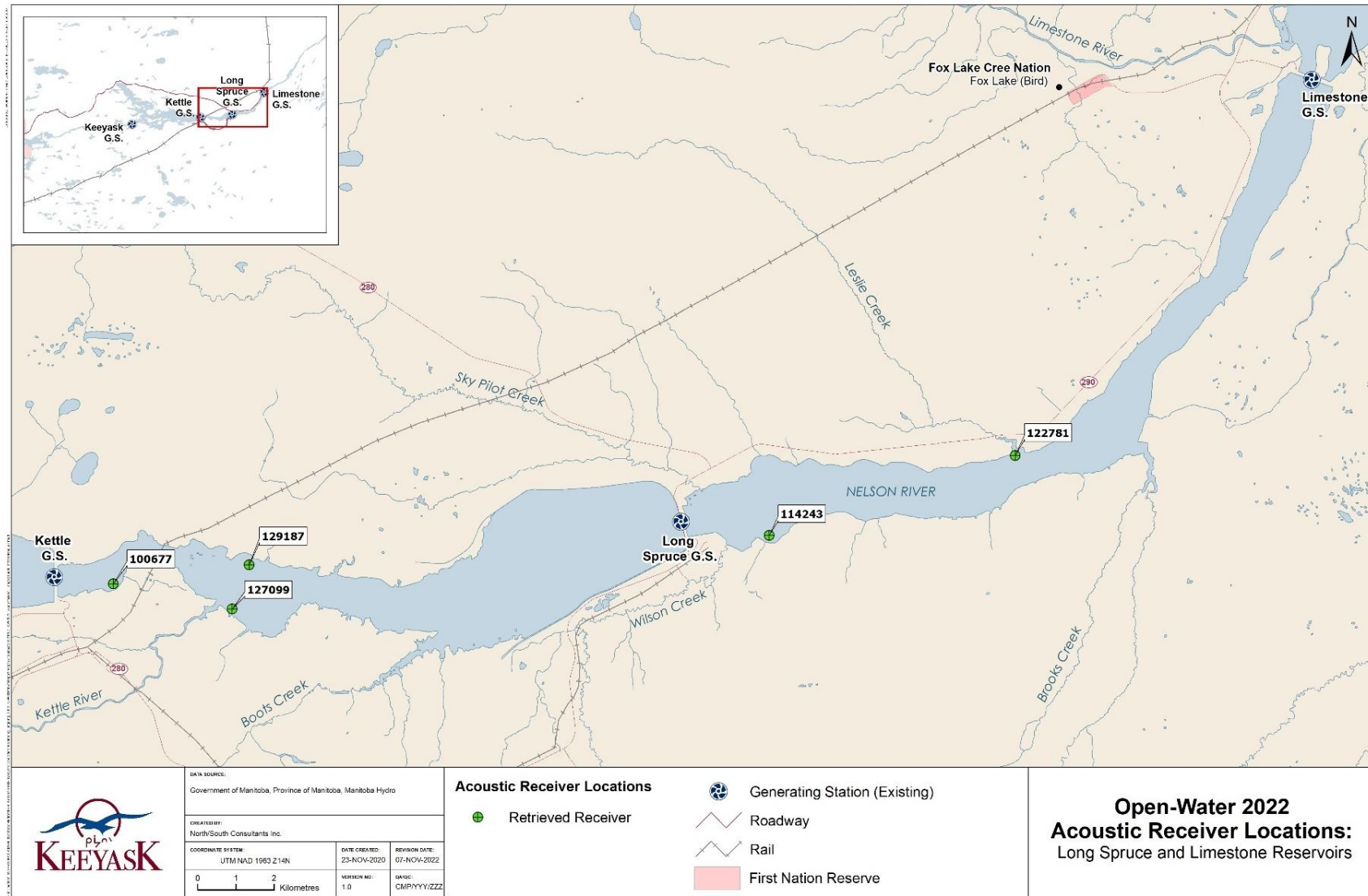
To describe fish movements for reporting purposes, the study area was divided into eleven different zones. The area upstream of the Keeyask GS was divided into six zones (Zones 1–5.5), while Stephens Lake was divided into three zones (Zones 6.5, 6, and 7). The Long Spruce reservoir is referred to as Zone 8 and the Limestone reservoir as Zone 9. Two additional zones were created in 2022 close to the Keeyask GS. Zone 5.5 is located within 2.1 rkm upstream of the GS, and Zone 6.5 is located within 1.2 rkm downstream of the GS.



Map 4: Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between May and October 2022. The river is divided into six "zones" based on placement of receiver "gates." River kilometer (rkm) distances at zone divisions are indicated in red.



Map 5: Locations of stationary receivers set in Stephens Lake between May and October 2022. The river is divided into three "zones" based on placement of receiver "gates." The pre-impoundment river channel is shown in light blue. River kilometer (rkm) distances are indicated with a dotted red line.



Map 6: Locations of stationary receivers set between the Kettle and Limestone Generating Stations, May to October 2022.

3.1.3 DATA ANALYSIS

False detections can arise on acoustic telemetry receivers due to code collisions and/or environmental noise (Pincock 2012). To filter out false detections, a fish was required to be detected at least two times within a 30-minute interval at a given stationary receiver. Single detections were filtered and not used in most analyses; however, in instances when fish went undetected for lengthy periods, and/or rapid movements were suspected, raw data were also explored. In no instance did examination of raw data suggest that consideration of a single detection would result in a different behaviour or movement pattern compared with the result when single detections were removed.

Movements were analysed in terms of rkm distance, with the base of the Keeyask GS representing a distance of 0 rkm. The area located downstream of the Keeyask GS (*i.e.*, Stephens Lake and the Long Spruce Reservoir) were given positive (+) distance values from the GS, while the area located upstream (*i.e.*, Gull and Clark lakes) were given negative (-) distance values (Figures 1 and 2). The average rkm distance from the GS was calculated over a 4-hour interval and plotted versus time for each fish. Total detection ranges were calculated by subtracting the furthest downstream detection location from the location of the furthest upstream detection. The proportion of time that all fish spent within each river zone during each 4-hour interval was plotted and presented as a percentage of the study period. For example, a fish spent 44% of the time between May 1 and May 31 within Zone 4 means that the fish was detected within Zone 4 for 44% of the 186 4-hour intervals between May 1 and May 31.

Rapid downstream movements observed within two weeks of tagging were classified as caused by tagging mortality or stress. If the fish made a rapid downstream movement within two weeks of tagging followed by upstream and downstream movements, it was classified as tagging stress. If a fish made a rapid downstream movement within two weeks of tagging and was not detected again or did not display upstream movements, it was classified as a tagging mortality. If a fish was not detected for more than one year, it was classified as missing.

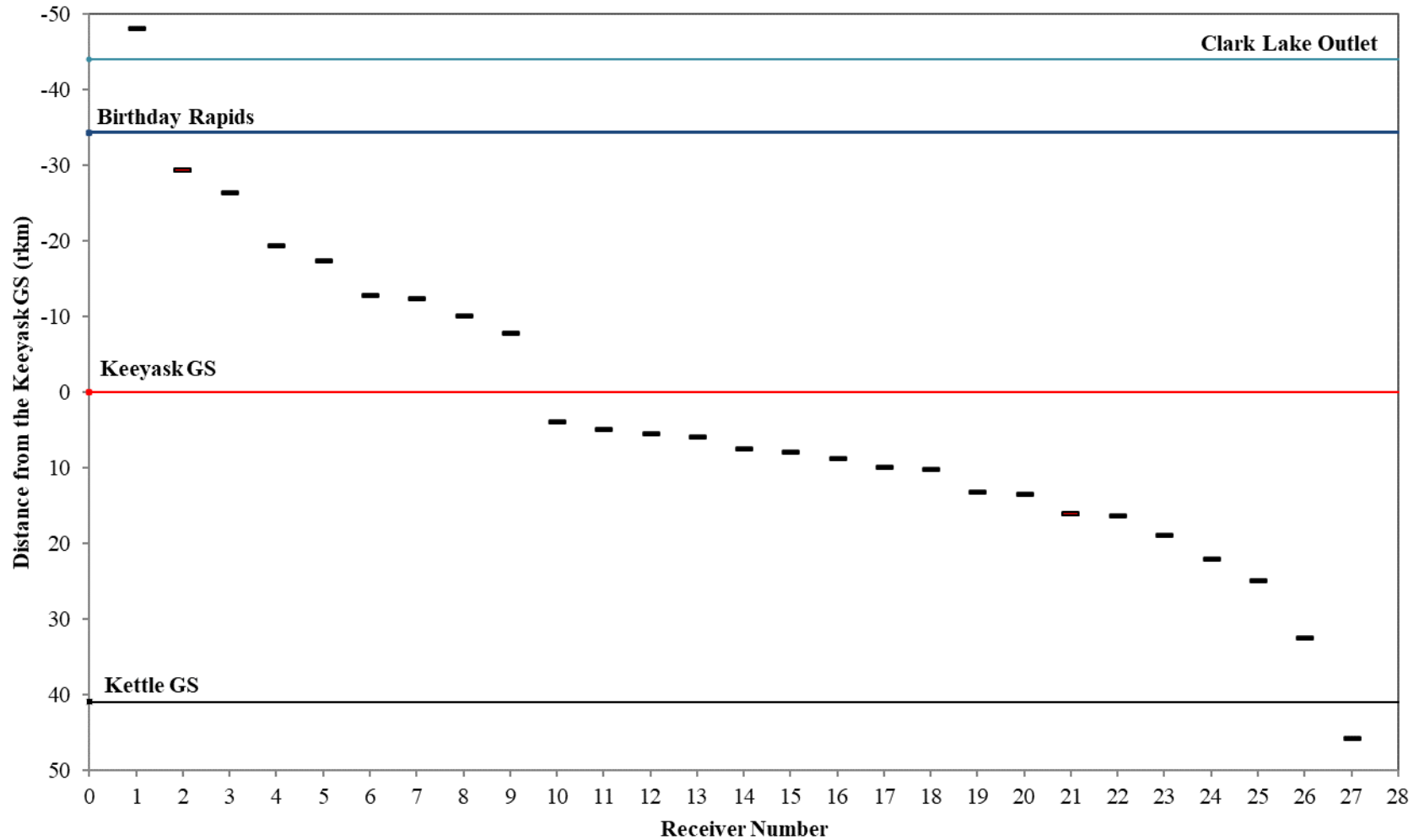


Figure 1: Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Kettle GS between October 2021 and May 2022. A red dash indicates a receiver that was lost.

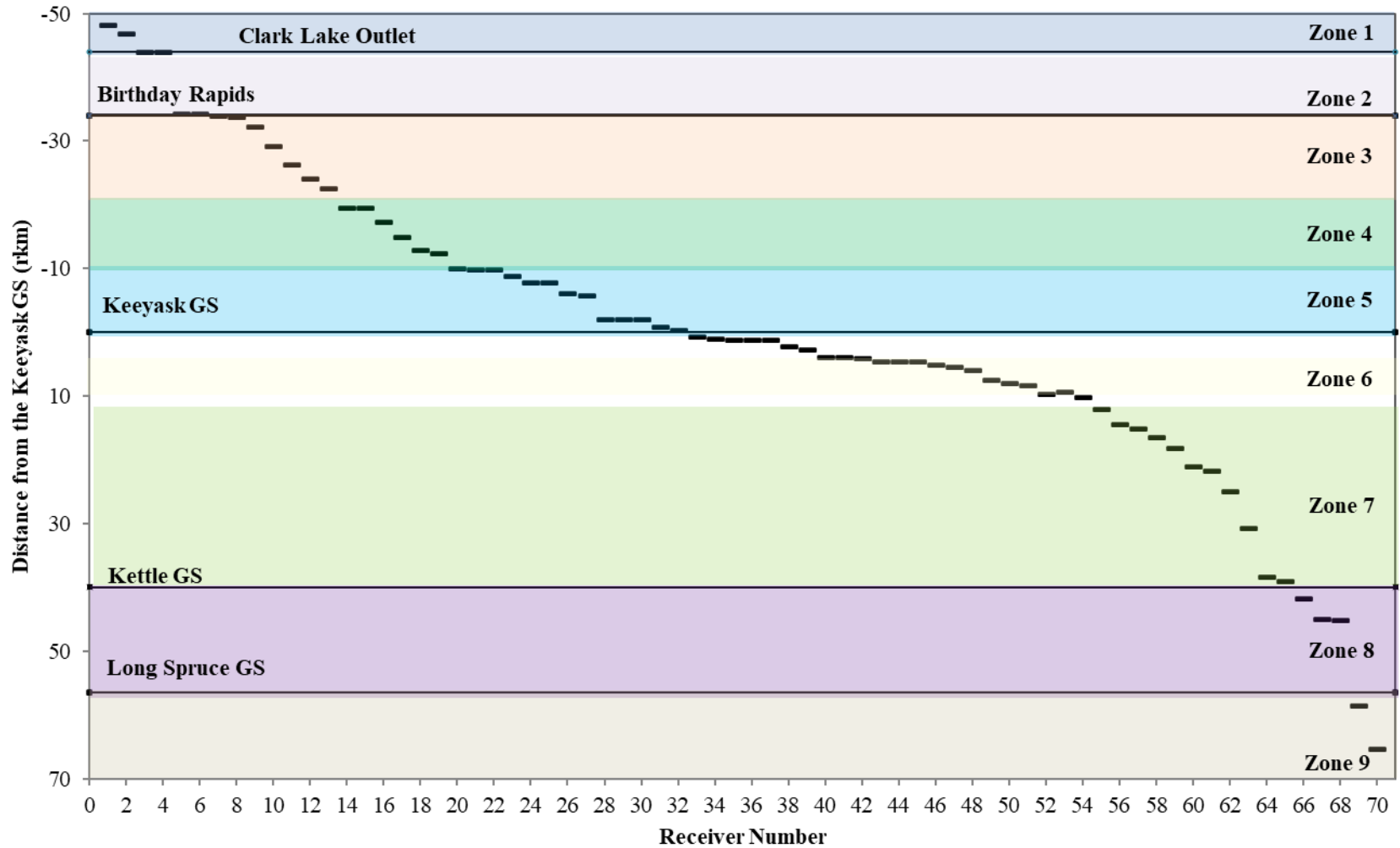


Figure 2: Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake (Zone 1) and the Limestone GS (Zone 9) between May and October, 2022. River zones upstream and downstream of The Keeyask GS are indicated by shading.

4.0 RESULTS

Section 4.1 provides a summary of movements observed for all active tags since the date of tagging to the time that tags expired in July 2022. A detection summary by season and year, including the farthest upstream and downstream detection locations for each tagged whitefish, is presented in Appendix 1. Individual movement summaries for each Lake Whitefish tagged in 2017 are presented in Appendices 2 and 3.

4.1 2017-2022 RESULTS SUMMARY

4.1.1 UPSTREAM OF THE KEEYASK GS

Twenty-two Lake Whitefish were tagged upstream of the Keeyask GS in October 2017. Prior to winter 2021/2022, three moved downstream through the Keeyask GS into Stephens Lake:

- #31727 was tagged on October 12, 2017 immediately downstream of Birthday Rapids and moved downstream through Gull Rapids between November 10, 2017, and May 30, 2018. It made multiple upstream and downstream movements before moving to rkm 16.8 on June 25, 2018. It had been detected constantly at this location and is considered a mortality and is not discussed in the remainder of this report (Appendix A2-3).
- #31738 was tagged on October 11, 2017 immediately downstream of Birthday Rapids and moved downstream through Gull Rapids on July 26, 2018 (Appendix A2-14).
- #31740 moved downstream through Gull Rapids immediately after it was tagged on October 11, 2017. It was detected in Stephens Lake for 20 days before moving downstream through the Kettle GS. It was first detected in the Long Spruce reservoir on January 29, 2018 (Appendix A2-16).

Three fish are missing and based on the time since tagging, it is likely that these tags have now expired.

- #31728 was last detected in middle Keeyask reservoir (rkm -26.5) on October 6, 2019 (Appendix A2-4).
- #31737 was last detected downstream of Birthday Rapids on October 9, 2020 (Appendix A2-13).
- #31744 was last detected in the middle Keeyask reservoir (rkm -26.5) on June 7, 2018 (Appendix A2-20).

Therefore, accounting for the three fish that moved downstream and the three fish that are considered missing, 16 Lake Whitefish were available to be detected upstream of the Keeyask GS at the beginning of the 2021/2022 winter period.

4.1.2 STEPHENS LAKE

Forty Lake Whitefish were tagged in Stephens Lake in October 2017. Twenty-eight fish were only detected briefly after tagging and/or are missing and, based on the time since tagging, likely have tags that have expired. These fish are not discussed for the remainder of the report.

- #31698 was last detected in the upstream portion of Stephens Lake on October 15, 2017 (Appendix A3-1).
- #31701 was tagged on October 9, 2017 immediately downstream of the GS construction site. It was never detected after tagging (Appendix A3-4).
- #31704 was last detected in upper Stephens Lake on October 1, 2020 (Appendix A3-7).
- #31706 was tagged on October 9, 2017 immediately downstream of the GS construction site. It moved immediately downstream and was last detected 6.5 km downstream of the GS on October 15, 2017 (Appendix A3-9).
- #31707 was last detected in upper Stephens Lake on February 28, 2019 (Appendix A3-10).
- #31708 was last detected on September 15, 2018 in upper Stephens Lake (Appendix A3-11).
- #31710 was last detected in upper Stephens Lake on September 10, 2019 (Appendix A3-13).
- #31711 was detected for eight days in 2017 and was last detected on October 26, 2017 (Appendix A3-14).
- #31712 was last detected on July 1, 2018, 16.8 km downstream of the GS (Appendix A3-15).
- #31713 was last detected on October 14, 2017 moving between upper and lower Stephens Lake (Appendix A3-16).
- #31714 was last detected on October 27, 2020 moving between upper and southern Stephens Lake (Appendix A3-17).
- #31717 was last detected on October 20, 2017 in lower Stephens Lake (Appendix A3-20).
- #31718 was tagged on October 9, 2017 immediately downstream of the GS construction site. It was detected briefly near the GS after tagging and was located in upper Stephens Lake for two days in June 2018 (Appendix A3-21).
- #31719 was tagged on October 9, 2017 immediately downstream of the GS construction site. It was detected briefly in upper Stephens Lake after tagging (Appendix A3-22).
- #31720 was detected in upper Stephens Lake until October 15, 2017 (Appendix A3-23).
- #31721 was last detected on October 15, 2017 in upper Stephens Lake (Appendix A3-24).

- #31723 moved between upper and lower Stephens Lake and was last detected on October 22, 2017 (Appendix A3-25).
- #31724 was last detected in upper Stephens Lake on August 11, 2020 (Appendix A3-26).
- #31725 was last detected on July 7, 2018 in lower Stephens Lake (Appendix A3-27).
- #31747 was last detected in upper Stephens Lake in September 2018 (Appendix A3-28).
- #31748 was last detected immediately upstream of the Kettle GS on June 14, 2019 (Appendix A3-29).
- #31749 was last detected in lower Stephens Lake in June 2018 (Appendix A3-30).
- #31751 was last detected on August 10, 2018 in lower Stephens Lake (Appendix A3-32).
- #31752 displaying upstream and downstream movements throughout Stephens Lake until November 30, 2017(Appendix A3-33).
- #31755 moved throughout upper Stephens Lake after tagging and was last detected on October 14, 2017 (Appendix A3-36).
- #31757 was last detected on September, 2018 in lower Stephens Lake (Appendix A3-38).
- #53761 was last detected in lower Stephens Lake on July 28, 2019 (Appendix A3-39).
- #53762 was last detected on June 9, 2018 in lower Stephens Lake (Appendix A3-40).

One fish moved downstream out of Stephens Lake through the Kettle GS into the Long Spruce reservoir:

- #31756 was tagged on October 8, 2017 immediately downstream of the GS construction site. It moved between upper and lower Stephens Lake until October 26, 2017, when it began to move downstream. It was last detected in Stephens Lake on October 29, 2017. It was detected in the Long Spruce reservoir on November 1, 2017 (Appendix A3-37).

In summary, 40 Lake Whitefish were tagged in Stephens Lake in 2017, 28 of which are missing or have expired tags, and one of which moved downstream through the Kettle GS. Three fish moved downstream through the site of the Keeyask GS, one of which continues to be detected in Stephens Lake (Section 4.1.1). Therefore, 12 fish were available to be detected in Stephens Lake during winter 2021/2022.

4.2 WINTER 2021/2022

Water temperature, as measured in the Nelson River mainstem, reached 9°C on October 16, 2021, and decreased to 6°C by October 25 (Figure 3). Based on these water temperatures, the time between October 16 and 25 is referred to as the spawning period.

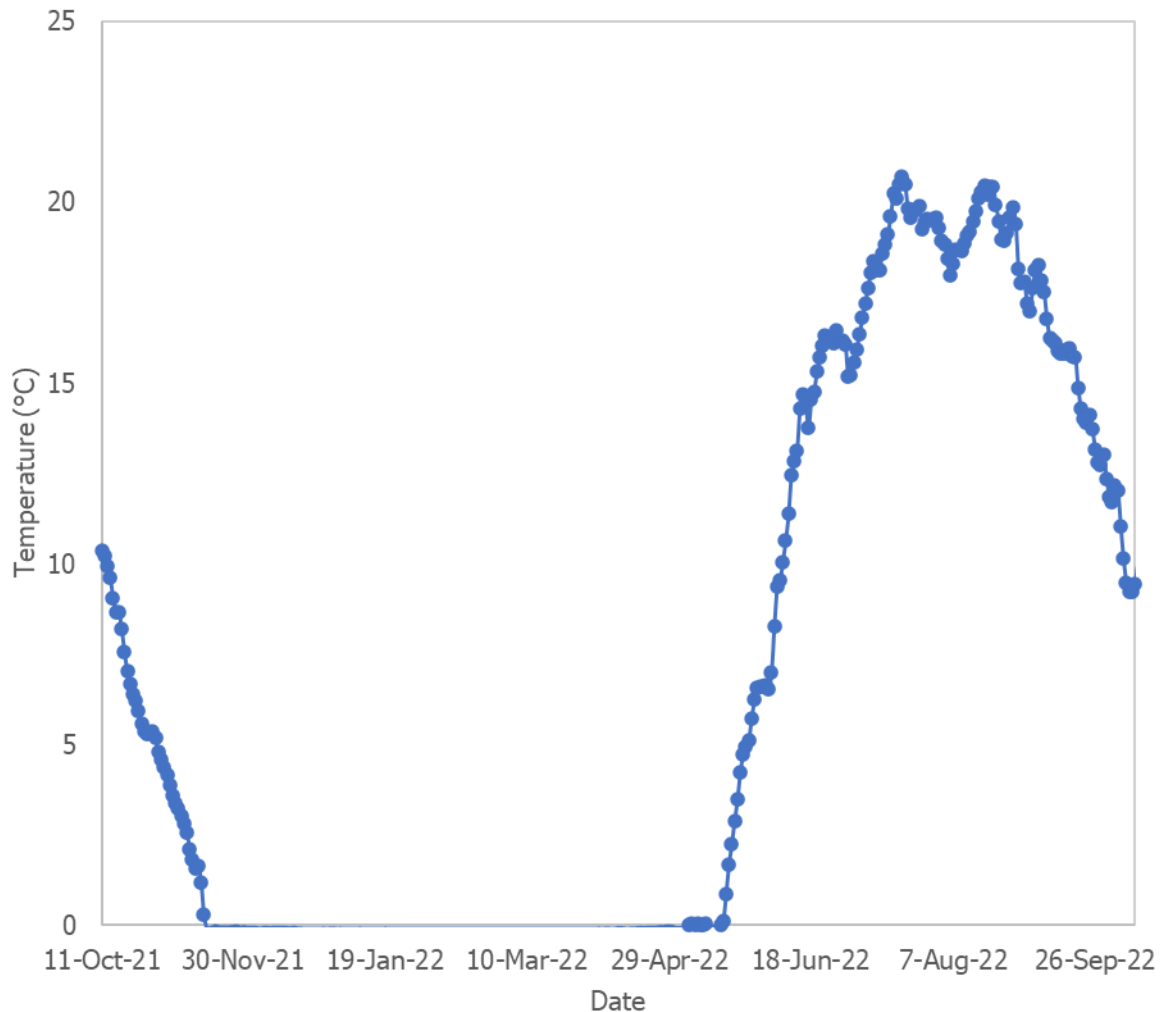


Figure 3: Water temperature in the Nelson River mainstem from October 4, 2021, to October 16, 2022.

4.2.1 UPSTREAM OF THE KEEYASK GS

All nine receivers deployed between Clark Lake and the Keeyask GS during the 2021/2022 winter period were retrieved (Figure 1). Fifteen of 16 (94%) Lake Whitefish available for detection were located a total of 19,927 times (range: 43–3,142 detections per individual) (Figure 4; Appendix A1-1). Fish were detected on three to 80 days of the 217-day winter period (1–37% of the time) for an average of 20 days, or for 9% of the study period (standard deviation [StDev] = 19 days). Detections were logged at all receivers, with the farthest upstream in Clark Lake (rkm - 48.2; four fish; 27%) and the farthest downstream in lower Gull Lake (rkm -7.9; two fish; 13%). During the 2021 spawning period (October 16–25), nine fish (60%) were at the receiver closest to Birthday Rapids.

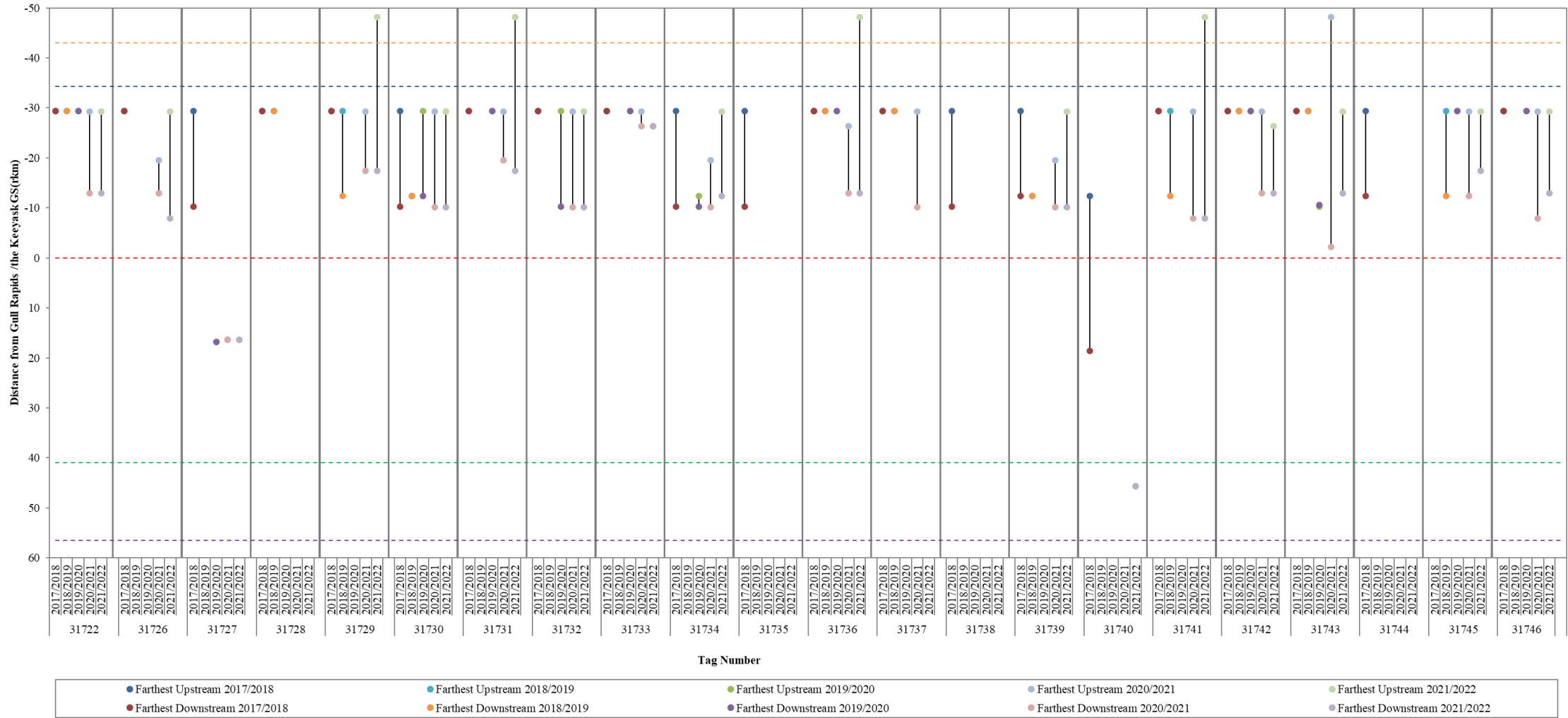


Figure 4: Detection ranges for individual Lake Whitefish (n = 22) tagged with acoustic transmitters upstream of the Keeyask GS during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids; red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).



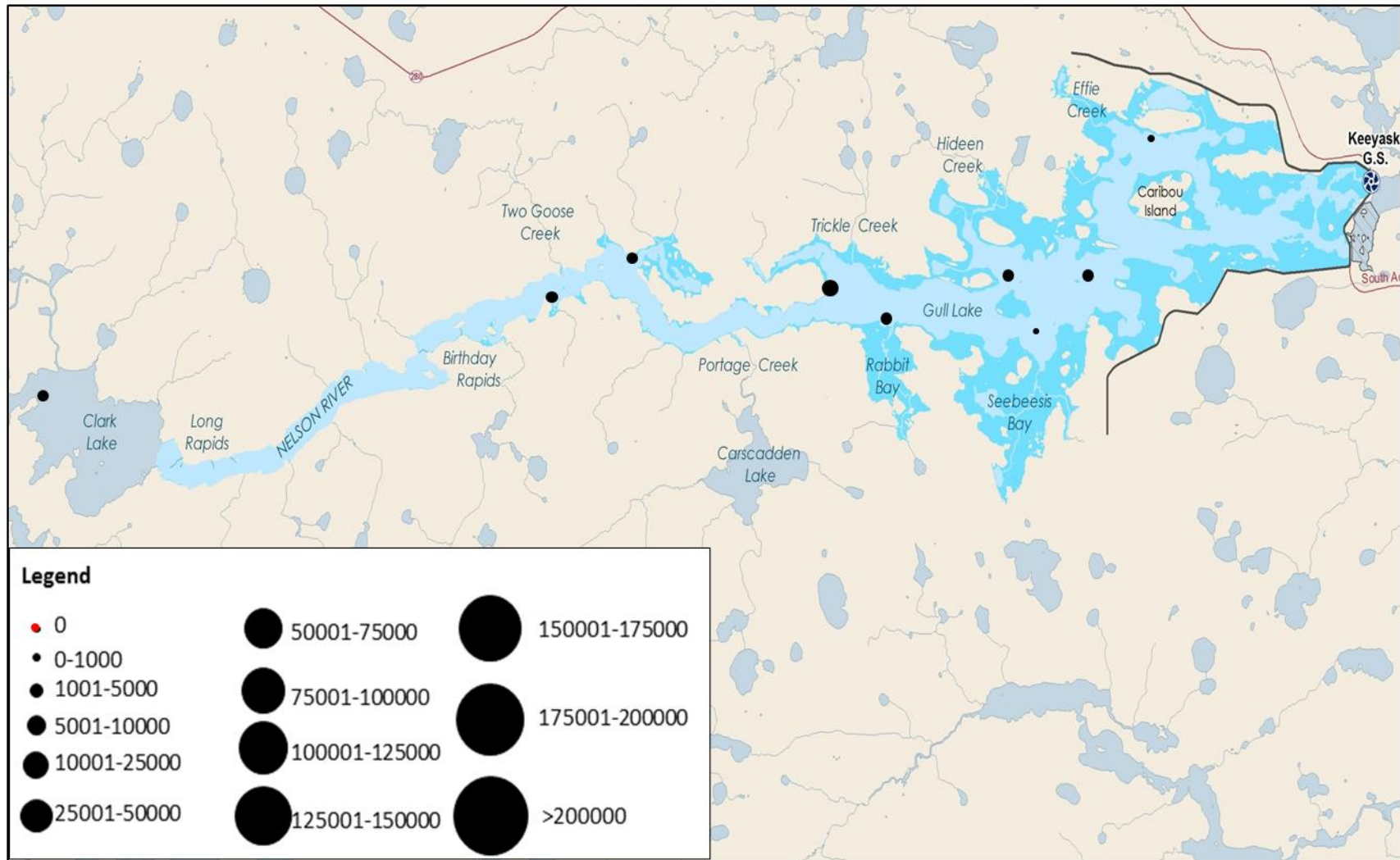


Figure 5: Relative number of detections at each acoustic receiver set between Clark Lake and the Keyyask GS during winter 2021/2022 (October 11, 2021 to May 15, 2022). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

The majority of detections were logged by receivers located at the inlet of Gull Lake ($n = 6,778$; 34%; Figure 5). Movements were as follows:

- Eleven fish (73%) moved between the middle Keeyask reservoir and Gull Lake. These fish were detected as far upstream as rkm -29.3 (just downstream of Birthday Rapids) and as far downstream as lower Gull Lake (rkm -7.9).
- Four (27%) moved as far upstream as Clark Lake (rkm -48.2).
 - Three (#31729, #31736, #31741) were detected here briefly following the spawning period (in early November 2021) and returned to Gull Lake prior to the end of the winter period.
 - #31731 we last detected at the inlet to Clark Lake and likely moved upstream past the receiver array. It returned downstream to the Keeyask reservoir during the 2022 open-water period (Section 4.3.1).

Individual movement graphs can be found in Appendix 2.

4.2.2 STEPHENS LAKE

All of the 17 receivers deployed in Stephens Lake during the 2021/2022 winter period were retrieved. Seven of 12 (58%) of Lake Whitefish available for detection were located a total of 19,827 times (range: 12– 14,979 detections per individual) (Figure 6; Appendix A1-2). Fish were detected on one to 120 days of the 217-day winter period (0.5–55% of the time) for an average of 29 days, or 13% of the study period (StDev = 59 days). The farthest upstream detections occurred at rkm 3.9 (by all seven fish), while the farthest downstream occurred at rkm 18.8 (by one fish; 13%). The average total movement range was 5.9 rkm (range: 0.0–14.9 rkm).

The majority of detections were logged in the southern portion of Stephens Lake by a single fish (#31699) at rkm 13.4 ($n = 6,288$; 32%) (Figure 7). Two fish moved as far downstream as rkm 16.1 and 18.8, while the remaining five fish moved throughout the upper portion of Stephens Lake, as far upstream as rkm 3.9 and as far downstream as rkm 8.7.

Individual movement graphs can be found in Appendix 3.

4.2.3 LONG SPRUCE RESERVOIR

One fish (#31740) was detected in the Long Spruce reservoir. This fish was detected exclusively at rkm 45.7 ($n = 32$) for a single day on December 3. It has consistently been detected at this location since its first detection in the Long Spruce reservoir on September 19, 2020.

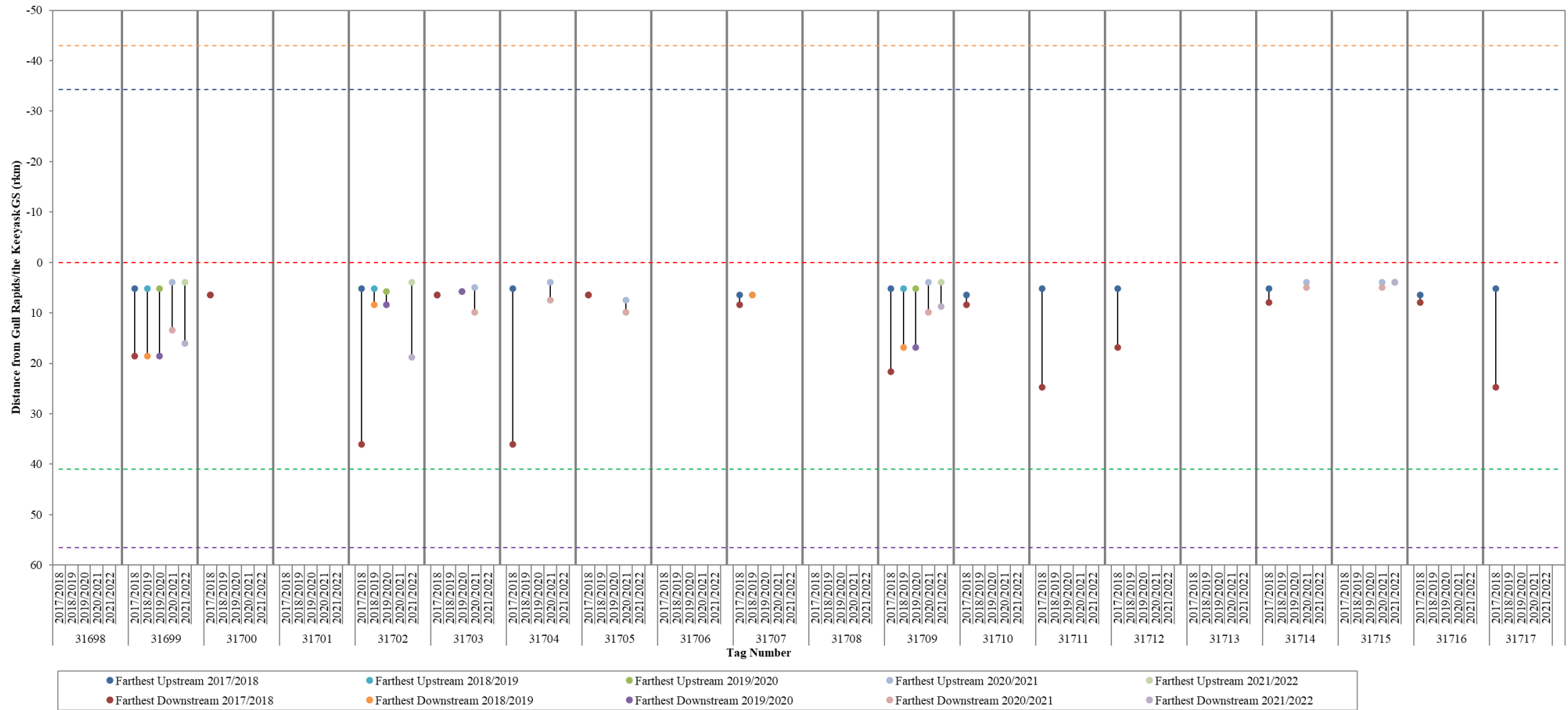


Figure 6: Detection ranges for individual Lake Whitefish (n = 40) tagged with acoustic transmitters in Stephens Lake during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids; red = the Keyask GS; green = Kettle GS; purple = Long Spruce GS).



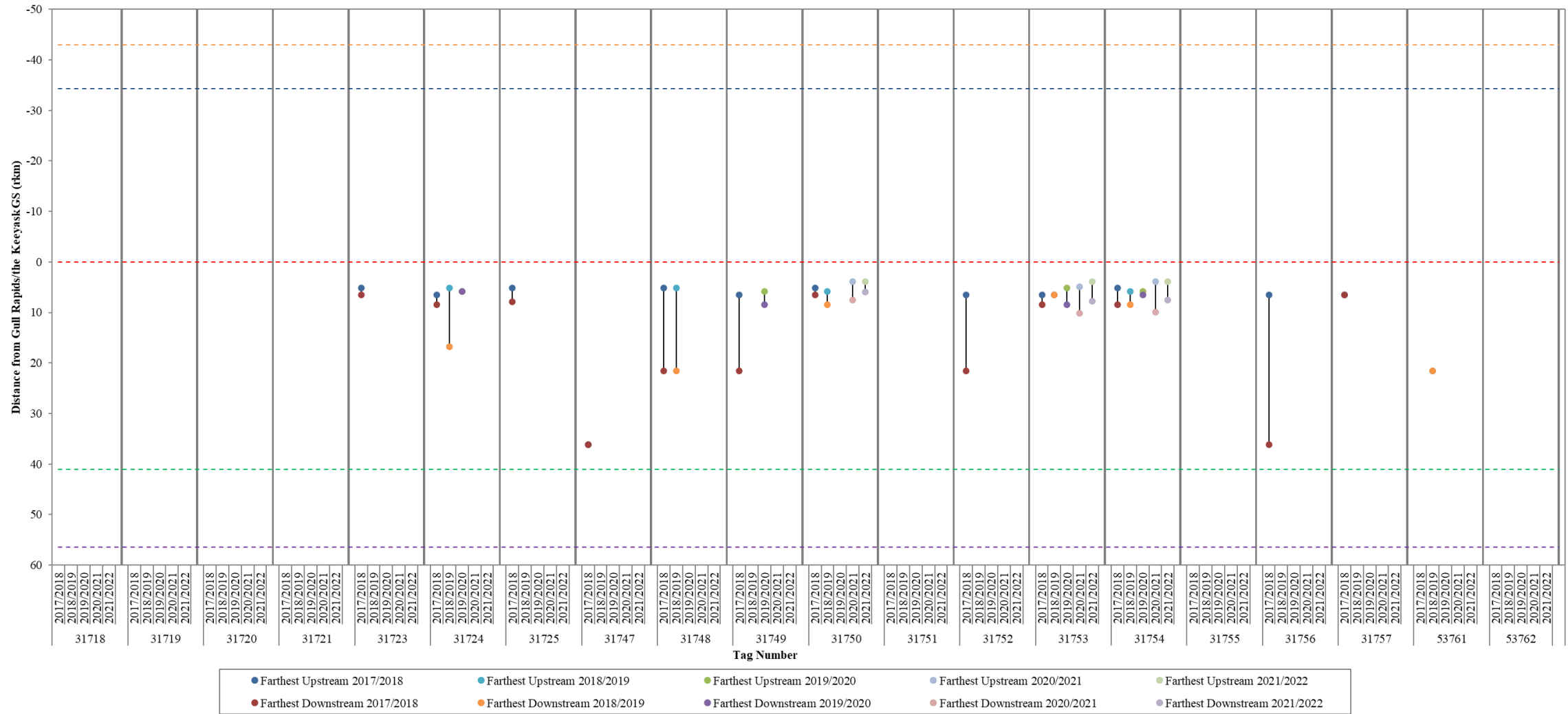


Figure 6: Detection ranges for individual Lake Whitefish (n = 40) tagged with acoustic transmitters in Stephens Lake during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids; red = the Keyyask GS; green = Kettle GS; purple = Long Spruce GS) (continued).



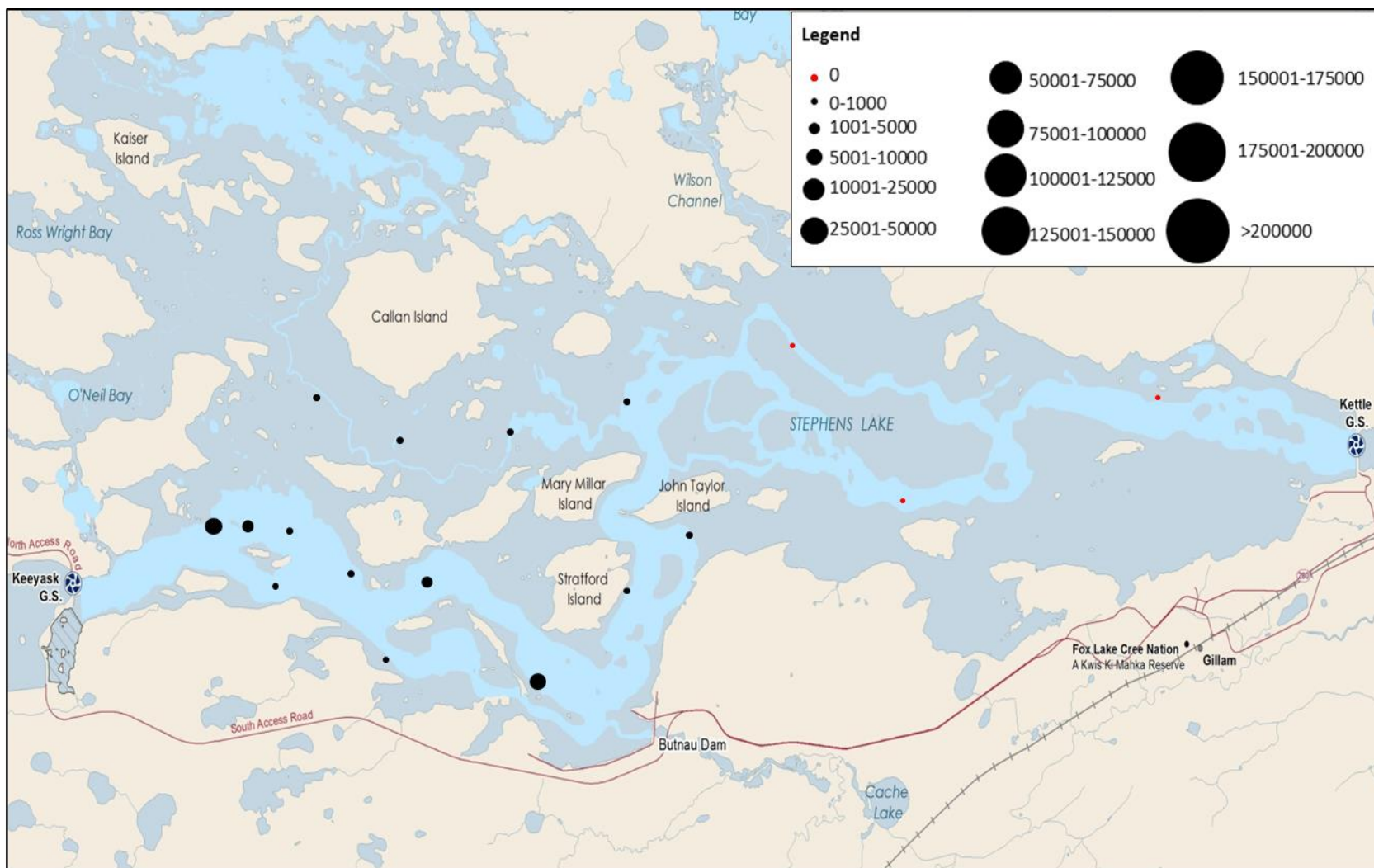


Figure 7: Relative number of detections at each acoustic receiver set in Stephens Lake during winter 2021/2022 (October 11, 2021 to May 15, 2022). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

4.3 OPEN-WATER 2022

As all Lake Whitefish in this study were initially tagged in 2017, acoustic tags were set to expire during the 2022 open-water period. Final detection dates ranged between July 10 and 17, 2022. Therefore, the 2022 open-water period was defined as May 16–July 17, encompassing only 63 days.

All stationary acoustic receivers deployed upstream of the Keeyask GS ($n = 32$), downstream of the Kettle GS ($n = 3$), and downstream of the Long Spruce GS ($n = 2$) during the 2022 open-water period were successfully retrieved (Maps 4–6). One of the 33 receivers deployed in Stephens Lake (#108002; rkm 21.7) went missing part way through the open-water period. No data were retrieved from this receiver after August 19, 2022 (Map 6).

4.3.1 UPSTREAM OF THE KEEYASK GS

Fifteen of 16 (94%) Lake Whitefish available for detection were located upstream of the Keeyask GS during the 2022 open-water period. Fish were detected 30–4,091 times for 2–29 days of the 63-day open-water period (3–46% of the time) for an average of 14 days, or 22% of the study period (StDev = 9 days) (Appendix A1-3). The average movement range was 4.3 rkm (StDev = 3.6 rkm; range: 0.0–9.6 rkm). The farthest upstream detections occurred in the middle Keeyask reservoir (rkm -26.4; by two fish; 13%), while the farthest downstream detections occurred in lower Gull Lake at rkm -6.2 (by one fish; 7%) (Figure 8). No tagged fish moved downstream through the Keeyask GS. Most detections occurred in Gull Lake; at rkm -12.9 ($n = 5,958$; 38%) and near the entrance at rkm -19.5 ($n = 4,655$; 30%) (Figure 9).

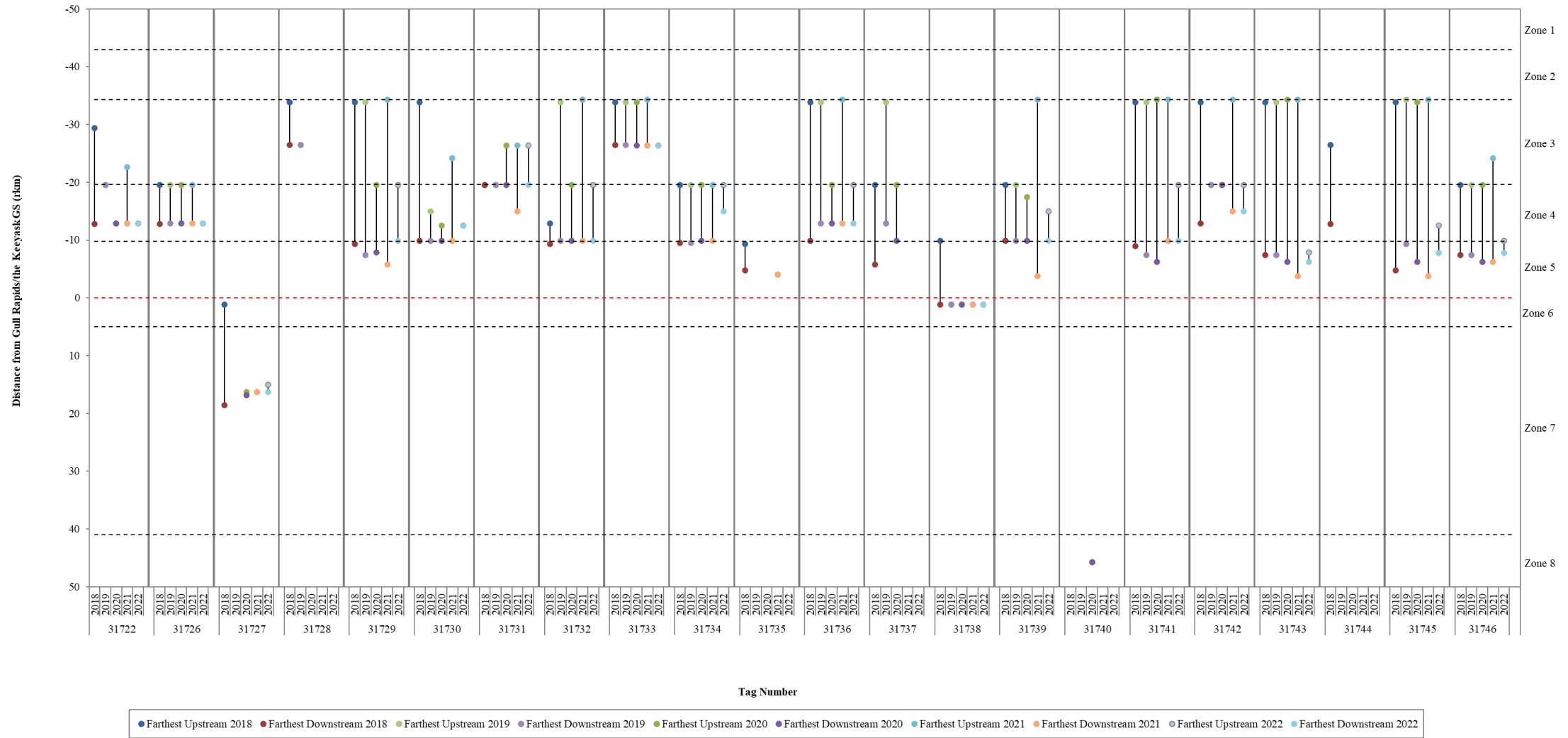


Figure 8: Detection ranges for individual Lake Whitefish (n = 22) tagged with acoustic transmitters upstream of the Keyask GS during the 2018 (May 1 to October 10), 2019 (May 1 to October 7), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to July 17) open-water periods. Horizontal dotted lines demarcate zones with the red line representing the Keyask GS.



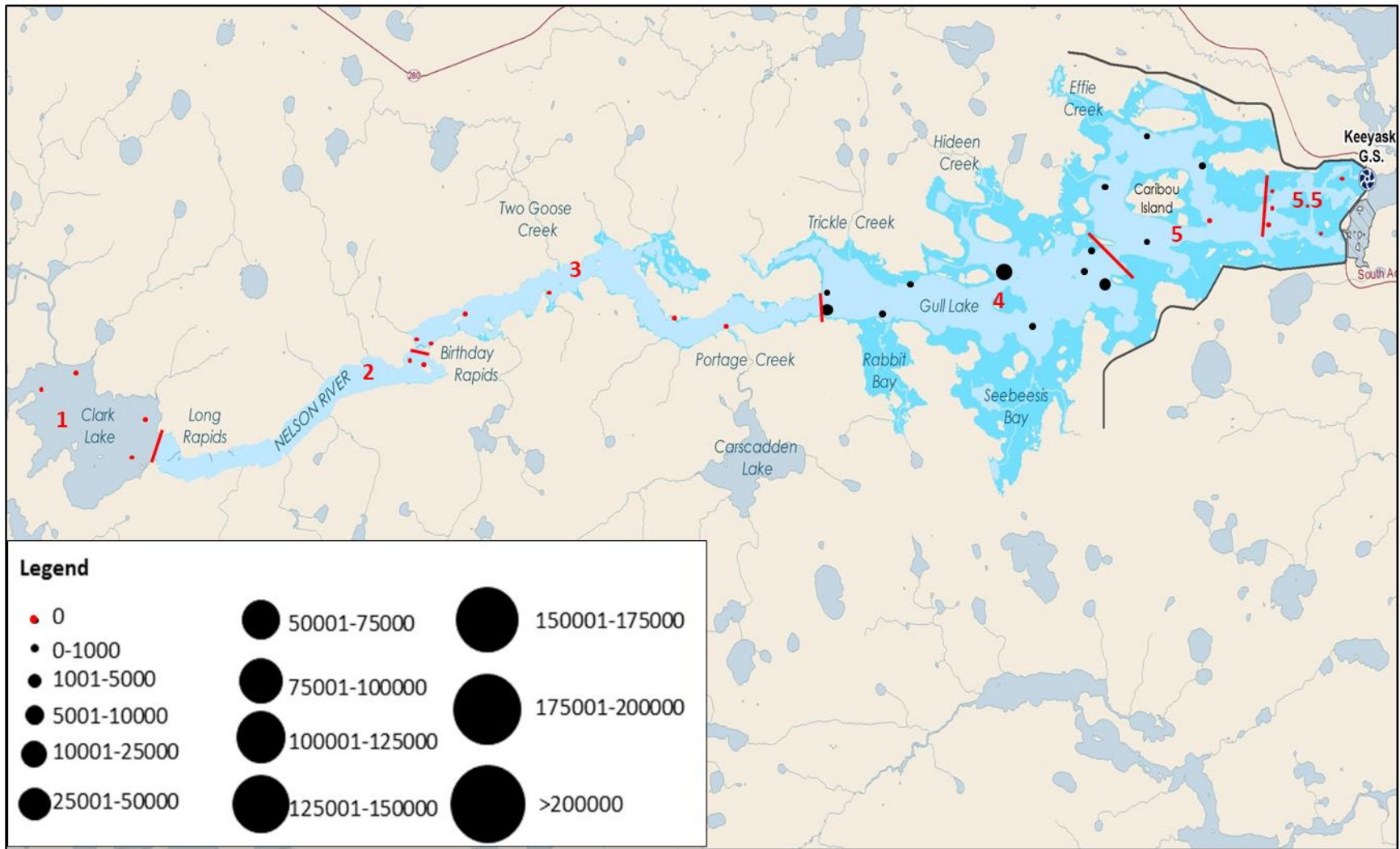


Figure 9: Relative number of detections at each acoustic receiver set in the Nelson River between Clark Lake and the Keeyask GS during the 2022 open-water period (May 16 to July 17). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot. The river is divided into six "zones" based on placement of receiver "gates."

4.3.1.1 PROPORTIONAL DISTRIBUTION

Lake Whitefish were detected most often in Zone 4 in upper Gull Lake, spending an average of 78% of the study period in this zone (StDev = 42%, range: 0–100%) (Table 3). Lake Whitefish were detected for an average of 7% of the study period in Zone 3 (the middle Keeyask reservoir; StDev = 25%; range: 0–95%) and 15% of the study period in Zone 5 in lower Gull Lake (StDev = 36%; range: 0–100%). No whitefish were detected in Zones 1 (Clark Lake), 2 (between Clark Lake and Birthday Rapids), and 5.5 (immediately upstream of the Keeyask GS). Because all transmitters expired in July, fish were only tracked for a small portion of the 2022 open-water period, and therefore proportional distributions are not directly comparable to previous years.

Table 3: Proportion of time spent in each river zone by Lake Whitefish implanted with acoustic transmitters upstream of the Keeyask GS during a portion of the 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16), 2018 (June 6 to October 10), 2019 (June 2 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to July 17) open-water periods. Note that the 2022 open-water period is much shorter than previous years as tags expired.

Tagging Year	Study Year	Zone					
		1	2	3	4	5	5.5
2014	2015	0.2	0.5	32.0	45.4	21.9	-
	2016	6.6	5.6	20.8	50.3	16.6	-
	2017	18.8	0.5	19.1	51.3	10.2	-
	2018	0.0	0.0	21.6	55.0	23.4	-
2017	2019	0.0	0.0	16.8	66.9	16.3	-
	2020	0.0	0.0	8.7	69.4	22.0	-
	2021	0.0	2.3	13.4	68.5	15.7	-
	2022	0.0	0.0	6.8	78.1	15.0	0.0

4.3.1.2 MOVEMENT PATTERNS

Of the 15 fish detected at the beginning of the 2022 open-water period, 13 (87%) were exclusively detected in Gull Lake.

- Eleven were exclusively detected in the upper portion (Zone 4).
 - Six (#31729, #31732, #31734, #31736, #31741, and #31742) moved as far upstream as -19.5 rkm, near the entrance to the lake.
 - One (#31739) moved as far upstream as -15.0 rkm.
 - Two (#31722 and #31726) were exclusively detected at rkm -12.9.
 - One (#31730) was exclusively detected at rkm -12.5.
- One (#31743) was exclusively detected in the lower portion (Zone 5), moving between rkms -7.9 and -6.2.
- One (#31745) moved between both Zone 4 and 5 (rkms -12.5 to -7.8).

Two (13%) were detected in the middle Keeyask reservoir (Zone 3).

- One (#31733) was exclusively detected at rkm -26.4.
- One (#31731) moved between rkms -26.4 and -19.5.

No fish were detected immediately upstream of the Keeyask GS (Zone 5.5) or moving downstream through the GS during open-water 2022 (Figure 10).

4.3.2 STEPHENS LAKE

Six of 12 (46%) Lake Whitefish available for detection were located in Stephens Lake during the 2022 open-water period. These fish were detected between two and 22,650 times over two to 53 days of the 63-day open-water period (3–84% of the time) for an average of 21 days, or 33% of the study period (StDev = 18 days) (Appendix A1-4). The average total movement range was 5.4 rkm (StDev = 6.6 rkm; range: 0.0–16.1 rkm) (Figure 11). The farthest upstream detections occurred at rkm 1.0 (by one fish; 8%), while the farthest downstream detections occurred in lower Stephens Lake at rkm 22.0 (by one fish; 8%). The majority of detections ($n = 22,682$; 77%) were recorded by the receiver located near the Keeyask GS, near the North shore, at rkm 2.2, however, the majority of these detections ($n = 22,650$) were logged by a single fish (#31700) (Figure 12).

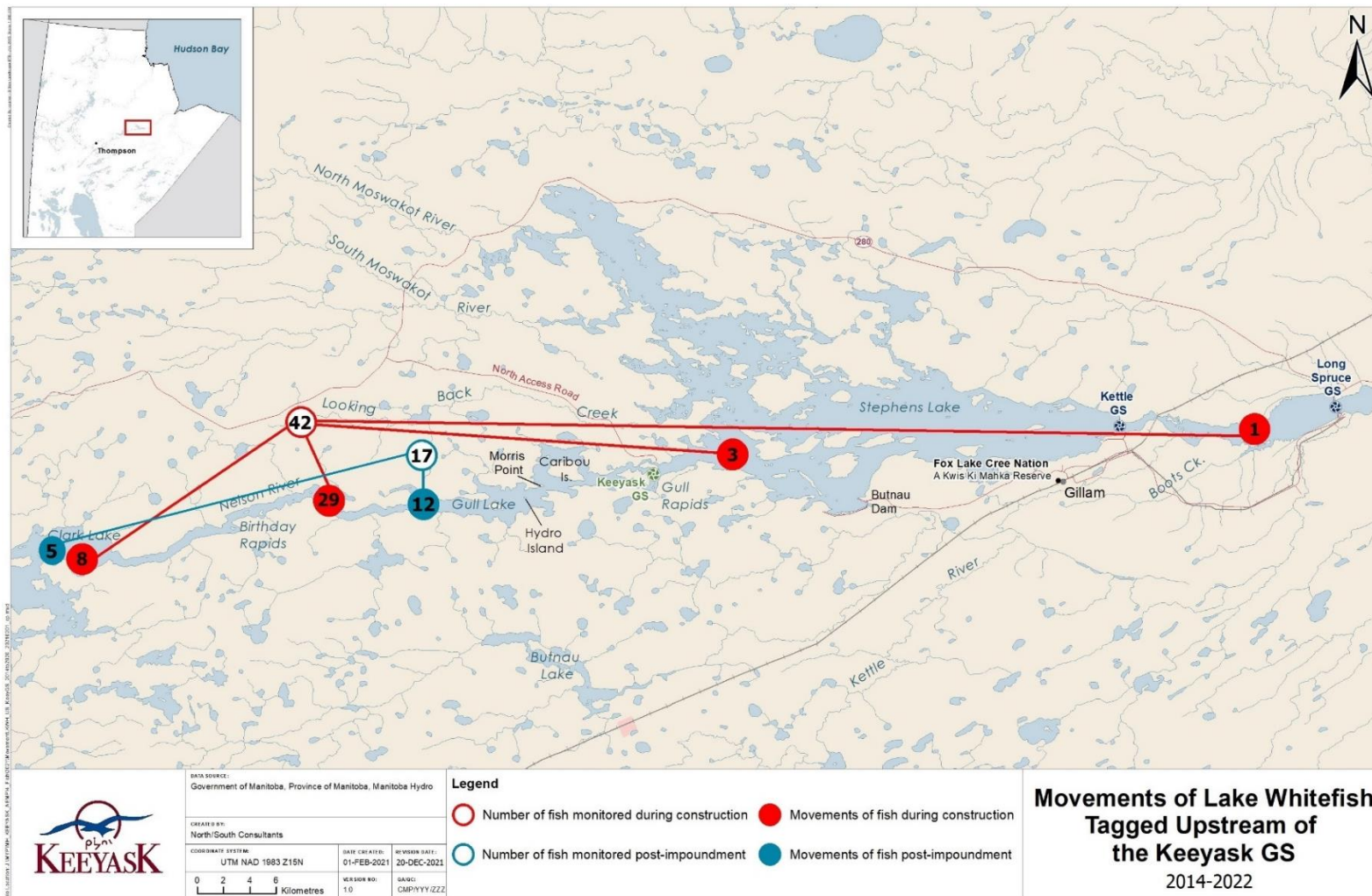


Figure 10: Map showing how many Lake Whitefish moved upstream to Clark Lake, stayed in the Keeyask reservoir, moved into Stephens Lake, and moved downstream through the Kettle GS during construction (red) and after reservoir impoundment (blue). Movements of fish due to tagging stress or mortality were not included. Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected.

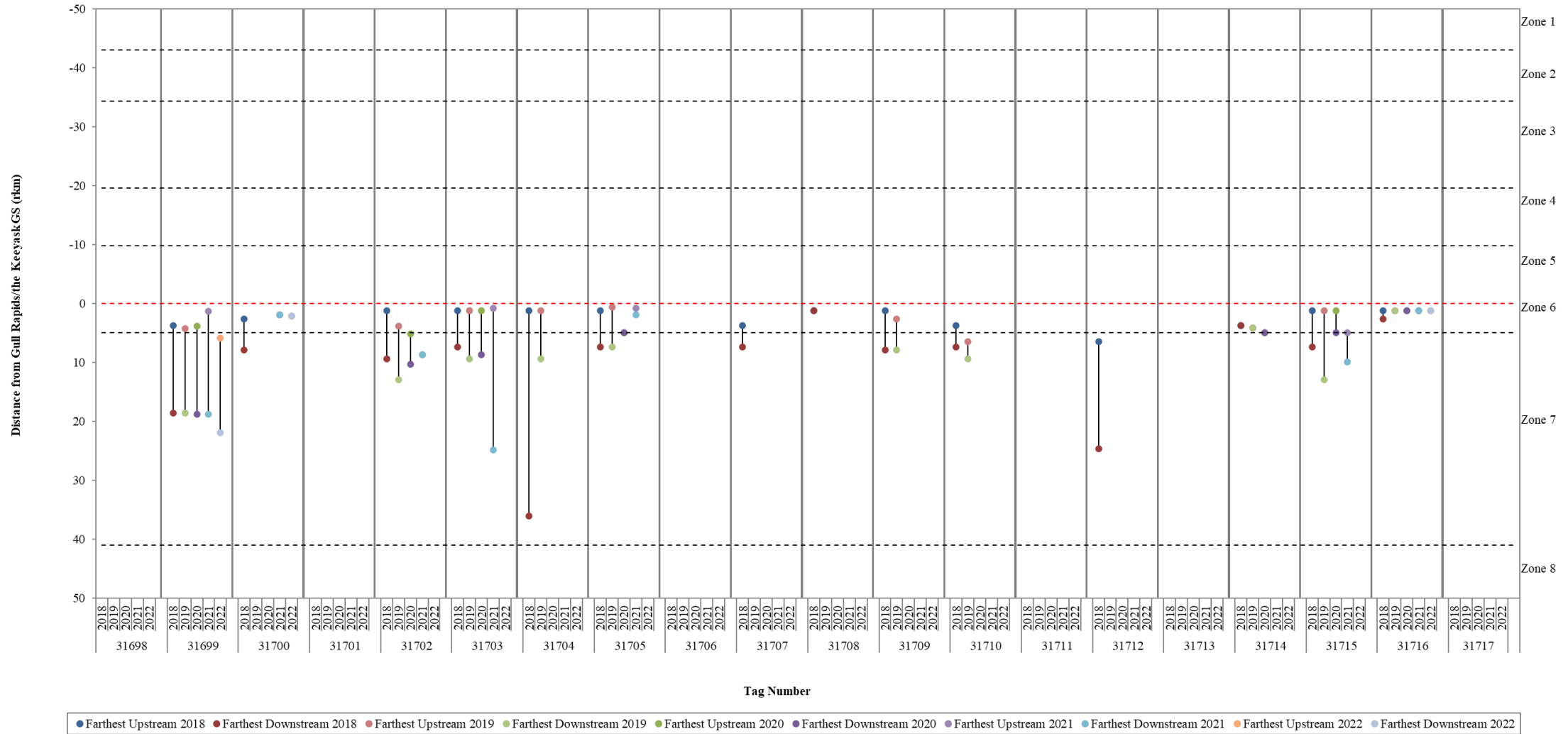


Figure 11: Detection ranges for individual Lake Whitefish (n = 40) tagged with acoustic transmitters in Stephens Lake during the 2018 (May 1 to October 10), 2019 (May 1 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to July 17) open-water periods. Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS.



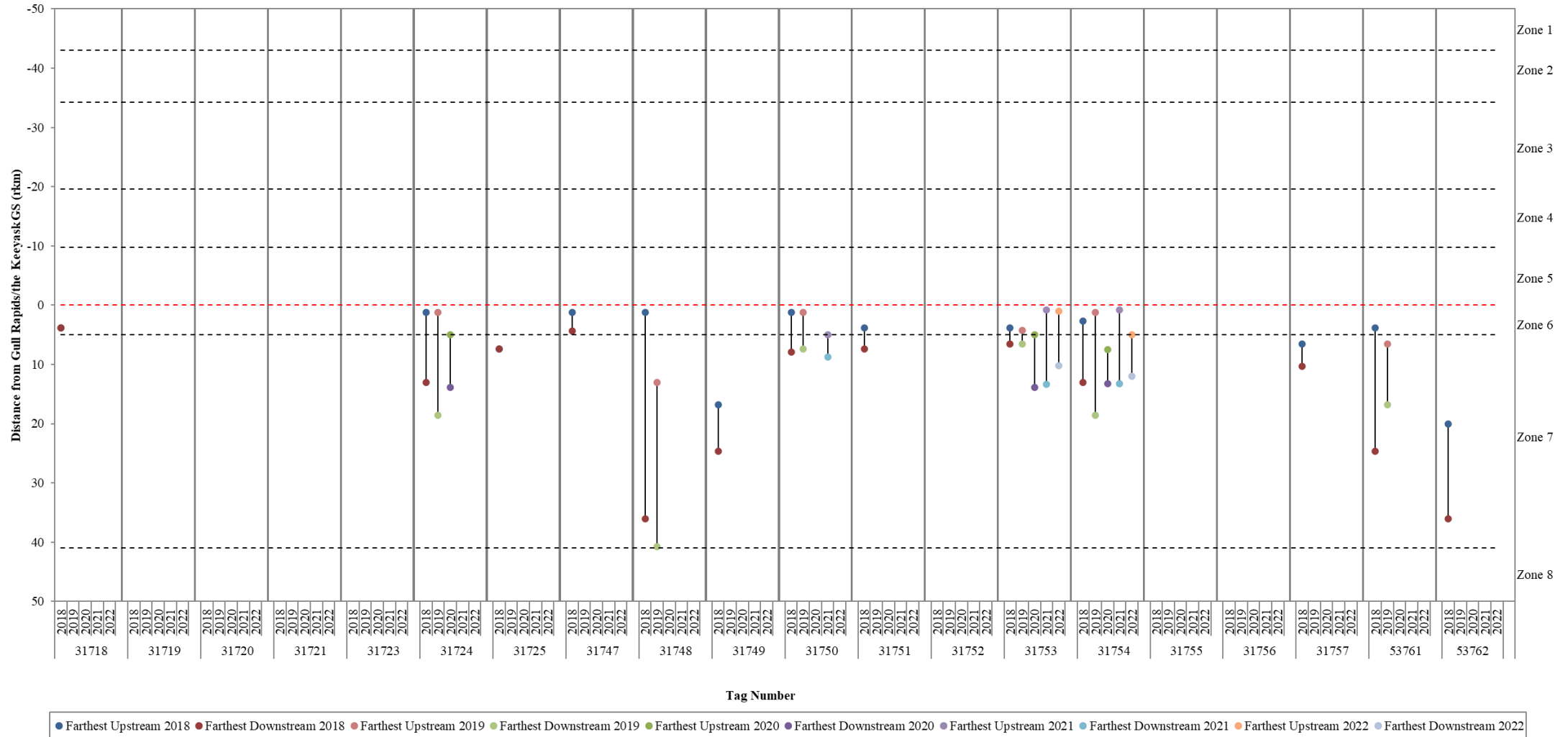


Figure 11: Detection ranges for individual Lake Whitefish (n = 40) tagged with acoustic transmitters in Stephens during the 2018 (May 1 to October 10), 2019 (May 1 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to July 17) open-water periods. Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).



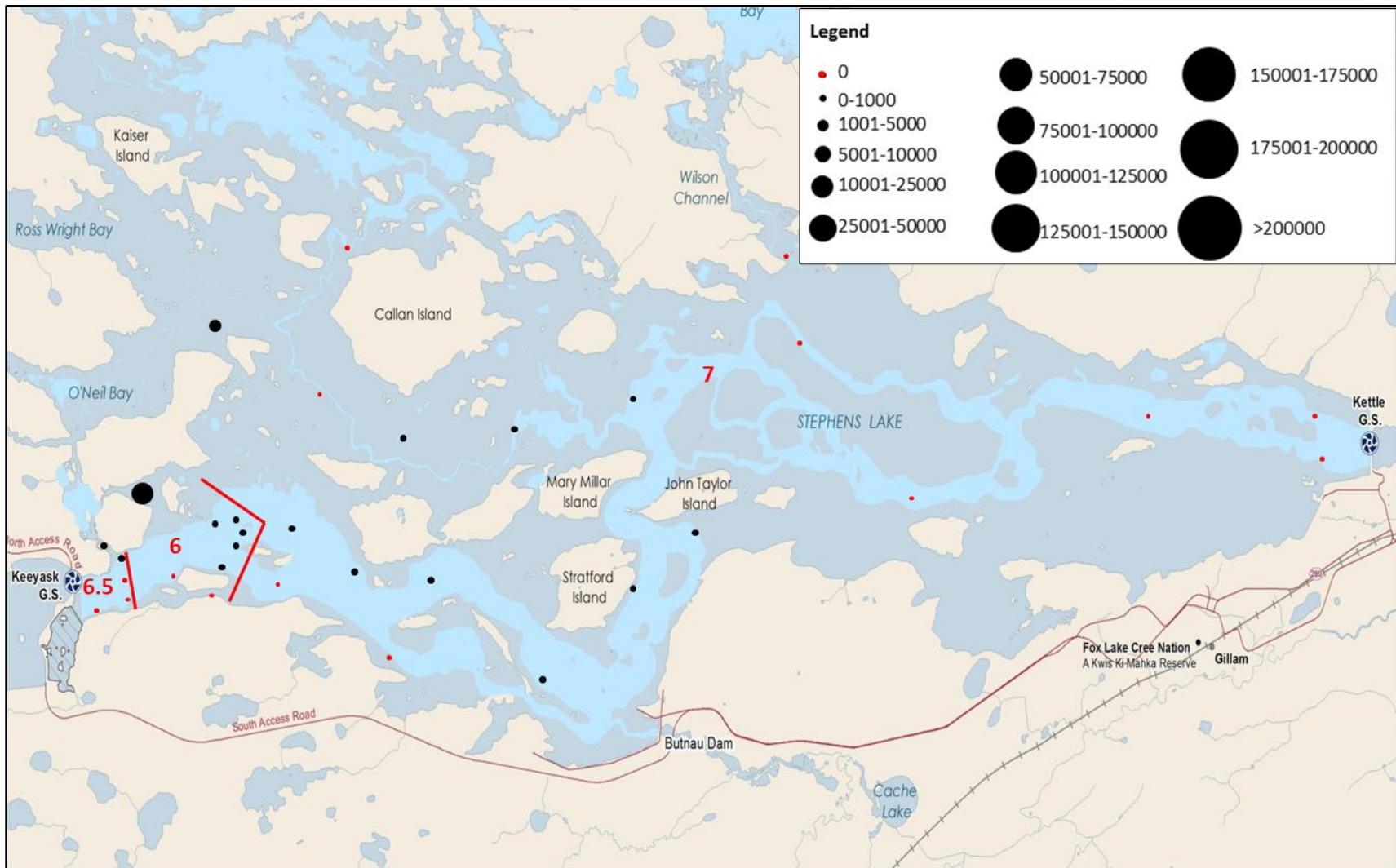


Figure 12: Relative number of detections at each acoustic receiver set in Stephens Lake during the 2022 open-water period (May 16 to July 17). Relative number of detections indicated by size of bubble. Receivers with no detections indicated with red dot. The river is divided into two "zones" based on placement of receiver "gates."

4.3.2.1 PROPORTIONAL DISTRIBUTION

Overall, Lake Whitefish spent slightly more time in Zone 7 (farther away from the Keeyask GS) than in Zones 6 and 6.5 during the 2022 open-water period (Table 4). On average, fish spent 57% of the time in Zone 7 (StDev = 45%; range: 0–100%) and 23% of the time in Zone 6 (StDev = 44%; range: 0–100%). Fish spent 20% of the time immediately downstream of the Keeyask GS in Zone 6.5 (StDev = 41%; range: 0–100%). Because all transmitters expired in July, fish were only tracked for a small portion of the 2022 open-water period, and therefore proportional distributions are not directly comparable to previous years.

Table 4: Proportion of time spent in each river zone by Lake Whitefish implanted with acoustic transmitters in Stephens Lake during a portion of the 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16), 2018 (June 6 to October 10), 2019 (June 2 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to July 17) open-water periods.

Tagging Year	Study Year	Zone		
		6.5	6	7
2014	2015	-	66.4	45.2
	2016	-	55.3	44.7
	2017	-	52.4	47.6
	2018	-	43.2	56.8
	2019	-	36.4	63.6
2017	2020	-	19.8	80.2
	2021	-	35.5	64.5
	2022	16.8	19.1	64.1

4.3.2.2 MOVEMENT PATTERNS

Of the six Lake Whitefish detected in Stephens Lake during the 2022 open-water period, four were detected exclusively in the upstream portion of Stephens Lake.

- Two (#31716 and #31738) were detected on the north shore downstream of the powerhouse at rkm 1.2.
- #31700 was detected in a bay on the north shore at rkm 2.2.
- #31753 moved between rkm 1.0 and 10.2.

Two moved farther downstream in Stephens Lake.

- #31699 moved between rkms 5.9 and 22.0. This fish has shown the same movement pattern since being tagged in 2017.
- #31754 moved between rkm 5.0 and 12.0.

No Lake Whitefish were observed moving downstream through the Kettle GS out of Stephens Lake (Figure 13).

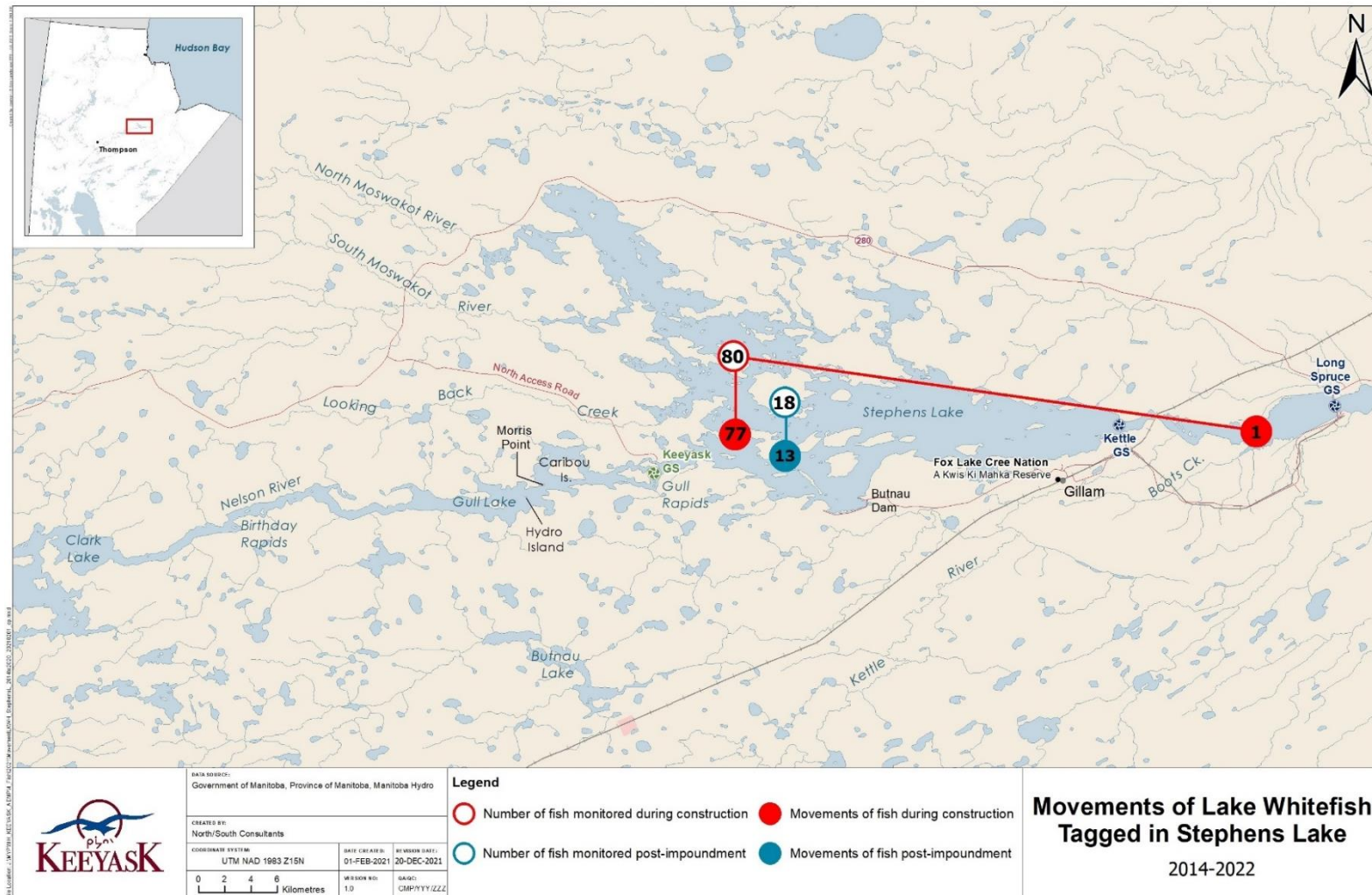


Figure 13: Map showing how many Lake Whitefish moved upstream through Gull Rapids (before it was no longer possible in 2018), stayed in Stephens Lake, and moved downstream through the Kettle GS during construction (red) and after reservoir impoundment (blue). Movements of fish due to tagging stress or mortality were not included. Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected.

4.3.3 LONG SPRUCE AND LIMESTONE RESERVOIRS

One fish (#31740) was detected in the Long Spruce reservoir in winter 2021/2022 and was available to be detected during open-water 2022. It was not detected and it is likely that this tag expired.

5.0 DISCUSSION

Lake Whitefish movement monitoring was initiated in 2014 to describe movements during the construction and early operation (2014–2022) phases of the Keeyask Project. The intent of the study was to determine if habitat changes associated with construction of the GS would alter habitat use and coarse-scale movement patterns. The discussion below highlights movement patterns that have been observed and discusses the key questions (presented in the AEMP) with respect to potential impacts of construction and impoundment on Lake Whitefish and their movements.

5.1 EVALUATION OF METHODOLOGY

Monitoring movements of Lake Whitefish is challenging because tagged individuals are often detected infrequently as they often use tributaries and off-current embayments where receivers are not located. Despite this, the data collected to date (2014 to 2022) provides a good understanding of Lake Whitefish movements. This has been facilitated by the extensive array of stationary acoustic receivers spread over a ~100 km length of the Nelson River between Clark Lake and the Limestone GS, and the inclusion of receiver gates which provide confidence that movements of Lake Whitefish past key points are being detected.

5.2 WINTER MOVEMENT

Prior to reservoir impoundment in 2020, tracking during the winter period was limited by ice conditions which prevented use of a large receiver array, and only four receivers were set upstream of the Keeyask GS. However, forebay impoundment in fall 2020 allowed for additional receivers to be set in the reservoir, due to the increase in deep off-current areas. During the 2021/2022 winter period, 15 of 16 (94%) Lake Whitefish available for detection were located an average of 20 days (9% of the study period), and in the 2020/2021 winter period, all 16 fish were located for an average of 34 days (16% of the study period). This represents an increase from previous years when the average number of detection days were relatively low (two to seven days between 2014 and 2020). In all study years, Lake Whitefish have been observed moving to the area downstream of Birthday Rapids during the early portion of the winter period and returning downstream. These detections are likely related to spawning and post-spawning movements and were observed both before and after reservoir impoundment.

The winter array in Stephens Lake is more extensive, and more fish are detected for a greater portion of the winter period than upstream. Lake Whitefish are detected in both zones in Stephens Lake, closer and farther from the GS, during winter. It is suspected that some fish overwinter in the North arm of Stephens Lake, out of the detection range of the receiver array.

5.3 OPEN-WATER MOVEMENT

Detection rates of individual tagged Lake Whitefish have remained high upstream of the Keeyask GS during the open-water period: in 2018 all fish (available to be detected) were detected, 89% in 2019, 94% in 2020 and all fish in 2021 and 2022. This was higher than the 47–80% detection rates observed prior to 2018. In Stephens Lake, 46%–86% of fish have been detected each year.

Because all transmitters expired in July, fish were only tracked for a small portion of the 2022 open-water period, and therefore movement patterns are not directly comparable to previous years. However, as seen in previous years, Lake Whitefish tagged upstream of the Keeyask GS continued to spend most of their time in Gull Lake. Since the study began in 2014, fish have consistently used the upper portion (Zone 4) farther from the GS, more frequently than the lower portion (Zone 5), closer to the GS. Lake Whitefish in Stephens Lake continued to use areas both closer to and farther from the GS. Some have consistently been detected within the northern portion of Stephens Lake and likely move into the North arm outside of the receiver array.

5.4 KEY QUESTIONS

Commissioning of the Keeyask GS was completed in March 2022, when all powerhouse units became operational. Therefore, 2022 represents the first year of monitoring during the operation period. Key questions identified in the AEMP, relevant to the operation period, are addressed below.

What is the frequency of downstream movement through the Keeyask GS and when are the movements occurring?

Monitoring the movement of Lake Whitefish for the last eight years has shown that movements past the site of the Keeyask GS are rare. A maximum of 14% of fish tagged in 2014 (two of 20 fish; 10%) and 2017 (three of 22 fish; 14%) have made this movement, with one considered a tagging mortality. No Lake Whitefish have moved through the Keeyask GS since reservoir impoundment in 2020.

What types of habitat are Lake Whitefish utilizing in the Keeyask reservoir (i.e., are fish using the upper, middle, or lower end of the reservoir)?

Lake Whitefish have continued to spend the majority of the open-water period in Zone 4 of the lower Keeyask reservoir since the study began in 2014. During the spawning period, many Lake Whitefish move to the area downstream of Birthday Rapids (the middle Keeyask reservoir; Zone 3). This has continued in the two spawning periods following reservoir impoundment. Results suggest that impoundment and initial operation of the Keeyask GS has not affected Lake Whitefish movement patterns.

What proportion of the fish population moves from the Keeyask reservoir upstream past Birthday and/or Long rapids?

Prior to reservoir impoundment, eight fish (40%) moved upstream through Birthday Rapids into Clark Lake (Figure 17). One fish made two upstream movements in both 2016 and 2017. Post-impoundment, five fish (23%) have made upstream movements into Clark Lake: one in winter 2020/2021 and four in winter 2021/2022. These upstream movements were singular and brief, and all five fish returned downstream to the lower Keeyask reservoir.

6.0 SUMMARY AND CONCLUSIONS

- Because all transmitters expired in July, fish were only tracked for a small portion of the 2022 open-water period, and therefore movement patterns are not directly comparable to previous years. However, as seen in previous years, Lake Whitefish tagged upstream of the Keeyask GS continued to spend most of their time in the lower Keeyask reservoir. Lake Whitefish in Stephens Lake continued to use areas both closer to and farther from the GS. Some have consistently been detected within the northern portion of Stephens Lake and likely move into the North arm outside of the receiver array.
- The key questions as described in the AEMP for Lake Whitefish movement monitoring following impoundment of the Keeyask GS are:
 - *What is the frequency of downstream movement through the Keeyask GS and when are the movements occurring?*

Monitoring the movement of Lake Whitefish for the last eight years has shown that movements past the site of the Keeyask GS are rare. A maximum of 14% of fish tagged in 2014 (two of 20 fish; 10%) and 2017 (three of 22 fish; 14%) have made this movement, with one considered a tagging mortality. No Lake Whitefish have moved through the Keeyask GS since reservoir impoundment in 2020.
 - *What types of habitat are Lake Whitefish utilizing in the Keeyask reservoir (i.e., are fish using the upper, middle, or lower end of the reservoir)?*

Lake Whitefish tagged in both 2014 and 2017 used the upper portion of Gull Lake (Zone 4) most frequently. Post-impoundment, fish continued to move upstream to Birthday Rapids in fall, likely related to spawning.
 - *What proportion of the fish population moves from the Keeyask reservoir upstream past Birthday and/or Long rapids?*

Prior to reservoir impoundment, eight fish (40%) moved upstream through Birthday Rapids into Clark Lake. One fish made two upstream movements in both 2016 and 2017. Post-impoundment, five fish (23%) have made upstream movements into Clark Lake: one in winter 2020/2021 and four in winter 2021/2022. These upstream movements were singular and brief, and all five fish returned downstream to Gull Lake.
- This study represents the final year of acoustic tracking for Lake Whitefish in the Keeyask Study Area. Lake Whitefish acoustic tracking was initiated in 2014 to describe movements during the construction and early operation (2014–2022) phases of the Keeyask Project. The intent of the study was to determine if habitat changes associated with construction of the GS would alter habitat use and coarse-scale movement patterns. Overall, there has been no indication that Lake Whitefish movement patterns have changed as a result of the Project. Lake Whitefish tagged upstream of the Keeyask GS have consistently spent most of their time in Gull Lake, moving to Birthday Rapids in the fall, most likely to spawn.

Lake Whitefish in Stephens Lake use areas both closer to and farther from the GS. Some have consistently been detected within the northern portion of Stephens Lake and likely move into the North arm outside of the receiver array. Movements downstream through the Keeyask GS have been rare since the study began in 2014 and no Lake Whitefish have moved downstream through the GS since reservoir impoundment. Similarly, there has been no observed increase in Lake Whitefish movements upstream into Clark Lake.

- Coarse-scale movements of Lake Whitefish will continue to be monitored using mark-recapture methods. Spawn and fish community monitoring programs will continue to track abundance and spawning success.

7.0 LITERATURE CITED

- Barth, C.C., Neufeld, L.J. and Olynik, J.R. 2003. Movements of Northern Pike, Walleye, and Lake Whitefish tagged with radio and acoustic transmitters in the Gull (Keeyask) Study Area, 2001/2002. A report prepared for Manitoba Hydro by North/South Consultants Inc., December 2003. 119 pp.
- Burnett, D.C. and Hrenchuk, C.L. 2017. Lake Whitefish movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2015 to October 2016: Year 3 Construction. Keeyask Generation Project, Aquatic Effects Monitoring Plan Report #AEMP-2017-03. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2017. xiv + 125 pp.
- Green, D.J. and Derksen, A.J. 1987. Observations on the spawning of Lake Whitefish (*Coregonus clupeaformis*) in the Poplar River area of Lake Winnipeg, 1974 – 1977. Manitoba Department of Natural Resources, Fisheries Branch Manuscript Report 87–24: 86 pp.
- Hrenchuk, C.L. 2020. Lake Whitefish movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2018 to October 2019: Year 6 Construction. Keeyask Generation Project, Aquatic Effects Monitoring Plan Report #AEMP-2020-03. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2020. xv + 128 pp.
- Hrenchuk, C.L. 2021a. Adult Lake Sturgeon movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2019 to September 2020: Year 7 Construction. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2021-01. A report prepared for Manitoba Hydro by North/South Consultants Inc.
- Hrenchuk, C.L. 2021b. Juvenile Lake Sturgeon movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2019 to September 2020: Year 7 Construction. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2021-02. A report prepared for Manitoba Hydro by North/South Consultants Inc.
- Hrenchuk, C.L. 2021c. Walleye movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2019 to September 2020: Year 7 Construction. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2021-04. A report prepared for Manitoba Hydro by North/South Consultants Inc.
- Hrenchuk, C.L. and Barth, C.C. 2013. Results of adult Lake Sturgeon movement monitoring in the Nelson River between Clark Lake and the Long Spruce Generating Station, October 2011 to October 2012. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2013. 137 pp.

- Hrenchuk, C.L. and Barth, C.C. 2015. Lake Whitefish movement monitoring 2014: Preliminary results. A report prepared for Manitoba Hydro by North/South Consultants Inc., January 2015. 12 pp.
- Keeyask Hydropower Limited Partnership. 2014. Keeyask Generation Project: Aquatic effects monitoring plan. A report prepared by Keeyask Hydropower Limited Partnership, Winnipeg, MB. 216 pp. + appendices.
- Lacho, C.D. and Hrenchuk, C.L. 2018. Lake Whitefish movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2016 to October 2017: Year 4 Construction. Keeyask Generation Project, Aquatic Effects Monitoring Plan Report #AEMP-2018-05. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2018. xv + 129 pp.
- Lacho, C.D. and C.L. Hrenchuk. 2019. Lake Whitefish movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2017 to October 2018: Year 5 Construction. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2019-03. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2019. xv + 128 pp.
- Lavergne, S.C. and Hrenchuk, C.L. 2016. Lake Whitefish movement monitoring in the Nelson River between Clark Lake and the Long Spruce Generating Station, October 2014 to October 2015: Year 2 Construction. Keeyask Generation Project Aquatic Effects Monitoring Report #AEMP-2016-06. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2016. xii + 105 pp.
- Manitoba Hydro Public Affairs. December 1999. Long Spruce Generating Station. Brochure. 4 pp.
- Murray, L. and Barth, C.C. 2007. Movements of radio- and acoustic-tagged Northern Pike, Walleye, and Lake Whitefish in the Keeyask Study Area: May 2003 to October 2004, and a summary of findings from 2001–2005. A report prepared for Manitoba Hydro by North/South Consultants Inc., April 2007. 95 pp.
- Murray, L., Barth, C.C. and Olynik, J.R. 2005. Movements of radio- and acoustic-tagged Northern Pike, Walleye, and Lake Whitefish in the Keeyask Study Area: May 2002 to April 2003. A report prepared for Manitoba Hydro by North/South Consultants Inc., August 2005. 107 pp.
- Pincock, D.G. 2012. False detections: What they are and how to remove them from detection data. VEMCO, DOC-004691, Bedford, Nova Scotia. Available: www.vemco.com/pdf/false_detections.pdf. (April 2013).
- Pisiak, D.J. 2005a. Results of summer index gillnetting studies in Stephens Lake, Manitoba, and seasonal investigations of adult and larval fish communities in the reach of the Nelson River between Gull Rapids and Stephens Lake, 2002. A report prepared for Manitoba Hydro by North/South Consultants Inc., January 2005. xv + 159 pp.

- Pisiak, D.J. 2005b. Results of summer index gillnetting studies in Stephens Lake, Manitoba, and seasonal investigations of fish communities in the reach of the Nelson River between Gull Rapids and Stephens Lake, 2003, year 3. A report prepared for Manitoba Hydro by North/South Consultants Inc., October 2005. xxi + 289 pp.
- Scott, W.B. and Crossman, E.J. 1998. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin 184: 966 pp.
- Stewart, K. and Watkinson, D. 2004. Freshwater fishes of Manitoba. University of Manitoba Press. 276 pp.

APPENDICES

APPENDIX 1: DETECTION SUMMARIES FOR LAKE WHITEFISH TAGGED AND MONITORED IN THE KEEYASK STUDY AREA BETWEEN 2017 AND 2022.

Table A1-1:	Number of detections (n), number of days detected, farthest upstream (U/S) and downstream (D/S) river kilometre (rkm) detection sites, and detection range for Lake Whitefish tagged upstream of the Keeyask GS during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods.	50
Table A1-2:	Number of detections (n), number of days detected, farthest upstream (U/S) and downstream (D/S) river kilometre (rkm) detection sites, and detection range for Lake Whitefish tagged in Stephens Lake during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods.	51
Table A1-3:	Number of detections (n), number of days detected, farthest upstream (U/S) and downstream (D/S) river kilometre (rkm) detection sites, and detection range for Lake Whitefish tagged upstream of the Keeyask GS during the 2018 (May 1 to October 10), 2019 (May 1 to October 17), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to July 17) open-water periods.	52
Table A1-4:	Number of detections (n), number of days detected, farthest upstream (U/S) and downstream (D/S) river kilometre (rkm) detection sites, and detection range for Lake Whitefish tagged in Stephens Lake during the 2018 (May 1 to October 10), 2019 (May 1 to October 7), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to July 17) open-water periods.....	53

Table A1-1: Number of detections (n), number of days detected, farthest upstream (U/S) and downstream (D/S) river kilometre (rkm) detection sites, and detection range for Lake Whitefish tagged upstream of the Keeyask GS during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods. Tag ID highlighted yellow = lost tags. Tag ID highlighted purple = fish moved downstream through the Keeyask GS. Tag ID highlighted red = fish moved downstream through the Kettle GS.

Tag ID	Date tagged	2017/2018					2018/2019					2019/2020					2020/2021					2021/2022				
		n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)
31722	07-Oct-17	3	1	-29.4	-29.4	0.0	8	1	-29.4	-29.4	0.0	20	2	-29.4	-29.4	0.0	561	16	-29.3	-12.9	16.4	2206	21	-29.3	-12.9	16.4
31726	12-Oct-17	13	2	-29.4	-29.4	0.0	-	-	-	-	-	-	-	-	-	-	13266	151	-19.5	-12.9	6.6	3064	33	-29.3	-7.9	21.4
31727	12-Oct-17	132	5	-29.4	-10.3	19.1	92461	202	16.8	16.8	0.0	90685	201	16.8	16.8	0.0	33204	190	16.3	16.3	0.0	22436	158	16.3	16.3	0.0
31728	14-Oct-17	8	1	-29.4	-29.4	0.0	15	1	-29.4	-29.4	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31729	14-Oct-17	5	1	-29.4	-29.4	0.0	26	2	-29.4	-12.4	17.0	-	-	-	-	-	287	9	-29.3	-17.4	11.9	798	20	-48.2	-17.4	30.8
31730	14-Oct-17	106	3	-29.4	-10.3	19.1	6	1	-12.4	-12.4	0.0	10	3	-29.4	-12.4	17.0	363	22	-29.3	-10.1	19.2	2130	29	-29.3	-10.1	19.2
31731	14-Oct-17	153	5	-29.4	-29.4	0.0	-	-	-	-	-	33	1	-29.4	-29.4	0.0	202	5	-29.3	-19.5	9.8	455	16	-48.2	-17.4	30.8
31732	12-Oct-17	14	1	-29.4	-29.4	0.0	-	-	-	-	-	114	7	-29.4	-10.3	19.1	2299	114	-29.3	-10.1	19.2	3142	80	-29.3	-10.1	19.2
31733	14-Oct-17	9	1	-29.4	-29.4	0.0	-	-	-	-	-	4	1	-29.4	-29.4	0.0	1532	12	-29.3	-26.4	2.9	1875	10	-26.4	-26.4	0.0
31734	14-Oct-17	5914	16	-29.4	-10.3	19.1	-	-	-	-	-	111	11	-12.4	-10.3	2.1	1100	28	-19.5	-10.1	9.4	326	8	-29.3	-12.4	16.9
31735	12-Oct-17	50	2	-29.4	-10.3	19.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
31736	12-Oct-17	26	1	-29.4	-29.4	0.0	6	1	-29.4	-29.4	0.0	3	1	-29.4	-29.4	0.0	359	12	-26.4	-12.9	13.5	1585	11	-48.2	-12.9	35.3
31737	12-Oct-17	138	4	-29.4	-10.3	19.1	39	3	-29.4	-12.4	17.0	-	-	-	-	-	365	10	-29.3	-10.1	19.2	-	-	-	-	-
31738	11-Oct-17	227	7	-29.4	-10.3	19.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
31739	11-Oct-17	145	3	-29.4	-12.4	17.0	76	4	-12.4	-12.4	0.0	-	-	-	-	-	1113	32	-19.5	-10.1	9.4	883	14	-29.3	-10.1	19.2
31740	11-Oct-17	948	11	-29.4	18.6	48.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	8	45.7	45.7	0.0
31741	11-Oct-17	9	1	-29.4	-29.4	0.0	22	2	-29.4	-12.4	17.0	-	-	-	-	-	3657	47	-29.3	-7.9	21.4	640	23	-48.2	-7.9	40.3
31742	11-Oct-17	3	1	-29.4	-29.4	0.0	9	1	-29.4	-29.4	0.0	45	1	-29.4	-29.4	0.0	1204	21	-29.3	-12.9	16.4	43	3	-26.4	-12.9	13.5
31743	11-Oct-17	4	1	-29.4	-29.4	0.0	10	1	-29.4	-29.4	0.0	2	1	-10.3	-10.3	0.0	2533	20	-48.2	-2.2	46.0	75	5	-29.3	-12.9	16.4
31744	11-Oct-17	280	14	-29.4	-12.4	17.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
31745	11-Oct-17	-	-	-	-	-	170	5	-29.4	-12.4	17.0	7	1	-29.4	-29.4	0.0	32	3	-29.3	-12.4	16.9	180	7	-29.3	-17.4	11.9
31746	11-Oct-17	434	5	-29.4	-29.4	0.0	-	-	-	-	-	17	1	-29.4	-29.4	0.0	2597	46	-29.3	-7.9	21.4	2525	19	-29.3	-12.9	16.4

Table A1-2: Number of detections (n), number of days detected, farthest upstream (U/S) and downstream (D/S) river kilometre (rkm) detection sites, and detection range for Lake Whitefish tagged in Stephens Lake during the 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) winter periods. Tag id highlighted yellow = lost tags. Tag id highlighted red = fish moved downstream through the Kettle GS.

Tag ID	Date tagged	2017/2018					2018/2019					2019/2020					2020/2021					2021/2022				
		n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)
31698	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31699	09-Oct-17	16567	160	5.2	18.6	13.4	36290	147	5.2	18.6	13.4	26940	153	5.2	18.6	13.4	50822	199	3.9	13.4	9.5	14979	120	3.9	16.1	12.2
31700	09-Oct-17	69	3	6.5	6.5	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31701	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31702	09-Oct-17	8556	66	5.2	36.1	30.9	122	5	5.2	8.4	3.2	11939	41	5.8	8.4	2.6	-	-	-	-	-	743	24	3.9	18.8	14.9
31703	09-Oct-17	7	2	6.5	6.5	0.0	-	-	-	-	-	3	1	5.8	5.8	0.0	77	1	4.9	9.9	5.0	-	-	-	-	-
31704	09-Oct-17	1111	22	5.2	36.1	30.9	-	-	-	-	-	-	-	-	-	-	30	2	3.9	7.5	3.6	-	-	-	-	-
31705	09-Oct-17	44	1	6.5	6.5	0.0	-	-	-	-	-	-	-	-	-	-	66	1	7.5	9.9	2.4	-	-	-	-	-
31706	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31707	09-Oct-17	7193	61	6.5	8.4	1.9	5715	26	6.5	6.5	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31708	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31709	09-Oct-17	841	18	5.2	21.6	16.4	163	2	5.2	16.8	11.6	669	8	5.2	16.8	11.6	1595	24	3.9	9.9	6.0	1120	29	3.9	8.7	4.8
31710	09-Oct-17	34	3	6.5	8.4	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31711	09-Oct-17	154	5	5.2	24.7	19.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31712	09-Oct-17	12134	73	5.2	16.8	11.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31713	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31714	09-Oct-17	77	3	5.2	7.9	2.7	-	-	-	-	-	-	-	-	-	-	7	1	3.9	4.9	1.0	-	-	-	-	-
31715	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	189	6	3.9	4.9	1.0	12	1	3.9	3.9	0.0
31716	08-Oct-17	426	3	6.5	7.9	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31717	08-Oct-17	173	2	5.2	24.7	19.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31718	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31719	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31720	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31721	08-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31723	10-Oct-17	36	2	5.2	6.5	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31724	10-Oct-17	35	2	6.5	8.4	1.9	198	7	5.2	16.8	11.6	6	1	5.8	5.8	0.0	-	-	-	-	-	-	-	-	-	-
31725	10-Oct-17	29	1	5.2	7.9	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31747	10-Oct-17	46	2	36.1	36.1	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31748	10-Oct-17	52985	179	5.2	21.6	16.4	16765	135	5.2	21.6	16.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31749	10-Oct-17	1100	13	6.5	21.6	15.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31750	10-Oct-17	503	5	5.2	6.5	1.3	64	4	5.8	8.4	2.6	967	11	5.8	8.4	2.6	189	8	3.9	7.5	3.6	1224	11	3.9	5.9	2.0
31751	10-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31752	10-Oct-17	736	16	6.5	21.6	15.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31753	10-Oct-17	1414	10	6.5	8.4	1.9	16	3	6.5	6.5	0.0	567	17	5.2	8.4	3.2	208	7	4.9	10.2	5.3	1228	12	3.9	7.8	3.9
31754	10-Oct-17	9850	73	5.2	8.4	3.2	593	7	5.8	8.4	2.6	114	2	5.8	6.5	-	389	10	3.9	9.9	6.0	521	8	3.9	7.5	3.6
31755	10-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31756	10-Oct-17	346	5	6.5	36.1	29.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31757	10-Oct-17	6	2	6.5	6.5	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53761	10-Oct-17	-	-	-	-	-	9	2	21.6	21.6	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53762	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A1-3: Number of detections (n), number of days detected, farthest upstream (U/S) and downstream (D/S) river kilometre (rkm) detection sites, and detection range for Lake Whitefish tagged upstream of the Keyyask GS during the 2018 (May 1 to October 10), 2019 (May 1 to October 17), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to July 17) open-water periods. Tag id highlighted yellow = lost tags. Tag id highlighted purple = fish moved downstream through the Keyyask GS. Tag id highlighted red = fish moved downstream through the Kettle GS.

Tag ID	Date tagged	2018					2019					2020					2021					2022				
		n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)
31722	07-Oct-17	6868	62	-29.4	-12.8	16.6	6733	58	-19.5	-12.9	6.6	6884	58	-12.9	-12.9	0.0	6928	83	-22.6	-12.9	9.7	757	22	-12.9	-12.9	0.0
31726	12-Oct-17	13454	93	-19.5	-12.8	6.7	3978	52	-19.5	-12.9	6.6	4155	46	-19.5	-12.9	6.6	2662	29	-19.5	-12.9	6.6	50	4	-12.9	-12.9	0.0
31727	12-Oct-17	6891	86	1.2	18.6	17.4	-	-	-	-	-	21964	123	16.3	16.8	0.5	7625	86	16.3	16.3	0.0	5607	50	15.0	16.3	1.3
31728	14-Oct-17	16398	77	-33.8	-26.5	7.3	9171	67	-26.5	-26.5	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
31729	14-Oct-17	11540	70	-33.8	-9.3	24.5	12091	81	-33.8	-7.4	26.4	7792	59	-19.5	-7.9	11.6	6844	59	-34.3	-5.8	28.5	980	16	-19.5	-9.9	9.6
31730	14-Oct-17	18066	73	-33.8	-9.9	23.9	2797	43	-15	-9.9	5.1	5404	20	-12.5	-9.9	2.6	5661	60	-24.2	-9.9	14.3	53	2	-12.5	-12.5	0.0
31731	14-Oct-17	105	13	-19.5	-19.5	0.0	102	11	-19.5	-19.5	0.0	334	21	-26.4	-19.5	6.9	919	41	-26.4	-15.0	11.4	30	4	-26.4	-19.5	6.9
31732	12-Oct-17	3780	73	-12.9	-9.3	3.6	3773	24	-33.8	-9.9	23.9	4299	43	-19.5	-9.9	9.6	11861	86	-34.3	-9.9	24.4	1167	22	-19.5	-9.9	9.6
31733	14-Oct-17	14460	74	-33.8	-26.5	7.3	8963	45	-33.8	-26.5	7.3	636	19	-33.8	-26.4	7.4	14188	60	-34.3	-26.4	7.9	38	2	-26.4	-26.4	0.0
31734	14-Oct-17	2432	26	-19.5	-9.9	9.6	491	27	-19.5	-9.9	9.6	4997	41	-19.5	-9.9	9.6	12716	70	-19.5	-9.9	9.6	4091	29	-19.5	-15.0	4.5
31735	12-Oct-17	2746	25	-9.3	-4.8	4.5	-	-	-	-	-	-	-	-	-	-	3052	17	-4.0	-4.0	0.0	-	-	-	-	-
31736	12-Oct-17	16257	82	-33.8	-9.9	23.9	5103	66	-33.8	-12.9	20.9	2362	44	-19.5	-12.9	6.6	1288	46	-34.3	-12.9	21.4	447	14	-19.5	-12.9	6.6
31737	12-Oct-17	4807	62	-19.5	-5.8	13.7	2665	52	-33.8	-9	24.8	9975	52	-19.5	-9.9	9.6	-	-	-	-	-	-	-	-	-	
31738	11-Oct-17	4222	73	-9.9	1.2	11.1	294	30	1.2	1.2	0.0	8	3	1.2	1.2	0.0	94	7	1.2	1.2	0.0	2	2	1.2	1.2	0.0
31739	11-Oct-17	4182	40	-19.5	-9.9	9.6	5998	79	-19.5	-9.9	9.6	9940	55	-17.4	-9.9	7.5	7420	69	-34.3	-3.8	30.5	3224	12	-15.0	-9.9	5.1
31740	11-Oct-17	-	-	-	-	-	-	-	-	-	-	228	5	45.7	45.7	0.0	-	-	-	-	-	-	-	-	-	
31741	11-Oct-17	17796	113	-33.8	-9	24.8	12895	59	-33.8	-7.4	26.4	3538	63	-34.3	-6.2	28.1	16638	103	-34.3	-9.9	24.4	1782	27	-19.5	-9.9	9.6
31742	11-Oct-17	1990	36	-33.8	-12.9	20.9	325	14	-19.5	-19.5	0.0	2508	35	-19.5	-19.5	0.0	3272	68	-34.3	-15.0	19.3	95	8	-19.5	-15.0	4.5
31743	11-Oct-17	19757	92	-33.8	-7.4	26.4	19373	102	-33.8	-7.4	26.4	4394	50	-34.3	-6.2	28.1	5101	58	-34.3	-3.8	30.5	107	7	-7.9	-6.2	1.7
31744	11-Oct-17	440	7	-26.5	-12.8	13.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
31745	11-Oct-17	9343	93	-33.8	-4.8	29.0	14373	69	-34.3	-9.3	25.0	5974	47	-33.8	-6.2	27.6	11229	69	-34.3	-3.8	30.5	1391	16	-12.5	-7.8	4.7
31746	11-Oct-17	26627	121	-19.5	-7.4	12.1	22103	116	-19.5	-7.4	12.1	15247	81	-19.5	-6.2	13.3	6400	83	-24.2	-6.2	18.0	1301	19	-9.9	-7.8	2.1

Table A1-4: Number of detections (n), number of days detected, farthest upstream (U/S) and downstream (D/S) river kilometre (rkm) detection sites, and detection range for Lake Whitefish tagged in Stephens Lake during the 2018 (May 1 to October 10), 2019 (May 1 to October 7), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to July 17) open-water periods. Tag id highlighted yellow = lost tags. Tag id highlighted red = fish moved downstream through the Kettle GS.

Tag ID	Date tagged	2018					2019					2020					2021					2022				
		n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)	n	# Days	Farthest U/S (rkm)	Farthest D/S (rkm)	Range (rkm)
31698	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31699	09-Oct-17	13497	113	3.8	18.6	14.8	18807	123	4.3	18.6	14.3	10373	86	3.9	18.8	14.9	23231	146	1.3	18.8	17.5	1213	26	5.9	22.0	16.1
31700	09-Oct-17	1789	46	2.7	7.9	5.2	-	-	-	-	-	-	-	-	-	-	9	2	1.9	1.9	0.0	22650	53	2.2	2.2	0
31701	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31702	09-Oct-17	11844	65	1.2	9.4	8.2	9734	56	3.9	13	9.1	2081	35	5.2	10.3	5.1	378	8	8.7	8.7	0.0	-	-	-	-	-
31703	09-Oct-17	2854	19	1.2	7.4	6.2	7597	30	1.2	9.4	8.2	527	8	1.2	8.7	7.5	1118	20	0.8	24.9	24.1	-	-	-	-	-
31704	09-Oct-17	1888	24	1.2	36.1	34.9	2025	22	1.2	9.4	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
31705	09-Oct-17	932	5	1.2	7.4	6.2	886	10	0.6	7.4	6.8	7	1	5	5	0.0	501	5	0.8	1.9	1.1	-	-	-	-	-
31706	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31707	09-Oct-17	13071	31	3.8	7.4	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31708	09-Oct-17	21	5	1.2	1.2	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31709	09-Oct-17	7230	11	1.2	7.9	6.7	536	2	2.7	7.9	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31710	09-Oct-17	361	14	3.8	7.4	3.6	438	8	6.5	9.4	2.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31711	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31712	09-Oct-17	5045	43	6.5	24.7	18.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31713	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31714	09-Oct-17	77	4	3.8	3.8	0.0	1887	29	4.2	4.2	0.0	182	12	5	5	0.0	-	-	-	-	-	-	-	-	-	-
31715	09-Oct-17	1024	5	1.2	7.4	6.2	213	4	1.2	13	11.8	229	5	1.2	5	3.8	121	5	5.0	9.9	4.9	-	-	-	-	-
31716	08-Oct-17	34874	75	1.2	2.7	1.5	59102	131	1.2	1.2	0.0	37887	81	1.2	1.2	0.0	38325	126	1.2	1.2	0.0	506	21	1.2	1.2	0.0
31717	08-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31718	09-Oct-17	64	2	3.8	3.8	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31719	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31720	09-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31721	08-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31723	10-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31724	10-Oct-17	11143	54	1.2	13	11.8	12347	71	1.2	18.6	17.4	1967	42	5	13	8.0	-	-	-	-	-	-	-	-	-	-
31725	10-Oct-17	62	1	7.4	7.4	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31747	10-Oct-17	249	4	1.2	4.4	3.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31748	10-Oct-17	8800	94	1.2	36.1	34.9	1053	24	13	40.8	27.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31749	10-Oct-17	52	6	16.8	24.7	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31750	10-Oct-17	5820	21	1.2	7.9	6.7	288	5	1.2	7.4	6.2	-	-	-	-	-	144	5	5.0	8.7	3.7	-	-	-	-	-
31751	10-Oct-17	15	2	3.8	7.4	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31752	10-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31753	10-Oct-17	5106	53	3.8	6.5	2.7	1963	37	4.2	6.5	2.3	1853	29	5	13.9	8.9	2839	46	0.8	13.4	12.6	1852	22	1.0	10.2	9.2
31754	10-Oct-17	4662	53	2.7	13	10.3	2666	33	1.2	18.6	17.4	605	15	7.5	13.2	5.7	5512	30	0.8	13.2	12.4	37	3	5.0	12.0	7.0
31755	10-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31756	10-Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31757	10-Oct-17	404	6	6.5	10.3	3.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53761	10-Oct-17	1817	46	3.8	24.7	20.9	219	5	6.5	16.8	10.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53762	09-Oct-17	61	4	20	36.1	16.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX 2: LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC-TAGGED LAKE WHITEFISH IN GULL LAKE, OCTOBER 2017 TO OCTOBER 2022.

Figure A2-1:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31722) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	56
Figure A2-2:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31726) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	57
Figure A2-3:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31727) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	58
Figure A2-4:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31728) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	59
Figure A2-5:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31729) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	60
Figure A2-6:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31730) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	61
Figure A2-7:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31731) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	62
Figure A2-8:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31732) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	63
Figure A2-9:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31733) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	64
Figure A2-10:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31734) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	65
Figure A2-11:	Position of a Lake Whitefish tagged with an acoustic transmitter (code #31735) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	66

Figure A2-12: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31736) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.67

Figure A2-13: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31737) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.68

Figure A2-14: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31738) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.69

Figure A2-15: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31739) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.70

Figure A2-16: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31740) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.71

Figure A2-17: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31741) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.72

Figure A2-18: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31742) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.73

Figure A2-19: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31743) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.74

Figure A2-20: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31744) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.75

Figure A2-21: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31745) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.76

Figure A2-22: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31746) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.77

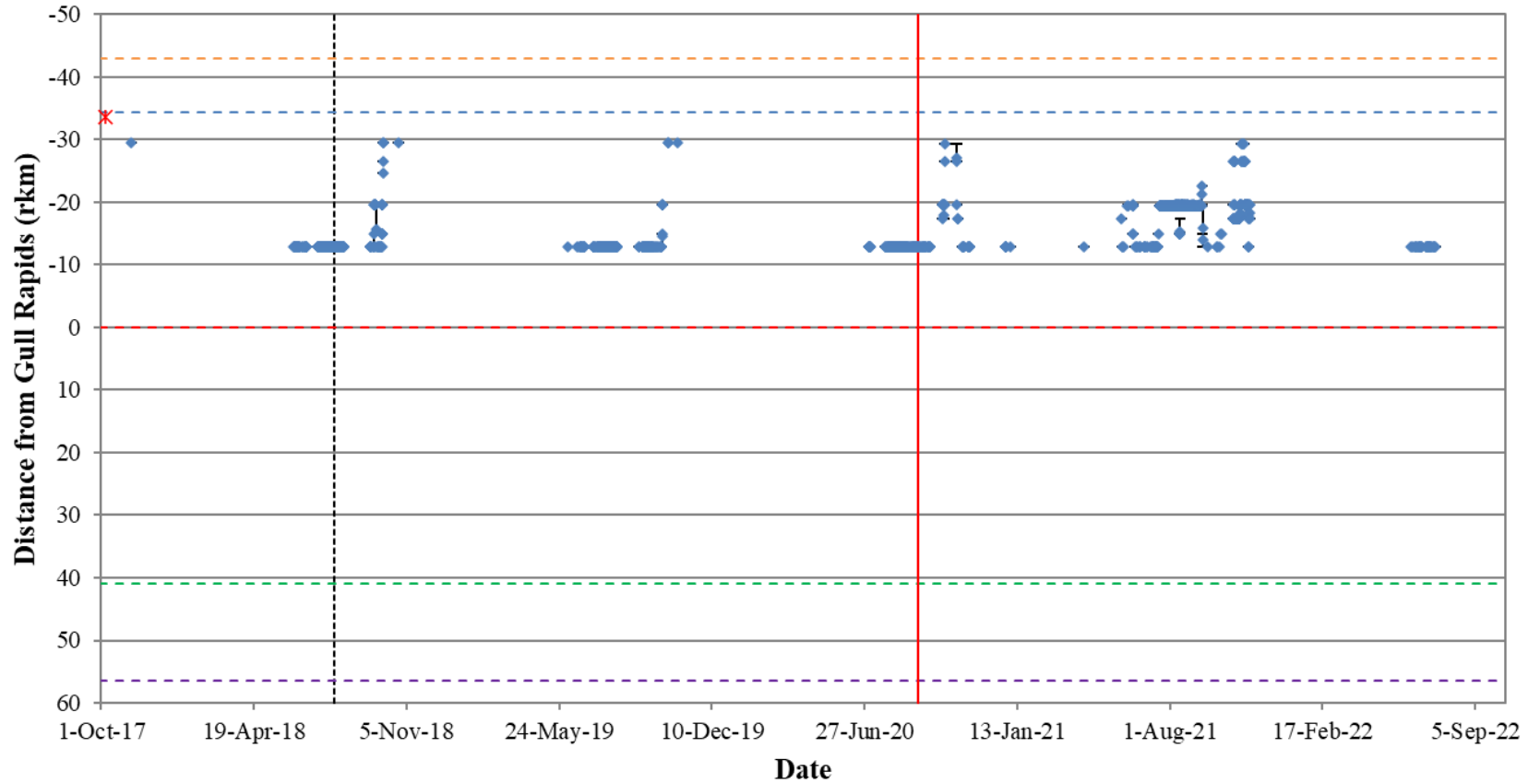


Figure A2-1: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31722) in the Nelson River between Clark Lake and the Keyyask GS, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

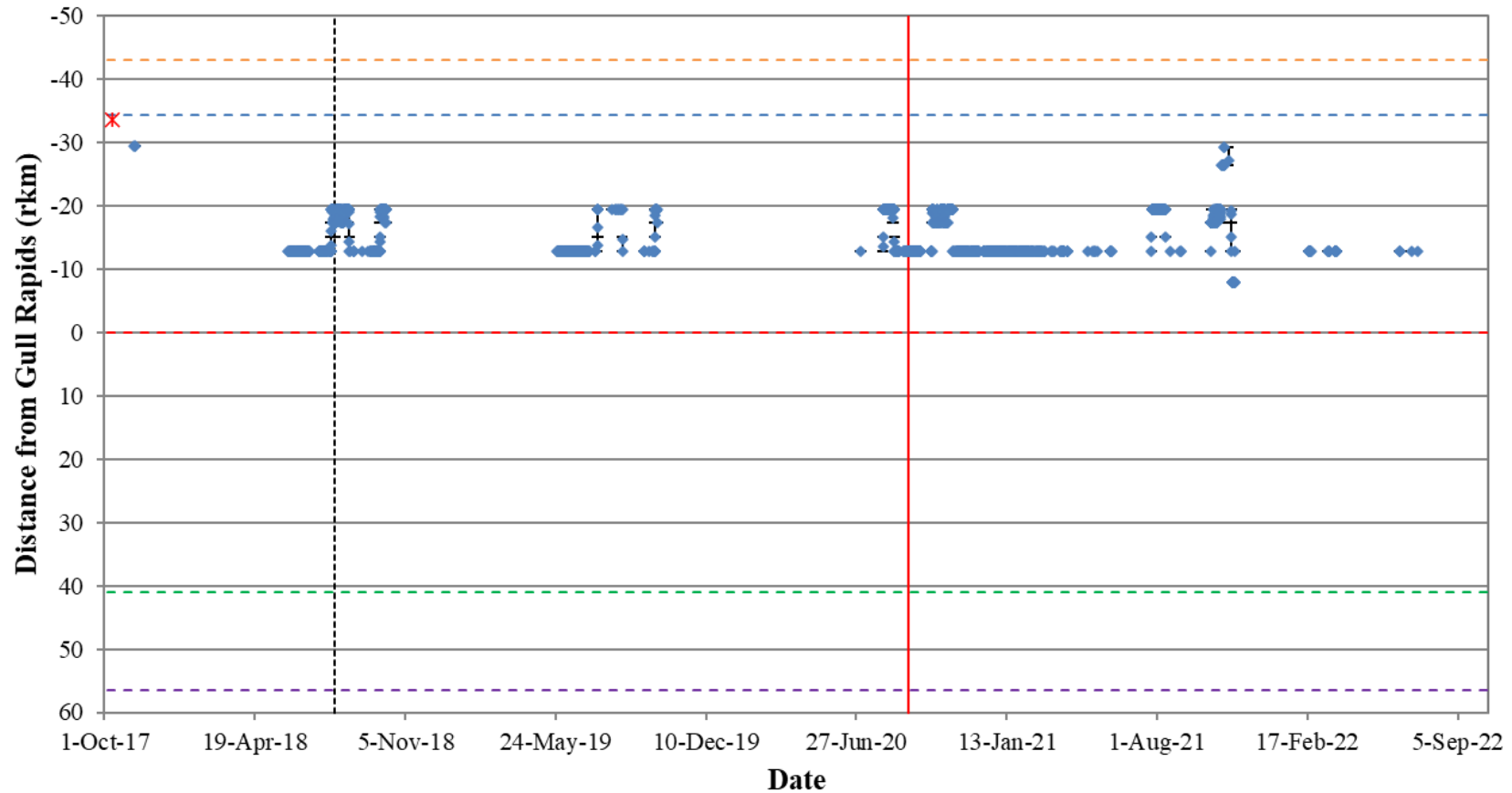


Figure A2-2: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31726) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

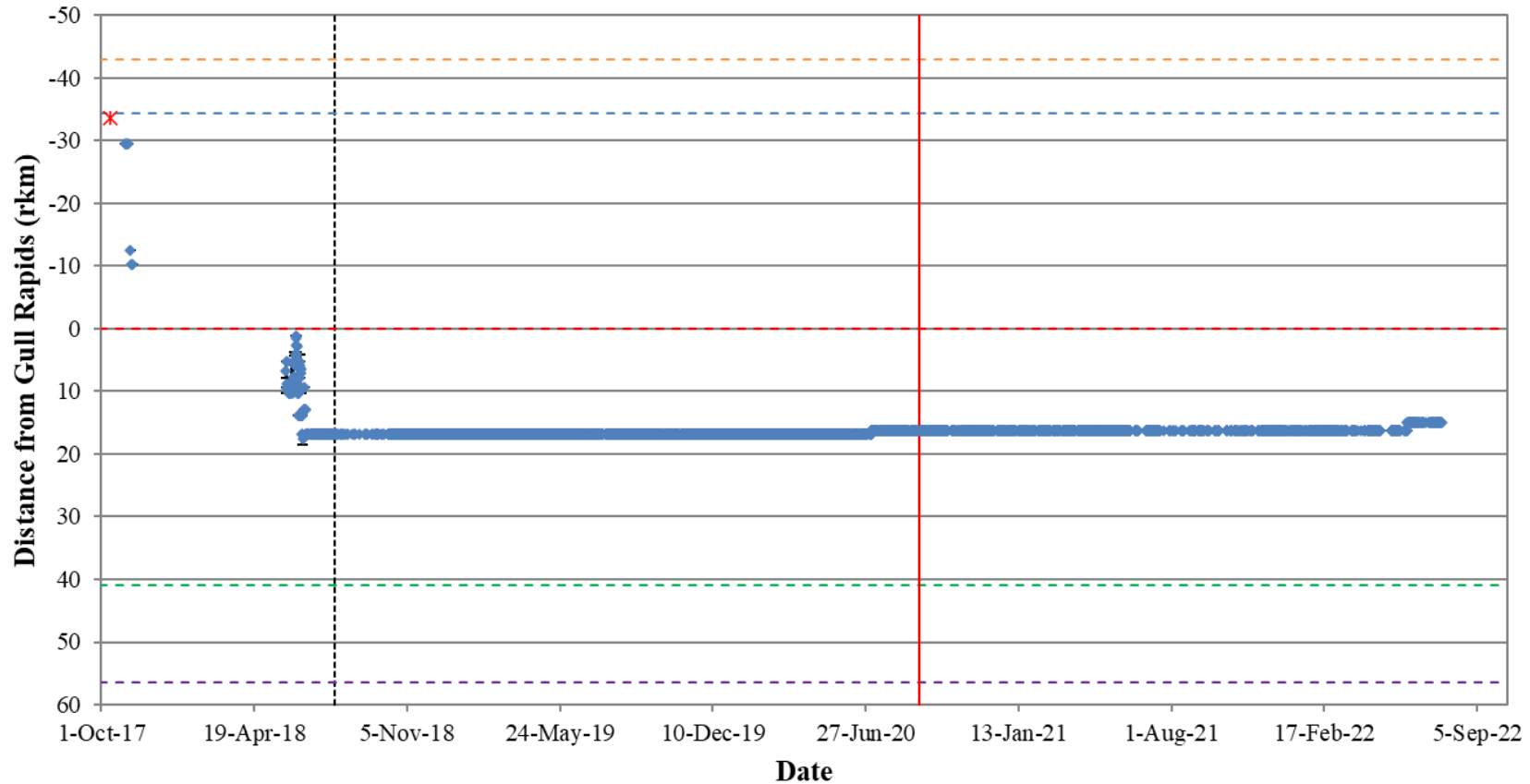


Figure A2-3: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31727) in the Nelson River between Clark Lake and the Keyyask GS, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

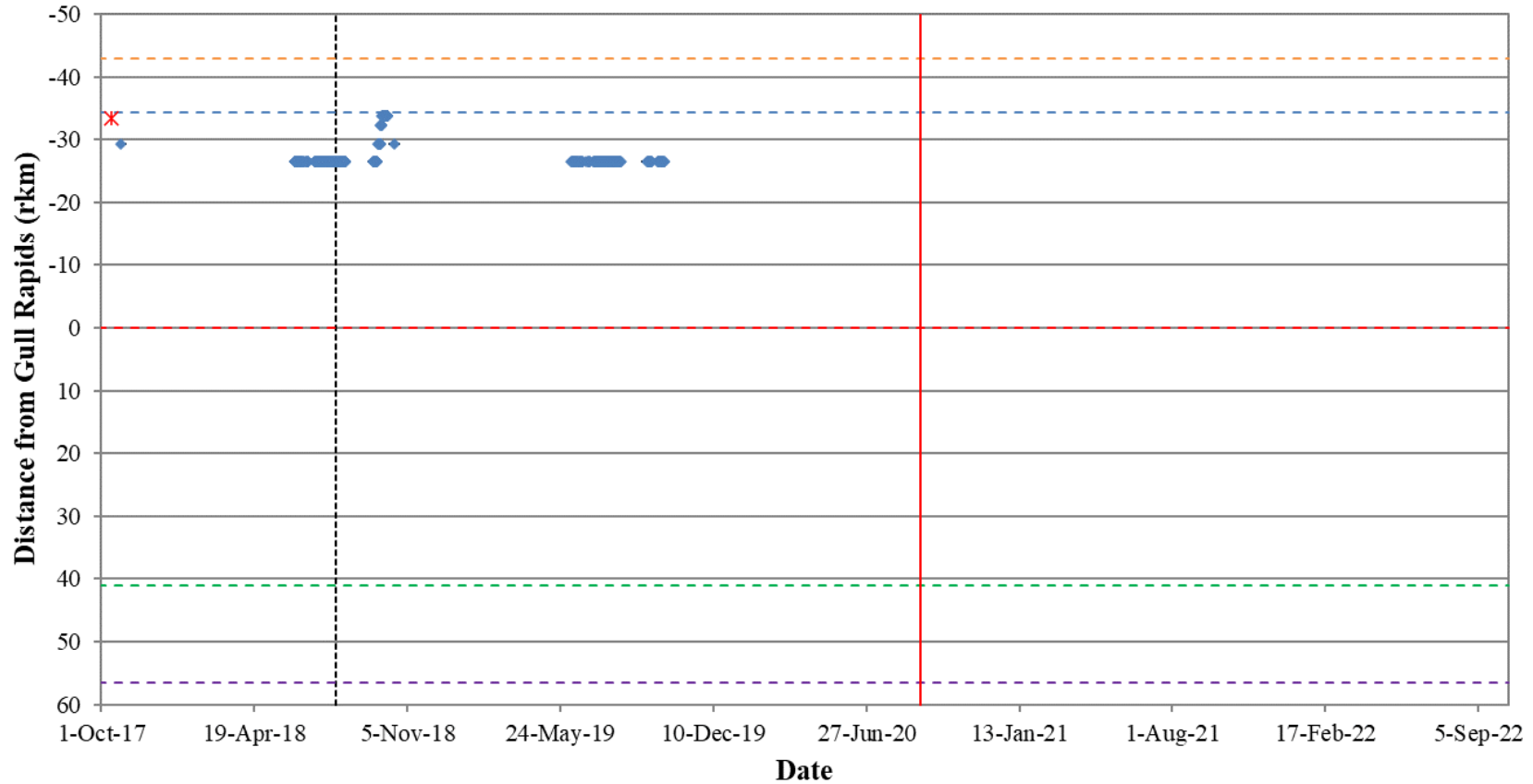


Figure A2-4: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31728) in the Nelson River between Clark Lake and the Keyeyask GS, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

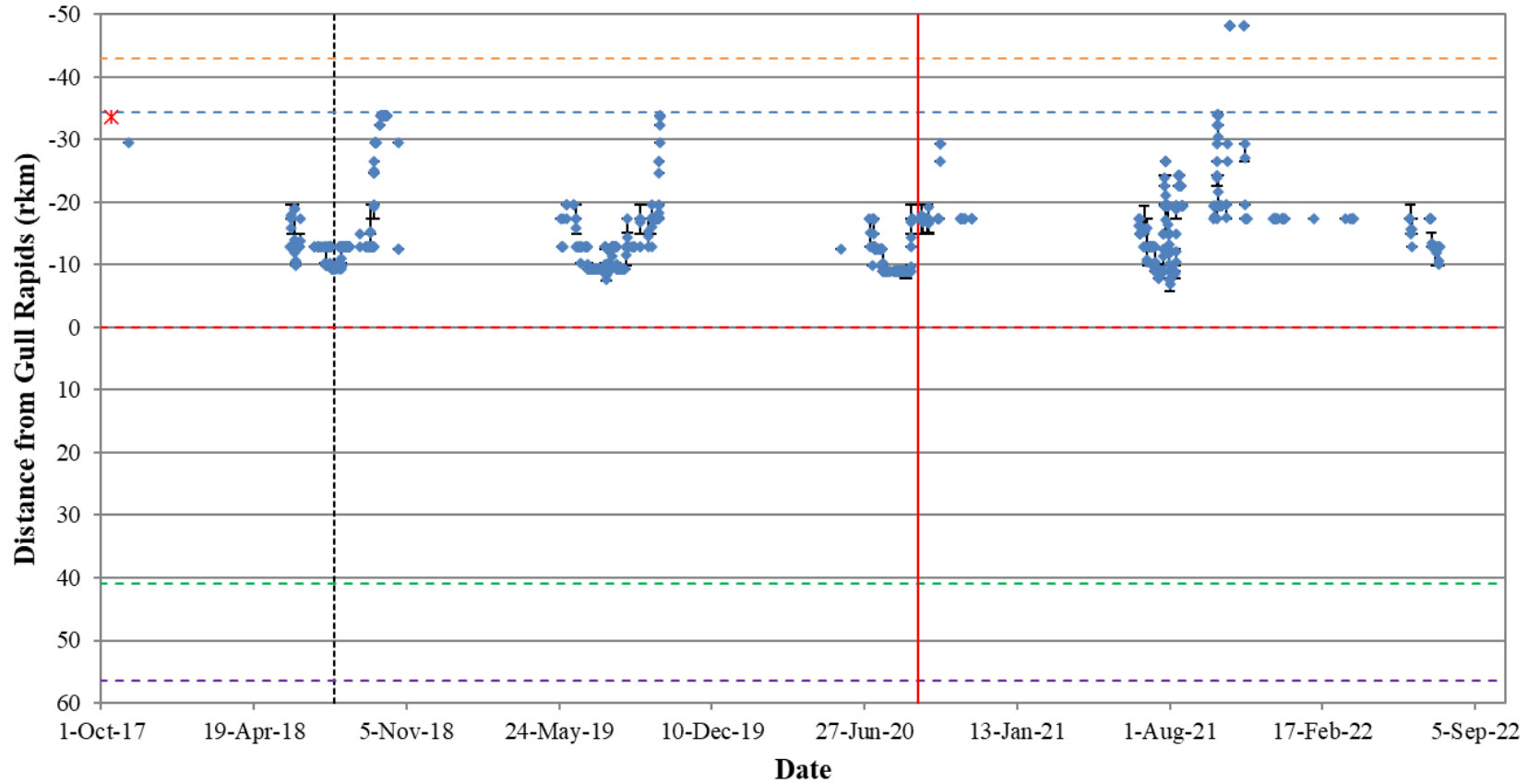


Figure A2-5: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31729) in the Nelson River between Clark Lake and the Keyeyask GS, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

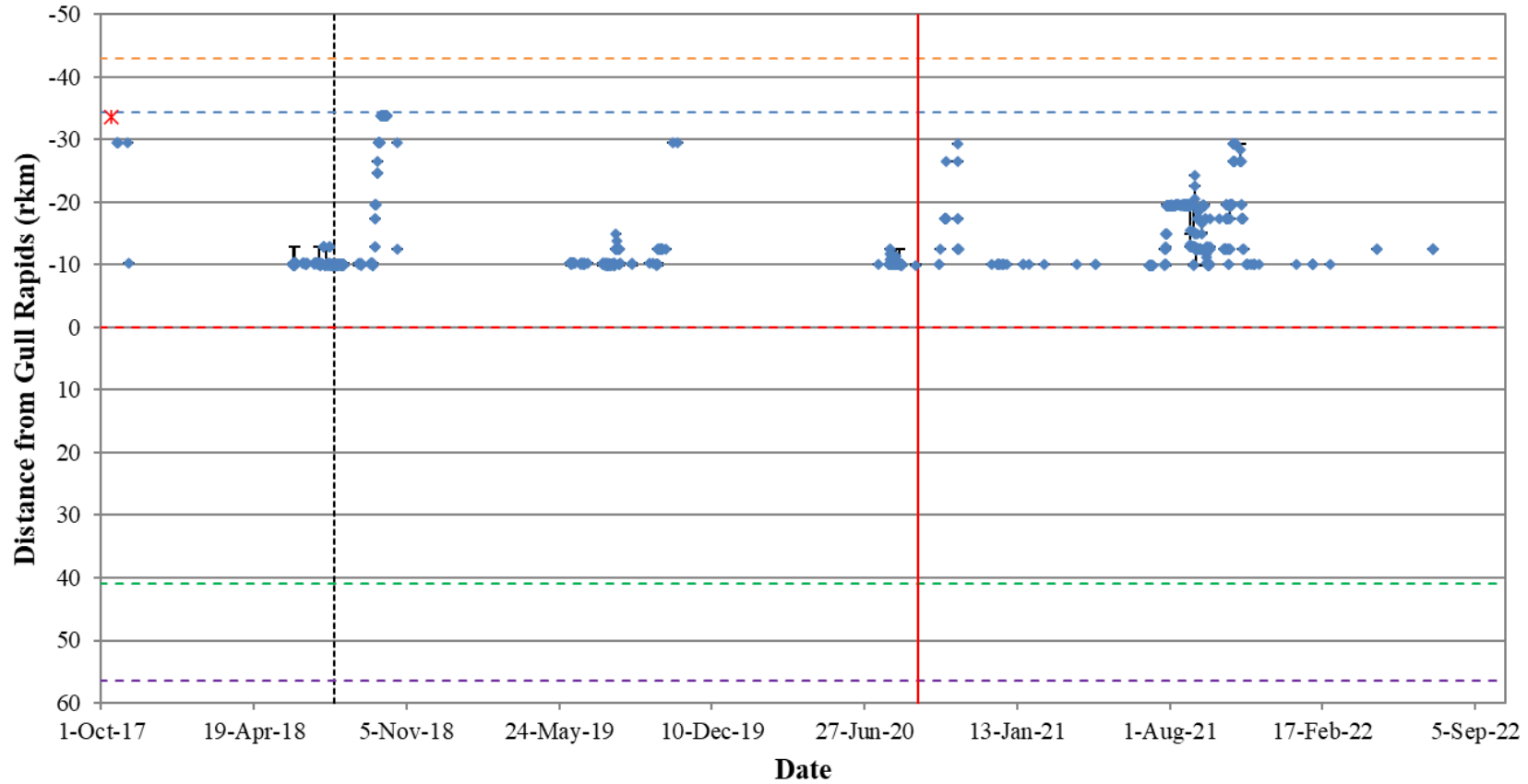


Figure A2-6: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31730) in the Nelson River between Clark Lake and the Keyeyask GS, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

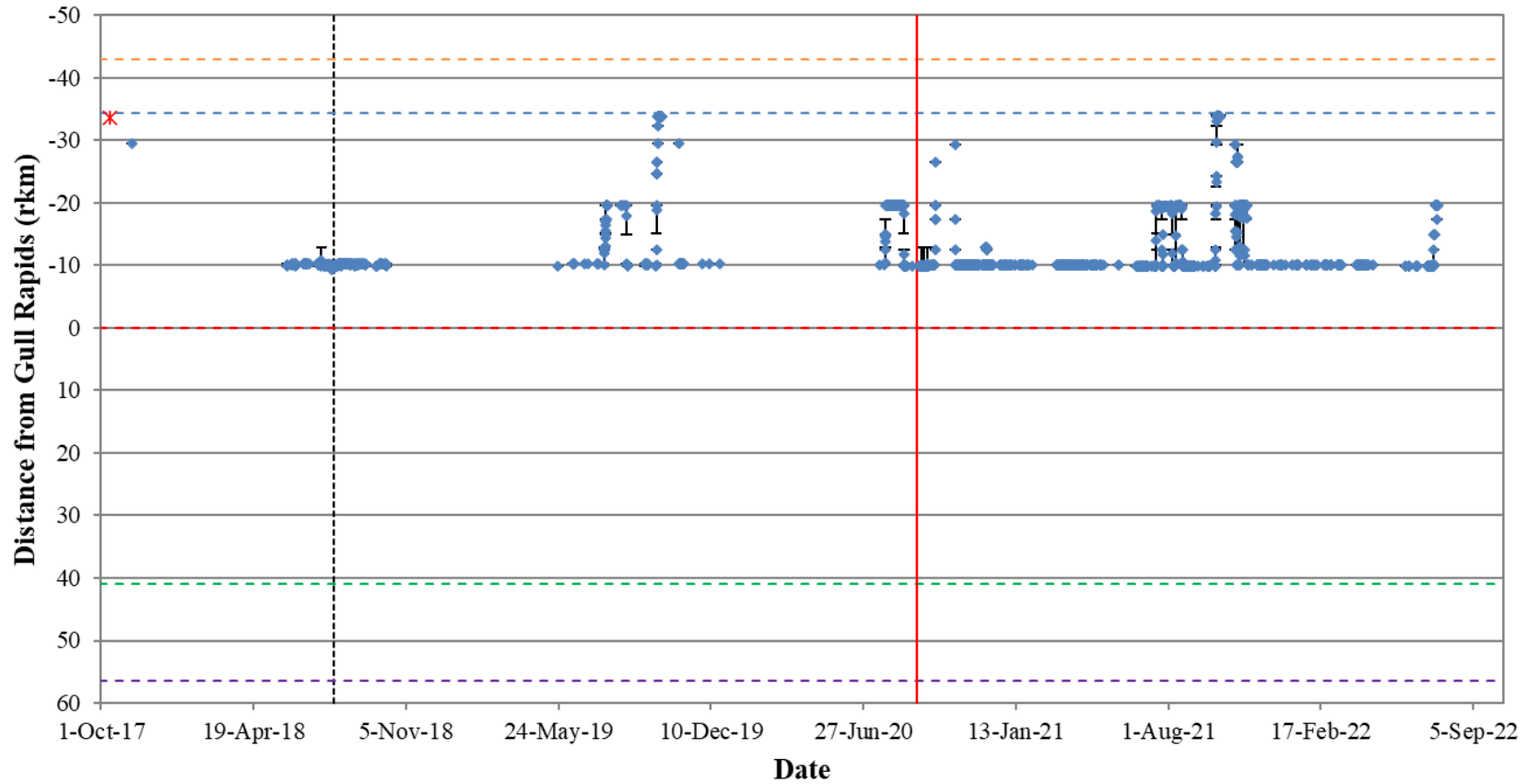


Figure A2-8: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31732) in the Nelson River between Clark Lake and the Keyeyask GS, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

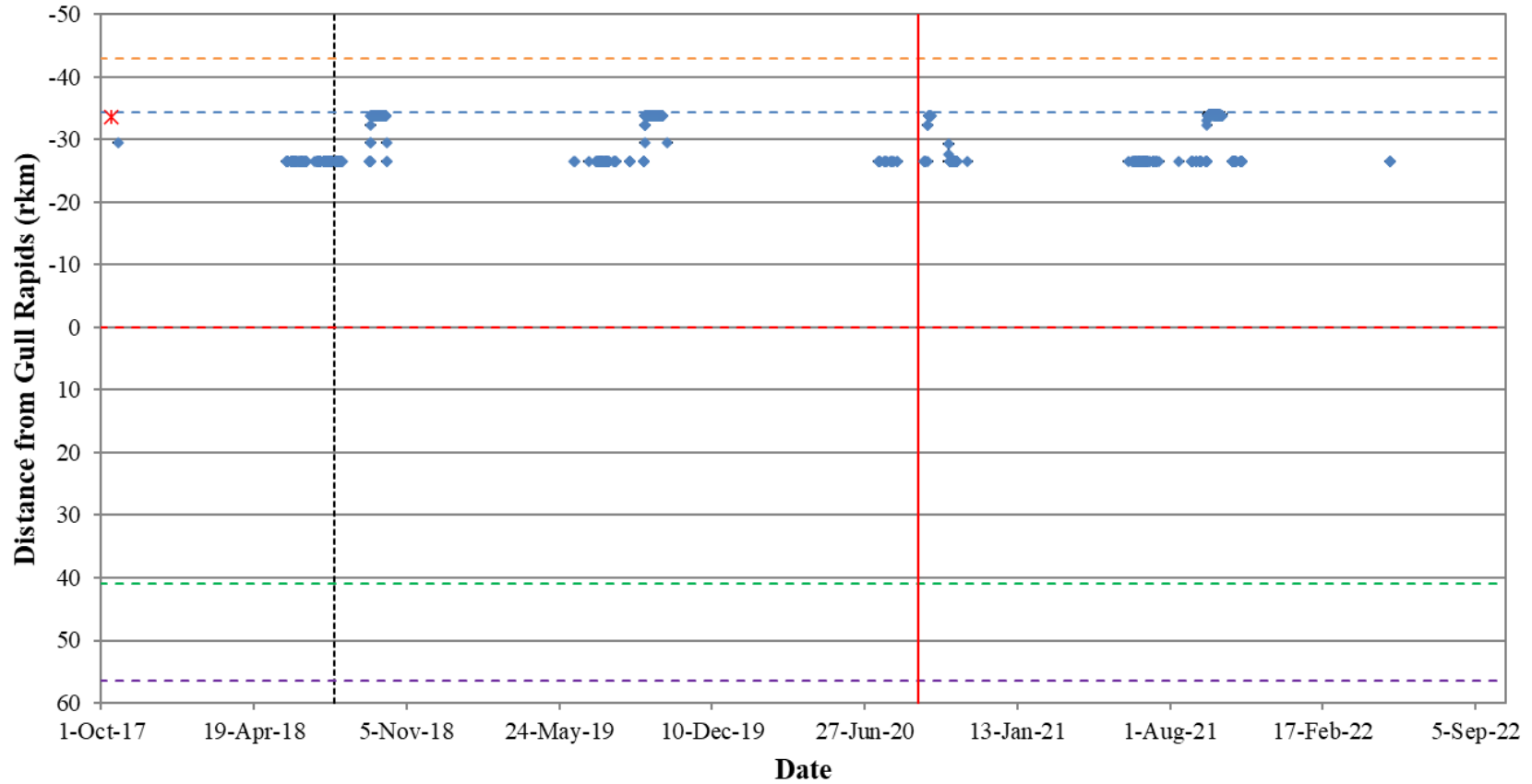


Figure A2-9: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31733) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

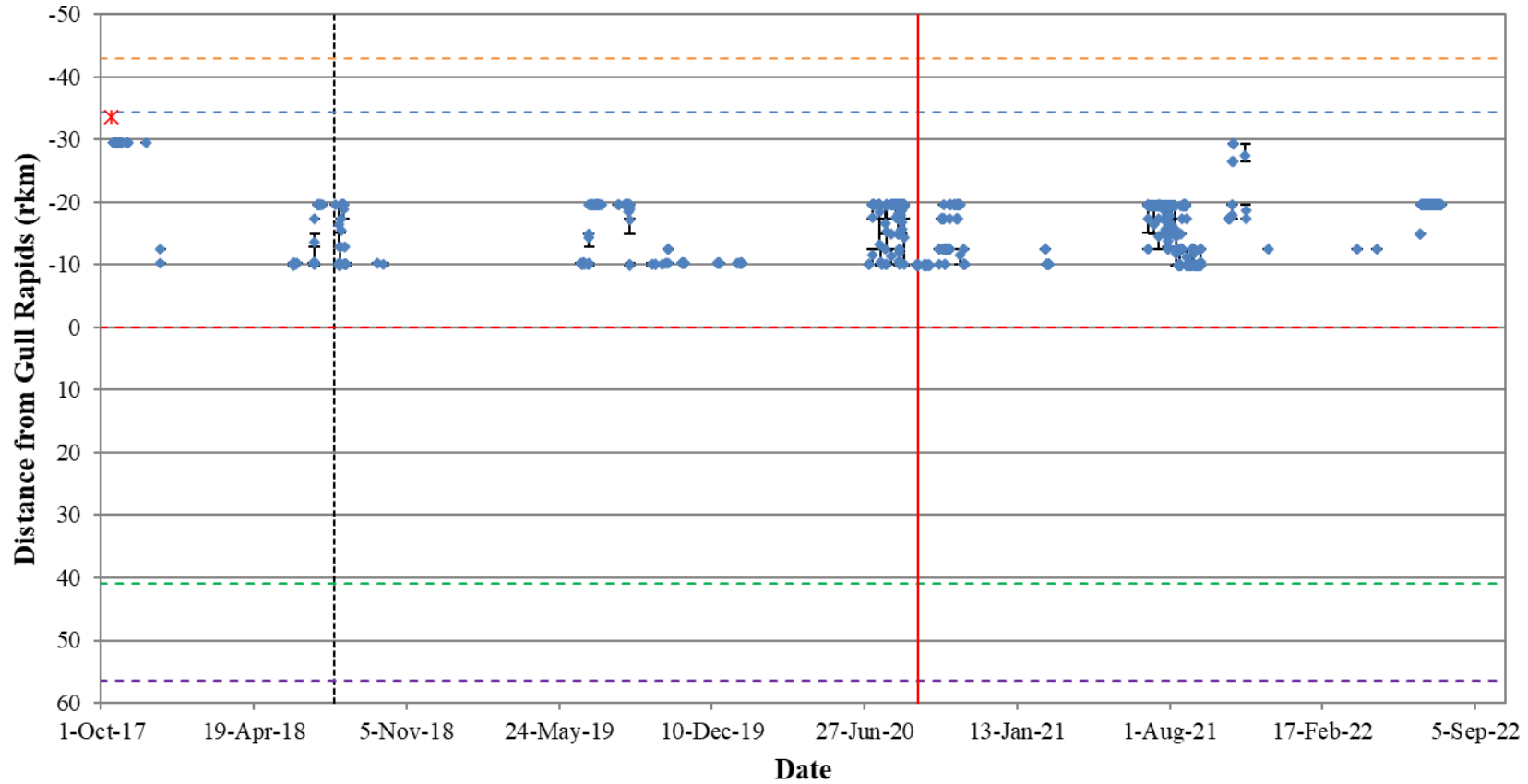


Figure A2-10: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31734) in the Nelson River between Clark Lake and the Keyyask GS, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

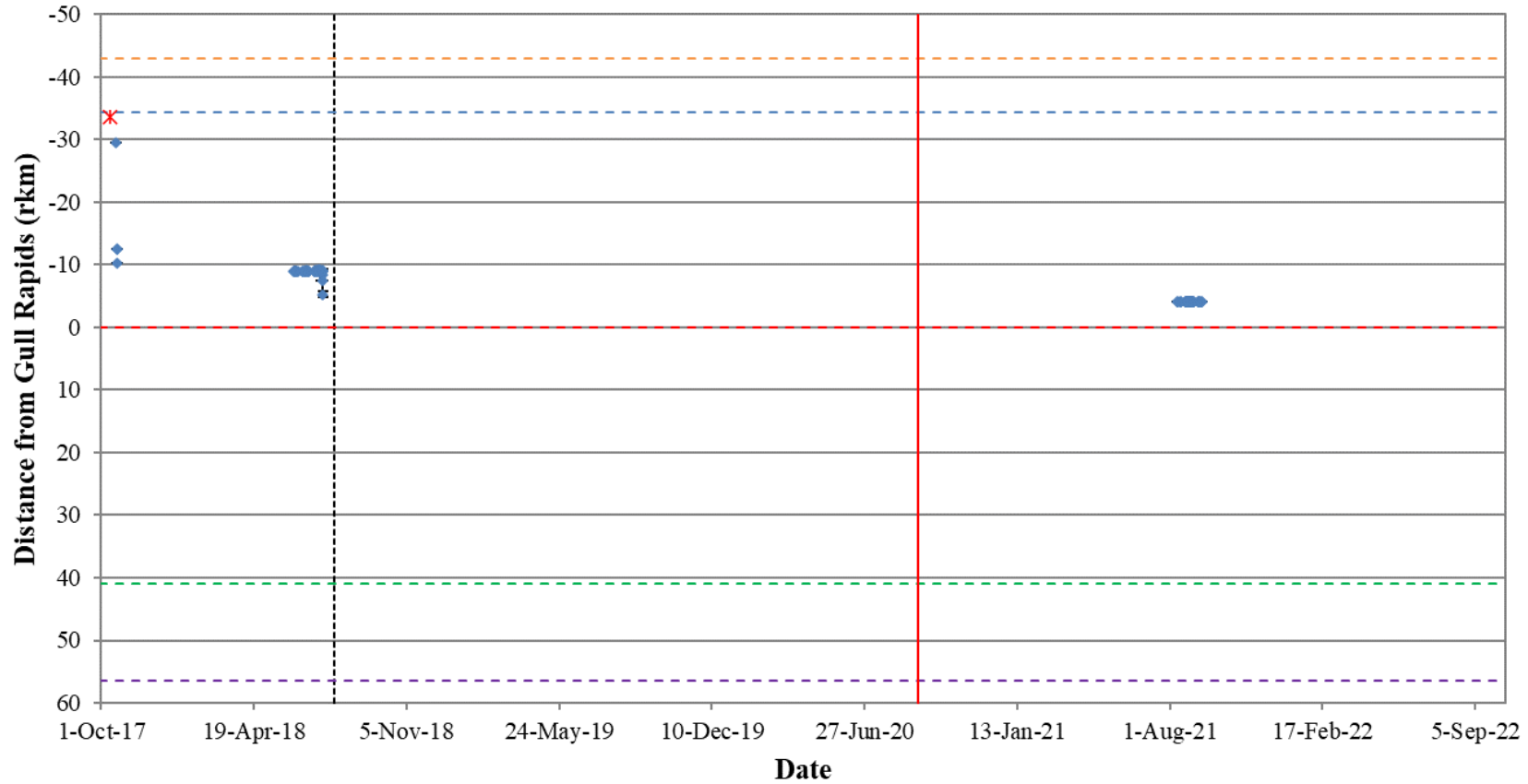


Figure A2-11: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31735) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

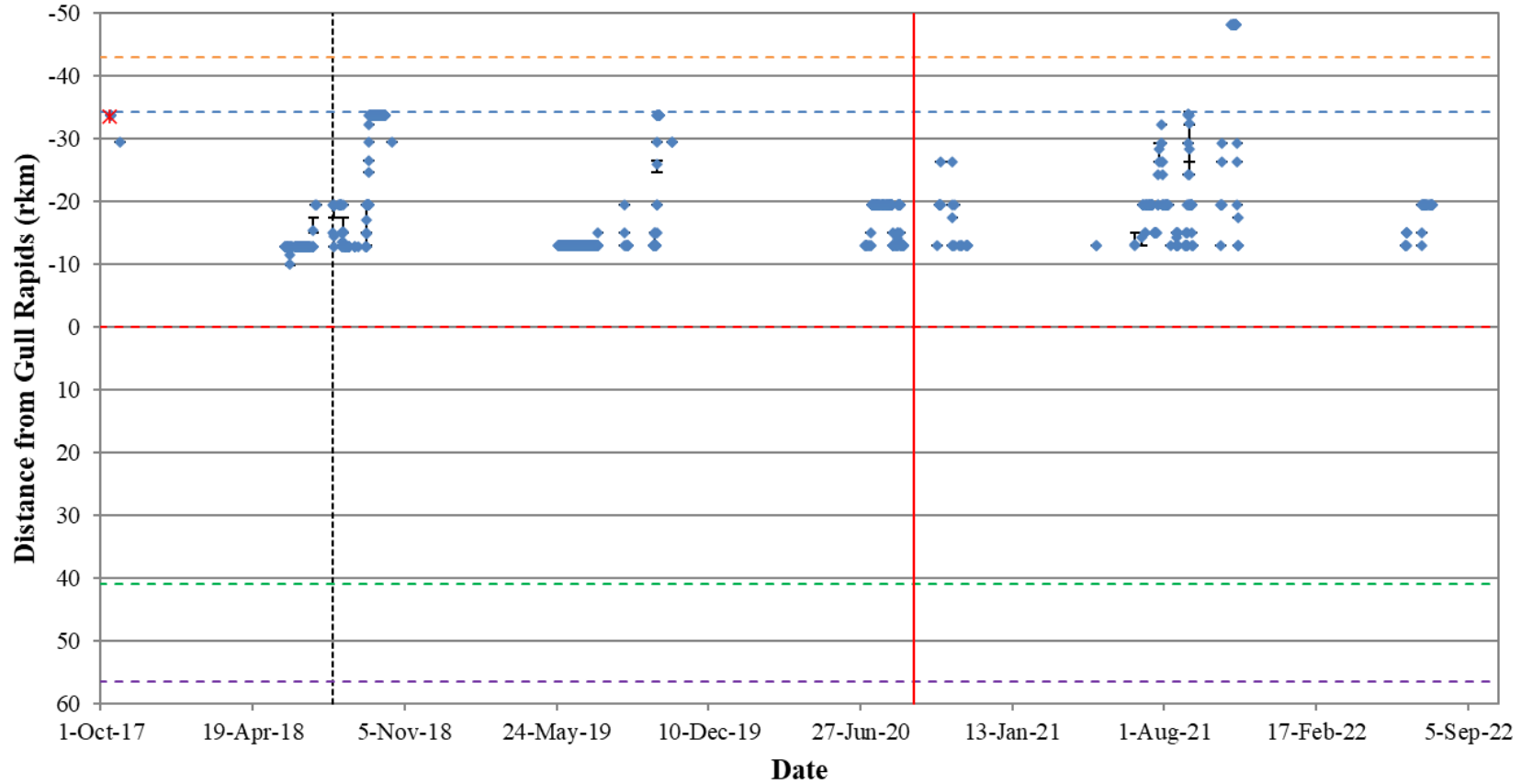


Figure A2-12: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31736) in the Nelson River between Clark Lake and the Keyyask GS, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

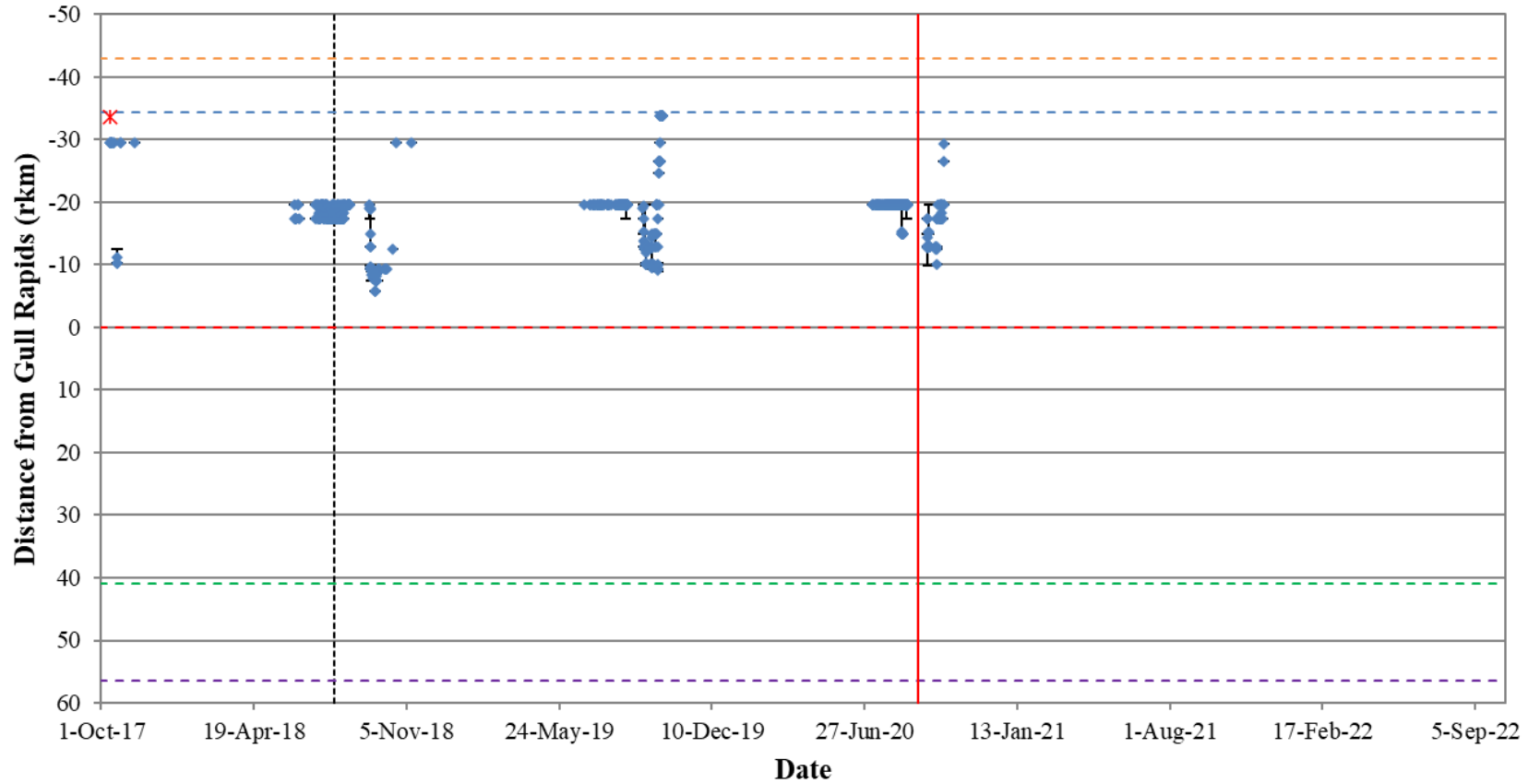


Figure A2-13: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31737) in the Nelson River between Clark Lake and the Keyyask GS, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

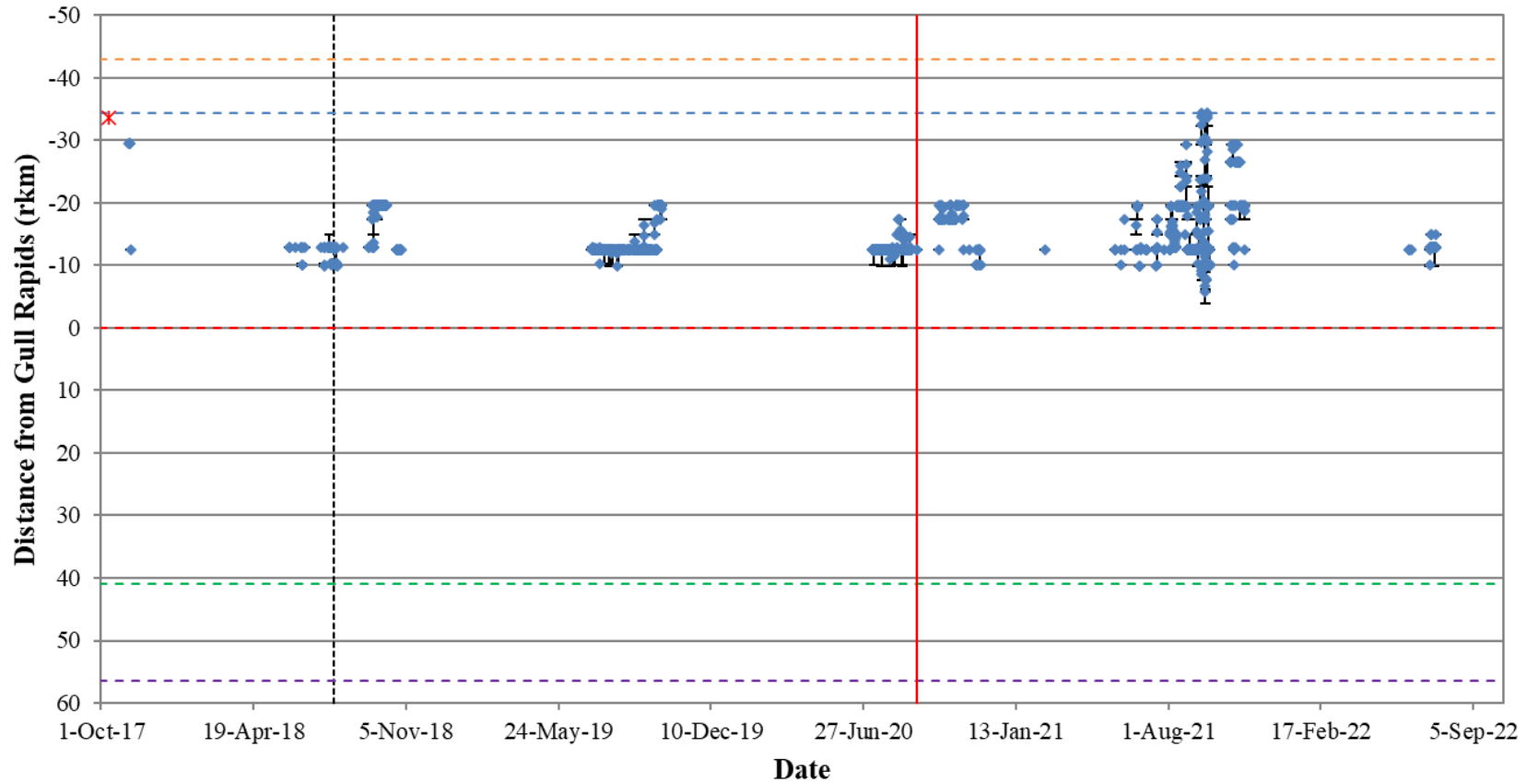


Figure A2-15: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31739) in the Nelson River between Clark Lake and the Keyyask GS, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

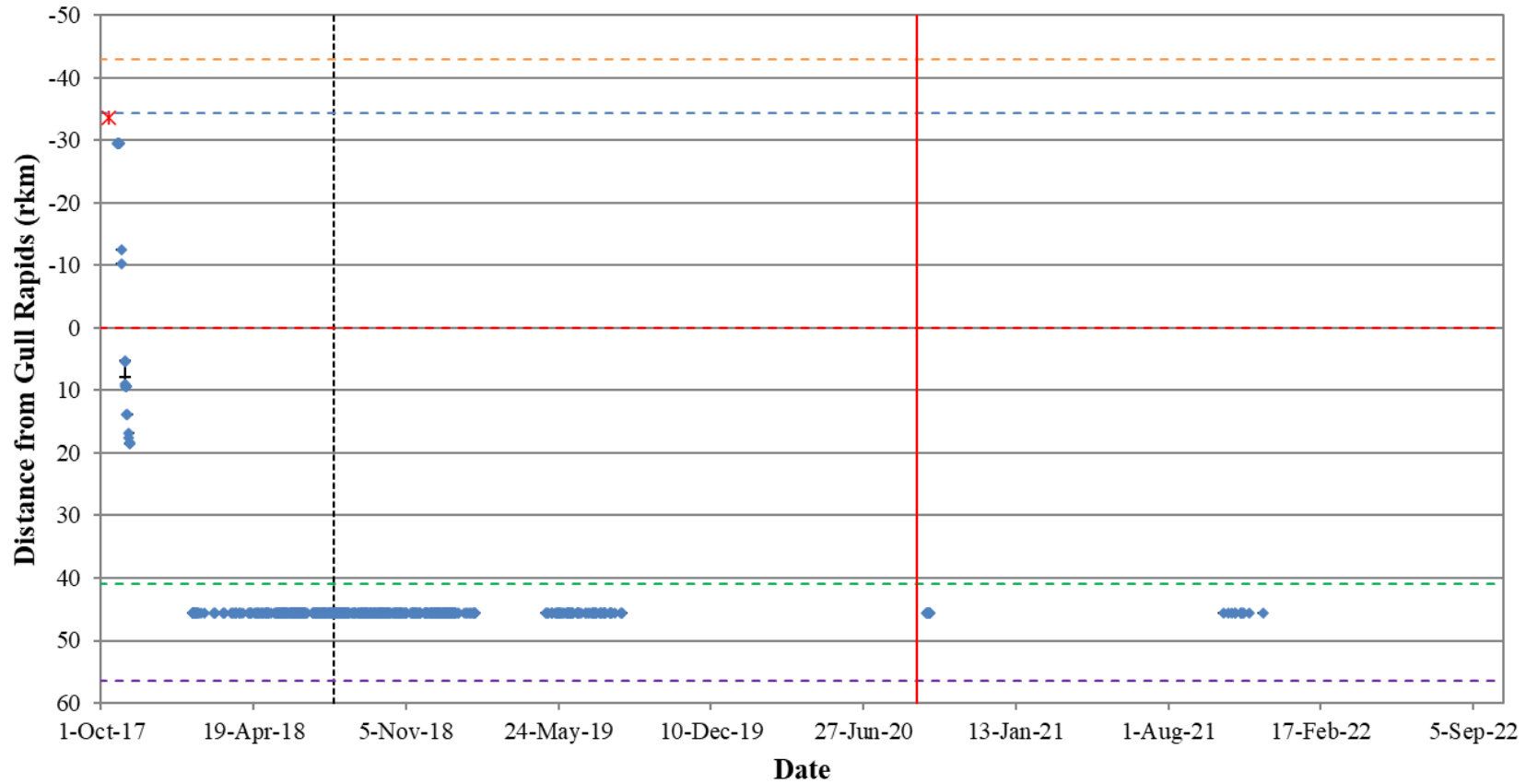


Figure A2-16: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31740) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

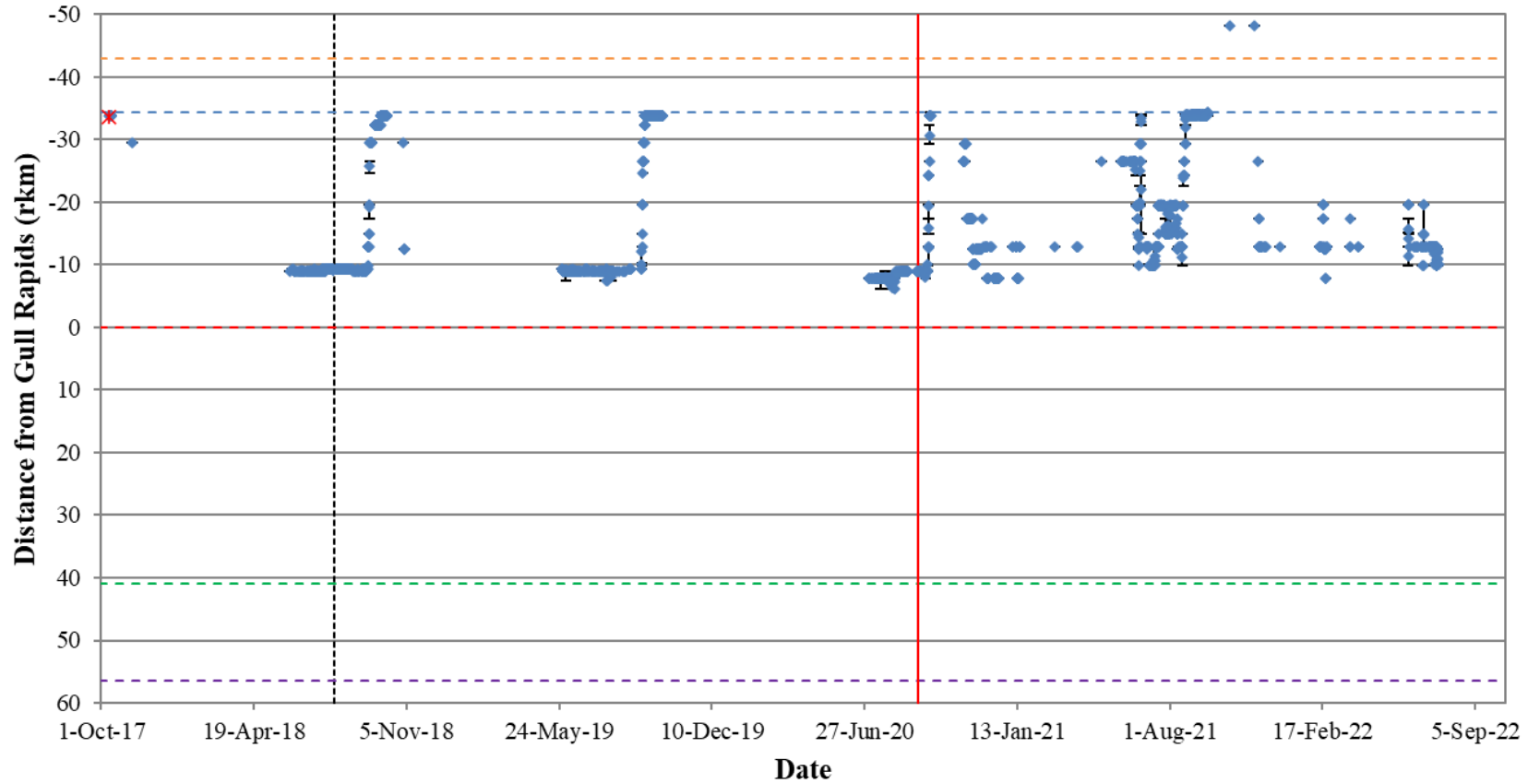


Figure A2-17: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31741) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

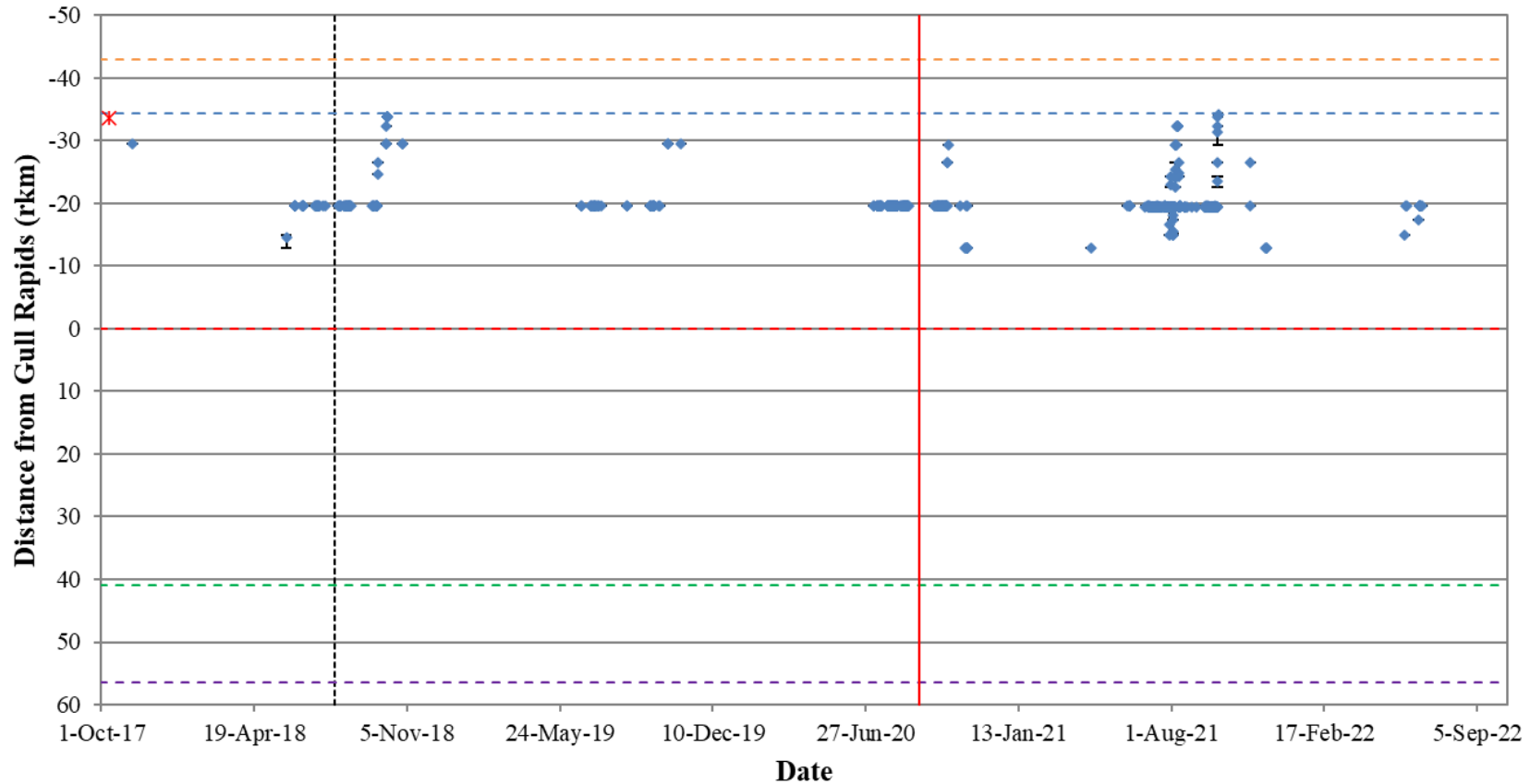


Figure A2-18: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31742) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

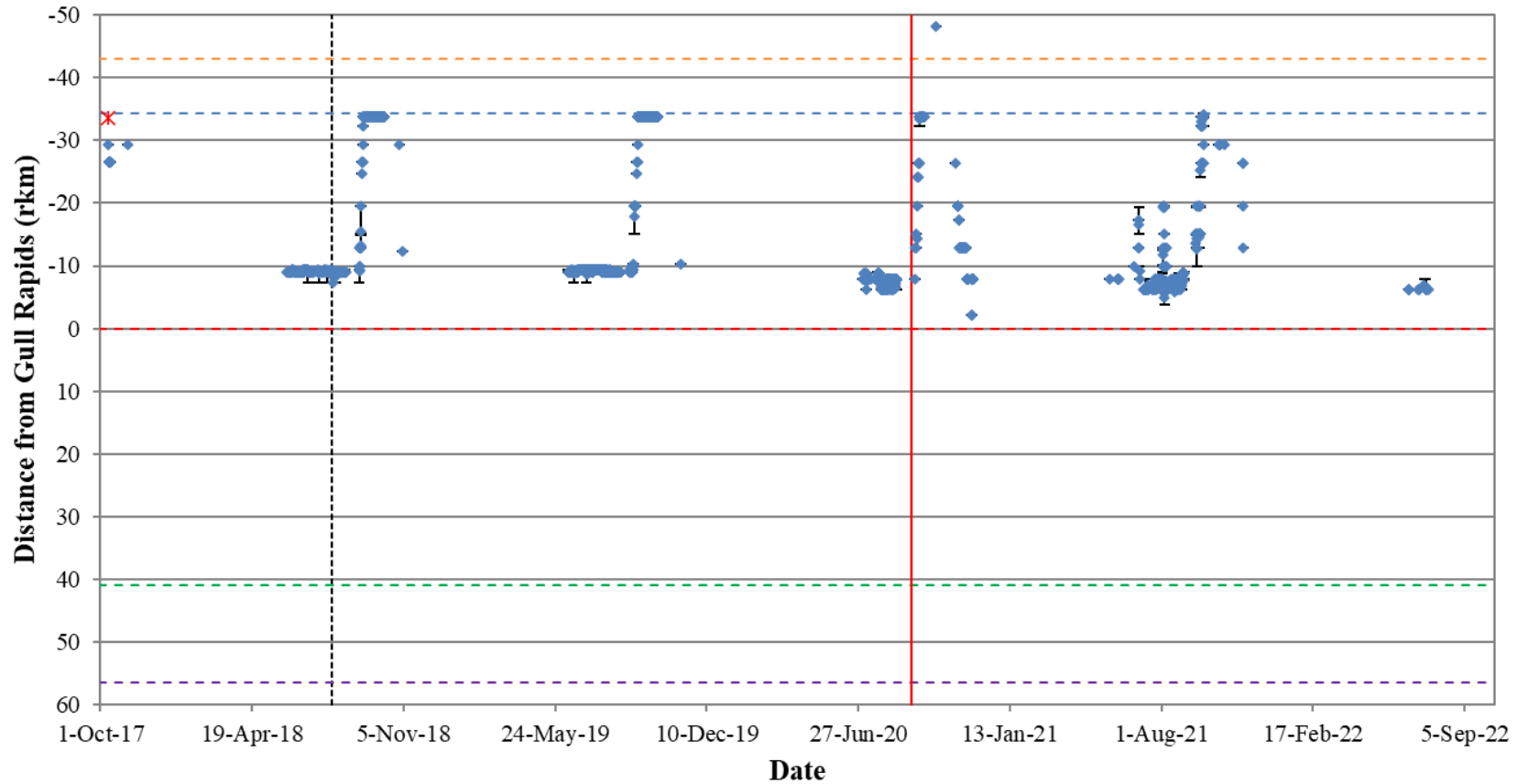


Figure A2-19: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31743) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

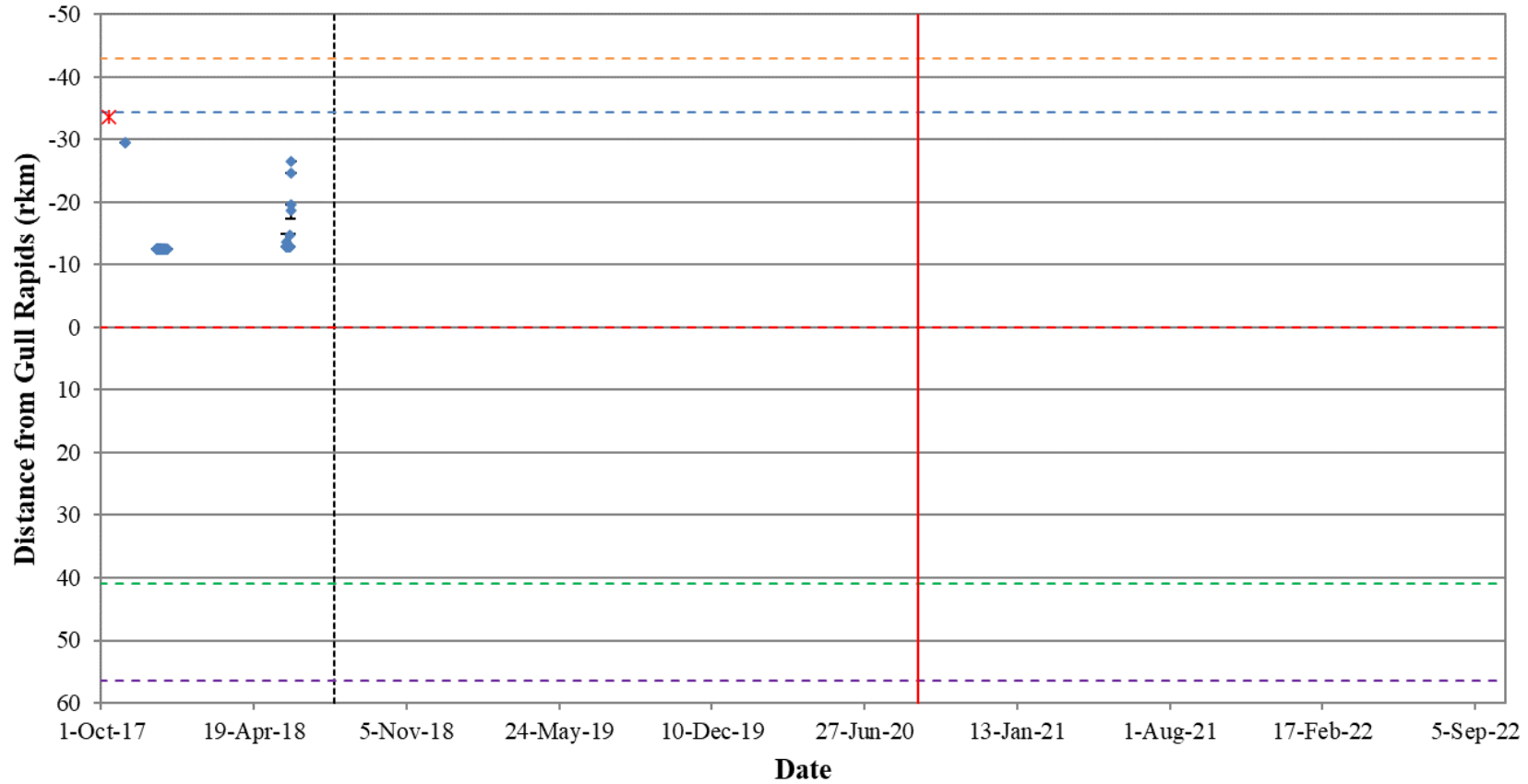


Figure A2-20: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31744) in the Nelson River between Clark Lake and the Keeyask GS, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

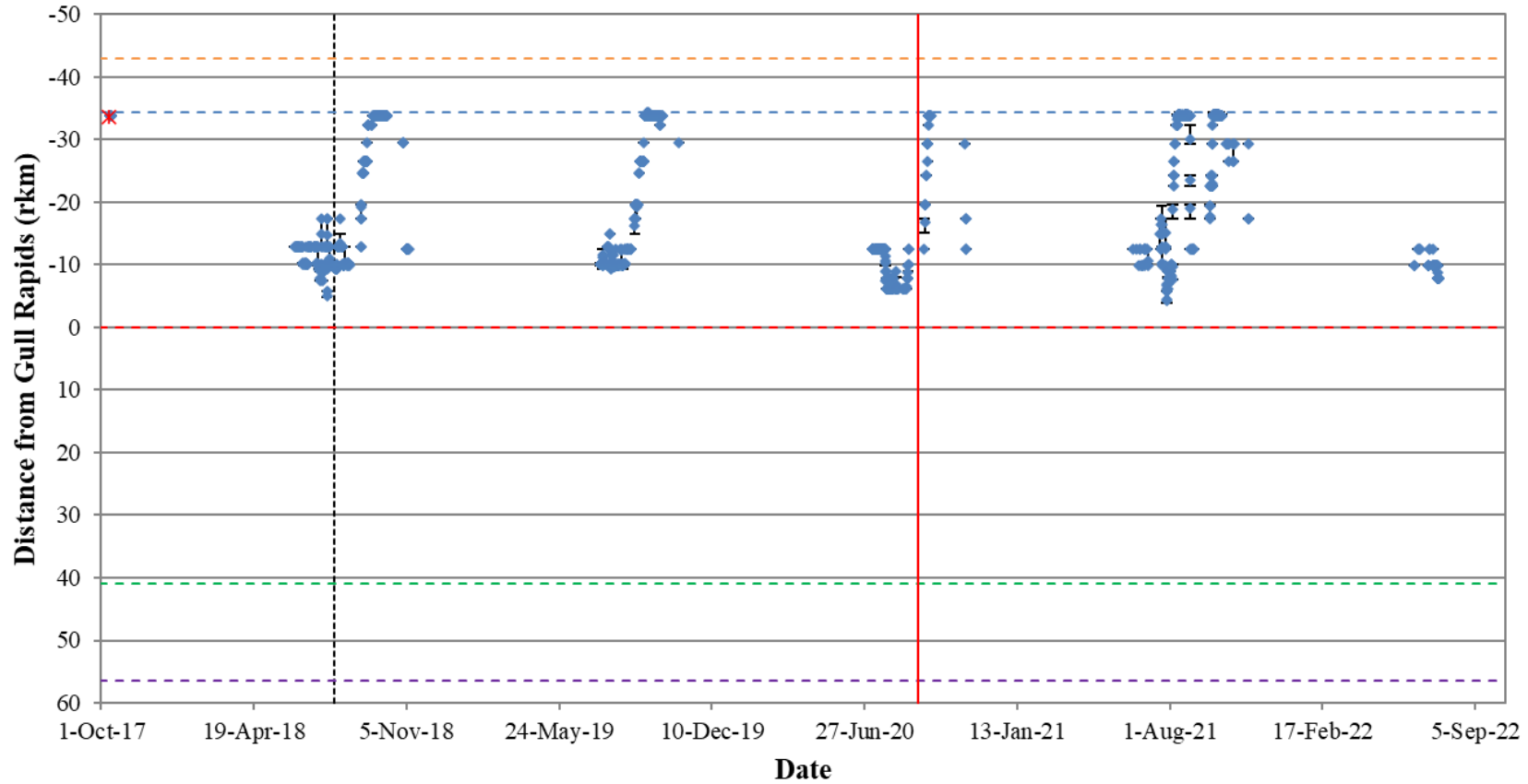


Figure A2-21: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31745) in the Nelson River between Clark Lake and the Keyyask GS, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

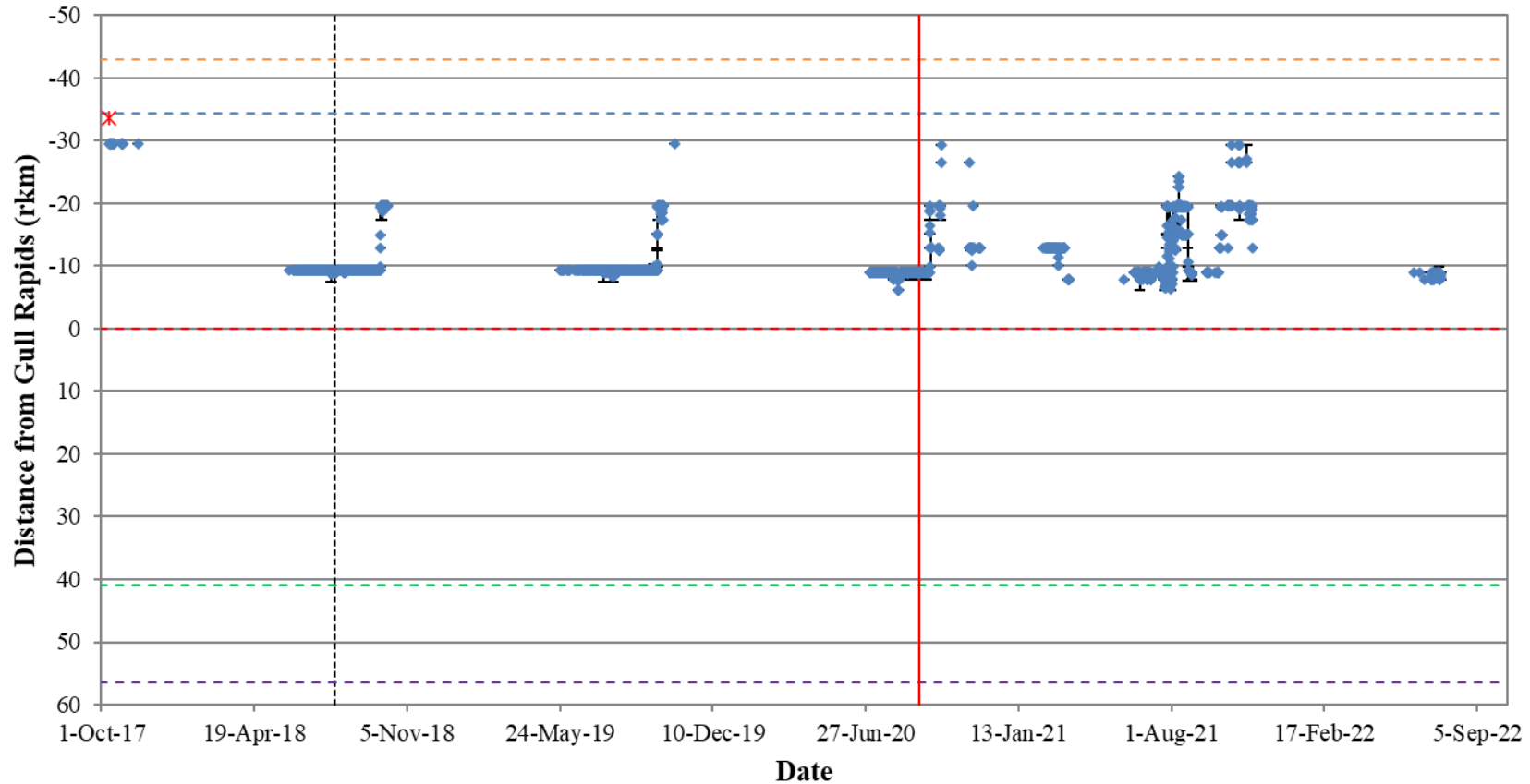


Figure A2-22: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31746) in the Nelson River between Clark Lake and the Keyeyask GS, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

APPENDIX 3: LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC- TAGGED LAKE WHITEFISH IN STEPHENS LAKE, OCTOBER 2017 TO OCTOBER 2022.

Figure A3-1: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31698) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	82
Figure A3-2: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31699) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	83
Figure A3-3: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31700) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	84
Figure A3-4: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31701) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	85
Figure A3-5: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31702) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	86
Figure A3-6: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31703) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	87
Figure A3-7: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31704) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	88
Figure A3-8: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31705) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	89
Figure A3-9: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31706) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	90
Figure A3-10: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31707) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	91
Figure A3-11: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31708) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.	92

Figure A3-12: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31709) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.93

Figure A3-13: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31710) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.94

Figure A3-14: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31711) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.95

Figure A3-15: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31712) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.96

Figure A3-16: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31713) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.97

Figure A3-17: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31714) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.98

Figure A3-18: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31715) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.99

Figure A3-19: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31716) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.100

Figure A3-20: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31717) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.101

Figure A3-21: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31718) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.102

Figure A3-22: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31719) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.103

Figure A3-23: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31720) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.104

Figure A3-24: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31721) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022.105



Figure A3-25: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31723) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 106

Figure A3-26: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31724) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 107

Figure A3-27: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31725) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 108

Figure A3-28: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31747) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 109

Figure A3-29: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31748) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 110

Figure A3-30: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31749) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 111

Figure A3-31: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31750) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 112

Figure A3-32: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31751) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 113

Figure A3-33: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31752) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 114

Figure A3-34: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31753) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 115

Figure A3-35: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31754) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 116

Figure A3-36: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31755) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 117

Figure A3-37: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31756) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 118



Figure A3-38: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31757) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 119

Figure A3-39: Position of a Lake Whitefish tagged with an acoustic transmitter (code #53761) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 120

Figure A3-40: Position of a Lake Whitefish tagged with an acoustic transmitter (code #53762) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. 121

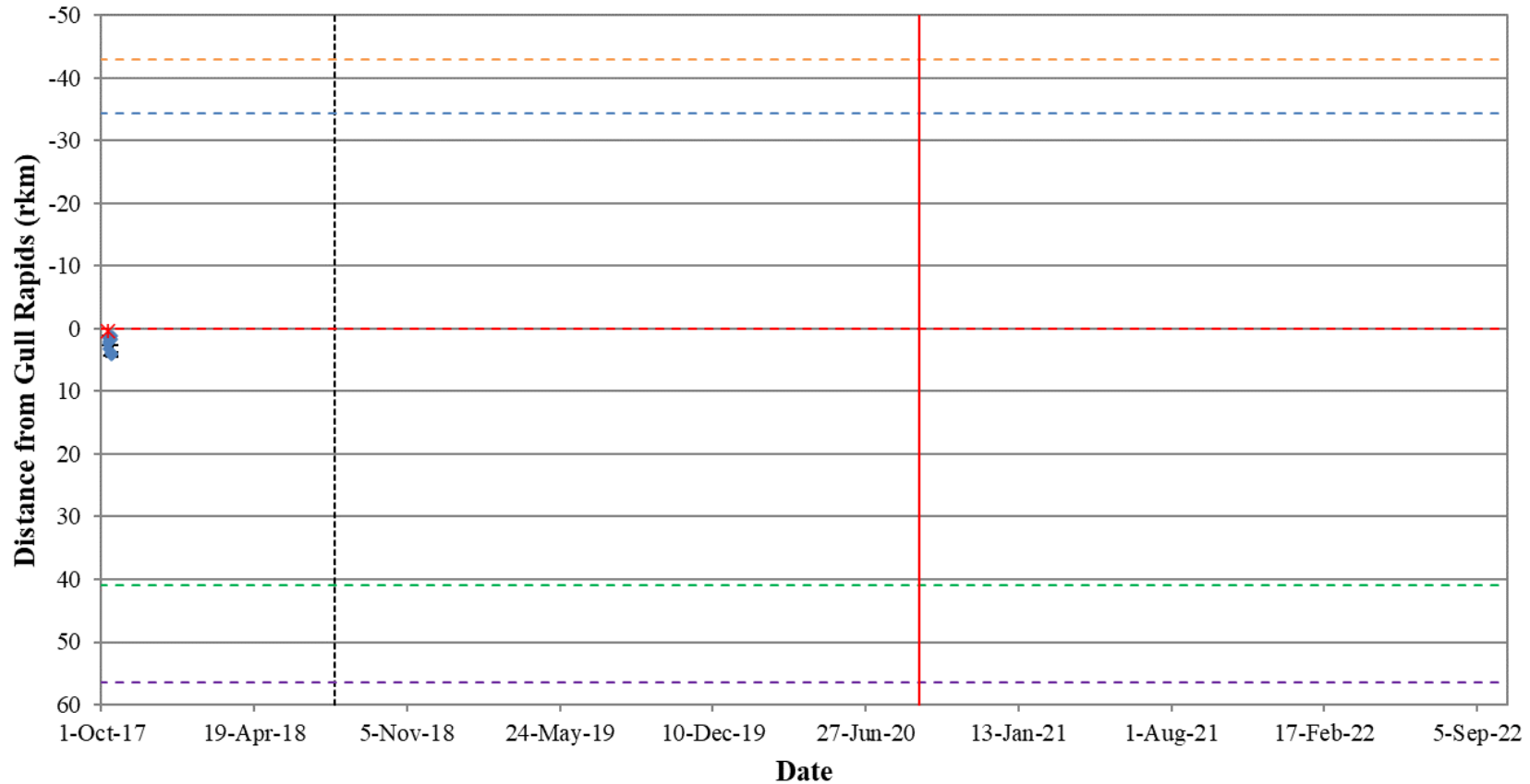


Figure A3-1: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31698) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

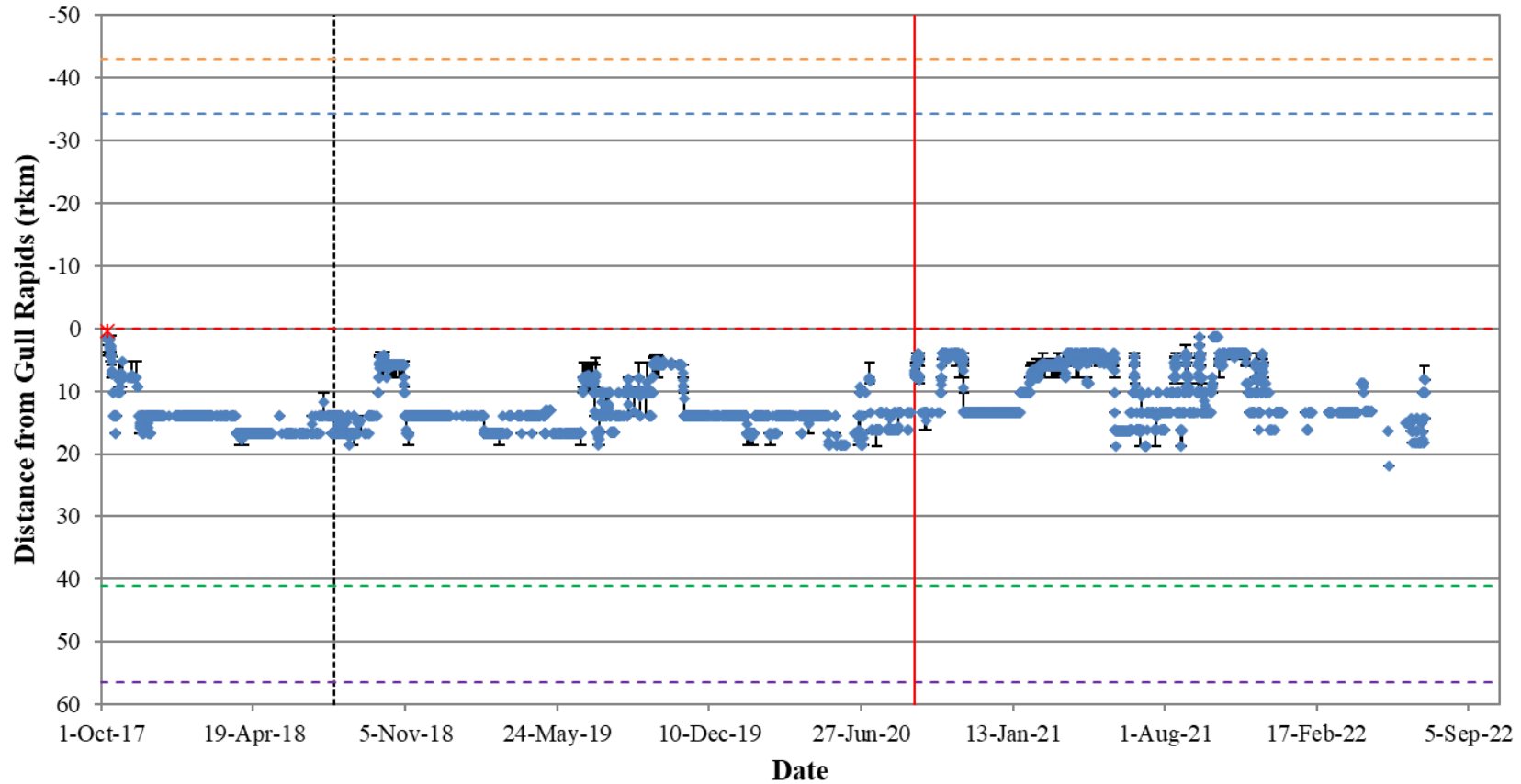


Figure A3-2: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31699) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

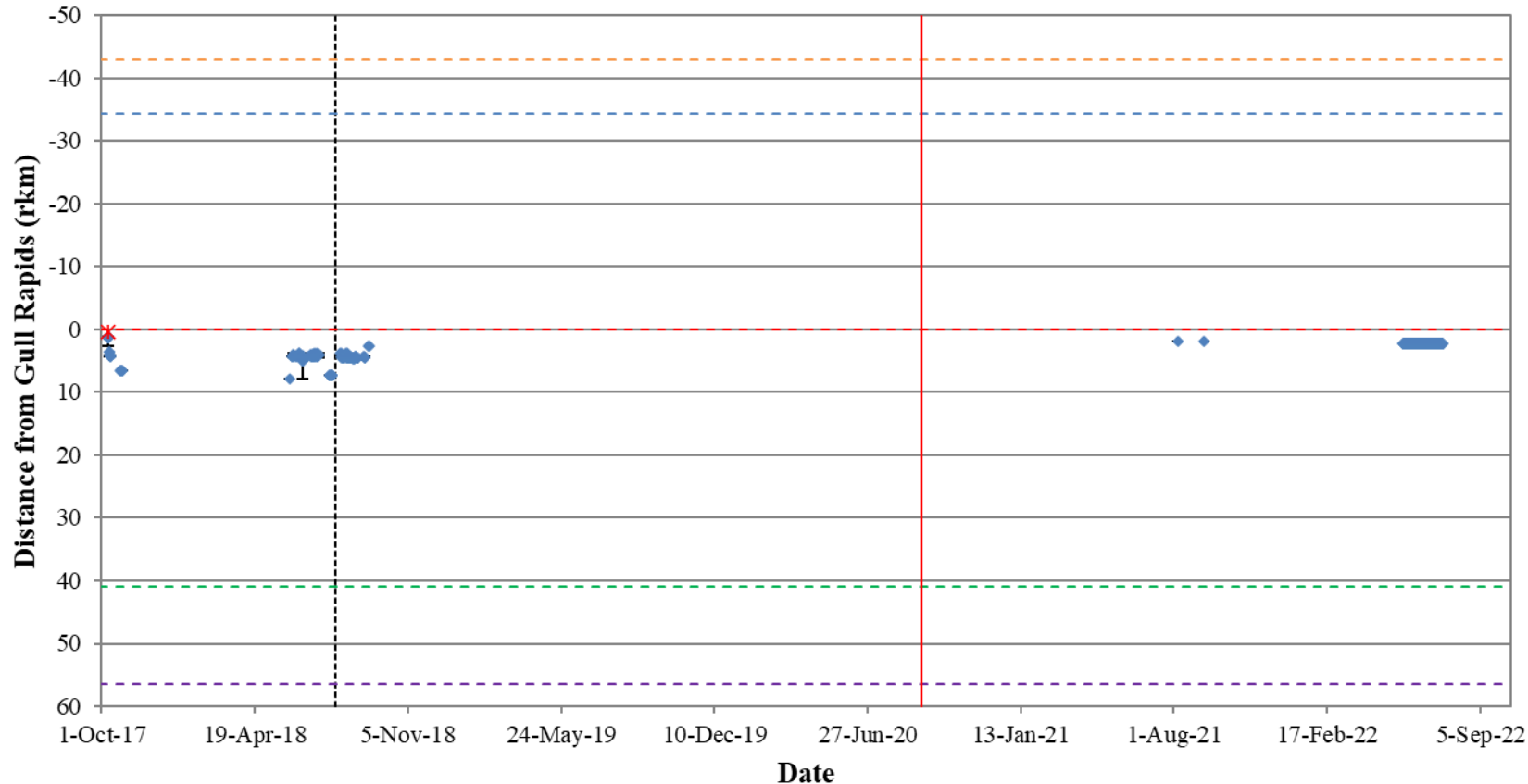


Figure A3-3: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31700) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

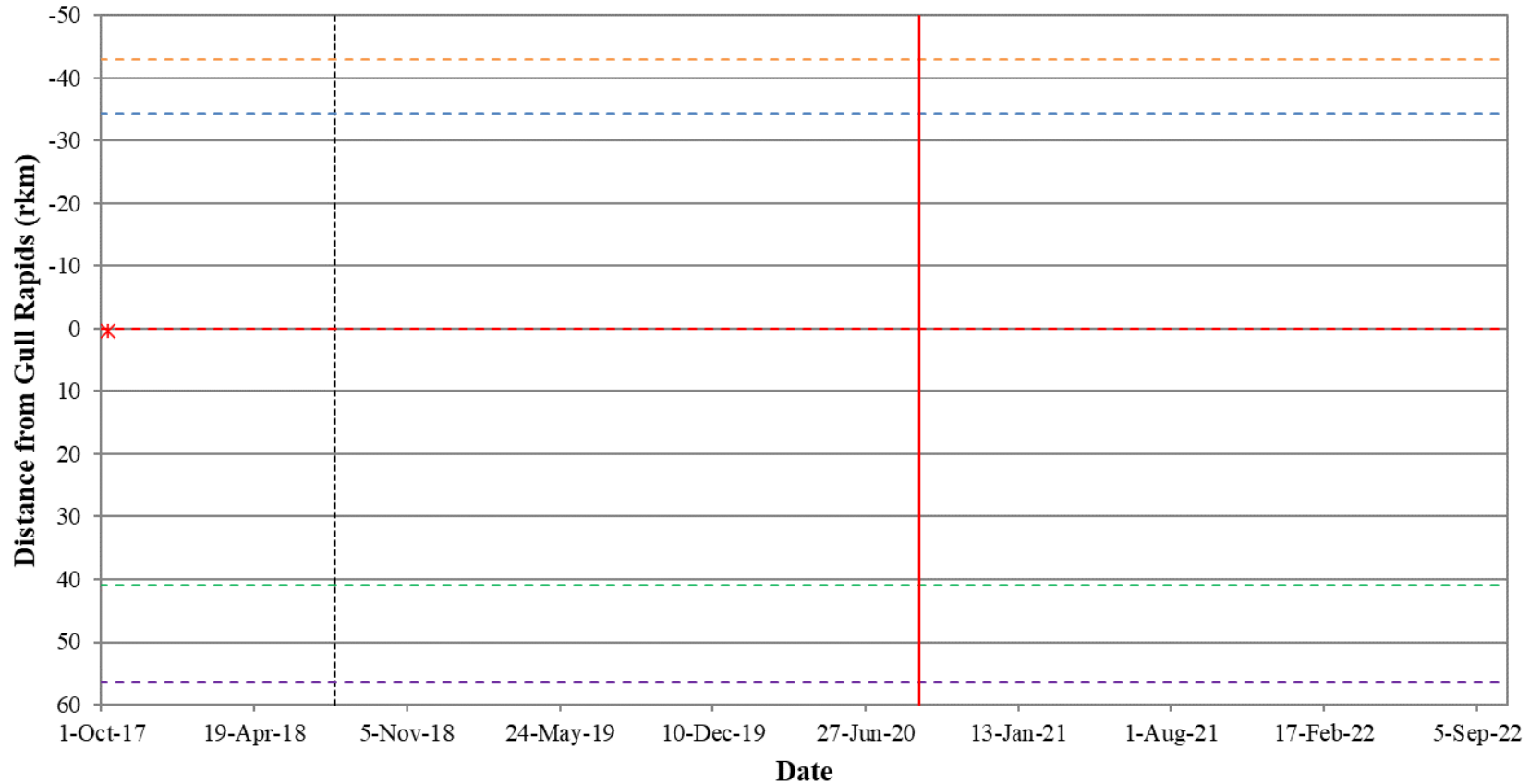


Figure A3-4: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31701) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

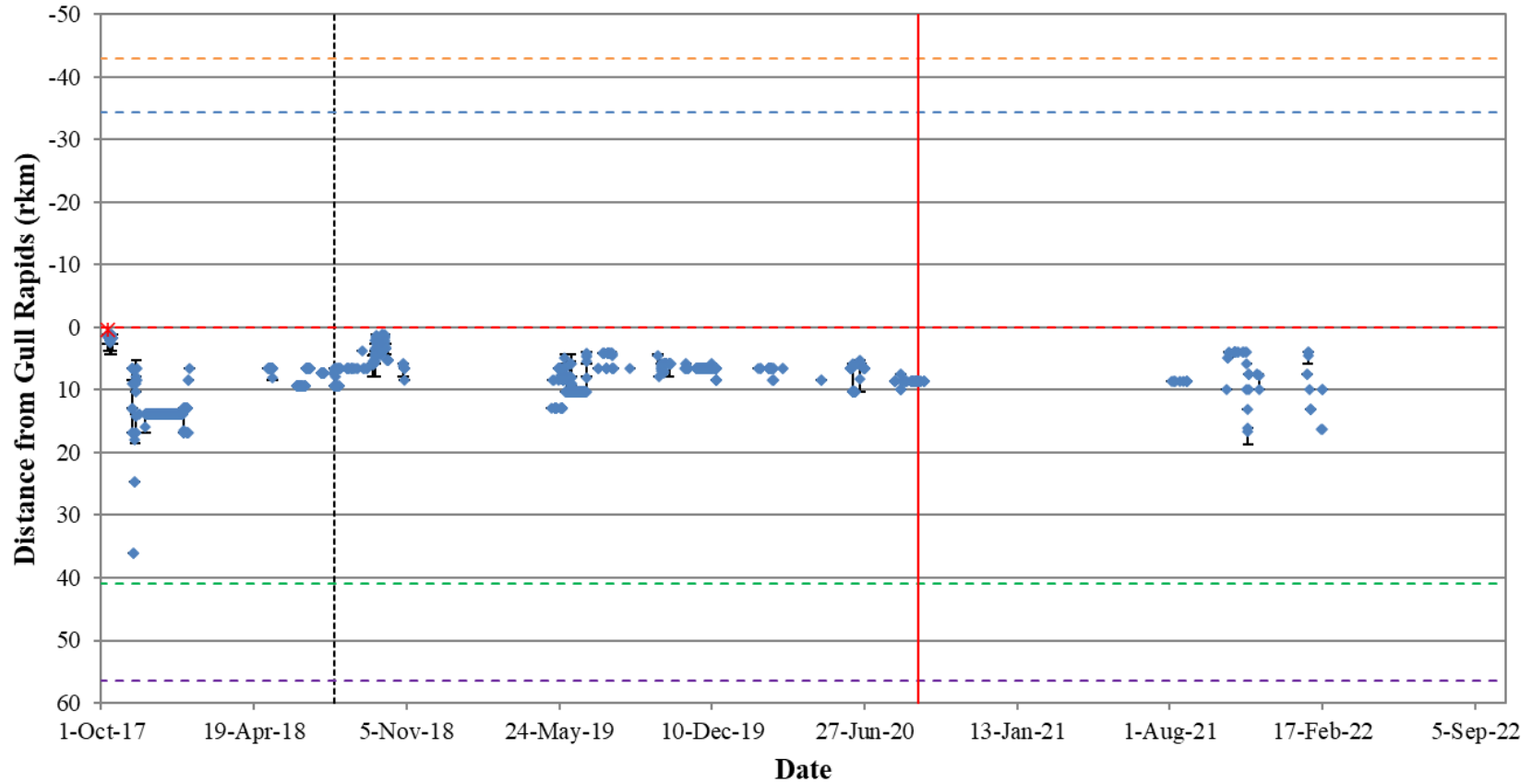


Figure A3-5: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31702) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

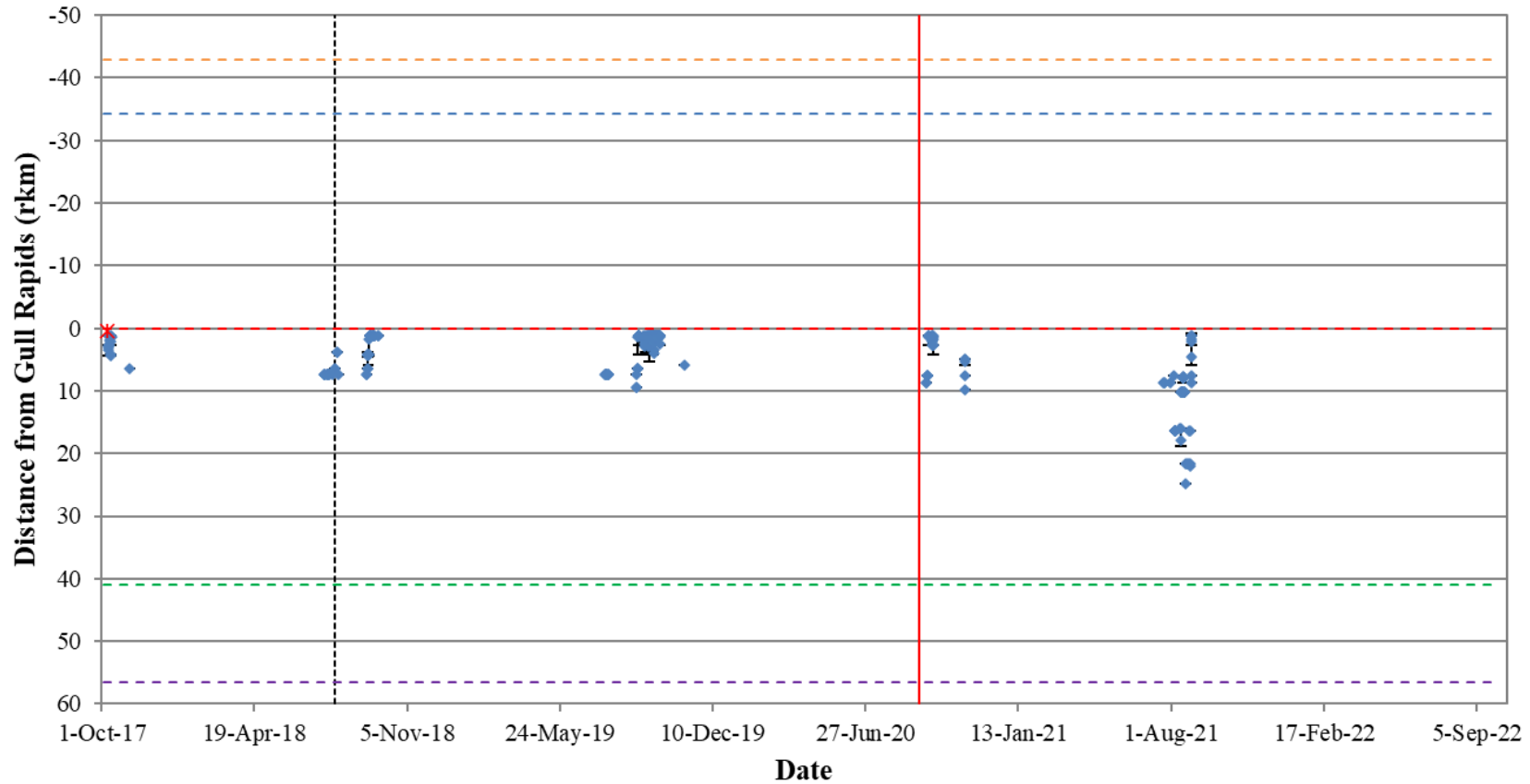


Figure A3-6: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31703) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

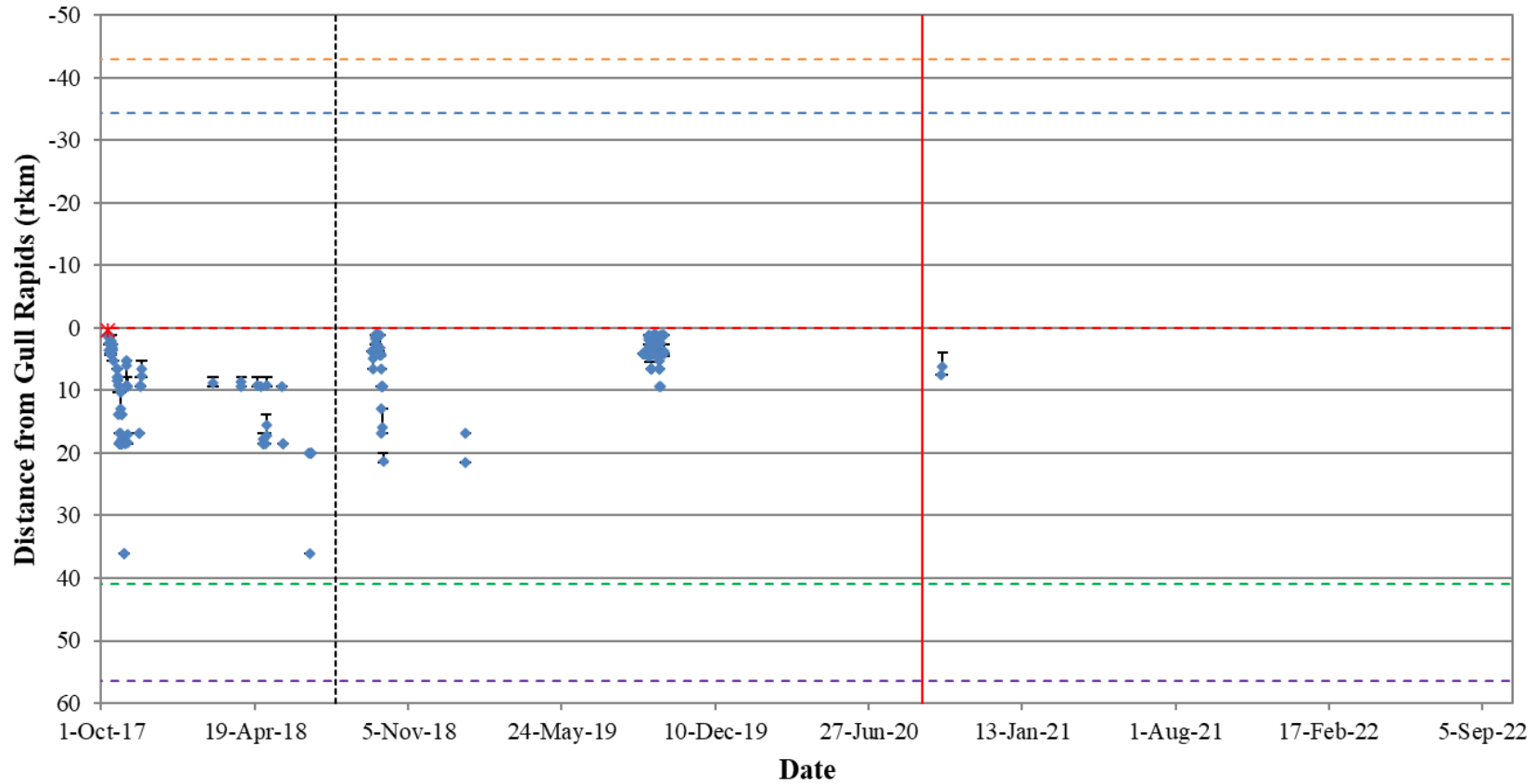


Figure A3-7: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31704) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

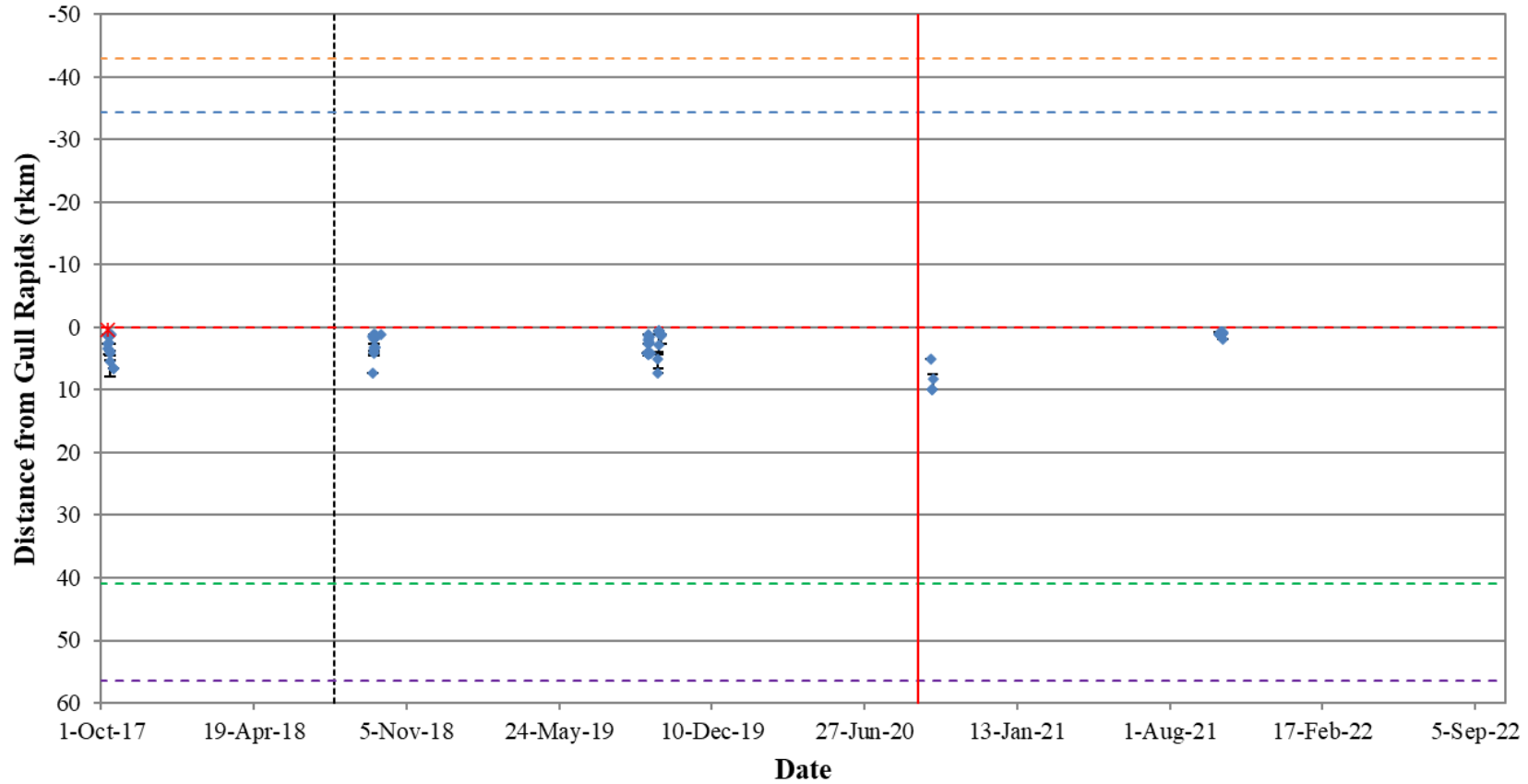


Figure A3-8: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31705) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

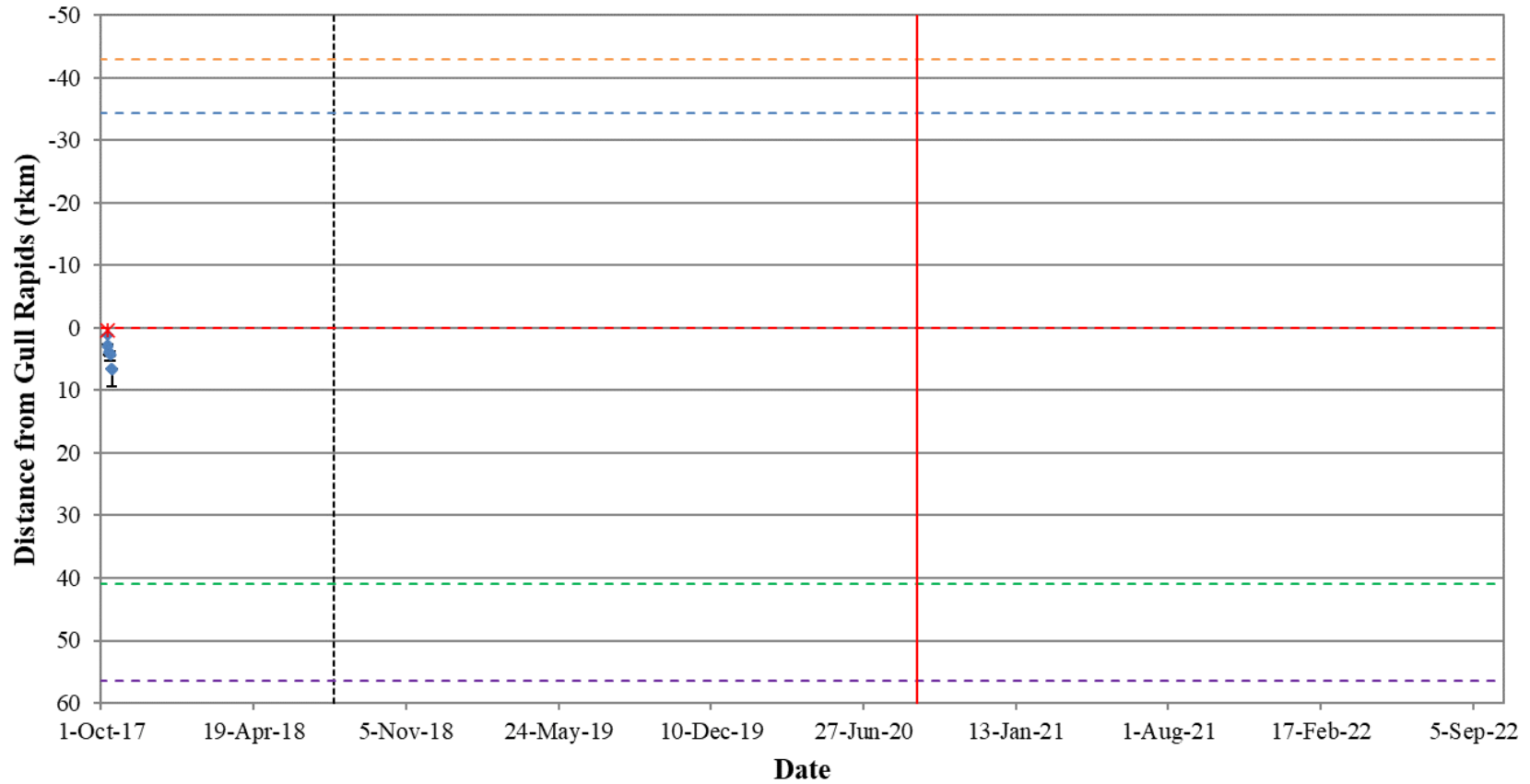


Figure A3-9: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31706) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

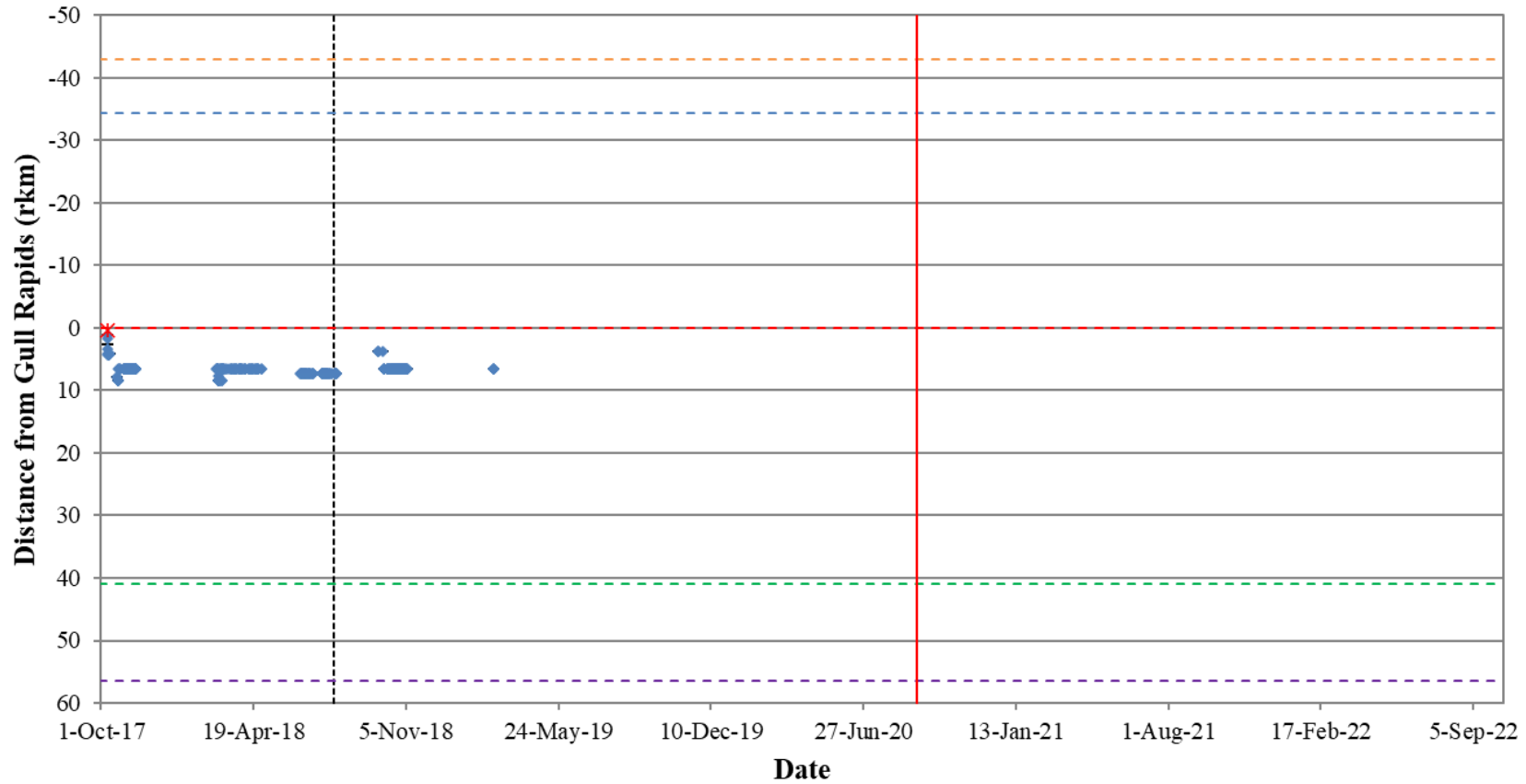


Figure A3-10: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31707) in Stephens Lake, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

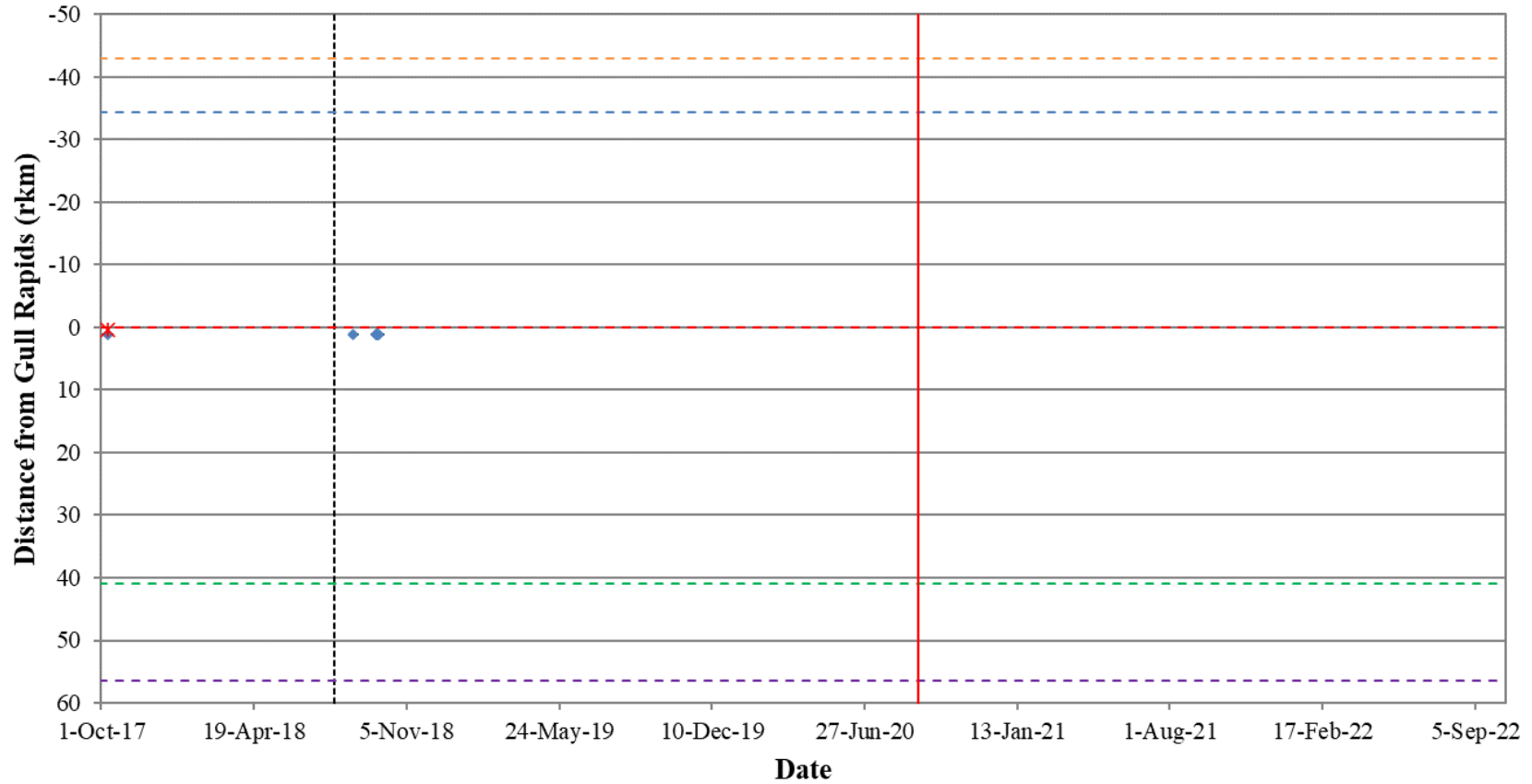


Figure A3-11: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31708) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

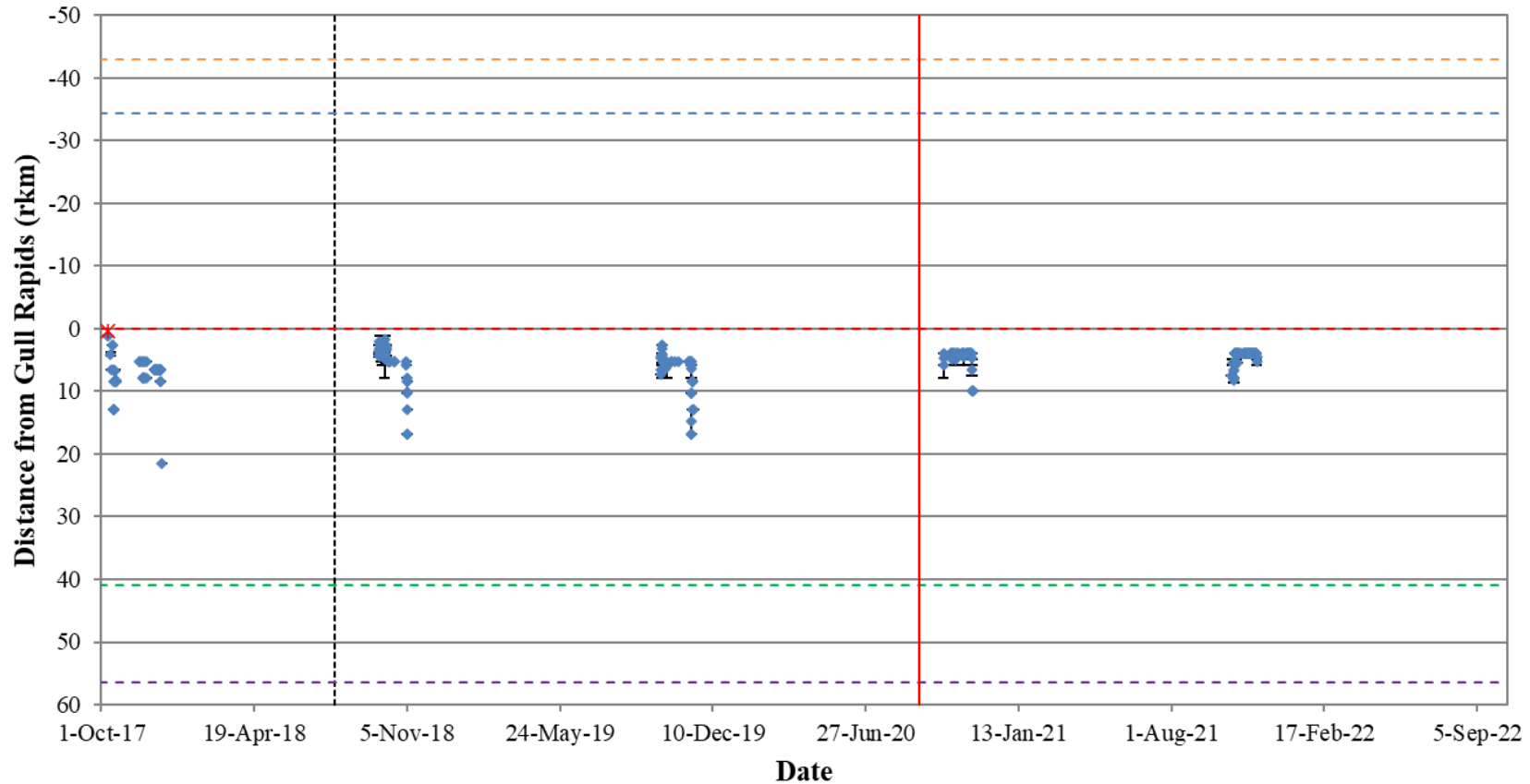


Figure A3-12: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31709) in Stephens Lake, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

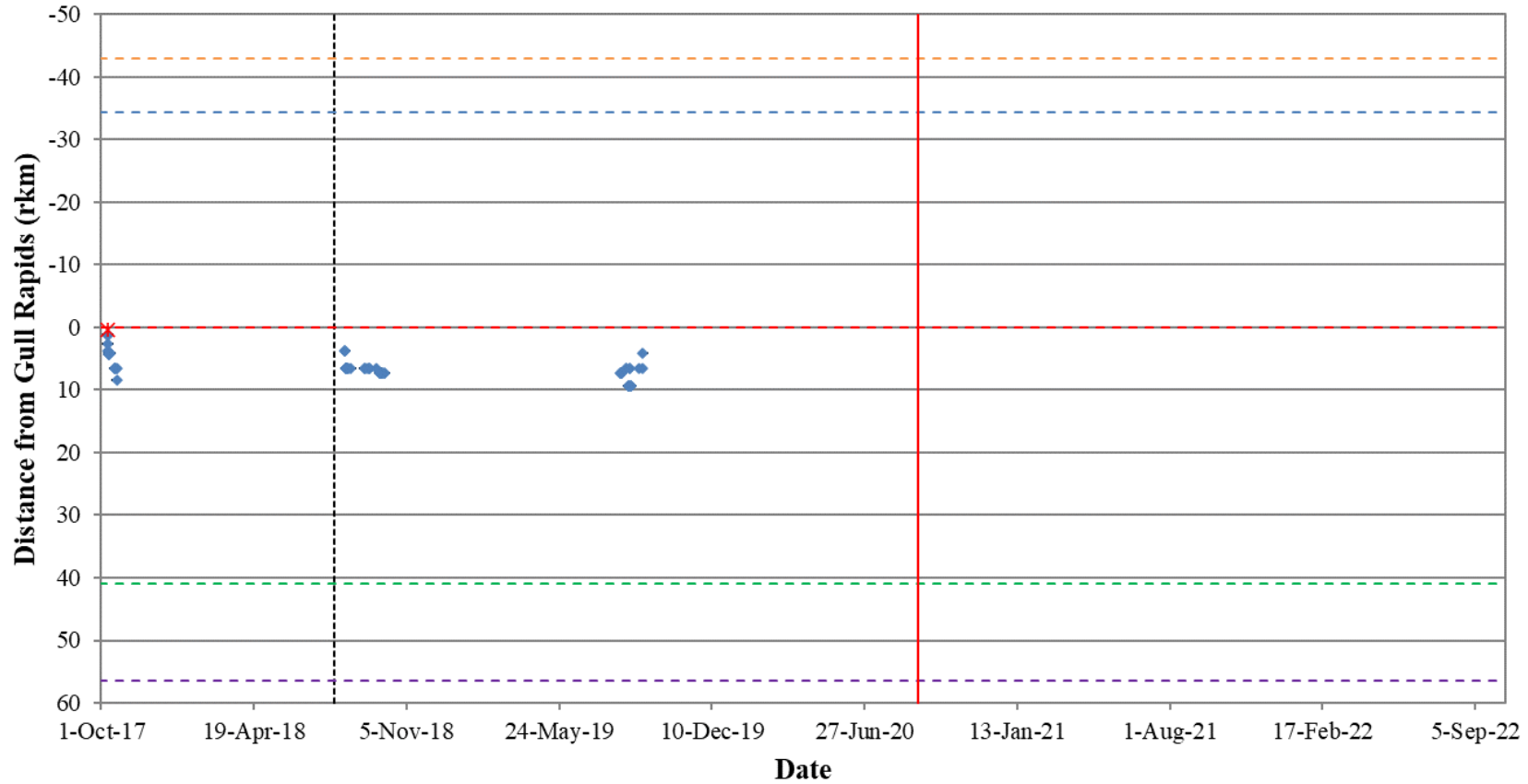


Figure A3-13: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31710) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

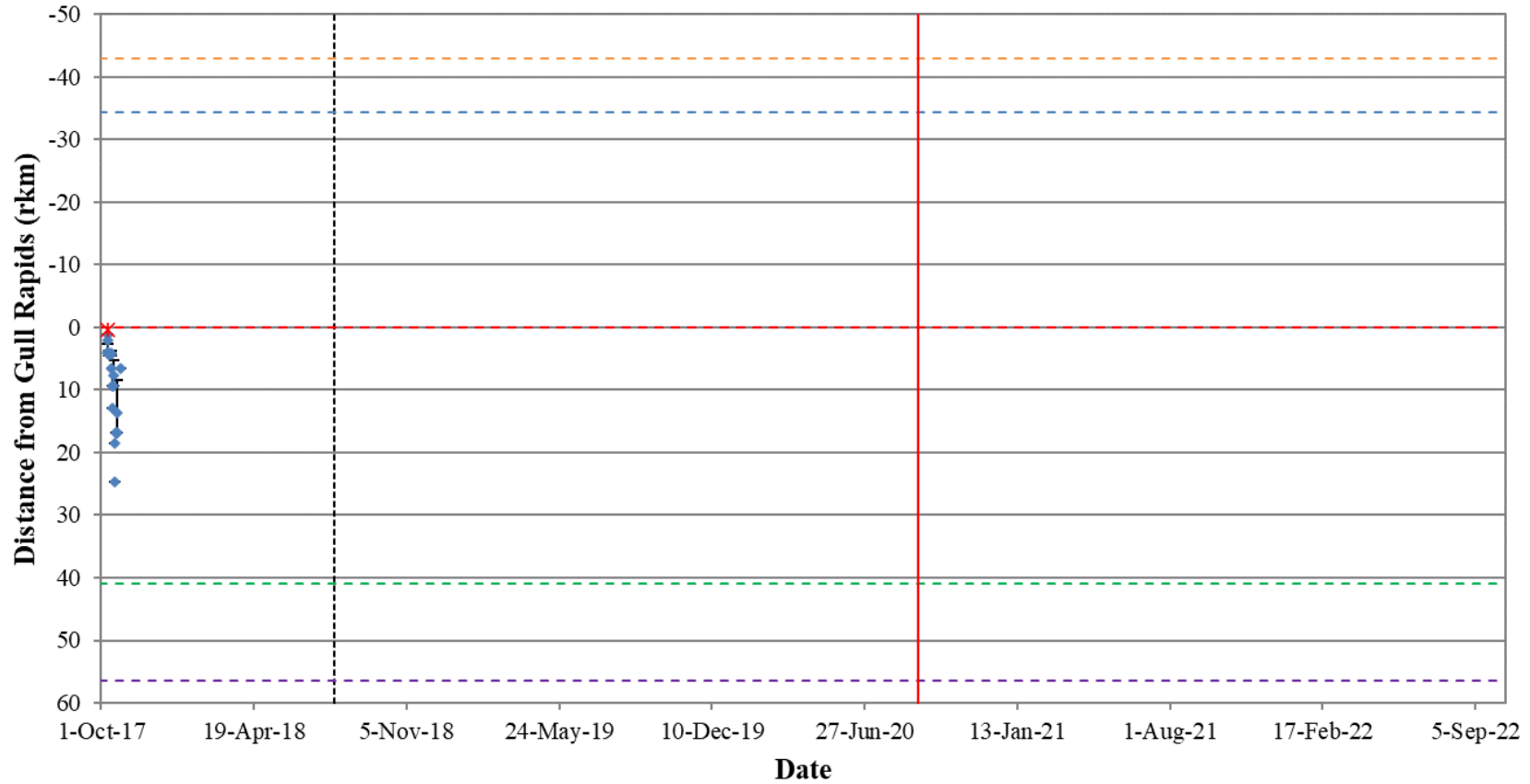


Figure A3-14: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31711) in Stephens Lake, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

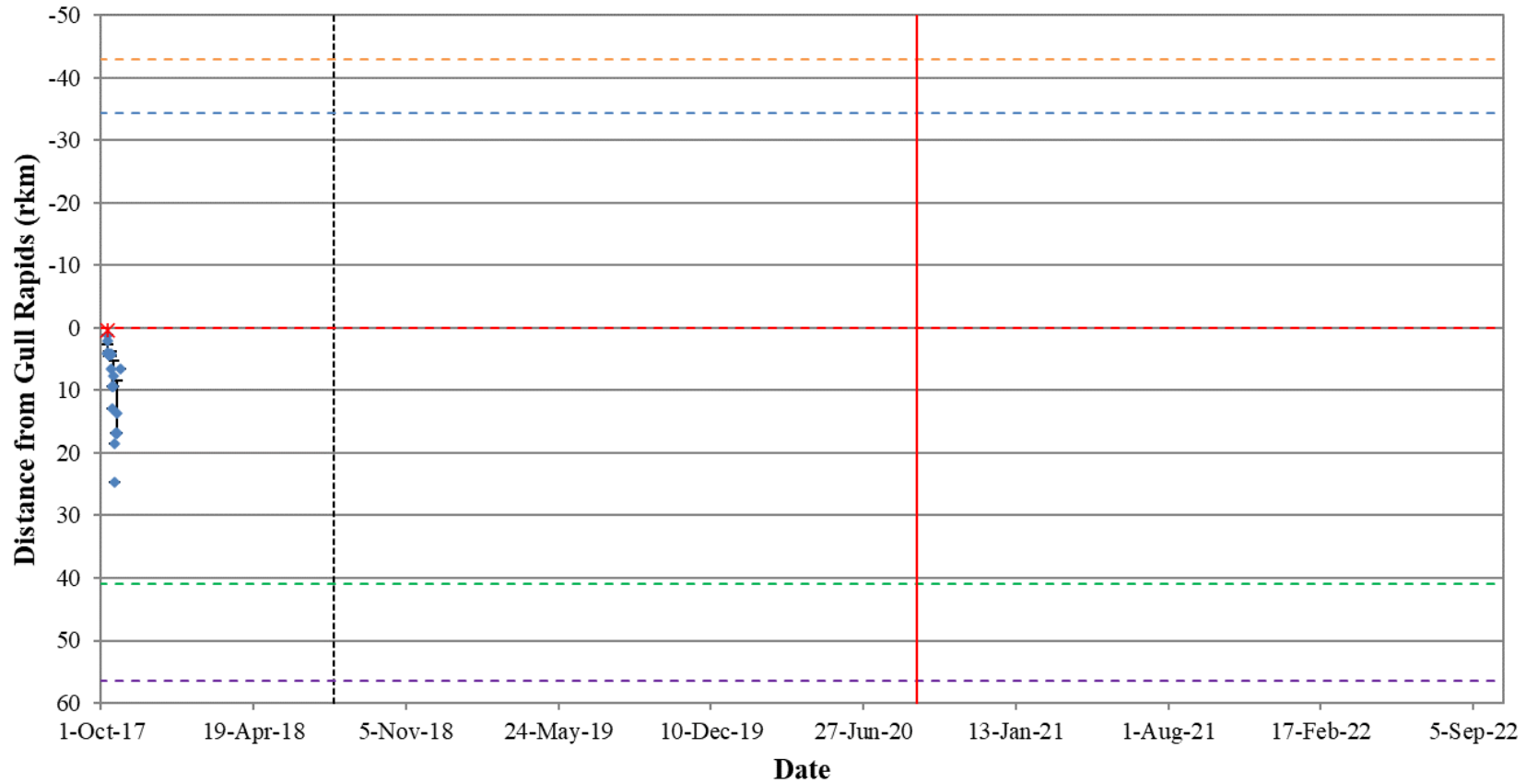


Figure A3-15: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31712) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

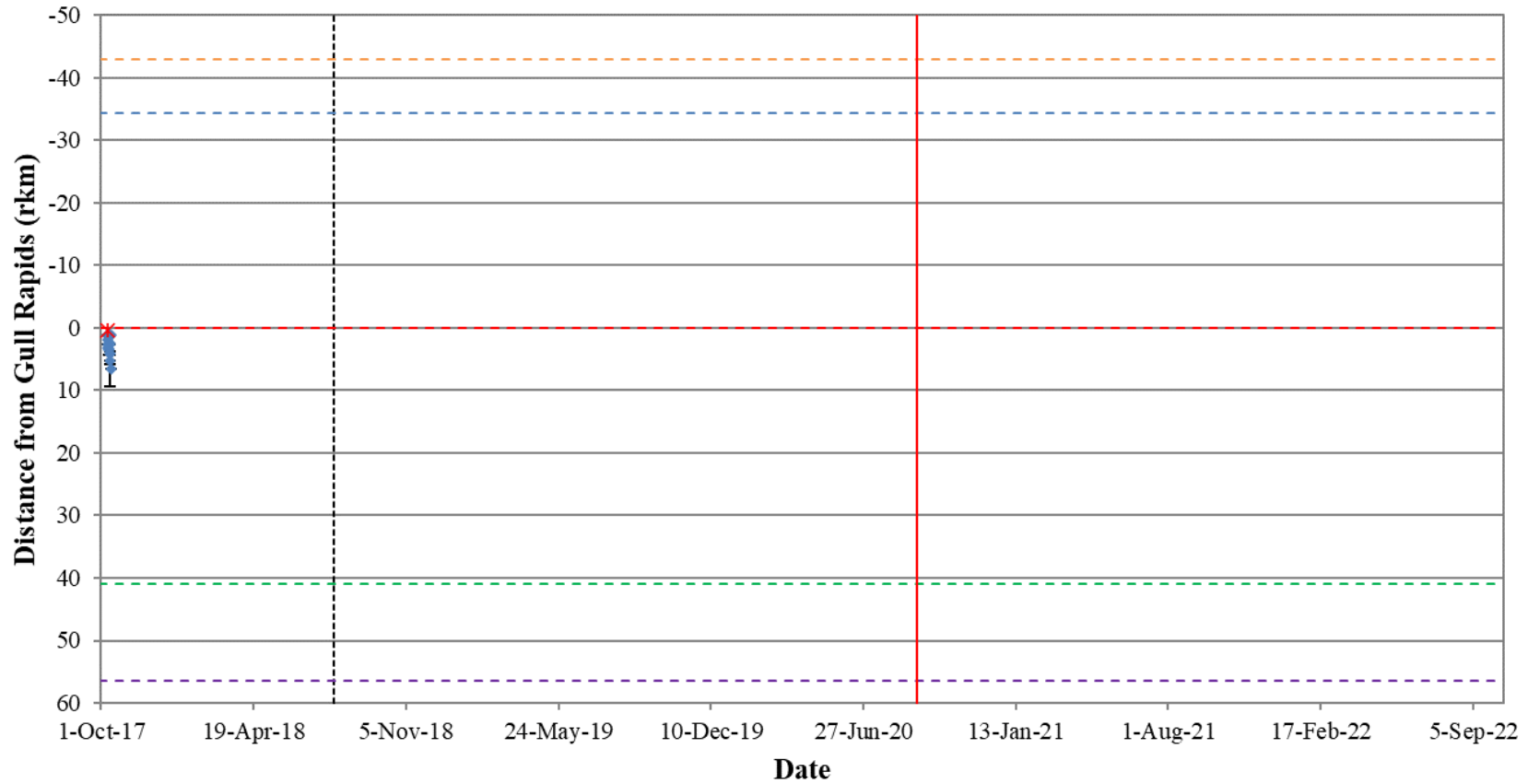


Figure A3-16: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31713) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

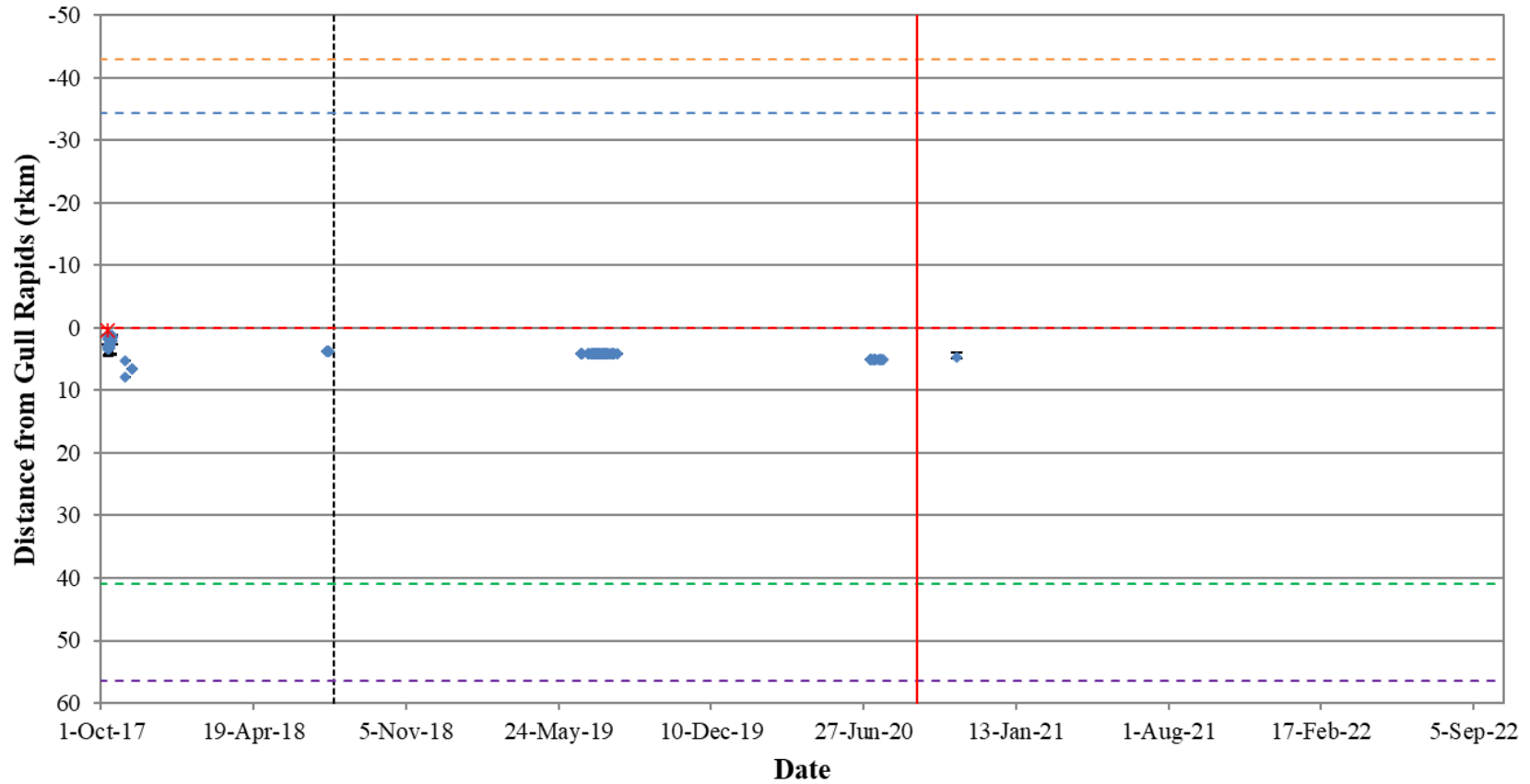


Figure A3-17: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31714) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

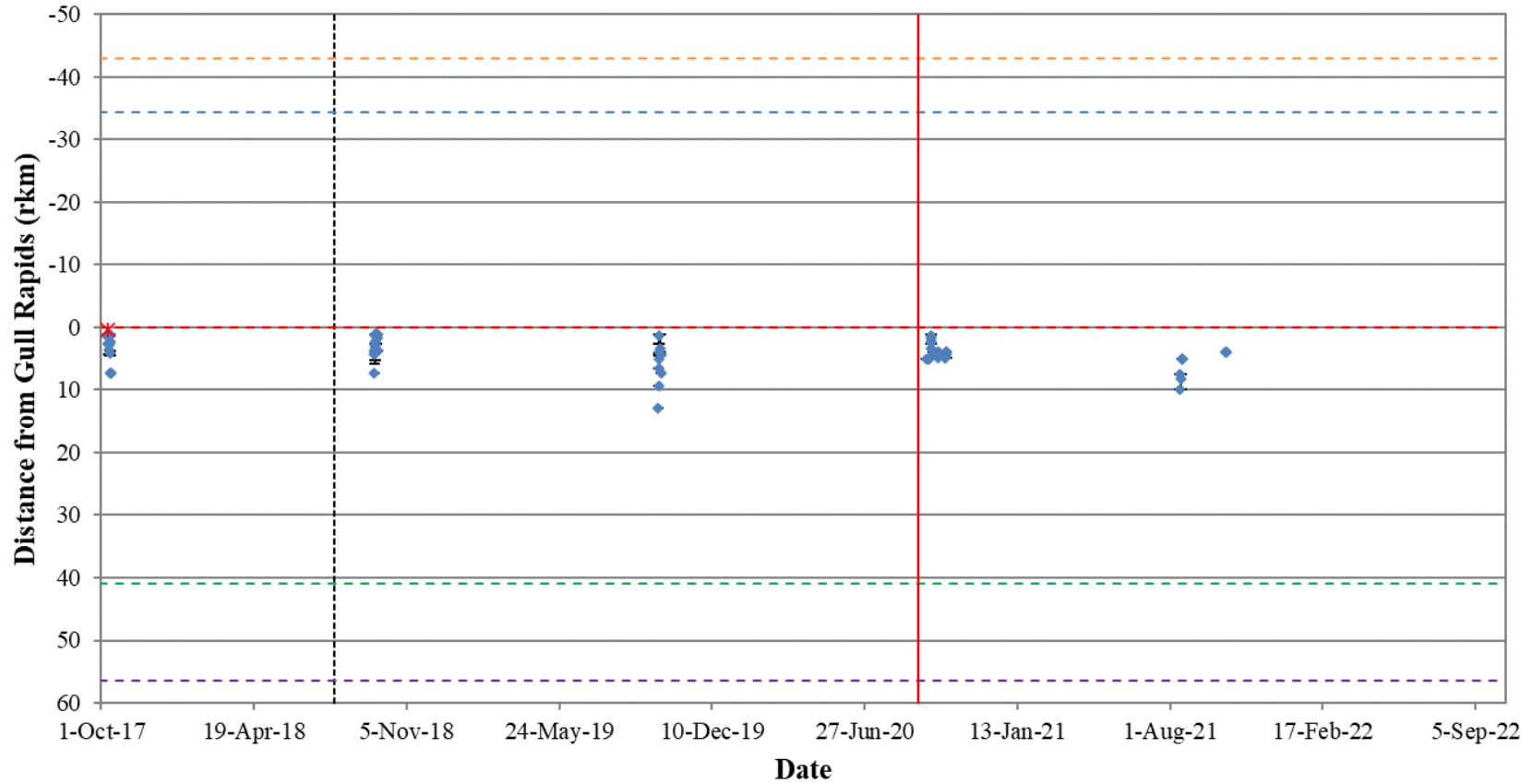


Figure A3-18: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31715) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask

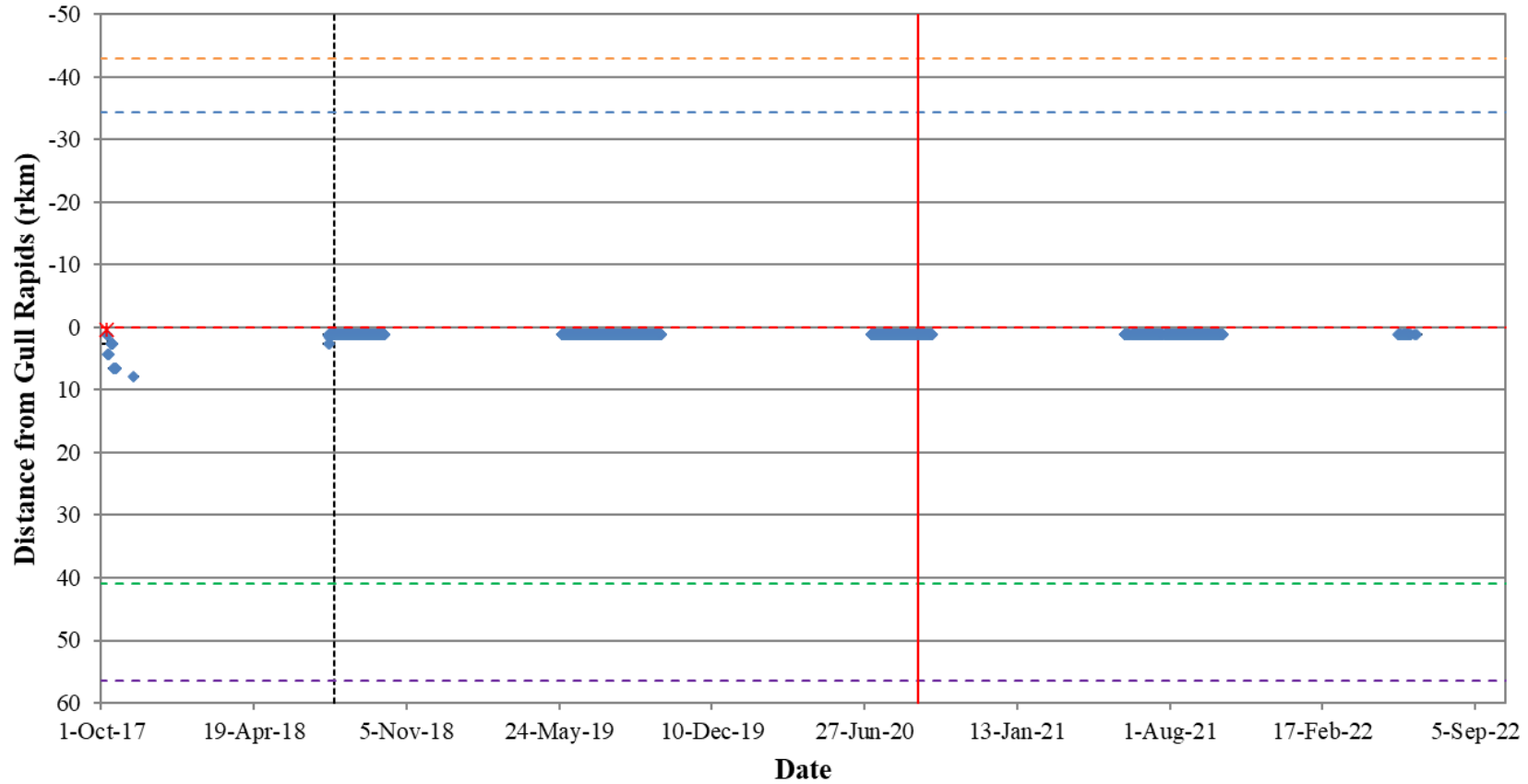


Figure A3-19: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31716) in Stephens Lake, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

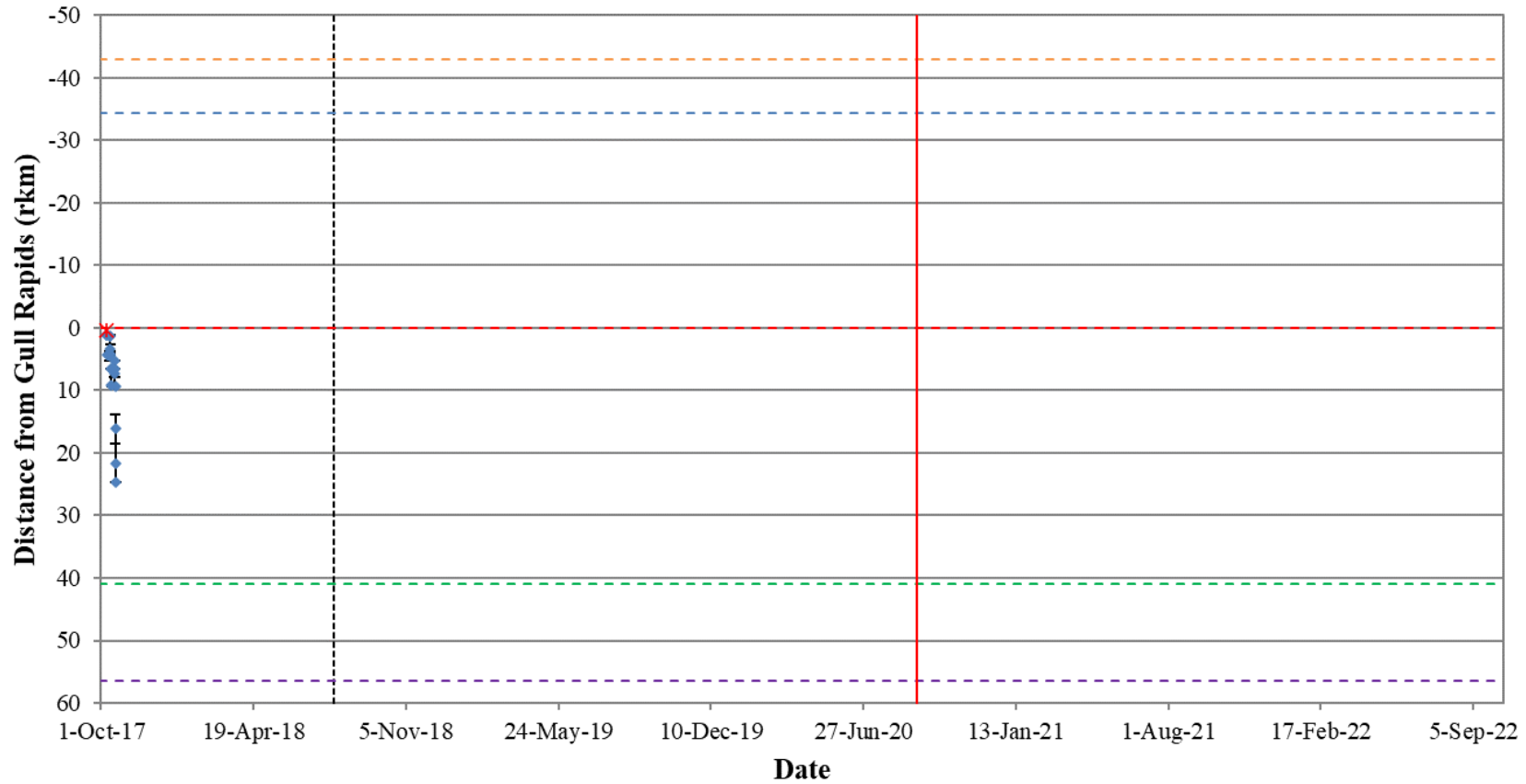


Figure A3-20: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31717) in Stephens Lake, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

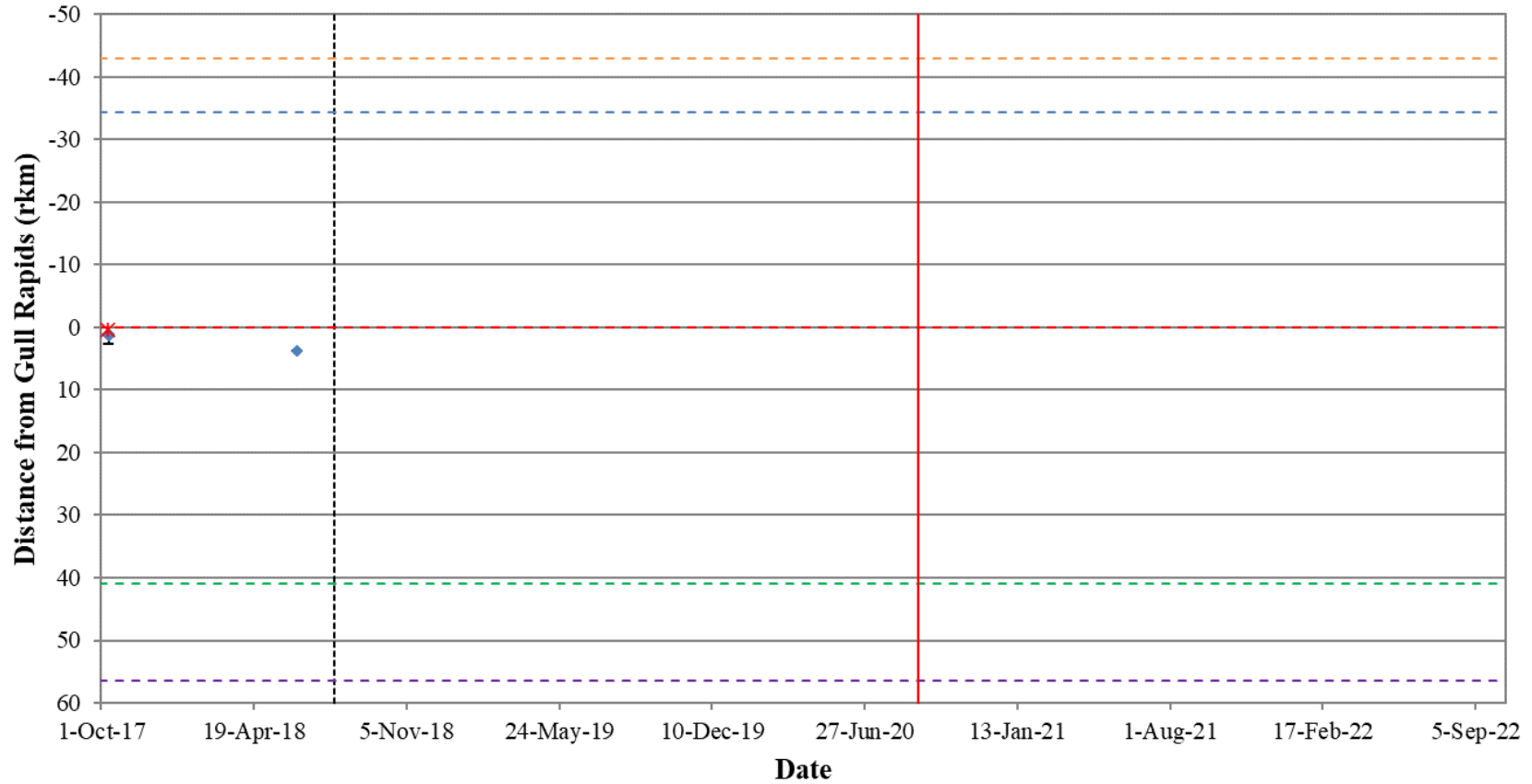


Figure A3-21: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31718) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

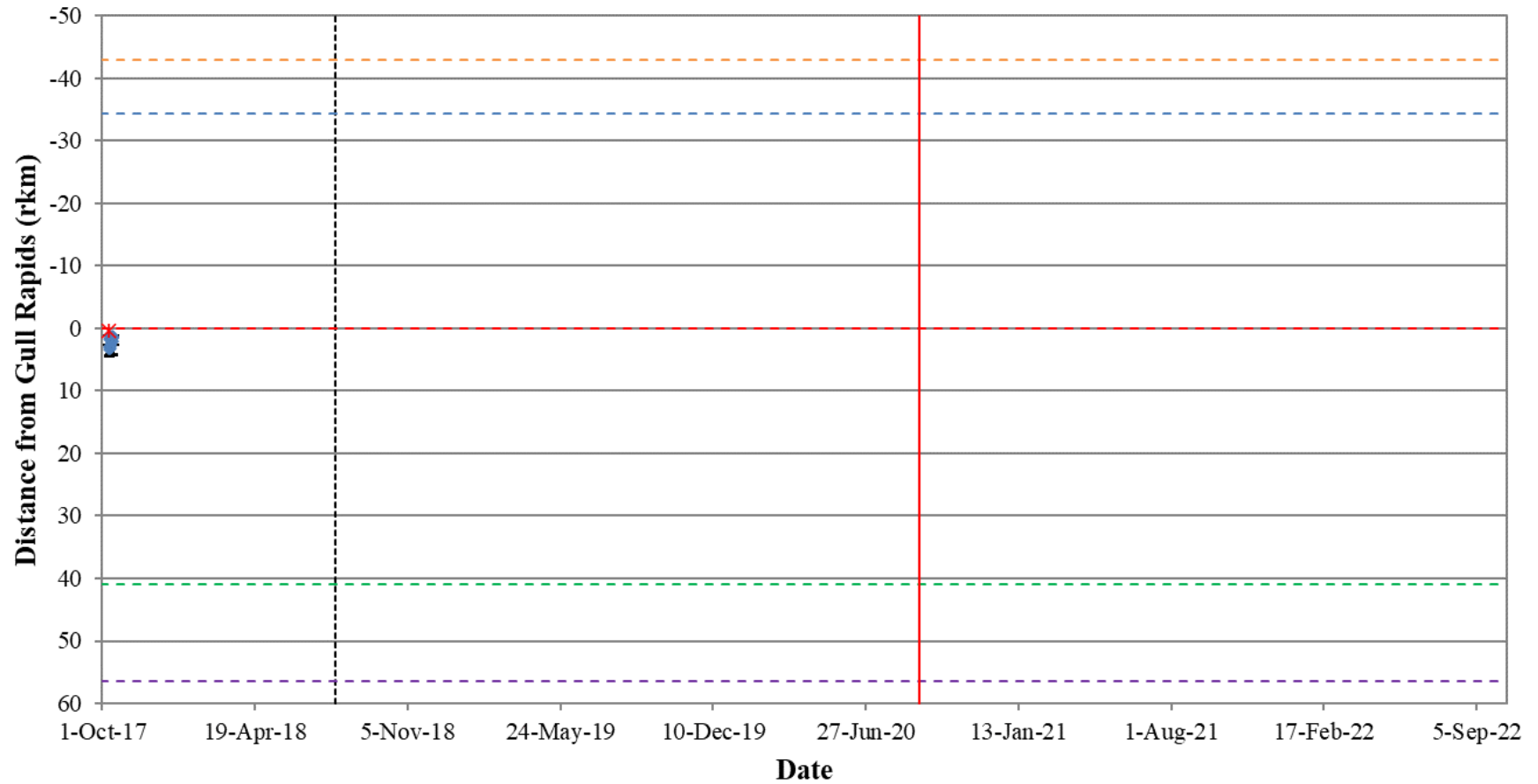


Figure A3-22: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31719) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

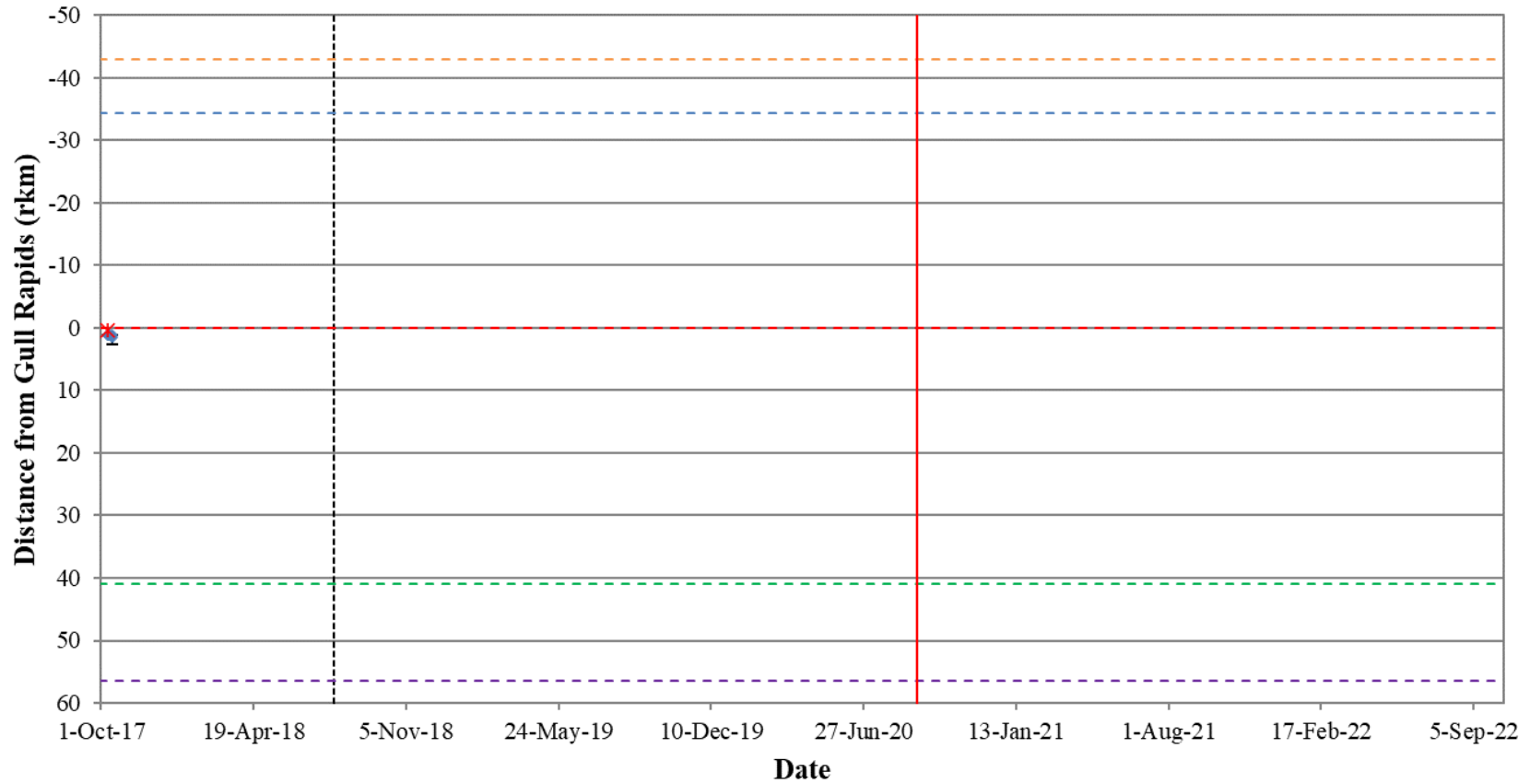


Figure A3-23: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31720) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

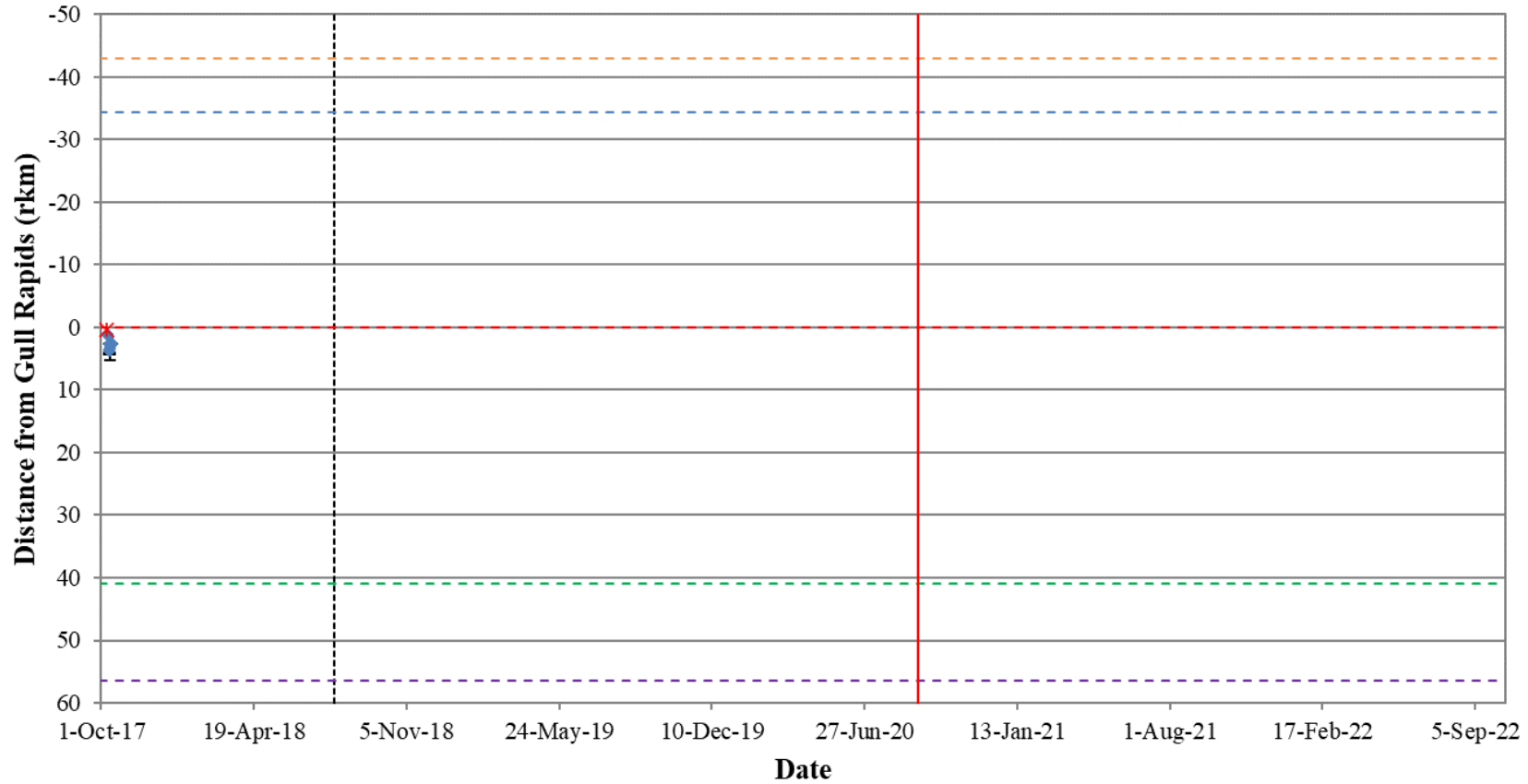


Figure A3-24: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31721) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

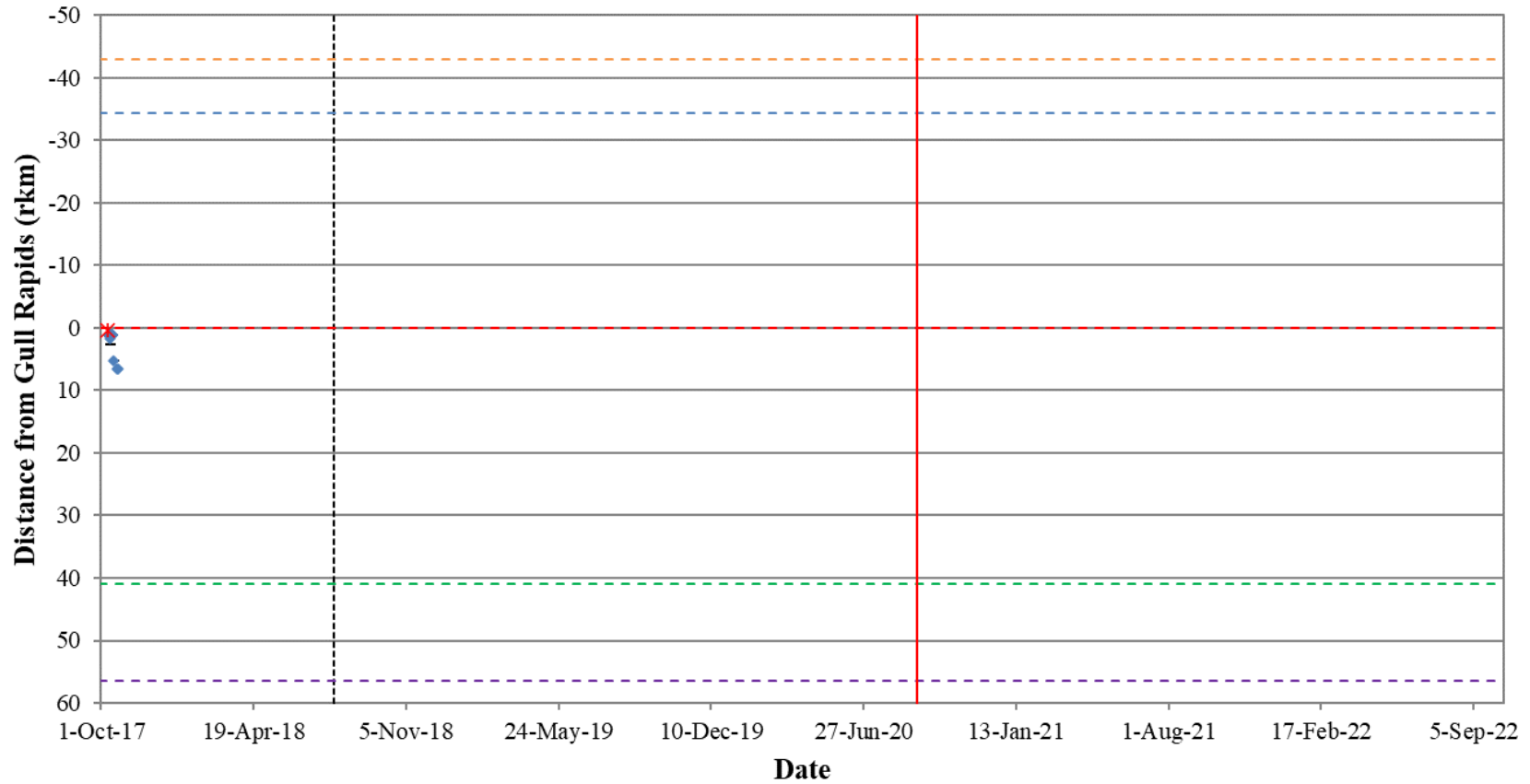


Figure A3-25: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31723) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

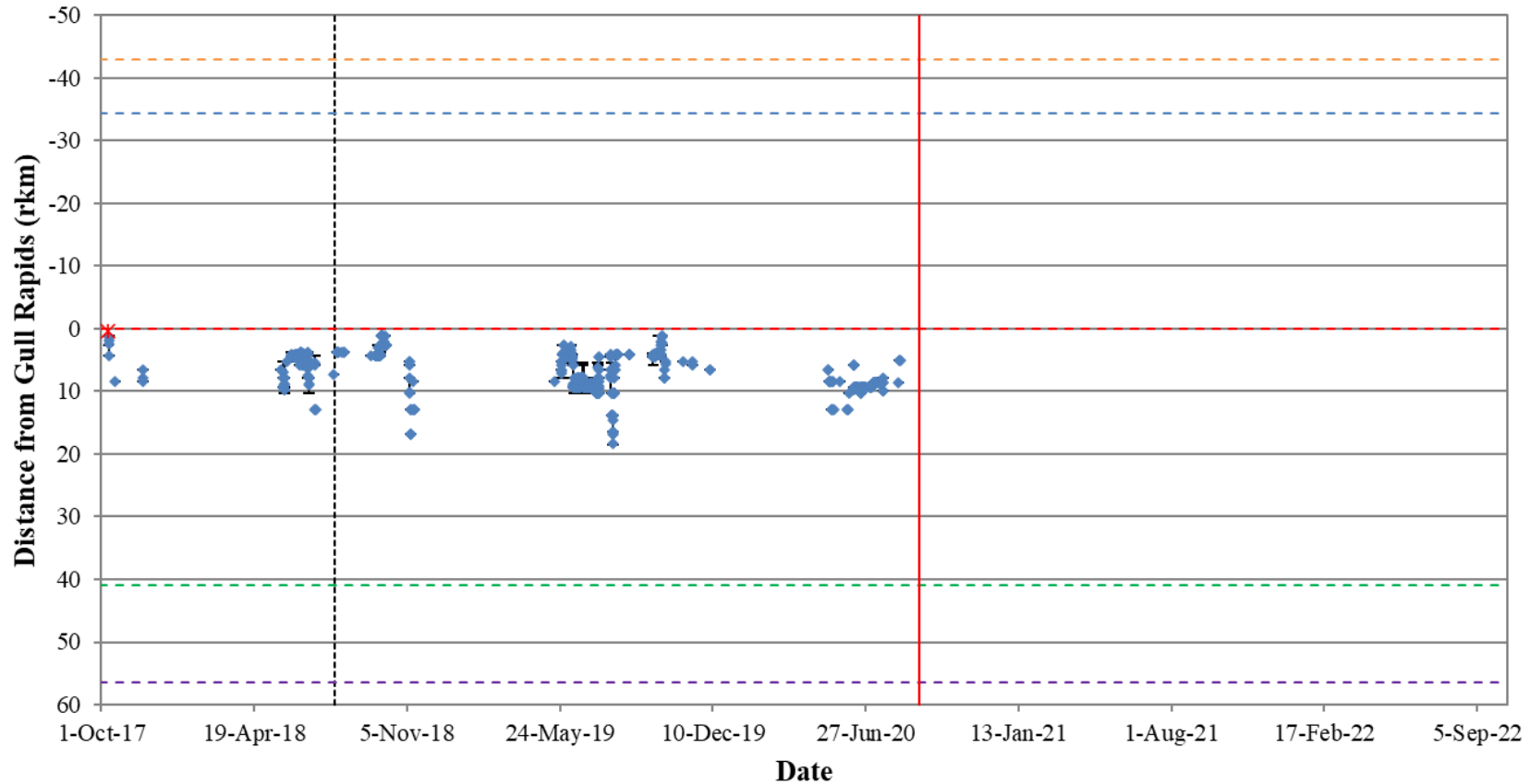


Figure A3-26: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31724) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

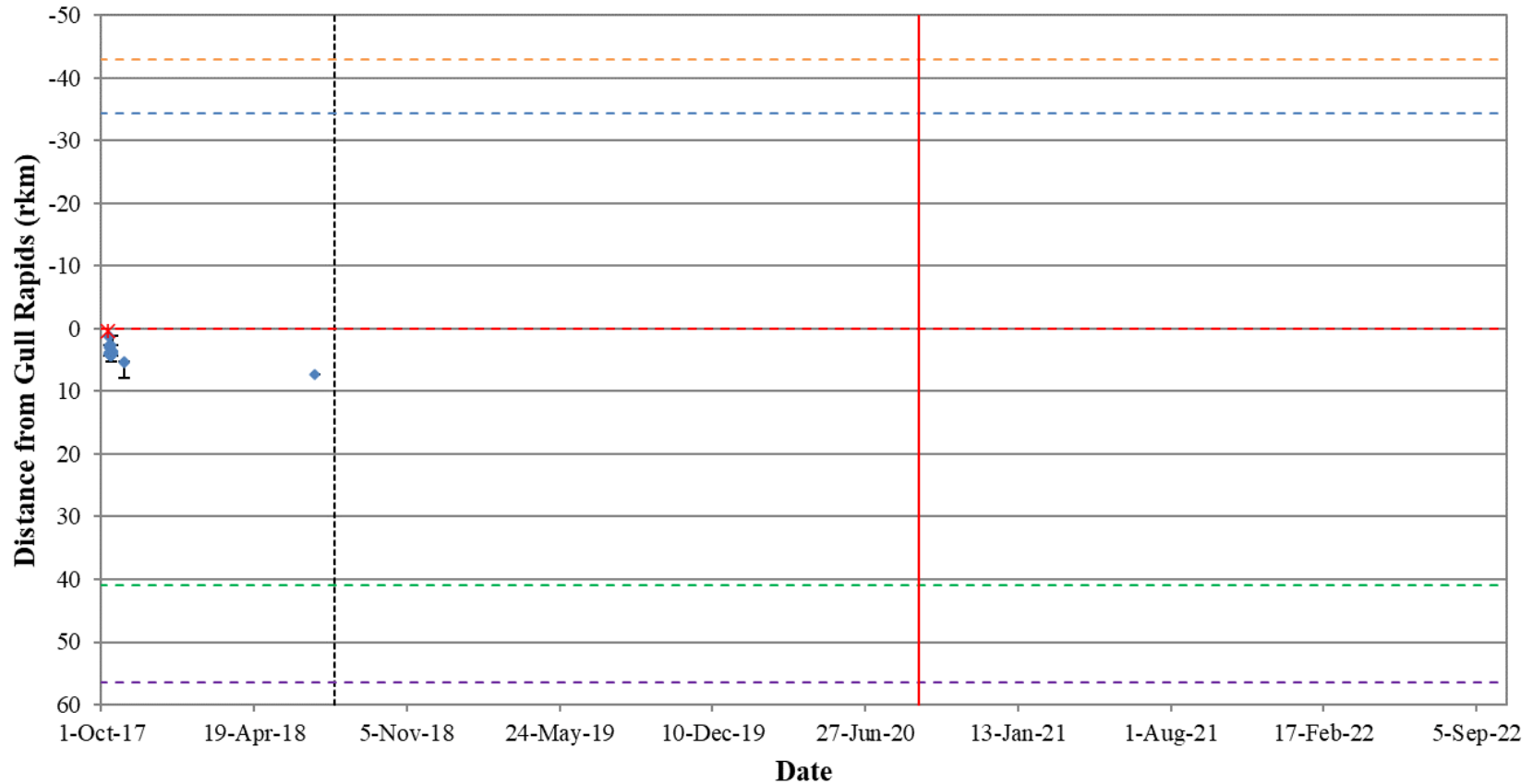


Figure A3-27: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31725) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

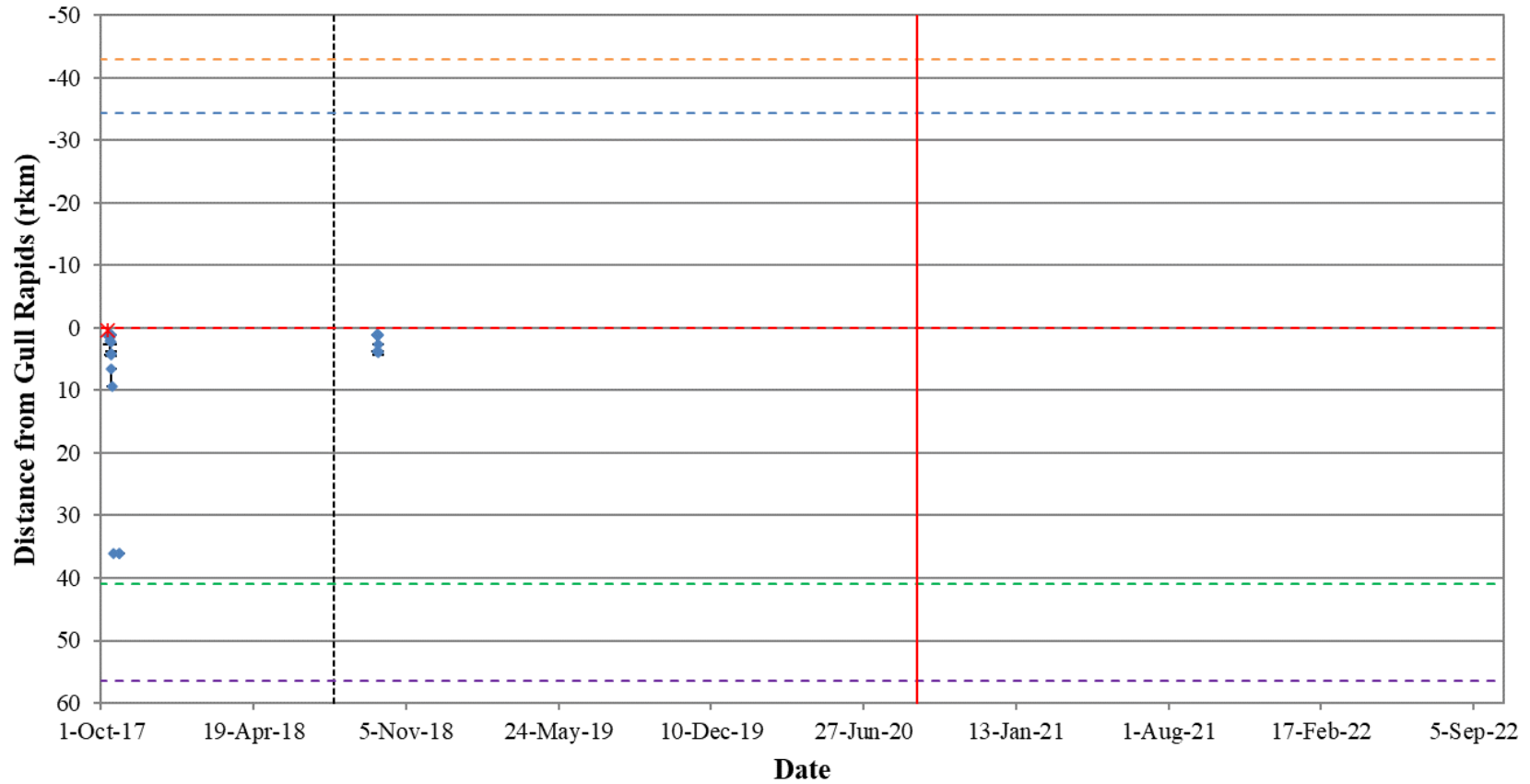


Figure A3-28: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31747) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

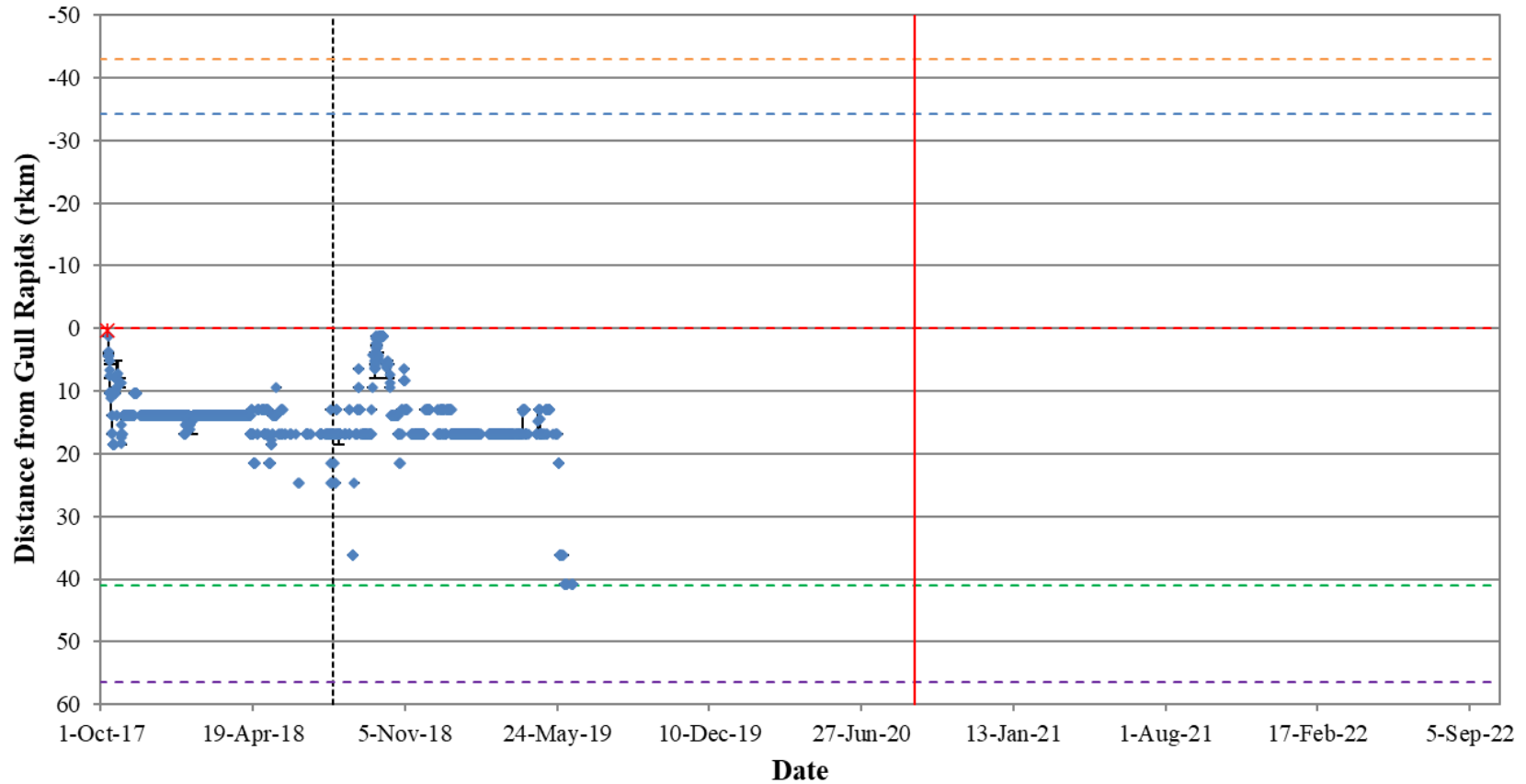


Figure A3-29: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31748) in Stephens Lake, in relation to the Keeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

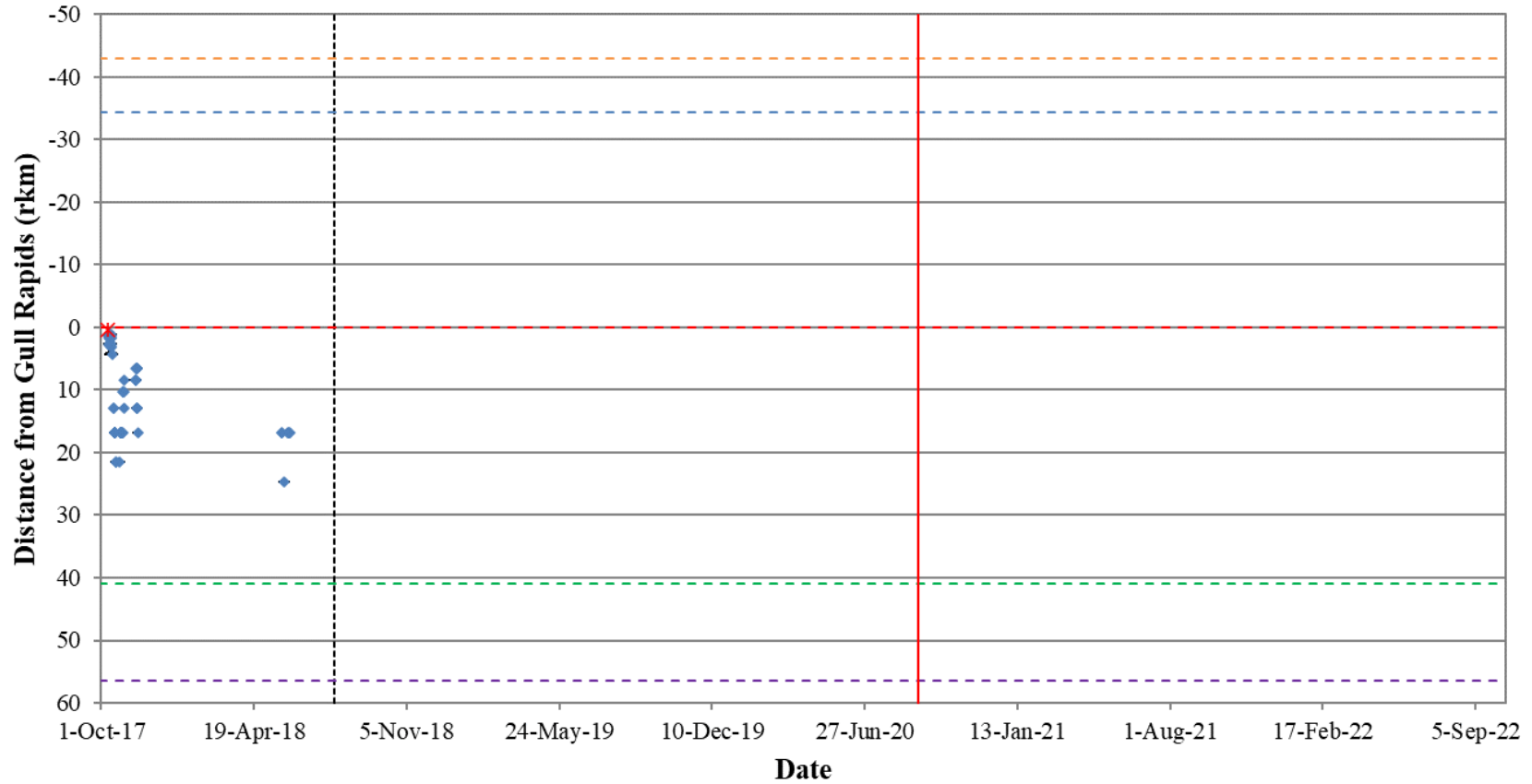


Figure A3-30: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31749) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

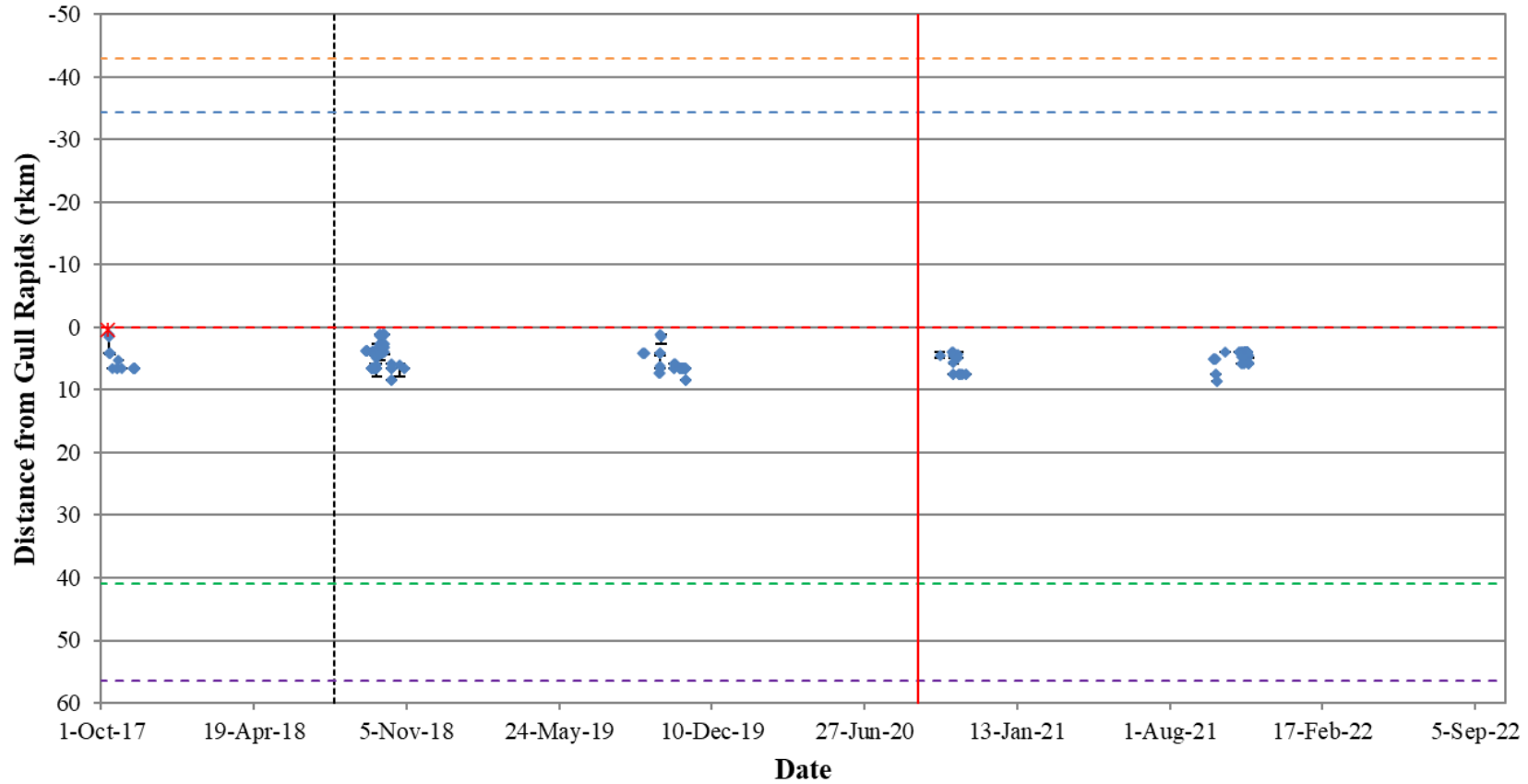


Figure A3-31: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31750) in Stephens Lake, in relation to the Keyeyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyeyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

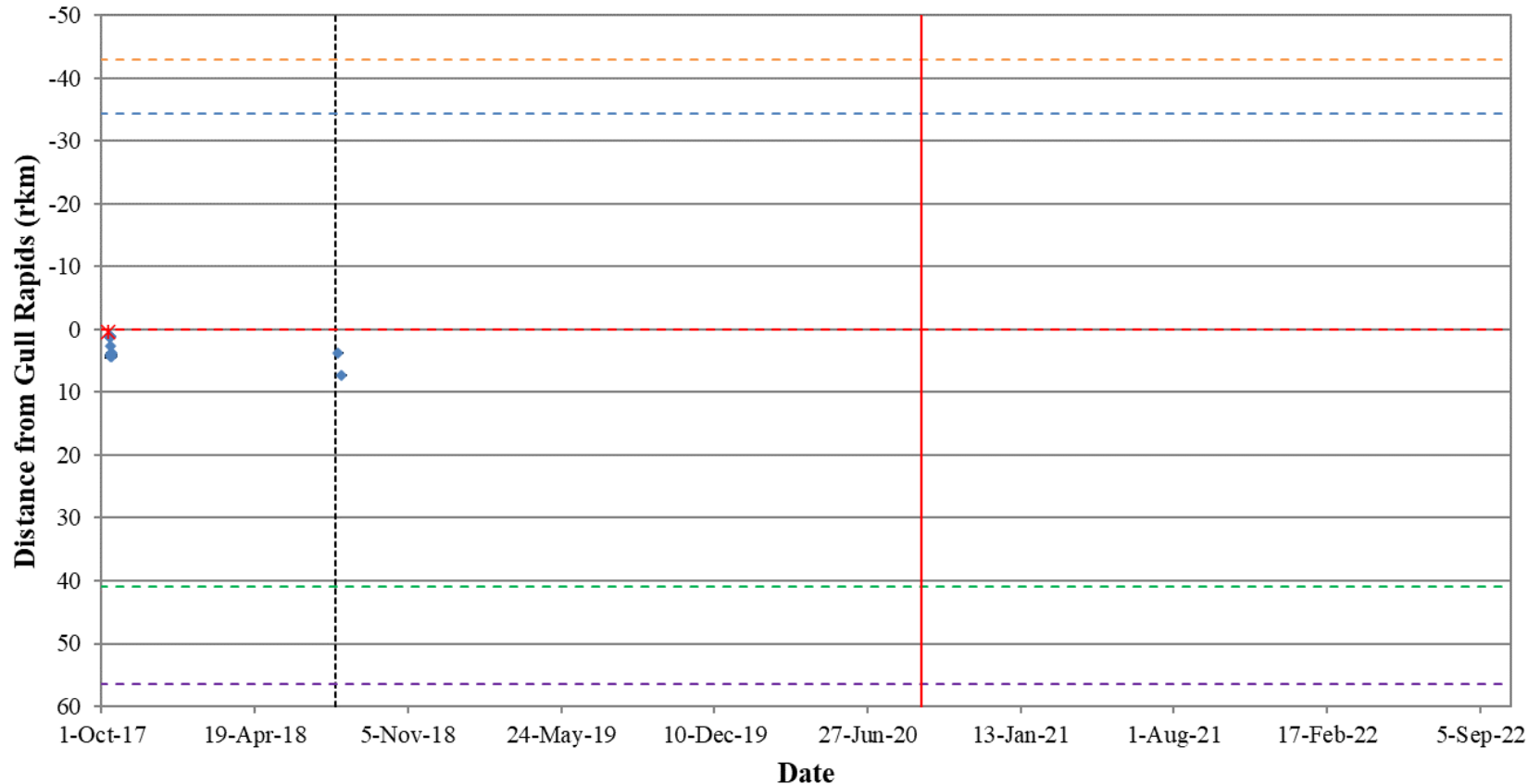


Figure A3-32: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31751) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

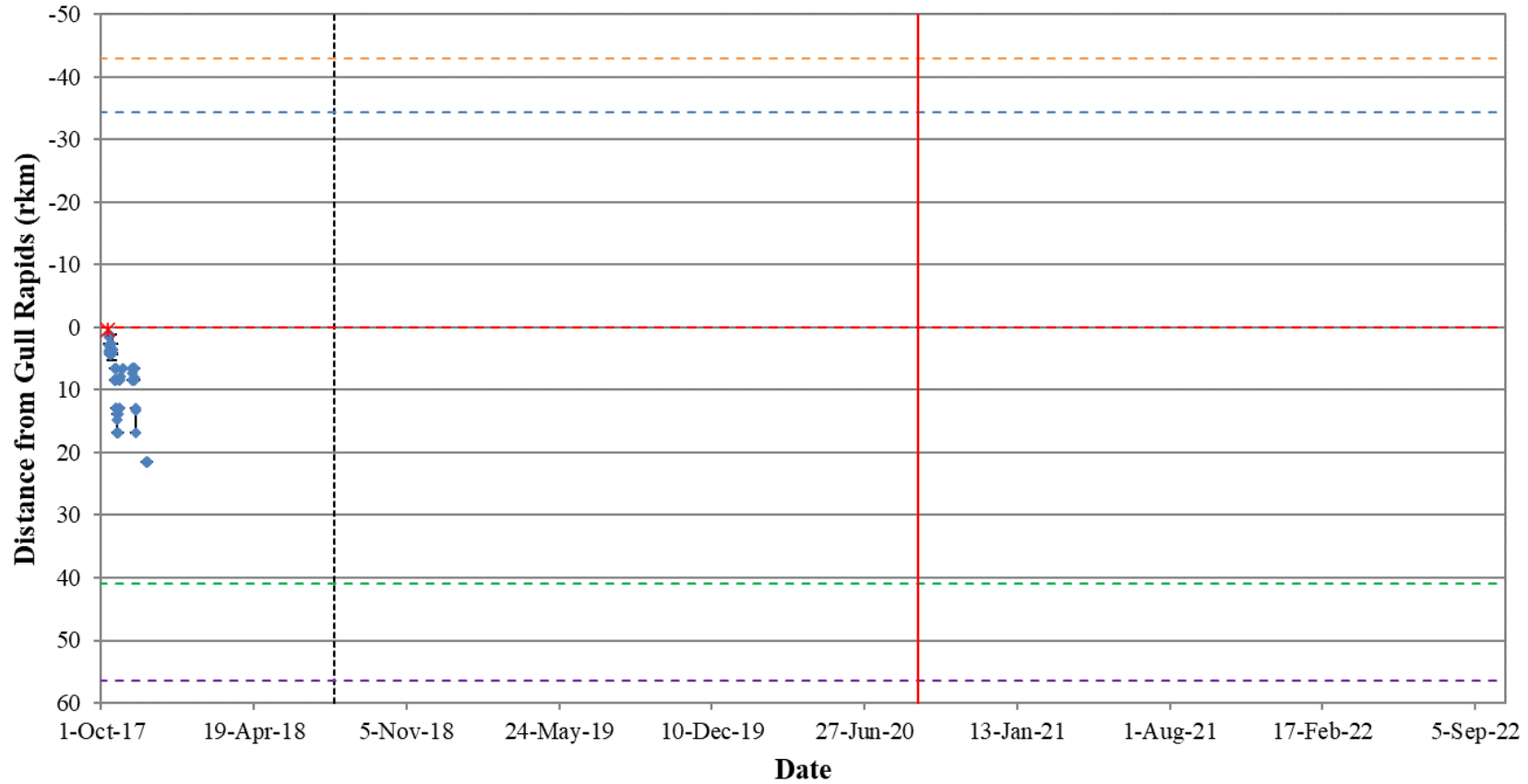


Figure A3-33: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31752) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

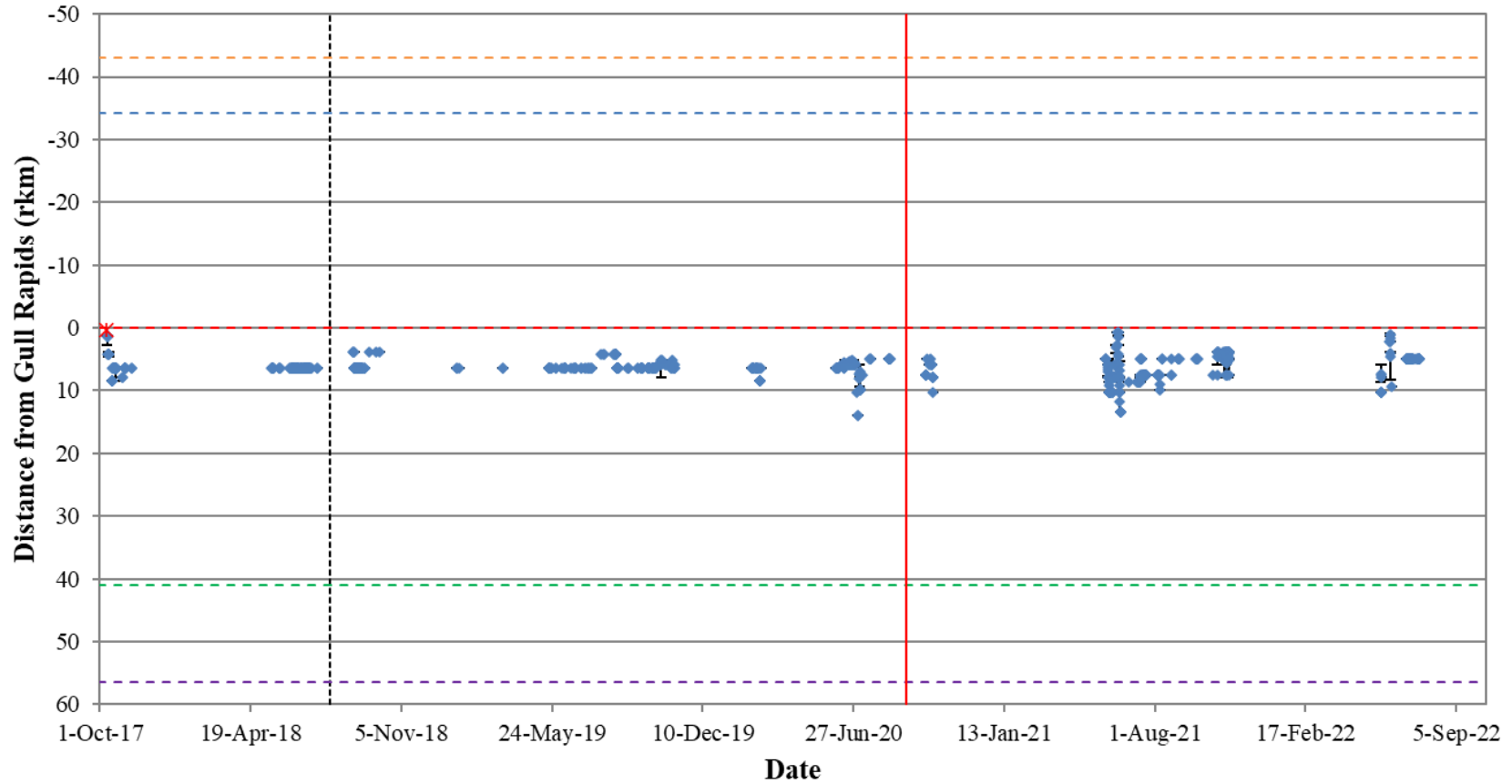


Figure A3-34: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31753) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

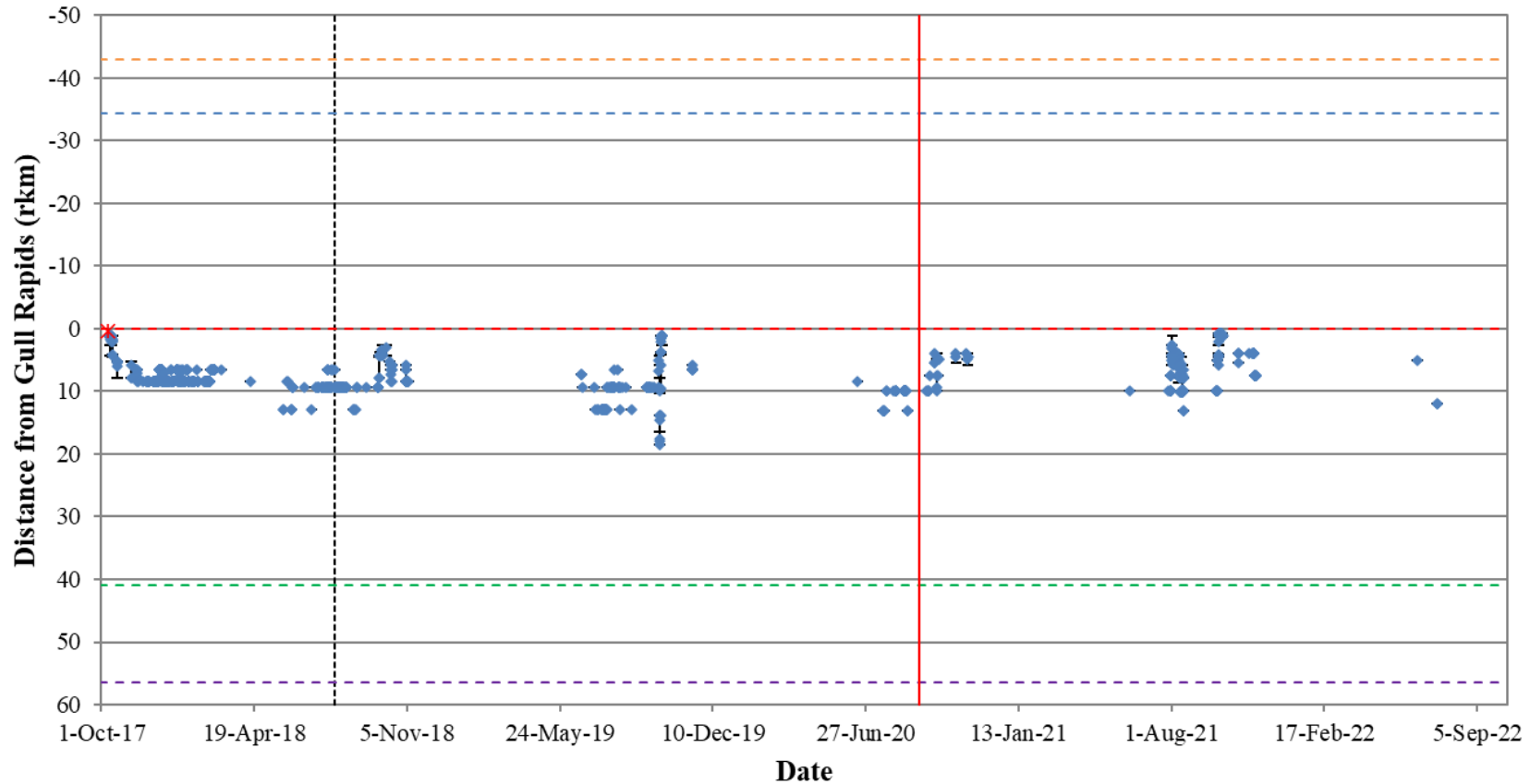


Figure A3-35: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31754) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

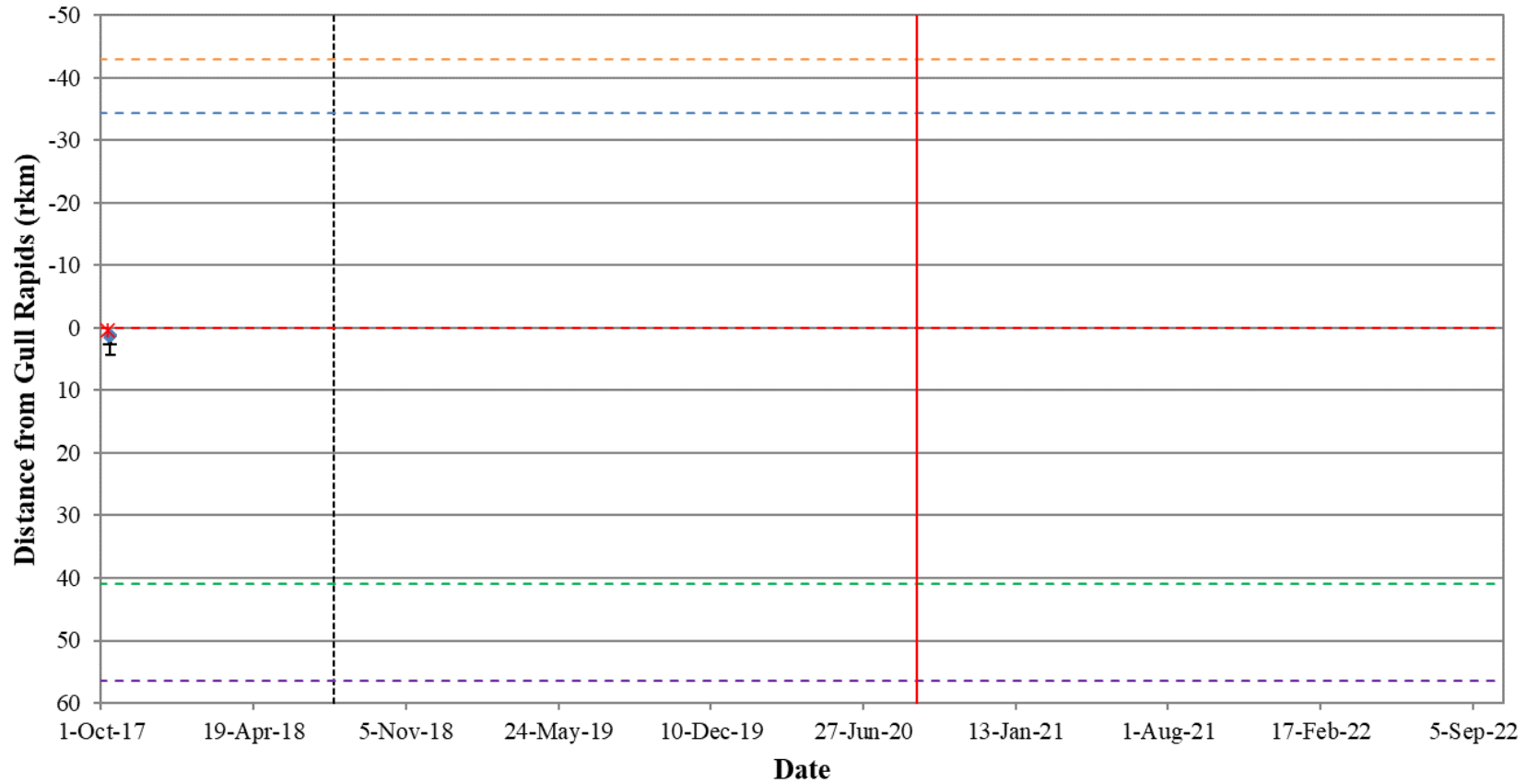


Figure A3-36: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31755) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

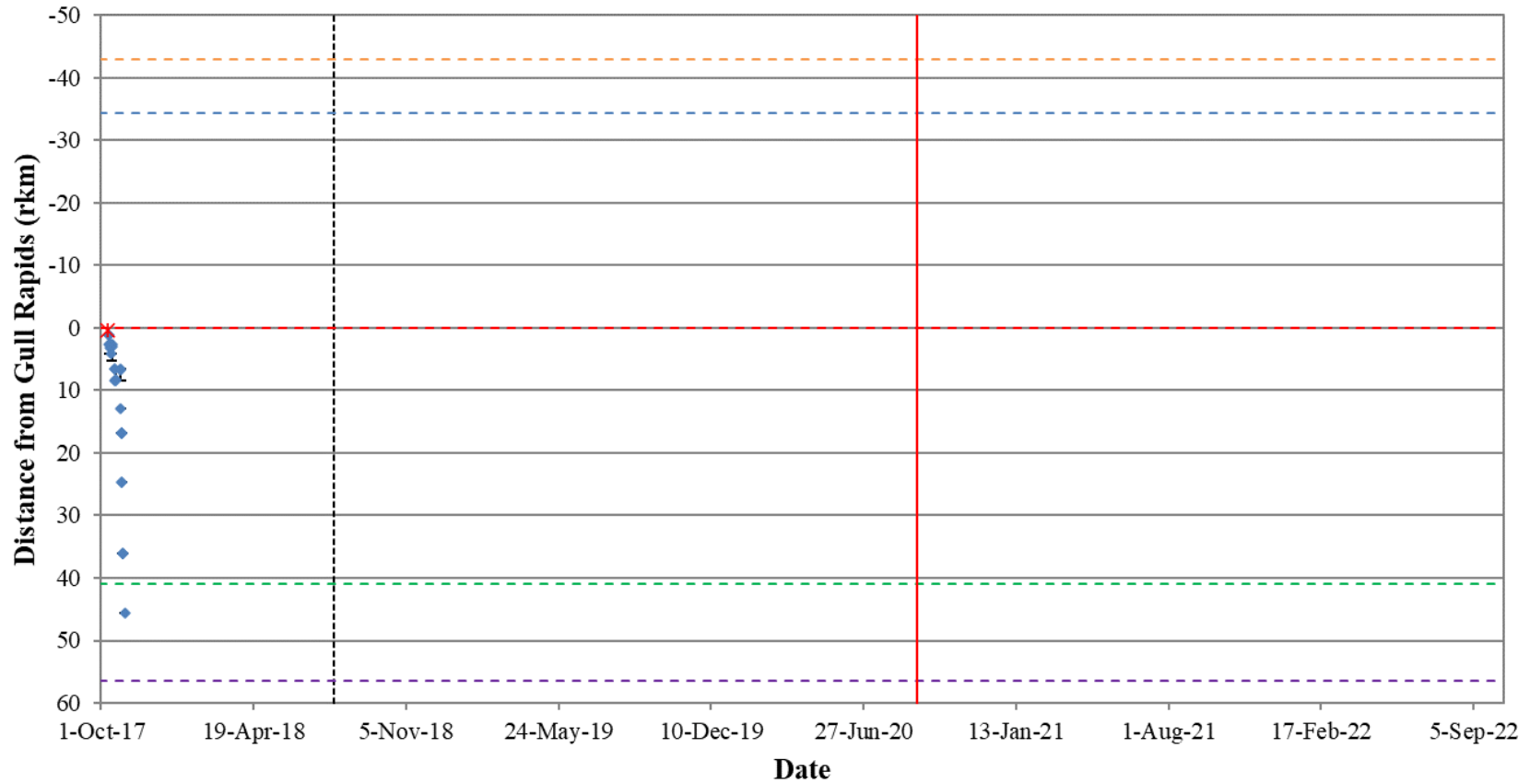


Figure A3-37: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31756) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

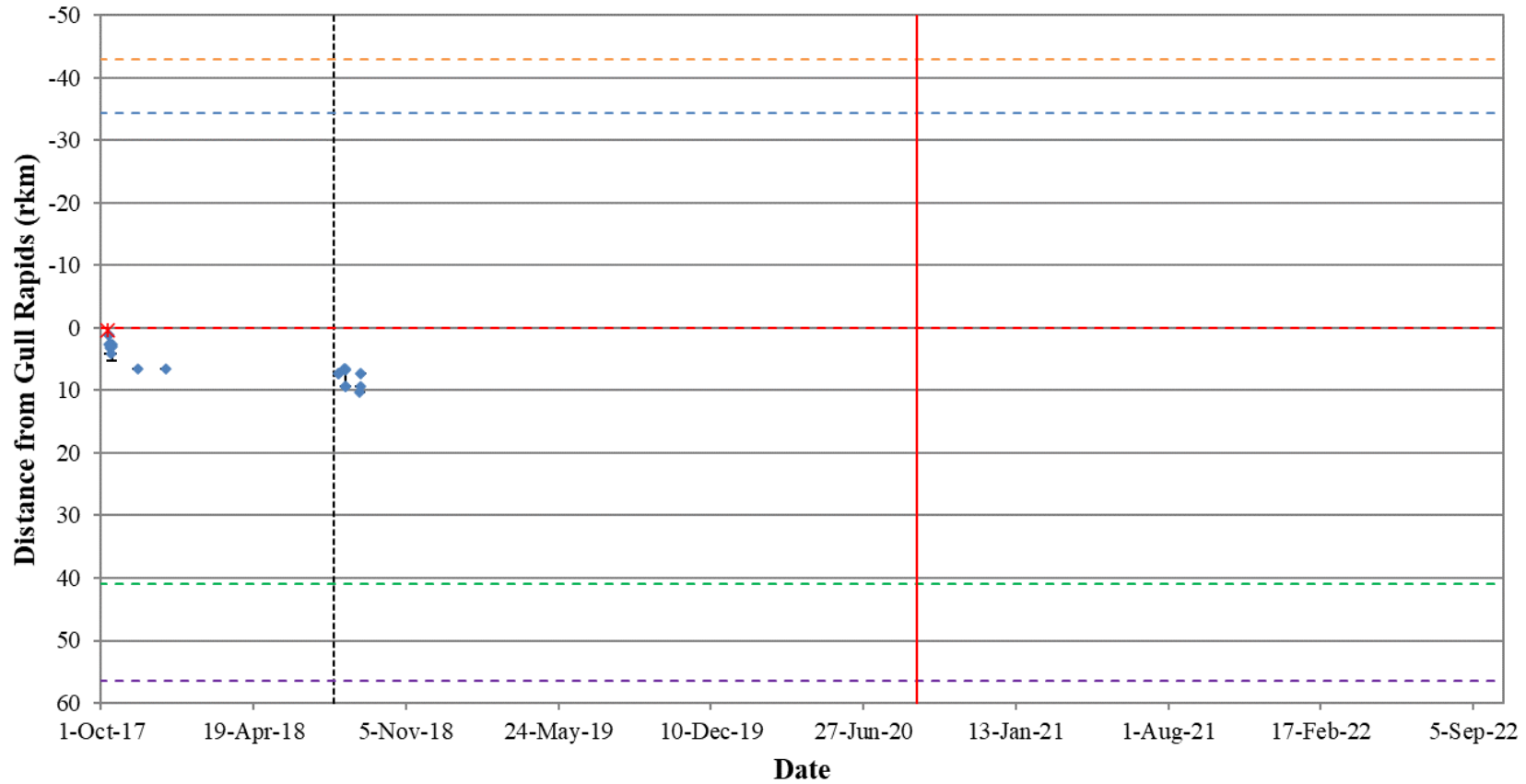


Figure A3-38: Position of a Lake Whitefish tagged with an acoustic transmitter (code #31757) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

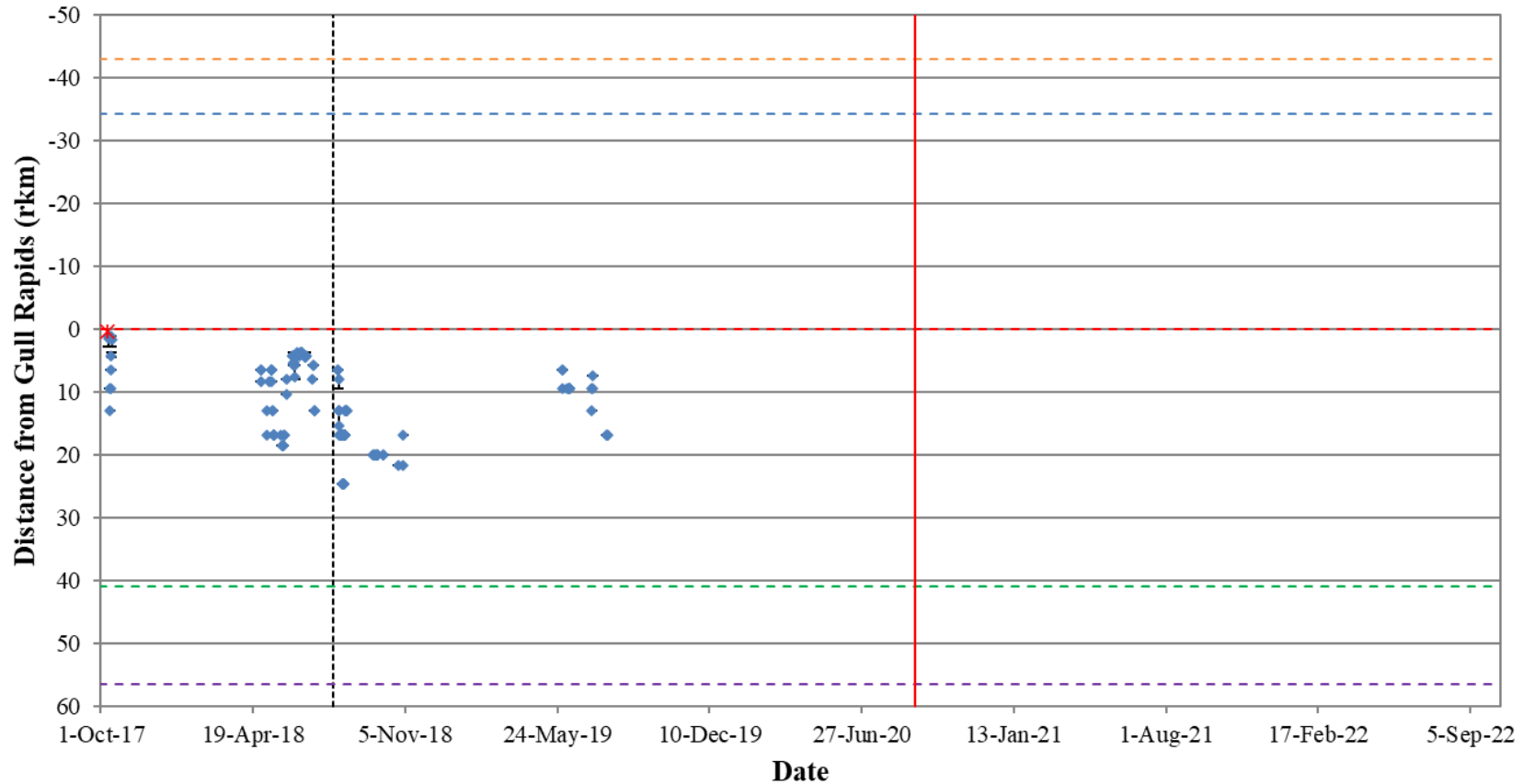


Figure A3-39: Position of a Lake Whitefish tagged with an acoustic transmitter (code #53761) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).

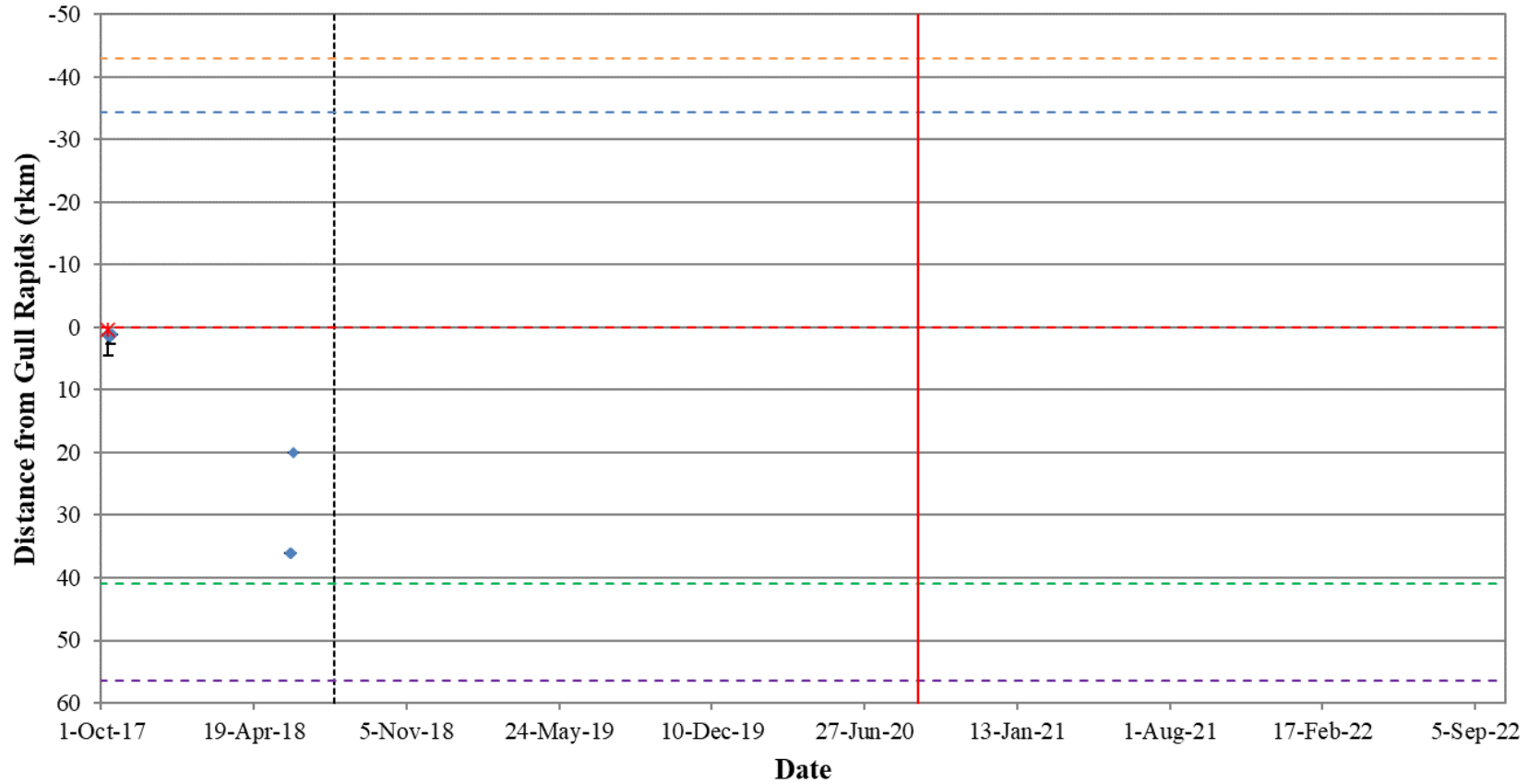


Figure A3-40: Position of a Lake Whitefish tagged with an acoustic transmitter (code #53762) in Stephens Lake, in relation to the Keyyask GS (rkm 0), from October 2017 to July 2022. The date and location of tagging are indicated by a red star. Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Keyyask GS; green = Kettle GS, purple = Long Spruce GS). Vertical black dotted line indicates start of spillway operation (August 3, 2018). Vertical solid red line indicates the completion of reservoir impoundment (September 5, 2020).