



Keeyask Generation Project Aquatic Effects Monitoring Plan

Walleye Movement Monitoring Report

AEMP-2018-06



KEEYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2018-06

WALLEYE MOVEMENT MONITORING IN THE NELSON RIVER BETWEEN CLARK LAKE AND THE LIMESTONE GENERATING STATION, OCTOBER 2016 TO OCTOBER 2017: YEAR 4 CONSTRUCTION

Prepared for

Manitoba Hydro

By

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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 with the construction of cofferdams that blocked flow in the north and central channels of Gull Rapids (see map). During the winter of 2015/2016, the Spillway Cofferdam, which partially blocks the south channel was constructed. Beginning late in 2016 and continuing in 2017, the Tailrace Cofferdam was constructed. Work was completed in fall 2017 with the exception of an opening that was left to allow fish movement into and out of the cofferdam over the 2017/18 winter.

The movements of Walleye over Birthday Rapids and Gull Rapids were monitored prior to the start of the construction monitoring program in 2013, but because different methods were used to collect data under the Aquatic Effects Monitoring Plan (AEMP), the results are not directly comparable. While earlier studies did not record detailed fish movement patterns between Clark Lake and Stephens Lake, the data indicated that the majority of Walleye continued to live in the area where they had been tagged and did not swim across rapids into different parts of the river. When fish occasionally crossed either Birthday or Gull rapids, they did so in the summer or fall, which suggests that these movements were not a necessary part of spring egg-laying behaviour. A small number of Walleye also moved downstream through the generating stations/spillways along the lower Nelson River.

This report presents results of Walleye movement monitoring from October 2016 to October 2017 and provides a summary of data collected since the monitoring program was initiated in June 2013. Although tags originally implanted in 2013/2014 expired in 2016, tags applied to Walleye in 2016 will continue to provide movement information until 2020. Monitoring fish movements is an important component of the overall plan to monitor the impacts of construction and operation of the Keeyask GS on fish. Walleye was identified as one of the key species to monitor because it is: of commercial and domestic importance, abundant in the Keeyask area, known to pass through Gull Rapids in either direction prior to the start of construction, and resilient enough to survive the acoustic tagging procedure.



Map of instream structures at the Keeyask Generating Station site, September 2017.

Why is the study being done?

Monitoring during construction is being done to answer two questions:

Are there Walleye close to the construction site, particularly during spawning?

If Walleye are in the river close to the construction area, they could be harmed by high amounts of mud in the water or they could be trapped inside an area that will be drained.

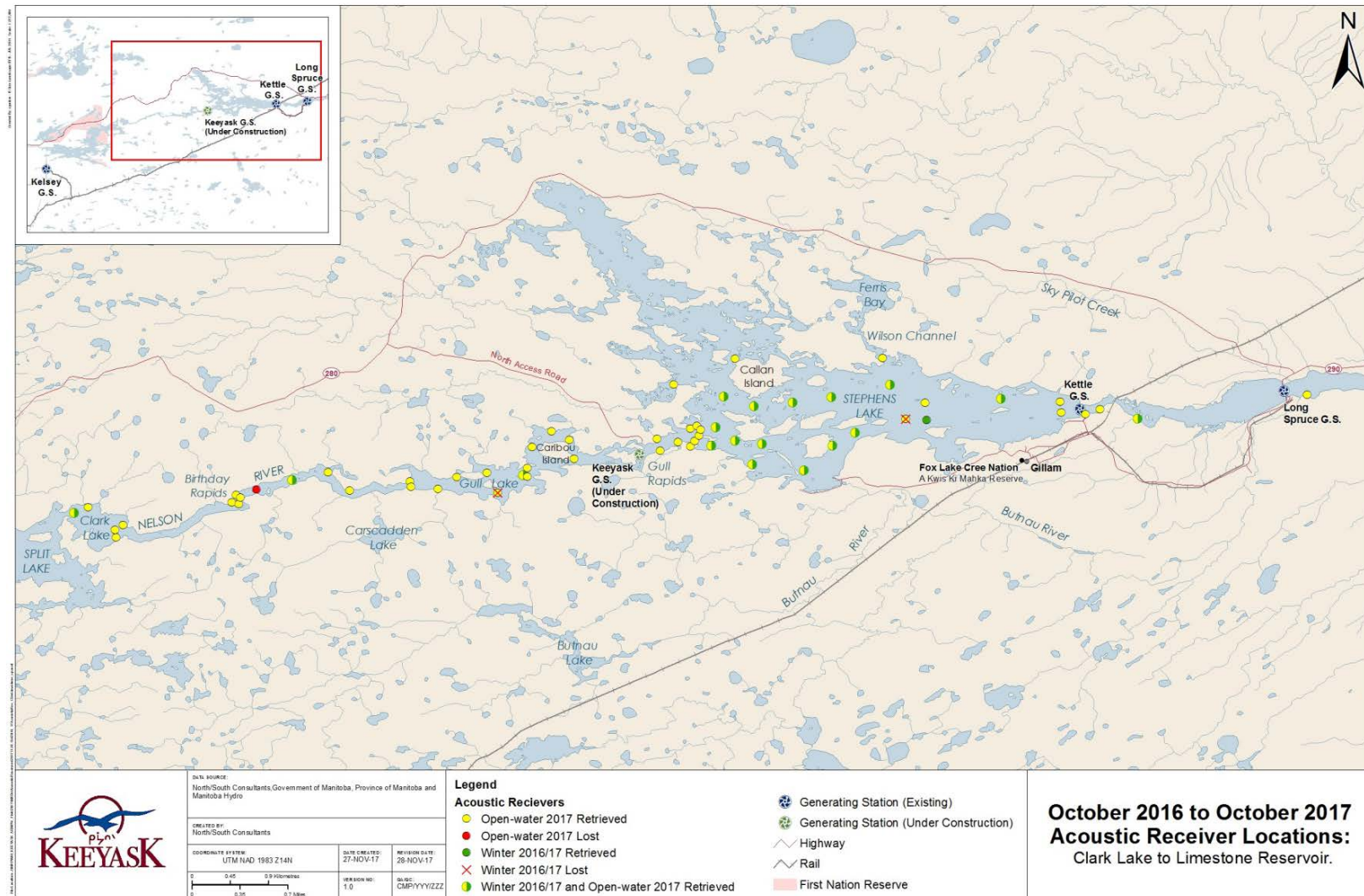
How many Walleye are moving through and/or away from Gull Rapids during construction and how far are they going?

Movement studies tell us how many Walleye are moving up or down through Gull Rapids, how far they travel up or downstream away from the site, whether they are leaving the Keeyask area completely and when they are making these movements. The distance they travel is monitored as far upstream as the inlet to Clark Lake and downstream as far as the Limestone reservoir.

What was done?

The movements of Walleye were tracked using acoustic telemetry. This is a technique in which a tag 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 study area map below). Each fish is given a battery powered transmitter that sends out a unique ping, and the pings can be detected up to 1 kilometre (km) away from a receiver. By looking at the pings recorded by different receivers, the movement of each fish can be tracked.

Eighty Walleye were tagged in 2013, 40 upstream and 40 downstream of Gull Rapids. Because the batteries in these transmitters expired in 2016, an additional 80 transmitters were applied to Walleye in June 2016: 40 upstream and 40 downstream of Gull Rapids. Eight of the fish tagged upstream moved downstream through Gull Rapids post-tagging, so an additional eight tags were applied upstream of Gull Rapids in fall 2016. The batteries in tags applied to Walleye in 2016 will expire in 2020.



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.

What was found?

A third of the fish tagged in 2016 moved downstream, 12 in 2016 and four in 2017. This is different than what was observed for fish tagged in 2013/2014 where only six (15%) of the 40 tagged fish moved downstream through Gull Rapids over four years of monitoring (2013–2016). The reason for this difference is unknown. Most of the downstream movements in 2016 occurred within two weeks of tag application and may have been related to stress associated with tagging. Downstream movements in 2017 may have been affected by the very high flow in the river. Of the fish that remained upstream of Gull Rapids in 2017, 12 exhibited the same movement patterns observed in previous years, while three were detected too briefly to determine movement patterns and two displayed movement patterns that differed from 2016.

In Stephens Lake, the majority of the fish tagged in 2013/2014 and 2016 remained in the upstream part of the lake, within 10 km of the construction site. Similar to Walleye tagged in Gull Lake, more fish tagged in 2016 (13%) moved downstream relative to those tagged in 2013/2014 (3%). In 2017, five fish moved downstream through Kettle GS and two of these continued to move downstream through the Long Spruce GS. In comparison, a single fish tagged in 2013/2014 passed through Kettle GS over four years. No fish tagged in 2016 has moved upstream through Gull Rapids. Only one fish tagged in 2013/2014 moved upstream through the rapids. This fish moved upstream early in 2014, before construction of the Keeyask GS started. Because construction has blocked off half of Gull Rapids, flows through the open channel are very fast. It is likely that fish are no longer able to swim upstream through the rapids.

What does it mean?

Many Walleye use habitat immediately downstream of the construction site in Stephens Lake, including during the spawning period. They do not appear to be disturbed by construction activity. The number of tagged Walleye moving downstream through Gull Rapids, the Kettle GS, and the Long Spruce GS in 2016–2017 is greater than during 2013–2016. Increased downstream movements are likely related to tagging stress and high river flows. No Walleye have been recorded moving upstream over Gull Rapids since construction began.

What will be done next?

Fish that were tagged in 2016 can be tracked until 2020, after which the tags will expire. Ongoing tracking of fish during construction will provide additional information about where the fish are moving, and if they continue to use areas near the construction site. Continued monitoring during normal river flows will show if the increase in downstream movements seen in 2016 and 2017 was an unusual event or whether it represents a change in movement patterns compared to 2013 to 2016.

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TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	STUDY SETTING.....	3
2.1	CONSTRUCTION SUMMARY.....	4
2.2	FLOWS AND WATER LEVELS	4
3.0	METHODS.....	6
3.1	ACOUSTIC TELEMETRY	6
3.1.1	Acoustic Transmitter Application	6
3.1.2	Acoustic Receivers.....	6
3.1.2.1	Winter 2016/2017	7
3.1.2.2	Open-water 2017.....	7
3.1.3	Data Analysis	8
4.0	RESULTS.....	10
4.1	2016 RESULTS SUMMARY.....	10
4.1.1	Upstream of Gull Rapids	10
4.1.2	Stephens Lake	12
4.2	WINTER 2016/2017	13
4.2.1	Upstream of Gull Rapids	13
4.2.2	Stephens Lake	13
4.2.3	Long Spruce Reservoir.....	14
4.3	OPEN-WATER 2017	14
4.3.1	Acoustic Receiver Retrieval.....	14
4.3.2	Upstream of Gull Rapids	14
4.3.2.1	Proportional Distribution	15
4.3.2.2	Movements.....	15
4.3.2.3	Movements Through Gull Rapids	16
4.3.3	Stephens Lake	17
4.3.3.1	Proportional Distribution	18
4.3.3.2	Movements.....	18
4.3.3.3	Movements Through Kettle GS.....	19
4.3.4	Long Spruce Reservoir.....	21
4.3.5	Limestone Reservoir	21

5.0	DISCUSSION	22
5.1	EVALUATION OF METHODOLOGY	23
5.2	MOVEMENT PATTERNS	24
5.3	MOVEMENTS THROUGH BARRIERS	24
5.4	KEY QUESTIONS.....	25
6.0	SUMMARY AND CONCLUSIONS	26
7.0	LITERATURE CITED	27

LIST OF TABLES

Table 1:	Number of acoustic tags applied to Walleye in the Keeyask Study Area (upstream of Gull Rapids and in Stephens Lake) between June 2013 and October 2017.	31
Table 2:	Proportion of time spent in each river zone by Walleye tagged upstream of Gull Rapids and in Stephens Lake in both 2013/2014 and 2016 during a portion of the 2013 (June 4 to October 15), 2014 (June 4 to October 3), 2015 (June 4 to October 11), 2016 (June 4 to October 19), and 2017 (June 7 to October 16) open-water periods.	31

LIST OF FIGURES

Figure 1:	Locations of stationary acoustic receivers (dashes) in relation to the base of Gull Rapids (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Limestone GS between October, 2016 and June, 2017	33
Figure 2:	Locations of stationary acoustic receivers (dashes) in relation to the base of Gull Rapids (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Limestone GS between June and October, 2017.	34
Figure 3:	Detection ranges for individual Walleye tagged with acoustic transmitters upstream of Gull Rapids in 2016 during the winter period (2016–2017).	35
Figure 4:	Relative number of detections of Walleye at each acoustic receiver set between Clark Lake and Gull Rapids during winter 2016/2017 (October 20, 2016, to April 30, 2017).....	37
Figure 5:	Detection ranges for individual Walleye tagged with acoustic transmitters in Stephens Lake in 2016 during the winter period (2016–2017).....	38
Figure 6:	Relative number of detections of Walleye at each acoustic receiver set in Stephens Lake during winter 2016/2017 (October 20, 2016, to April 30, 2017)	40
Figure 7:	Detection ranges for individual Walleye tagged with acoustic transmitters upstream of Gull Rapids in 2016 during the open-water period (2016–2017)	41
Figure 8:	Relative number of detections of Walleye at each acoustic receiver set between Clark Lake and Gull Rapids during the 2017 open-water period (May 1 to October 16).	43
Figure 9:	Proportional distributions by zone, for individual Walleye tagged with acoustic transmitters upstream of Keeyask GS in 2016 during a portion of the 2017 open-water period (June 7 to October 16).	44
Figure 10:	Proportional distribution by zone for 49 Walleye tagged with acoustic transmitters in the Keeyask GS Area in 2013/2014 and 2016 (demarcated with solid black line) during a portion of the 2013 (August 25 to October 15), 2014 (June 4 to October 10), 2015 (June 4 to October 11), 2016 (June 25 to October 19), and 2017 (June 7 to October 16) open-water periods.....	45
Figure 11:	Detection ranges for individual Walleye tagged with acoustic transmitters in Stephens Lake in 2016 during the open-water period (2016–2017)	46
Figure 12:	Relative number of detections of Walleye at each acoustic receiver set in Stephens Lake during the 2017 open-water period (May 1 to October 16).....	48

LIST OF MAPS

Map 1:	Map of the lower Nelson River showing the site of the Keeyask Generating Station and the Walleye movement monitoring study setting.	50
Map 2:	Map of instream structures at the Keeyask Generating Station site, September 2017.	51
Map 3:	Locations of stationary receivers set in the Nelson River from Clark Lake to Gull Rapids between October 2016 and June 2017.	52
Map 4:	Locations of stationary receivers set in Stephens Lake from Gull Rapids to Kettle GS between October 2016 and June 2017.	53
Map 5:	Location of the stationary receiver set in the Long Spruce reservoir between October 2016 and June 2017.	54
Map 6:	Locations of stationary receivers set in the Nelson River from Clark Lake to Gull Rapids between June and October 2017.	55
Map 7:	Locations of stationary receivers set in Stephens Lake between June and October 2017.	56
Map 8:	Locations of stationary receivers set in the Long Spruce and Limestone reservoirs between June and October 2016.	57

LIST OF APPENDICES

Appendix 1:	Detection summaries for Walleye tagged and monitored in the Keeyask Study Area between 2016 and 2017	59
Appendix 2:	Location summary for individual acoustic tagged Walleye upstream of Gull Rapids June 2016 to October 2017.....	68
Appendix 3:	Location summary for individual acoustic tagged Walleye in Stephens Lake June 2016 to October 2017	120
Appendix 4:	Biological and Tag information for Walleye tagged upstream and downstream of Gull Rapids	163

1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt (MW) hydroelectric generating station at Gull (Keeyask) Rapids on the lower Nelson River in northern Manitoba. The Project is approximately 725 kilometres (km) northeast of Winnipeg, 35 km upstream of the existing Kettle Generating Station, where Gull Lake flows into Stephens Lake, 60 km east of the community of Split Lake, 180 km east-northeast of Thompson and 30 km west of Gillam (Map 1). Construction of the Project began in July 2014.

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, Walleye (*Sander vitreus*) movement, for the construction and operation phases of the Project.

Pre-construction (baseline) movements of Walleye were monitored using radio telemetry from 2001 to 2005 (Barth *et al.* 2003; Murray *et al.* 2005; Murray and Barth 2007). Radio 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 the majority of Walleye did not move upstream or downstream over rapids into adjacent study reaches; instead, they remained within the reach where they had been tagged. Those few fish that moved over one or more sets of rapids did so in the summer or fall, suggesting that these movements were not associated with a life history event such as spawning. A small number of Walleye also moved downstream through the generating stations/spillways along the lower Nelson River. Additional information on long distance movements was obtained from mark-recapture studies; for example, Walleye were found to move downstream into Stephens Lake after spawning in Gull Rapids. As pre-Project studies were not designed to record detailed movement patterns 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.

In 2013, 80 Walleye were tagged with acoustic transmitters to assess the frequency of movement through Gull Rapids and to monitor the potential impact that construction of the Keeyask GS may have on movement (Hrenchuk and Barth 2014). Movements of these Walleye from the tagging date until October 2014 are provided in Murray *et al.* (2015); results from October 2014 to October 2015 are presented in Burnett *et al.* (2016); results from October 2015 to October 2016 are presented in Hrenchuk and Lacho (2017).

As the transmitters applied in 2013 reached the end of their battery life in 2016, additional transmitters were applied to Walleye during 2016 to continue the movement study until 2020.

Results from June to October 2016 are presented in Hrenchuk and Lacho (2017). This report provides results of Walleye movement monitoring from October 2016 to October 2017 and summarizes what has been observed since the program began in 2013.

Walleye movements in the main flow of the Nelson River near the construction site may be affected by the installation of cofferdams that block upstream and downstream movements (Map 2), altered flow patterns, and disturbances such as blasting that may increase emigration from the construction area. The broad objective of Walleye movement monitoring is to better understand their movements and habitat use during generating station construction, with particular focus on movements in the vicinity of Gull Rapids.

As presented in the AEMP, the key questions to be answered about Walleye movement monitoring during construction of the Keeyask GS are:

- What is the number (or proportion) of tagged Walleye that move past the construction site?
- Are Walleye utilizing habitat in the vicinity of construction activities (particularly during spawning)?

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. Water velocities were classified as low (0.2–0.5 metres per second [m/s]), moderate (0.5–1.5 m/s), or high (greater than 1.5 m/s), as described in the Keeyask AE SV.

Clark Lake is located immediately downstream of Split Lake, and approximately 42 km upstream of Gull Rapids (Map 1). 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.

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream of Gull Rapids (Maps 1 and 3). The drop in elevation from the upstream to downstream side of Birthday Rapids is approximately 2 m. The 14 km reach of the Nelson River between Birthday Rapids and Gull Lake is characterized as a large and somewhat uniform channel with medium to high water velocities. There are a few large bays with reduced water velocity and a number of small tributaries that drain into the Nelson River.

Gull Lake is a section of the Nelson River where the river widens, with moderate to low water velocity. Gull Lake is herein defined as the reach of the Nelson River beginning approximately 17 km upstream of Gull Rapids and 14 km downstream of Birthday Rapids, where the river widens to the north into a bay around a large point of land (Maps 1 and 3), and extending to the downstream end of Caribou Island, approximately 3 km upstream of Gull Rapids. Gull Lake has three distinct basins, the first extending from the upstream end of the lake downstream approximately 6 km to a large island; the second extending from the large island to Morris Point (a constriction in the river immediately upstream of Caribou Island); and the third extending from Morris Point to the downstream end of Caribou Island (Map 3).

Gull Rapids is located approximately 3 km downstream of Caribou Island on the Nelson River (Map 1). The rapids are approximately 2 km in length, and the river elevation drops approximately 11 m along its 2 km length. Two large islands and several small islands occur within the rapids, prior to the river narrowing; these features are within the Project footprint and have been substantially altered during construction (Map 2). A summary of construction activities at Gull Rapids is provided in Section 2.1.

Just below Gull Rapids, the Nelson River enters Stephens Lake. Stephens Lake was formed in 1971 by construction of the Kettle GS. Between Gull Rapids and Stephens Lake, there is an approximately 6 km long reach of the Nelson River that, although affected by water regulation at the Kettle GS, remains riverine habitat with moderate velocity. Construction has altered the flow

distribution immediately downstream of Gull Rapids as all flow now passes via the south channel of Gull Rapids.

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 (Map 4). 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 (Map 1). Kettle GS is located approximately 40 km downstream of Gull Rapids.

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 (Map 1).

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..

2.1 CONSTRUCTION SUMMARY

Construction of the Keeyask GS began in mid-July 2014 with the construction of cofferdams in the north and central channels of Gull Rapids (Map 2). These cofferdams resulted in the dewatering of the north and central channels and the diversion of all flow to the south channel. Construction of the spillway cofferdam, which extends into the south channel of Gull Rapids, was completed in 2015. During 2016 there was little instream construction until placement of rock for the Tailrace Cofferdam began in late fall and continued into 2017. Large rocks were placed in the Nelson River to form the inner and outer groins of the Tailrace Cofferdam. An opening was left in the rock groins to allow fish to move into and out of the cofferdam. Placement of fine material between the two sections of the cofferdam began and was completed in late-2017. An opening was created to allow fish to move freely over the winter of 2017/18. The opening will be closed in spring 2018.

2.2 FLOWS AND WATER LEVELS

From October 2016 to October 2017, Split Lake outflows ranged from about 3,200–6,600 m³/s. Flow exceeded the historical annual median flow of approximately 3,300 m³/s each month except for October 2017 when it dropped to about 3,200 m³/s. From about October 2016

through mid-September 2017, the flow exceeded the historical 75th percentile flow of about 3,780 m³/s, and from about May to mid-August 2017 the flow exceeded the 95th percentile flow of approximately 5,230 m³/s. During the spring melt in May 2017, flow rose to about 6,590 m³/s, which is near the historical maximum flow observed in August 2005. Water levels varied in conjunction with flow, ranging from about 154.9–156.6 m ASL on Gull Lake, with the highest level observed during the near historical maximum flow in May.

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 range (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. Initially, the receiver array was designed to monitor movements of adult Lake Sturgeon (Hrenchuk *et al.* 2018); however the same array is also used to monitor juvenile Lake Sturgeon (Lacho *et al.* 2018), Lake Whitefish (Lacho and Hrenchuk 2018), and Walleye (the focus of this report).

3.1.1 ACOUSTIC TRANSMITTER APPLICATION

Acoustic transmitters (Vemco V13-1x) were first applied to Walleye in 2013 (40 upstream and 40 downstream of Gull Rapids) and 2014 (nine upstream and two downstream) (Murray *et al.* 2015). These transmitters expired during the 2016 open-water period. To continue Walleye movement monitoring with a similar sample size, 80 acoustic transmitters (Vemco V13-1x¹) were applied to Walleye between May 27 and June 7, 2016: 40 upstream, and 40 downstream of Gull Rapids (Table 1). Immediately after tagging (*i.e.*, within 22 days), eight fish tagged upstream of Gull Rapids moved downstream into Stephens Lake. In order to return the number of tagged fish upstream of Gull Rapids to the original sample size, eight additional transmitters were applied on September 24, 2016 (described in Hrenchuk and Lacho 2017).

3.1.2 ACOUSTIC RECEIVERS

Since 2013, stationary acoustic receivers (VEMCO model VR2 and VR2W, Shad Bay, Nova Scotia) were used to continuously monitor tagged Walleye 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 first four 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

¹ Battery life for tags implanted in 2013 was 1,480 days; tags implanted in 2016 had a battery life of 1,735 days.

phase (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 sturgeon 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 in previous years several were lost, likely due to disruption 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, especially in Gull Lake, is limited.

3.1.2.1 WINTER 2016/2017

The stationary acoustic receiver array for the winter 2016/2017 (October 20, 2016 to April 30, 2017) period consisted of 21 receivers. Four were set upstream of Gull Rapids, 16 throughout Stephens Lake, and one in the Long Spruce reservoir (Maps 3, 4, and 5).

The winter 2016/2017 receiver array differed slightly from the array used in winter 2015/2016. Three receivers that were previously set immediately upstream of the Kettle GS (one at rkm 40.0 and two at rkm 40.8, on either side of an island) were lost during winter 2015/2016, and two others had been lost during winter 2014/2015 and 2013/2014. Given the pattern of loss, the receivers were not reset at this location. Three receivers were added to the array in Stephens Lake in 2016/2017 to increase detection coverage: #125555 at rkm 5.2, #114237 at rkm 5.8, and #107993 at rkm 36.1 (Map 4).

3.1.2.2 OPEN-WATER 2017

An array of 60 receivers was used during the 2017 open-water period (defined as May 1 to October 16, 2017). Twenty-six were set upstream of Gull Rapids, thirty in Stephens Lake, three in the Long Spruce reservoir, and one in the Limestone reservoir (Maps 6, 7, and 8).

The 2017 open-water array differed slightly from arrays used in previous years. One receiver (#125552) was set in a new location in Stephens Lake, in a channel between a small island and the southern shore at rkm 3.8 (Map 7). During the 2016 open-water period, it was suspected that fish were using this channel to move between Zones 6 and 7 and were being missed by the receiver gate, which is described below. During the 2016 open-water period, a receiver was set downstream of the Long Spruce GS along the north shore at rkm 57.6. Due to abnormally high flows observed in 2017, it was not possible to reset this receiver (Map 8).

During winter 2016, the Keeyask Fisheries Regulatory Review Committee (KFRRRC)

¹ suggested that a receiver be placed in close proximity to the upstream side of Gull Rapids to monitor potential fish movements adjacent to the construction site. However, due to high flows and safety concerns during the 2017 open-water period, a suitable location was not found.

Receiver “gates” were established in several key areas selected based on river morphology (channel restrictions) and characteristics of habitat (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 they were last detected.

Four gates were established between Clark Lake and Gull Rapids (44.0, 34.0, 19.0, and 10.0 rkms upstream of Gull Rapids), and two were established in Stephens Lake (4.5 and 40.0 rkms downstream of Gull Rapids) (Maps 6 and 7). The area upstream of Gull Rapids was divided into five zones (Map 6; Zones 1–5), while Stephens Lake was divided into two zones (Map 7; Zones 6 and 7). The Long Spruce reservoir is referred to as Zone 8 and the Limestone reservoir as Zone 9. The location of the “gates” has remained consistent since first set in 2013.

On October 16, 2017, the majority of receivers were removed and a subset ($n = 20$) were redeployed to monitor movements during winter 2017/2018.

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 Gull Rapids representing a distance of 0 rkm. The area located downstream of Gull Rapids (*i.e.*, Stephens Lake and the Long Spruce reservoir) were given positive (+) distance values from Gull Rapids, 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 Gull Rapids was calculated over a 4-hour interval and

¹ The KFRRC is a committee of representatives from the KHLP, Manitoba Conservation and Water Stewardship (Fisheries Branch), and Fisheries and Oceans Canada. As described in the AEMP, the KFRRC reviews monitoring results to determine whether adaptive management measures, including changes to mitigation and offsetting measures, may be required.

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 was calculated and plotted.

4.0 RESULTS

Section 4.1 provides a summary of movements of fish tagged in 2016 prior to winter 2016/2017. Figures 3 to 12 provide movement range, relative detection frequency, and proportional distribution of tagged fish both upstream and downstream of the construction site by season. Appendix A1 provides detection summaries, Appendices A2 and A3 provide movement summaries, by river kilometre, for each Walleye tagged in 2016. Biological information associated with each tagged fish is provided in Appendix A4.

To date, all the tagged Walleye that have moved downstream past generating stations on the Nelson River did so when the spillway was operational, so it is unknown whether these fish moved over the spillway or through one of the turbines.

4.1 2016 RESULTS SUMMARY

4.1.1 UPSTREAM OF GULL RAPIDS

Forty tags were applied to Walleye upstream of Gull Rapids between May 28 and June 7, 2016, and an additional eight transmitters were applied on September 24, 2016, bringing the total number of tagged fish to 48 (Table 1). Eight fish were only detected briefly in Gull Lake (between 1 and 18 days) after being tagged, and are considered missing:

- #53763 was tagged at rkm -14.8 on June 5, 2016. It was located in upper Gull Lake (rkm -19.5 to -14.8) until June 18, when it moved downstream. It was last detected at rkm -9.9 on June 19, 2016.
- #53766 was tagged at rkm -12.5 on September 24, 2016. It remained at this location until October 4, when it moved downstream to lower Gull Lake. It was last detected at rkm -9.5 on October 12, 2016.
- #53770 was tagged at rkm -14.8 on June 5, 2016. It was located at rkm -17.4 until June 11, 2016.
- #53774 was tagged at rkm -14.8 on June 5, 2016. It remained at rkm -17.4 until June 10, after which it moved downstream to lower Gull Lake. It was last detected at rkm -9.0 on June 16, 2016.
- #53778 was tagged at rkm -14.8 on June 3, 2016. It remained at rkm -17.4 until June 16. It then moved downstream and was last detected at rkm -9.5 on June 16, 2016.
- #53779 was tagged at rkm -14.8 on June 3, 2016. It was located at rkm -12.9 until June 13, 2016.

- #53790 was tagged at rkm -17.4 on May 29, 2016. It was located here until June 1, 2016.
- #53802 was tagged at rkm -14.8 on June 7, 2016. It moved downstream immediately and was last detected at rkm -5.8 on June 8, 2016.

These eight missing fish are not discussed in the remainder of this report. Therefore, 40 Walleye were available to be detected upstream of Gull Rapids prior to winter 2016/2017.

Prior to winter 2016/2017, 12 of the 40 tagged Walleye moved downstream through Gull Rapids into Stephens Lake:

- Five moved into Stephens Lake and made multiple upstream and downstream movements:
 - #53759 was tagged on September 24, 2016, at rkm -17.5 and moved downstream through Gull Rapids on September 29 (Appendix A2-2).
 - #53760 was tagged on September 24, 2016, at rkm -17.5 and moved downstream through Gull Rapids on October 3 (Appendix A2-3).
 - #53775 was tagged on June 5, 2016, at rkm -14.8 and moved downstream through Gull Rapids on June 18 (Appendix A2-16).
 - #53788 was tagged on May 30, 2016, at rkm -14.8 and moved downstream through Gull Rapids on June 21 (Appendix A2-29).
 - #53799 was tagged on June 7, 2016, at rkm -14.8 and moved downstream through Gull Rapids on October 16 (Appendix A2-40).
- Four (#53769, #53771, #53782, and #53791) moved downstream through Gull Rapids into Stephens Lake, and then continued to move downstream into the Long Spruce Reservoir, one continued downstream and moved into the Limestone Reservoir:
 - #53769 was tagged on June 5, 2016, at rkm -14.8. It moved through Gull Rapids between August 16 and September 1, and through the Kettle GS on September 11 (Appendix A2-10).
 - #53771 was tagged on May 31, 2016, at rkm -14.8. It moved downstream through Gull Rapids between July 27 and 31. It moved into the Long Spruce reservoir on August 19 and was detected in the Limestone reservoir on August 21 (Appendix A2-12).
 - #53782 was tagged on May 31, 2016, at rkm -19.5. It moved downstream through Gull Rapids between June 10 and 17, and moved through the Kettle GS between July 28 and August 8 (Appendix A2-23).
 - #53791 was tagged on May 29, 2016, at rkm -19.5. It moved downstream immediately after being tagged and was detected in Stephens Lake on June 5. It moved through the Kettle GS on June 27 (Appendix A2-32).

- Three moved downstream through Gull Rapids and were detected briefly (for one to seven days) in Stephens Lake with no upstream movements:
 - #53764 was tagged on June 5, 2016, at rkm -14.8 and moved downstream through Gull Rapids on June 12 (Appendix A2-5).
 - #53786 was tagged on May 30, 2016, at rkm -14.8 and moved downstream through Gull Rapids on June 2 (Appendix A2-27).
 - #53801 was tagged on June 7, 2016, at rkm -14.8 and moved downstream through Gull Rapids on the same day (Appendix A2-42).

In summary, 48 Walleye were tagged upstream of Gull Rapids between May and September, 2016. Eight fish are considered missing and 12 fish moved downstream into Stephens Lake. Therefore, 28 fish were available to be detected upstream of Gull Rapids during winter 2016/2017.

4.1.2 STEPHENS LAKE

Forty tags were applied to Walleye in Stephens Lake between May 27 and June 1, 2016. Since that time, seven fish have gone missing:

- One (#53727) has never been detected since being tagged on May 28, 2016, at rkm 1.2.
- Five were detected briefly (between 12 and 29 days) after being tagged and are considered missing:
 - #53726 was tagged on May 27, 2016, at rkm 1.2. It was detected in upper Stephens Lake (rkm 1.2 to 4.4) until June 5. It moved downstream and was last located at rkm 16.8 on June 19, 2017 (Appendix A3-4).
 - #53732 was tagged on May 28, 2016, at rkm 1.2. It was detected moving between rkm 1.2 and 4.5 until June 2, after which it moved downstream. It was last detected in the northern portion of Stephens Lake at rkm 13.0 on June 14, 2016 (Appendix A3-9).
 - #53742 was tagged on May 30, 2016, at rkm 1.2. It was located between rkm 1.2 and 2.7 until June 11, 2016 (Appendix A3-19).
 - #53743 was tagged on May 31, 2016, at rkm 1.2. It immediately moved downstream and was last located on June 13, 2016, at rkm 9.4 (Appendix A3-20).
 - #53754 was tagged on May 31, 2016, at rkm 1.2. It immediately moved downstream and was last located on June 28, 2016, at rkm 18.6 (Appendix A3-31).
- One (#53735) has been located constantly at a single location. This fish was tagged on May 30, 2016, at rkm 1.2. It moved downstream immediately after tagging and was detected at rkm 18.6 on June 16, 2016. It has been located here on every day since this

date with no upstream or downstream movements. It is likely that this fish represents a tagging mortality and the tag has remained within the detection range of this receiver (Appendix A3-12).

These seven fish are not discussed in the remainder of this report.

In summary, 12 fish moved downstream from Gull Lake and five of these continued to be detected in Stephens Lake. 40 Walleye were tagged in Stephens Lake in 2016, seven of which are considered missing. Therefore, 38 fish were available to be detected in Stephens Lake during winter 2016/2017.

4.2 WINTER 2016/2017

4.2.1 UPSTREAM OF GULL RAPIDS

The winter receiver array consisted of four receivers deployed at rkms -48.2, -29.4, -12.9, and -10.1 (Figure 1). Three of these receivers were retrieved; the receiver deployed at rkm -12.9 could not be located and was likely moved by ice (Map 3). Four of the 28 fish (14%) available to be detected were located a total of 1,699 times (range: 2–1,663 detections per individual) (Appendix A1-1). Fish were detected between one and 46 days of the 193 day winter period. On average, fish were detected on 12 days, or for 6% of the study period (StDev = 22.5 days). The majority of detections (1,684; 99%) occurred at rkm -10.1 (Figure 4). A single fish (#6425) was located as far upstream as Clark Lake (rkm -48.2), and no fish were located by the receiver downstream of Birthday Rapids (rkm -29.4) (Figure 3).

4.2.2 STEPHENS LAKE

Sixteen receivers were deployed in Stephens Lake during the 2016/2017 winter period, between rkms 5.2 and 36.1 (Figure 1). Fifteen of these receivers were retrieved; the receiver deployed at rkm 23.5 was not retrieved due to the buildup of large woody debris that occurred during the winter months (Map 4).

Positions were obtained for 30 of the 38 fish (79%) available to be detected, for a total of 429,293 detections (range: 5–108,116 detections per individual) (Appendix A1-2). Fish were detected on 1 to 192 days of the 193 day winter period (0–99% of the time). On average, fish were detected on 70 days, or for 36% of the study period (StDev = 59.7 days). Ten (33%) were located as far upstream as rkm 5.2, while three (10%) were located as far downstream as rkm 24.7 (Figure 5). The average overall movement range was 4.8 rkm (StDev = 4.2 rkm; range 0.0–13.4 rkm) (Figure 5; Appendix A1-2).

The majority of detections were logged at rkms 18.6 ($n = 197,006$; 46%), 7.9 ($n = 62,174$; 15%), and 5.2 ($n = 57,106$; 13%). Five fish were detected in the northern portion of Stephens Lake at rkms 13.0 (#53730, #53734, and #53748) and 16.8 (#53749 and #53756) (Figure 6).

4.2.3 LONG SPRUCE RESERVOIR

The single receiver set in the Long Spruce reservoir was retrieved (Map 5). None of the three Walleye (#53769, #53782, and #53791) last detected in this area were located during winter 2016/2017 (Appendices A2-10, A2-23, and A2-32).

4.3 OPEN-WATER 2017

4.3.1 ACOUSTIC RECEIVER RETRIEVAL

Stationary acoustic receivers deployed in Stephens Lake (30), in the Long Spruce reservoir (3), and in the Limestone reservoir (1) during the 2017 open-water period were successfully retrieved (Maps 7 and 8). One of the 26 receivers deployed upstream of Gull Rapids (#129189) at rkm -32.3 went missing part way through the study period (Map 6). No data were retrieved from this receiver after July 23, 2017. For the first time in 2017, a receiver was successfully deployed and retrieved in the North Arm of Stephens Lake.

4.3.2 UPSTREAM OF GULL RAPIDS

Twenty-eight Walleye were available to be detected upstream of Gull Rapids during the 2017 open-water period (section 4.1.1). Twenty-one of these (75%) were detected between 3 and 24,523 times for 1–122 days of the 169 day open-water period (1–72% of the time; Appendix A1-3). The average total movement range was 18.4 rkm (StDev = 22.2 rkm; range: 0.0–85.1 rkm) (Figure 7; Appendix A1-3). The farthest upstream detections occurred at rkm -48.2 (by 2 fish; 10%) while the farthest downstream occurred at rkm -5.8 (by one fish; 5%) (Figures 7 and 8; Appendix A1-3). Four fish moved downstream through Gull Rapids into Stephens Lake (discussed in Section 4.4.2.3).

Of the seven fish that were not detected:

- Four (#53780, #53787, #53800, and #53806) were detected for the majority of the 2016 open-water period (48 to 136 days post-tagging) moving throughout Gull Lake (Appendices A2-21, A2-28, A2-41, and A2-47). One (#53806) moved as far upstream as Birthday Rapids (rkm -33.8).

- Two (#53767 and #53803) were last detected during the 2016/2017 winter period (on January 8 and 21, respectively) at rkm -10.1 (Appendices A2-8 and A2-44).
- One (#53807) was last detected on August 19, 2016, at the outlet of Clark Lake (rkm -48.2). This fish may have continued to move upstream past the receiver array (Appendix A2-48).

4.3.2.1 PROPORTIONAL DISTRIBUTION

As in 2016, individual Walleye used Zone 4 (upper and middle basins of Gull Lake) most often, spending an average of 64% (StDev = 40%; range: 0–100%) of the study period in this area (Table 2; Figures 9 and 10). The remaining four zones were used less frequently:

- Zone 1 at 6% (StDev = 17%; range: 0–68%);
- Zone 2 at 2% (StDev = 6%; range: 0–26%);
- Zone 3 at 12% (StDev = 24%; range: 0–89%); and
- Zone 5 at 16% (StDev = 33%; range: 0–100%).

4.3.2.2 MOVEMENTS

Twelve fish displayed the same pattern of movement in 2017 as in 2016:

- Six remained exclusively in Gull Lake:
 - Three (#53768, #53795, and #53805) remained in upper Gull Lake, moving no further downstream than rkm -14.8 (Appendices A2-9, A2-36, and A2-46).
 - Two (#53776 and #53792) moved throughout Gull Lake (Appendices A2-17 and A2-33).
 - One (#53765) remained within the lower portion of Zone 4 in Gull Lake (rkm -10.1 to -9.9) (Appendix A2-6).
- Three (#53784, #53794, and #53796) moved between Birthday Rapids and Gull Lake (Appendices A2-25, A2-35, and A2-37).
- Two (#53783 and #53797) remained in the upper portion of Gull Lake for the majority of both the 2016 and 2017 open-water periods, moving upstream to Clark Lake at the end of August, and returning to Gull Lake in June (Appendices A2-24 and A2-38).
- One (#53789) remained below Birthday Rapids (rkm -32.3) for the majority of both open water periods, moving upstream to Clark Lake in October (Appendix A2-30).

Movement patterns could not be determined for nine Walleye:

- Three (#53781, #53798, and #53804) were only detected briefly (3 to 160 times on 1 to 4 days) during the 2017 open-water period (Appendices A2-22, A2-39, and A2-45).

- Six displayed movements that differed from 2016:
 - One (#53772) moved between rkm -24.3 and -14.8 during open-water 2016. In 2017, it made a single downstream movement from rkm -29.4 to -7.4 in lower Gull Lake (Appendix A2-13).
 - One (#53785) moved between rkm -19.5 and -12.9 during open-water 2016. In 2017, it made a single downstream movement from rkm -17.4 to -5.8 in lower Gull Lake (Appendix A2-26).
 - Four (#53758, #53773, #53777, and #53793) moved downstream through Gull Rapids (described in Section 4.3.2.3).

4.3.2.3 MOVEMENTS THROUGH GULL RAPIDS

Four Walleye moved downstream through Gull Rapids:

- Two remained in Stephens Lake:
 - #53758 was tagged on September 24, 2016, at rkm -17.5 and was detected between rkm -10.1 and -9.9 until the end of the 2016 open-water period (Appendix A2-1). It was detected again in Zone 4 of Gull Lake (rkm -9.9) on June 10, 2017. It moved upstream and was located at Birthday Rapids (rkm -33.8) between July 21 and 26. It returned to Gull Lake and was last located at rkm -5.8 on July 28.
 - It was first detected in Stephens Lake on August 9 at rkm 1.2. It was only located until August 11, but made multiple upstream and downstream movements (between rkm 1.2 and 5.2) during this time.
 - #53793 was tagged on June 7, 2016, at rkm -17.4 and was detected between rkm -19.5 and -12.9 for the remainder of the 2016 open-water period (Appendix A2-34). It was detected at rkm -12.8 on June 6, 2017, but immediately moved downstream and was last detected in Gull Lake on June 8 at rkm -5.8.
 - It was first detected in Stephens Lake on June 8 at rkm 2.7. It was last detected here on June 9.
- Two continued to move downstream through the Kettle GS:
 - #53773 was tagged on June 5, 2016, at rkm -14.8. It was located in Gull Lake for the majority of the 2016 open-water period, but made a single upstream movement to Birthday Rapids from August 12 to 22. It returned to Gull Lake and was last detected at rkm -11.8 on September 18 (Appendix A2-14). This fish was detected again at rkm -17.4 on June 6, 2017. It remained between rkm -19.5 and -11.9 until July 13, and was last detected at rkm -9.5.
 - It was first detected in Stephens Lake on July 16 at rkm 1.2 and continued to move downstream, and was last detected at rkm 36.1 on July 18.

- It was detected downstream of the Kettle GS (rkm 42.7) on July 19, when the spillway was open. It made multiple movements between rkm 42.7 and 43.5 until July 22, and is therefore presumed to have survived passage.
- #53777 was tagged on May 29, 2016, at rkm -17.4. It was detected between rkm -19.5 and -14.8 until the end of August when it began to move upstream. It was last detected in 2016 in Clark Lake (rkm -48.2) on September 24 (Appendix A2-18). The next detection for this fish occurred downstream of Birthday Rapids (rkm -26.5) on June 13, 2017. It remained in upper Gull Lake until August 10 and was last detected at rkm -5.8 on August 14, 2017.
 - It was first detected in Stephens Lake on August 23 at rkm 1.2. It continued to move downstream and was last detected at rkm 40.9 on August 25.
 - The first detection of this fish in the Long Spruce reservoir occurred on August 26, and the first detection in the Limestone reservoir occurred on August 31. The spillways of both stations were operational during the time of passage. This fish was detected until September 2, downstream of the Limestone GS and is therefore presumed to have survived passage.

4.3.3 STEPHENS LAKE

Thirty-eight Walleye were available to be detected in Stephens Lake during the 2017 open-water study period (Section 4.2.2). Thirty-three of these (87%) were detected between 35 and 61,299 times for 8–156 days of the 169 day open-water period (5–92% of the time; Appendix A1-4). The average total movement range was 21.9 rkm (StDev = 16.1 rkm; range: 1.0–57.4 rkm) (Figure 11; Appendix A1-4). The farthest upstream detections occurred at rkm 1.2 (by 15 fish; 45%) while the farthest downstream occurred at rkm 40.8 (by two fish; 6%) (Figures 11 and 12; Appendix A1-4). Six fish moved downstream through the Kettle GS into the Long Spruce reservoir (described in Section 4.3.3.3).

Five fish located during open-water 2016 were not detected during the 2017 open-water period. Of these:

- Three (#53733, #53739, and #53812) were detected for the majority of the 2016 open-water period (between 40 and 137 days post-tagging) moving throughout Stephens Lake (rkm 1.2 to 20.0) (Appendices A3-10, A3-16, and A3-39).
- Two moved downstream through Gull Rapids in 2016:
 - #53759 was last detected during the 2016/2017 winter period (on October 26, 2016) in the southern portion of Stephens Lake at rkm 16.8 (Appendix A2-2).

- #53788 was last detected moving between rkm 1.2 and 5.2 from June 21 to July 9, 2016 (Appendix A2-29).

4.3.3.1 PROPORTIONAL DISTRIBUTION

As in 2016, individual Walleye used Zone 7 (the lower portion of Stephens Lake) most frequently, spending an average of 66% (StDev = 32%, range: 1–100%) of the study period in this area. Zone 6 was used an average of 34% (StDev = 32%, range: 0–99%) of the time (Table 2; Figures 10 and 12). A greater proportion of fish were detected close to Gull Rapids during the beginning of the study period than at the end (Figures 10 and 12). Zone 6 was used an average of:

- 73% (StDev = 8%; range: 58–85%) of the time between June 7 and 18, 2017.
- 52% (StDev = 3%; range: 38–54%) of the time between June 19 and July 19.
- 18% (StDev = 4%; range: 12–38%) of the time between July 20 and October 16.

4.3.3.2 MOVEMENTS

Nine Walleye were located in the upstream portion of Stephens Lake, at or upstream of rkm 10.3, for the majority of the 2017 open-water period. These fish had movement ranges between 1.0 and 9.1 rkm:

- Two (#53724 and #53740) were detected most often in the area immediately downstream of Gull Rapids (Zone 6), but made brief downstream movements into the upstream end of Zone 7 (Appendices A3-2 and A3-17).
- Five (#53730, #53749, #53750, #53760, and #53811) made regular movements between Zone 6 and the upstream end of Zone 7 (Appendices A3-7, A3-26, A3-27, A2-3, and A3-38).
- Two (#53731 and #53755) were detected further downstream (rkms 13.0 and 13.9, respectively) at the beginning of the open-water period (prior to June 13) but moved upstream and remained within 10.3 rkm of Gull Rapids for the remainder of the open-water period (Appendix A3-8 and A3-32).

One (#53748) remained exclusively in the northern portion of Stephens Lake, and was located only by the four receivers surrounding Callan Island (#100779, #114227, #122862, and #122866; Map 7; Appendix A3-25).

Seventeen Walleye made more extensive movements throughout the lake:

- Four (#53723, #53725, #53756, and #53808) remained within 13.9 rkm of Gull Rapids (Appendices A3-1, A3-3, A3-33, and A3-35).
- Five moved as far downstream as rkm 18.6:

- Three (#53729, #53734, and #53741) made regular upstream and downstream movements (Appendices A3-6, A3-11, and A3-18).
- Two (#53809 and #53810) made single downstream movements to this location and were detected here for the remainder of the study period (Appendices A3-36 and A3-37).
- Six moved as far downstream as rkm 24.7:
 - Four (#53736, #53745, #53757, and #53775) made regular upstream and downstream movements (Appendices A3-13, A3-22, A3-34, and A2-16).
 - Two (#53744 and #53752) made a single downstream movements to this location and were detected here for the remainder of the study period (Appendices A3-21 and A3-29).
- Two (#53738 and #53753) were detected close to Gull Rapids, then moved steadily downstream until being detected at the receivers immediately upstream of the Kettle GS (at rkm 40.8 and 40.9, respectively); neither fish was detected again during the study period (Appendices A3-15 and A3-30).

The remaining six Walleye moved downstream through the Kettle GS (described in section 4.3.3.3).

4.3.3.3 MOVEMENTS THROUGH KETTLE GS

Six fish moved downstream through the Kettle GS. Four moved downstream in August, one in July, and one in June. The spillways were operational during all passage events. Of these six fish:

- Three remained in the Long Spruce Reservoir:
 - #53737 was tagged on May 29, 2016, at rkm 1.2, and remained within upper Stephens Lake (upstream of rkm 9.4) for the remainder of the 2016 open-water period (Appendix A3-14).
 - It was located in upper Stephens Lake at the beginning of the 2017 open-water period, and remained between rkm 3.8 and 9.4 until July 16 when it moved downstream. It was last located in Stephens Lake on July 14. It was located in the Long Spruce reservoir at rkm 47.5 for a single day (July 16). It is unclear if this fish survived passage.
 - #53747 was tagged on May 31, 2016, at rkm 1.2, and remained within upper Stephens Lake (upstream of rkm 10.3) for the remainder of the 2016 open-water period (Appendix A3-24).
 - It was located in upper Stephens Lake at the beginning of the 2017 open-water period, and remained between rkm 1.2 and 3.8 until July 15 when it moved downstream to rkm 18.6. It made multiple upstream and downstream movements until August 21. It was first located in the Long

Spruce reservoir on August 23, and moved between rkm 42.7 and 47.5 until September 7, indicating it survived passage.

- #53799 was tagged on June 7, 2016, upstream of Gull Rapids (at rkm -14.8). It moved downstream into Stephens Lake on June 16, and was located regularly between rkm 1.2 and 7.0 until 15 January, 2017 (Appendix A2-40).
 - During the open water period it was located in upper Stephens Lake (rkm 1.2 to 5.2) from June 5 to 15. It then moved downstream and was last located at rkm 40.8 on June 25. The next detection for this fish occurred in the Long Spruce reservoir at rkm 47.5 where it was located for a single day (June 25). It is unclear if this fish survived passage.
- Three continued to move downstream through the Long Spruce GS:
 - #53728 was tagged on May 28, 2016, at rkm 1.2. It was located in upper Stephens Lake until July 12, when it moved downstream to rkm 18.6. It moved upstream to rkm 7.9 on January 17, 2017 and remained there for the rest of the 2016/2017 winter period (Appendix A3-5).
 - This fish moved between rkm 2.7 and 7.9 at the beginning of the 2017 open-water period, but began to move downstream on June 12. It was last located in Stephens Lake at rkm 36.1 on August 10. It was first located in the Long Spruce reservoir on August 12 and moved between rkm 42.7 and 47.5 until September 13.
 - The next detection of this fish occurred in the Limestone reservoir on September 16. The fish was located several times between September 16 and September 18 and is therefore presumed to have survived passage. It should be noted that the Long Spruce GS spillways were only open sporadically (from 0 to 13 hours per day) between September 13 and 16, therefore, it is unclear whether or not they were open when this fish passed the GS.
 - #53746 was tagged on May 31, 2016, at rkm 1.2. It moved downstream immediately after being tagged and was last located in 2016 at rkm 18.6 on June 7 (Appendix A3-23). This fish was next located in Stephens Lake on May 8, 2017, at rkm 18.6. It moved upstream and was located between rkm 3.8 and 7.9 until June 9 when it moved downstream and was last detected in Stephens Lake on June 13 at rkm 18.6.
 - It was subsequently located in the Long Spruce reservoir for a single day (August 4) at rkm 47.5. The next detection for this fish occurred in the Limestone reservoir (rkm 58.6) on August 8 and 9. Because it was located on multiple locations over this two day period, it is presumed that this fish survived passage.
 - #53751 was tagged on May 31, 2016, at rkm 1.2 and was located between rkm 1.2 and 18.6 for the entirety of the 2016 open-water period. In 2017, it was

located in upper Stephens Lake (rkm 1.2 to 3.8) before moving downstream on July 30. It was last located in Stephens Lake at rkm 36.1 on August 4 (Appendix A3-28).

- This fish was first located in the Long Spruce reservoir on August 6 and 7 and in the Limestone reservoir on August 8. It is unclear if this fish survived passage through the Long Spruce GS.

4.3.4 LONG SPRUCE RESERVOIR

One of the three Walleye last detected in the Long Spruce reservoir in 2016 was located during the 2017 open-water period:

- #53769 was detected 410 times over 4 days at rkm 47.5. It was last detected on June 26, 2017 (Appendix A2-10).

The other two Walleye were not detected during the 2017 open-water period:

- #53782 was last detected in the Long Spruce reservoir on August 8, 2016 at rkm 43.5 (Appendix A2-23).
- #53791 was last detected at rkms 43.5 and 44.9 on June 27, 2016 (Appendix A2-32).

4.3.5 LIMESTONE RESERVOIR

The single Walleye last detected in the Limestone reservoir in 2016 was not located during the 2017 open-water period. Walleye #53771 was last detected at rkm 58.6 on August 21, 2016 (Appendix A2-12).

5.0 DISCUSSION

Walleye movement monitoring was initiated in 2013 to describe movements during the pre-construction (2013) and construction phases (beginning July 2014) of the Project and to determine if disturbances associated with construction would alter habitat use and coarse-scale movement patterns upstream and downstream of the Project. Acoustic transmitters applied in 2013 and 2014 expired during the open-water period in 2016. Additional tags were applied both upstream and downstream of the construction site during the 2016 open-water period to allow for continued monitoring during construction of the GS. The sample size of tagged Walleye was similar to 2013: 48 transmitters were applied upstream of Gull Rapids, and 40 were applied in Stephens Lake. The discussion below highlights movement patterns observed for Walleye tagged in 2016, and compares to those observed in fish tagged in 2013/2014.

A comparison of results of the two data sets (*i.e.*, fish tagged in 2013/2014 vs. those tagged in 2016) indicates that a higher proportion of fish tagged in 2016 moved downstream through major barriers (*i.e.*, Gull Rapids, the Kettle GS, and the Long Spruce GS) relative to those tagged in 2013/2014 (discussed in detail in Section 5.3). After tags were applied in 2016, a considerable proportion of fish moved downstream within two months of being tagged. Hrenchuk and Lacho (2017) hypothesized that at least a portion of these downstream movements could be attributed to stress or mortality caused by the tagging procedure. Although this may be true, a relatively large proportion of Walleye also moved downstream through major barriers in 2017, more than a year after being tagged. These movements cannot be attributed to stress caused by the tagging procedure, which suggests that these fish may be influenced by external environmental factors.

Record-high flows were observed in the study area during the 2017 open-water period, which may have contributed to the observed downstream movements. From about October 2016 through mid-September 2017, the flows exceeded the historical 75th percentile flow of about 3,780 m³/s, and from about May to mid-August 2017 the flows exceeded the 95th percentile flow of approximately 5,230 m³/s. Walleye are known to move upstream or downstream, within or between waterbodies, to exploit spatially dynamic food sources and locate the best possible foraging conditions (Paragamian 1989; Williams and Eversole 2001; Murchie and Smokorowski 2004; Wang *et al.* 2007; Herbst *et al.* 2017). Under high flows, Walleye have been shown to increase their activity (become “hyperactive”) as a means to find suitable refugia, hold position in the water column, and/or to feed on increased levels of drifting invertebrates (Murchie and Smokorowski 2004). This increased level of activity makes them prone to entrainment under high flow scenarios. Both McDougall *et al.* (2016) and Carlson *et al.* (2017) documented higher than normal entrainment rates for Walleye during large-scale flood events in the Saskatchewan and Missouri river systems. Flood conditions during the 2017 open-water period may have contributed to the observed high rates of large-scale downstream movements and/or entrainment. Continued monitoring during average flow scenarios will show if these movements are anomalous or part of an on-going trend.

5.1 EVALUATION OF METHODOLOGY

Fish movement monitoring, via acoustic telemetry, is a significant component of the AEMP, and is being used to assess potential impacts of the Keeyask GS construction on several fish species including Lake Sturgeon (adults and juveniles), Walleye, and Lake Whitefish. Of these fish species/life stages, the methodology is most effective for monitoring movements of adult and juvenile Lake Sturgeon. Lake Sturgeon have a low natural mortality rate, occupy main channel habitats where receivers are located, and in the case of juveniles, rarely move. These are all characteristics that allow for frequent detections of tagged fish. Monitoring movements of Walleye and Lake Whitefish via acoustic telemetry has been less effective relative to Lake Sturgeon. This is because: i) tagged individuals are detected less frequently due to more frequent utilization of shallow water habitats outside the detection range of receivers; ii) potential use of tributaries and off-current embayments where receivers are not located; iii) stress from the tagging procedure may cause an initial downstream movement of some individuals which complicates data interpretation; and iv) a higher natural mortality rate relative to Lake Sturgeon causes a greater proportion of tags to be lost. These characteristics reduce the frequency of detection of tagged fish and the higher proportion of missing fish further complicates data interpretation. Despite this, the data collected to date provide a good understanding of Walleye 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 Walleye past key points are being detected.

One additional receiver was added to the receiver array during the open-water 2017 period. A receiver was deployed at rkm 3.8 in Stephens Lake in a channel between a small island and the southern shore. During open-water 2016, it was suspected that fish were using this channel to move between Zones 6 and 7 and were being missed by the receiver gate. During open-water 2017, 22 fish (67%) were detected a total of 19,668 times at this location. This receiver will continue to be deployed as part of the Stephens Lake receiver gate. Additionally, in 2017 a receiver was successfully deployed and retrieved in the North Arm of Stephens Lake, marking the first time this location has been monitored for the entire open-water period, further strengthening the array.

Despite the robust array of receivers, the proportion of detected Walleye has decreased with each study year, likely reflecting natural mortality rates. The proportion of detection of fish tagged upstream of Gull Rapids in 2013/2014 decreased from 98% in 2013, 81% in 2014, 76% in 2015 and 61% in 2016. The same was true for detection of fish tagged in Stephens Lake in 2013/2014: 100% of tagged fish were detected in 2013, 85% in 2014, 68% in 2015 and 49% in 2016. Fish tagged in 2016 continue to exhibit the same pattern. The proportion of fish detected has decreased from 100% in 2016 to 75% in 2017 upstream of Gull Rapids, and from 98% in 2016 to 87% in 2017 in Stephens Lake. This trend will likely continue with time as the fish age.

5.2 MOVEMENT PATTERNS

In general, there was little change in the movement patterns of Walleye tagged in 2013/2014 over four years of study. These fish tended to stay in the same general area, exhibiting similar movements each year. The opposite is true of Walleye tagged in 2016. A substantial proportion of these fish displayed large-scale downstream movements, and did not tend to display the same patterns of movement between years, especially those tagged upstream of Gull Rapids. Nearly half (*i.e.*, nine of 21) of the fish tagged upstream of Gull Rapids in 2016 were detected too infrequently to determine a movement pattern, or displayed large-scale downstream movements during the 2017 open-water period. The 12 fish that did display a movement pattern were split into four groups: those that remained in Gull Lake, those that moved between Birthday Rapids and Gull Lake, those that moved between Clark Lake and Gull Lake, and those that remained in the riverine area downstream of Birthday Rapids. This was similar to fish tagged in 2013/2014 which displayed two general movement patterns, either remaining in Gull Lake (largely within the upper basin), or moving between Gull and Clark lakes. Walleye tagged upstream of Gull Rapids in both 2013/2014 and 2016 did not spend much time in the vicinity of the Keeyask GS construction site.

In Stephens Lake, fish tagged in 2016 exhibited two patterns of movement: some remained exclusively within the upper 10.3 rkm during the open water period, while others moved extensively throughout the lake. In contrast to those tagged upstream of Gull Rapids, a high proportion of the Walleye tagged in Stephens Lake used habitat in the vicinity of the Keeyask GS construction site. In 2017, 15 fish (45%) were located at the receiver closest to the construction site (rkm 1.2), two of which remained within 5.0 rkm for the entire study period. These movement patterns mirror those observed for fish tagged in 2013/2014, though during 2013–2016 a greater proportion of fish remained within the upper portion of Stephens Lake (Table 2). In all study years since initial tagging in 2013, Walleye have been detected near Gull Rapids during the spring (likely for spawning) and have moved downstream in the summer and fall.

5.3 MOVEMENTS THROUGH BARRIERS

A substantial proportion of the Walleye tagged upstream of Gull Rapids in 2016 have made downstream movements through Gull Rapids, the Kettle GS, and the Long Spruce GS. Of the 48 fish tagged upstream of Gull Rapids in 2016, 16 (33%) moved downstream through Gull Rapids (12 in 2016 and three in 2017), seven (15%) moved downstream through the Kettle GS (four in 2016 and eight in 2017), and two (4%) moved downstream through the Long Spruce GS (one in 2016 and one in 2017). Of the 40 fish tagged in Stephens Lake in 2016, five (13%) moved downstream through the Kettle GS and three (8%) moved downstream through the Long Spruce GS in 2017.

Overall, large-scale downstream movements appear to be higher in 2016–2017 than during 2013–2016. Only 15% of Walleye initially tagged upstream of Gull Rapids in 2013/2014 moved downstream through Gull Rapids during four years of study, and 3% of fish tagged in Stephens Lake moved through the Kettle GS. Over the last two years, 33% of Walleye tagged upstream of Gull Rapids in 2016 have moved into Stephens Lake, and 10% and 8% of fish tagged in Stephens Lake have moved downstream through the Kettle and Long Spruce GSs, respectively.

Although downstream movements appear to have increased, the number of upstream movements through Gull Rapids has not. No Walleye (either those tagged in 2013/2014 or those tagged in 2016) have moved upstream over Gull Rapids since construction began in mid-2014. Only one Walleye has moved upstream (in 2013) since the study began. It is possible that fish are no longer able to move upstream through the rapids due to the blockage of the north channel and constricted flows within the south channel (discussed in Hrenchuk and Lacho 2017). Discharge in the Nelson River has been above median levels since the start of construction, and was higher in 2017, compounding the high water velocity in the south channel.

5.4 KEY QUESTIONS

The key questions/objectives of Walleye movement monitoring during construction, as described in the AEMP, and presented in the introduction of this report, are addressed below:

How many (or what proportion) of tagged Walleye move past the construction site?

Of the 48 Walleye tagged upstream of Gull Rapids in 2016, 16 (33%) moved downstream through Gull Rapids, 12 in 2016 and four in 2017. In contrast, only six (15%) of the 41 Walleye initially tagged upstream of Gull Rapids in 2013/2014 moved downstream through Gull Rapids between 2013 and 2016. No Walleye have moved upstream through Gull Rapids since construction began in 2014.

Are Walleye using habitat in the vicinity of construction activities, particularly during spawning?

Monitoring since 2013 has shown that Walleye tagged upstream of Gull Rapids do not spend much time in the vicinity of the construction site. With the exception of the fish that moved through Gull Rapids, a single Walleye tagged in 2016 was detected by the closest receiver to Gull Rapids (5.8 rkm upstream) in 2017. Similarly, Walleye tagged in 2013/2014 were rarely detected within 7.5 rkm upstream of the construction site, and none were detected by the closest receiver to Gull Rapids (5.8 rkm), save those that moved downstream through Gull Rapids.

In contrast, Walleye in Stephens Lake regularly use habitat directly downstream of the construction site. In all study years, Walleye (tagged both in 2013/2014 and 2016) have been detected near Gull Rapids during the spring and have likely continued to spawn in this area during the construction period.

6.0 SUMMARY AND CONCLUSIONS

- Transmitters applied to Walleye in 2013/2014 expired in 2016 and were not detected during the current study period. Movement patterns of these fish observed between 2013 and 2016 were compared to those of Walleye tagged in 2016.
- The two data sets (from fish tagged in 2013/2014 and fish tagged in 2016) were difficult to compare as a much larger proportion of fish tagged in 2016 moved downstream through barriers (Gull Rapids, Kettle GS, and Long Spruce GS) than those tagged in 2013/2014.
- Movement patterns of Walleye tagged upstream of Gull Rapids in 2016 were difficult to identify as nearly half (43%) of the detected fish were located infrequently or exhibited large-scale downstream movements. The remaining Walleye displayed four patterns: remaining in Gull Lake, moving between Birthday Rapids and Gull Lake, moving between Clark Lake and Gull Lake, or remaining in the riverine area downstream of Birthday Rapids.
 - Walleye tagged in 2013/2014 consistently displayed two general movement patterns, either remaining in Gull Lake (largely within the upper basin), or moving between Gull and Clark lakes.
- Walleye tagged in Stephens Lake in 2016 were split into two groups based on movement patterns: those that remained exclusively within the upper 10.3 rkm during the open-water period, and those that moved extensively throughout the lake.
 - These patterns were also observed for Walleye tagged in 2013/2014.
- The key questions, as described in the AEMP, for Walleye movement monitoring during construction of the Keeyask GS are as follows:
 - *What is the number (or the proportion) of tagged Walleye that move past the construction site?*

Of the 48 Walleye tagged upstream of Gull Rapids in 2016, 16 (33%) moved downstream through Gull Rapids, 12 in 2016 and four in 2017. In contrast, only six (15%) of the 41 Walleye initially tagged upstream of Gull Rapids in 2013/2014 moved downstream through Gull Rapids between 2013 and 2016. No Walleye have moved upstream through Gull Rapids since construction began in 2014.
 - *Are Walleye utilizing habitat in the vicinity of construction activities (particularly during spawning)?*

Monitoring since 2013 has shown that Walleye tagged upstream of Gull Rapids that remain in Gull Lake do not spend much time in the vicinity of the construction site. In contrast, Walleye tagged in Stephens Lake, or those that have moved downstream from Gull Lake, regularly use habitat directly downstream of the construction site.

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TABLES

Table 1: Number of acoustic tags applied to Walleye in the Keeyask Study Area (upstream of Gull Rapids and in Stephens Lake) between June 2013 and October 2017.

Year	Upstream GR	Stephens Lake	Total
2013*	40	40	80
2014*	9	2	11
2015*	0	0	0
2016	48	40	88
2017	0	0	0

*Tags no longer active during the current reporting period. Detailed information on movements (2013–2016) can be found in Hrenchuk and Barth (2014), Murray *et al.* (2015), Burnett *et al.* (2016), and Hrenchuk and Lacho (2017).

Table 2: Proportion of time spent in each river zone by Walleye tagged upstream of Gull Rapids and in Stephens Lake in both 2013/2014 and 2016 during a portion of the 2013 (June 4 to October 15), 2014 (June 4 to October 3), 2015 (June 4 to October 11), 2016 (June 4 to October 19), and 2017 (June 7 to October 16) open-water periods.

Tagging Year	Study Year	Upstream of Gull Rapids					Stephens Lake	
		1	2	3	4	5	6	7
2013/2014	2013	4.0	1.3	2.0	84.0	8.7	66.0	34.0
	2014	6.9	1.2	4.8	82.7	4.3	59.0	41.0
	2015	10.4	4.2	6.5	71.8	7.1	76.5	23.5
	2016	8.5	0.1	19.9	61.0	5.9	58.2	41.8
2016	2016	3.7	0.6	6.1	78.6	8.7	30.0	70.0
	2017	5.9	1.8	12.3	63.7	16.3	33.8	66.2

FIGURES

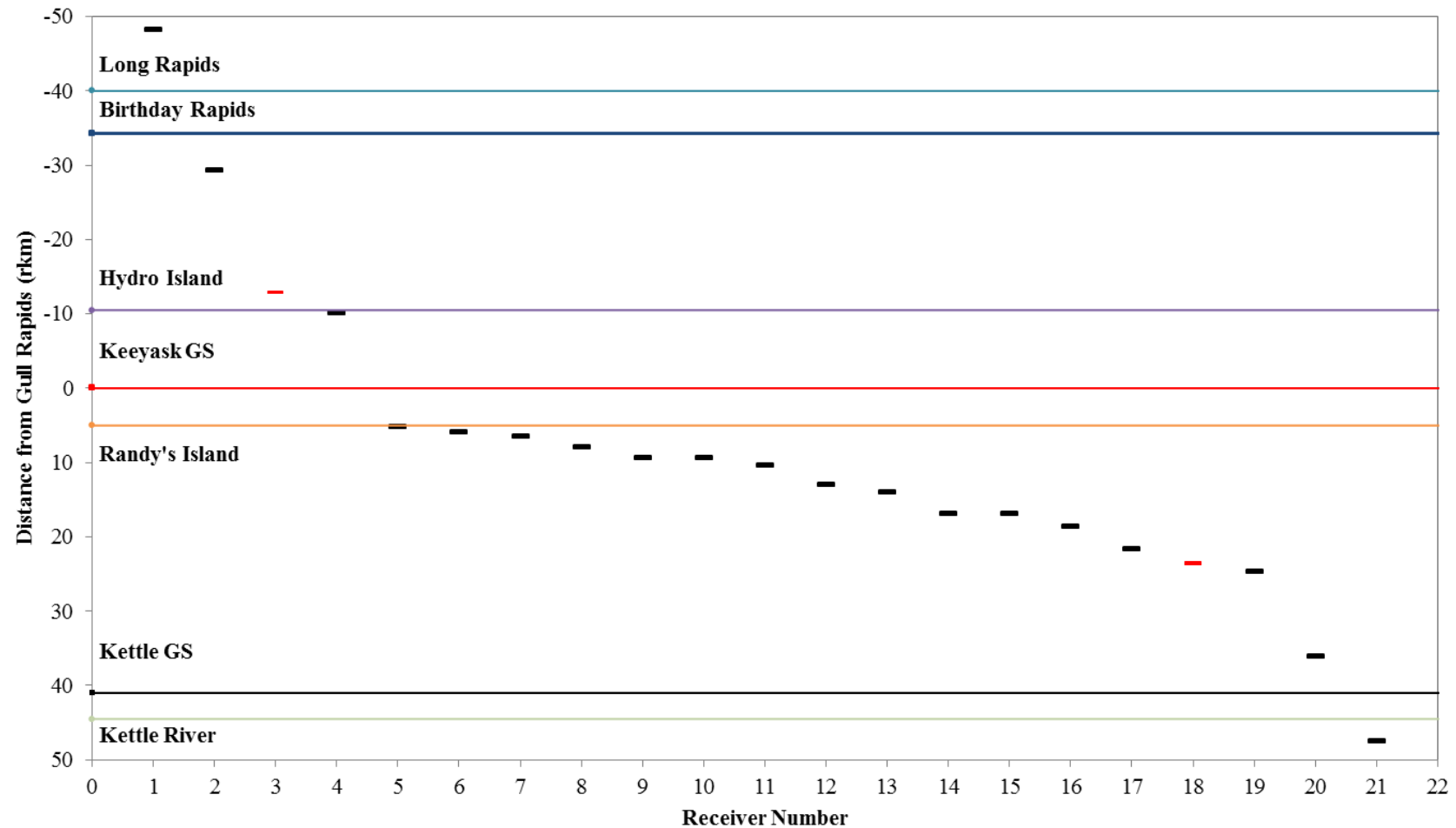


Figure 1: Locations of stationary acoustic receivers (dashes) in relation to the base of Gull Rapids (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Limestone GS between October, 2016 and June, 2017. A red dash indicates a receiver that was lost.

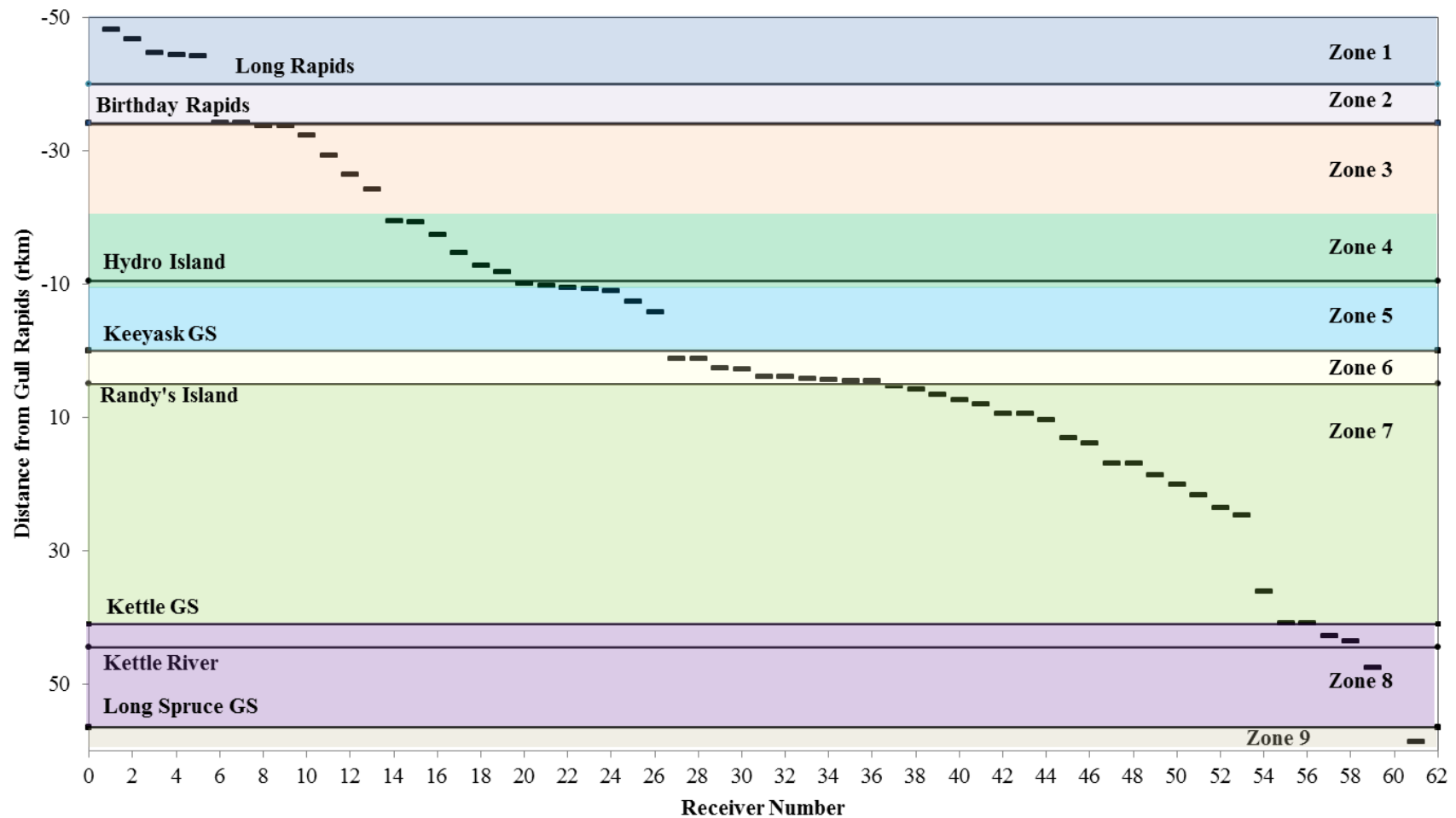


Figure 2: Locations of stationary acoustic receivers (dashes) in relation to the base of Gull Rapids (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Limestone GS between June and October, 2017. River zones upstream and downstream of Gull Rapids are indicated by shading.

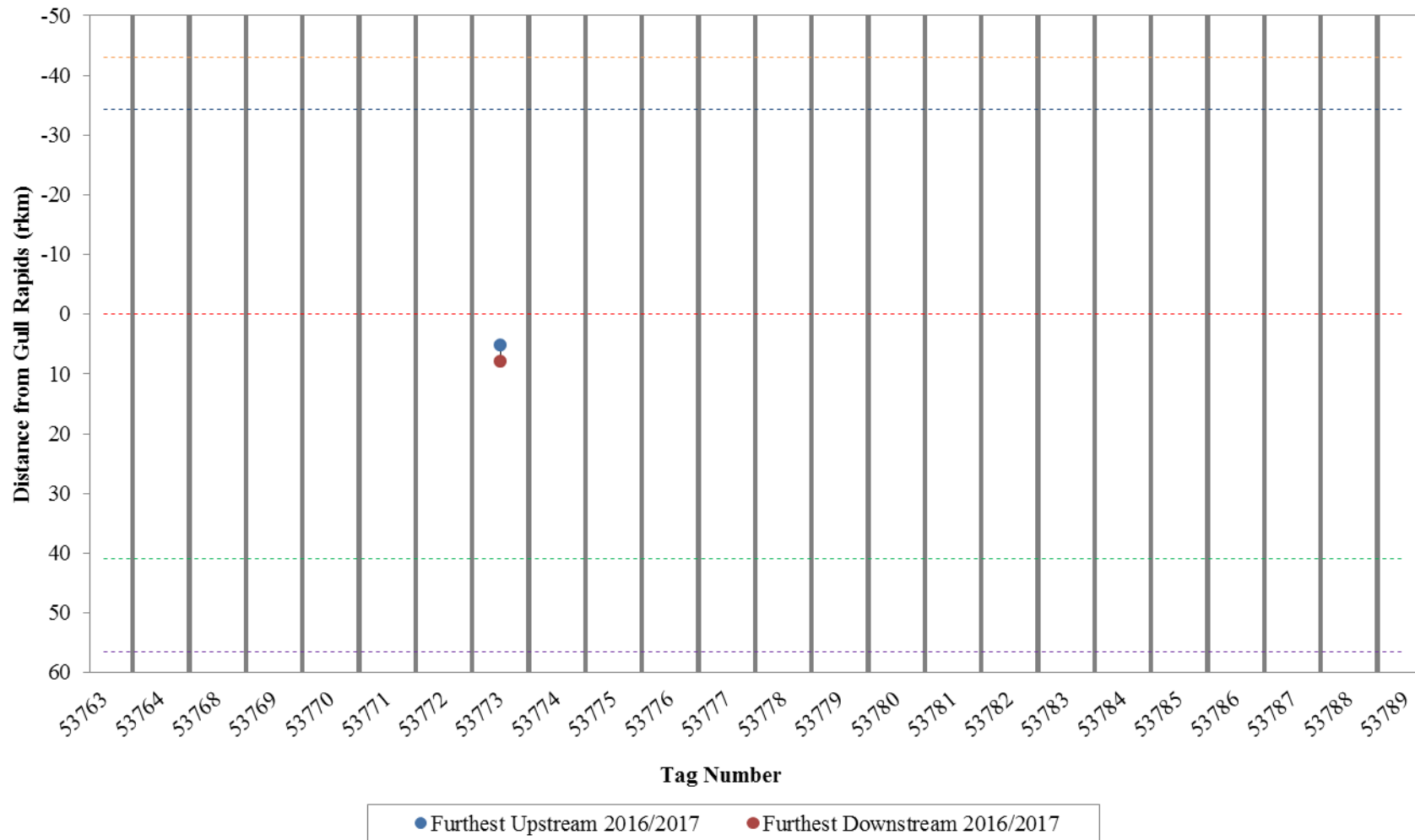


Figure 3: Detection ranges for individual Walleye tagged with acoustic transmitters upstream of Gull Rapids in 2016 during the winter period (2016–2017). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids; green = Kettle GS).

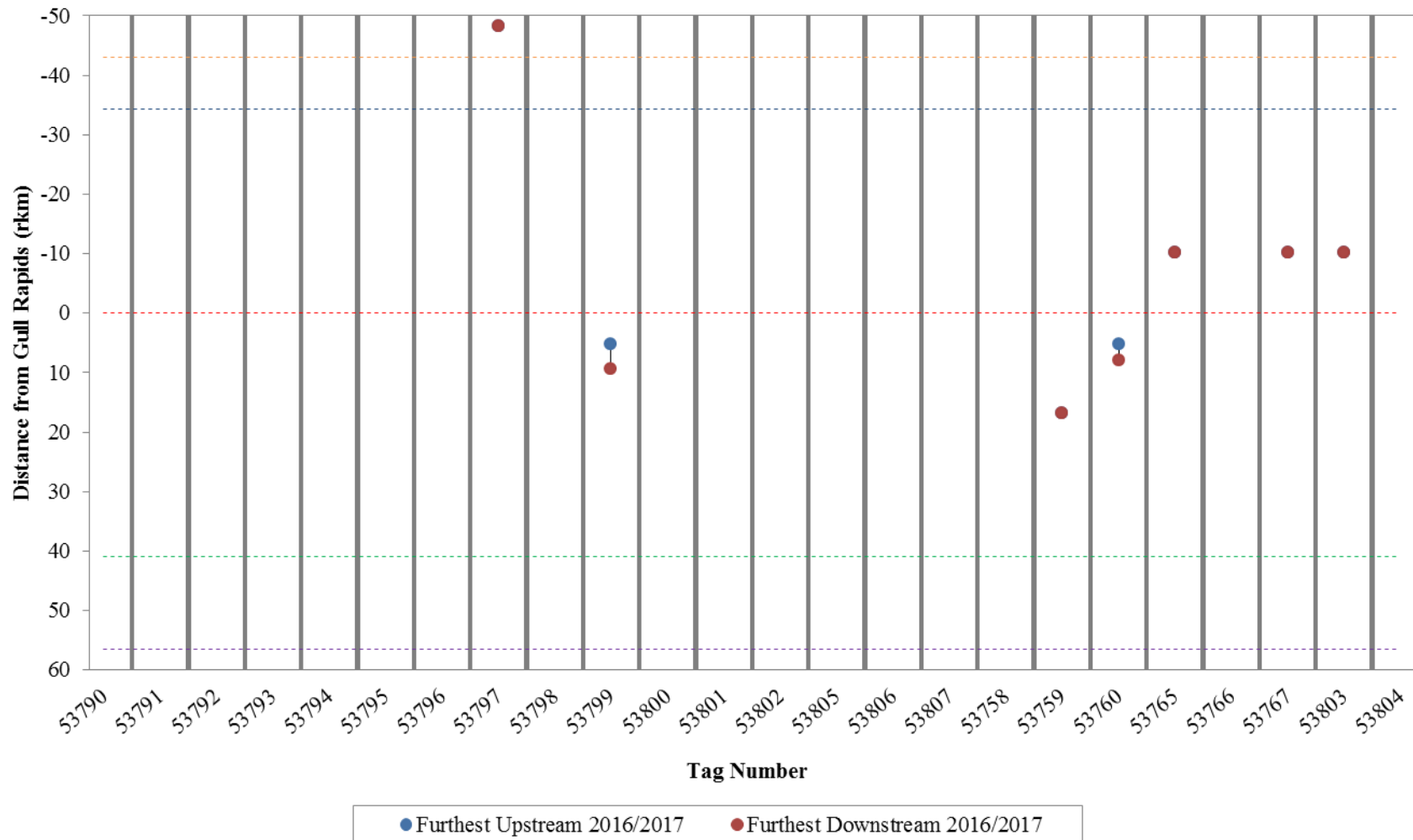


Figure 3: Detection ranges for individual Walleye tagged with acoustic transmitters upstream of Gull Rapids in 2016 during the winter period (2016–2017). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids; green = Kettle GS) (continued).

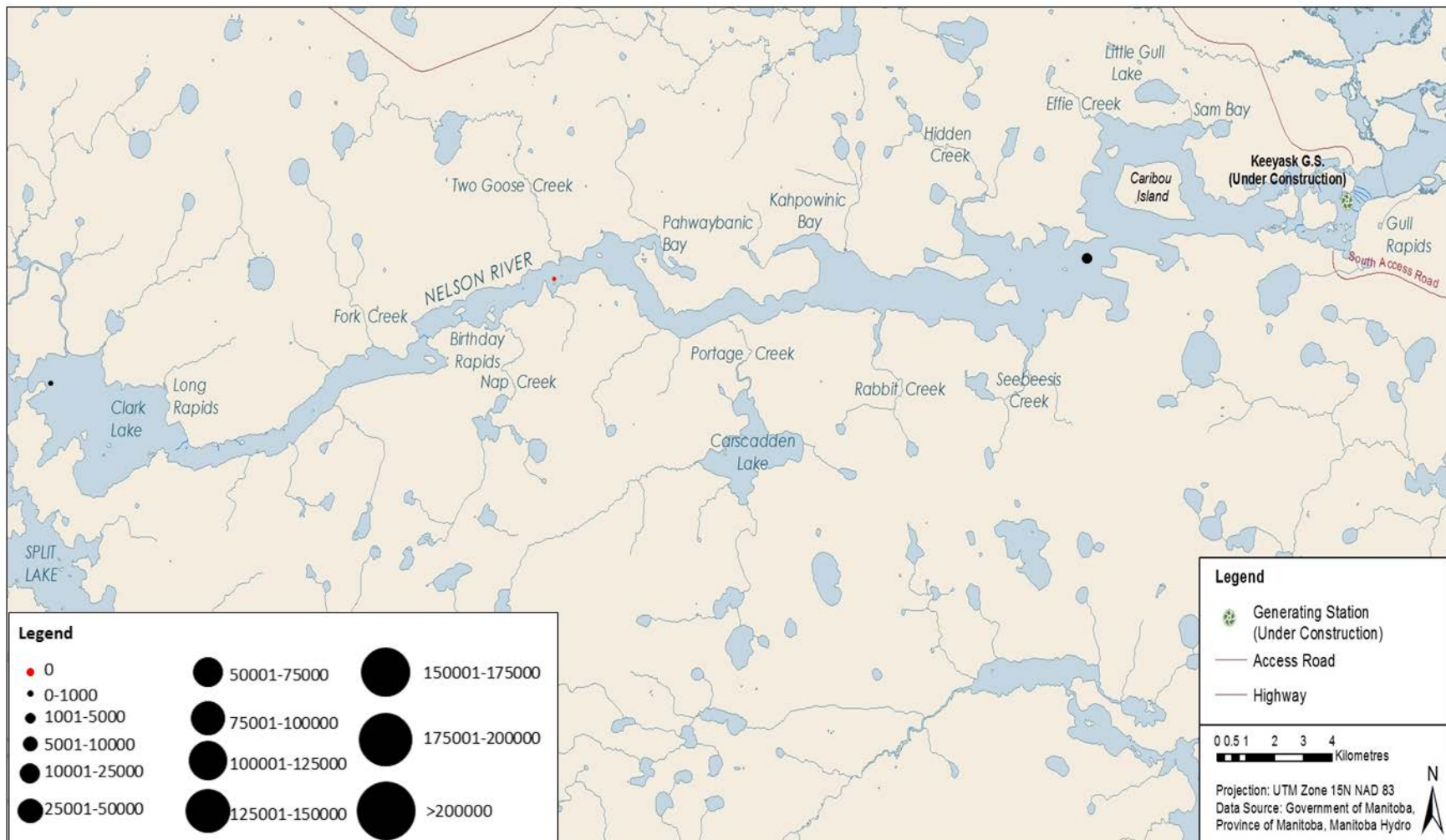


Figure 4: Relative number of detections of Walleye at each acoustic receiver set between Clark Lake and Gull Rapids during winter 2016/2017 (October 20, 2016, to April 30, 2017). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

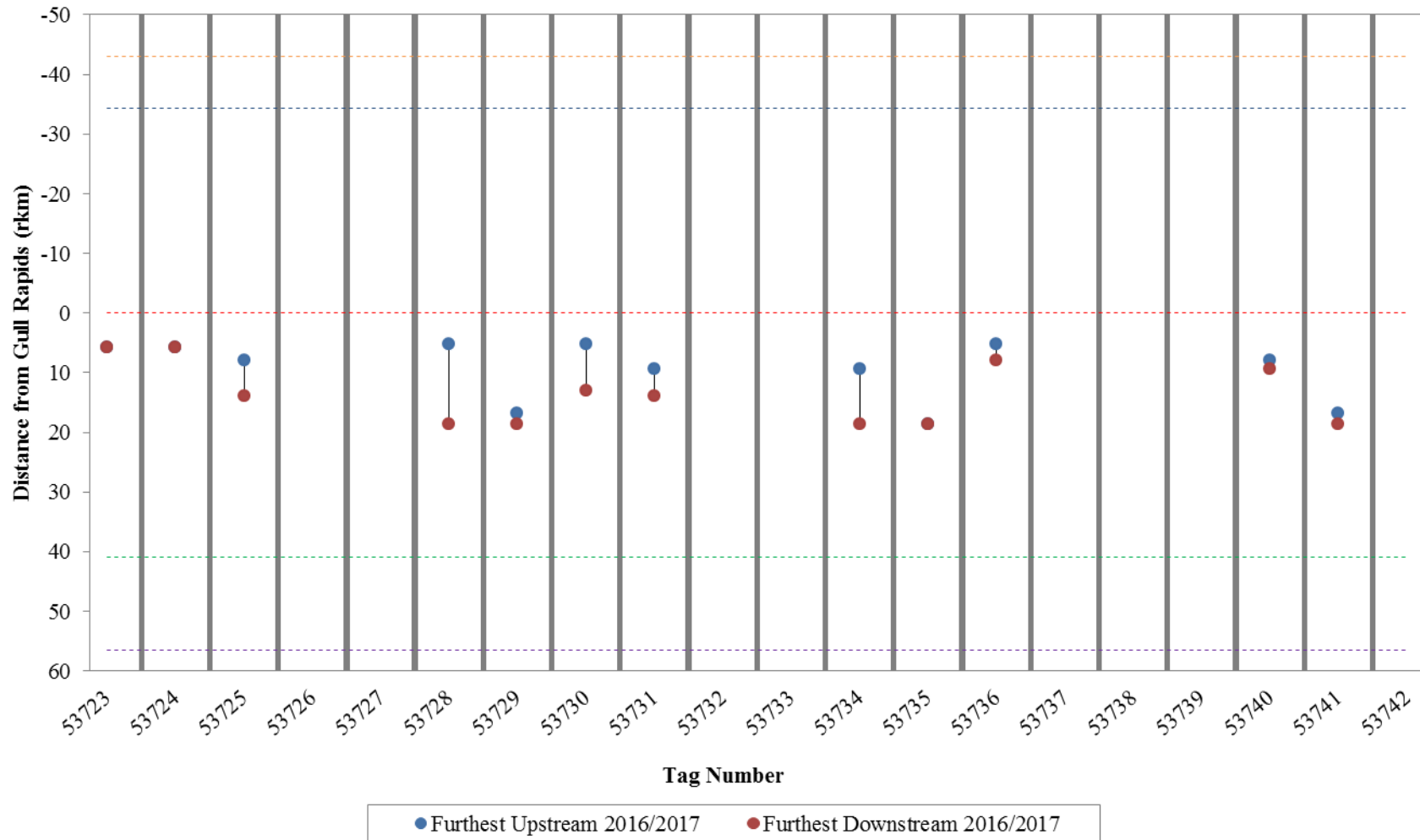


Figure 5: Detection ranges for individual Walleye tagged with acoustic transmitters in Stephens Lake in 2016 during the winter period (2016–2017). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids; green = Kettle GS).

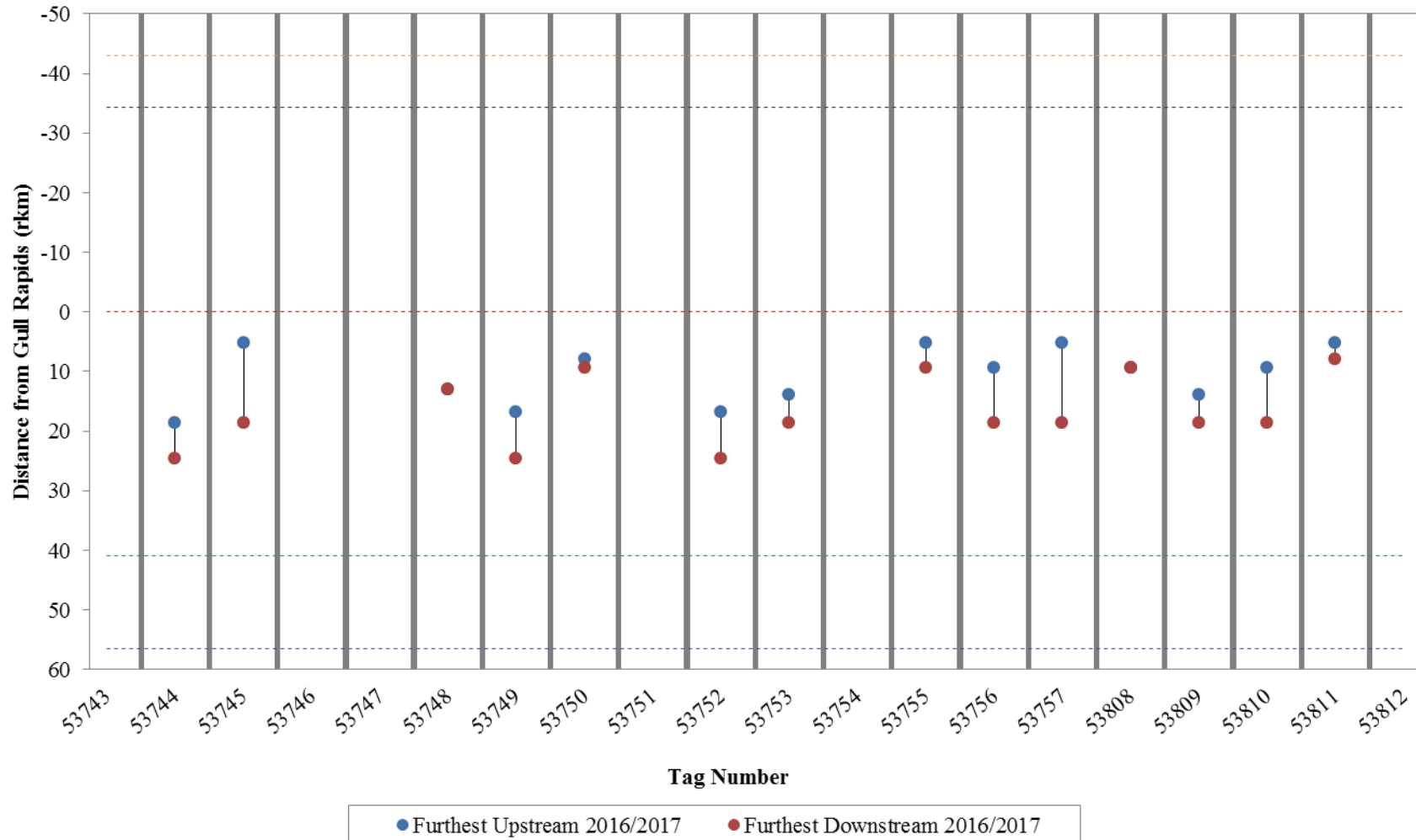


Figure 5: Detection ranges for individual Walleye tagged with acoustic transmitters in Stephens Lake in 2016 during the winter period (2016–2017). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids; green = Kettle GS) (continued).

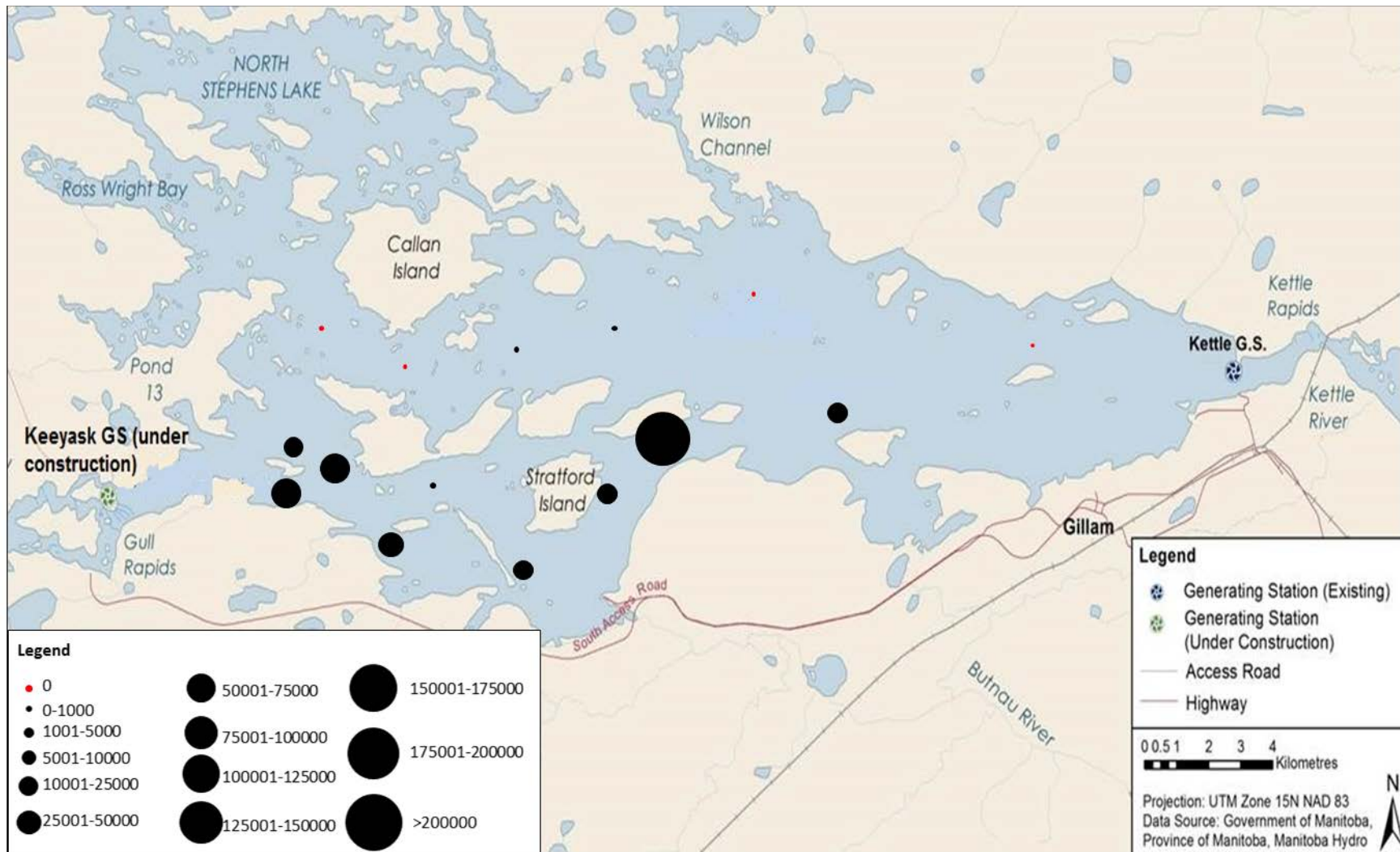


Figure 6: Relative number of detections of Walleye at each acoustic receiver set in Stephens Lake during winter 2016/2017 (October 20, 2016, to April 30, 2017). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

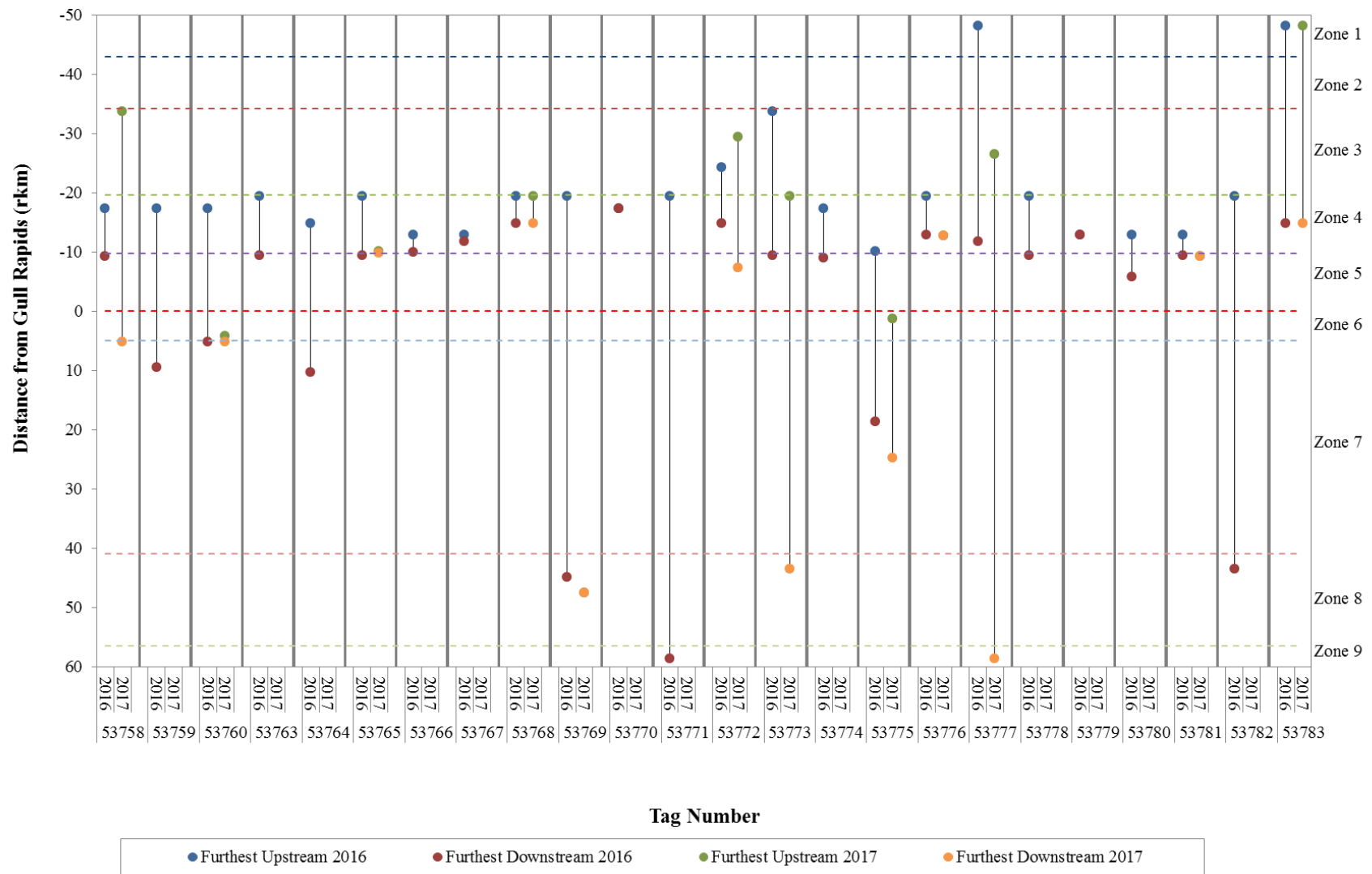


Figure 7: Detection ranges for individual Walleye tagged with acoustic transmitters upstream of Gull Rapids in 2016 during the open-water period (2016–2017). Horizontal dotted lines demarcate zones.



Figure 7: Detection ranges for individual Walleye tagged with acoustic transmitters upstream of Gull Rapids in 2016 during the open-water period (2016–2017). Horizontal dotted lines demarcate zones (continued).

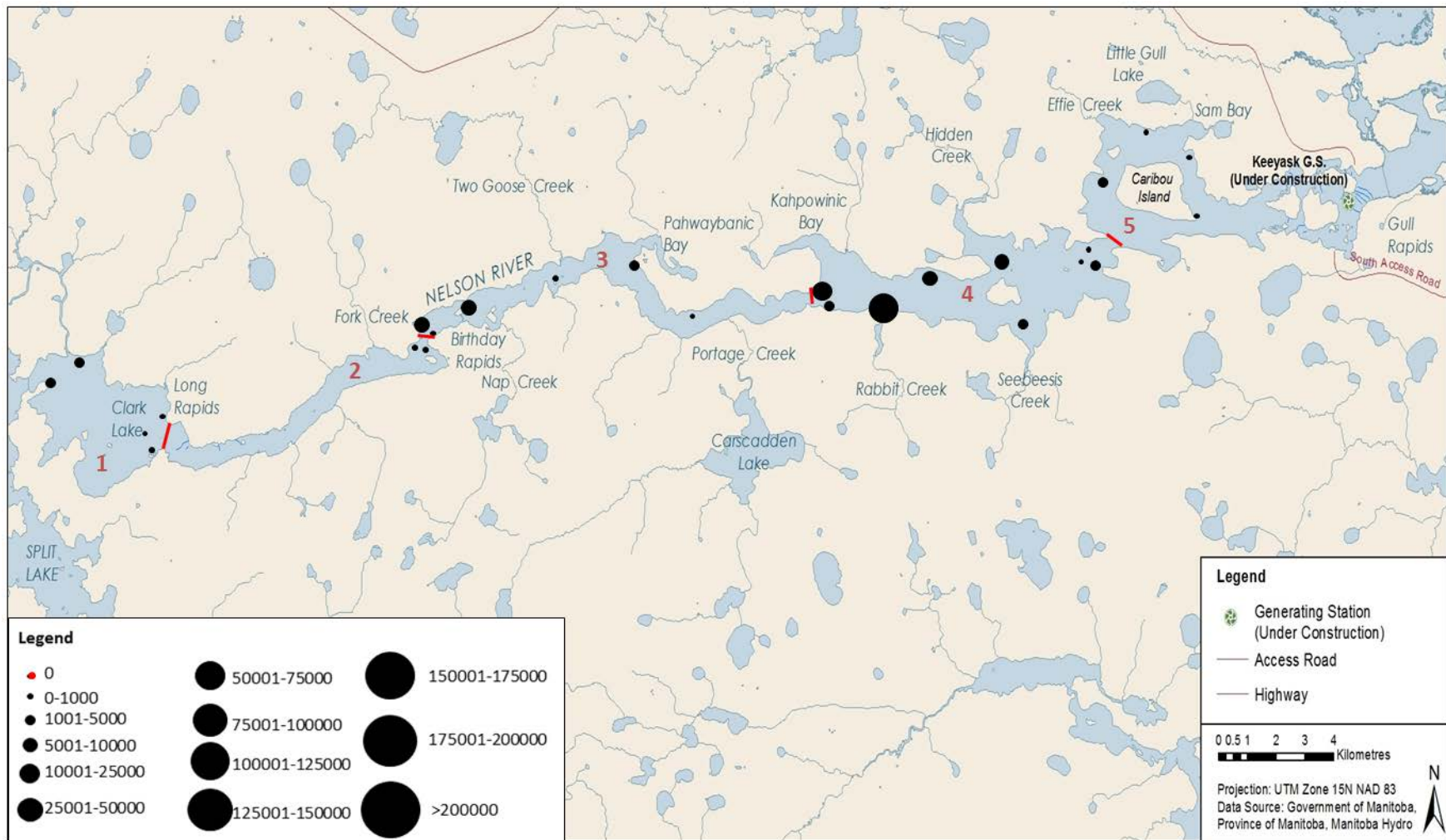


Figure 8: Relative number of detections of Walleye at each acoustic receiver set between Clark Lake and Gull Rapids during the 2017 open-water period (May 1 to October 16). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

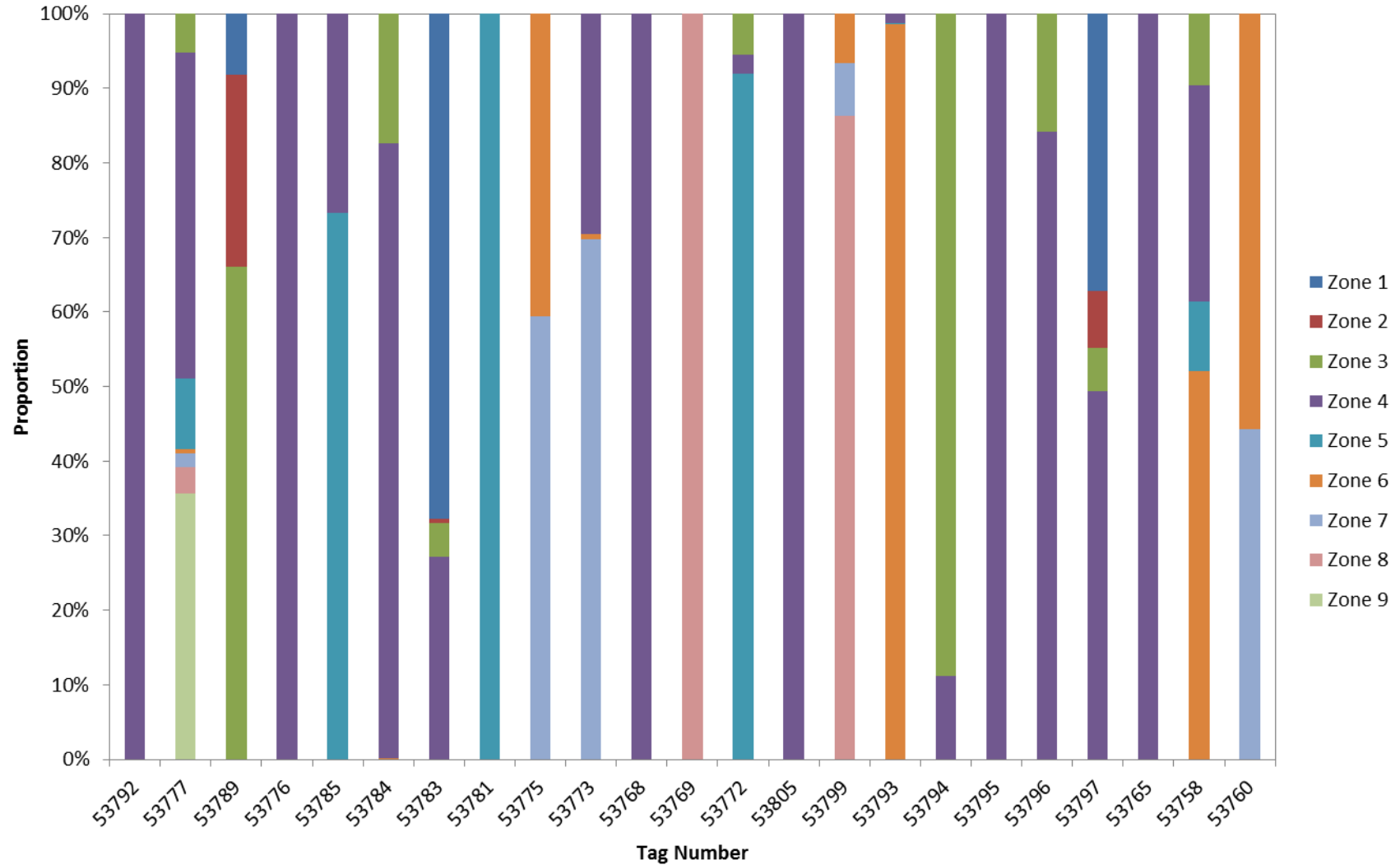


Figure 9: Proportional distributions by zone, for individual Walleye tagged with acoustic transmitters upstream of Keeyask GS in 2016 during a portion of the 2017 open-water period (June 7 to October 16).

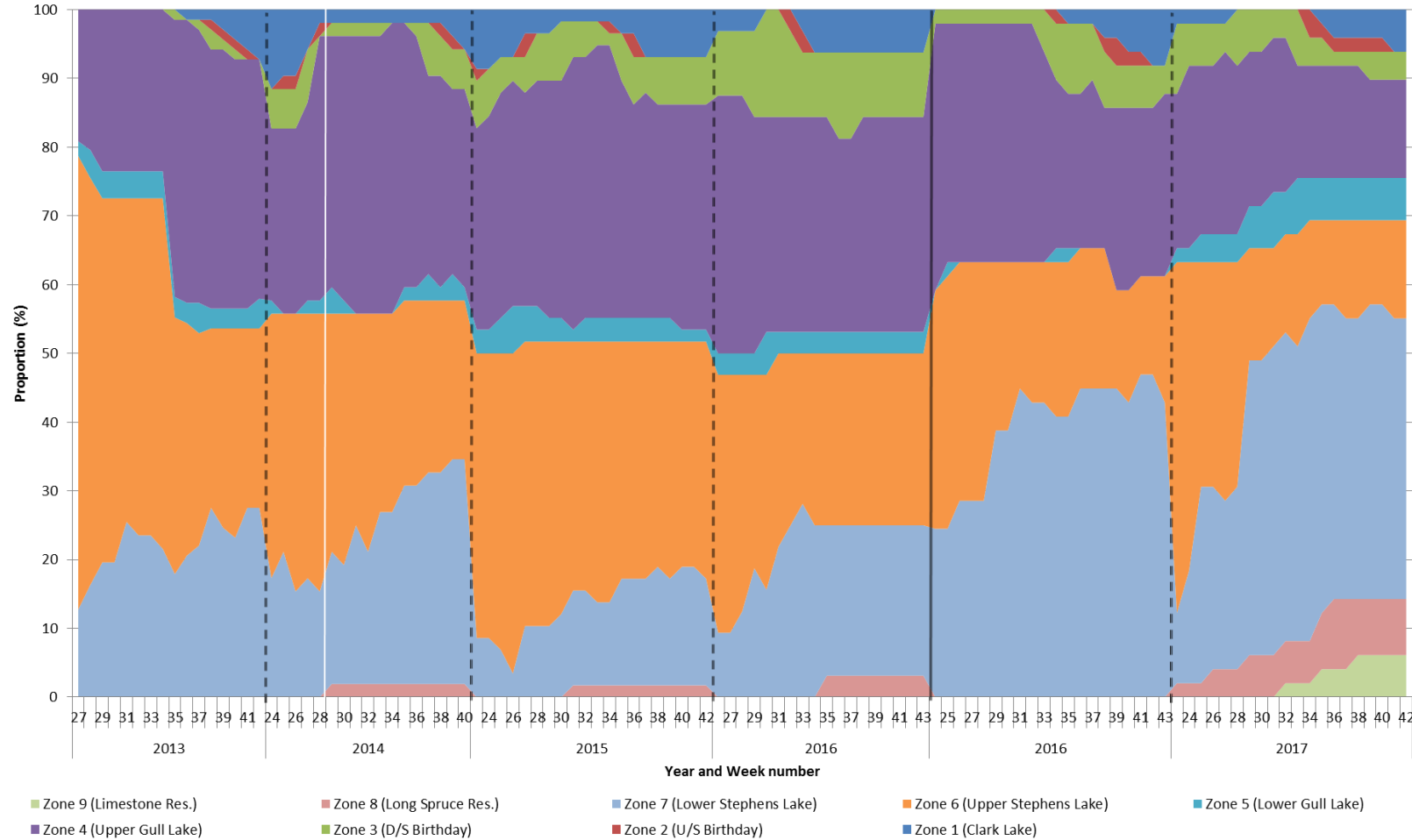


Figure 10: Proportional distribution by zone for 49 Walleye tagged with acoustic transmitters in the Keeyask GS Area in 2013/2014 and 2016 (demarcated with solid black line) during a portion of the 2013 (August 25 to October 15), 2014 (June 4 to October 10), 2015 (June 4 to October 11), 2016 (June 25 to October 19), and 2017 (June 7 to October 16) open-water periods. White line indicates the start of construction. Dotted black lines demarcate study years.

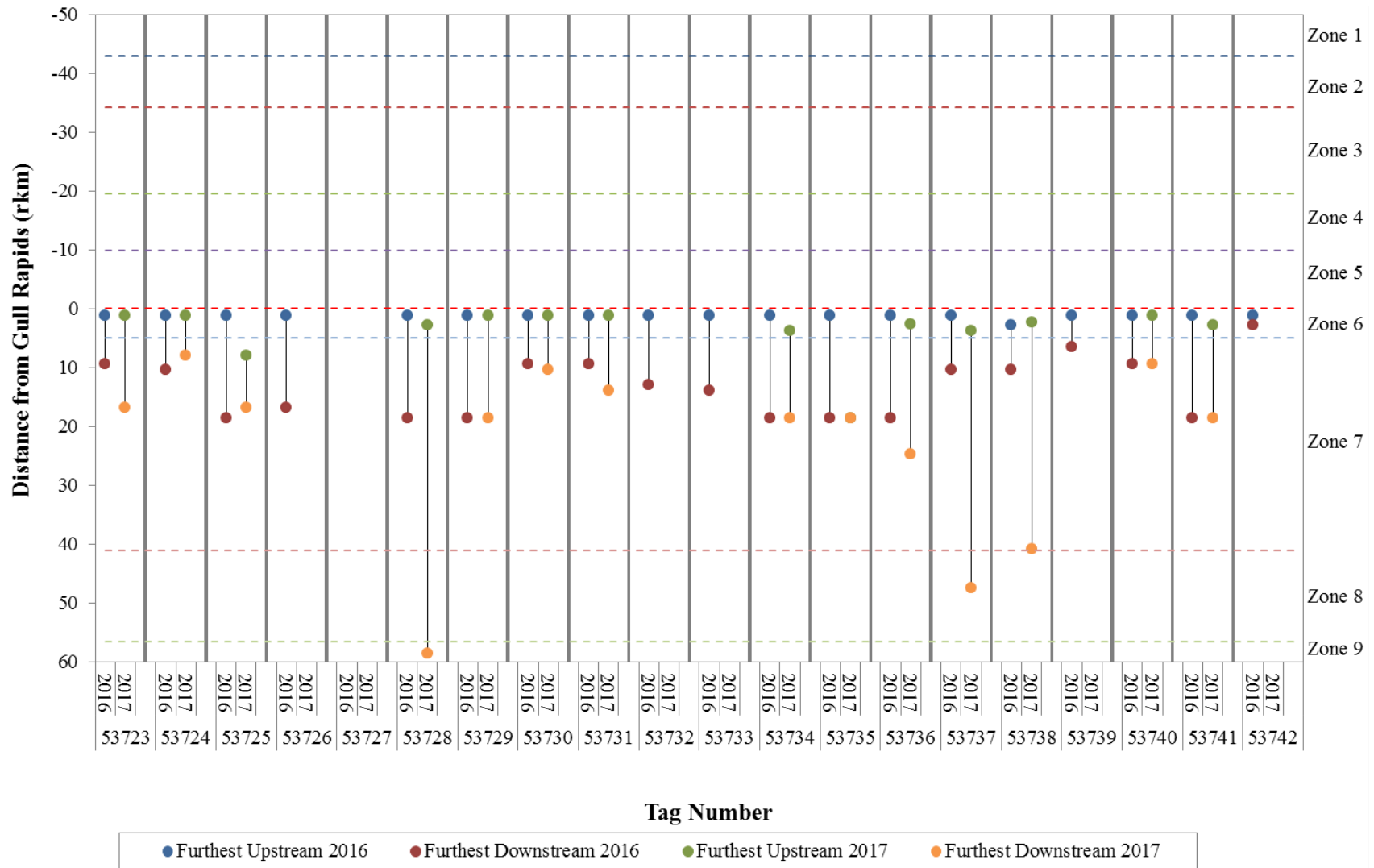


Figure 11: Detection ranges for individual Walleye tagged with acoustic transmitters in Stephens Lake in 2016 during the open-water period (2016–2017). Horizontal dotted demarcate zones.

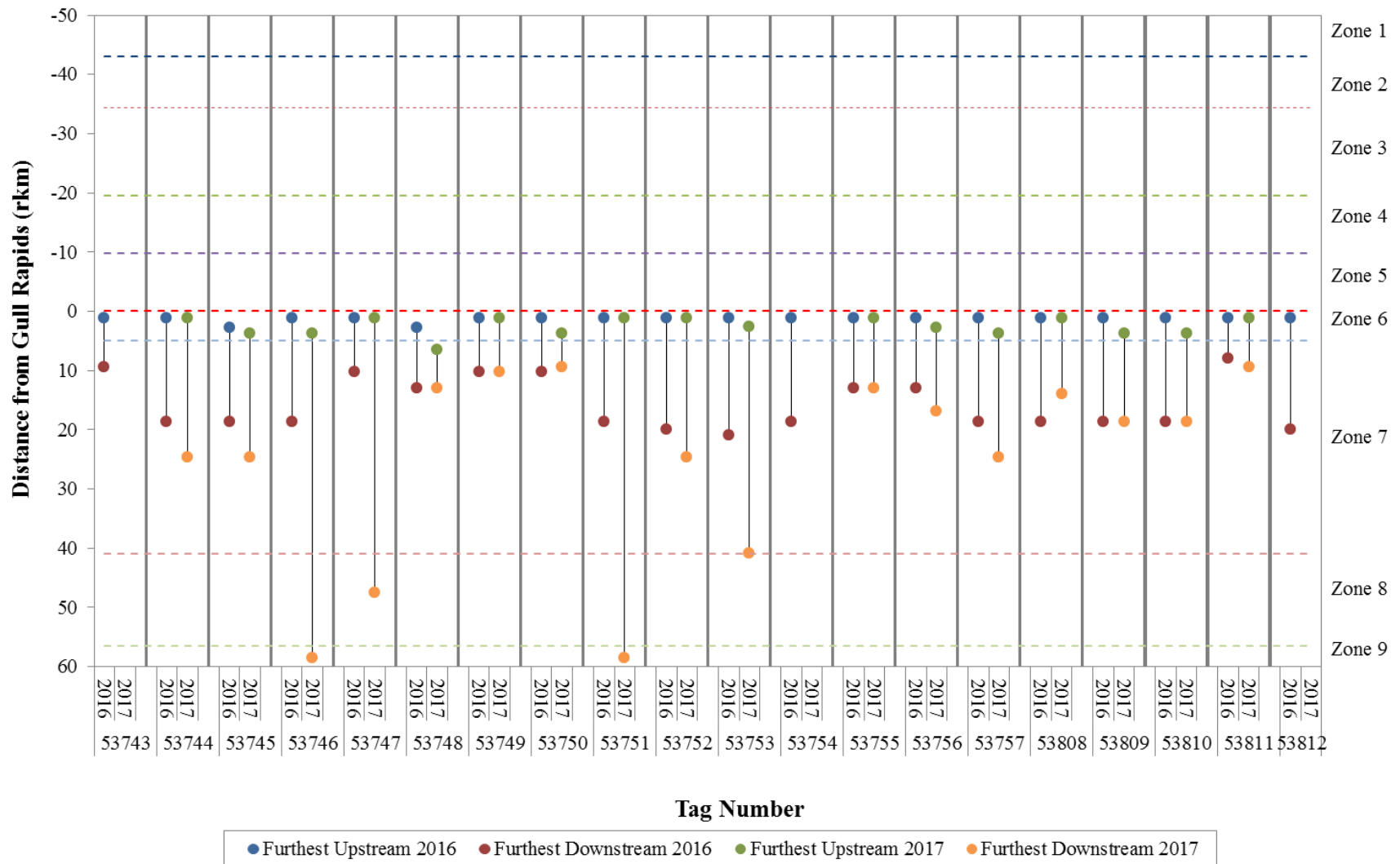


Figure 11: Detection ranges for individual Walleye tagged with acoustic transmitters in Stephens Lake in 2016 during the open-water period (2016–2017). Horizontal dotted lines demarcate zones (continued).

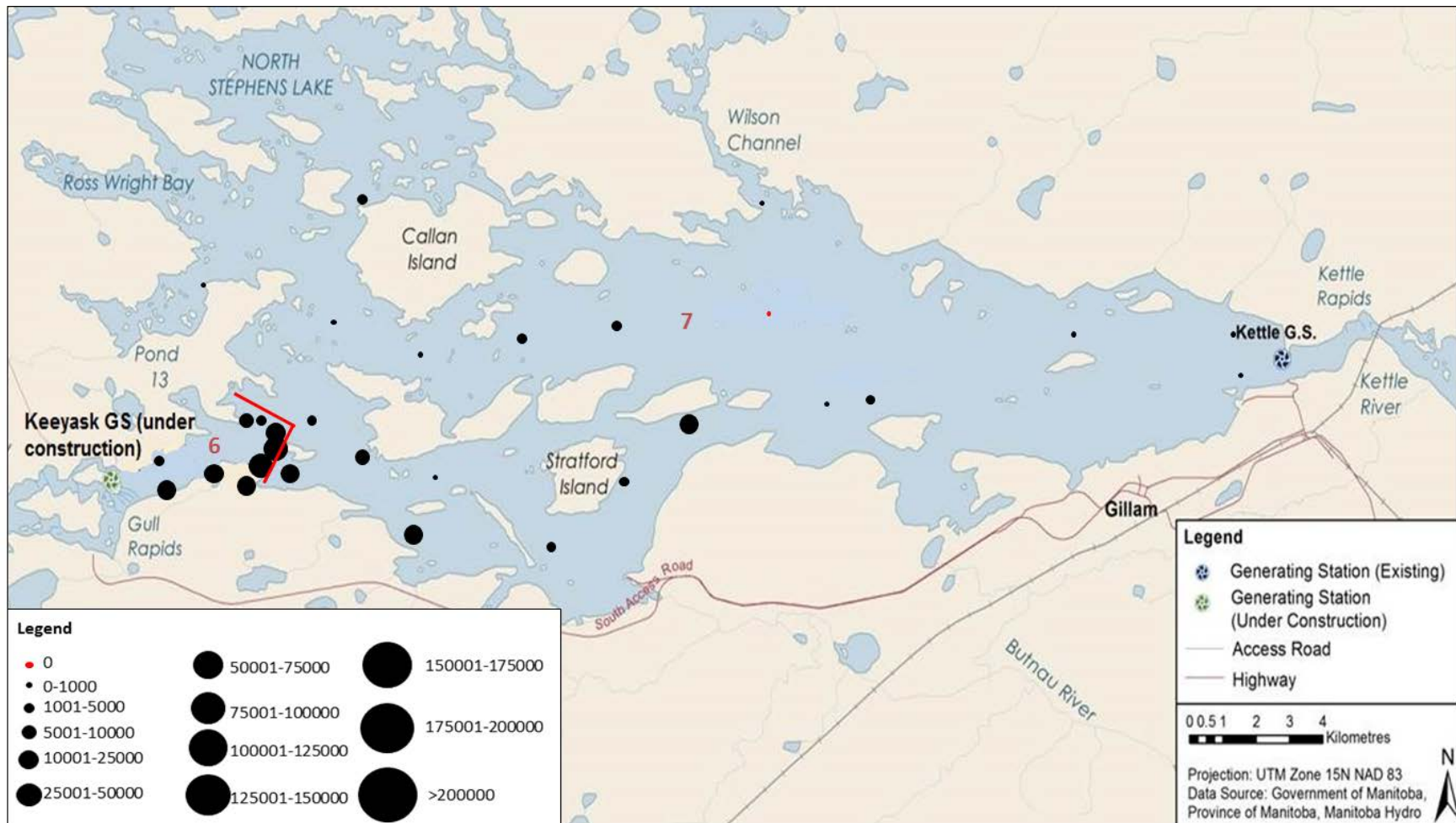
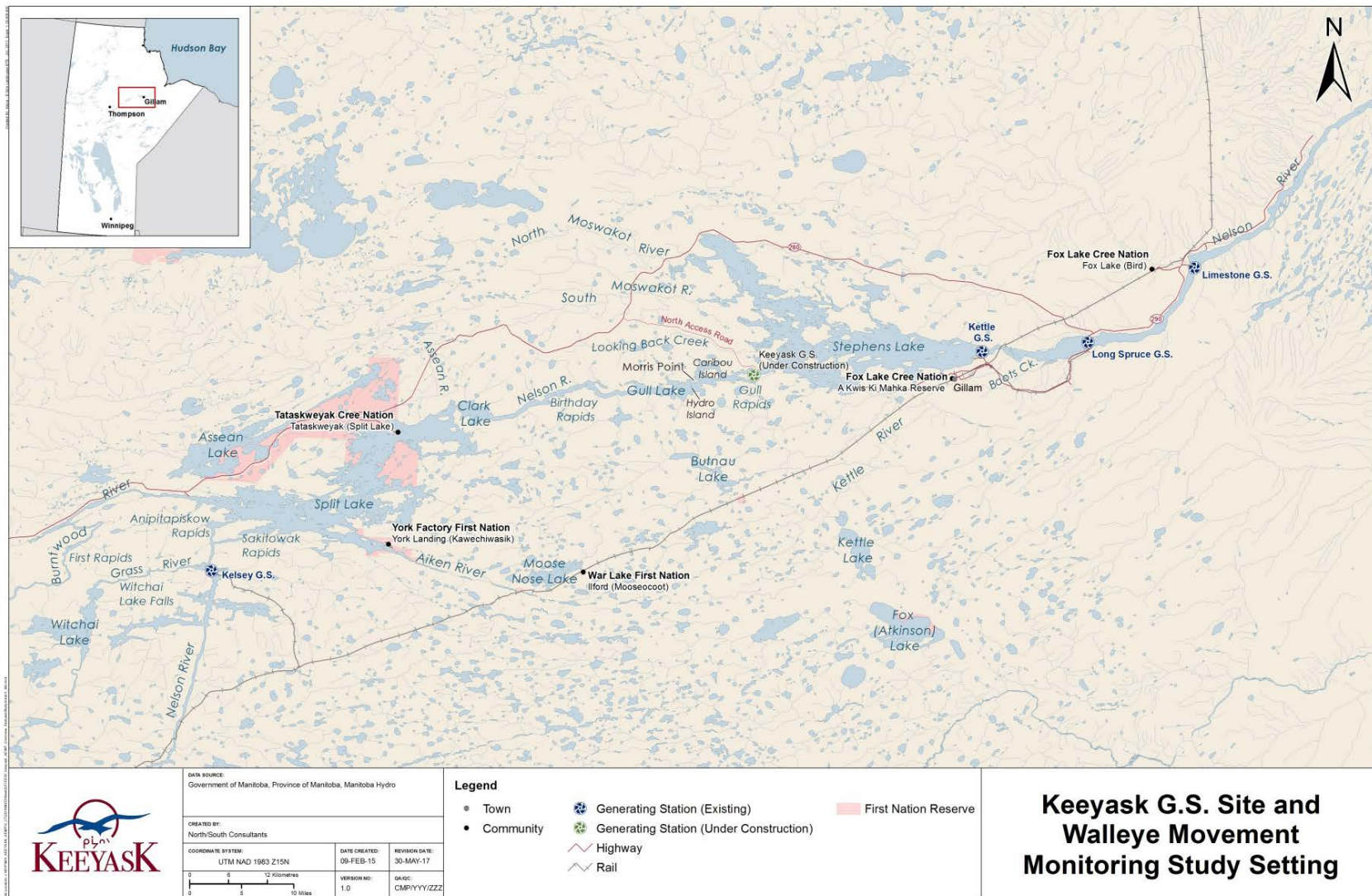


Figure 12: Relative number of detections of Walleye at each acoustic receiver set in Stephens Lake during the 2017 open-water period (May 1 to October 16). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

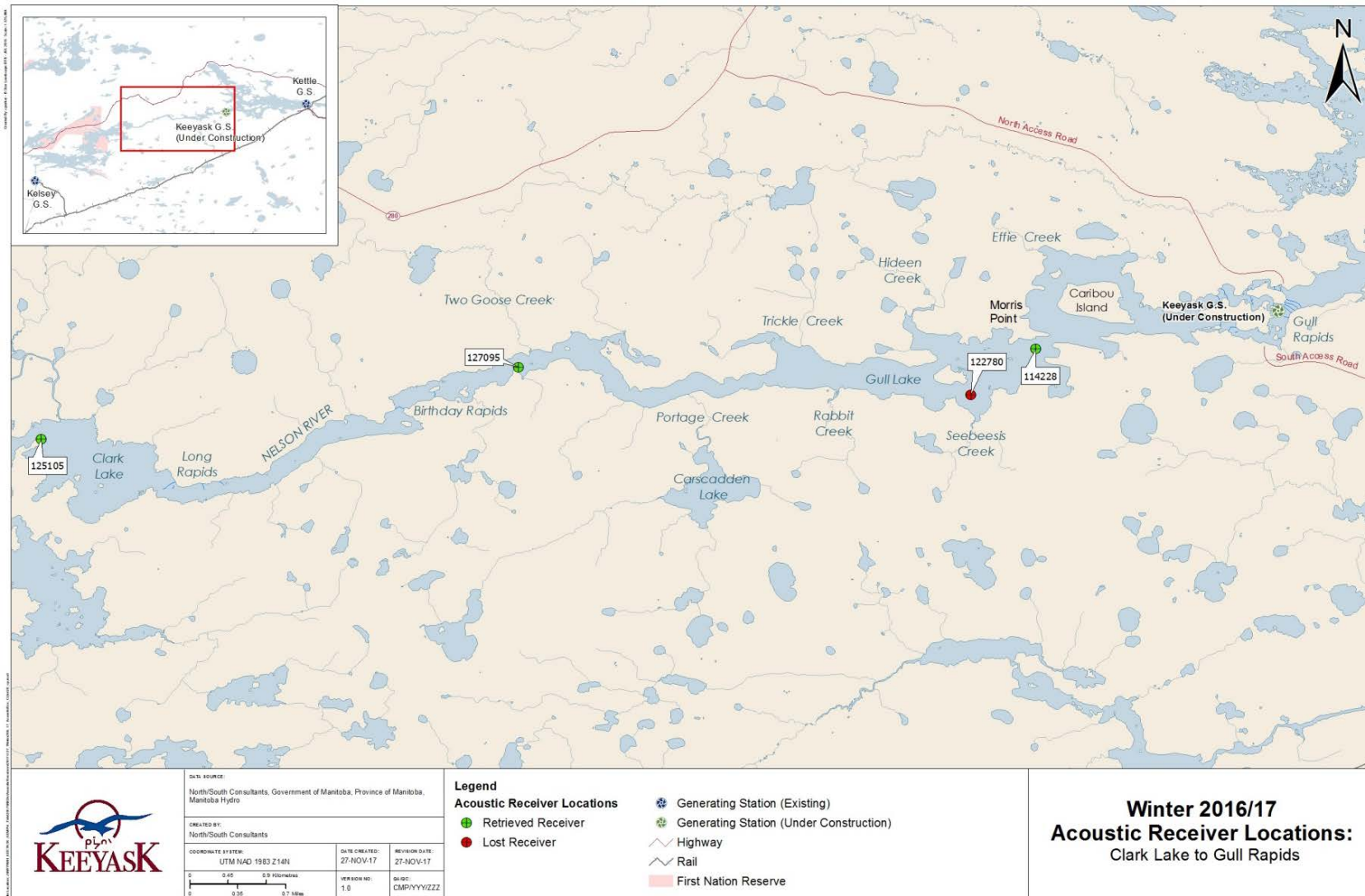
MAPS



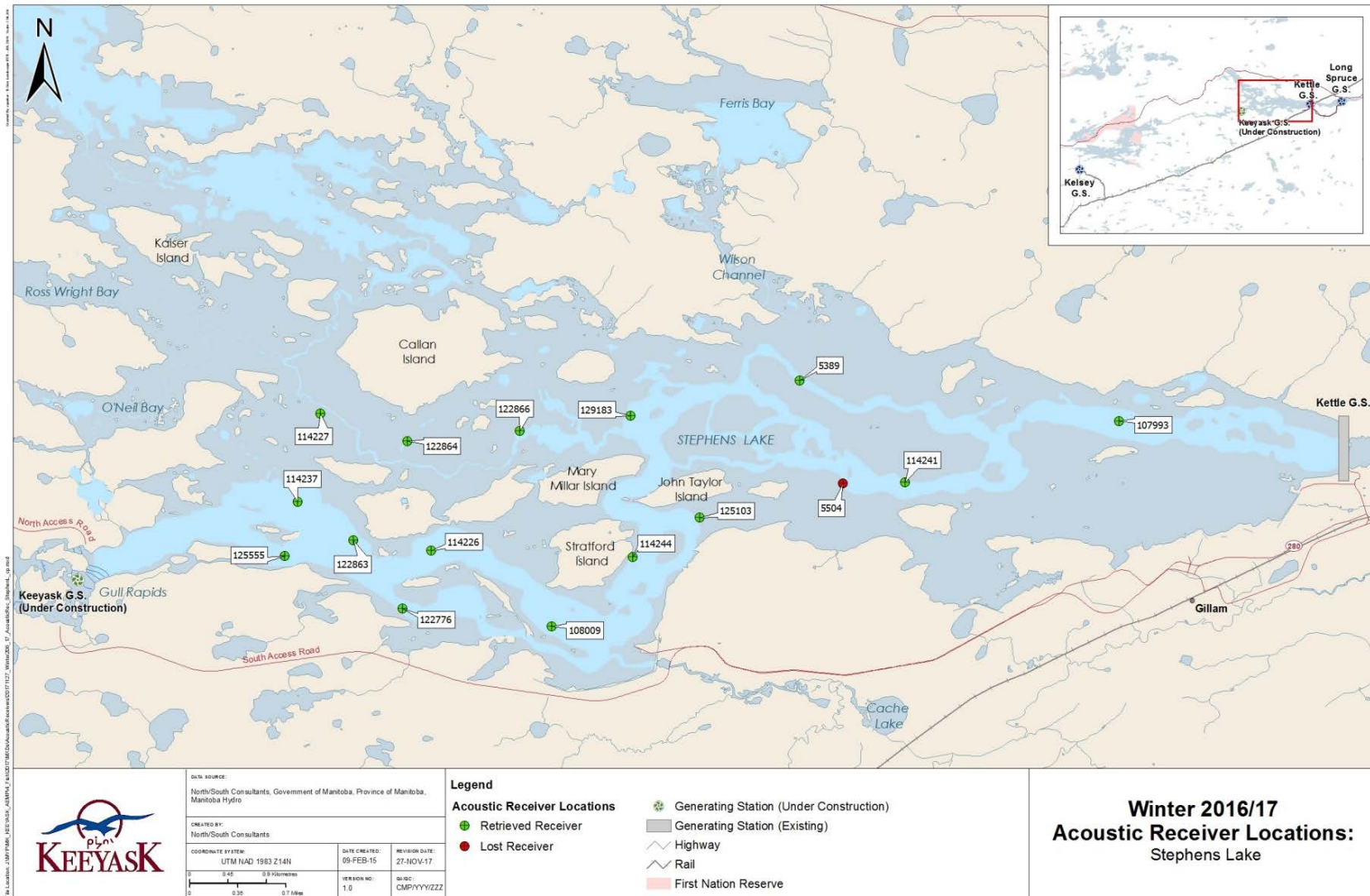
Map 1: Map of the lower Nelson River showing the site of the Keyeyask Generating Station and the Walleye movement monitoring study setting.



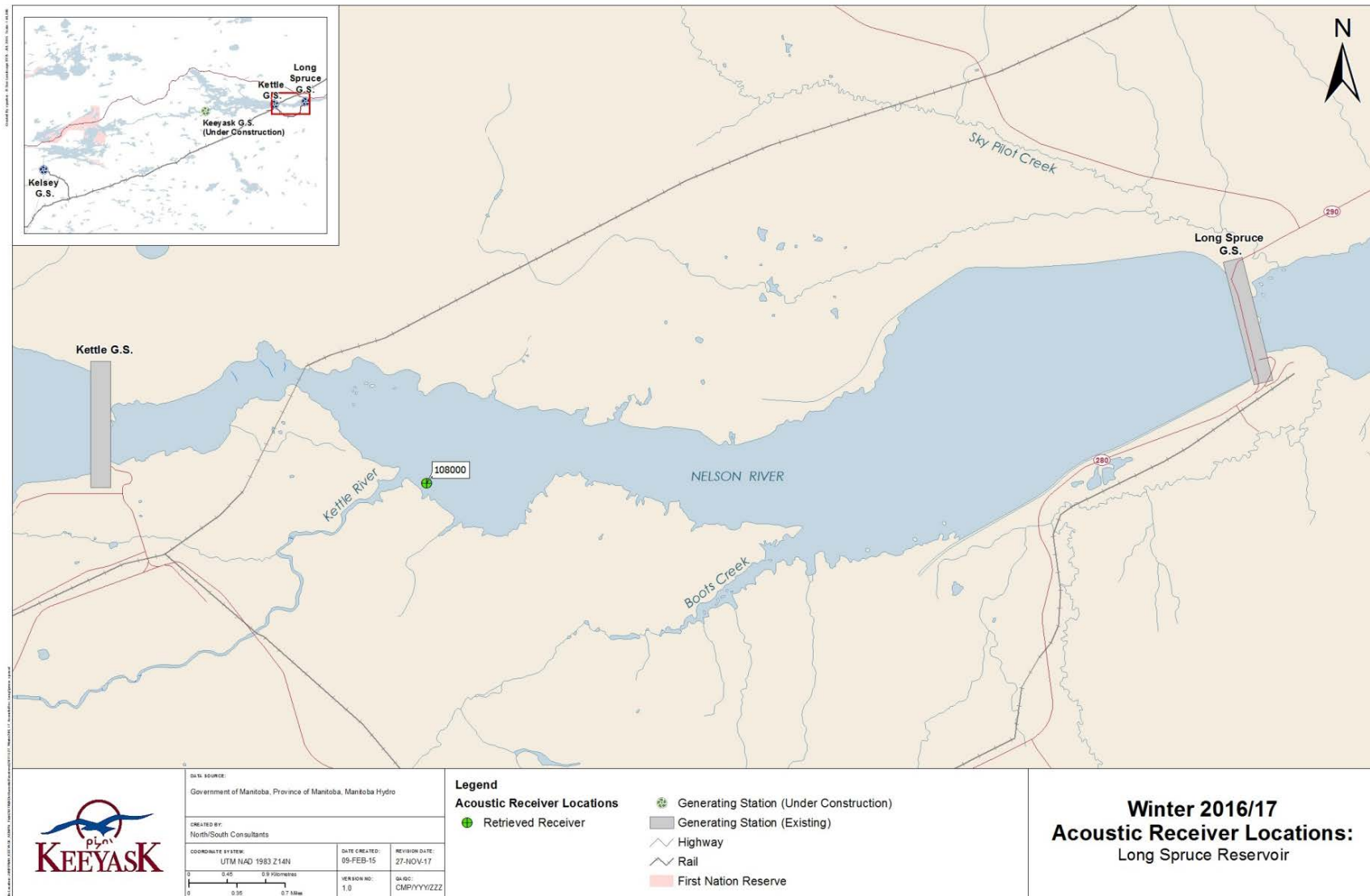
Map 2: Map of instream structures at the Keeyask Generating Station site, September 2017.



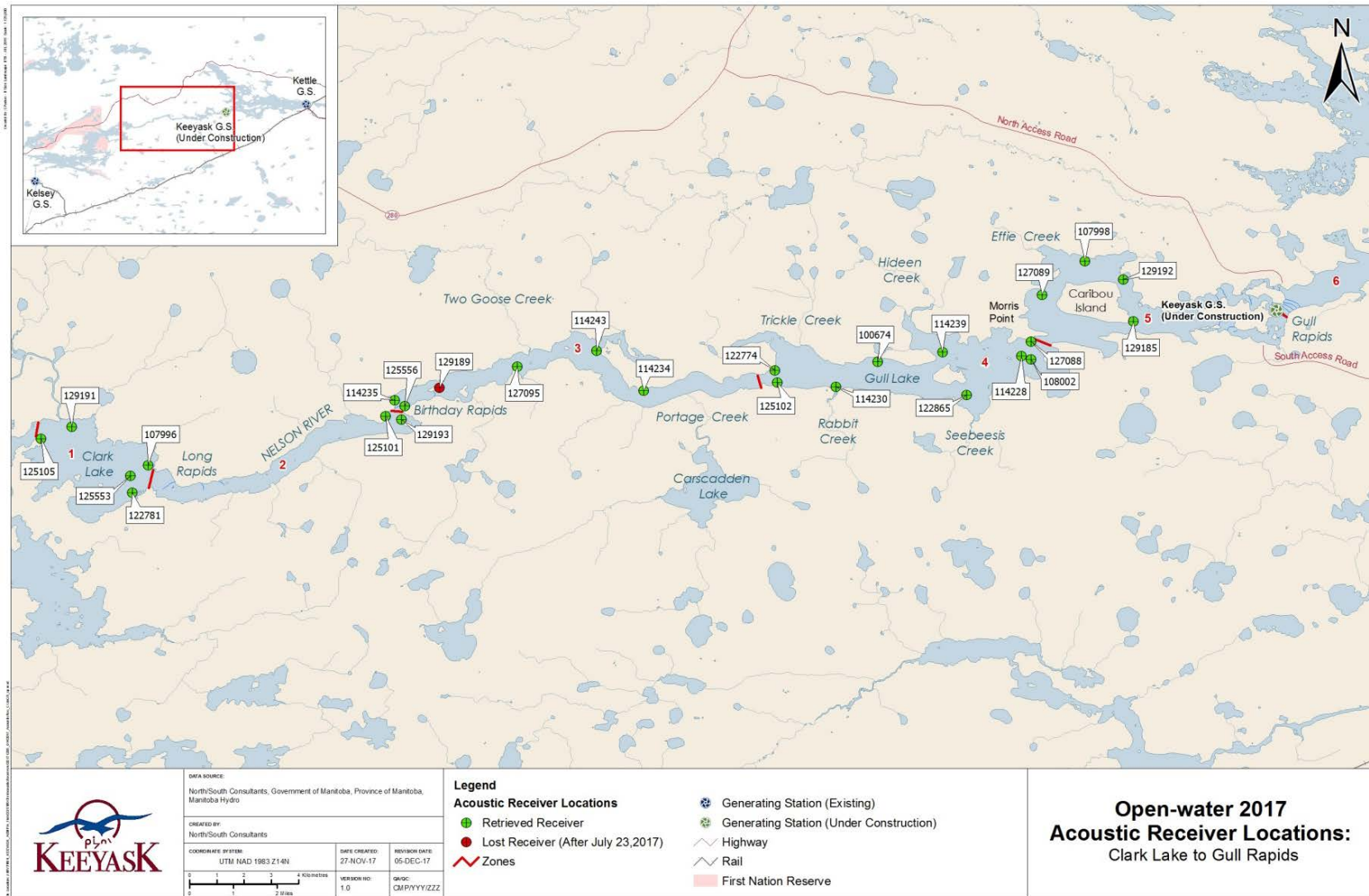
Map 3: Locations of stationary receivers set in the Nelson River from Clark Lake to Gull Rapids between October 2016 and June 2017.



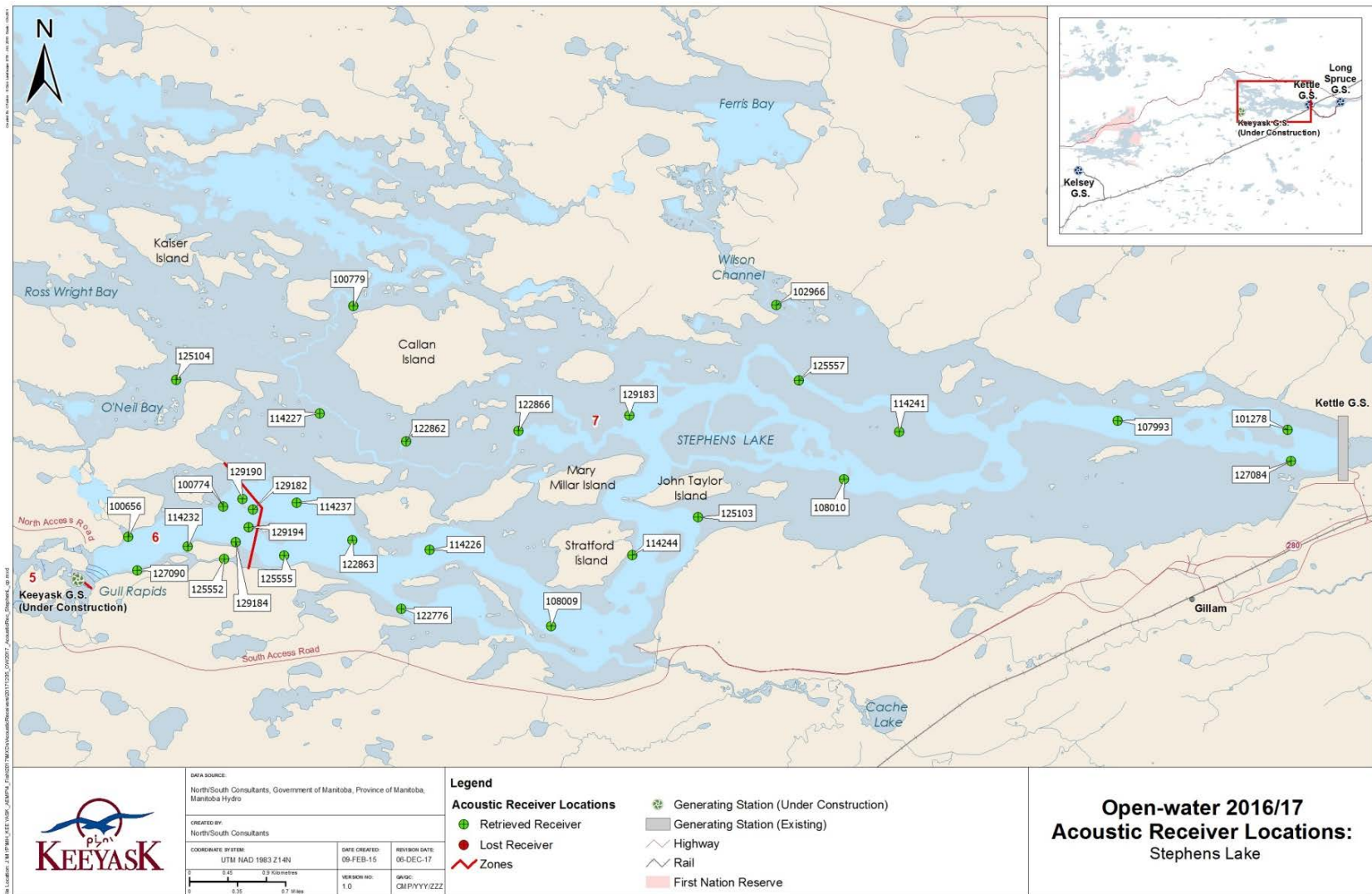
Map 4: Locations of stationary receivers set in Stephens Lake from Gull Rapids to Kettle GS between October 2016 and June 2017. The former (pre-impoundment) river channel is shown in light blue.



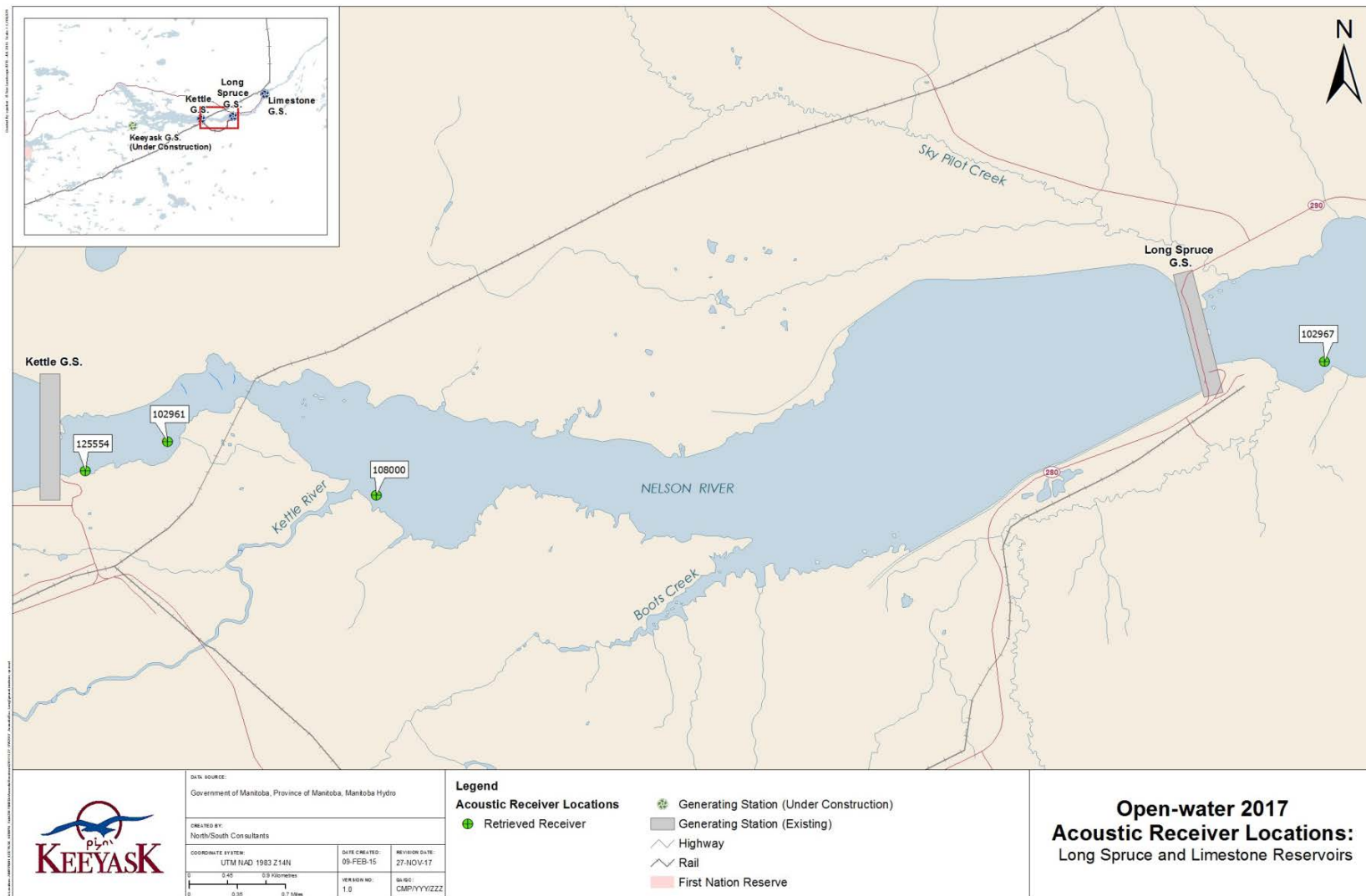
Map 5: Location of the stationary receiver set in the Long Spruce reservoir between October 2016 and June 2017.



Map 6: Locations of stationary receivers set in the Nelson River from Clark Lake to Gull Rapids between June and October 2017. The river is divided into five "zones" based on placement of receiver "gates."



Map 7: Locations of stationary receivers set in Stephens Lake between June and October 2017. The river is divided into two "zones" based on placement of receiver "gates." The pre-impoundment river channel is shown in light blue.



Map 8: Locations of stationary receivers set in the Long Spruce and Limestone reservoirs between June and October 2016.

APPENDICES

APPENDIX 1:

DETECTION SUMMARIES FOR WALLEYE TAGGED AND MONITORED IN THE KEEYASK STUDY AREA BETWEEN 2016 AND 2017

Table A1-1:	Detection summary for each of 48 Walleye tagged and monitored upstream of the Keeyask GS during the winter 2016/2017 period (October 20, 2016 to April 30, 2017). Tag id highlighted yellow = lost tag. Tag id highlighted purple = moved downstream through Gull Rapids.....	60
Table A1-2:	Detection summary for each of 40 Walleye tagged and monitored in Stephens Lake during the winter 2016/2017 period (October 20, 2016 to April 30, 2017). Tag id highlighted yellow = lost tag.....	62
Table A1-3:	Detection summary for each of 48 Walleye tagged and monitored upstream of the Keeyask GS during the open-water 2016 (May 1 to October 19) and 2017 (May 1 to October 16) periods. Tag id highlighted yellow = lost tag. Tag id highlighted purple = moved downstream through Gull Rapids. Tag id highlighted green = moved downstream through the Kettle GS. Tag id highlighted orange = moved downstream through the Long Spruce GS.....	64
Table A1-4:	Detection summary for each of 40 Walleye tagged and monitored in Stephens Lake during the open-water 2016 (May 1 to October 19) and 2017 (May 1 to October 16) periods. Tag id highlighted yellow = lost tag. Tag id highlighted green = moved downstream through the Kettle GS. Tag id highlighted orange = moved downstream through the Long Spruce GS.....	66

Table A1-1: Detection summary for each of 48 Walleye tagged and monitored upstream of the Keeyask GS during the winter 2016/2017 period (October 20, 2016 to April 30, 2017). Tag id highlighted yellow = lost tag. Tag id highlighted purple = moved downstream through Gull Rapids.

Tag ID	Date tagged	Fork Length (mm)	Weight (g)	n	# Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Range (rkm)
53758	24-Sep-16	423	750	0	-	-	-	-
53759	24-Sep-16	362	500	26	1	16.8	16.8	0.0
53760	24-Sep-16	512	1825	238	6	5.2	7.9	2.7
53763	5-Jun-16	510	-	0	-	-	-	-
53764	5-Jun-16	560	-	0	-	-	-	-
53765	24-Sep-16	491	1300	1663	46	-10.1	-10.1	0.0
53766	24-Sep-16	484	1250	0	-	-	-	-
53767	24-Sep-16	508	1450	19	1	-10.1	-10.1	0.0
53768	5-Jun-16	520	-	0	-	-	-	-
53769	5-Jun-16	393	-	0	-	-	-	-
53770	5-Jun-16	350	-	0	-	-	-	-
53771	5-Jun-16	353	-	0	-	-	-	-
53772	5-Jun-16	400	-	0	-	-	-	-
53773	5-Jun-16	405	-	0	-	-	-	-
53774	5-Jun-16	522	-	0	-	-	-	-
53775	5-Jun-16	514	-	12123	75	5.2	7.9	2.7
53776	30-May-16	535	-	0	-	-	-	-
53777	29-May-16	404	1050	0	-	-	-	-
53778	3-Jun-16	523	-	0	-	-	-	-
53779	3-Jun-16	400	-	0	-	-	-	-
53780	3-Jun-16	660	-	0	-	-	-	-
53781	2-Jun-16	525	-	0	-	-	-	-
53782	31-May-16	509	1550	0	-	-	-	-
53783	31-May-16	388	850	0	-	-	-	-
53784	30-May-16	510	-	0	-	-	-	-
53785	30-May-16	526	-	0	-	-	-	-
53786	30-May-16	400	-	0	-	-	-	-
53787	30-May-16	360	-	0	-	-	-	-
53788	30-May-16	603	-	0	-	-	-	-
53789	30-May-16	577	-	0	-	-	-	-
53790	29-May-16	533	2000	0	-	-	-	-
53791	29-May-16	400	725	0	-	-	-	-
53792	28-May-16	559	-	0	-	-	-	-
53793	7-Jun-16	560	2125	0	-	-	-	-
53794	7-Jun-16	440	1200	0	-	-	-	-

Table A1-1: Detection summary for each of 48 Walleye tagged and monitored upstream of the Keeyask GS during the winter 2016/2017 period (October 20, 2016 to April 30, 2017). Tag id highlighted yellow = lost tag. Tag id highlighted purple = moved downstream through Gull Rapids (continued).

Tag ID	Date tagged	Fork Length (mm)	Weight (g)	n	# Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Range (rkm)
53795	7-Jun-16	410	900	0	-	-	-	-
53796	7-Jun-16	441	1150	0	-	-	-	-
53797	7-Jun-16	520	1700	15	1	-48.2	-48.2	0.0
53798	7-Jun-16	495	1500	0	-	-	-	-
53799	7-Jun-16	511	1650	14789	65	5.2	9.4	4.2
53800	7-Jun-16	530	1750	0	-	-	-	-
53801	7-Jun-16	360	600	0	-	-	-	-
53802	7-Jun-16	468	1300	0	-	-	-	-
53803	24-Sep-16	484	1550	2	1	-10.1	-10.1	0.0
53804	24-Sep-16	410	700	0	-	-	-	-
53805	6-Jun-16	532	-	0	-	-	-	-
53806	6-Jun-16	405	-	0	-	-	-	-
53807	6-Jun-16	451	-	0	-	-	-	-

Table A1-2: Detection summary for each of 40 Walleye tagged and monitored in Stephens Lake during the winter 2016/2017 period (October 20, 2016 to April 30, 2017). Tag id highlighted yellow = lost tag.

Tag ID	Date tagged	Fork Length (mm)	Weight (g)	n	# Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Range (rkm)
53723	28-May-16	510	1500	5	1	5.8	5.8	0
53724	28-May-16	433	1050	87	7	5.8	5.8	0
53725	27-May-16	480	1200	18620	110	7.9	13.9	6
53726	27-May-16	412	800	0	-	-	-	-
53727	28-May-16	486	-	0	-	-	-	-
53728	28-May-16	507	1650	15806	111	5.2	18.6	13.4
53729	28-May-16	375	560	11525	58	16.8	18.6	1.8
53730	28-May-16	491	1700	569	9	5.2	13	7.8
53731	28-May-16	442	950	128	12	9.4	13.9	4.5
53732	28-May-16	530	1825	0	-	-	-	-
53733	30-May-16	322	500	0	-	-	-	-
53734	30-May-16	460	1325	23970	90	9.4	18.6	9.2
53735	30-May-16	374	600	108116	192	18.6	18.6	0
53736	30-May-16	398	900	43994	159	5.2	7.9	2.7
53737	29-May-16	508	1625	0	-	-	-	-
53738	31-May-16	522	1875	0	-	-	-	-
53739	31-May-16	480	1300	0	-	-	-	-
53740	31-May-16	482	1400	10630	101	7.9	9.4	1.5
53741	30-May-16	404	975	32009	171	16.8	18.6	1.8
53742	30-May-16	452	1250	0	-	-	-	-
53743	31-May-16	469	1450	0	-	-	-	-
53744	31-May-16	405	750	37297	118	18.6	24.7	6.1
53745	31-May-16	453	1200	13041	108	5.2	18.6	13.4
53746	31-May-16	467	1380	0	-	-	-	-
53747	31-May-16	520	1600	0	-	-	-	-
53748	31-May-16	442	975	23	5	13	13	0
53749	31-May-16	411	750	198	3	16.8	24.7	7.9
53750	31-May-16	531	1800	9445	128	7.9	9.4	1.5
53751	31-May-16	422	825	0	-	-	-	-
53752	31-May-16	468	1400	5868	28	16.8	24.7	7.9
53753	31-May-16	488	1325	495	19	13.9	18.6	4.7
53754	31-May-16	475	1375	0	-	-	-	-
53755	31-May-16	506	1475	2086	8	5.2	9.4	4.2

Table A1-2: Detection summary for each of 40 Walleye tagged and monitored in Stephens Lake during the winter 2016/2017 period (October 20, 2016 to April 30, 2017). Tag id highlighted yellow = lost tag (continued).

Tag ID	Date tagged	Fork Length (mm)	Weight (g)	n	# Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Range (rkm)
53756	01-Jun-16	495	1800	11795	77	9.4	18.6	9.2
53757	01-Jun-16	530	1750	13752	120	5.2	18.6	13.4
53808	01-Jun-16	360	600	203	2	9.4	9.4	0
53809	01-Jun-16	468	1300	15097	148	13.9	18.6	4.7
53810	01-Jun-16	532	-	6638	54	9.4	18.6	9.2
53811	01-Jun-16	405	-	20720	126	5.2	7.9	2.7
53812	01-Jun-16	451	-	0	-	-	-	-

Table A1-3: Detection summary for each of 48 Walleye tagged and monitored upstream of the Keeyask GS during the open-water 2016 (May 1 to October 19) and 2017 (May 1 to October 16) periods. Tag id highlighted yellow = lost tag. Tag id highlighted purple = moved downstream through Gull Rapids. Tag id highlighted green = moved downstream through the Kettle GS. Tag id highlighted orange = moved downstream through the Long Spruce GS.

Tag ID	Date tagged	Fork length (mm)	Weight (g)	2016					2017				
				n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
53758	24-Sep-16	423	750	409	10	-17.4	-9.3	8.1	6376	46	-33.8	5.2	39.0
53759	24-Sep-16	362	500	2725	18	-17.4	9.4	26.8	0	-	-	-	-
53760	24-Sep-16	512	1825	360	10	-17.4	5.2	22.6	35	8	4.2	5.2	1.0
53763	5-Jun-16	510	-	369	11	-19.5	-9.5	10	0	-	-	-	-
53764	5-Jun-16	560	-	717	6	-14.8	10.3	25.1	0	-	-	-	-
53765	24-Sep-16	491	1300	5790	20	-19.5	-9.5	10	1122	36	-10.1	-9.9	0.2
53766	24-Sep-16	484	1250	1164	11	-12.9	-10	3.4	0	-	-	-	-
53767	24-Sep-16	508	1450	1490	16	-12.9	-11.8	1.1	0	-	-	-	-
53768	5-Jun-16	520	-	5426	127	-19.5	-14.8	4.7	9240	117	-19.5	-14.8	4.7
53769	5-Jun-16	393	-	16254	94	-19.5	44.9	64.4	410	4	47.5	47.5	0.0
53770	5-Jun-16	350	-	299	3	-17.4	-17.4	0	0	-	-	-	-
53771	5-Jun-16	353	-	1919	26	-19.4	58.6	78	0	-	-	-	-
53772	5-Jun-16	400	-	2950	19	-24.3	-14.8	9.5	656	8	-29.4	-7.4	22.0
53773	5-Jun-16	405	-	7239	74	-33.8	-9.5	24.3	2895	36	-19.5	43.5	63.0
53774	5-Jun-16	522	-	1403	7	-17.4	-9	8.4	0	-	-	-	-
53775	5-Jun-16	514	-	9686	68	-10.1	18.6	28.7	7764	67	1.2	24.7	23.5
53776	30-May-16	535	-	10606	110	-19.5	-12.9	6.6	4044	33	-12.8	-12.8	0.0
53777	29-May-16	404	1050	8877	99	-48.2	-11.8	36.4	5624	55	-26.5	58.6	85.1
53778	3-Jun-16	523	-	6979	15	-19.5	-9.5	10	0	-	-	-	-
53779	3-Jun-16	400	-	389	7	-12.9	-12.9	0	0	-	-	-	-
53780	3-Jun-16	660	-	3585	28	-12.9	-5.8	7.1	0	-	-	-	-
53781	2-Jun-16	525	-	344	10	-12.9	-9.5	3.4	21	2	-9.3	-9.3	0.0
53782	31-May-16	509	1550	11144	48	-19.5	43.5	63	0	-	-	-	-
53783	31-May-16	388	850	18635	92	-48.2	-14.8	33.4	7435	44	-48.2	-14.8	33.4
53784	30-May-16	510	-	3309	85	-19.5	-11.8	7.7	6111	41	-33.8	-12.8	21.0

Table A1-3: Detection summary for each of 48 Walleye tagged and monitored upstream of the Keeyask GS during the open-water 2016 (May 1 to October 19) and 2017 (May 1 to October 16) periods. Tag id highlighted yellow = lost tag. Tag id highlighted purple = moved downstream through Gull Rapids. Tag id highlighted green = moved downstream through the Kettle GS. Tag id highlighted orange = moved downstream through the Long Spruce GS (continued).

Tag ID	Date tagged	Fork length (mm)	Weight (g)	2016					2017				
				n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
53785	30-May-16	526	-	30891	132	-19.5	-12.9	6.6	4227	42	-17.4	-5.8	11.6
53786	30-May-16	400	-	266	4	-14.8	2.7	17.5	0	-	-	-	-
53787	30-May-16	360	-	6972	92	-19.5	-5.8	13.7	0	-	-	-	-
53788	30-May-16	603	-	2521	24	-19.5	5.2	24.7	0	-	-	-	-
53789	30-May-16	577	-	17373	84	-44.3	-32.3	12	7018	51	-44.7	-32.3	12.4
53790	29-May-16	533	2000	1177	4	-17.4	-17.4	0	0	-	-	-	-
53791	29-May-16	400	725	1265	17	-19.5	44.9	64.4	0	-	-	-	-
53792	28-May-16	559	-	18568	130	-19.5	-11.8	7.7	19717	122	-19.5	-11.9	7.6
53793	7-Jun-16	560	2125	40350	133	-19.5	-12.9	6.6	56	3	-12.8	2.7	15.5
53794	7-Jun-16	440	1200	14606	97	-29.4	-11.8	17.6	4327	63	-33.8	-10.1	23.7
53795	7-Jun-16	410	900	7864	105	-19.5	-9.5	10	24523	122	-19.5	-17.4	2.1
53796	7-Jun-16	441	1150	4385	62	-26.5	-17.4	9.1	1926	44	-26.5	-19.4	7.1
53797	7-Jun-16	520	1700	17953	86	-48.2	-17.4	30.8	12338	93	-48.2	-17.4	30.8
53798	7-Jun-16	495	1500	11017	85	-19.5	-12.9	6.6	3	1	-10.1	-10.1	0.0
53799	7-Jun-16	511	1650	7477	59	-14.8	10.3	25.1	312	12	1.2	47.5	46.3
53800	7-Jun-16	530	1750	22181	94	-19.5	-5.8	13.7	0	-	-	-	-
53801	7-Jun-16	360	600	1488	8	-14.8	18.6	33.4	0	-	-	-	-
53802	7-Jun-16	468	1300	118	2	-14.8	-5.8	9	0	-	-	-	-
53803	24-Sep-16	484	1550	1530	21	-14.8	-11.8	3	0	-	-	-	-
53804	24-Sep-16	410	700	1829	17	-14.8	-11.8	3	160	4	-10.1	-7.4	2.7
53805	6-Jun-16	532	-	17640	129	-14.8	-14.8	0	8346	100	-19.5	-14.8	4.7
53806	6-Jun-16	405	-	24853	125	-34.3	-14.8	19.5	0	-	-	-	-
53807	6-Jun-16	451	-	7475	63	-48.2	-14.8	33.4	0	-	-	-	-

Table A1-4: Detection summary for each of 40 Walleye tagged and monitored in Stephens Lake during the open-water 2016 (May 1 to October 19) and 2017 (May 1 to October 16) periods. Tag id highlighted yellow = lost tag. Tag id highlighted green = moved downstream through the Kettle GS. Tag id highlighted orange = moved downstream through the Long Spruce GS.

Tag ID	Date tagged	Fork length (mm)	Weight (g)	2016					2017				
				n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
53723	28-May-16	510	1500	6822	52	1.2	9.4	8.2	11415	64	1.2	16.8	15.6
53724	28-May-16	433	1050	16473	97	1.2	10.3	9.1	2937	36	1.2	7.9	6.7
53725	27-May-16	480	1200	1918	22	1.2	18.6	17.4	5934	35	7.9	16.8	8.9
53726	27-May-16	412	800	1862	17	1.2	16.8	15.6	0	-	-	-	-
53727	28-May-16	486	-	0	-	-	-	-	0	-	-	-	-
53728	28-May-16	507	1650	13006	102	1.2	18.6	17.4	4712	42	2.7	58.6	55.9
53729	28-May-16	375	560	3470	41	1.2	18.6	17.4	2432	46	1.2	18.6	17.4
53730	28-May-16	491	1700	1907	15	1.2	9.4	8.2	4610	43	1.2	10.3	9.1
53731	28-May-16	442	950	4702	19	1.2	9.4	8.2	1757	26	1.2	13.9	12.7
53732	28-May-16	530	1825	380	7	1.2	13.0	11.8	0	-	-	-	-
53733	30-May-16	322	500	2770	34	1.2	13.9	12.7	0	-	-	-	-
53734	30-May-16	460	1325	2165	13	1.2	18.6	17.4	2137	28	3.8	18.6	14.8
53735	30-May-16	374	600	71469	135	1.2	18.6	17.4	98904	168	18.6	18.6	0.0
53736	30-May-16	398	900	5122	42	1.2	18.6	17.4	5996	48	2.6	24.7	22.1
53737	29-May-16	508	1625	2237	64	1.2	10.3	9.1	1772	21	3.8	47.5	43.7
53738	31-May-16	522	1875	7820	75	2.7	10.3	7.6	692	20	2.6	40.8	38.2
53739	31-May-16	480	1300	9452	111	1.2	6.5	5.3	0	-	-	-	-
53740	31-May-16	482	1400	12989	77	1.2	9.4	8.2	6334	60	1.2	9.4	8.2
53741	30-May-16	404	975	4836	76	1.2	18.6	17.4	11129	90	2.7	18.6	15.9
53742	30-May-16	452	1250	1118	12	1.2	2.7	1.5	0	-	-	-	-
53743	31-May-16	469	1450	466	9	1.2	9.4	8.2	0	-	-	-	-
53744	31-May-16	405	750	5132	56	1.2	18.6	17.4	6665	69	1.2	24.7	23.5
53745	31-May-16	453	1200	249	4	2.7	18.6	15.9	2884	25	3.8	24.7	20.9

Table A1-4: Detection summary for each of 40 Walleye tagged and monitored in Stephens Lake during the open-water 2016 (May 1 to October 19) and 2017 (May 1 to October 16) periods. Tag id highlighted yellow = lost tag. Tag id highlighted green = moved downstream through the Kettle GS. Tag id highlighted orange = moved downstream through the Long Spruce GS (continued).

Tag ID	Date tagged	Fork length (mm)	Weight (g)	2016					2017				
				n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
53746	31-May-16	467	1380	310	4	1.2	18.6	17.4	1449	19	3.8	58.6	54.8
53747	31-May-16	520	1600	19408	65	1.2	10.3	9.1	6715	47	1.2	47.5	46.3
53748	31-May-16	442	975	4332	57	2.7	13.0	10.3	558	20	6.5	13	6.5
53749	31-May-16	411	750	34767	132	1.2	10.3	9.1	2531	12	1.2	10.3	9.1
53750	31-May-16	531	1800	4459	52	1.2	10.3	9.1	15866	72	3.8	9.4	5.6
53751	31-May-16	422	825	8287	56	1.2	18.6	17.4	633	25	1.2	58.6	57.4
53752	31-May-16	468	1400	12710	51	1.2	20.0	18.8	7479	67	1.2	24.7	23.5
53753	31-May-16	488	1325	23679	89	1.2	21.0	19.8	3253	39	2.6	40.9	38.3
53754	31-May-16	475	1375	1653	11	1.2	18.6	17.4	0	-	-	-	-
53755	31-May-16	506	1475	12782	65	1.2	13.0	11.8	13253	100	1.2	13	11.8
53756	01-Jun-16	495	1800	2800	39	1.2	13.0	11.8	7437	91	2.7	16.8	14.1
53757	01-Jun-16	530	1750	714	5	1.2	18.6	17.4	1466	20	3.8	24.7	20.9
53808	01-Jun-16	360	600	5683	43	1.2	18.6	17.4	7513	63	1.2	13.9	12.7
53809	01-Jun-16	468	1300	3821	62	1.2	18.6	17.4	4659	58	3.8	18.6	14.8
53810	01-Jun-16	532	-	1340	43	1.2	18.6	17.4	2374	68	3.8	18.6	14.8
53811	01-Jun-16	405	-	62445	123	1.2	7.9	6.7	61299	156	1.2	9.4	8.2
53812	01-Jun-16	451	-	5047	27	1.2	20.0	18.8	0	-	-	-	-

APPENDIX 2:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED WALLEYE UPSTREAM OF GULL RAPIDS JUNE 2016 TO OCTOBER 2017

Figure A2-1:	Position of a Walleye tagged with an acoustic transmitter (code #53758) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	72
Figure A2-2:	Position of a Walleye tagged with an acoustic transmitter (code #53759) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	73
Figure A2-3:	Position of a Walleye tagged with an acoustic transmitter (code #53760) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	74
Figure A2-4:	Position of a Walleye tagged with an acoustic transmitter (code #53763) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	75
Figure A2-5:	Position of a Walleye tagged with an acoustic transmitter (code #53764) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	76
Figure A2-6:	Position of a Walleye tagged with an acoustic transmitter (code #53765) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	77
Figure A2-7:	Position of a Walleye tagged with an acoustic transmitter (code #53766) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	78
Figure A2-8:	Position of a Walleye tagged with an acoustic transmitter (code #53767) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	79
Figure A2-9:	Position of a Walleye tagged with an acoustic transmitter (code #53768) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	80
Figure A2-10:	Position of a Walleye tagged with an acoustic transmitter (code #53769) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	81

Figure A2-11: Position of a Walleye tagged with an acoustic transmitter (code #53770) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	82
Figure A2-12: Position of a Walleye tagged with an acoustic transmitter (code #53771) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	83
Figure A2-13: Position of a Walleye tagged with an acoustic transmitter (code #53772) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	84
Figure A2-14: Position of a Walleye tagged with an acoustic transmitter (code #53773) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	85
Figure A2-15: Position of a Walleye tagged with an acoustic transmitter (code #53774) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	86
Figure A2-16: Position of a Walleye tagged with an acoustic transmitter (code #53775) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	87
Figure A2-17: Position of a Walleye tagged with an acoustic transmitter (code #53776) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	88
Figure A2-18: Position of a Walleye tagged with an acoustic transmitter (code #53777) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	89
Figure A2-19: Position of a Walleye tagged with an acoustic transmitter (code #53778) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	90
Figure A2-20: Position of a Walleye tagged with an acoustic transmitter (code #53779) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	91
Figure A2-21: Position of a Walleye tagged with an acoustic transmitter (code #53780) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	92
Figure A2-22: Position of a Walleye tagged with an acoustic transmitter (code #53781) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	93
Figure A2-23: Position of a Walleye tagged with an acoustic transmitter (code #53782) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	94

Figure A2-24: Position of a Walleye tagged with an acoustic transmitter (code #53783) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	95
Figure A2-25: Position of a Walleye tagged with an acoustic transmitter (code #53784) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	96
Figure A2-26: Position of a Walleye tagged with an acoustic transmitter (code #53785) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	97
Figure A2-27: Position of a Walleye tagged with an acoustic transmitter (code #53786) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	98
Figure A2-28: Position of a Walleye tagged with an acoustic transmitter (code #53787) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	99
Figure A2-29: Position of a Walleye tagged with an acoustic transmitter (code #53788) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	100
Figure A2-30: Position of a Walleye tagged with an acoustic transmitter (code #53789) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	101
Figure A2-31: Position of a Walleye tagged with an acoustic transmitter (code #53790) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	102
Figure A2-32: Position of a Walleye tagged with an acoustic transmitter (code #53791) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	103
Figure A2-33: Position of a Walleye tagged with an acoustic transmitter (code #53792) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	104
Figure A2-34: Position of a Walleye tagged with an acoustic transmitter (code #53793) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	105
Figure A2-35: Position of a Walleye tagged with an acoustic transmitter (code #53794) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	106
Figure A2-36: Position of a Walleye tagged with an acoustic transmitter (code #53795) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	107

Figure A2-37: Position of a Walleye tagged with an acoustic transmitter (code #53796) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	108
Figure A2-38: Position of a Walleye tagged with an acoustic transmitter (code #53797) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	109
Figure A2-39: Position of a Walleye tagged with an acoustic transmitter (code #53798) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	110
Figure A2-40: Position of a Walleye tagged with an acoustic transmitter (code #53799) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	111
Figure A2-41: Position of a Walleye tagged with an acoustic transmitter (code #53800) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	112
Figure A2-42: Position of a Walleye tagged with an acoustic transmitter (code #53801) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	113
Figure A2-43: Position of a Walleye tagged with an acoustic transmitter (code #53802) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	114
Figure A2-44: Position of a Walleye tagged with an acoustic transmitter (code #53803) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	115
Figure A2-45: Position of a Walleye tagged with an acoustic transmitter (code #53804) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	116
Figure A2-46: Position of a Walleye tagged with an acoustic transmitter (code #53805) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	117
Figure A2-47: Position of a Walleye tagged with an acoustic transmitter (code #53806) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	118
Figure A2-48: Position of a Walleye tagged with an acoustic transmitter (code #53807) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	119

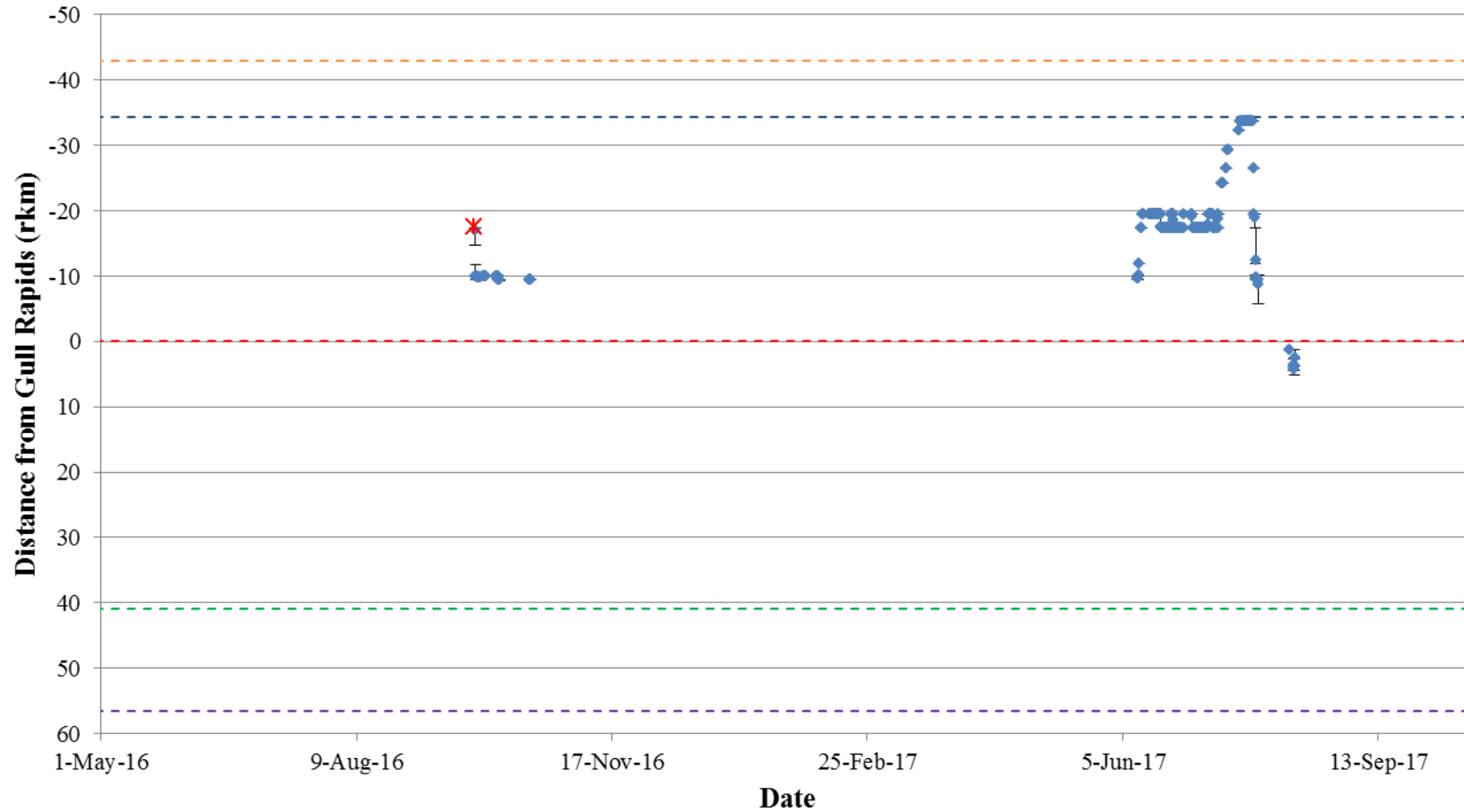


Figure A2-1: Position of a Walleye tagged with an acoustic transmitter (code #53758) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

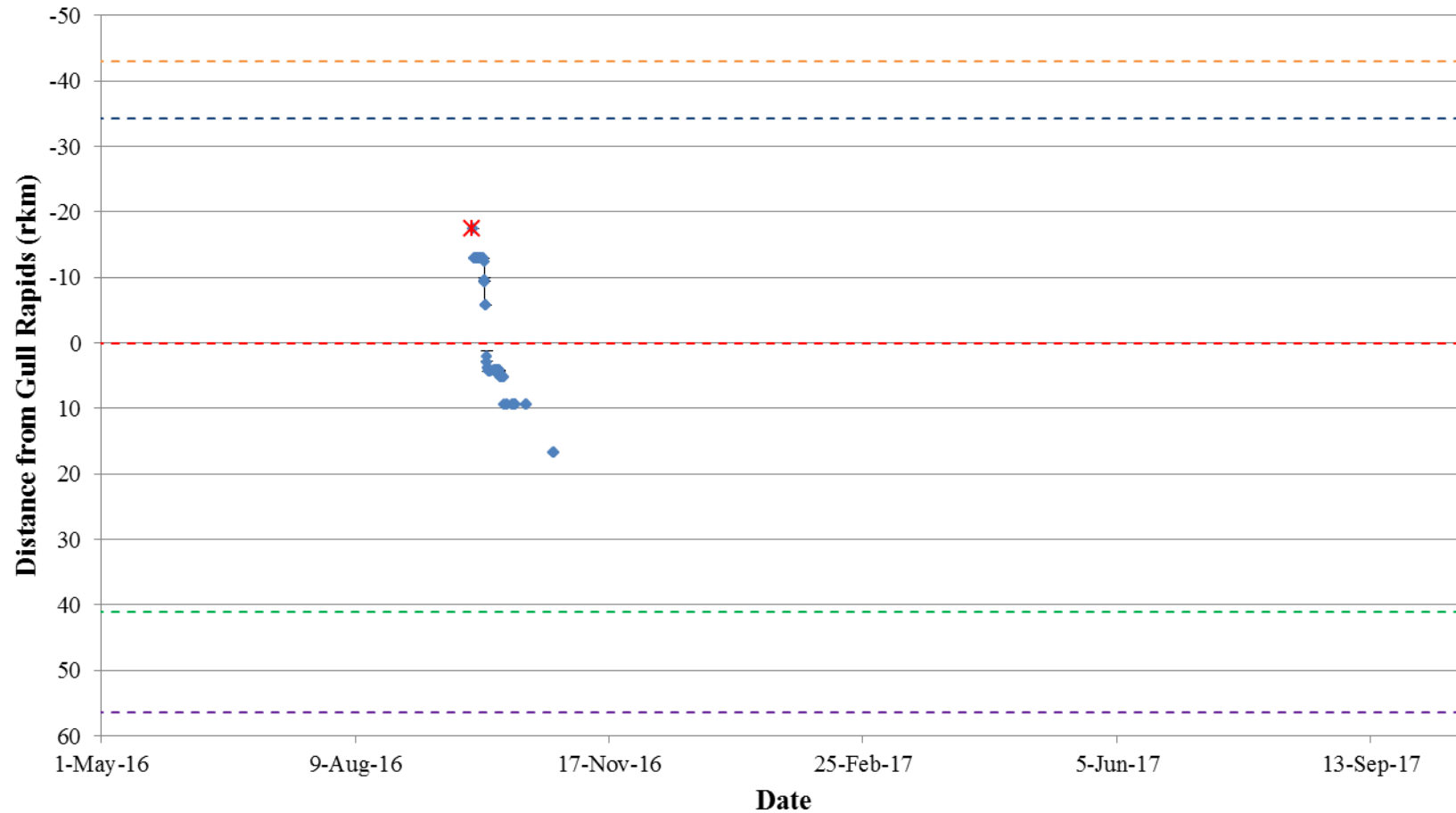


Figure A2-2: Position of a Walleye tagged with an acoustic transmitter (code #53759) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

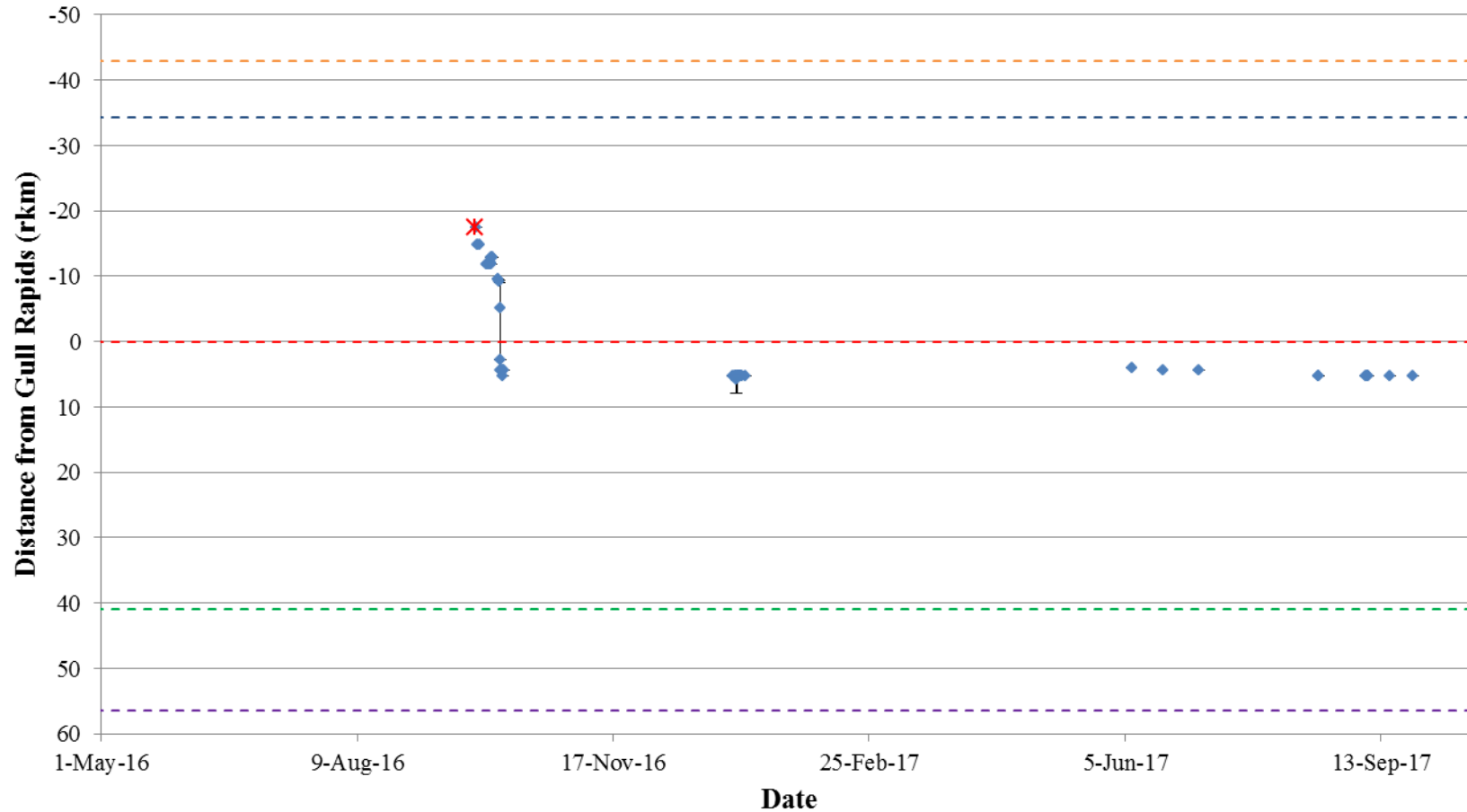


Figure A2-3: Position of a Walleye tagged with an acoustic transmitter (code #53760) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

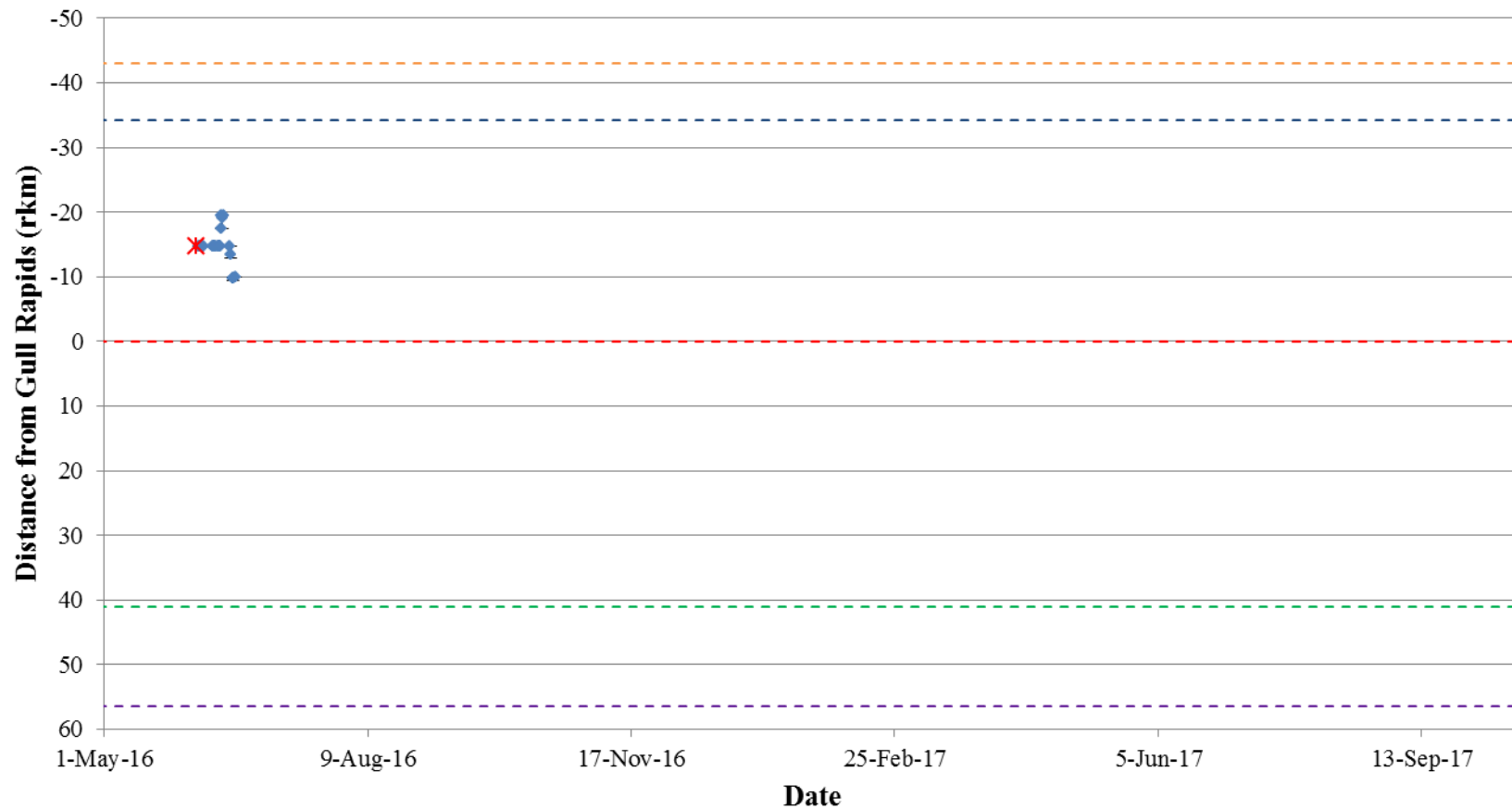


Figure A2-4: Position of a Walleye tagged with an acoustic transmitter (code #53763) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

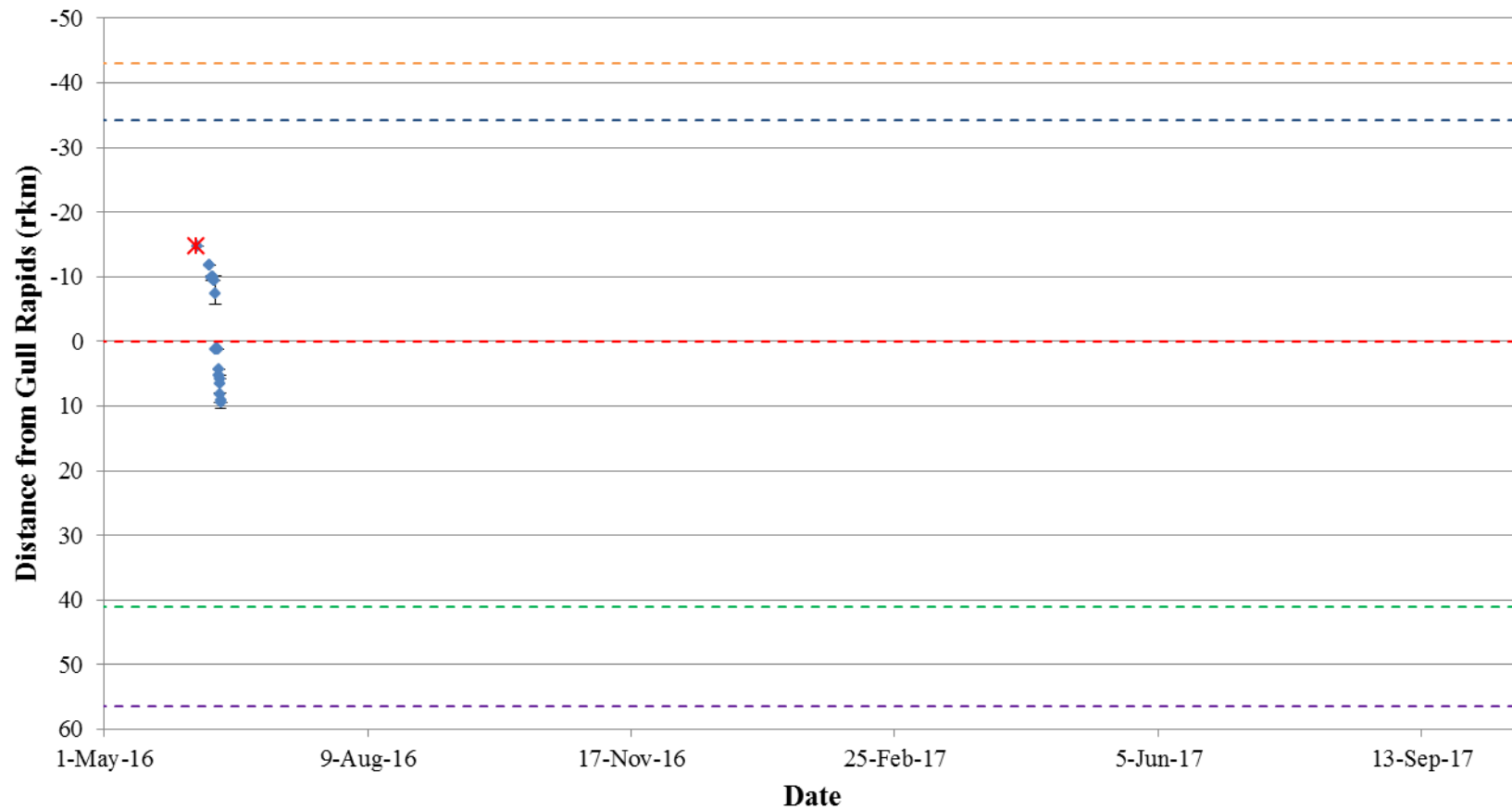


Figure A2-5: Position of a Walleye tagged with an acoustic transmitter (code #53764) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

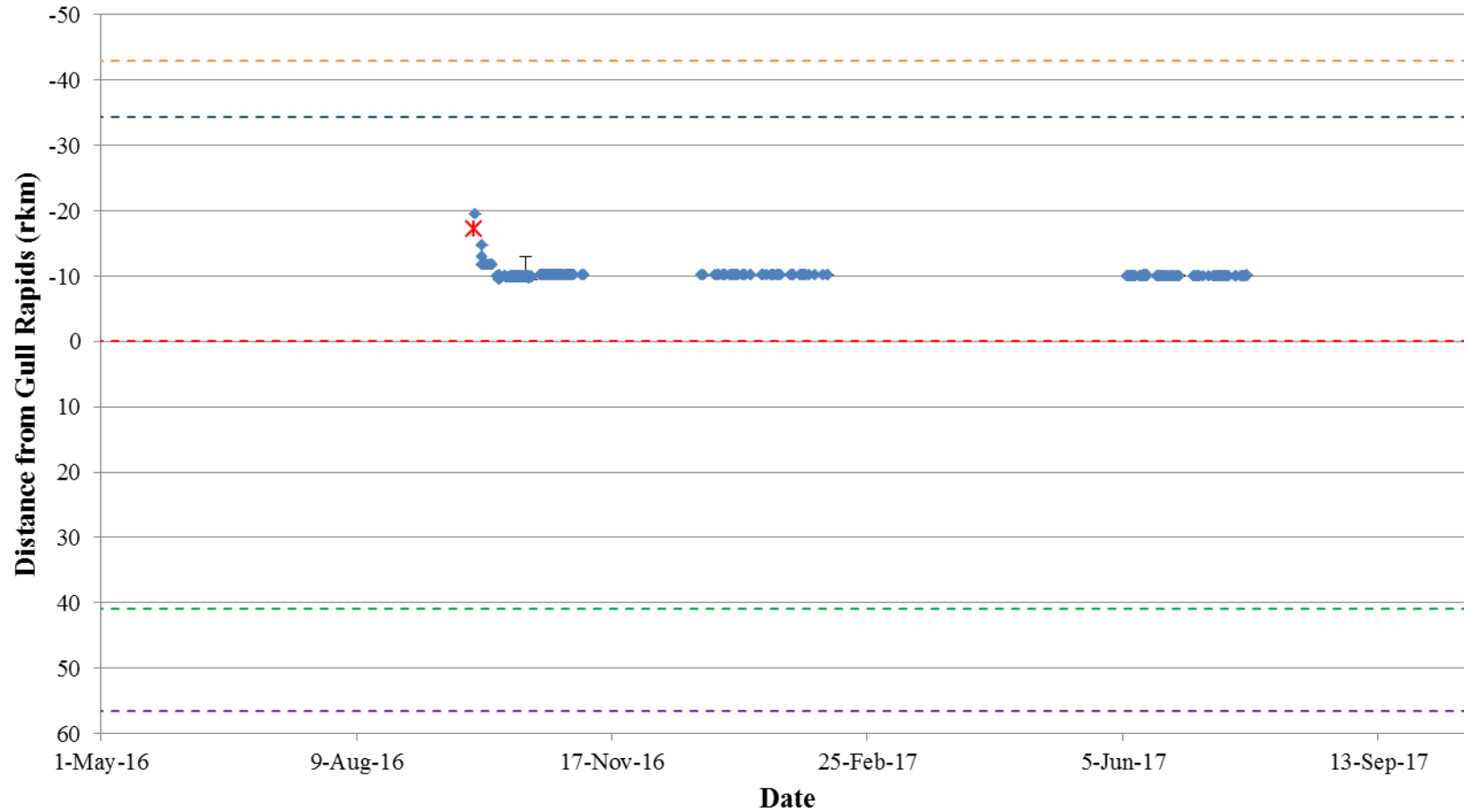


Figure A2-6: Position of a Walleye tagged with an acoustic transmitter (code #53765) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

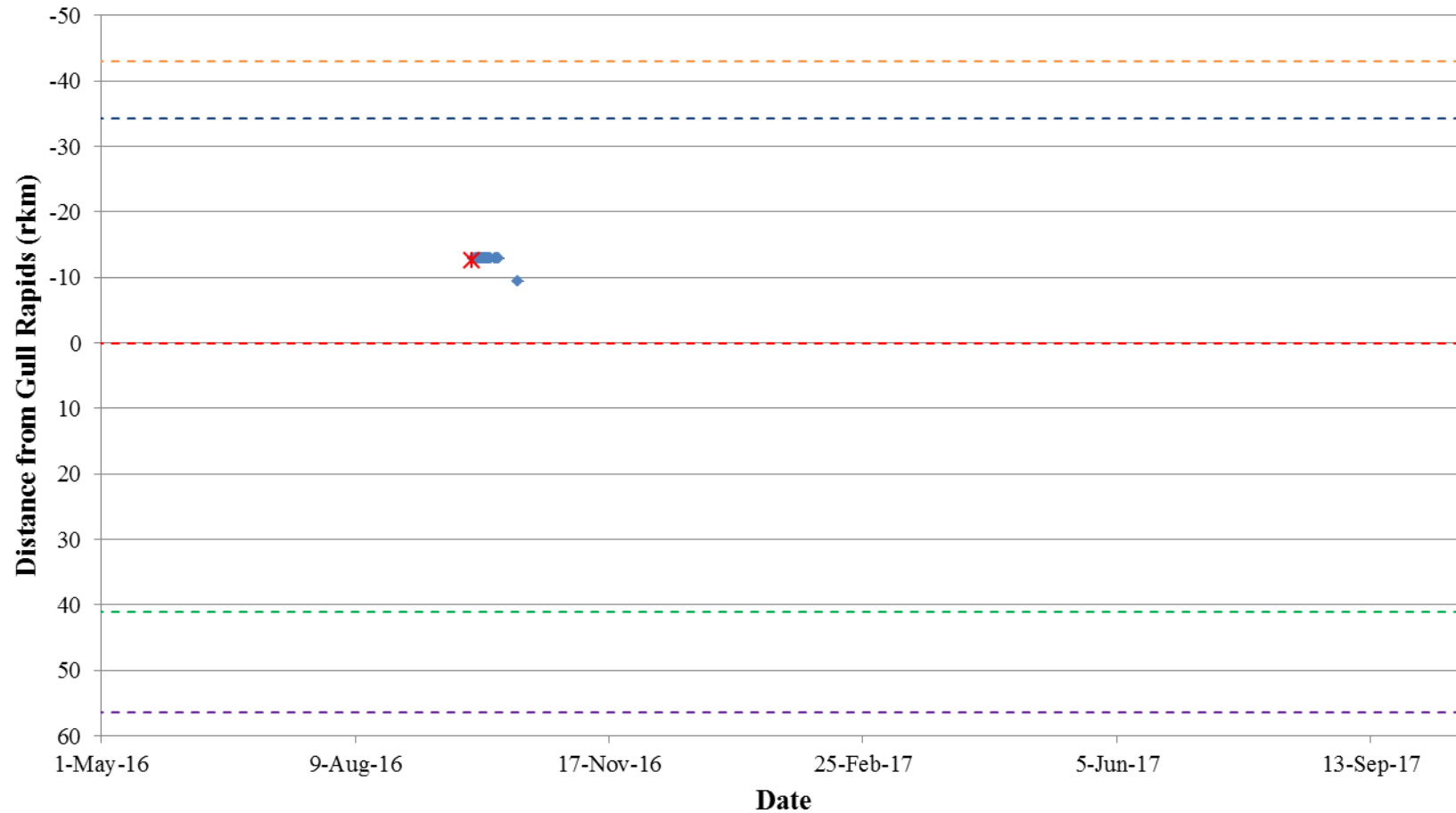
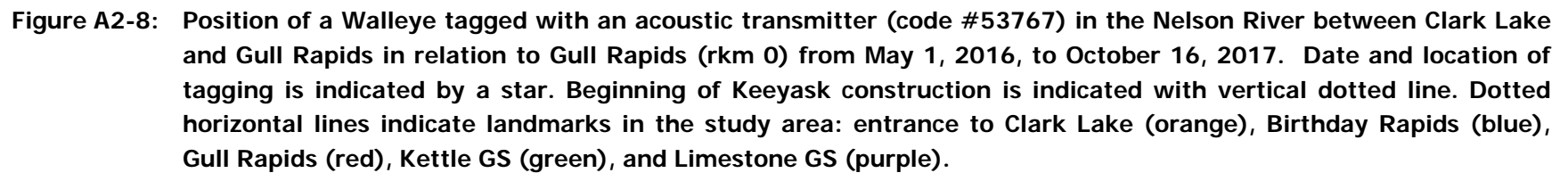


Figure A2-7: Position of a Walleye tagged with an acoustic transmitter (code #53766) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).



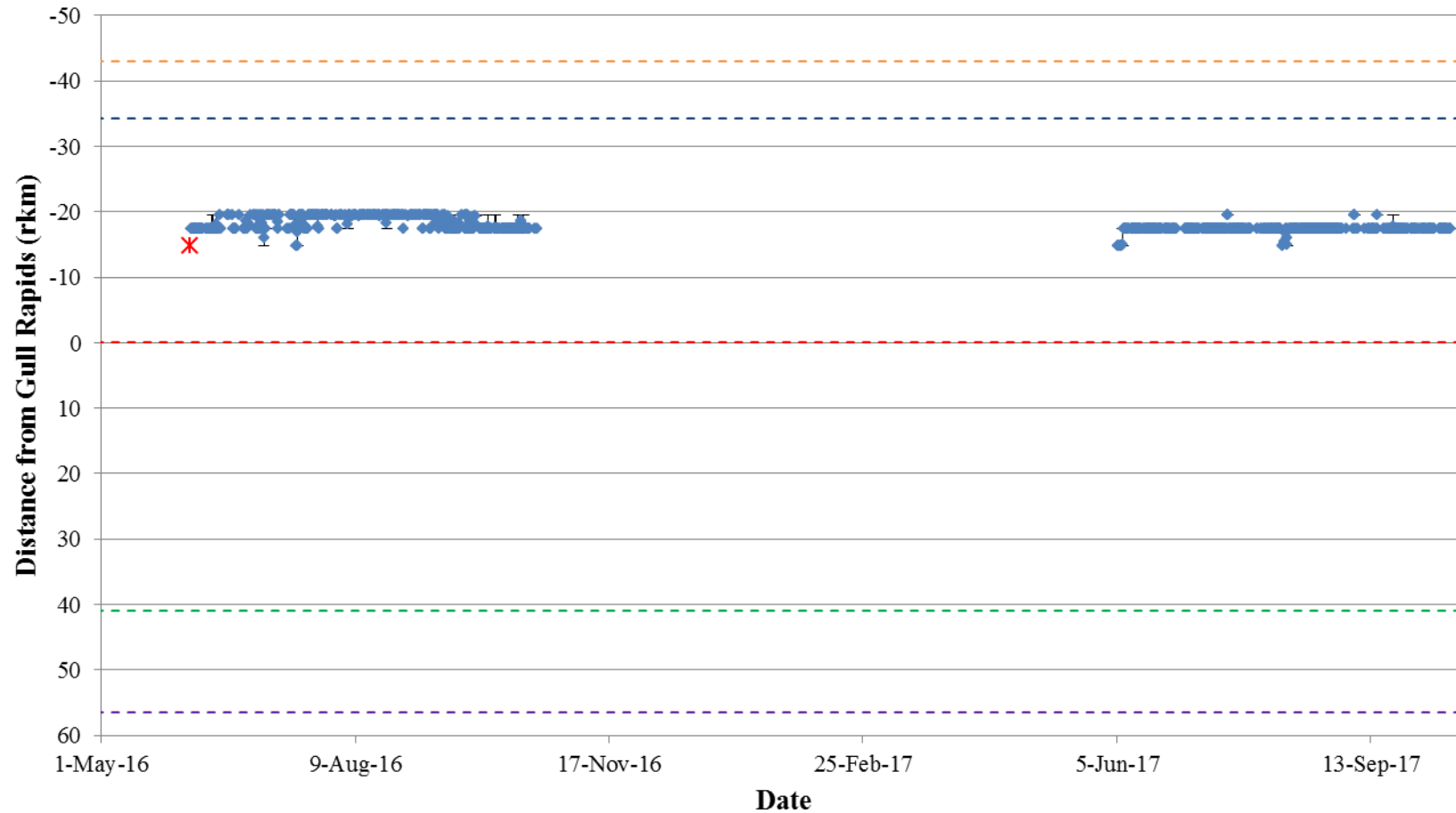


Figure A2-9: Position of a Walleye tagged with an acoustic transmitter (code #53768) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

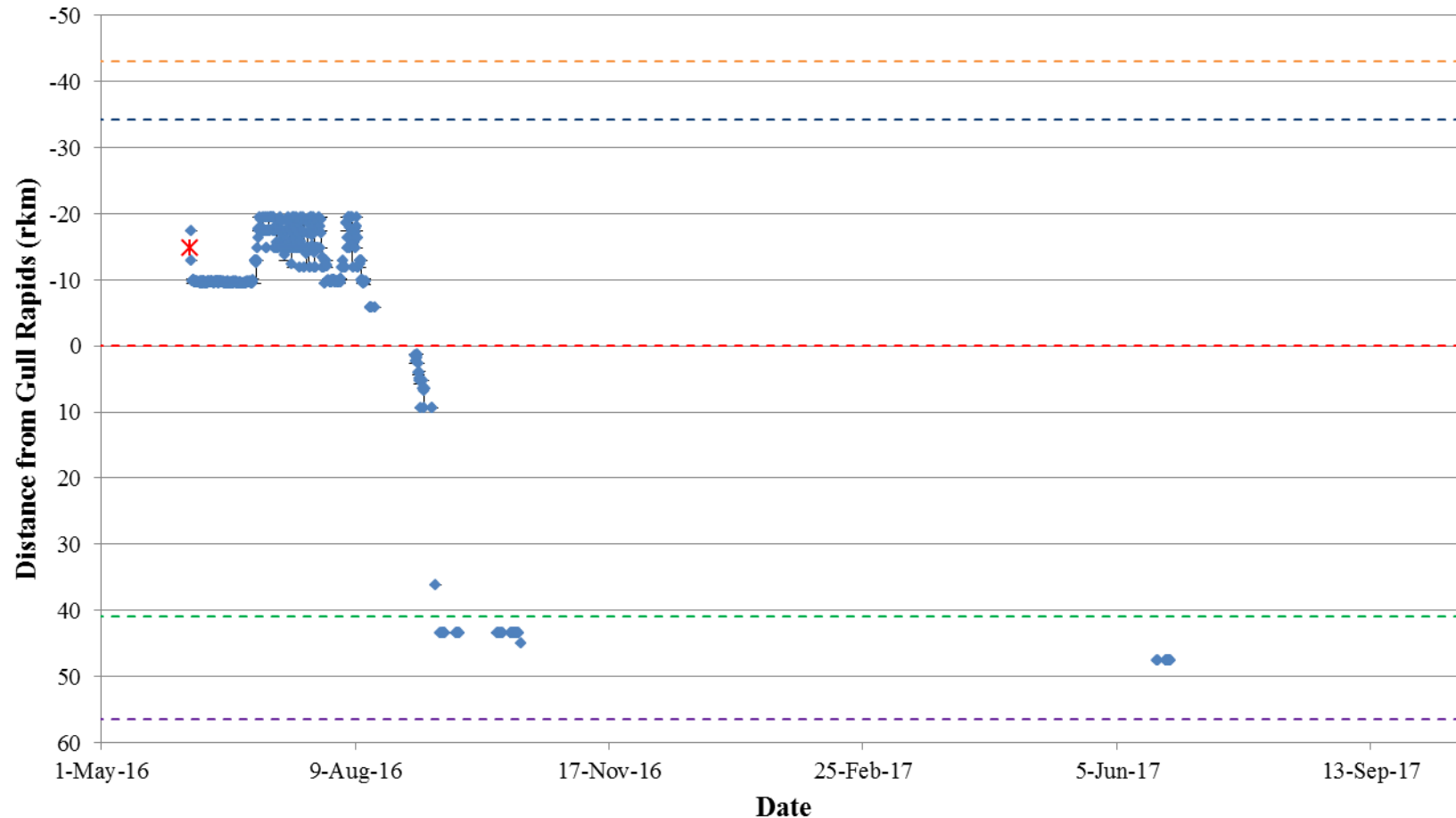


Figure A2-10: Position of a Walleye tagged with an acoustic transmitter (code #53769) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

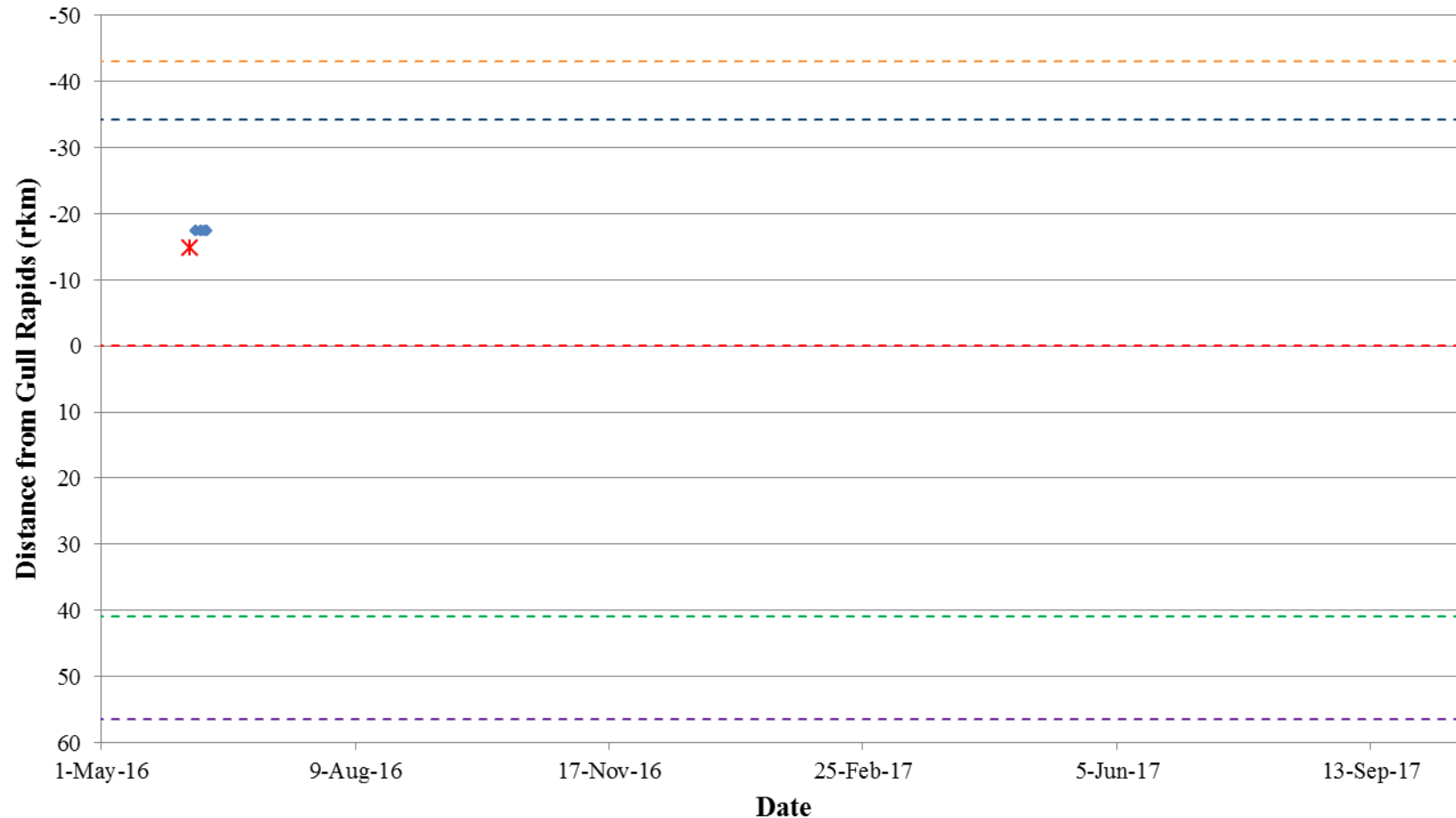


Figure A2-11: Position of a Walleye tagged with an acoustic transmitter (code #53770) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

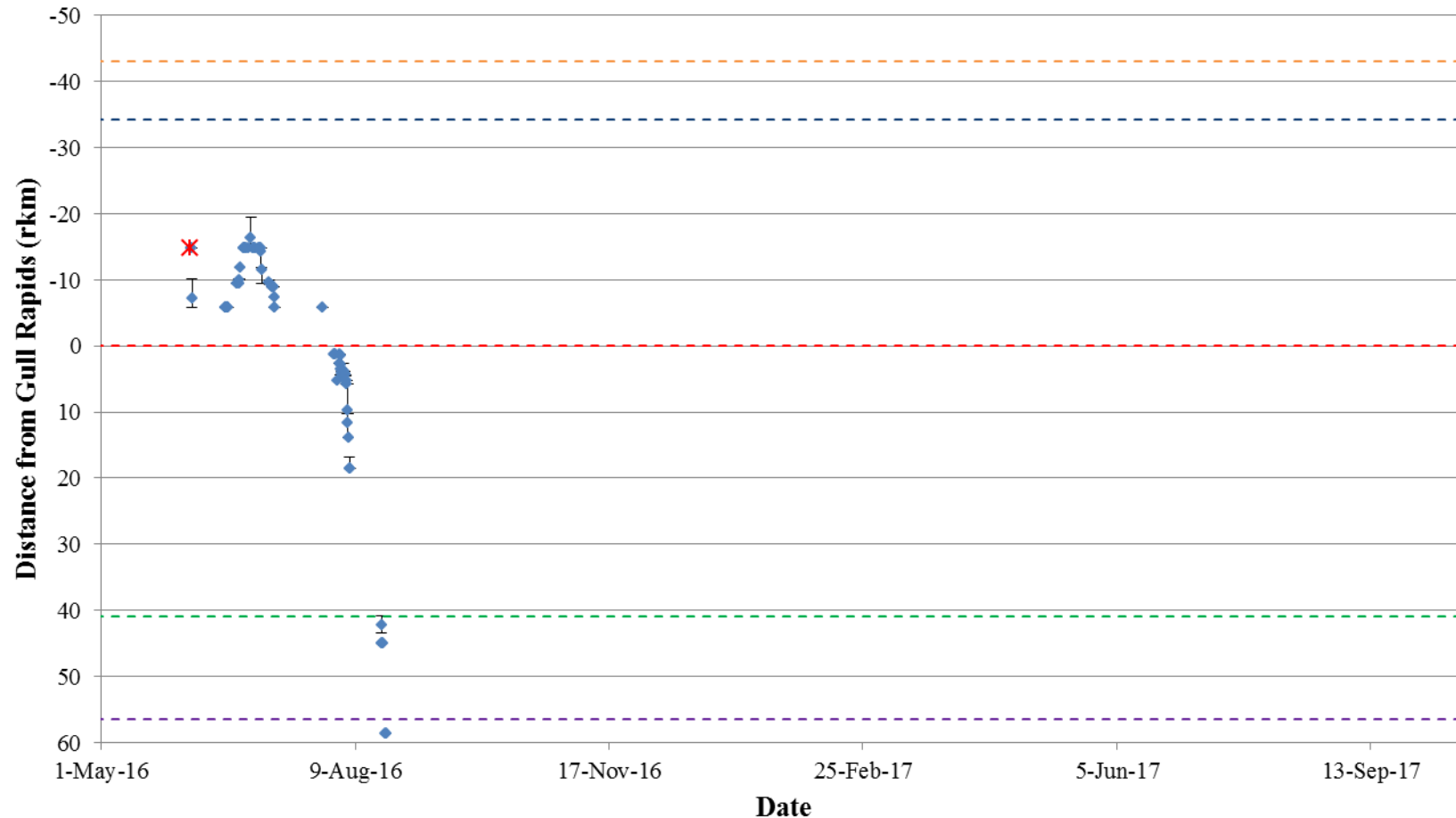
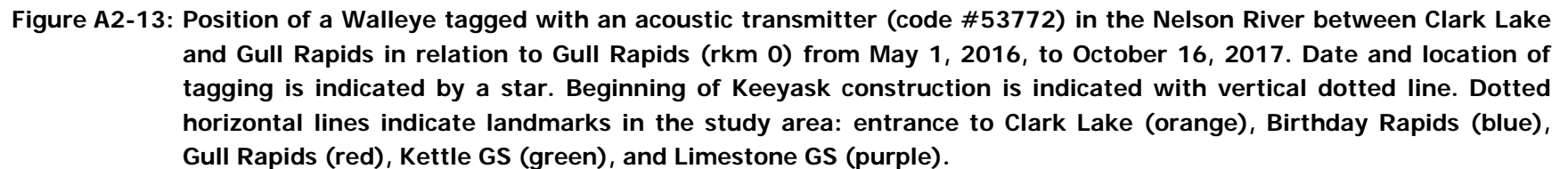


Figure A2-12: Position of a Walleye tagged with an acoustic transmitter (code #53771) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).



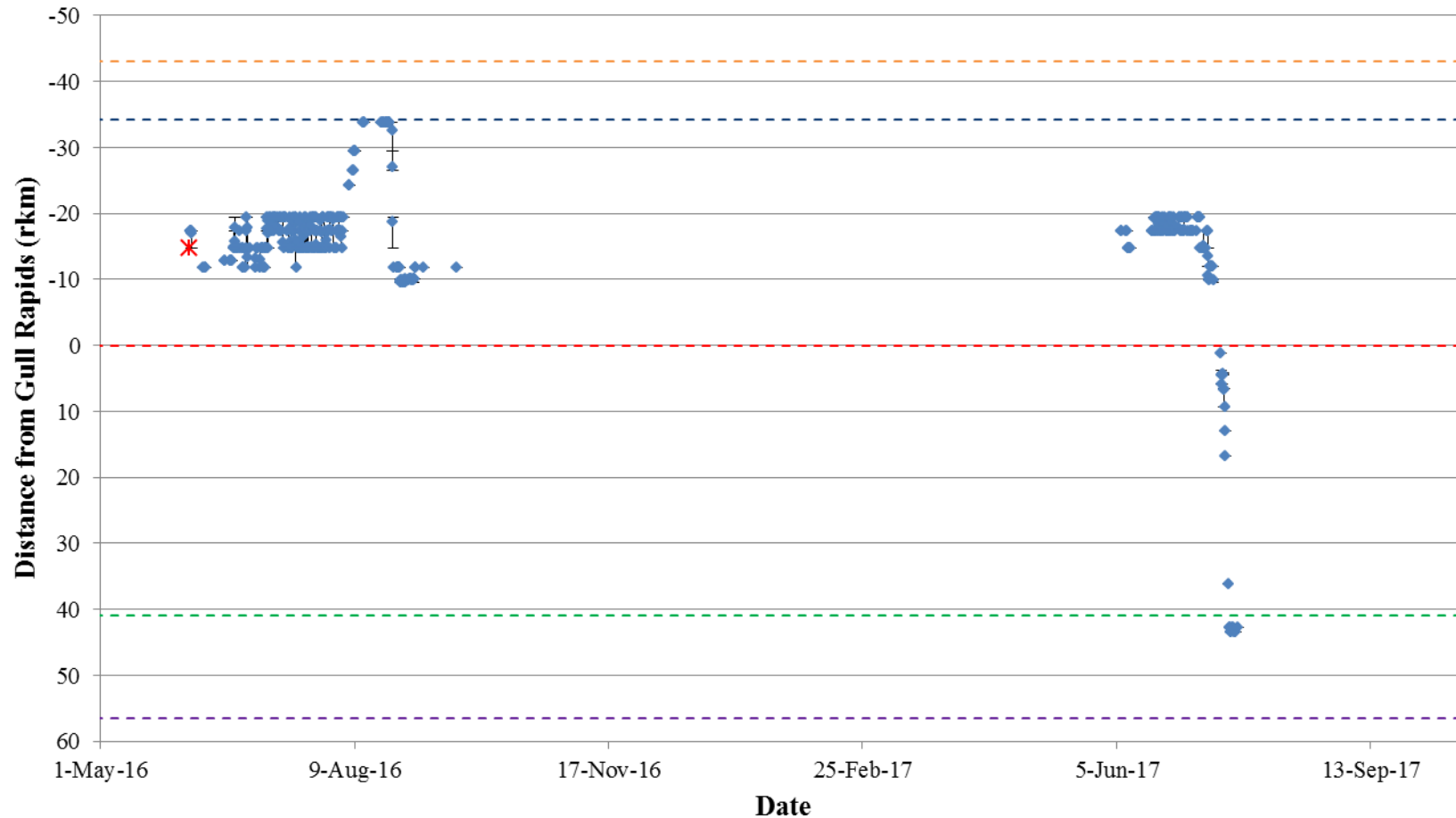


Figure A2-14: Position of a Walleye tagged with an acoustic transmitter (code #53773) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

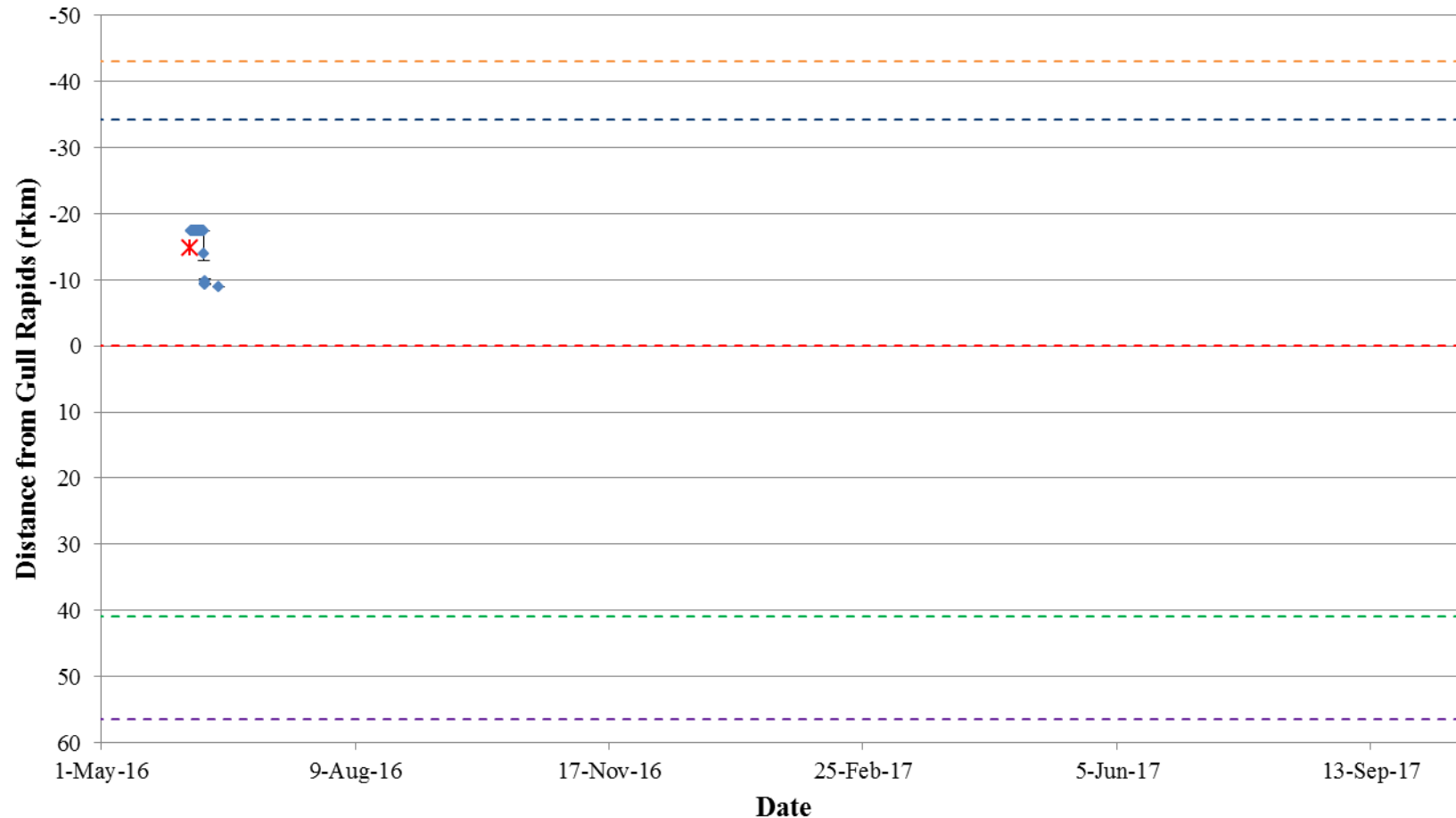


Figure A2-15: Position of a Walleye tagged with an acoustic transmitter (code #53774) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

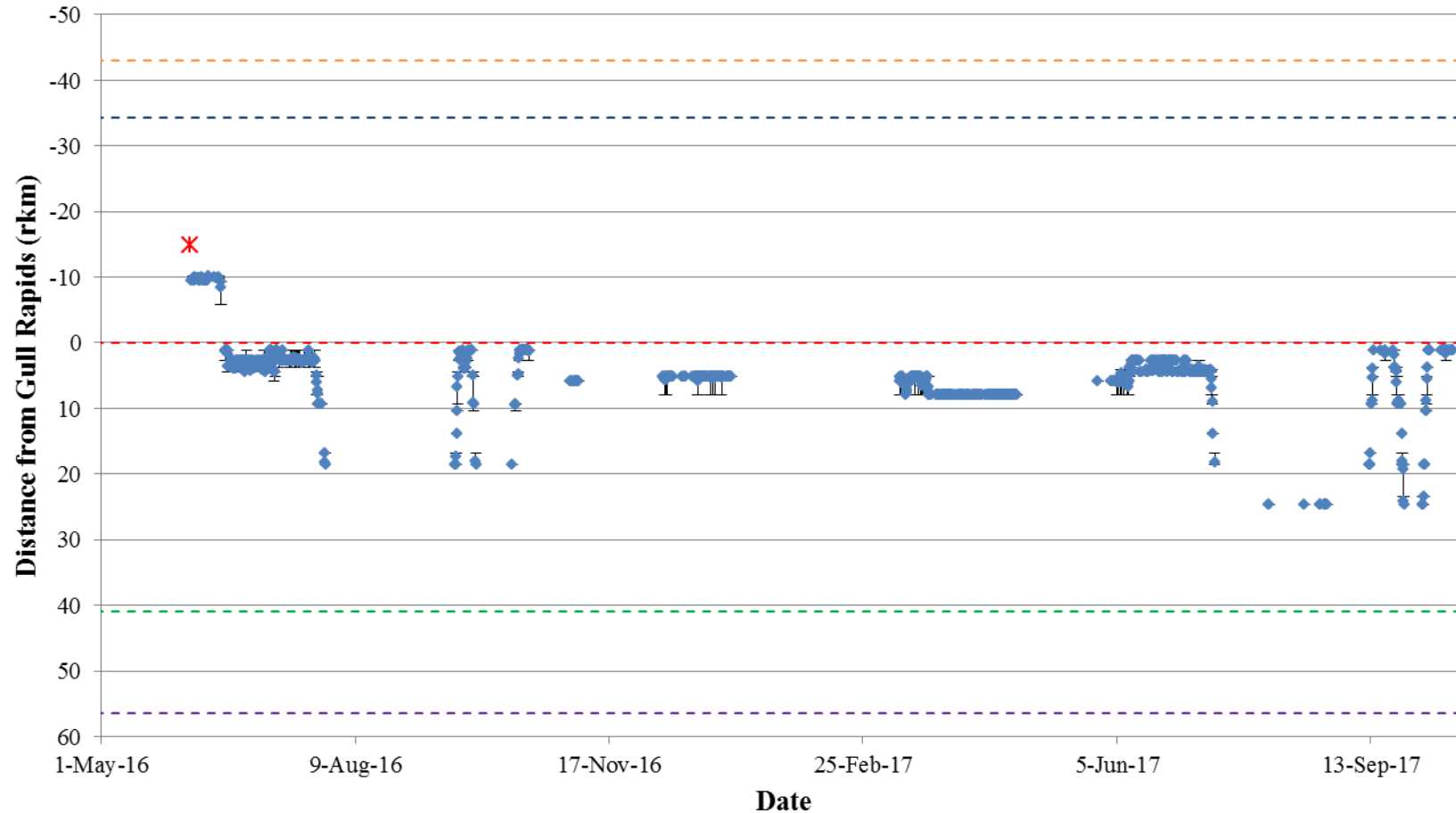


Figure A2-16: Position of a Walleye tagged with an acoustic transmitter (code #53775) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

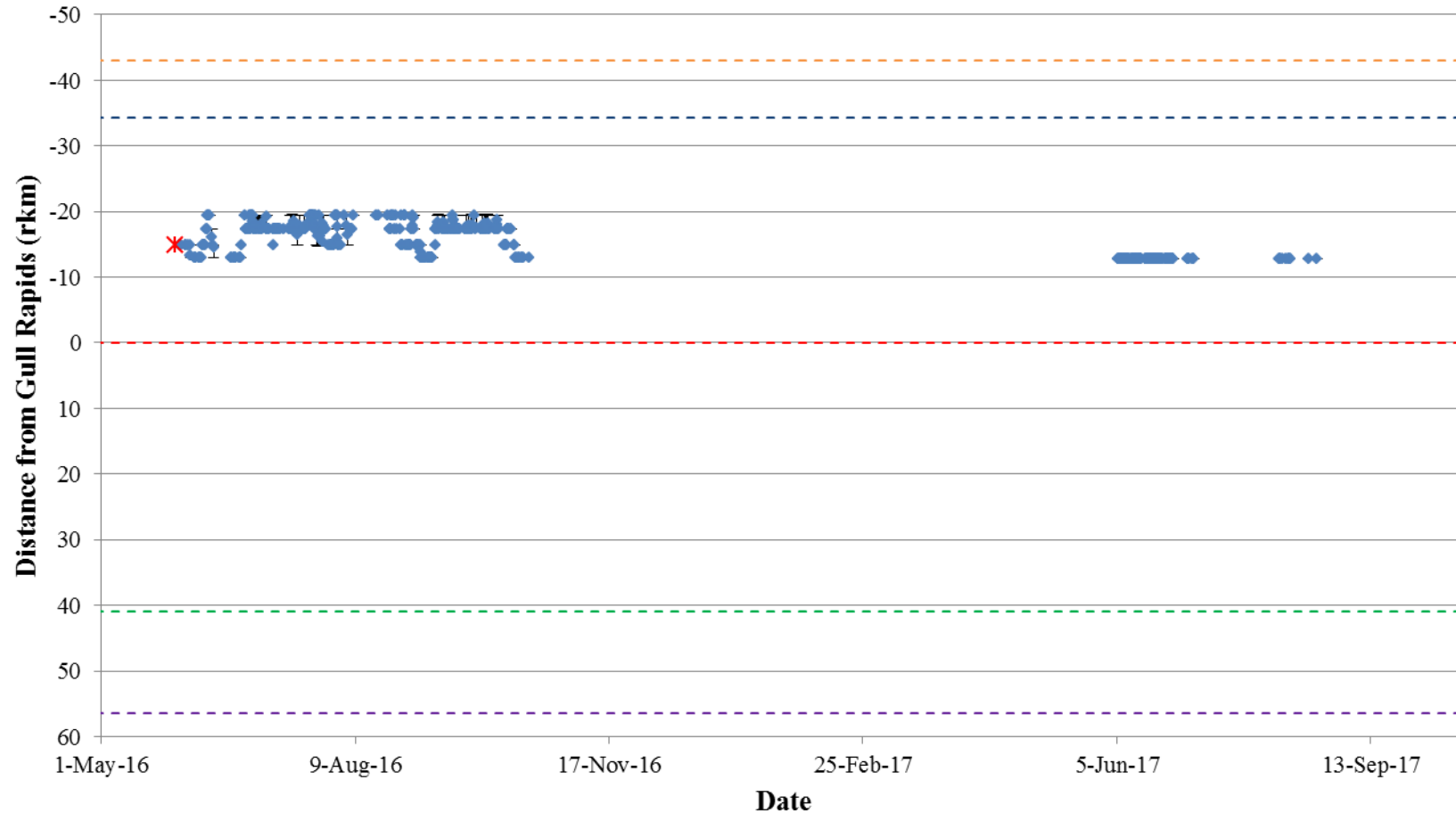


Figure A2-17: Position of a Walleye tagged with an acoustic transmitter (code #53776) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

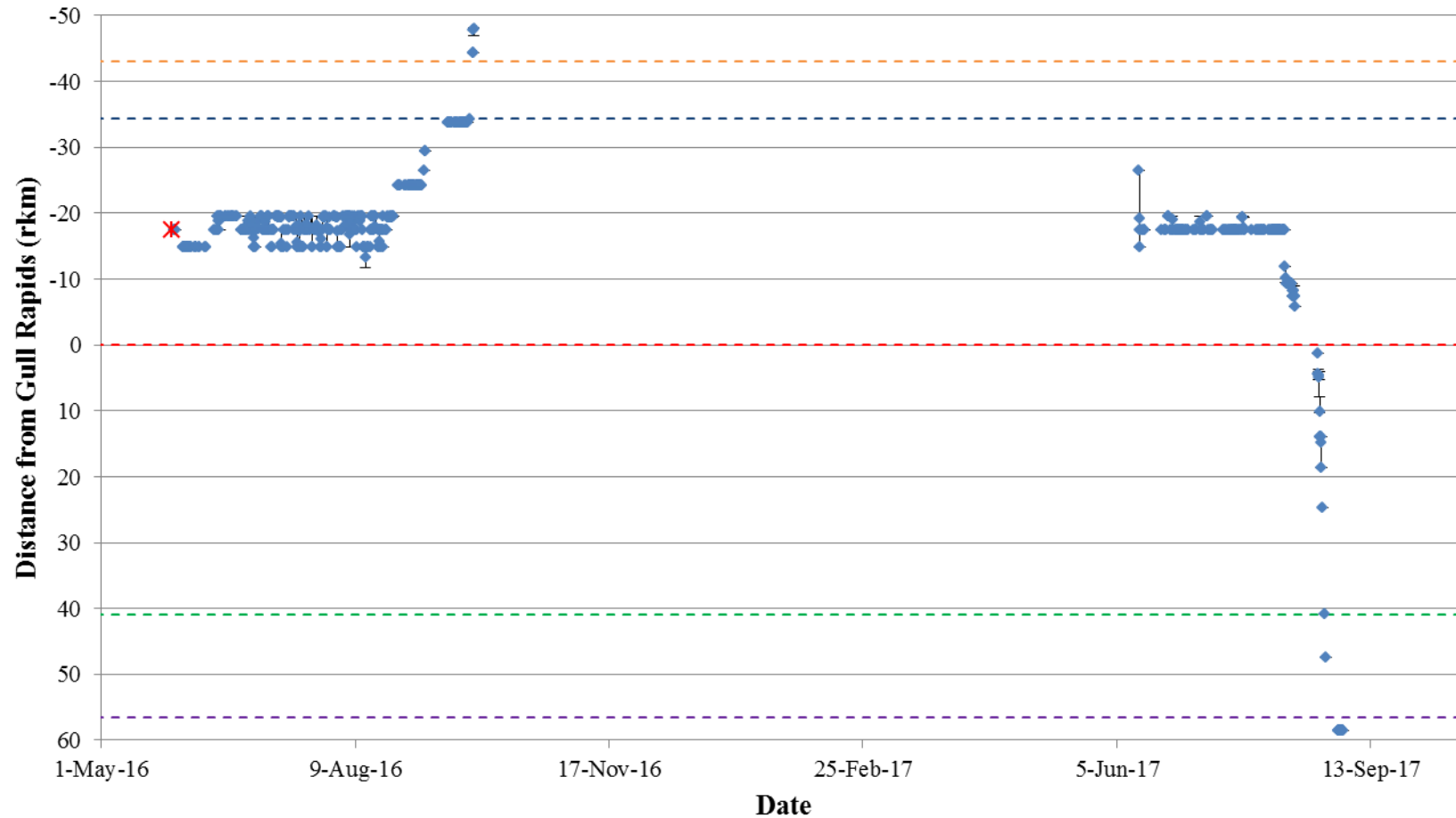


Figure A2-18: Position of a Walleye tagged with an acoustic transmitter (code #53777) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

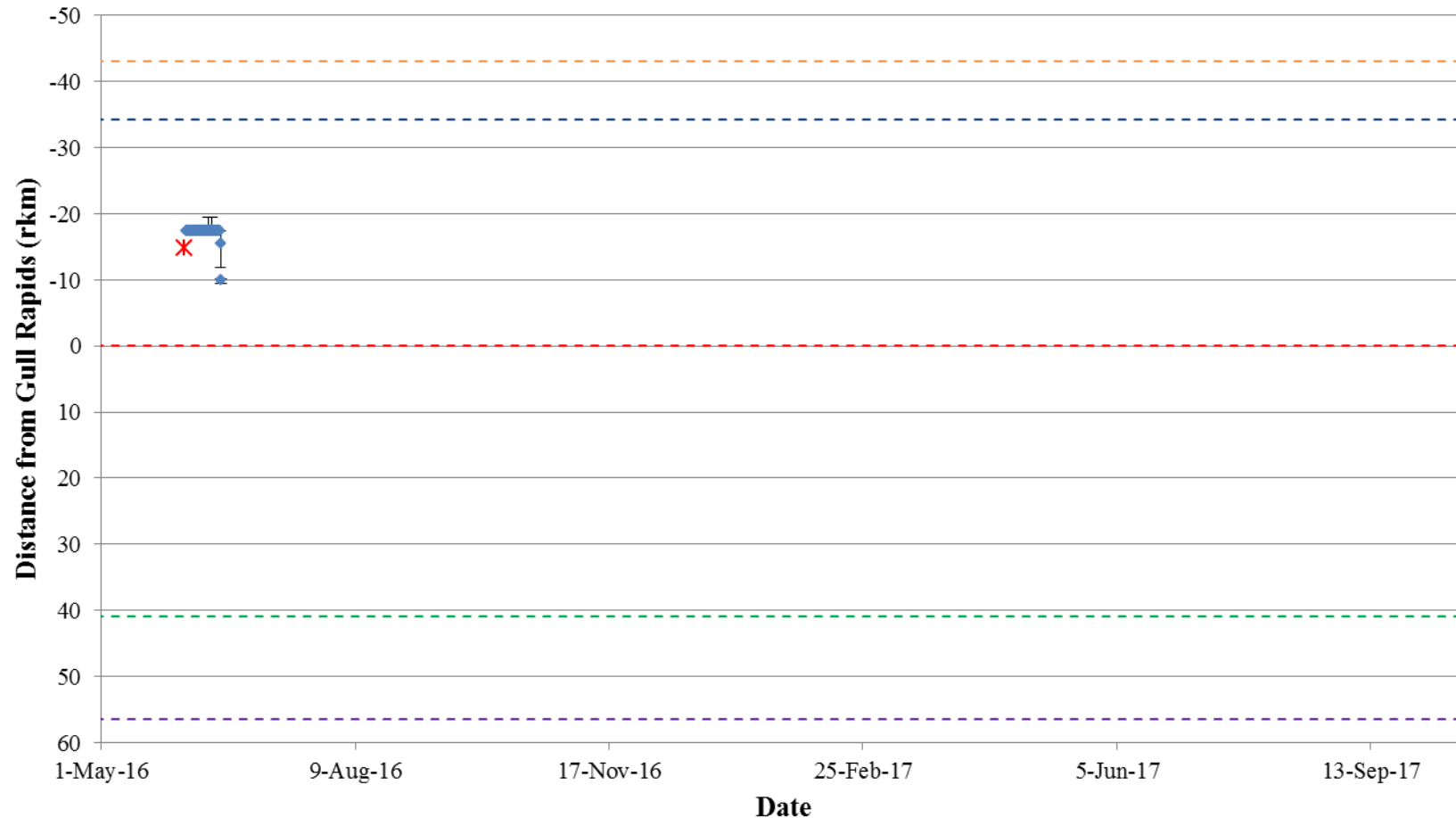


Figure A2-19: Position of a Walleye tagged with an acoustic transmitter (code #53778) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

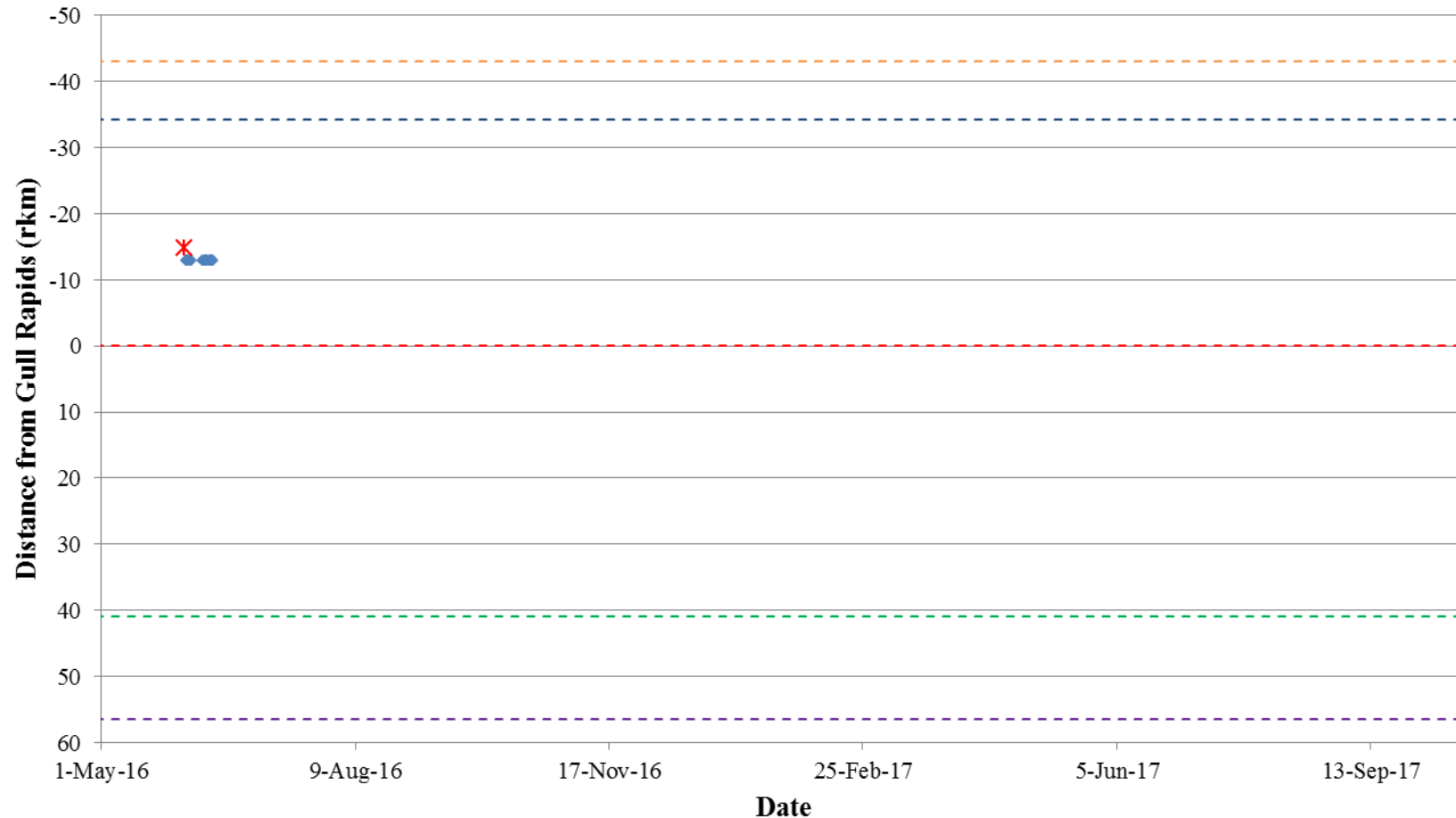


Figure A2-20: Position of a Walleye tagged with an acoustic transmitter (code #53779) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

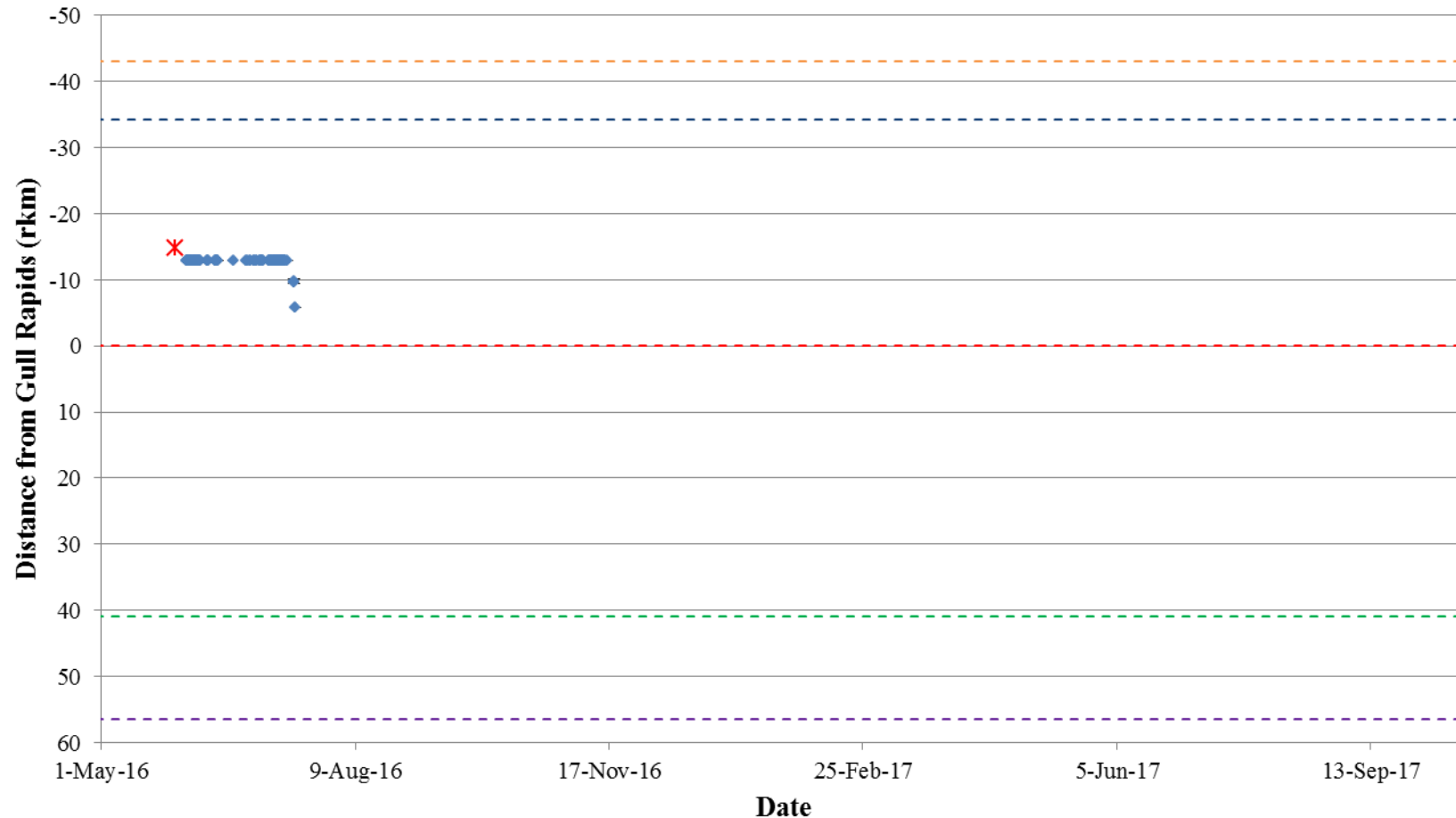


Figure A2-21: Position of a Walleye tagged with an acoustic transmitter (code #53780) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

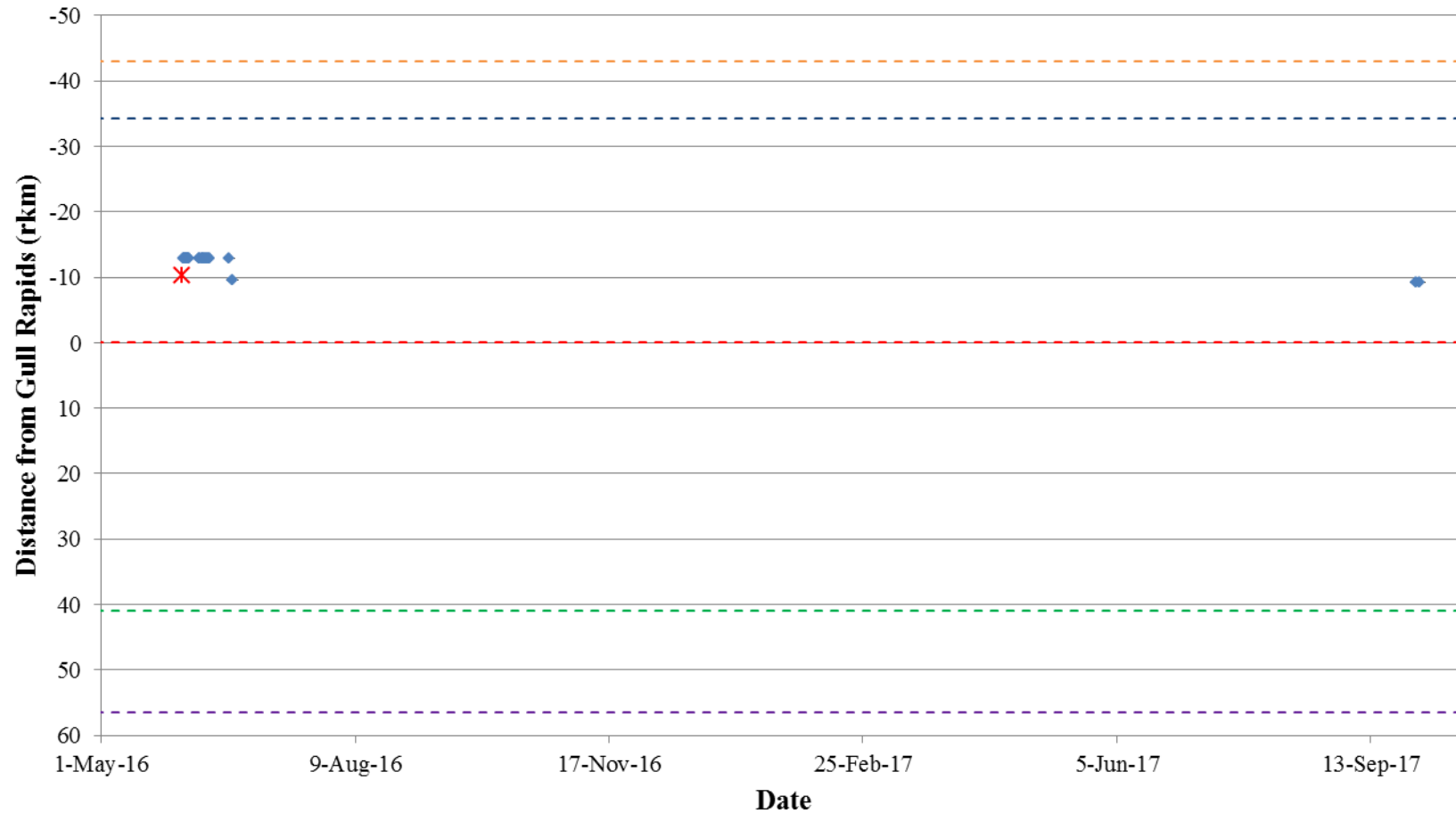


Figure A2-22: Position of a Walleye tagged with an acoustic transmitter (code #53781) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

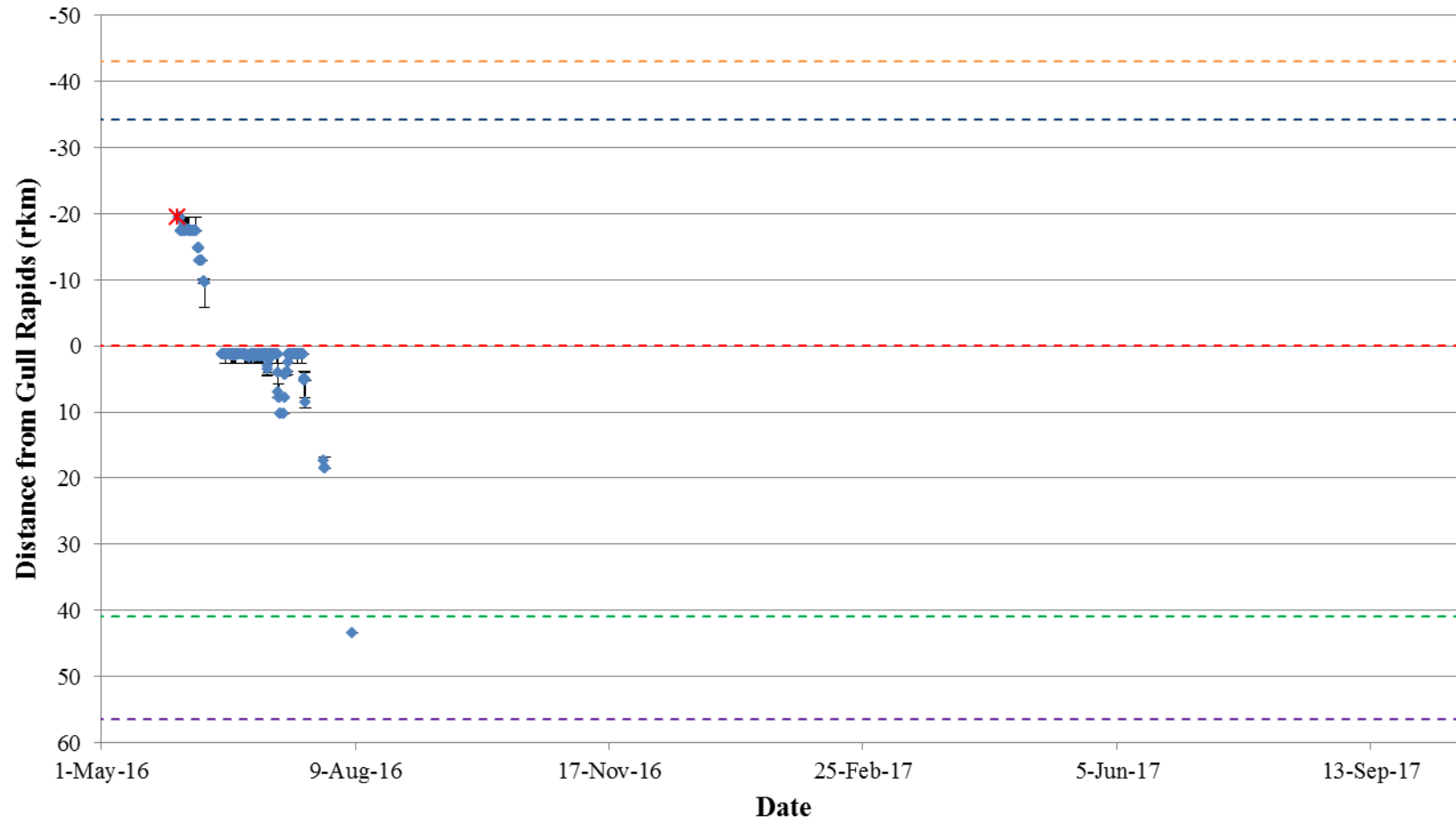


Figure A2-23: Position of a Walleye tagged with an acoustic transmitter (code #53782) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

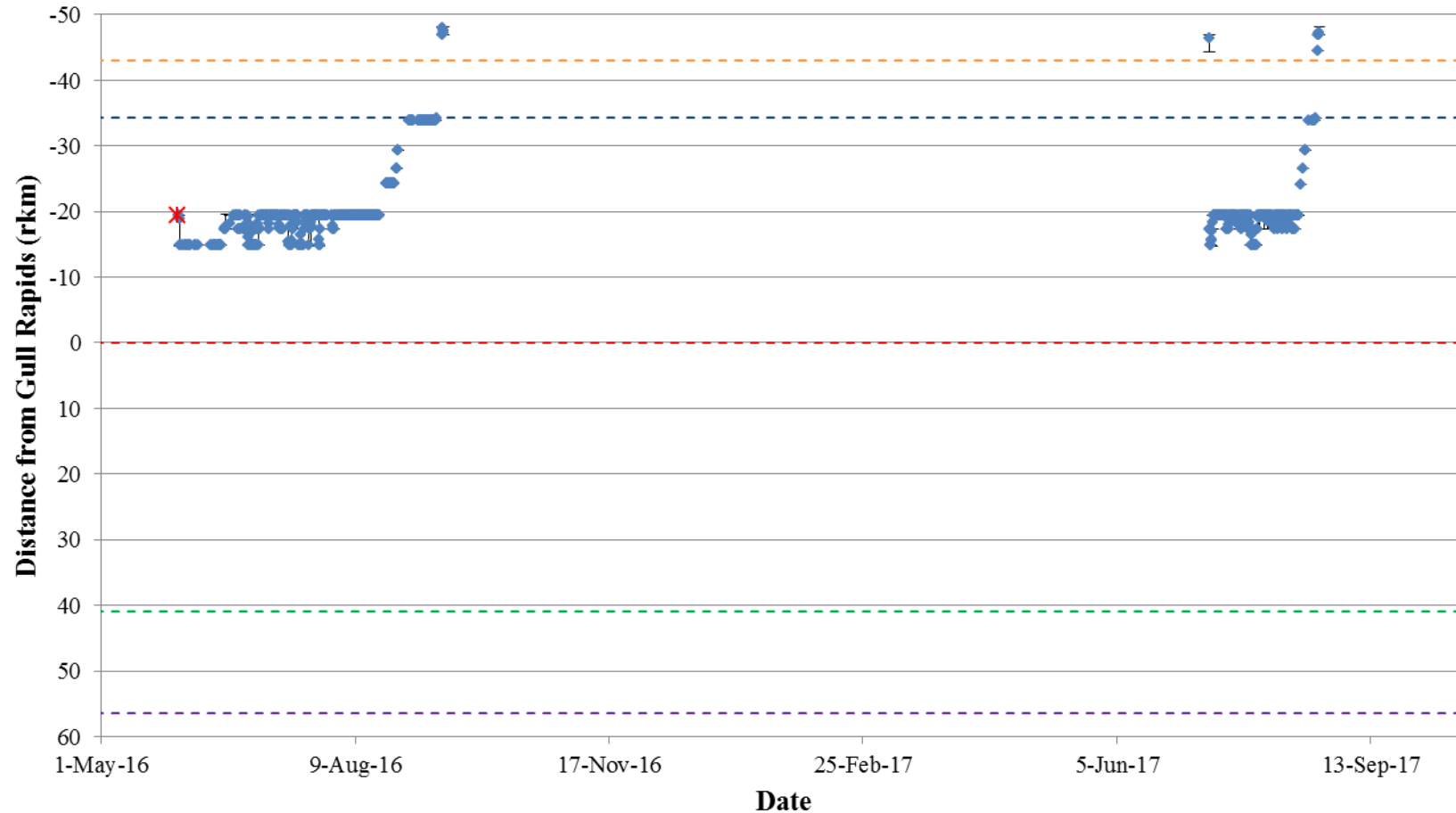


Figure A2-24: Position of a Walleye tagged with an acoustic transmitter (code #53783) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

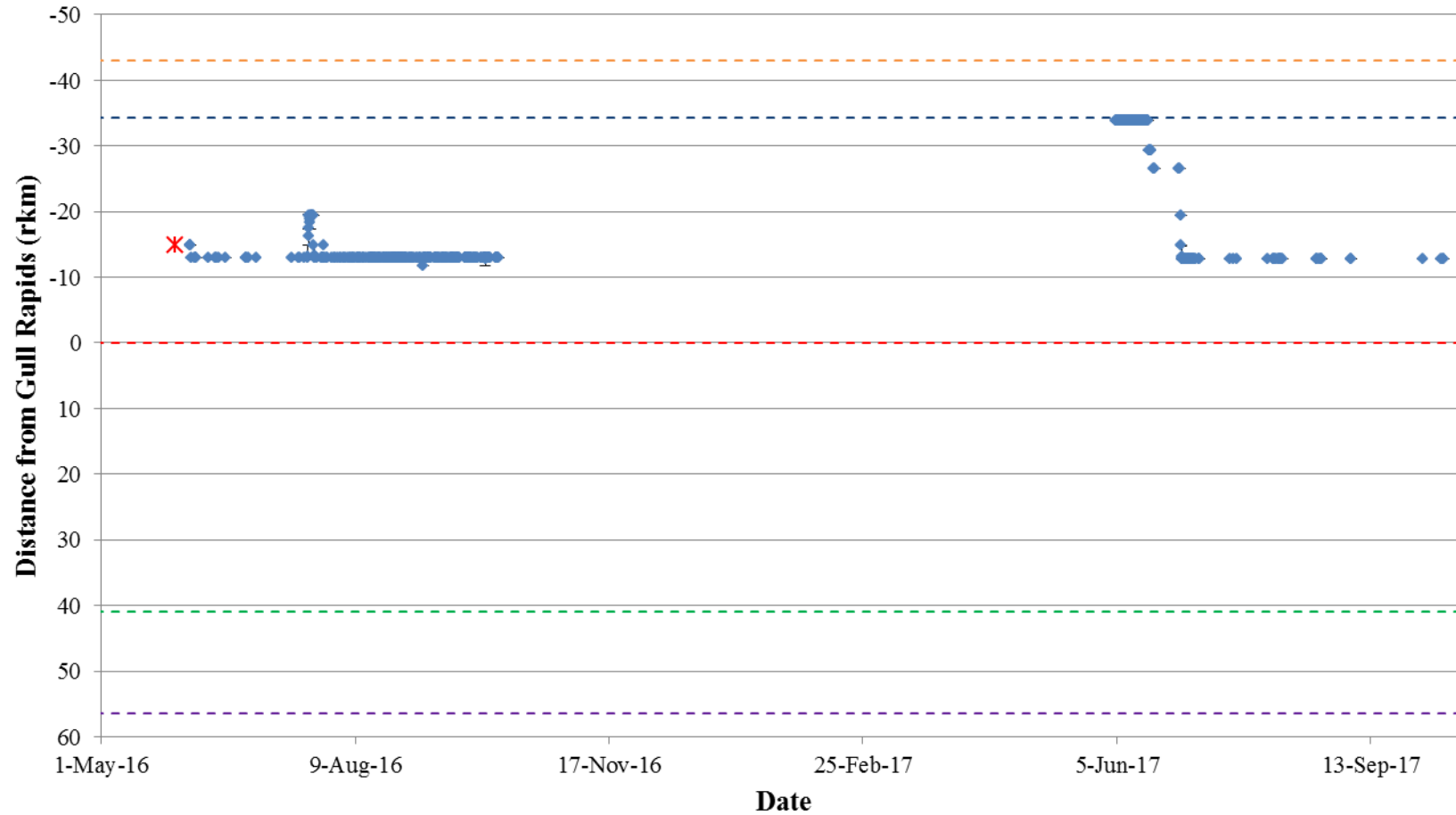


Figure A2-25: Position of a Walleye tagged with an acoustic transmitter (code #53784) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

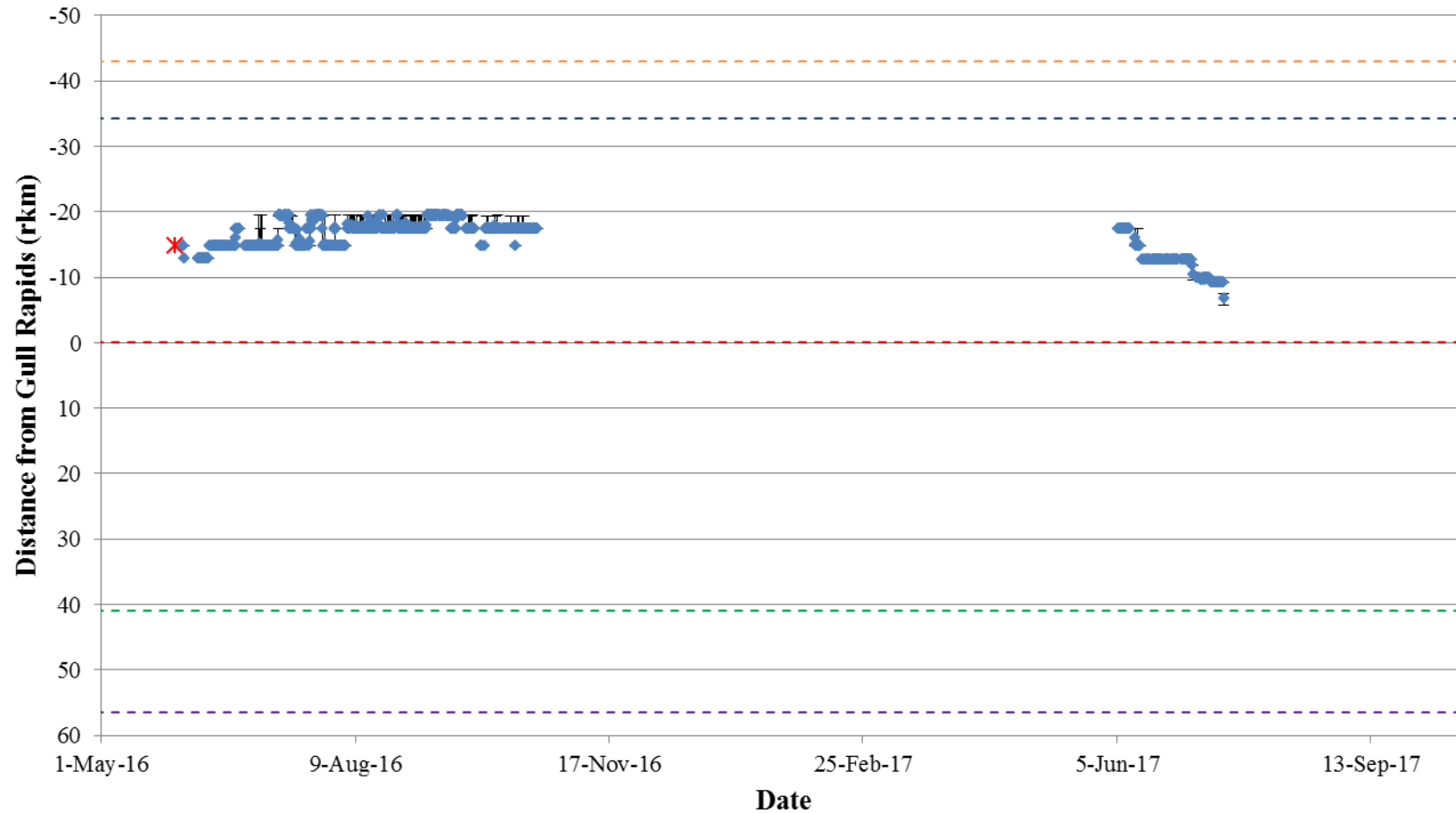


Figure A2-26: Position of a Walleye tagged with an acoustic transmitter (code #53785) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

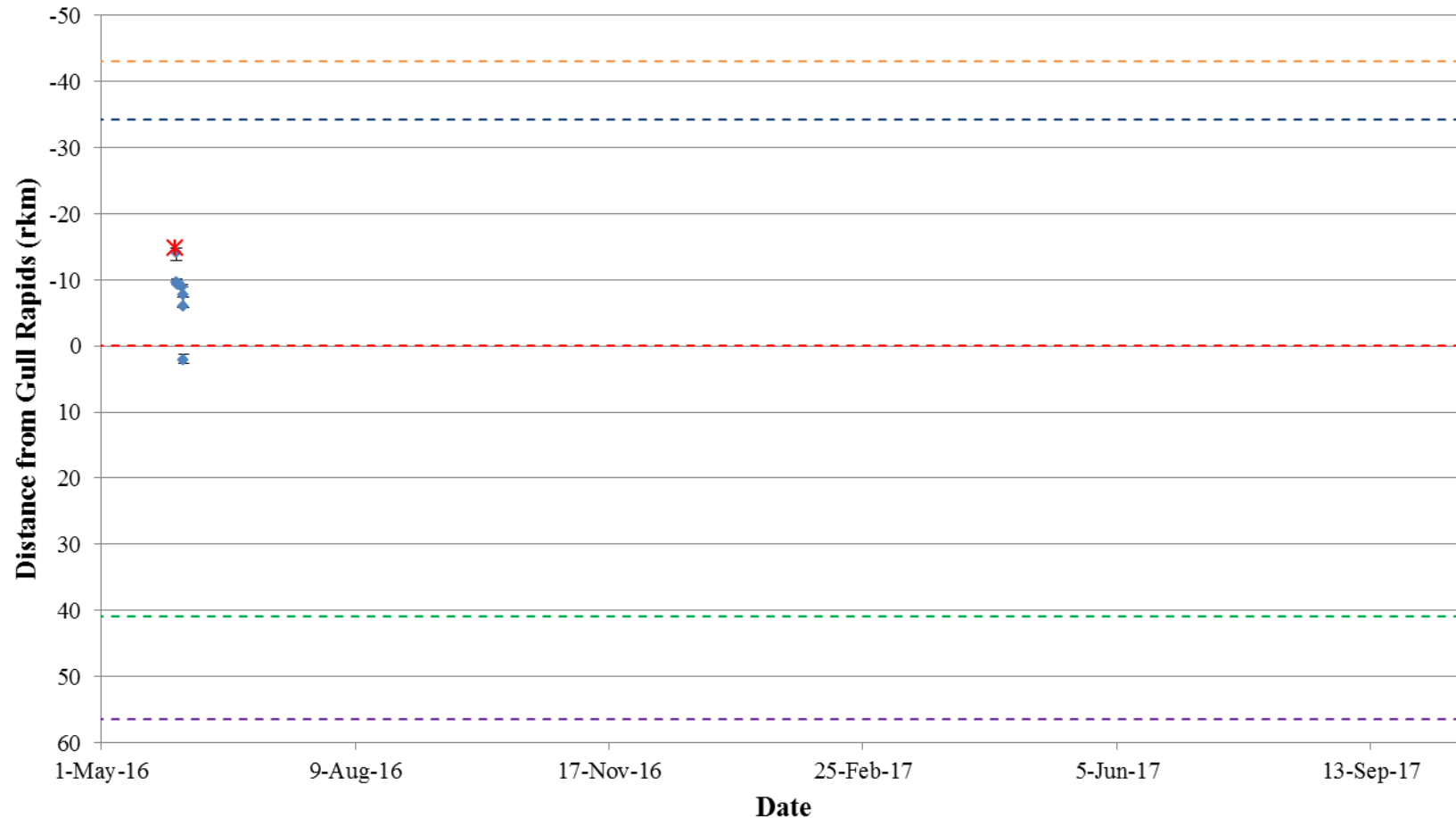


Figure A2-27: Position of a Walleye tagged with an acoustic transmitter (code #53786) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

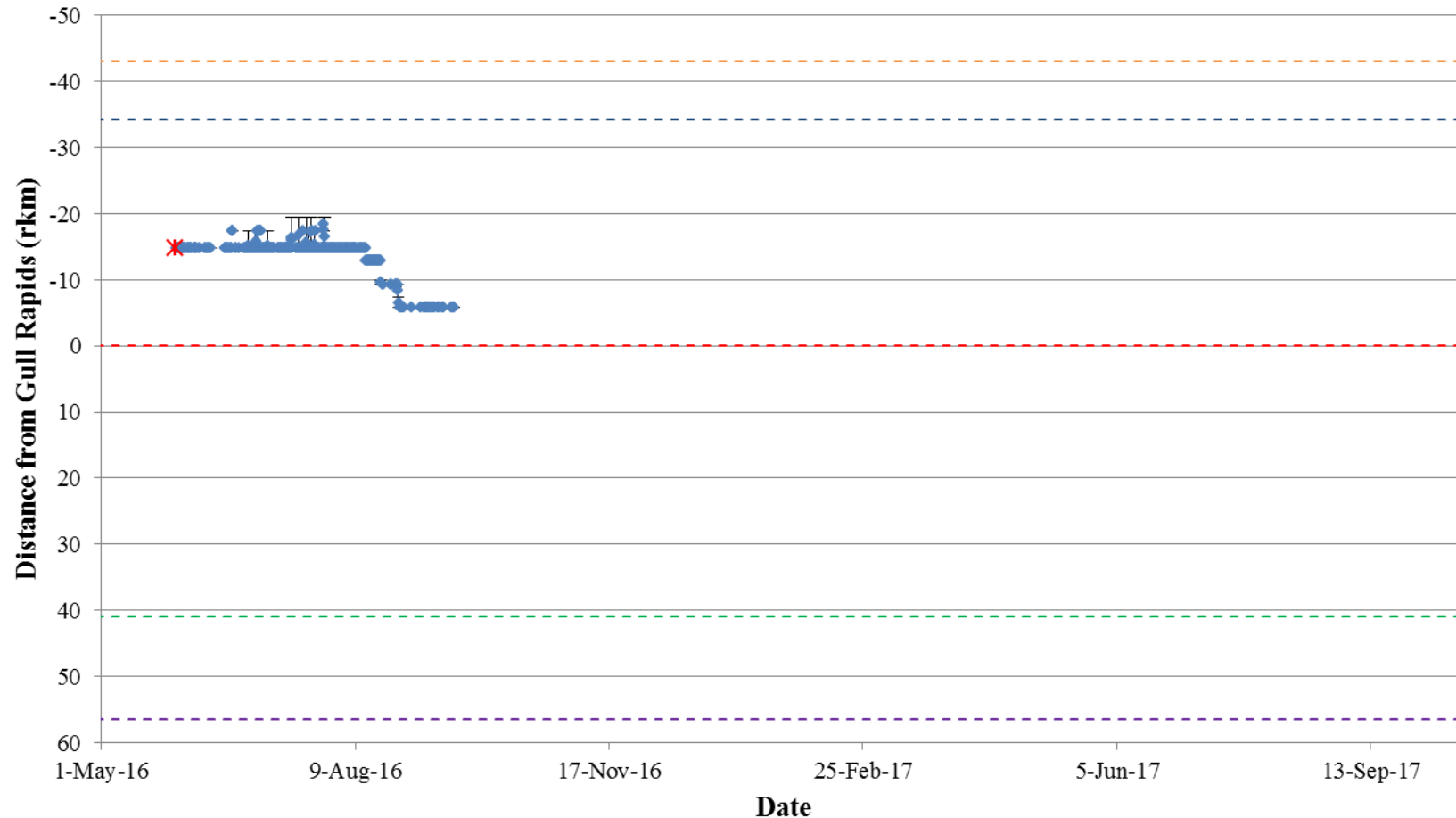


Figure A2-28: Position of a Walleye tagged with an acoustic transmitter (code #53787) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

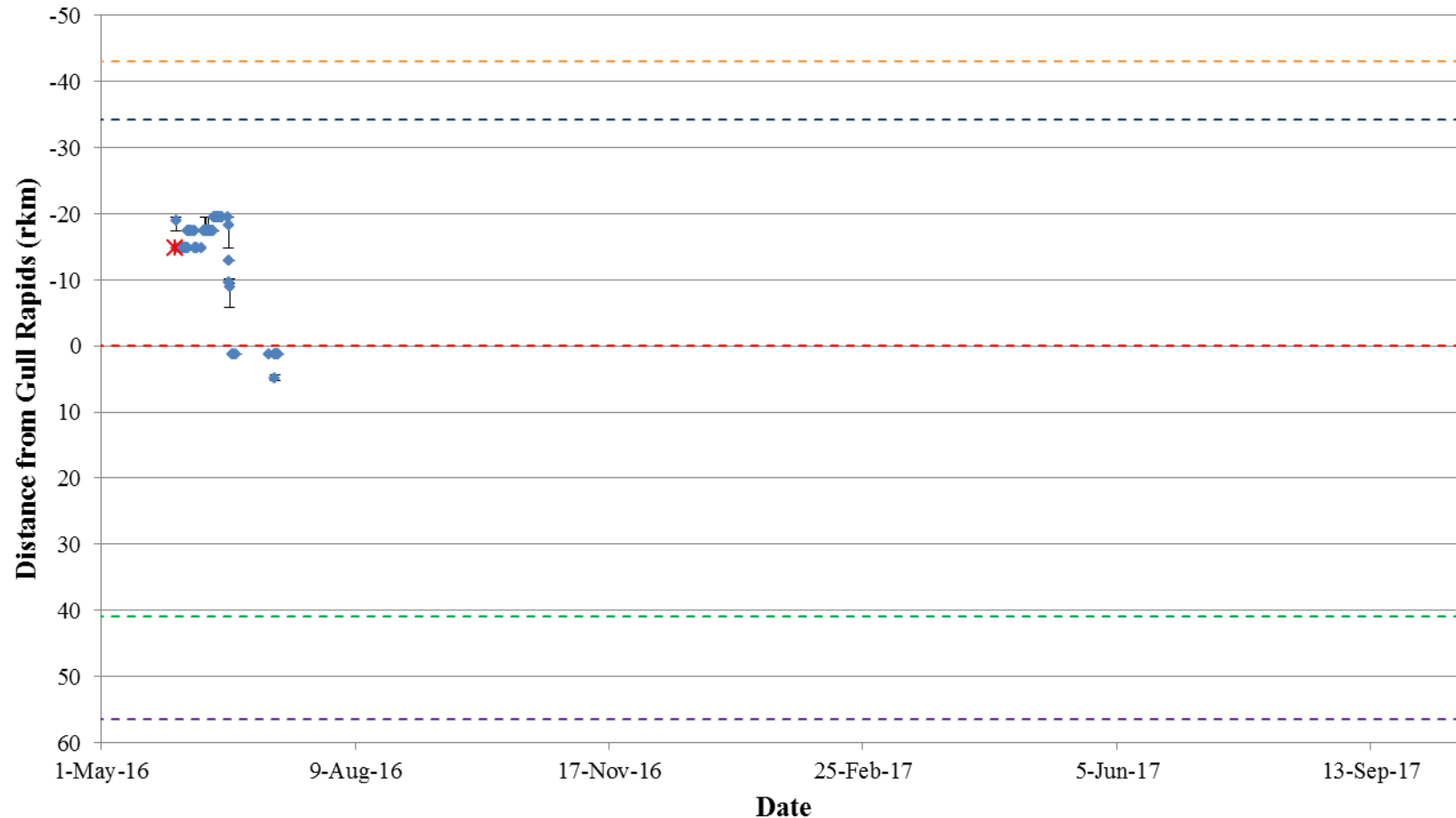


Figure A2-29: Position of a Walleye tagged with an acoustic transmitter (code #53788) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

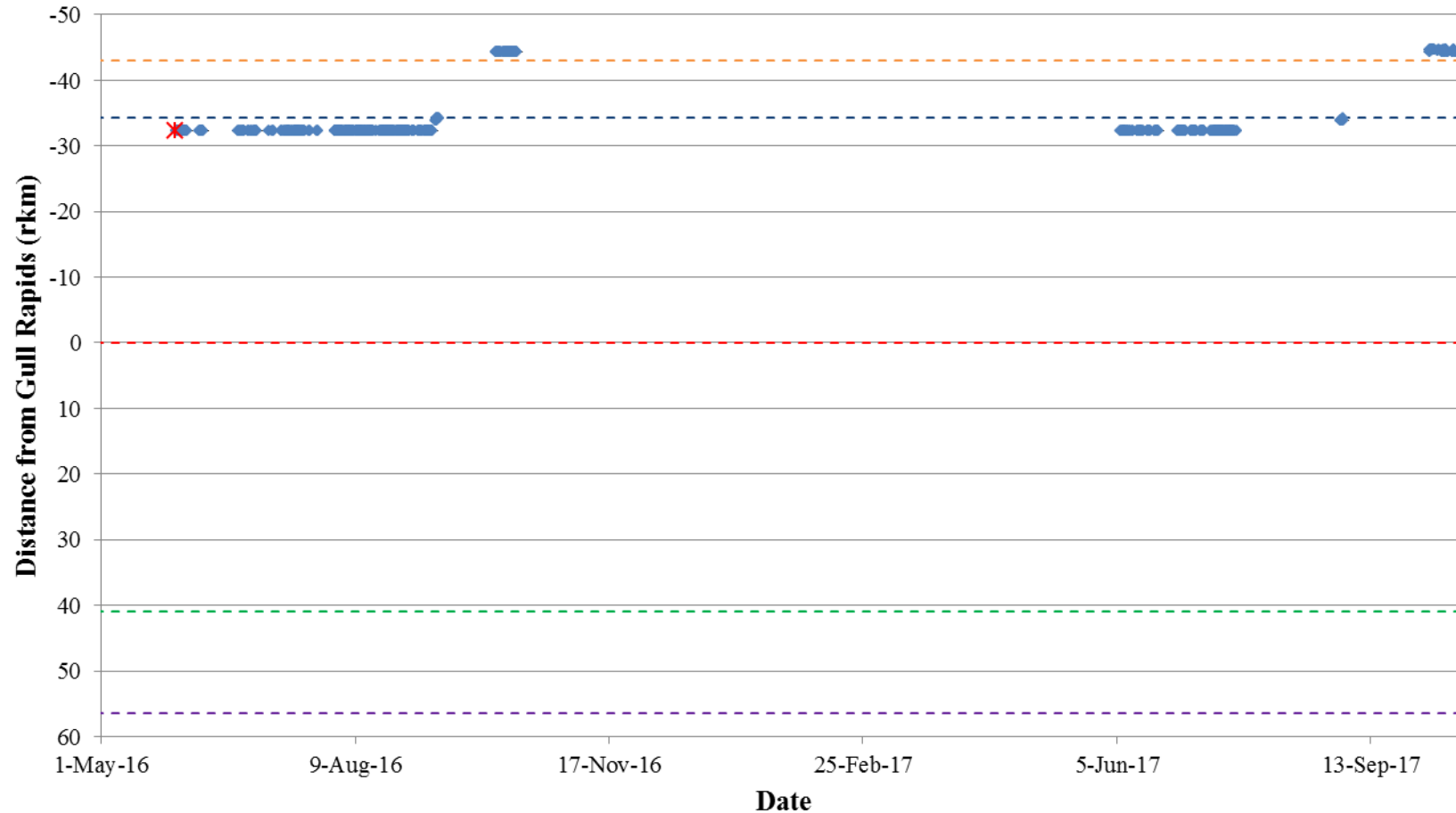


Figure A2-30: Position of a Walleye tagged with an acoustic transmitter (code #53789) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

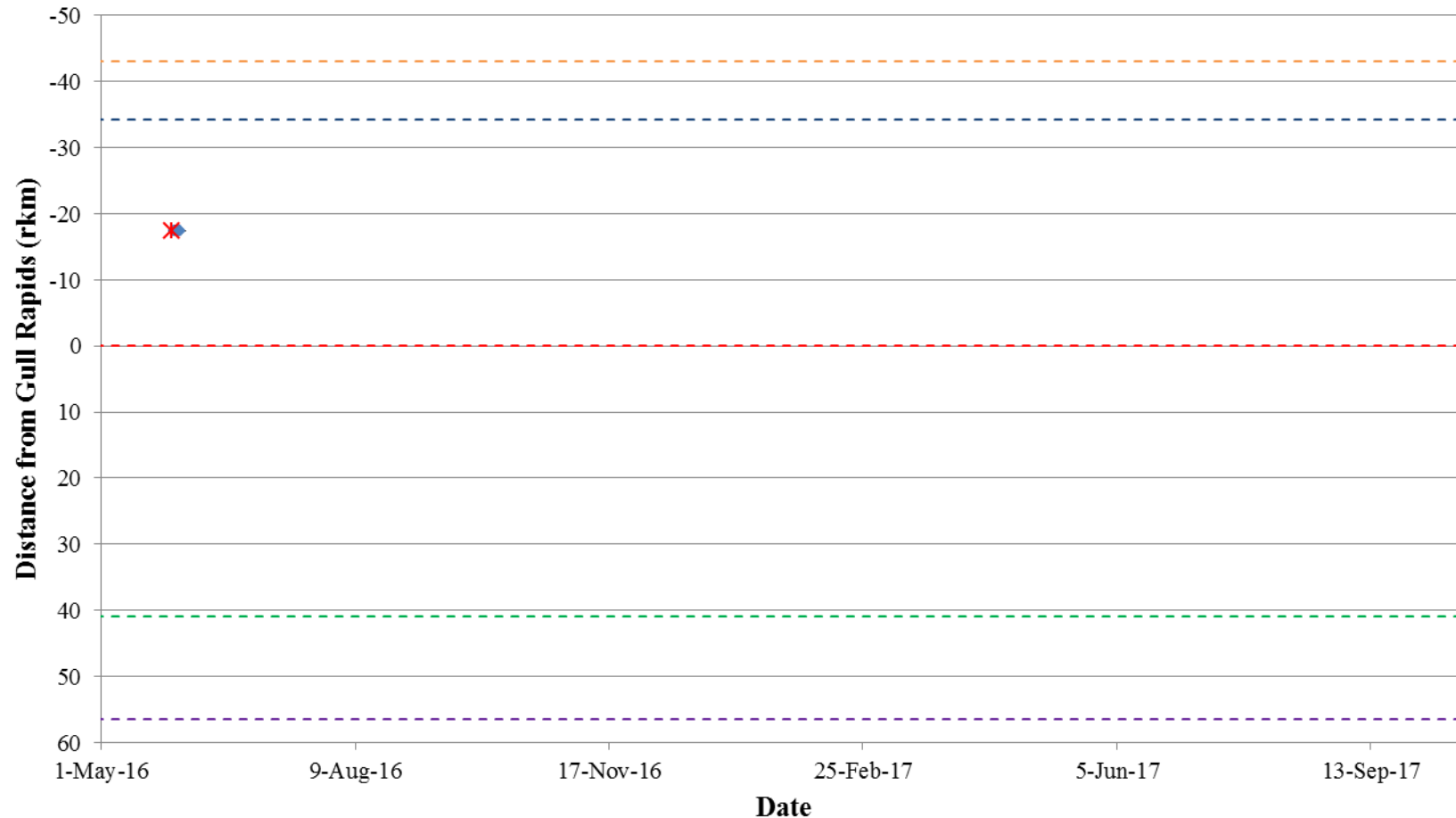


Figure A2-31: Position of a Walleye tagged with an acoustic transmitter (code #53790) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

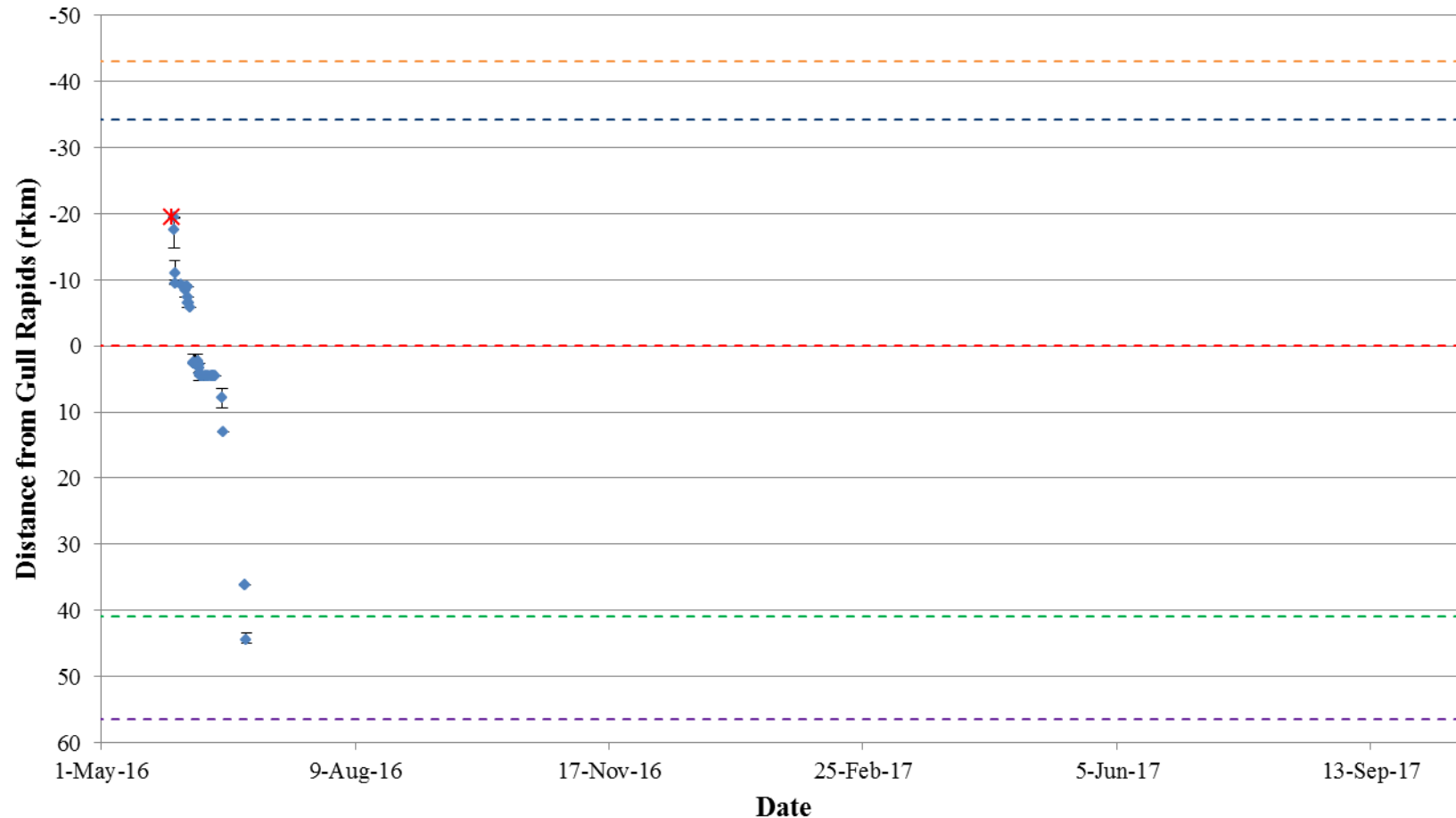


Figure A2-32: Position of a Walleye tagged with an acoustic transmitter (code #53791) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

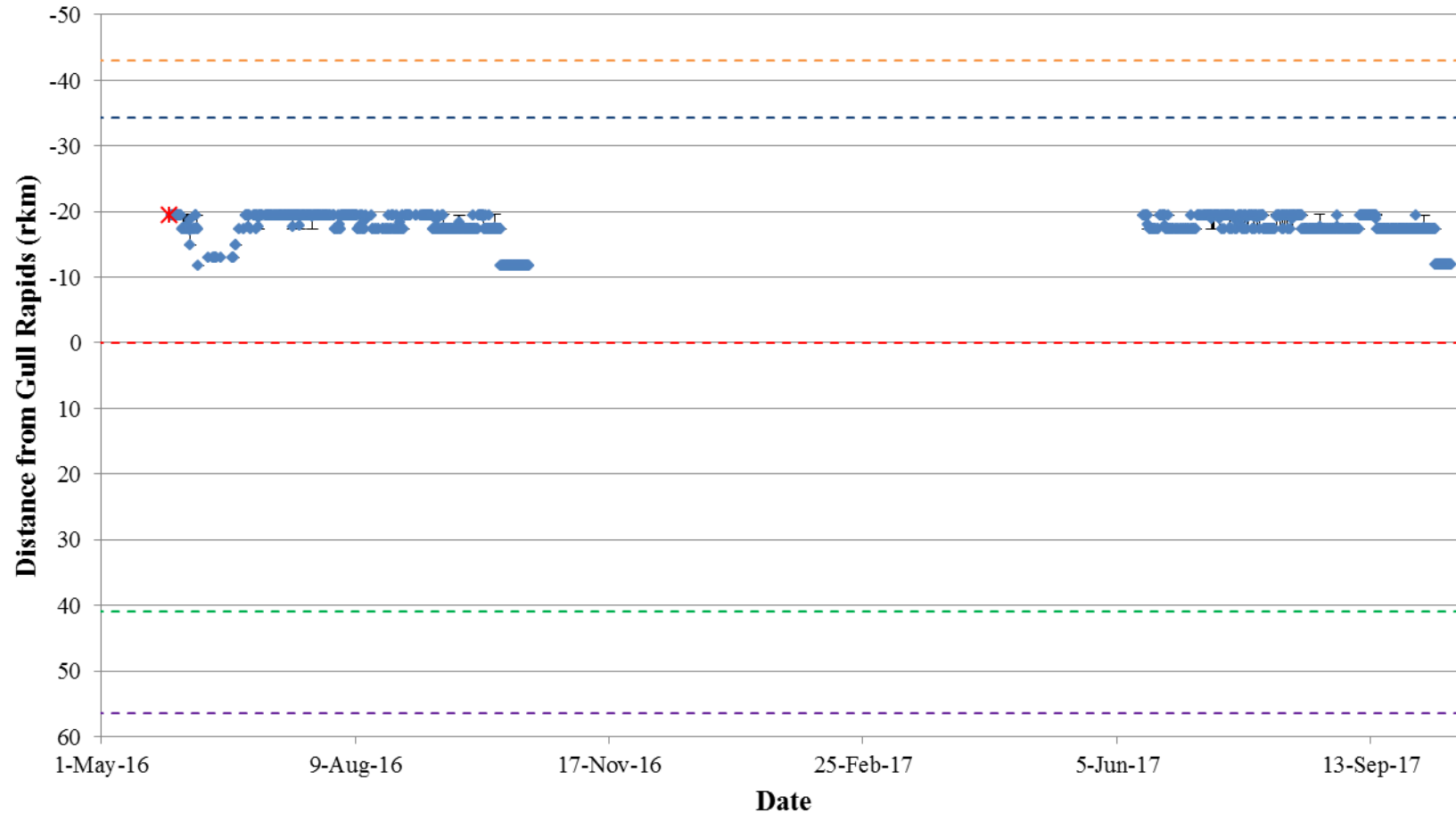
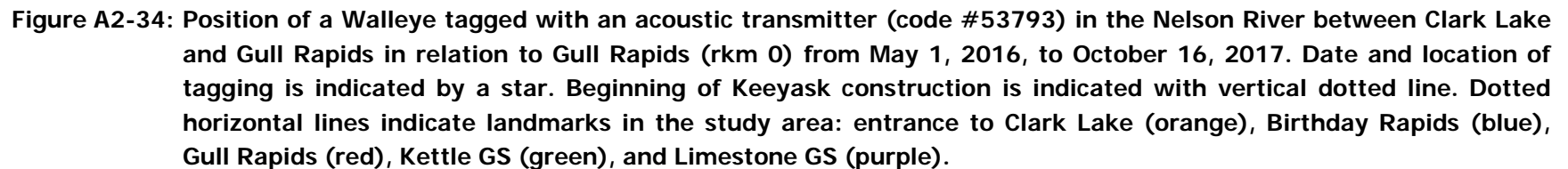


Figure A2-33: Position of a Walleye tagged with an acoustic transmitter (code #53792) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).



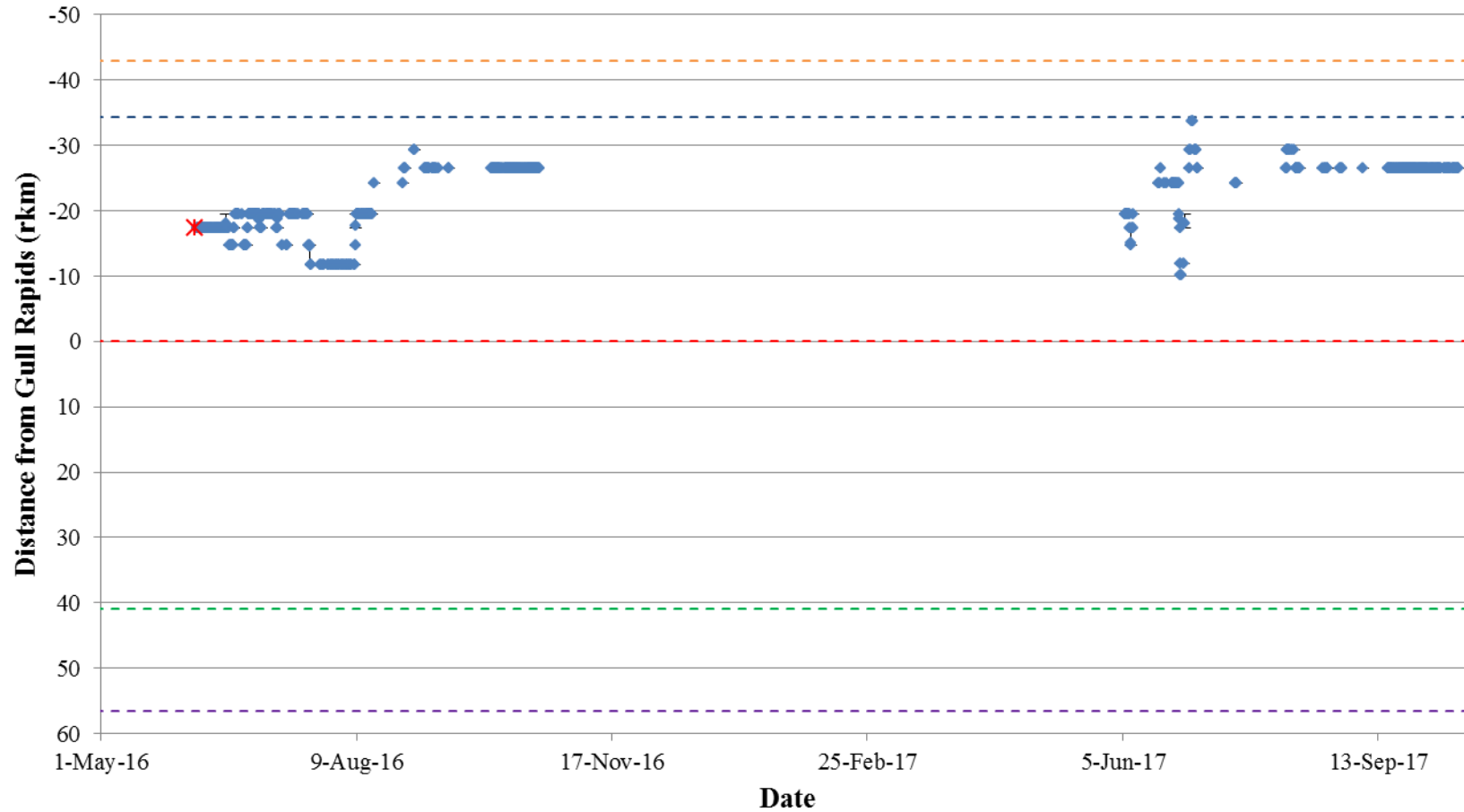


Figure A2-35: Position of a Walleye tagged with an acoustic transmitter (code #53794) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

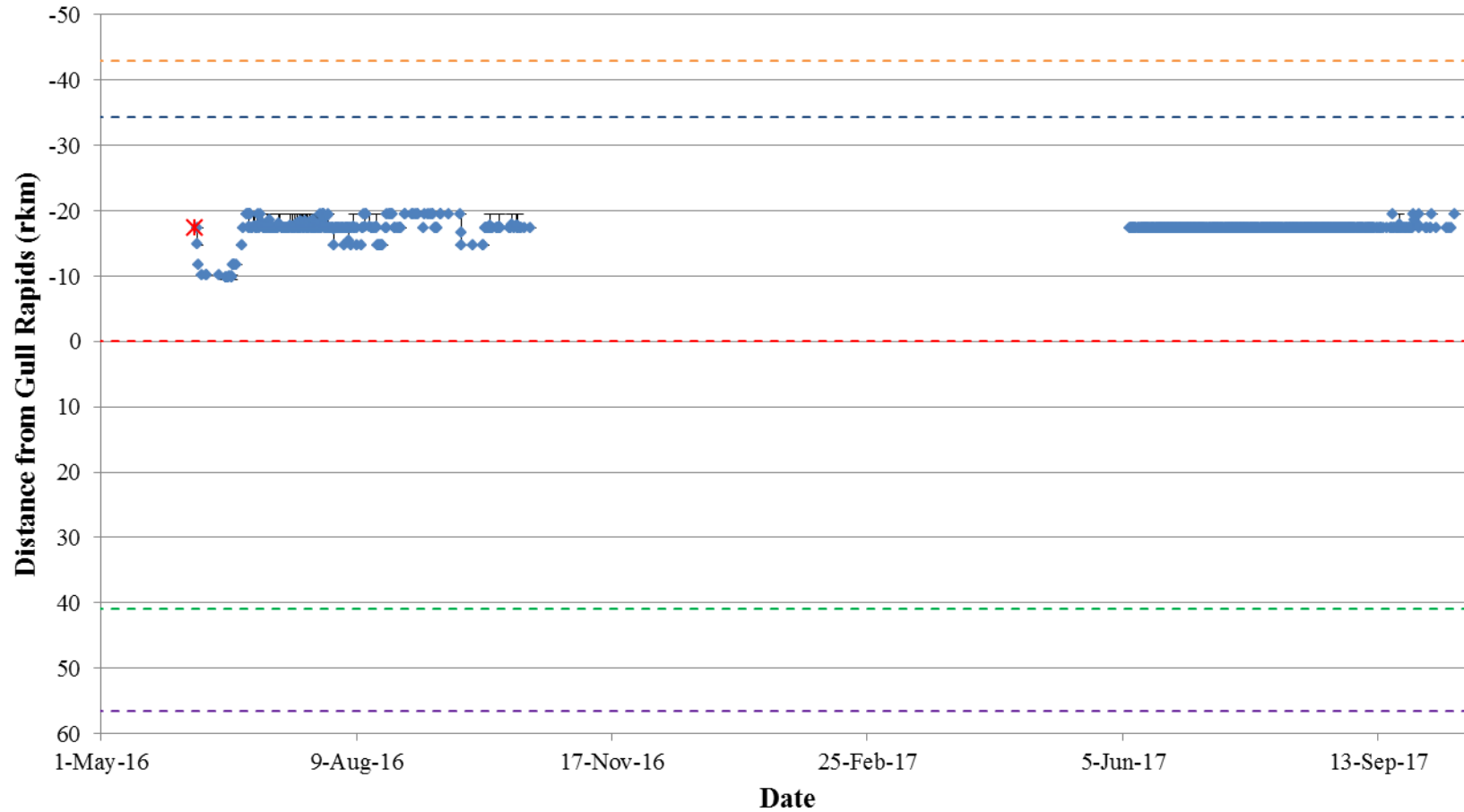


Figure A2-36: Position of a Walleye tagged with an acoustic transmitter (code #53795) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

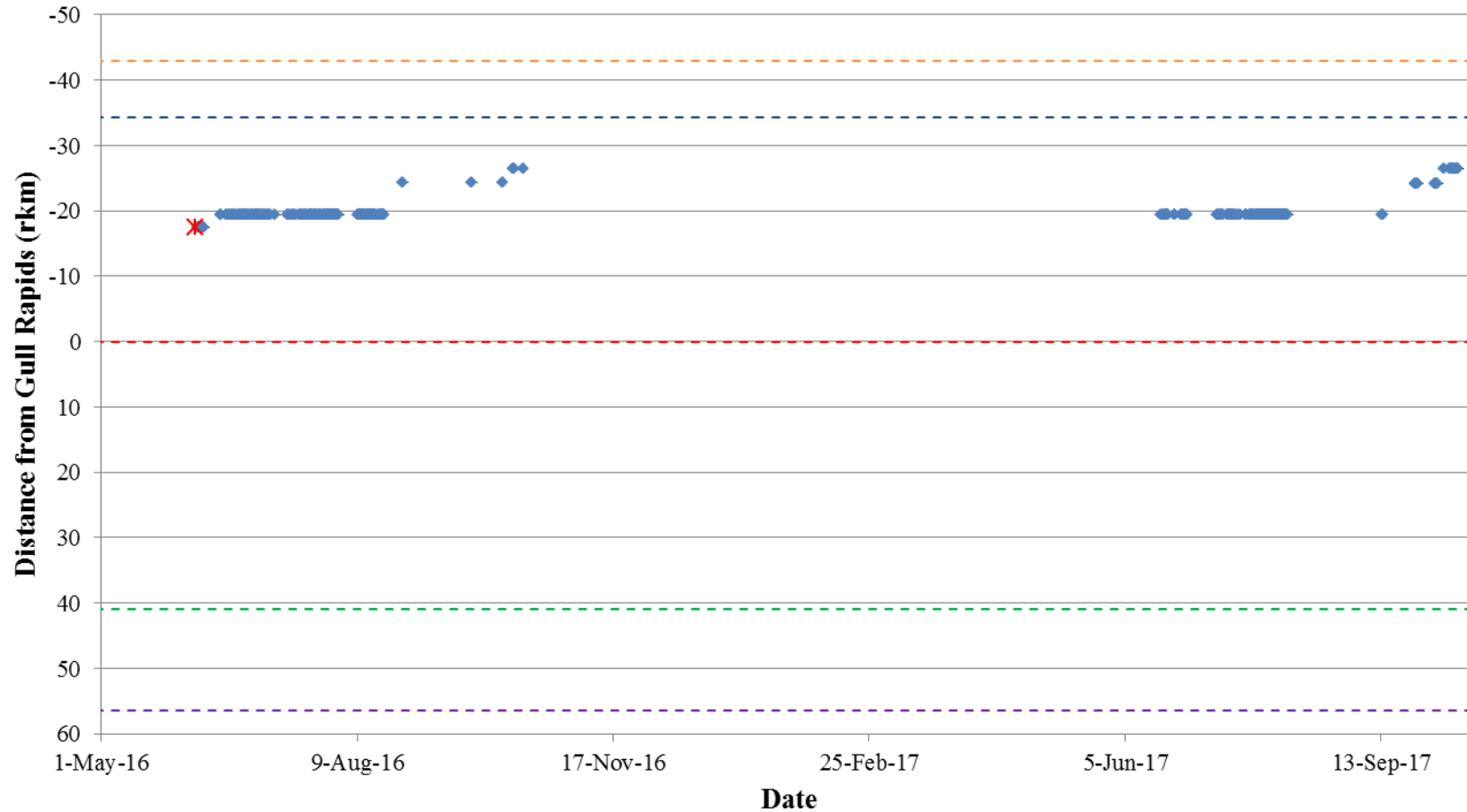


Figure A2-37: Position of a Walleye tagged with an acoustic transmitter (code #53796) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

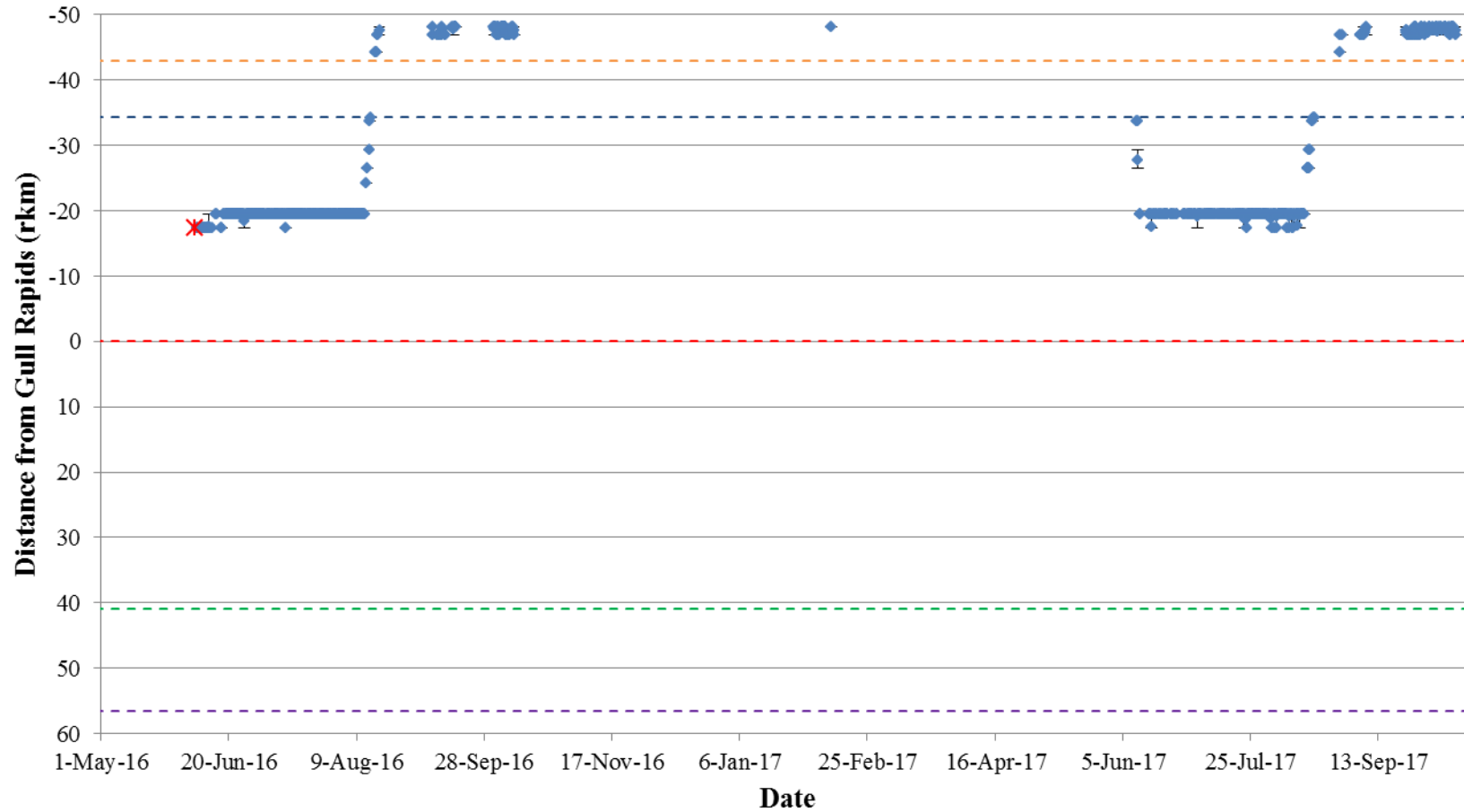


Figure A2-38: Position of a Walleye tagged with an acoustic transmitter (code #53797) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

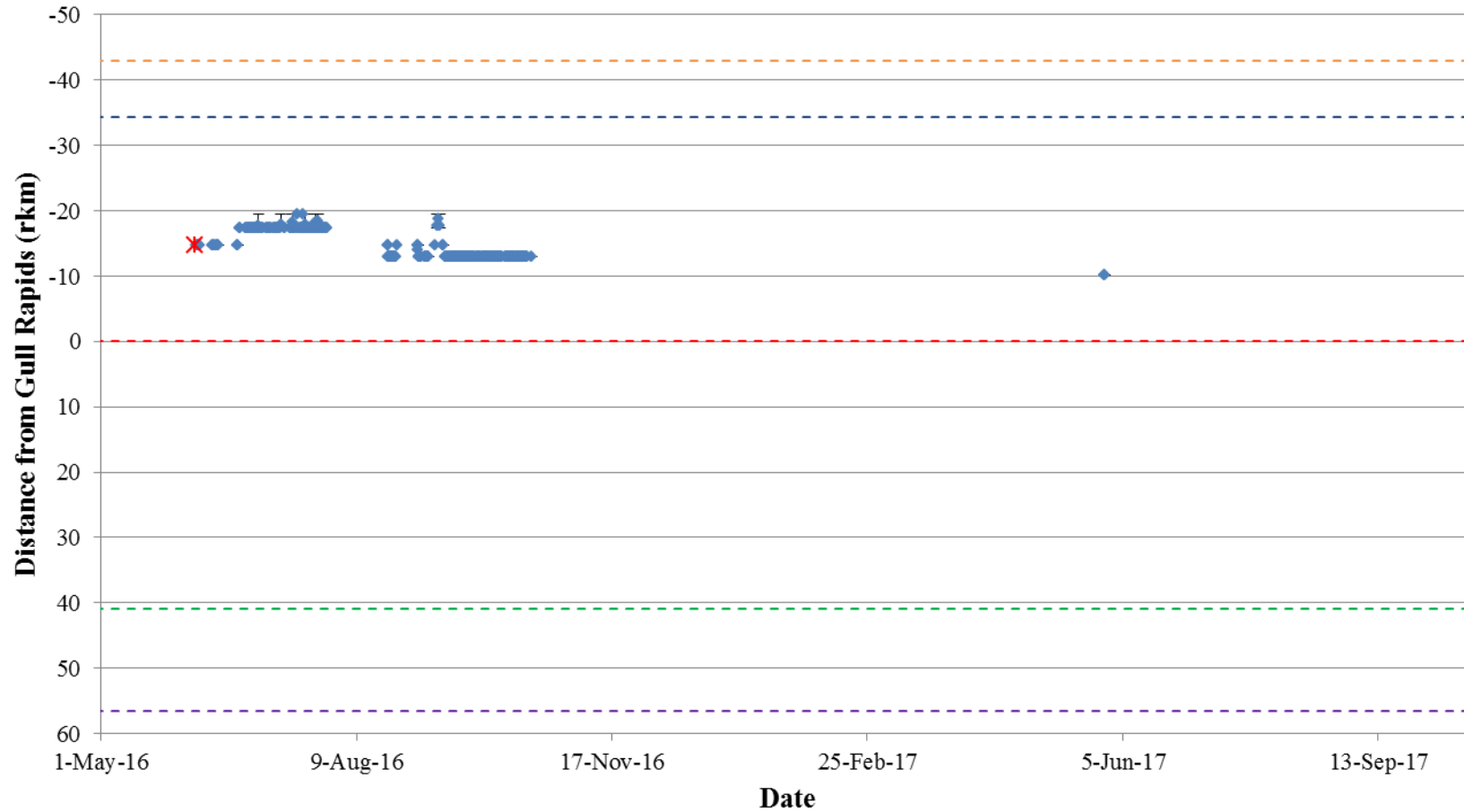


Figure A2-39: Position of a Walleye tagged with an acoustic transmitter (code #53798) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

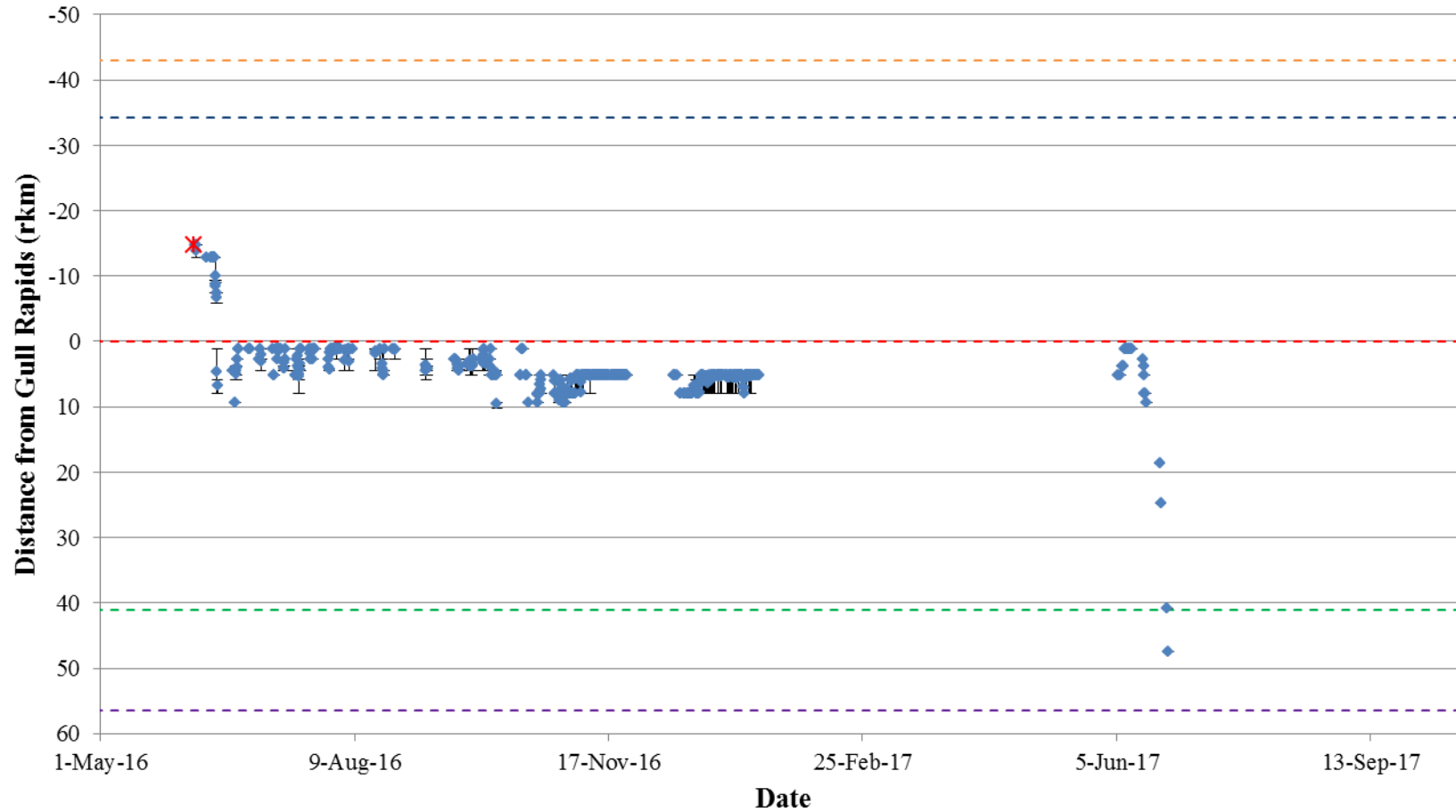


Figure A2-40: Position of a Walleye tagged with an acoustic transmitter (code #53799) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

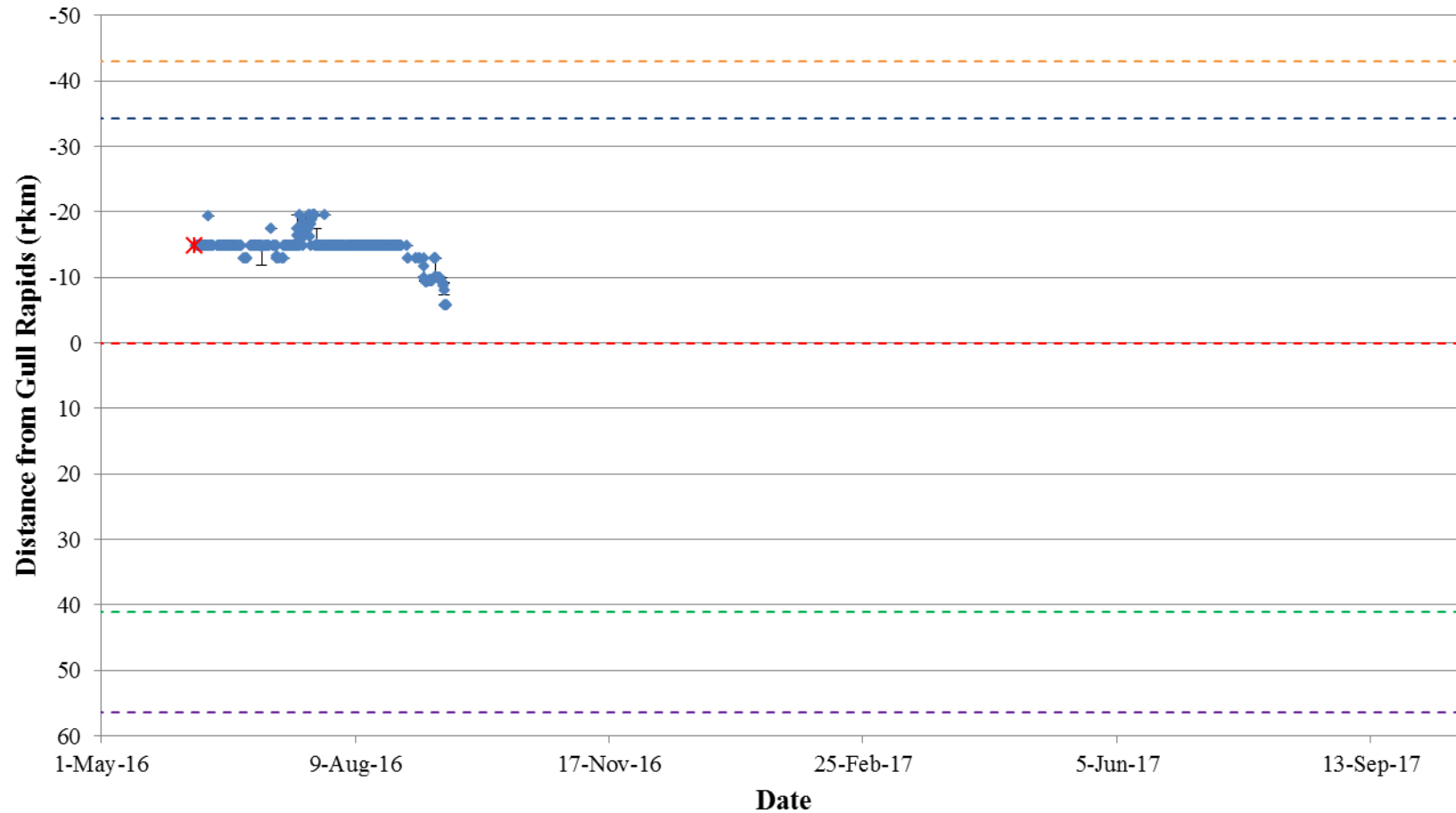


Figure A2-41: Position of a Walleye tagged with an acoustic transmitter (code #53800) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

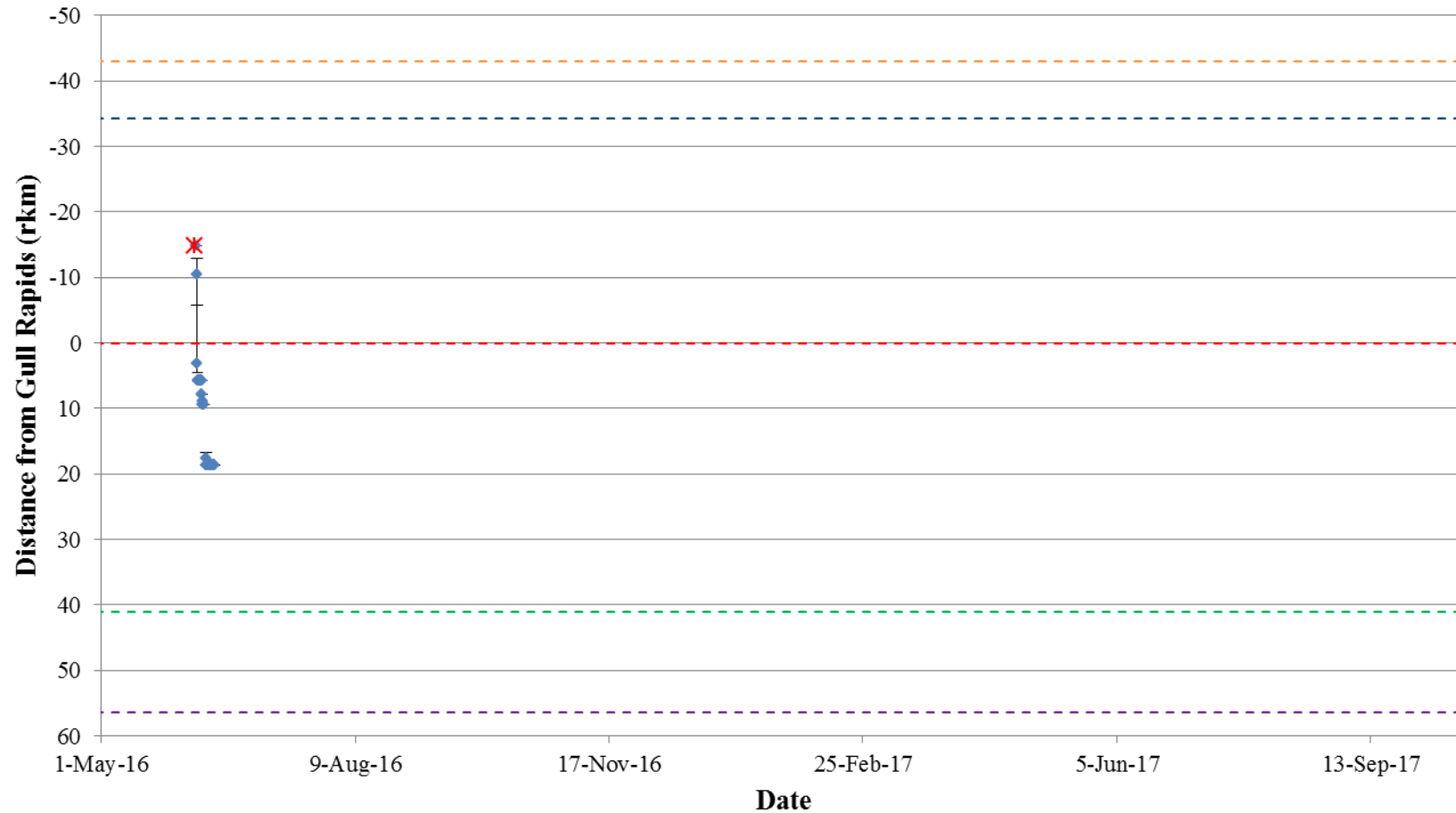


Figure A2-42: Position of a Walleye tagged with an acoustic transmitter (code #53801) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

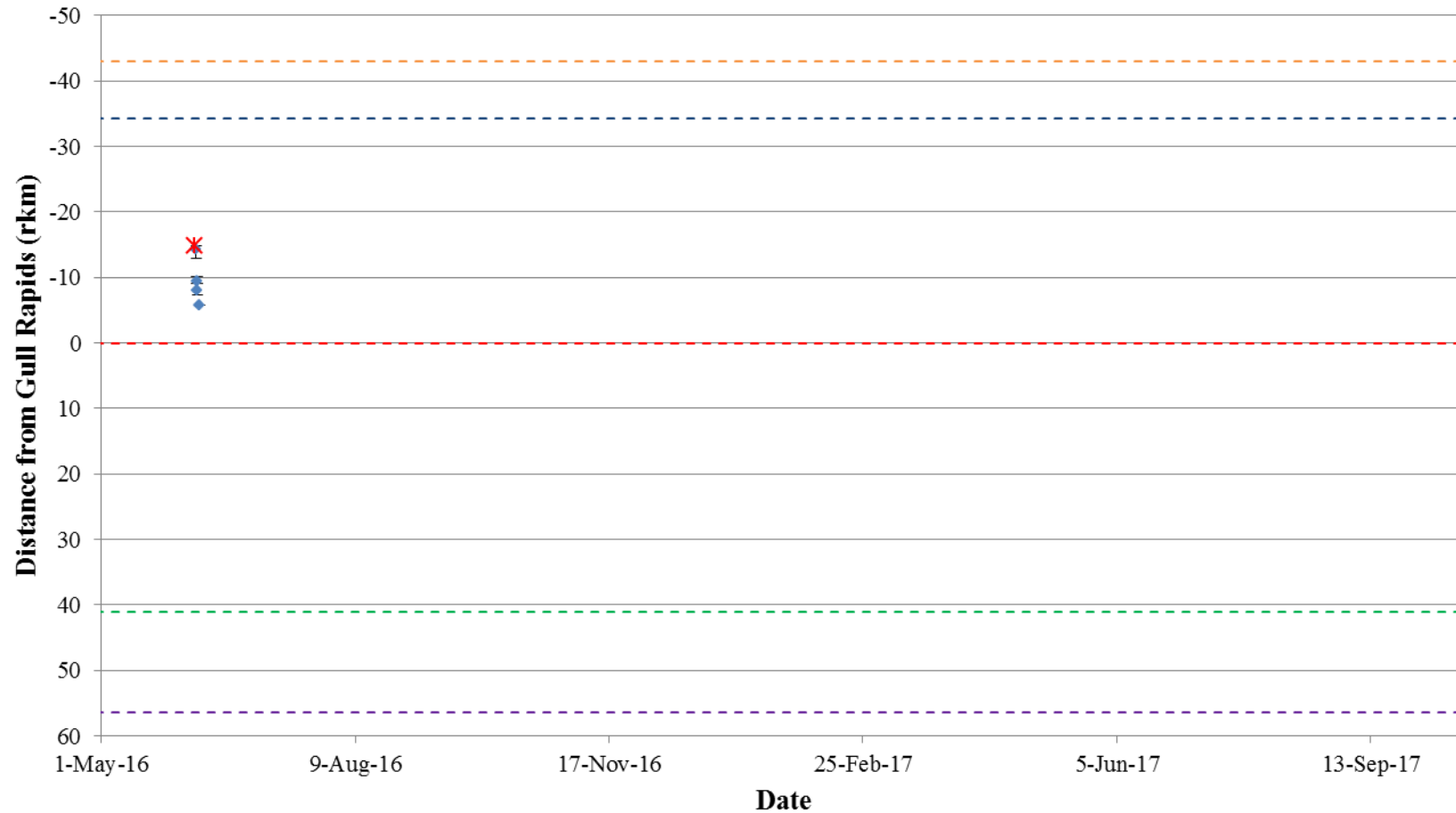


Figure A2-43: Position of a Walleye tagged with an acoustic transmitter (code #53802) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

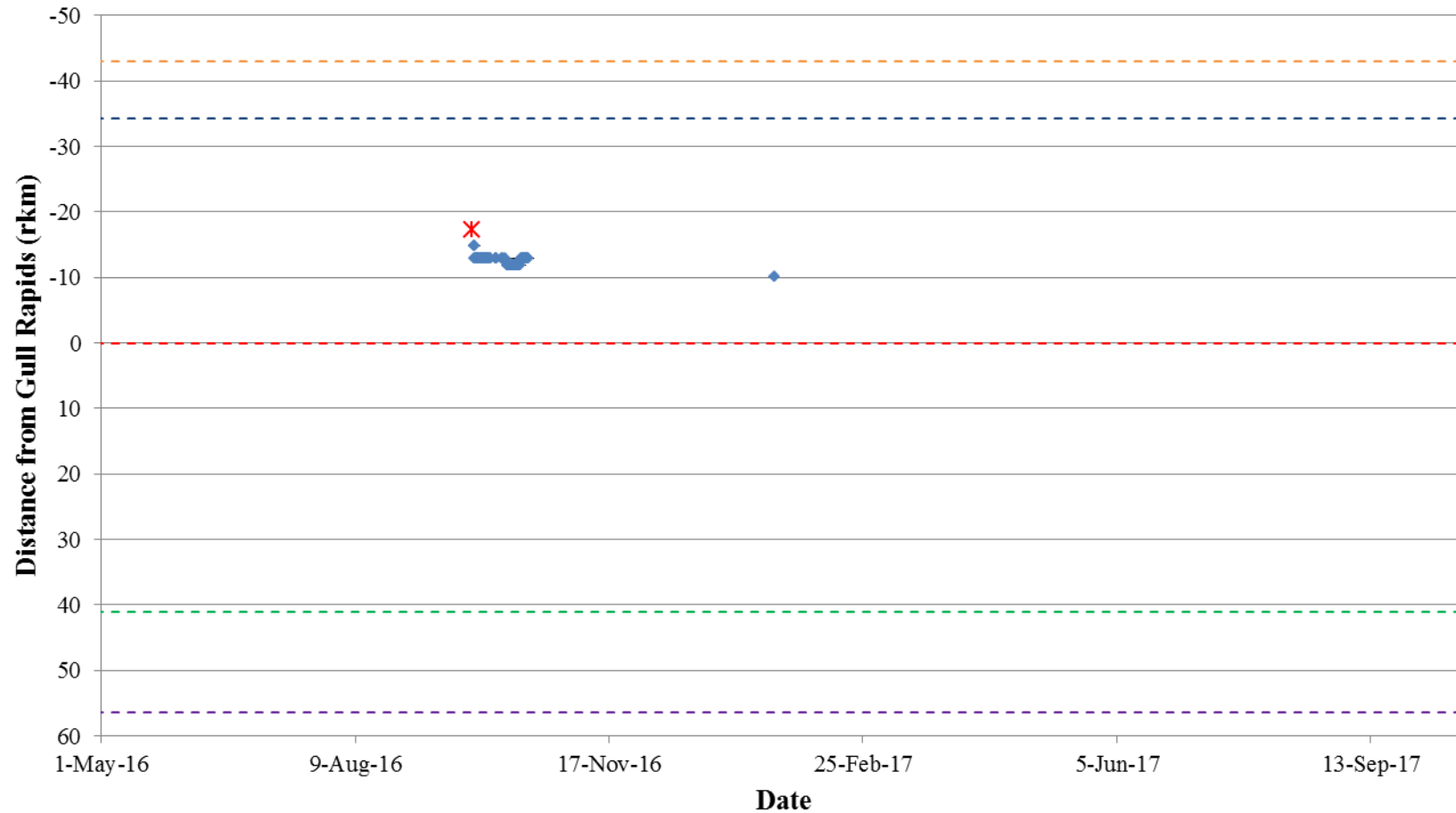


Figure A2-44: Position of a Walleye tagged with an acoustic transmitter (code #53803) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

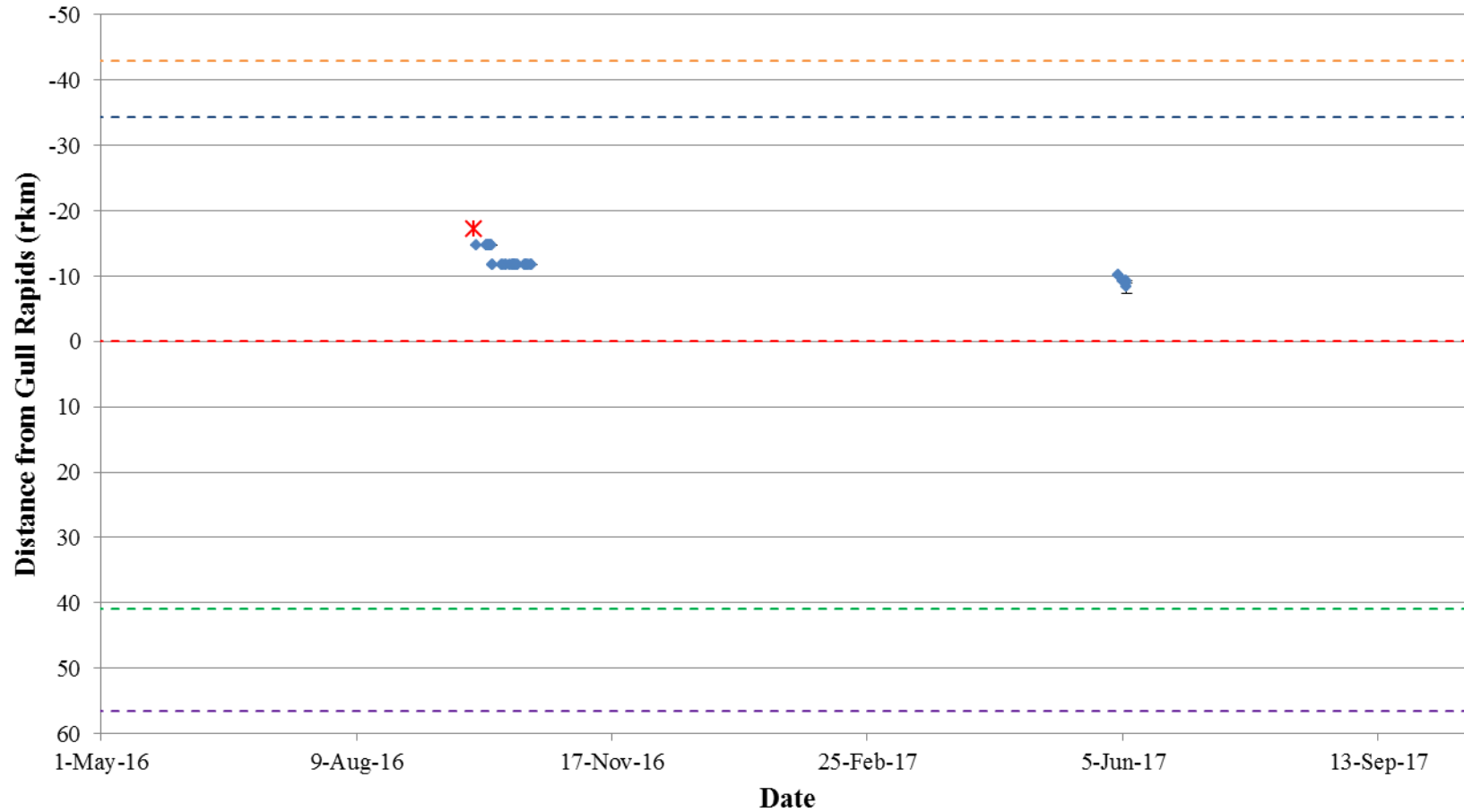


Figure A2-45: Position of a Walleye tagged with an acoustic transmitter (code #53804) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

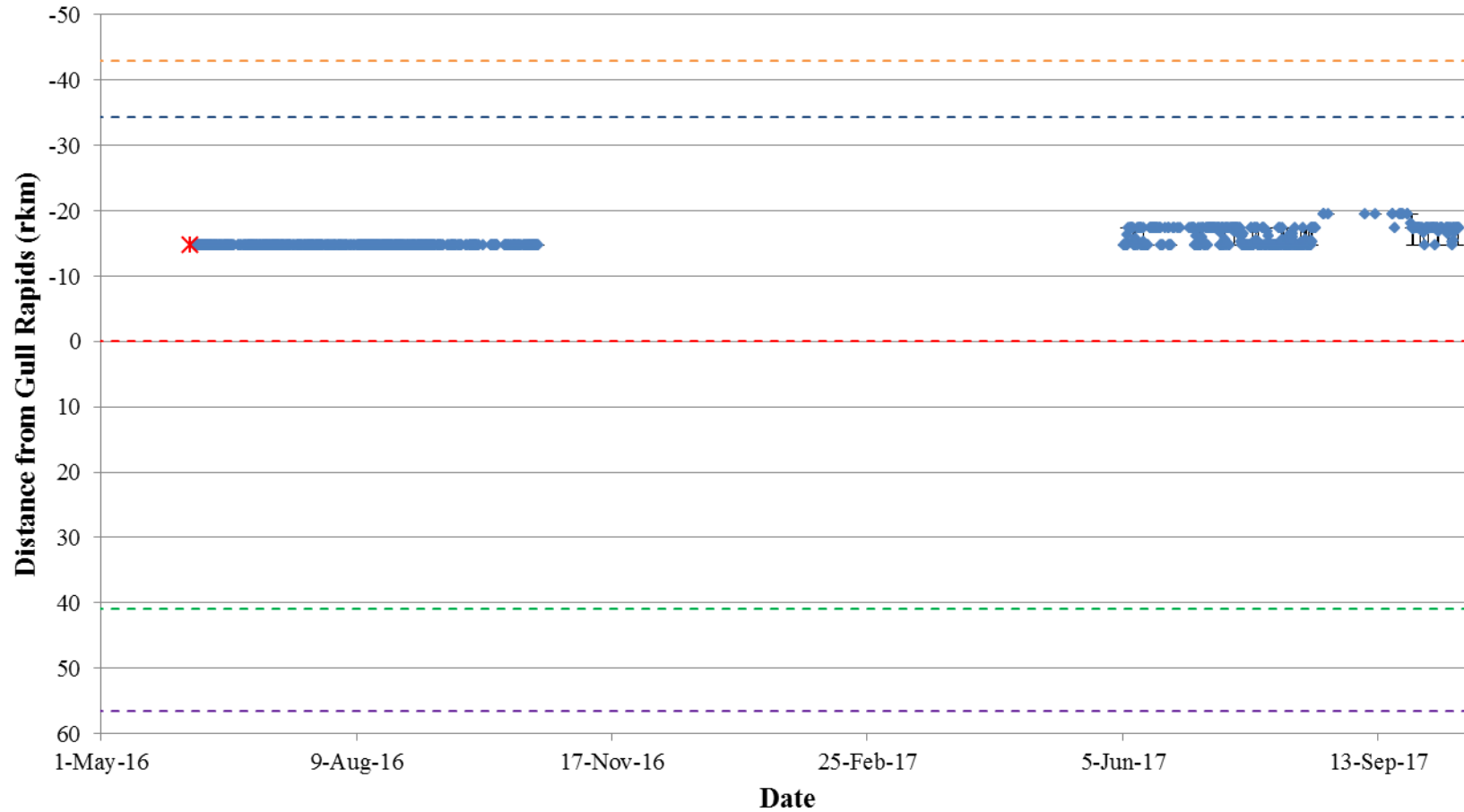


Figure A2-46: Position of a Walleye tagged with an acoustic transmitter (code #53805) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

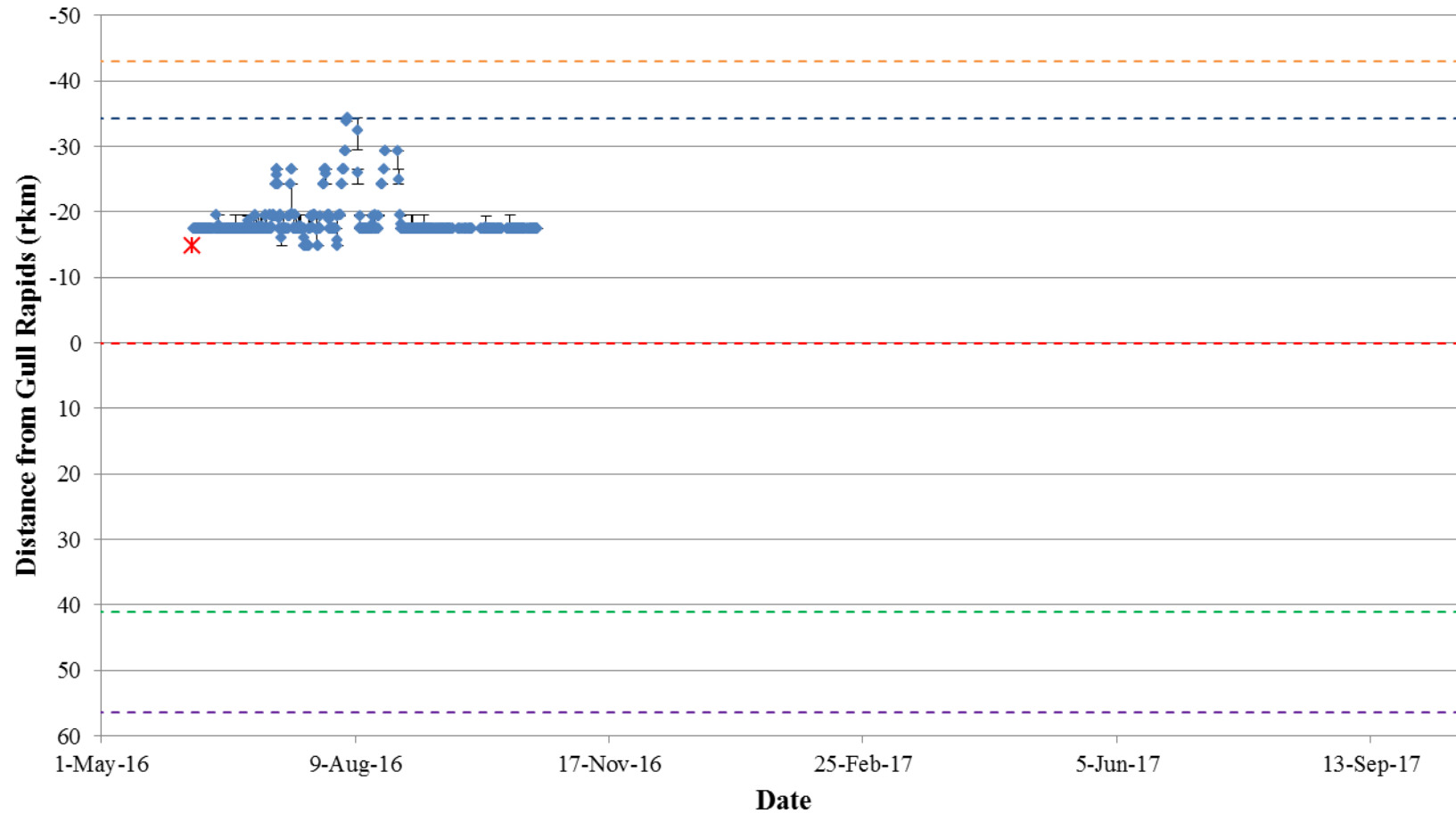


Figure A2-47: Position of a Walleye tagged with an acoustic transmitter (code #53806) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

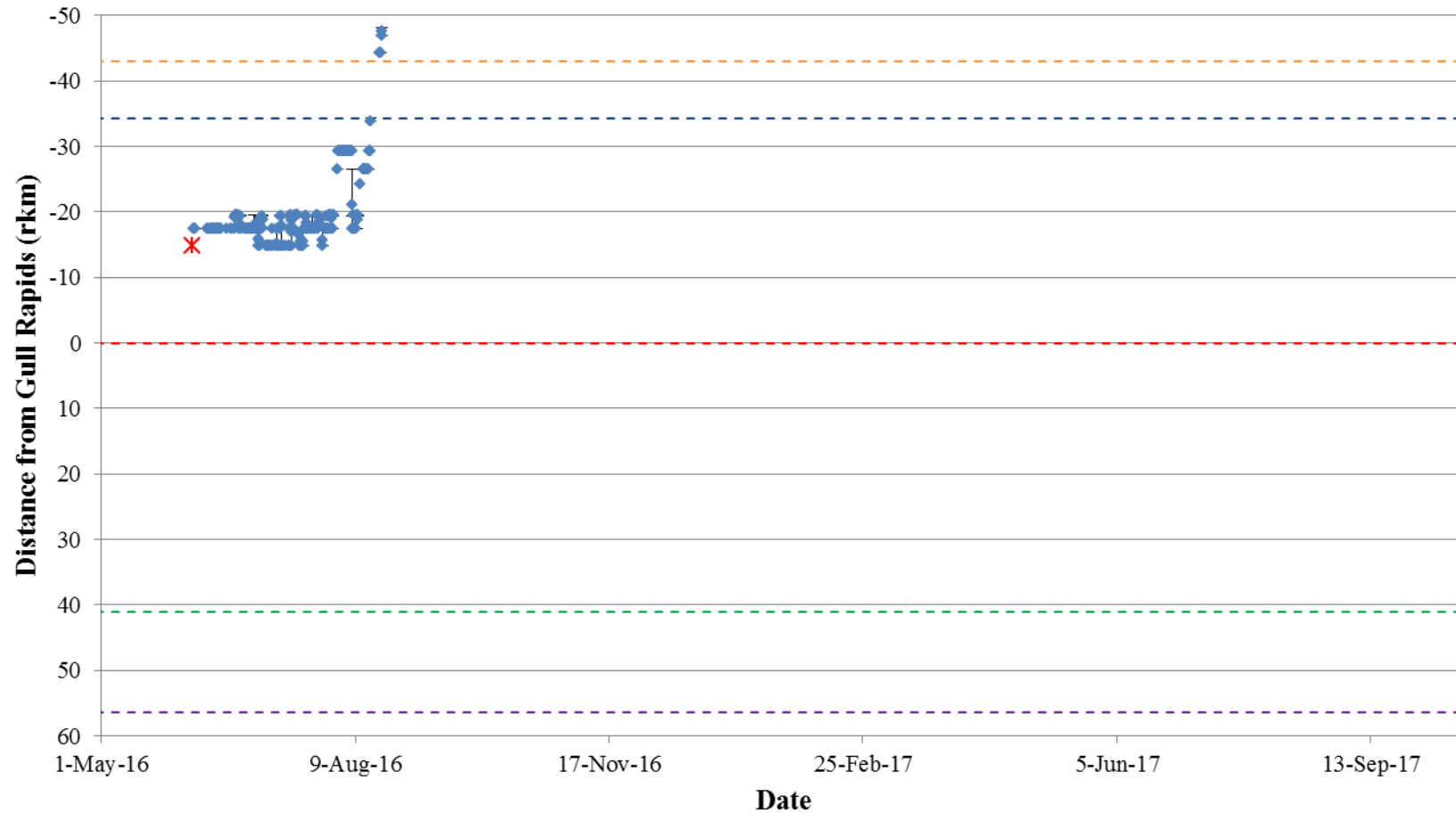


Figure A2-48: Position of a Walleye tagged with an acoustic transmitter (code #53807) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

APPENDIX 3:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED WALLEYE IN STEPHENS LAKE JUNE 2016 TO OCTOBER 2017

Figure A3-1: Position of a Walleye tagged with an acoustic transmitter (code #53723) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	124
Figure A3-2: Position of a Walleye tagged with an acoustic transmitter (code #53724) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	125
Figure A3-3: Position of a Walleye tagged with an acoustic transmitter (code #53725) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	126
Figure A3-4: Position of a Walleye tagged with an acoustic transmitter (code #53726) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	127
Figure A3-5: Position of a Walleye tagged with an acoustic transmitter (code #53728) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	128
Figure A3-6: Position of a Walleye tagged with an acoustic transmitter (code #53729) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	129
Figure A3-7: Position of a Walleye tagged with an acoustic transmitter (code #53730) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	130
Figure A3-8: Position of a Walleye tagged with an acoustic transmitter (code #53731) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	131
Figure A3-9: Position of a Walleye tagged with an acoustic transmitter (code #53732) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	132
Figure A3-10: Position of a Walleye tagged with an acoustic transmitter (code #53733) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	133

Figure A3-11: Position of a Walleye tagged with an acoustic transmitter (code #53734) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	134
Figure A3-12: Position of a Walleye tagged with an acoustic transmitter (code #53735) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	135
Figure A3-13: Position of a Walleye tagged with an acoustic transmitter (code #53736) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	136
Figure A3-14: Position of a Walleye tagged with an acoustic transmitter (code #53737) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	137
Figure A3-15: Position of a Walleye tagged with an acoustic transmitter (code #53738) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	138
Figure A3-16: Position of a Walleye tagged with an acoustic transmitter (code #53739) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	139
Figure A3-17: Position of a Walleye tagged with an acoustic transmitter (code #53740) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	140
Figure A3-18: Position of a Walleye tagged with an acoustic transmitter (code #53741) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	141
Figure A3-19: Position of a Walleye tagged with an acoustic transmitter (code #53742) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	142
Figure A3-20: Position of a Walleye tagged with an acoustic transmitter (code #53743) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	143
Figure A3-21: Position of a Walleye tagged with an acoustic transmitter (code #53744) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	144
Figure A3-22: Position of a Walleye tagged with an acoustic transmitter (code #53745) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	145
Figure A3-23: Position of a Walleye tagged with an acoustic transmitter (code #53746) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	146

Figure A3-24: Position of a Walleye tagged with an acoustic transmitter (code #53747) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	147
Figure A3-25: Position of a Walleye tagged with an acoustic transmitter (code #53748) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	148
Figure A3-26: Position of a Walleye tagged with an acoustic transmitter (code #53749) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	149
Figure A3-27: Position of a Walleye tagged with an acoustic transmitter (code #53750) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	150
Figure A3-28: Position of a Walleye tagged with an acoustic transmitter (code #53751) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	151
Figure A3-29: Position of a Walleye tagged with an acoustic transmitter (code #53752) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	152
Figure A3-30: Position of a Walleye tagged with an acoustic transmitter (code #53753) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	153
Figure A3-31: Position of a Walleye tagged with an acoustic transmitter (code #53754) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	154
Figure A3-32: Position of a Walleye tagged with an acoustic transmitter (code #53755) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	155
Figure A3-33: Position of a Walleye tagged with an acoustic transmitter (code #53756) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	156
Figure A3-34: Position of a Walleye tagged with an acoustic transmitter (code #53757) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	157
Figure A3-35: Position of a Walleye tagged with an acoustic transmitter (code #53808) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	158
Figure A3-36: Position of a Walleye tagged with an acoustic transmitter (code #53809) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	159

Figure A3-37: Position of a Walleye tagged with an acoustic transmitter (code #53810) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	160
Figure A3-38: Position of a Walleye tagged with an acoustic transmitter (code #53811) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	161
Figure A3-39: Position of a Walleye tagged with an acoustic transmitter (code #53812) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017.....	162

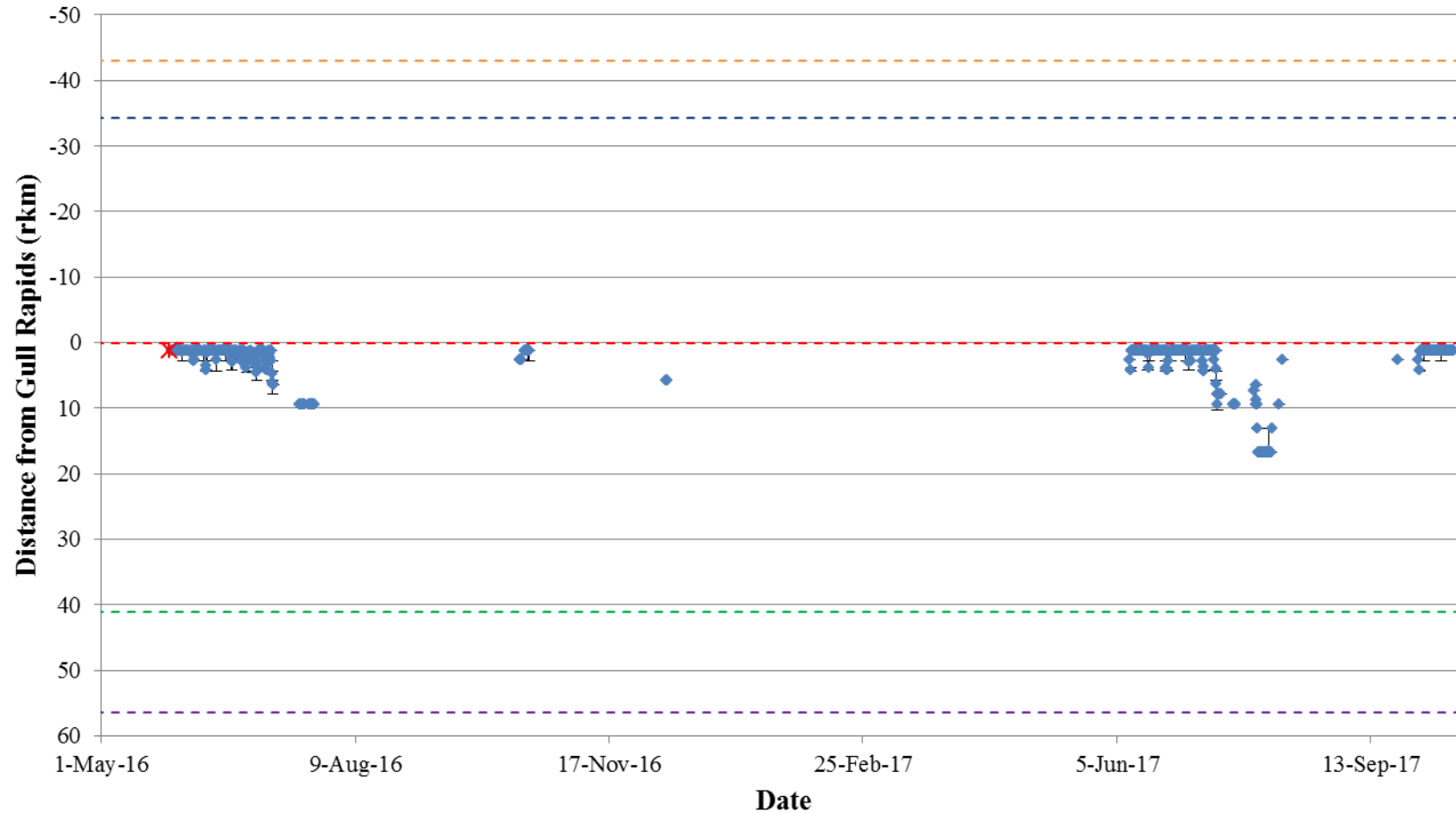


Figure A3-1: Position of a Walleye tagged with an acoustic transmitter (code #53723) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

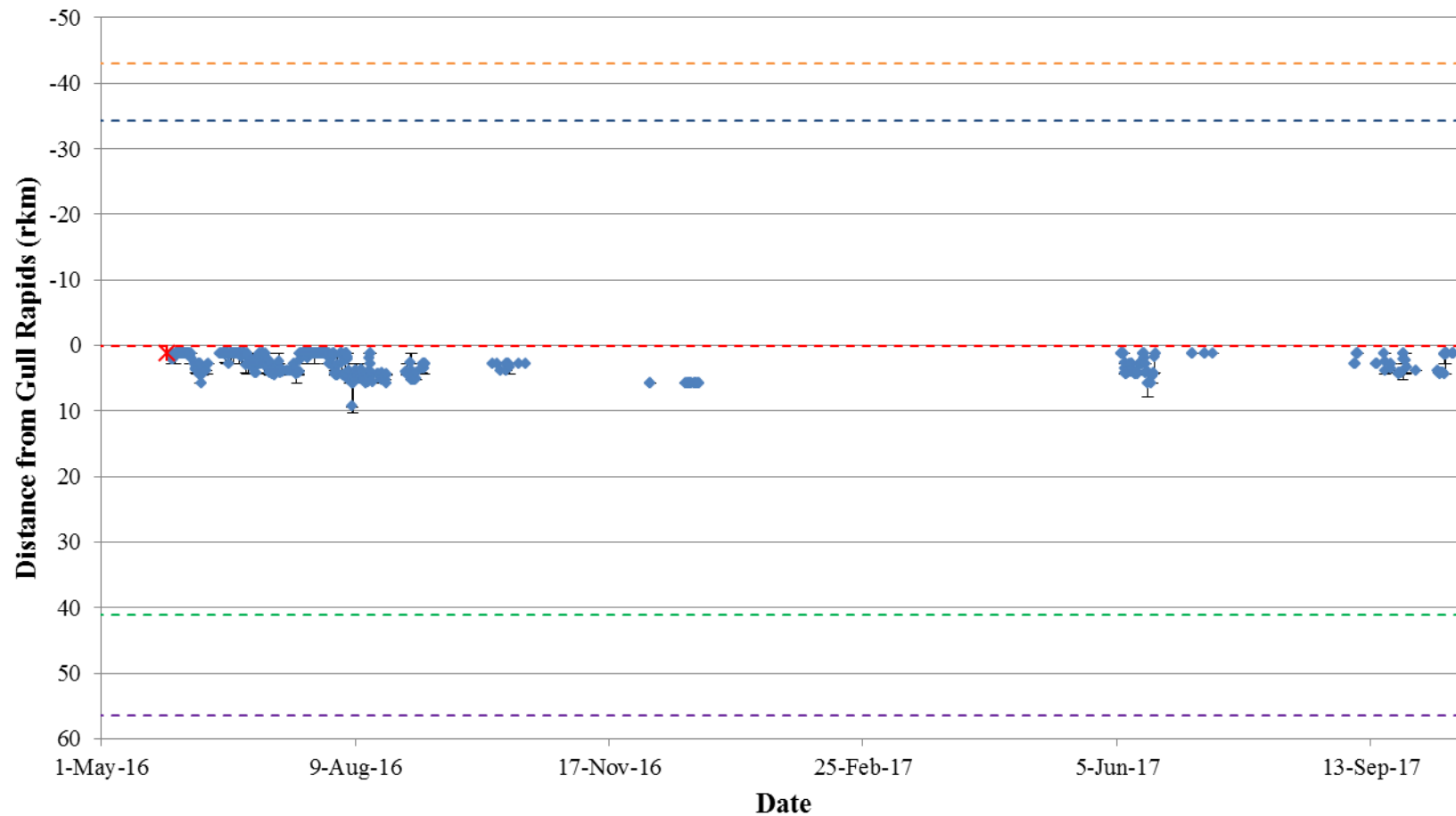


Figure A3-2: Position of a Walleye tagged with an acoustic transmitter (code #53724) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

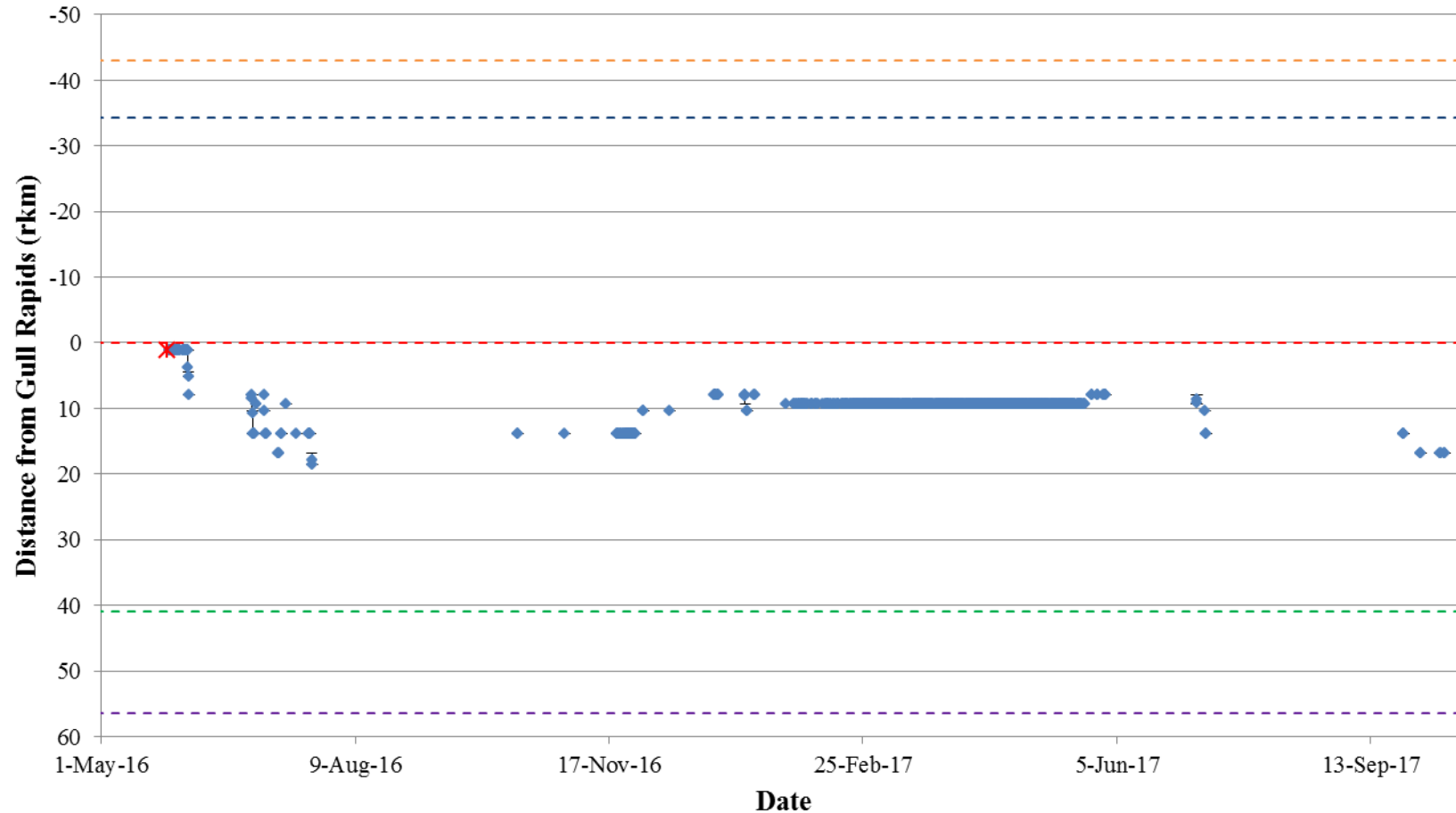


Figure A3-3: Position of a Walleye tagged with an acoustic transmitter (code #53725) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

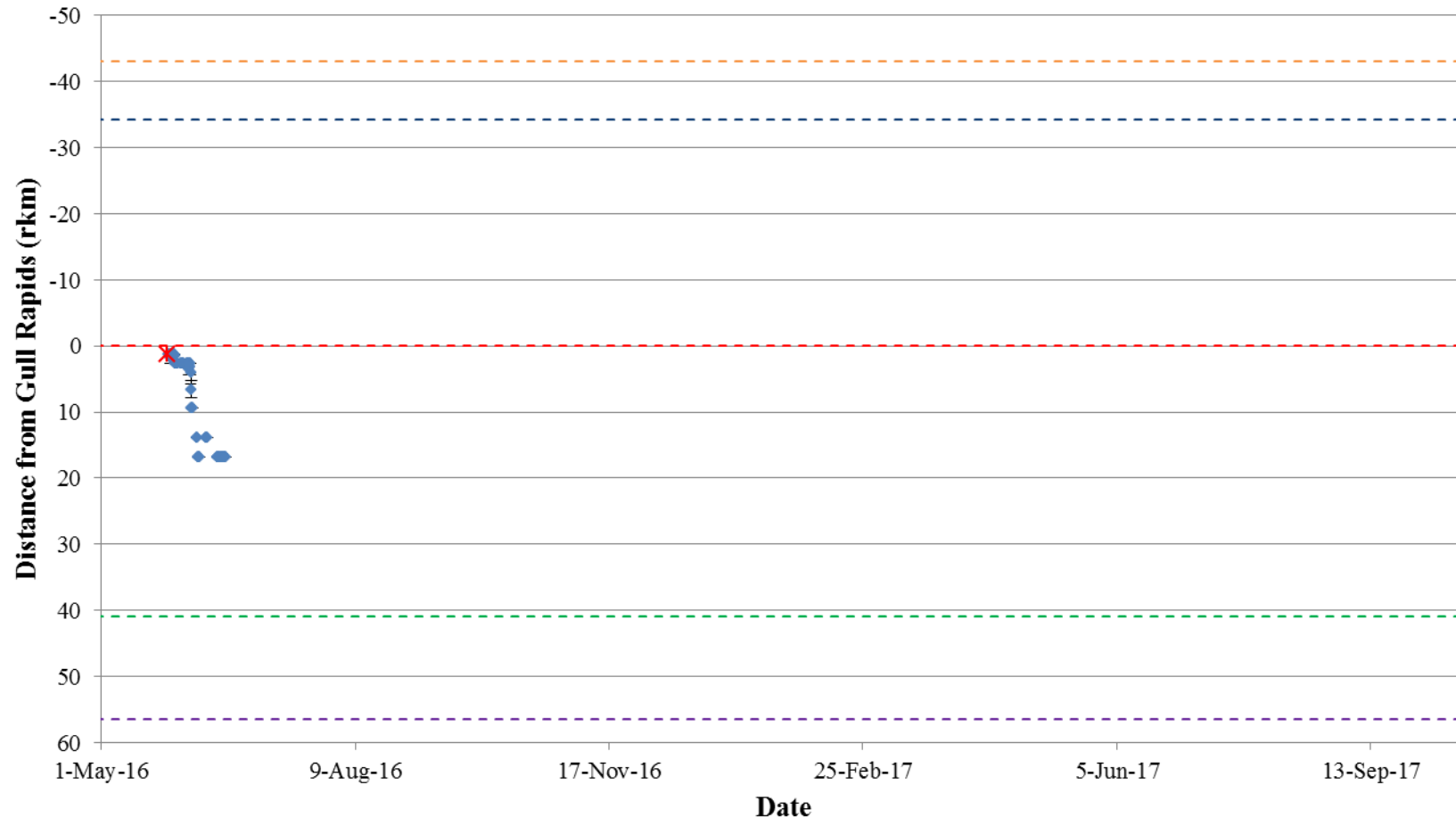


Figure A3-4: Position of a Walleye tagged with an acoustic transmitter (code #53726) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

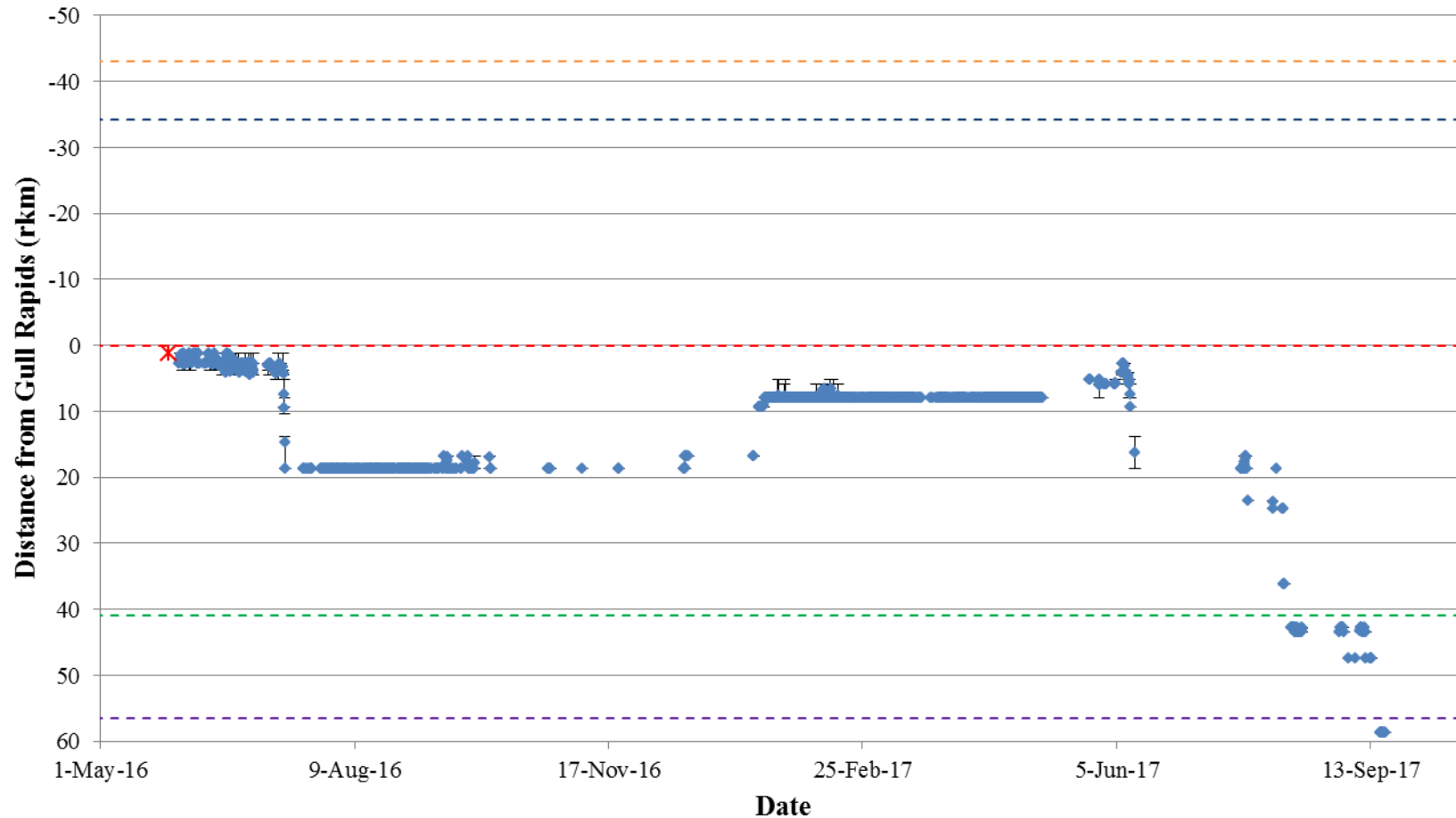


Figure A3-5: Position of a Walleye tagged with an acoustic transmitter (code #53728) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

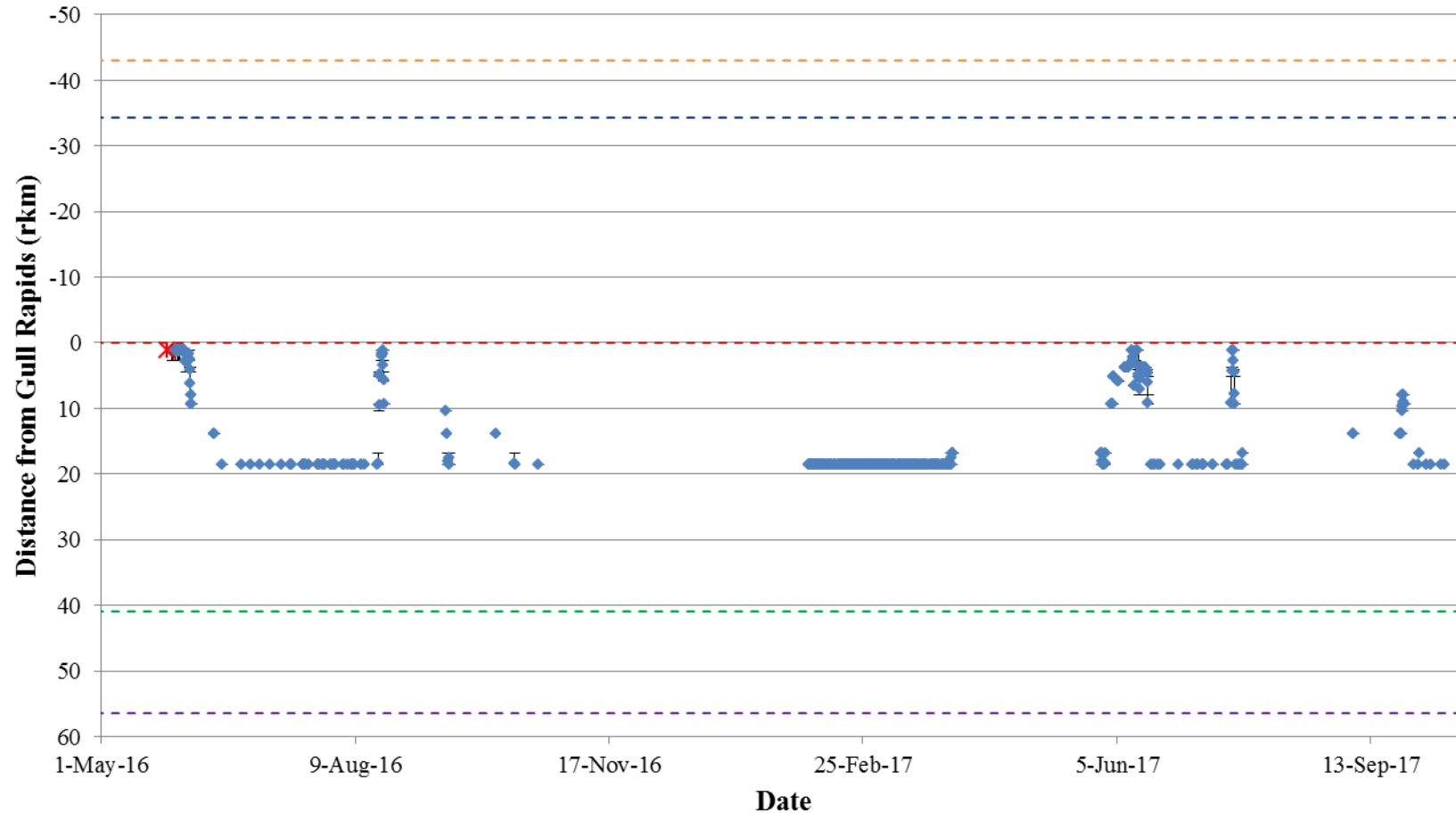


Figure A3-6: Position of a Walleye tagged with an acoustic transmitter (code #53729) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

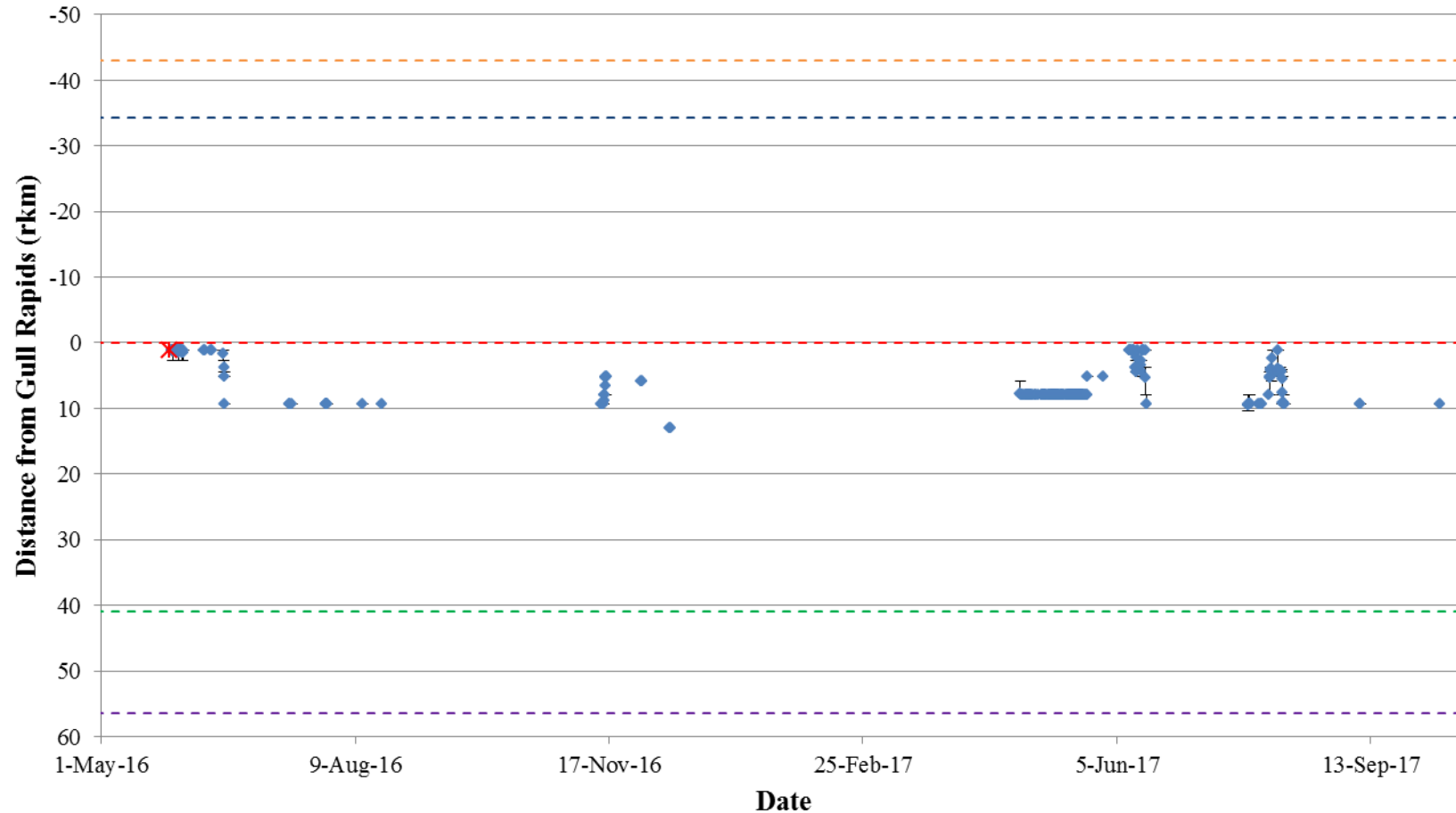


Figure A3-7: Position of a Walleye tagged with an acoustic transmitter (code #53730) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

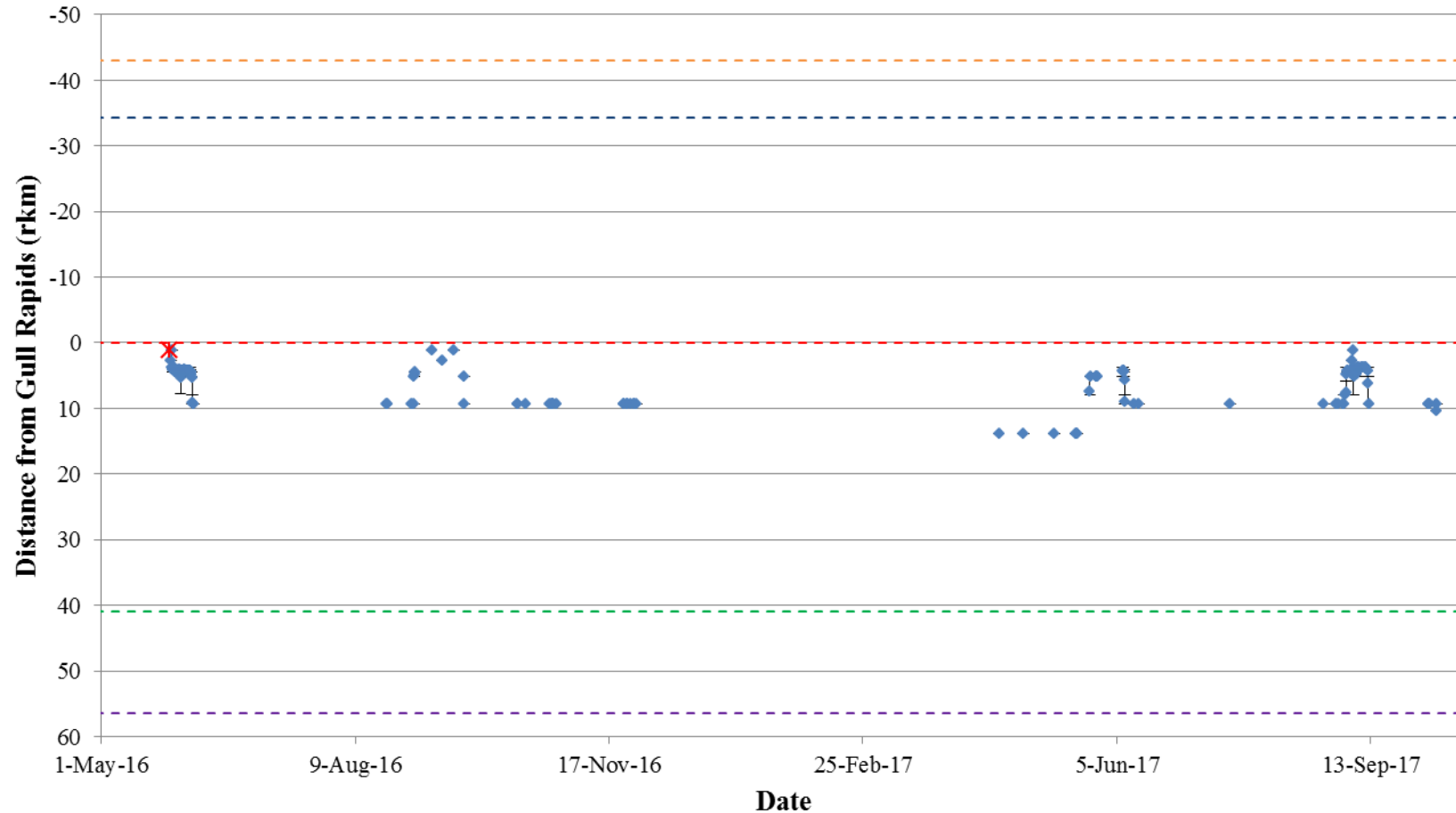


Figure A3-8: Position of a Walleye tagged with an acoustic transmitter (code #53731) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

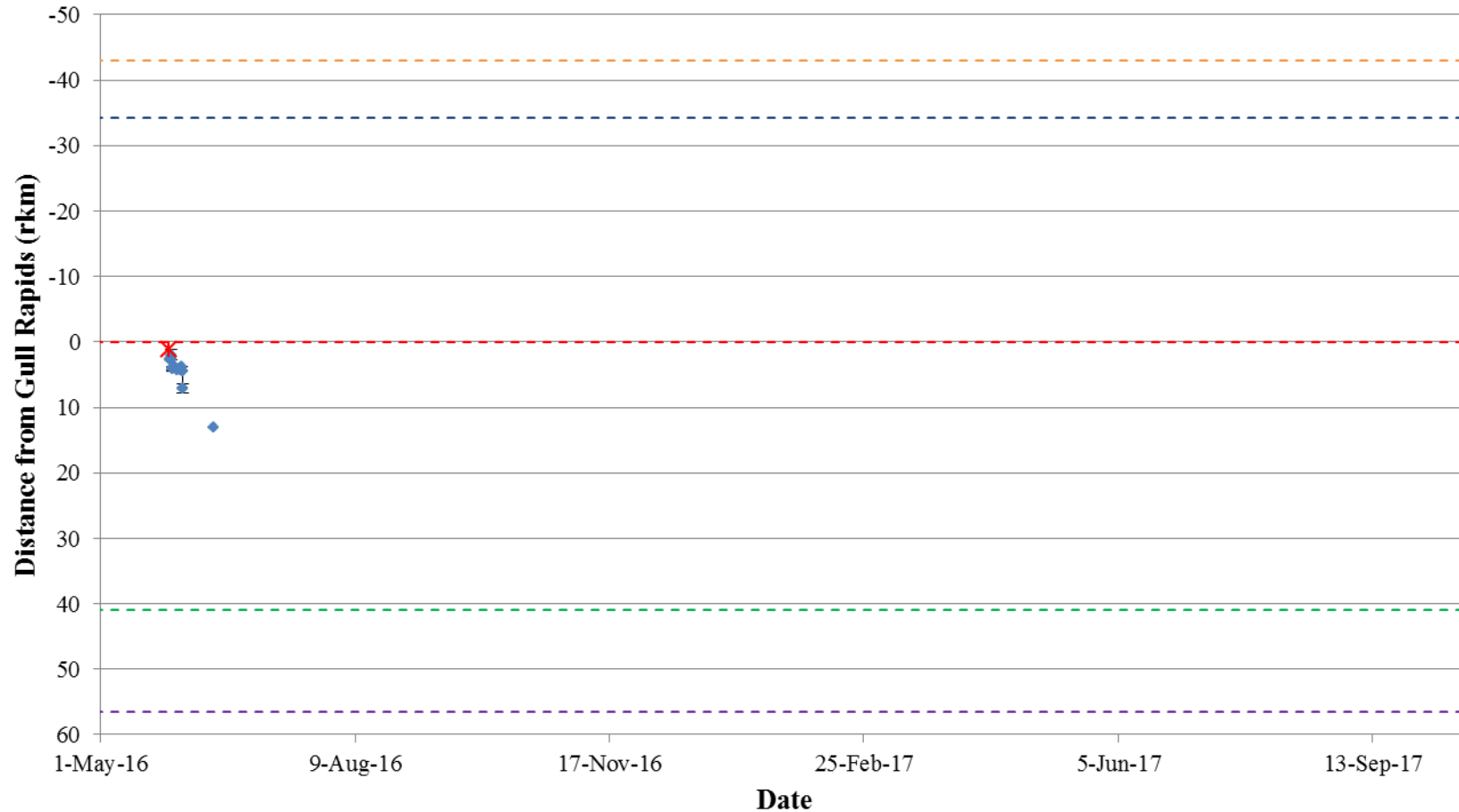


Figure A3-9: Position of a Walleye tagged with an acoustic transmitter (code #53732) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

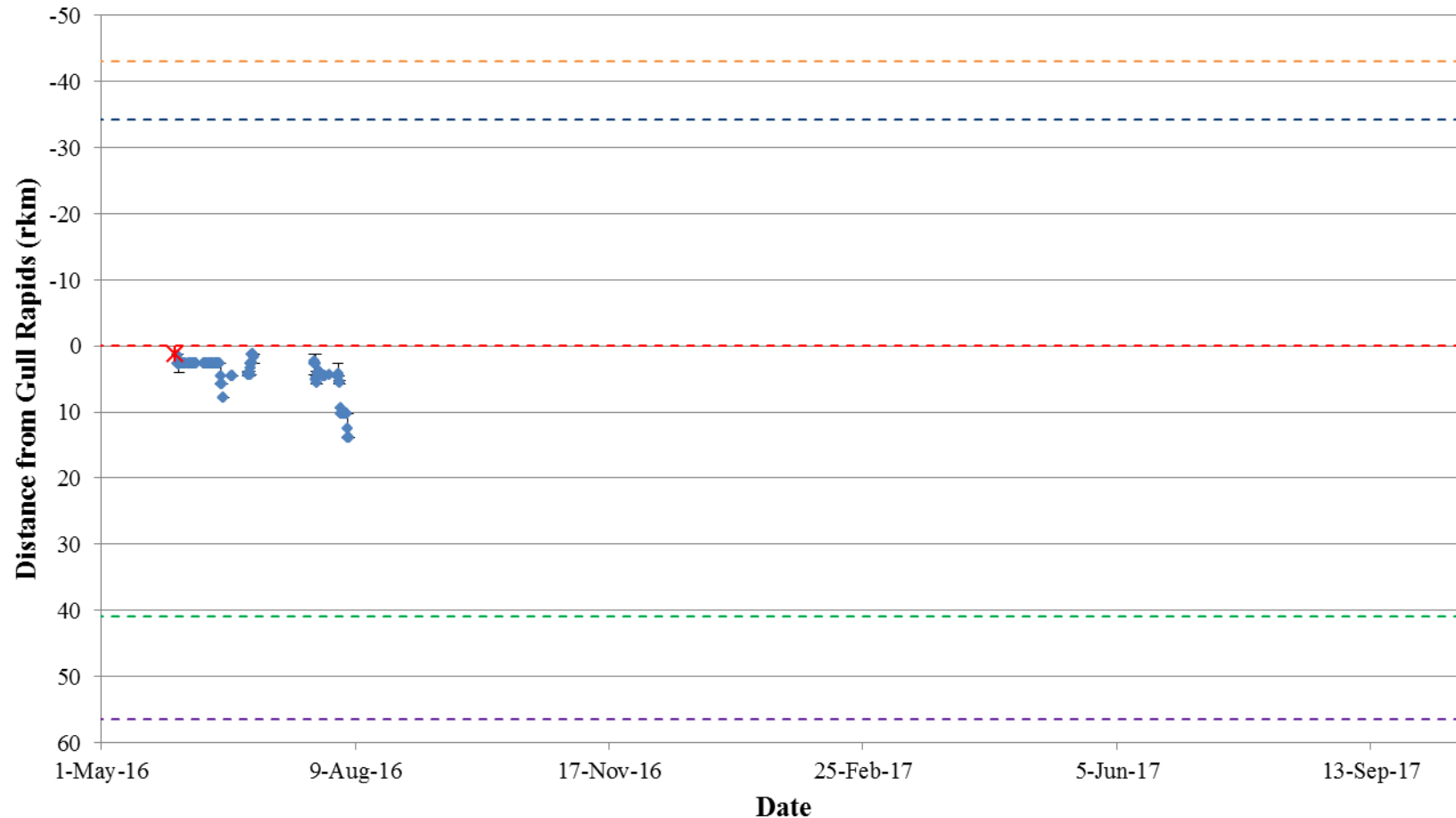


Figure A3-10: Position of a Walleye tagged with an acoustic transmitter (code #53733) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

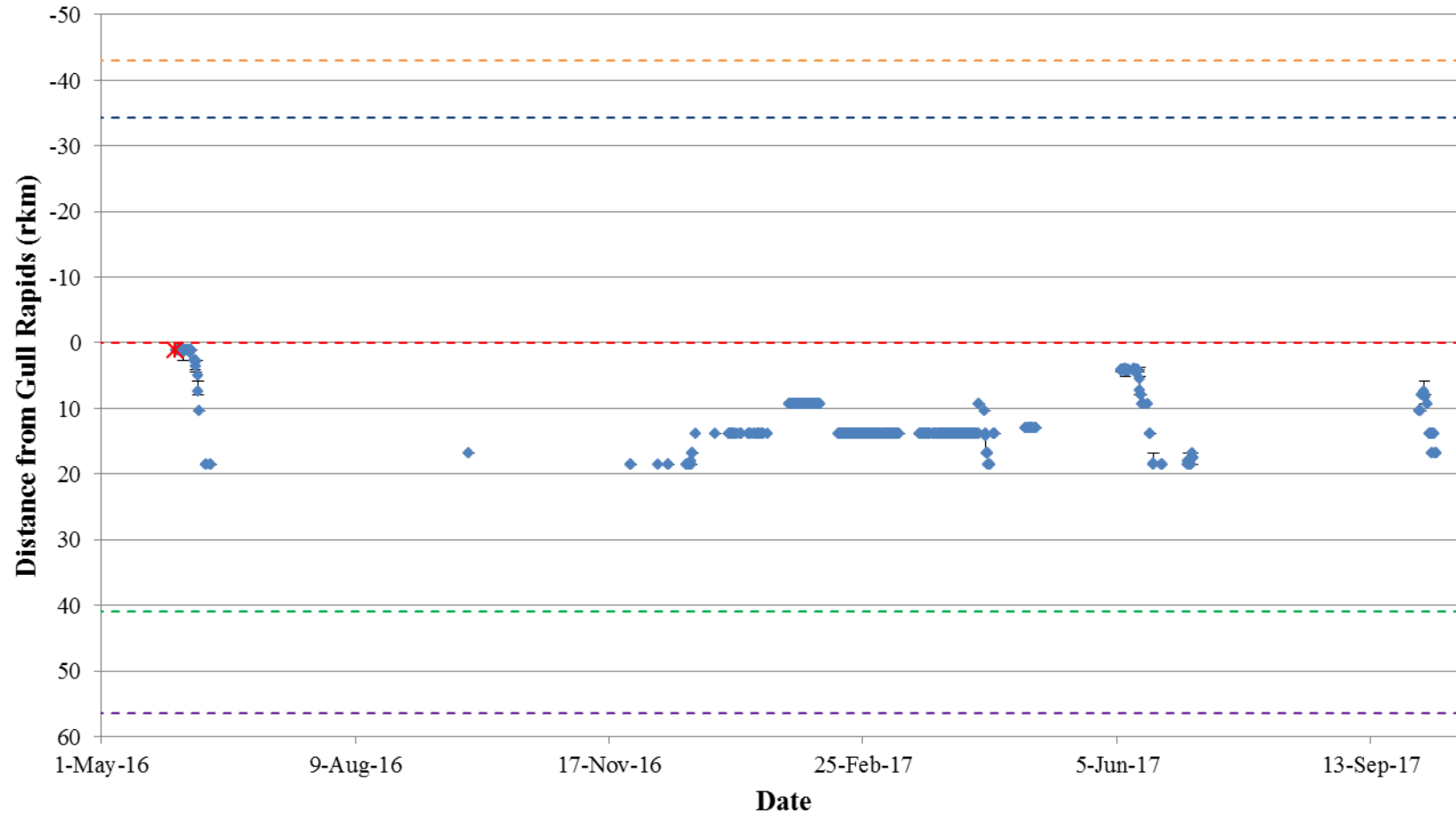


Figure A3-11: Position of a Walleye tagged with an acoustic transmitter (code #53734) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

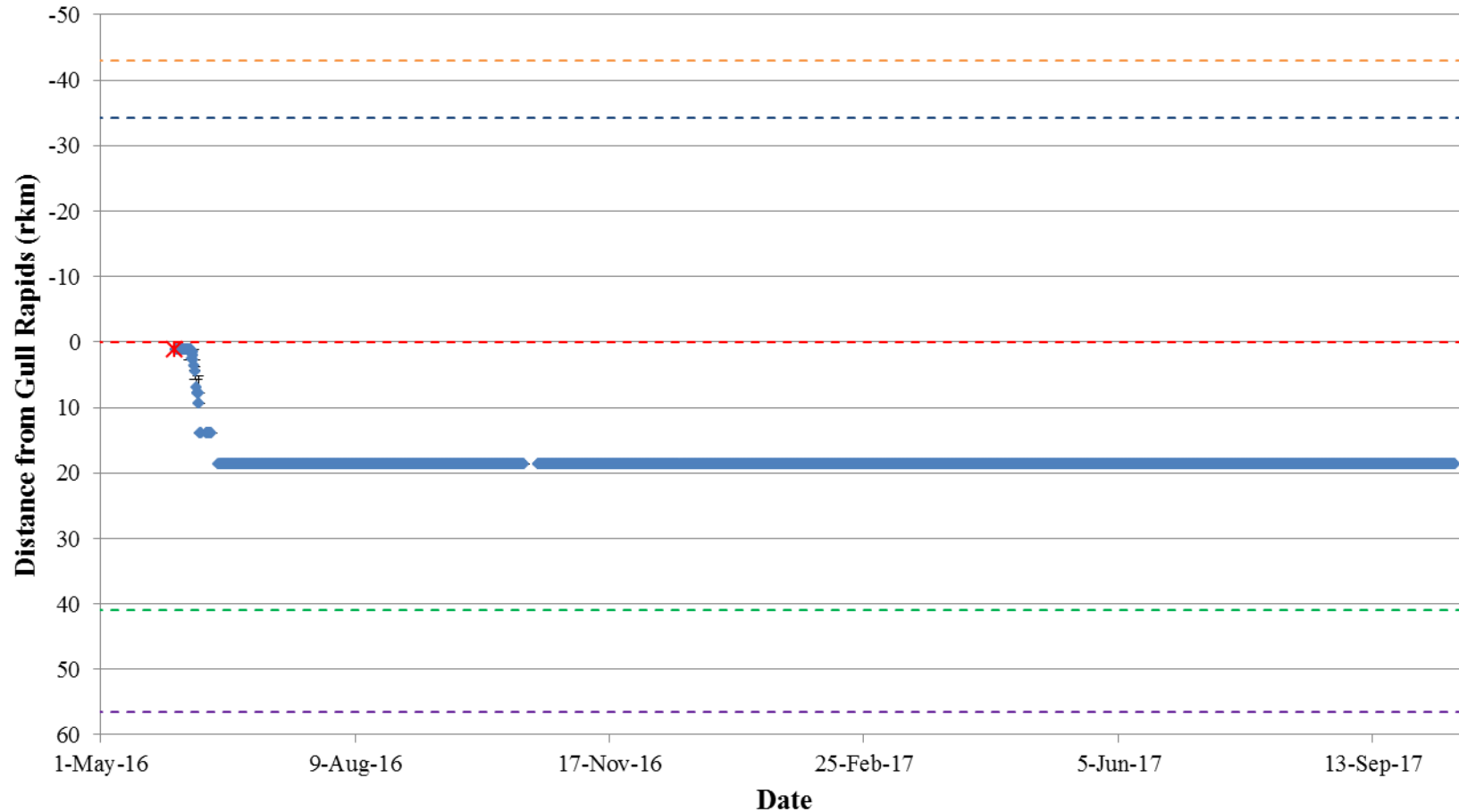


Figure A3-12: Position of a Walleye tagged with an acoustic transmitter (code #53735) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

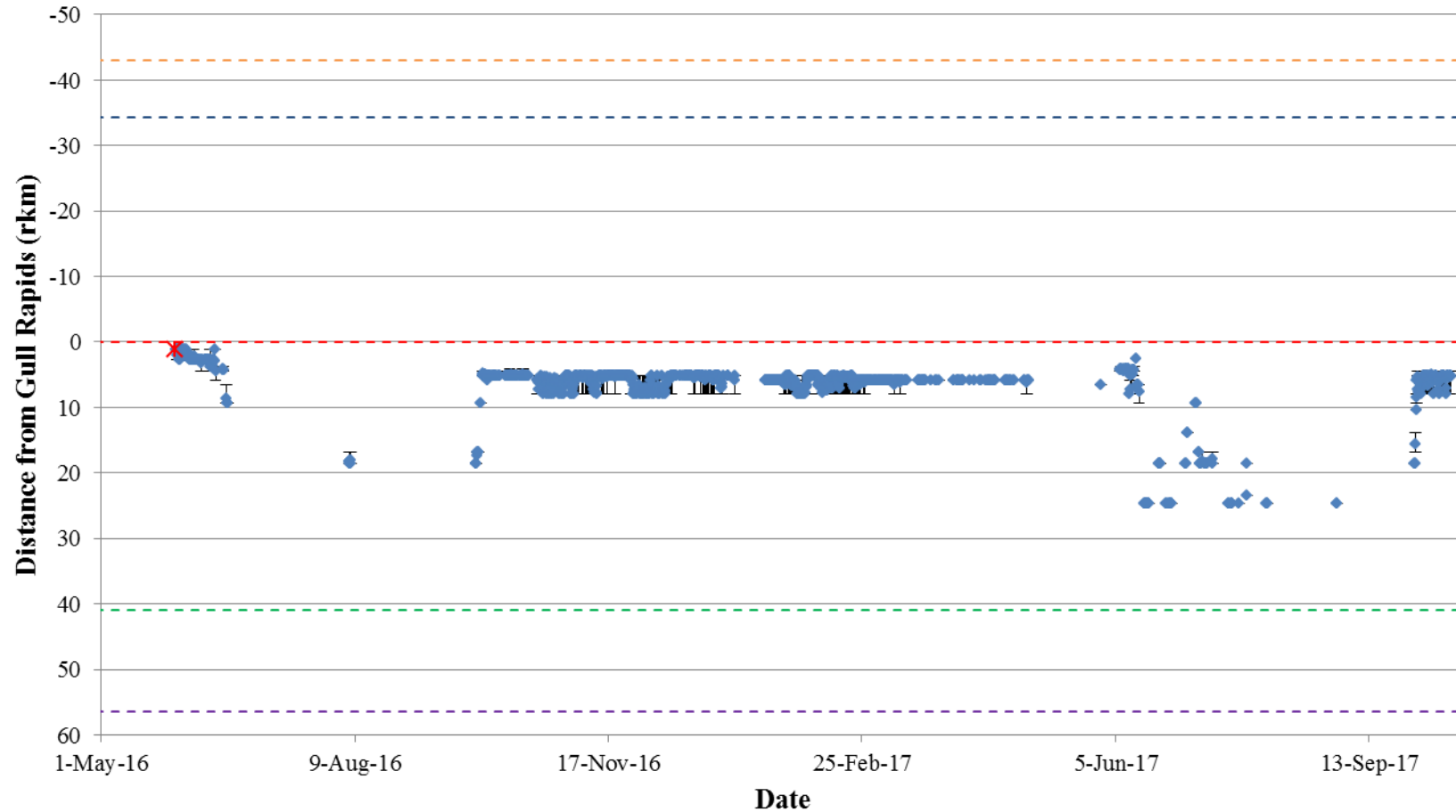


Figure A3-13: Position of a Walleye tagged with an acoustic transmitter (code #53736) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

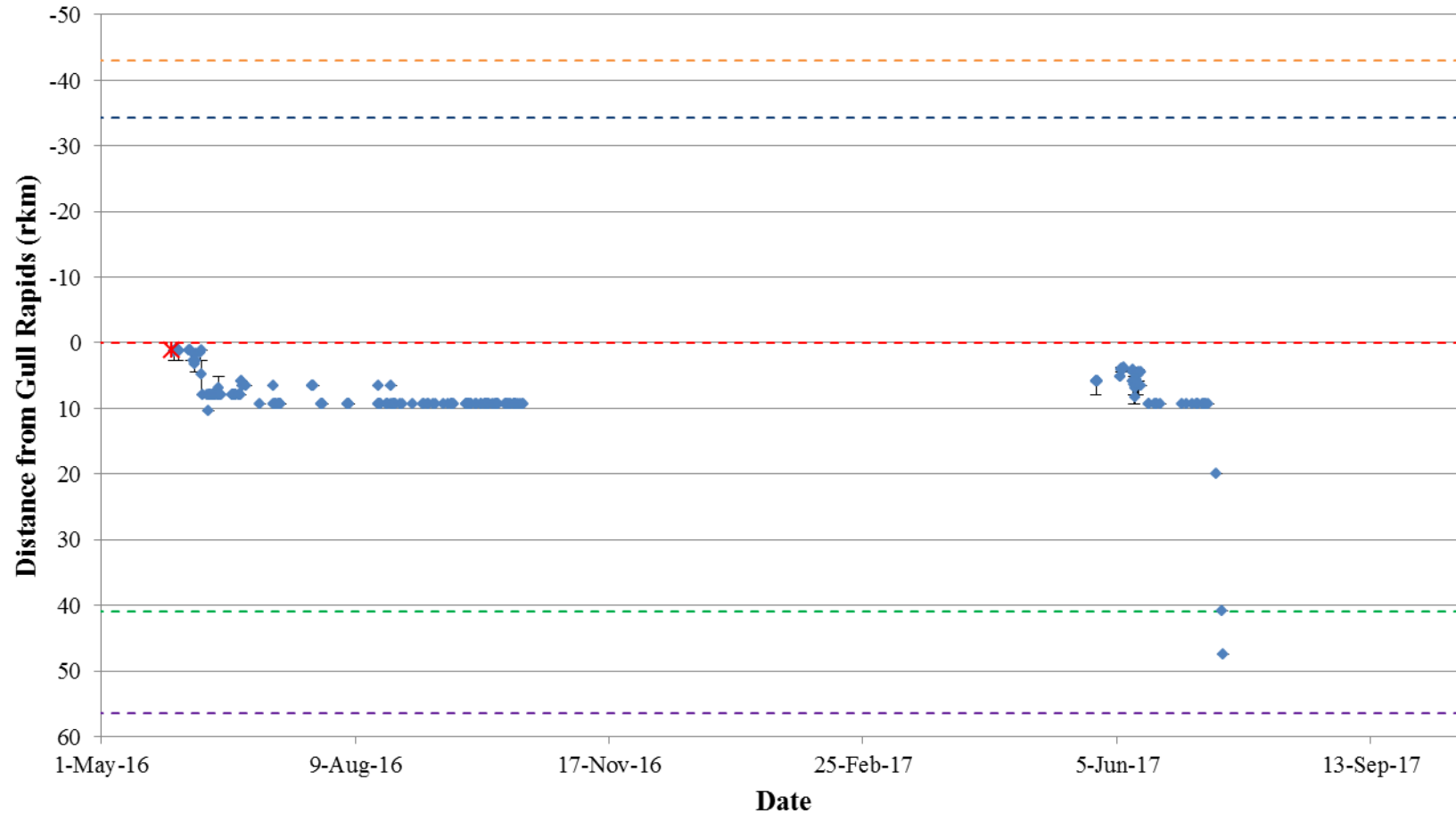


Figure A3-14: Position of a Walleye tagged with an acoustic transmitter (code #53737) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

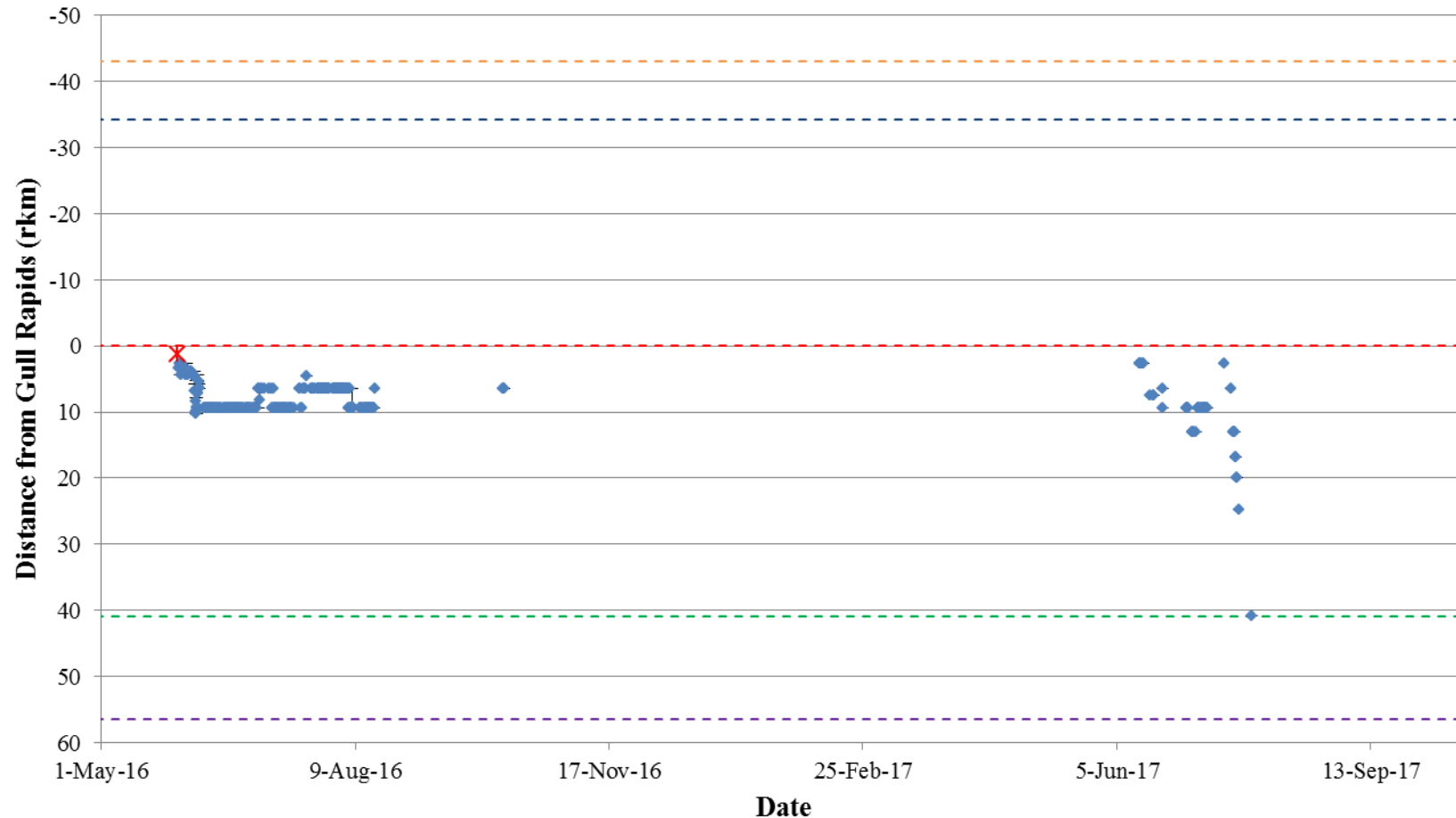


Figure A3-15: Position of a Walleye tagged with an acoustic transmitter (code #53738) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

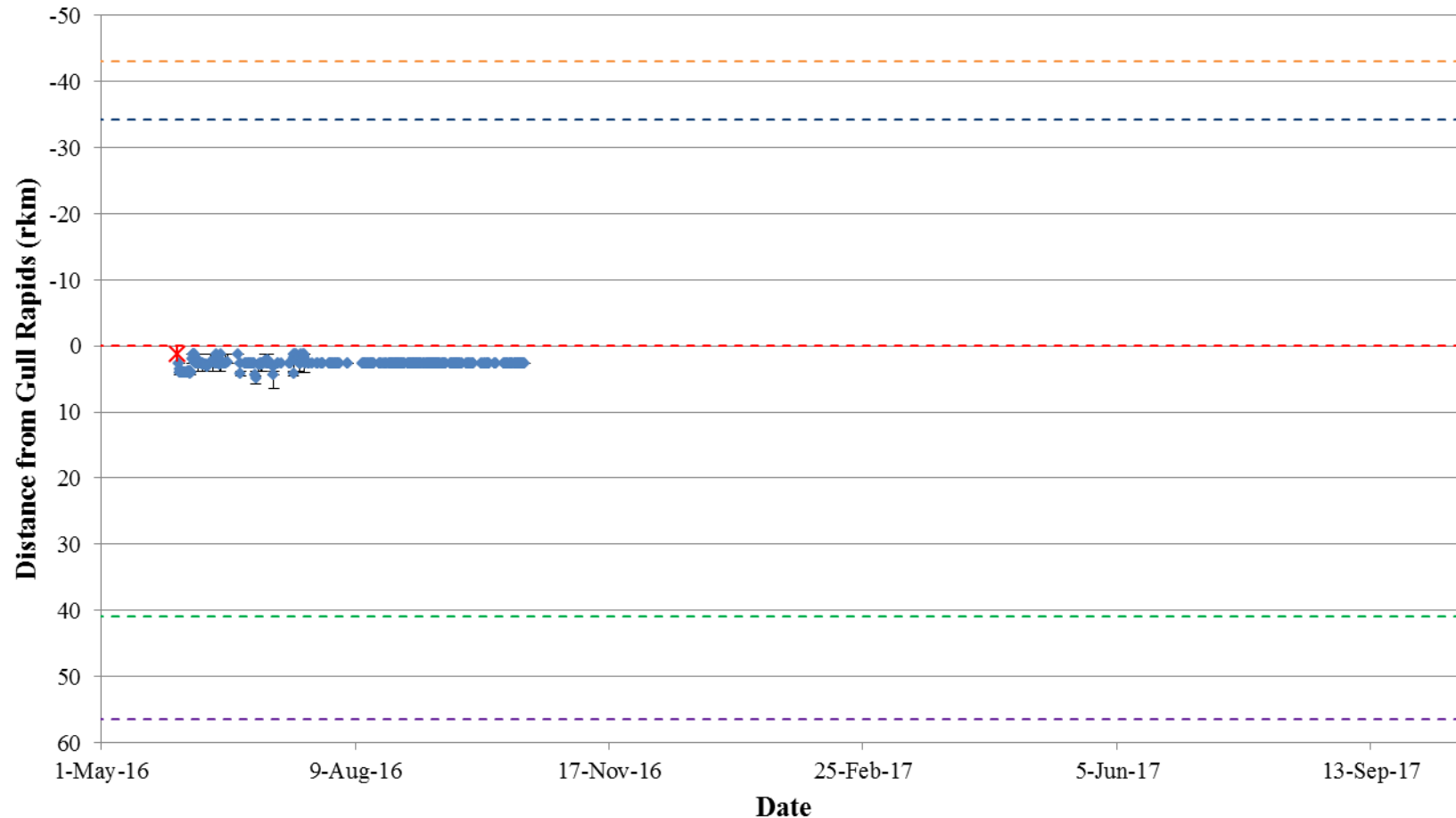


Figure A3-16: Position of a Walleye tagged with an acoustic transmitter (code #53739) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

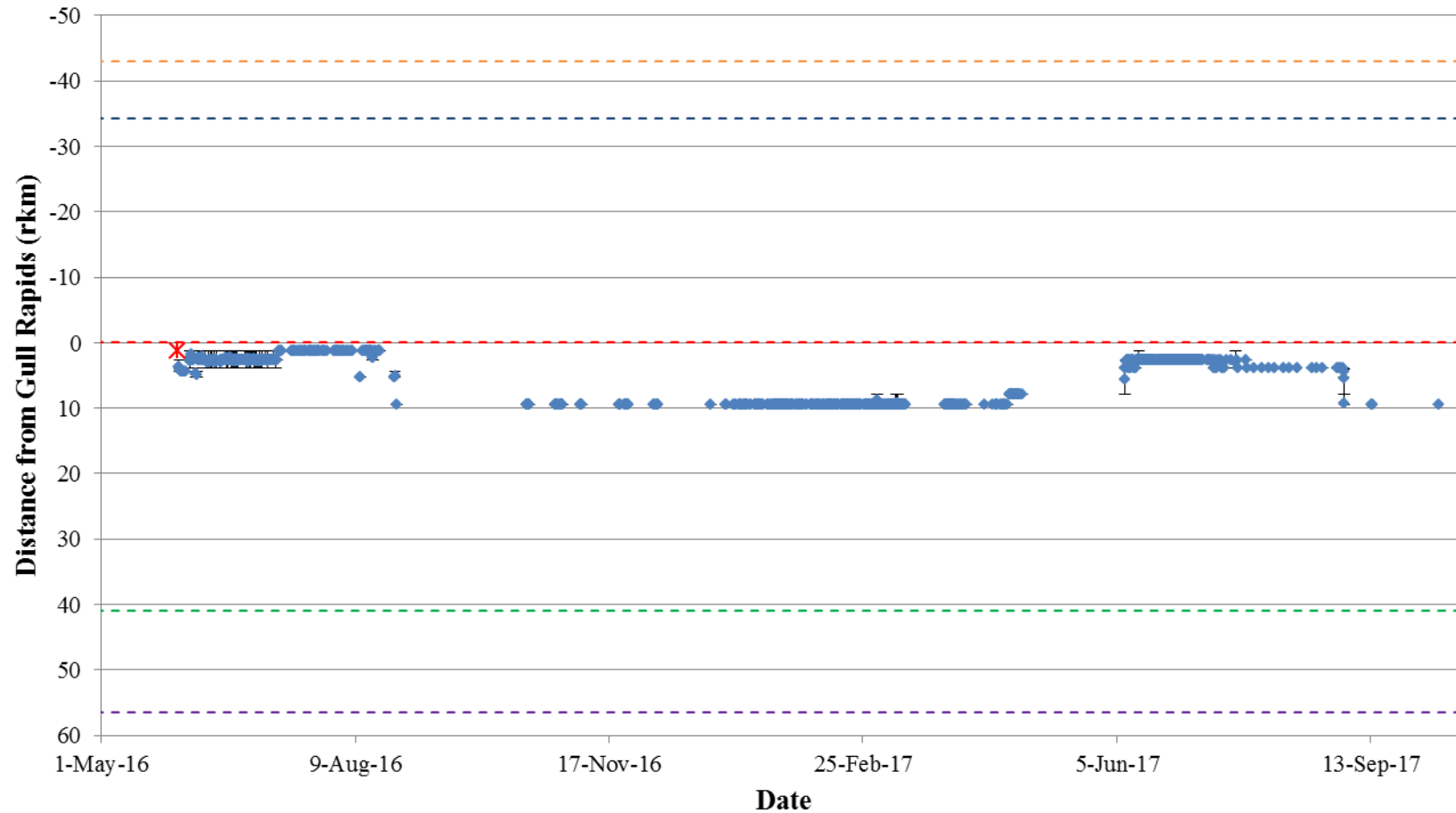


Figure A3-17: Position of a Walleye tagged with an acoustic transmitter (code #53740) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

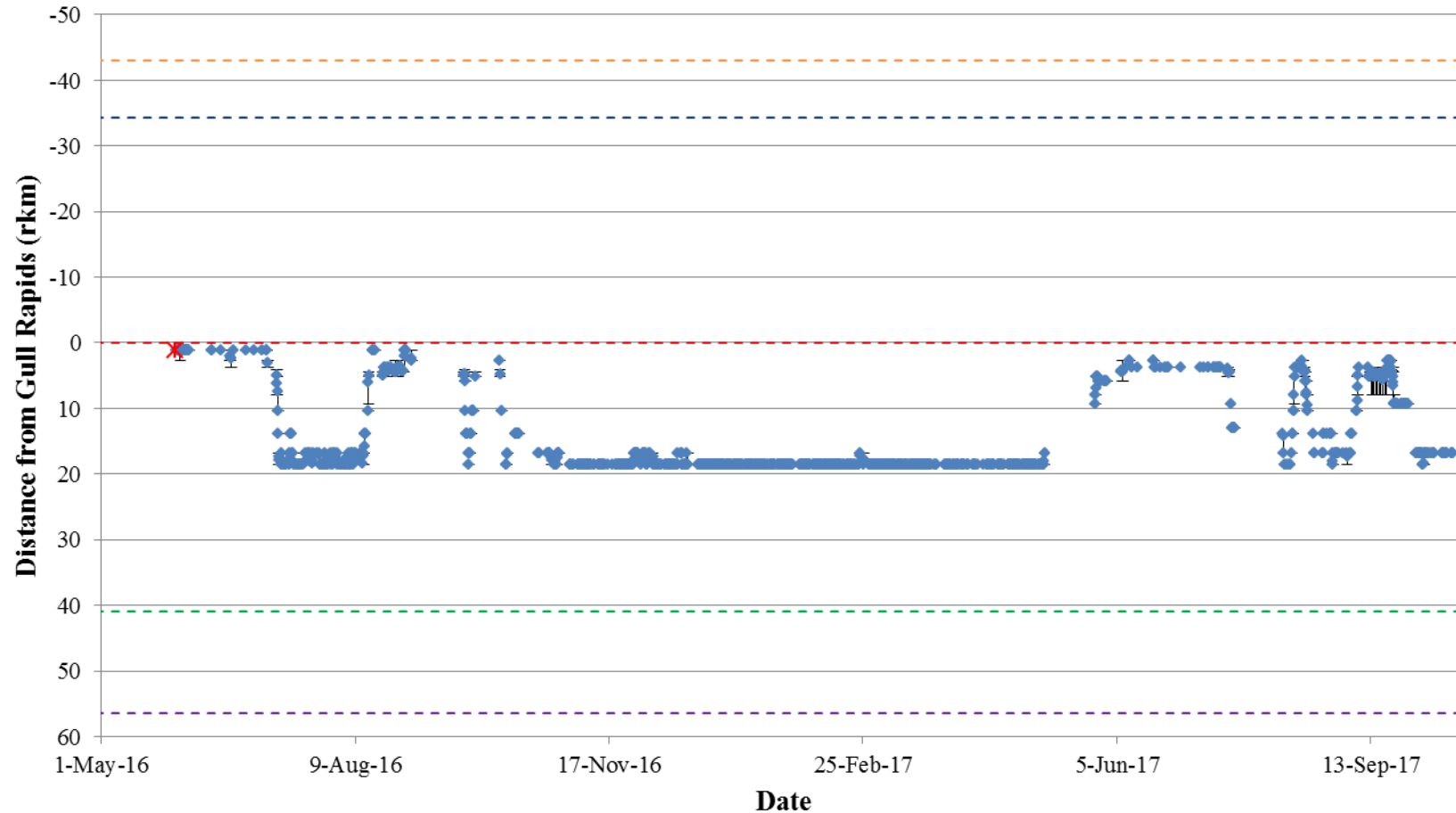


Figure A3-18: Position of a Walleye tagged with an acoustic transmitter (code #53741) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

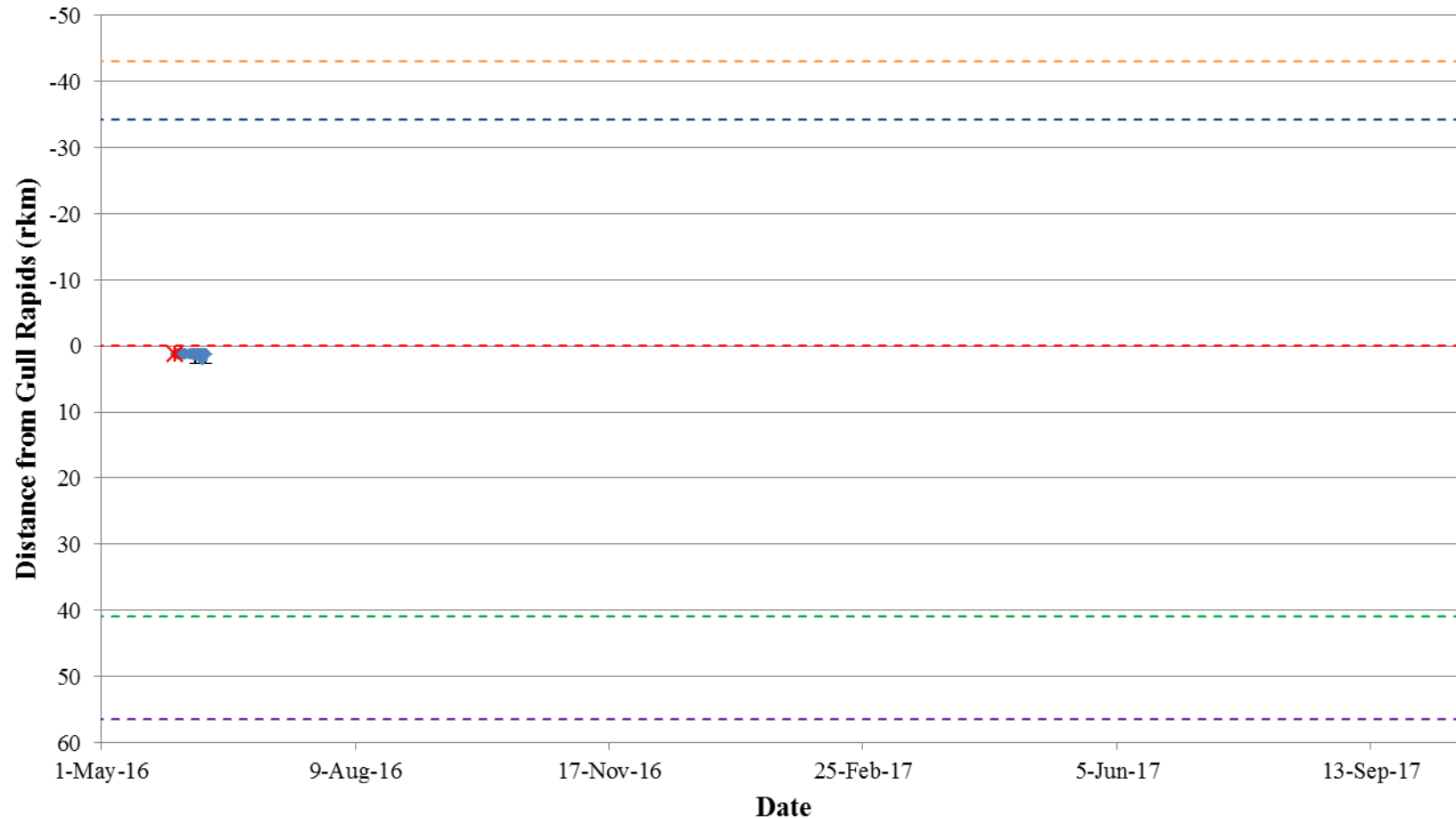


Figure A3-19: Position of a Walleye tagged with an acoustic transmitter (code #53742) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

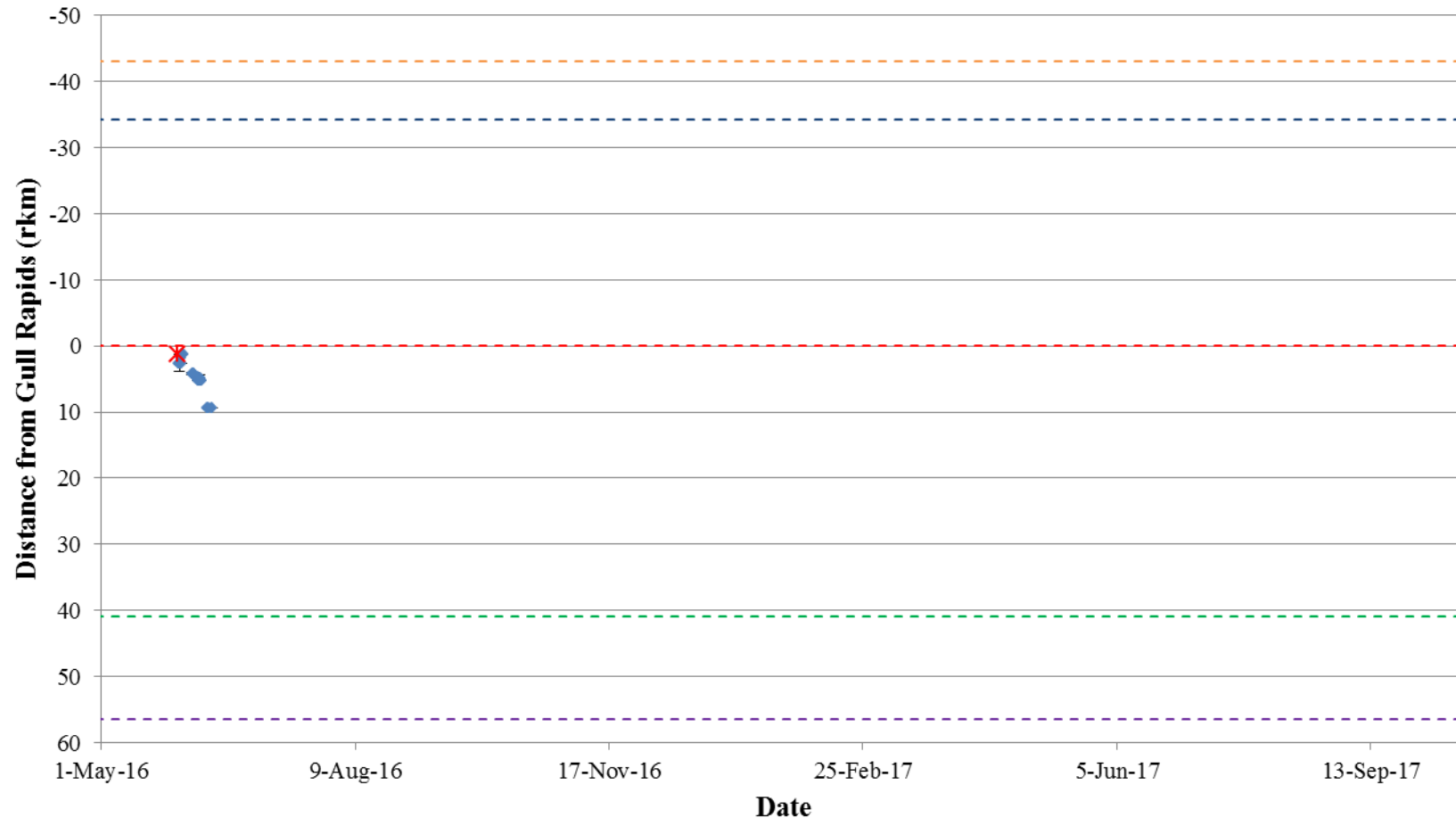


Figure A3-20: Position of a Walleye tagged with an acoustic transmitter (code #53743) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

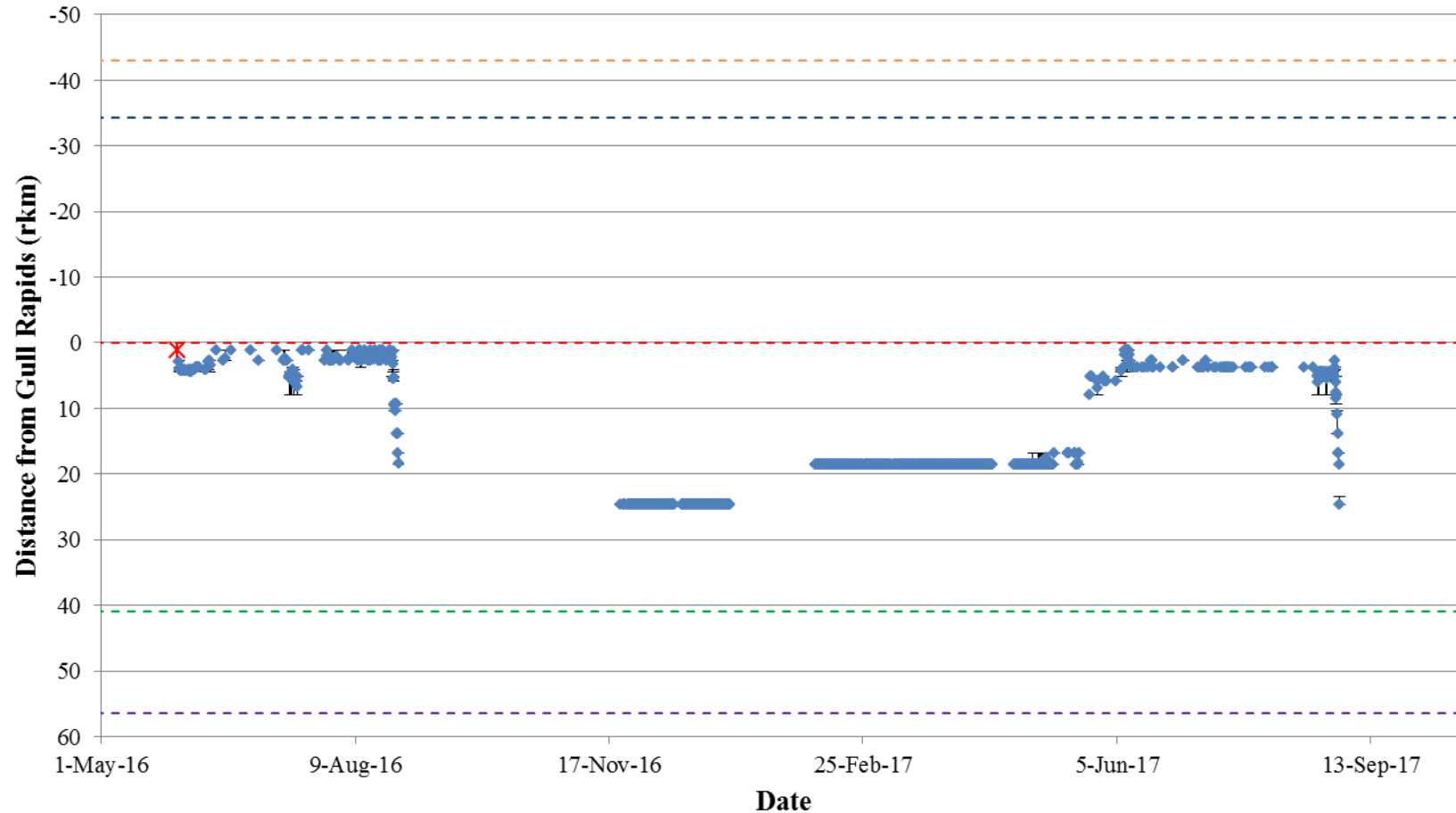


Figure A3-21: Position of a Walleye tagged with an acoustic transmitter (code #53744) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

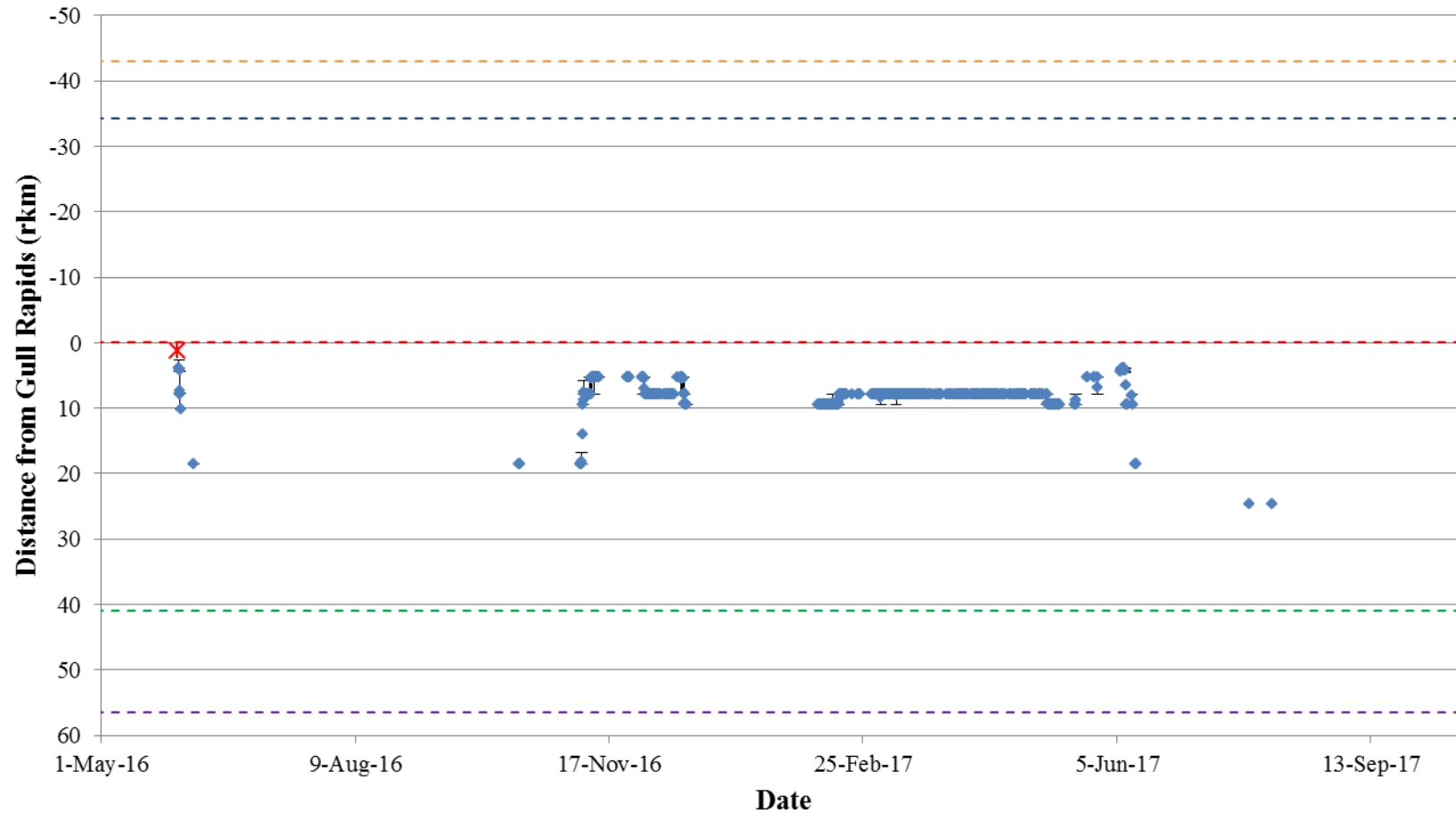


Figure A3-22: Position of a Walleye tagged with an acoustic transmitter (code #53745) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

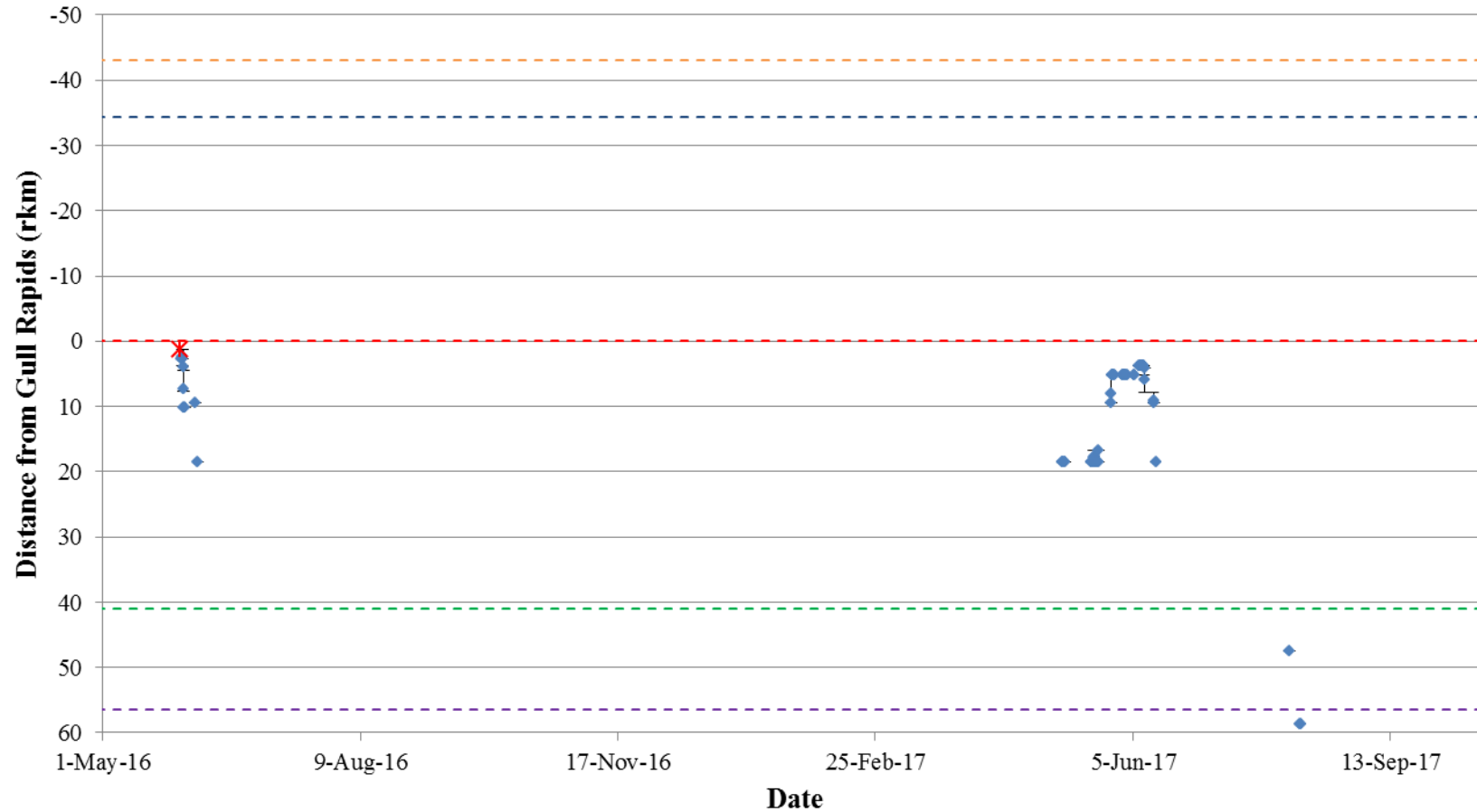


Figure A3-23: Position of a Walleye tagged with an acoustic transmitter (code #53746) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

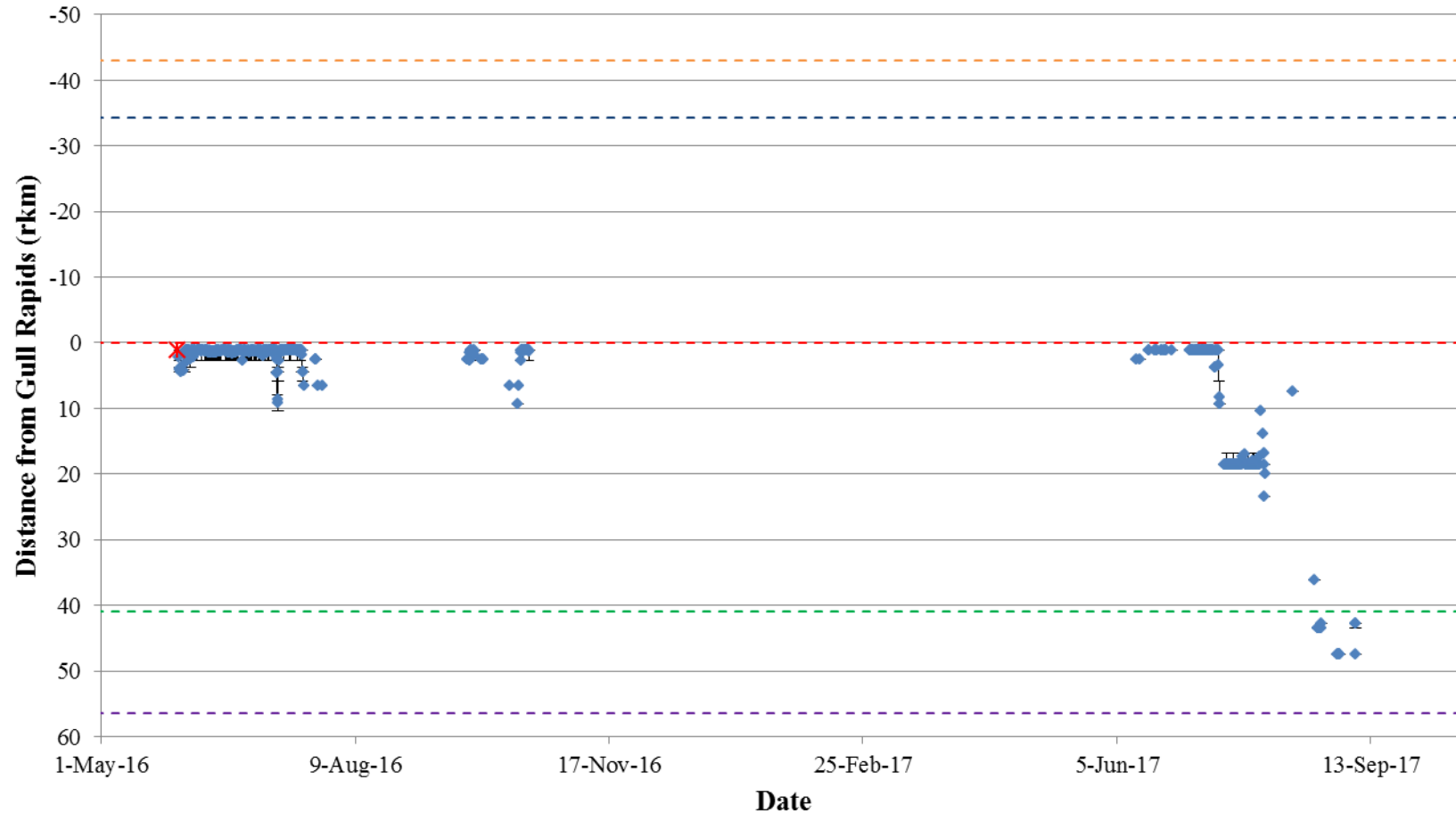


Figure A3-24: Position of a Walleye tagged with an acoustic transmitter (code #53747) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

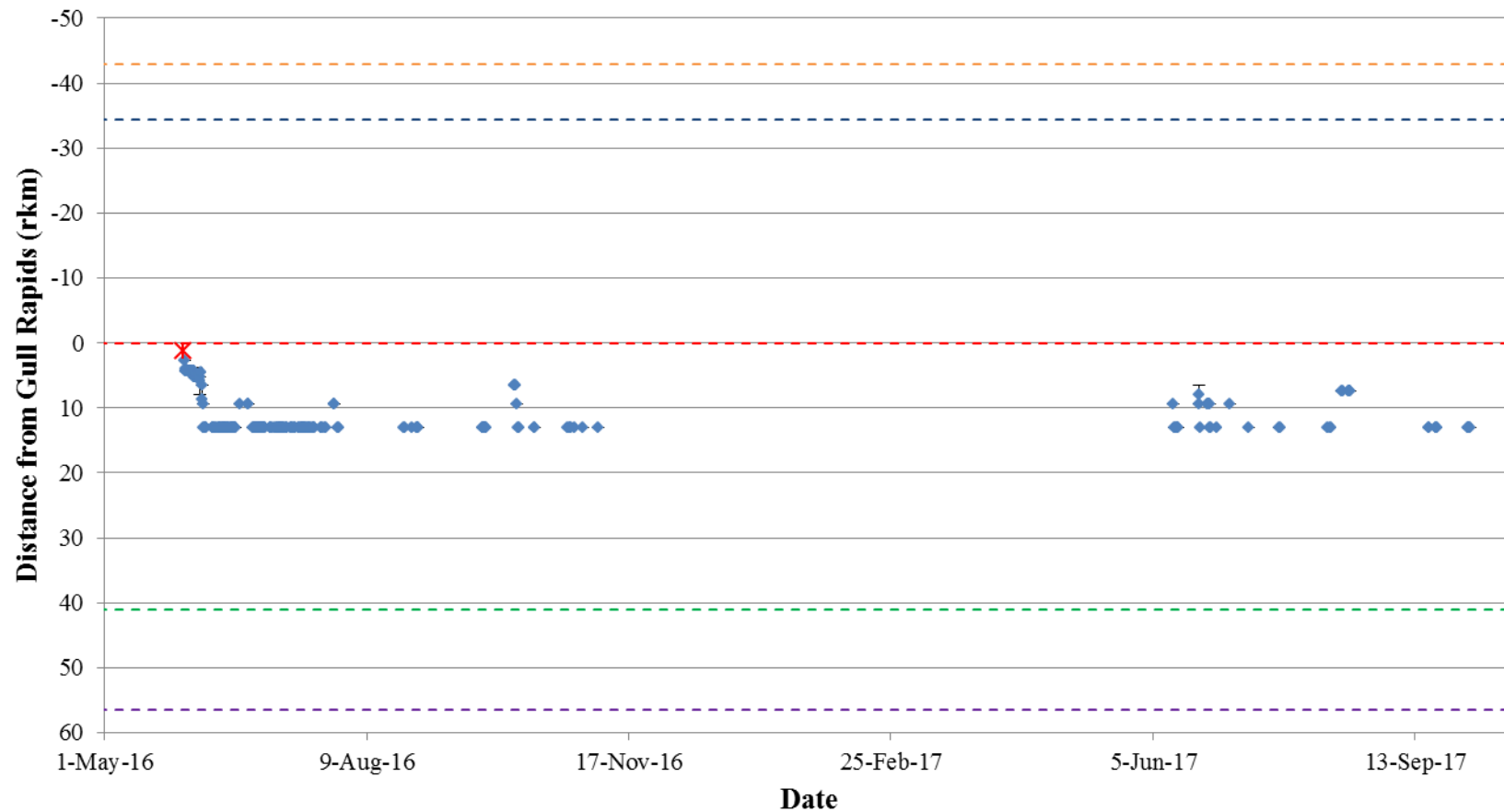


Figure A3-25: Position of a Walleye tagged with an acoustic transmitter (code #53748) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

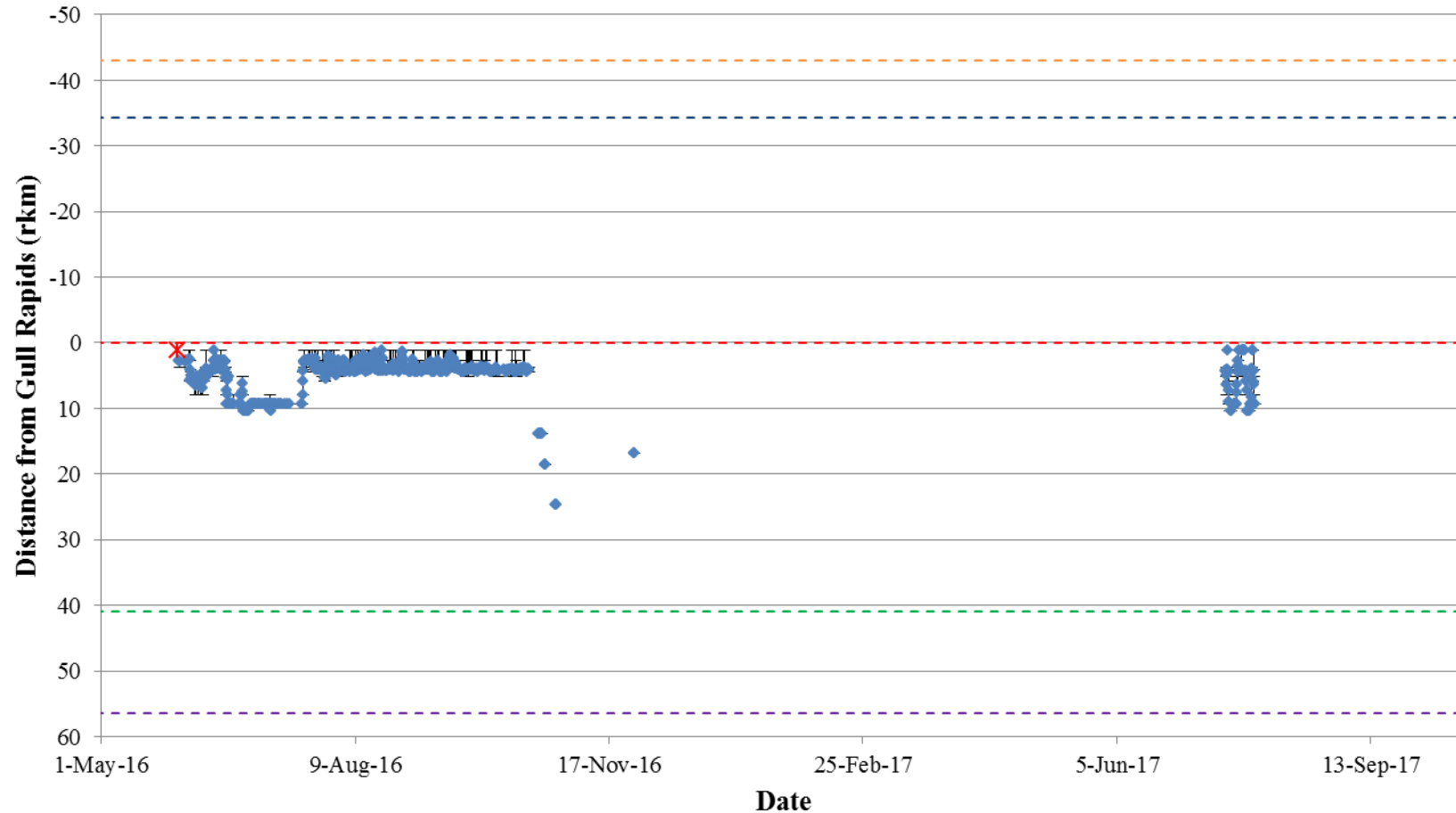


Figure A3-26: Position of a Walleye tagged with an acoustic transmitter (code #53749) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

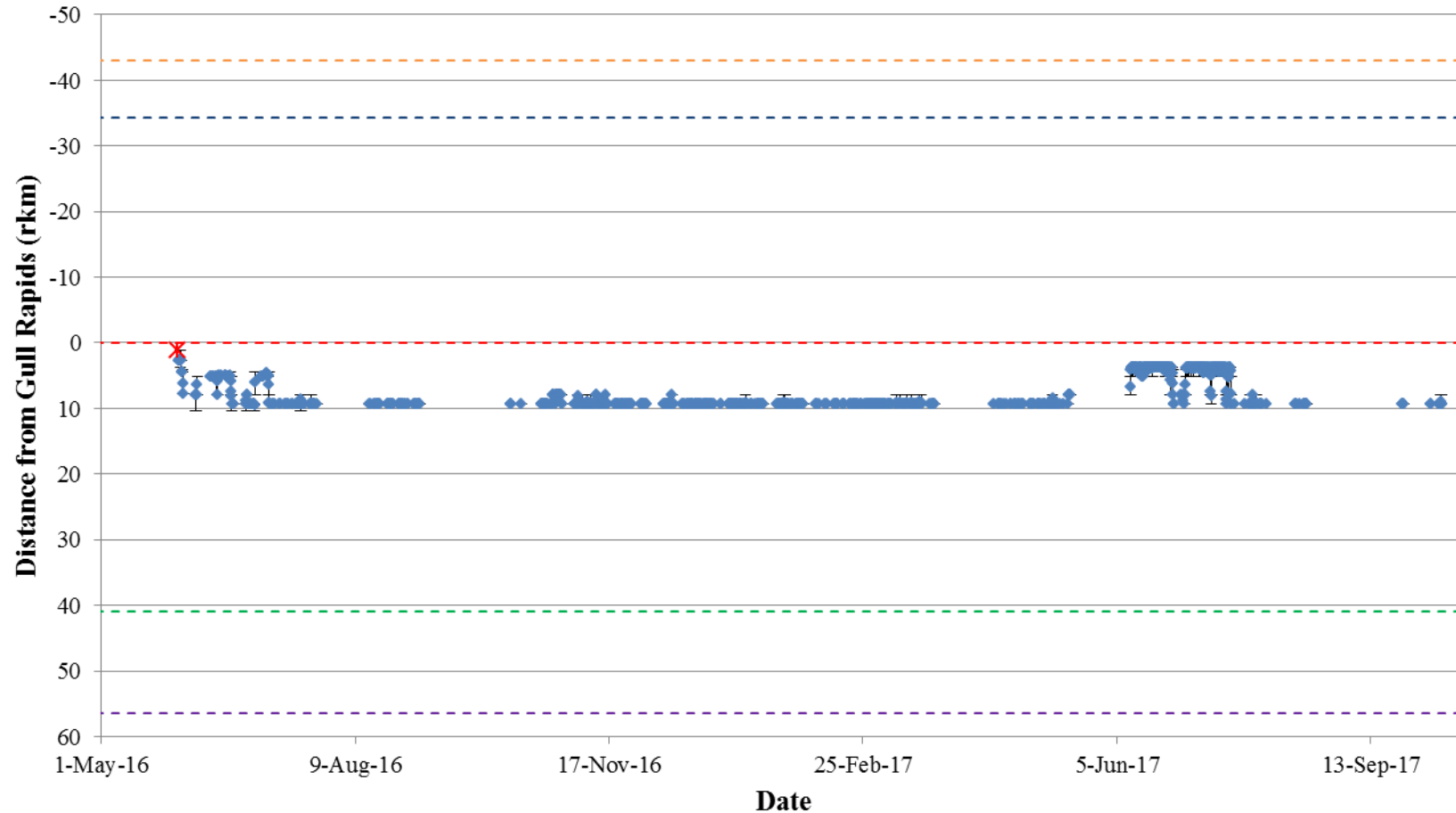


Figure A3-27: Position of a Walleye tagged with an acoustic transmitter (code #53750) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

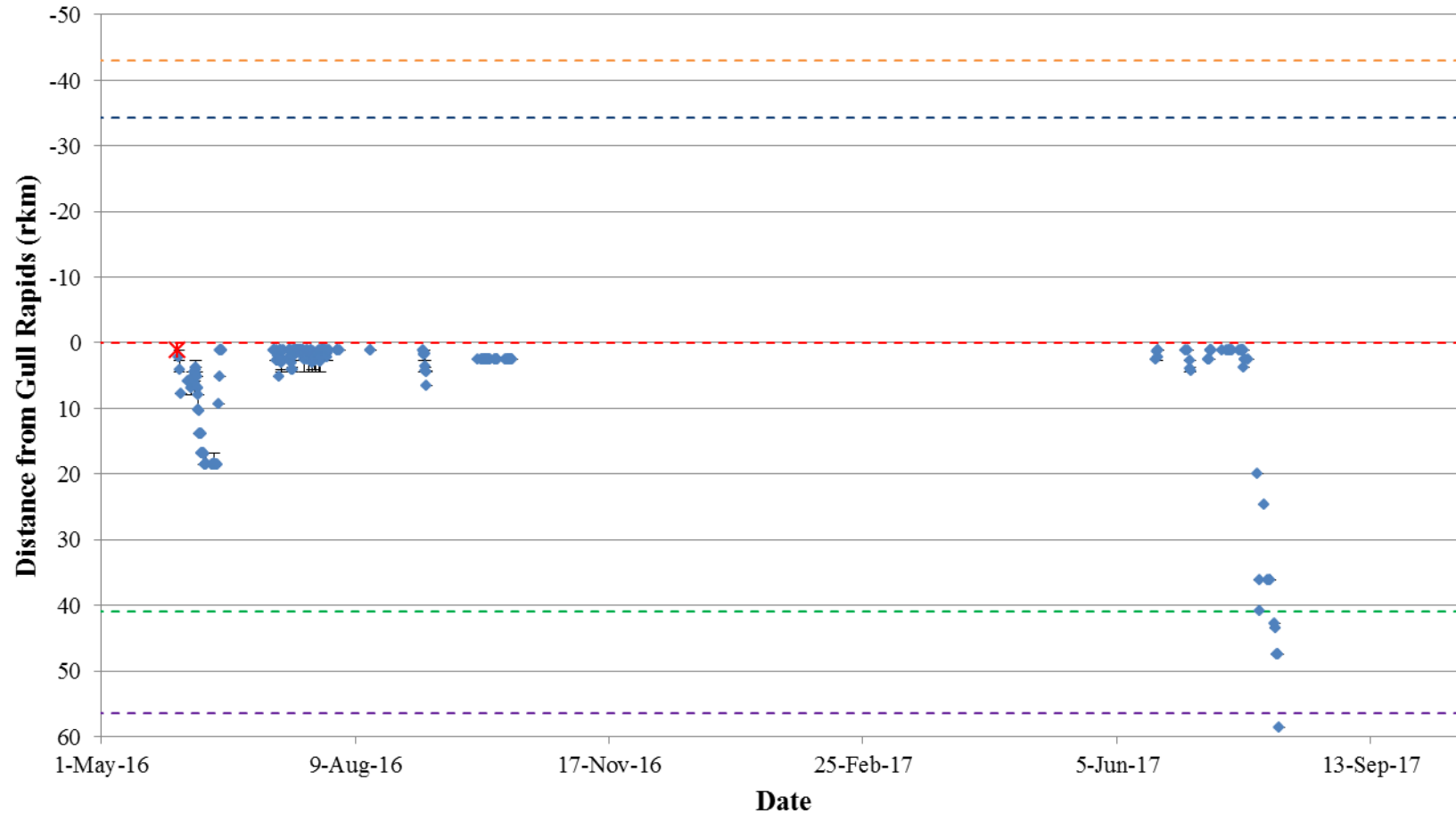


Figure A3-28: Position of a Walleye tagged with an acoustic transmitter (code #53751) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

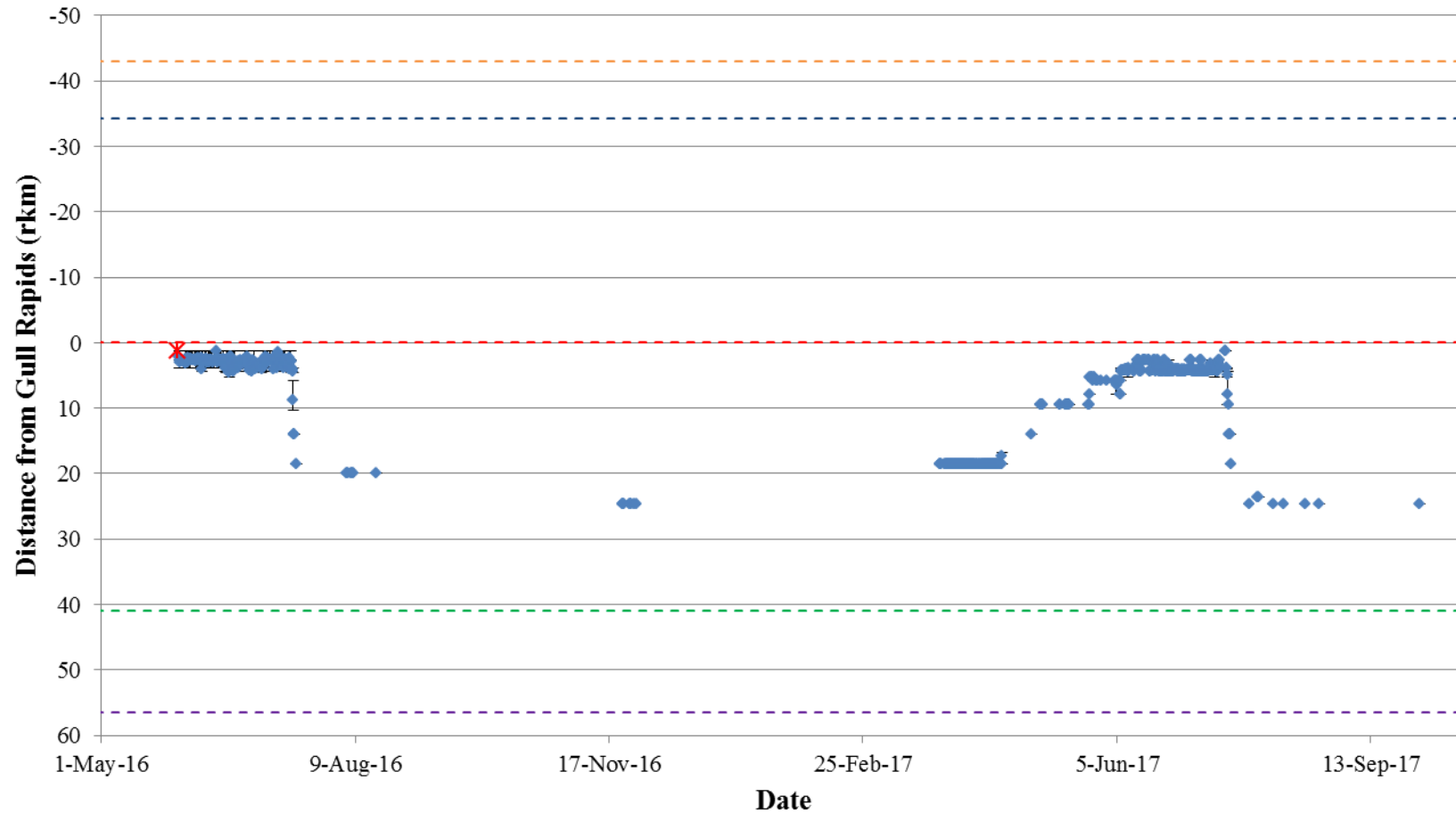


Figure A3-29: Position of a Walleye tagged with an acoustic transmitter (code #53752) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

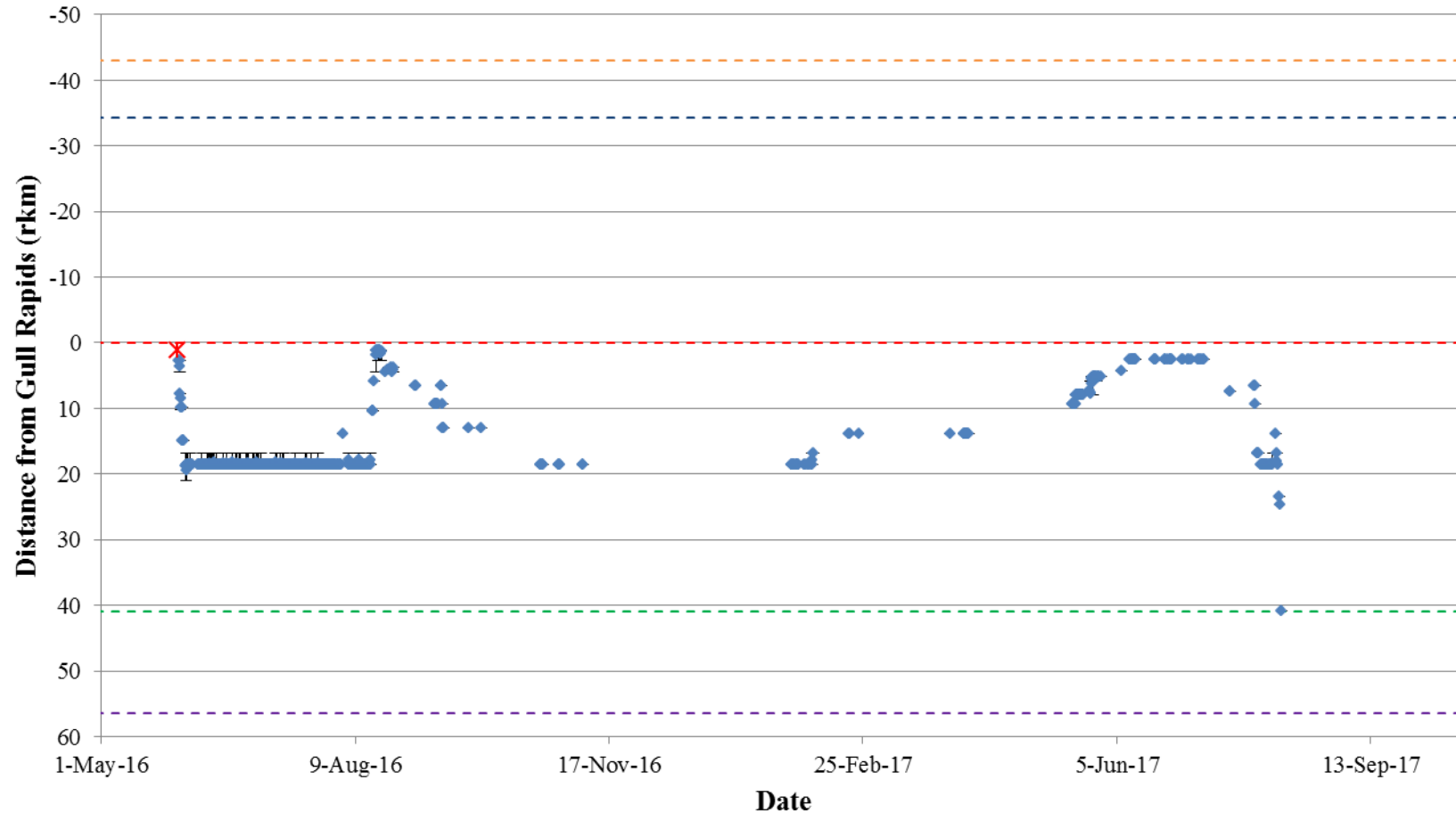
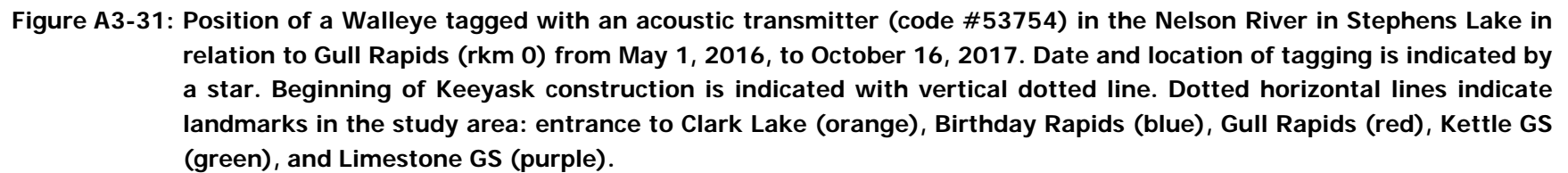


Figure A3-30: Position of a Walleye tagged with an acoustic transmitter (code #53753) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).



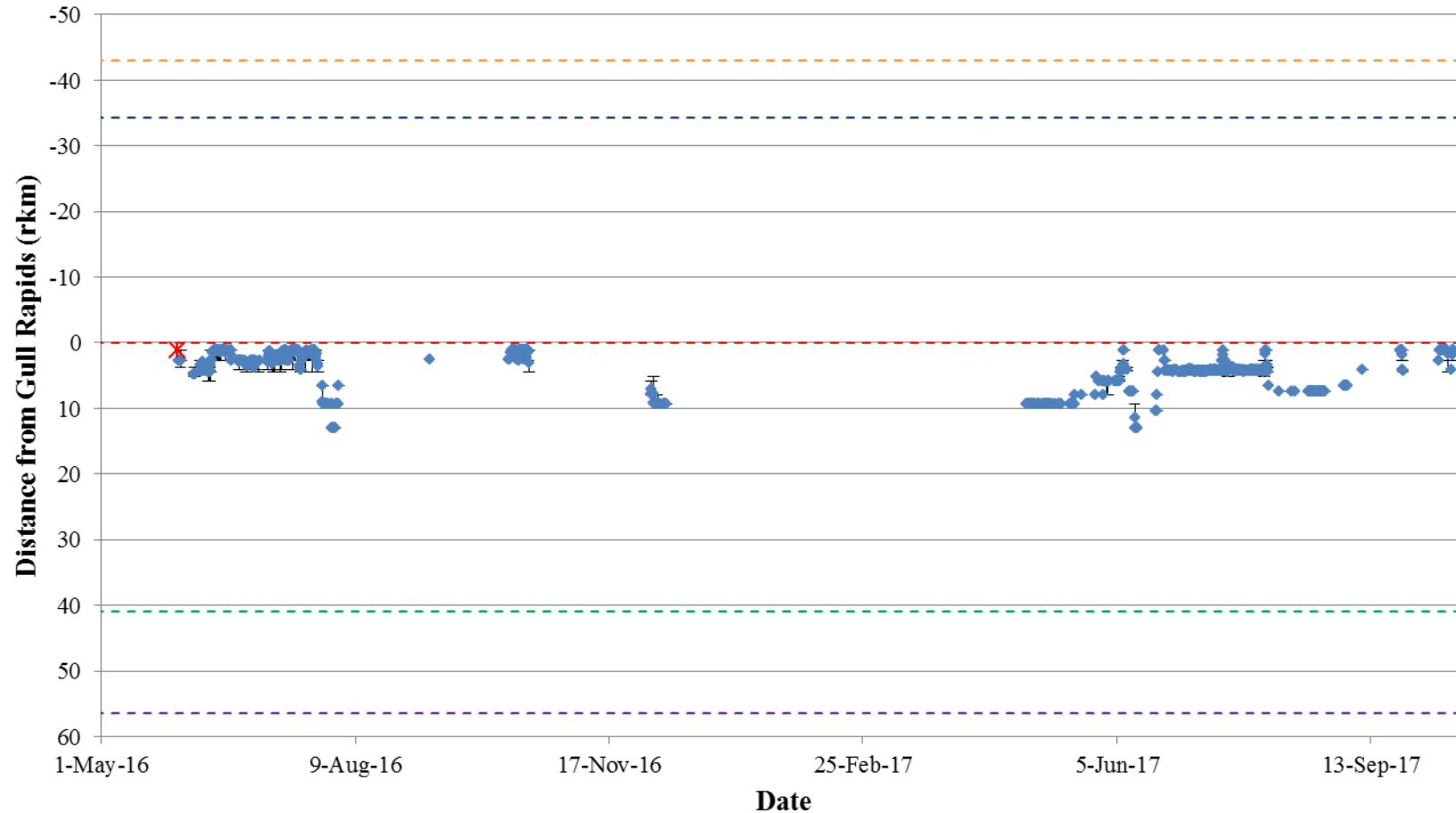


Figure A3-32: Position of a Walleye tagged with an acoustic transmitter (code #53755) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

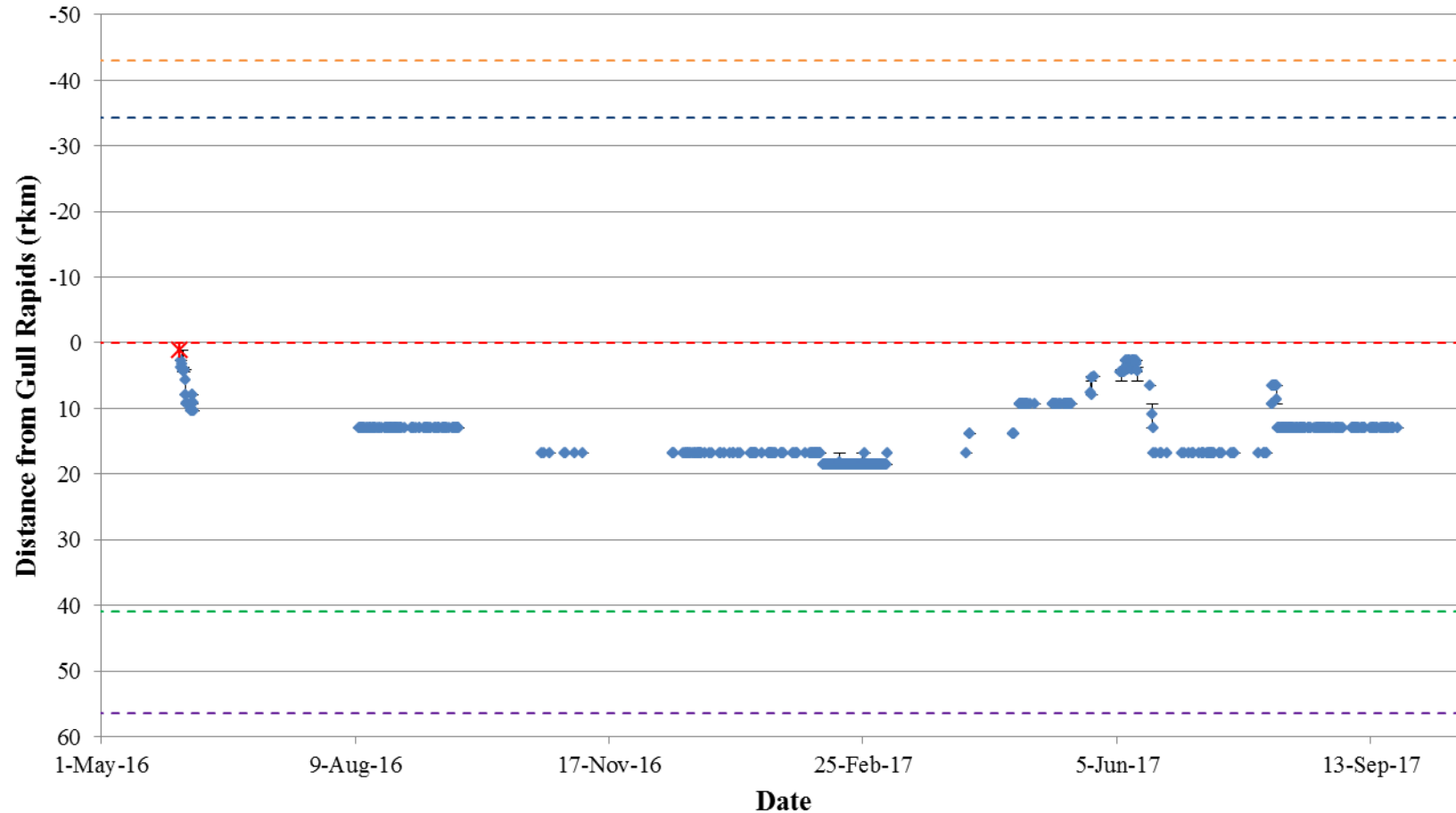


Figure A3-33: Position of a Walleye tagged with an acoustic transmitter (code #53756) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

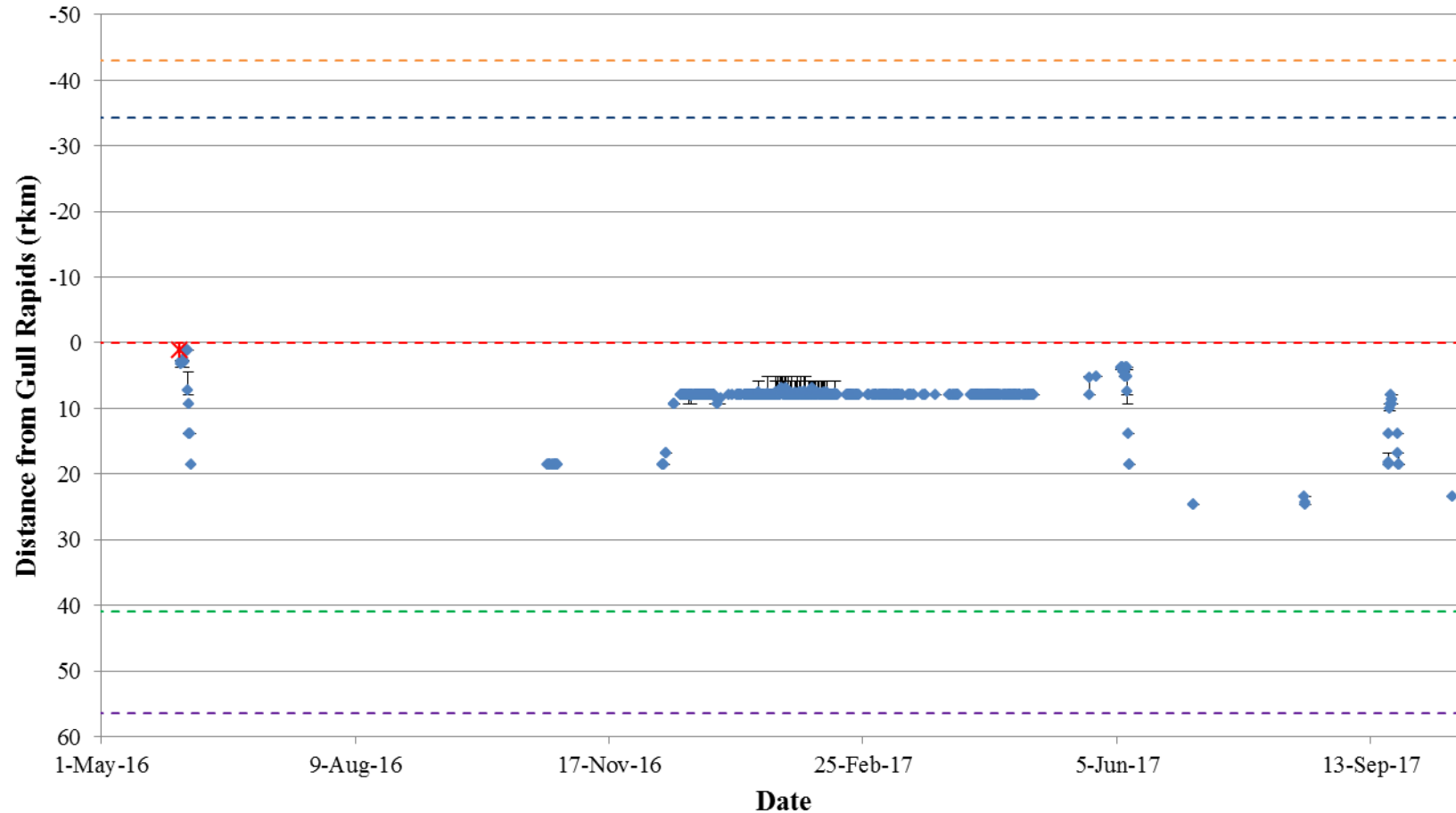


Figure A3-34: Position of a Walleye tagged with an acoustic transmitter (code #53757) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

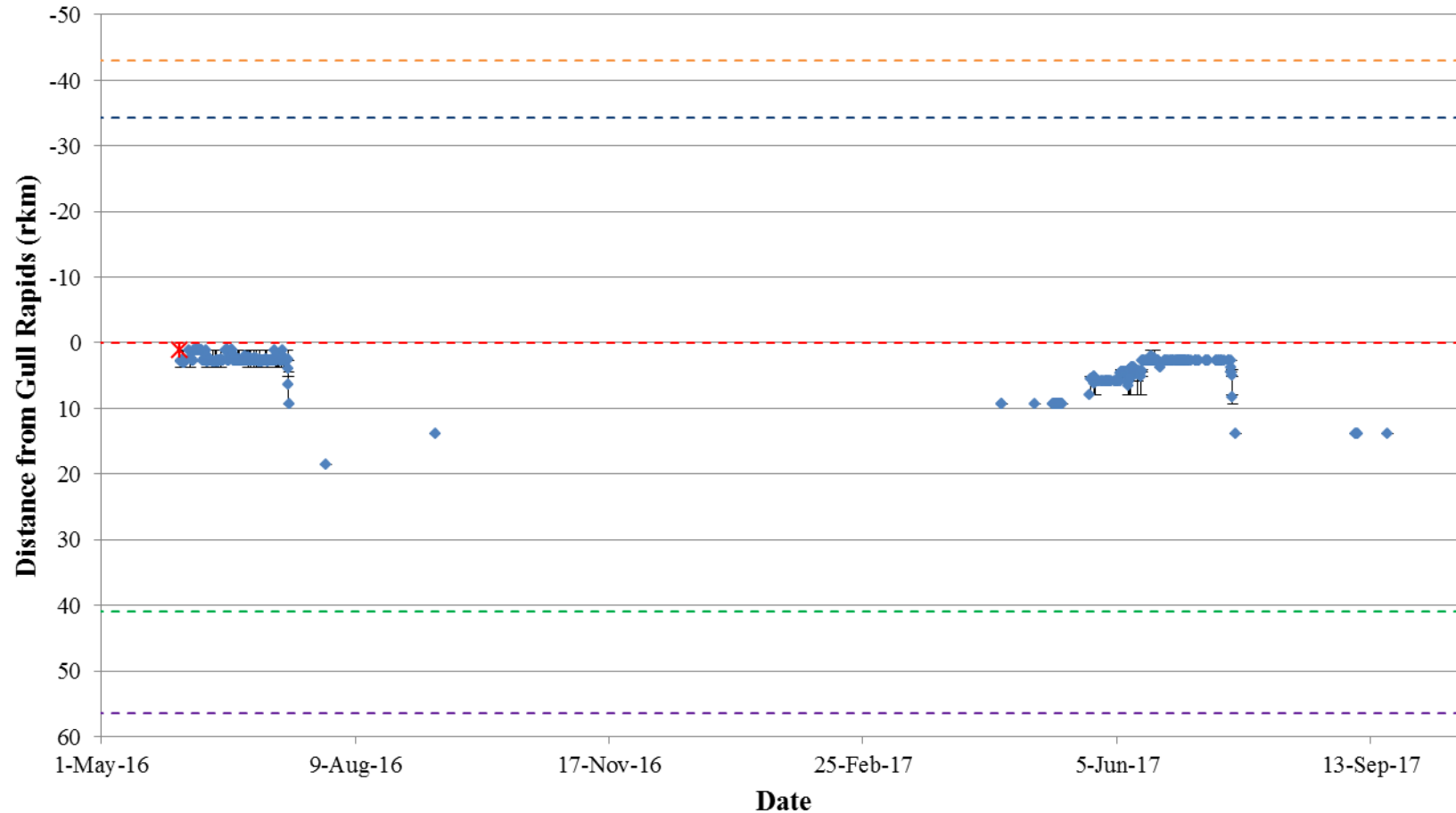


Figure A3-35: Position of a Walleye tagged with an acoustic transmitter (code #53808) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

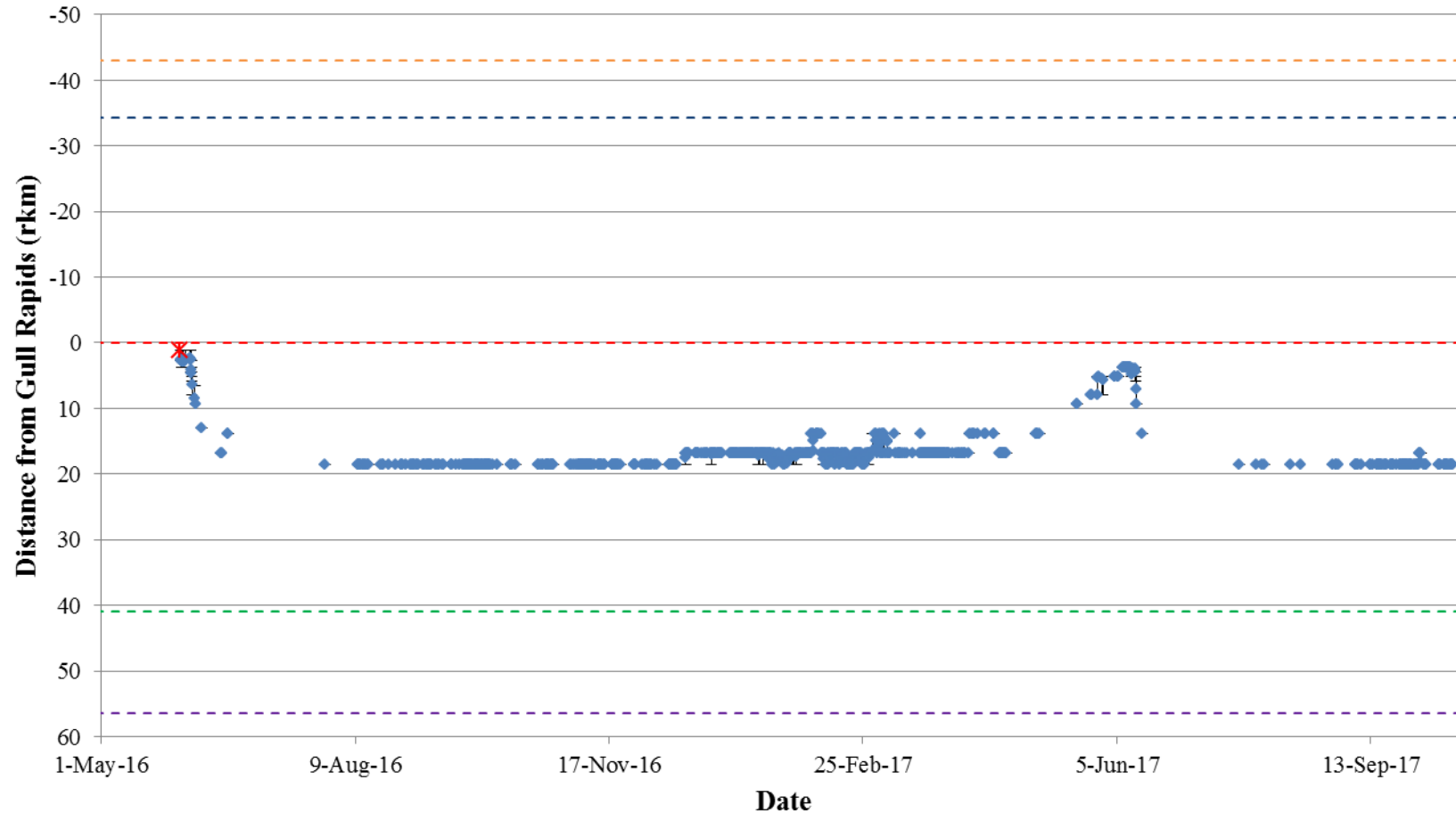


Figure A3-36: Position of a Walleye tagged with an acoustic transmitter (code #53809) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

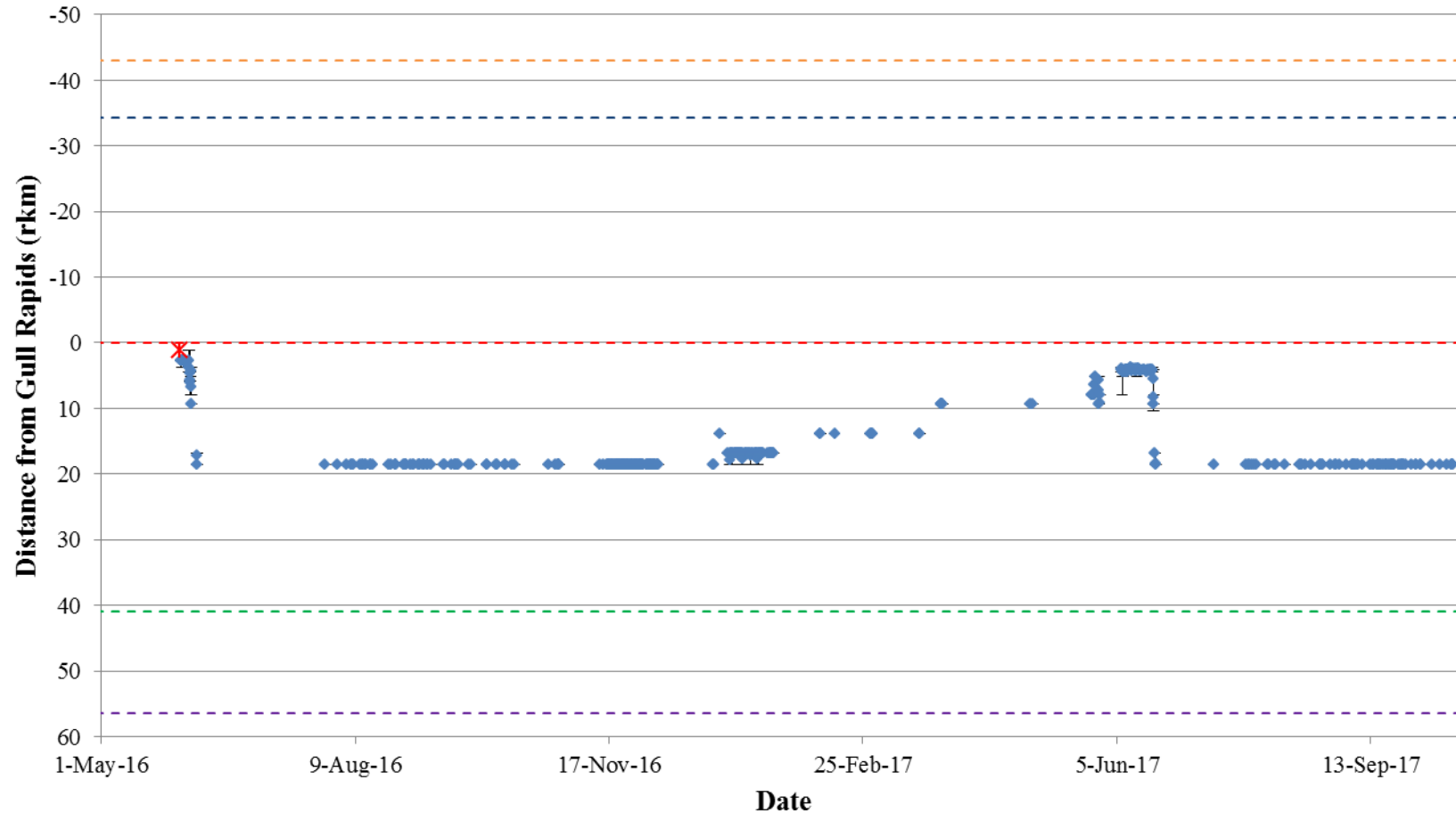


Figure A3-37: Position of a Walleye tagged with an acoustic transmitter (code #53810) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

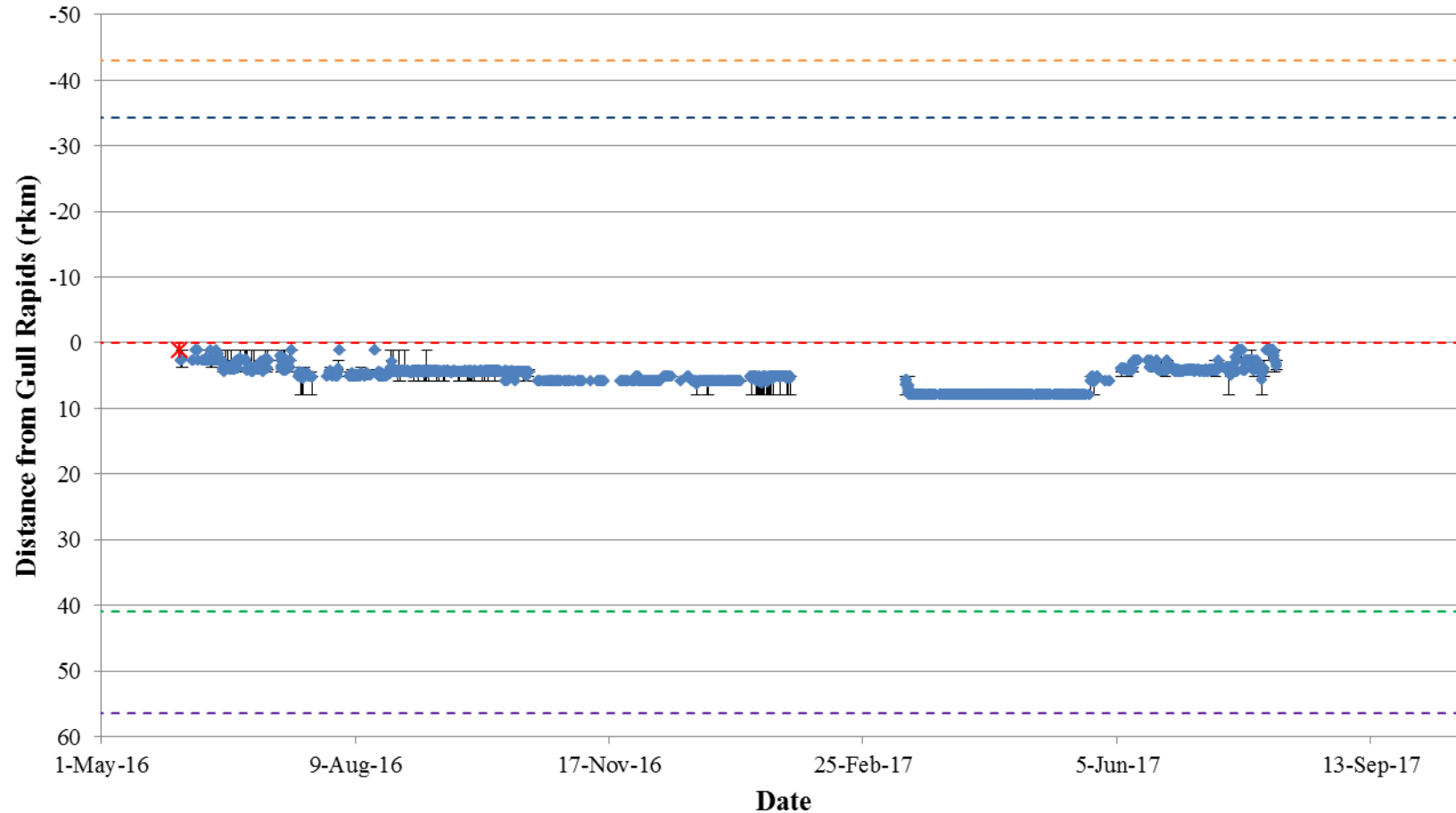


Figure A3-38: Position of a Walleye tagged with an acoustic transmitter (code #53811) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

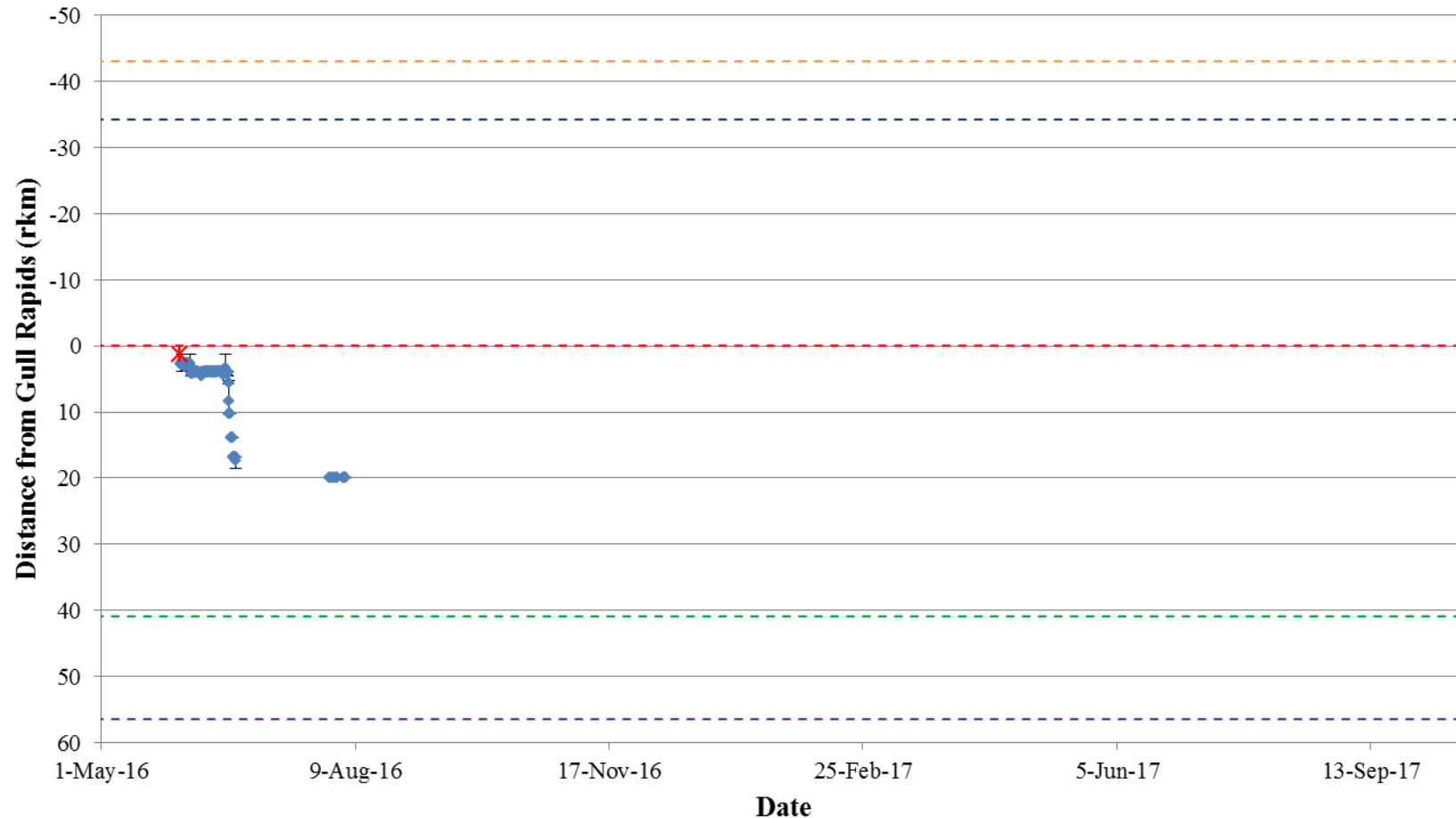


Figure A3-39: Position of a Walleye tagged with an acoustic transmitter (code #53812) in the Nelson River in Stephens Lake in relation to Gull Rapids (rkm 0) from May 1, 2016, to October 16, 2017. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with vertical dotted line. Dotted horizontal lines indicate landmarks in the study area: entrance to Clark Lake (orange), Birthday Rapids (blue), Gull Rapids (red), Kettle GS (green), and Limestone GS (purple).

APPENDIX 4: BIOLOGICAL AND TAG INFORMATION FOR WALLEYE TAGGED UPSTREAM AND DOWNSTREAM OF GULL RAPIDS

Table A4-1:	Tag and biological information for each Walleye acoustically tagged upstream of Gull Rapids in 2016.	164
Table A4-2:	Tag and biological information for each Walleye acoustically tagged upstream of Gull Rapids in 2016.	166

Table A4-1: Tag and biological information for each Walleye acoustically tagged upstream of Gull Rapids in 2016.

Tag ID	Date tagged	Tag Life (days)	Expiry date	Fork Length (mm)	Weight (g)
53763	05-Jun-16	1141	21-Jul-19	510	-
53764	05-Jun-16	1141	21-Jul-19	560	-
53768	05-Jun-16	1141	21-Jul-19	520	-
53769	05-Jun-16	1141	21-Jul-19	393	-
53770	05-Jun-16	1141	21-Jul-19	350	-
53771	05-Jun-16	1141	21-Jul-19	353	-
53772	05-Jun-16	1141	21-Jul-19	400	-
53773	05-Jun-16	1141	21-Jul-19	405	-
53774	05-Jun-16	1141	21-Jul-19	522	-
53775	05-Jun-16	1141	21-Jul-19	514	-
53776	30-May-16	1141	15-Jul-19	535	-
53777	29-May-16	1141	14-Jul-19	404	1050
53778	03-Jun-16	1141	19-Jul-19	523	-
53779	03-Jun-16	1141	19-Jul-19	400	-
53780	03-Jun-16	1141	19-Jul-19	660	-
53781	02-Jun-16	1141	18-Jul-19	525	-
53782	31-May-16	1141	16-Jul-19	509	1550
53783	31-May-16	1141	16-Jul-19	388	850
53784	30-May-16	1141	15-Jul-19	510	-
53785	30-May-16	1141	15-Jul-19	526	-
53786	30-May-16	1141	15-Jul-19	400	-
53787	30-May-16	1141	15-Jul-19	360	-
53788	30-May-16	1141	15-Jul-19	603	-
53789	30-May-16	1141	15-Jul-19	577	-
53790	29-May-16	1141	14-Jul-19	533	2000
53791	29-May-16	1141	14-Jul-19	400	725
53792	28-May-16	1141	13-Jul-19	559	-
53793	07-Jun-16	1141	23-Jul-19	560	2125
53794	07-Jun-16	1141	23-Jul-19	440	1200
53795	07-Jun-16	1141	23-Jul-19	410	900
53796	07-Jun-16	1141	23-Jul-19	441	1150
53797	07-Jun-16	1141	23-Jul-19	520	1700
53798	07-Jun-16	1141	23-Jul-19	495	1500

Table A4-1: Tag and biological information for each Walleye acoustically tagged upstream of Gull Rapids in 2016 (continued).

Tag ID	Date tagged	Tag Life (days)	Expiry date	Fork Length (mm)	Weight (g)
53799	07-Jun-16	1141	23-Jul-19	511	1650
53800	07-Jun-16	1141	23-Jul-19	530	1750
53801	07-Jun-16	1141	23-Jul-19	360	600
53802	07-Jun-16	1141	23-Jul-19	468	1300
53805	06-Jun-16	1141	22-Jul-19	532	-
53806	06-Jun-16	1141	22-Jul-19	405	-
53807	06-Jun-16	1141	22-Jul-19	451	-
53758	24-Sep-16	1141	09-Nov-19	423	750
53759	24-Sep-16	1141	09-Nov-19	362	500
53760	24-Sep-16	1141	09-Nov-19	512	1825
53765	24-Sep-16	1141	09-Nov-19	491	1300
53766	24-Sep-16	1141	09-Nov-19	484	1250
53767	24-Sep-16	1141	09-Nov-19	508	1450
53803	24-Sep-16	1141	09-Nov-19	484	1550
53804	24-Sep-16	1141	09-Nov-19	410	700

Table A4-2: Tag and biological information for each Walleye acoustically tagged upstream of Gull Rapids in 2016.

Tag ID	Date tagged	Tag Life (days)	Expiry date	Fork Length (mm)	Weight (g)
53723	28-May-16	1141	13-Jul-19	510	1500
53724	28-May-16	1141	13-Jul-19	433	1050
53725	27-May-16	1141	12-Jul-19	480	1200
53726	27-May-16	1141	12-Jul-19	412	800
53727	28-May-16	1141	13-Jul-19	486	-
53728	28-May-16	1141	13-Jul-19	507	1650
53729	28-May-16	1141	13-Jul-19	375	560
53730	28-May-16	1141	13-Jul-19	491	1700
53731	28-May-16	1141	13-Jul-19	442	950
53732	28-May-16	1141	13-Jul-19	530	1825
53733	30-May-16	1141	15-Jul-19	322	500
53734	30-May-16	1141	15-Jul-19	460	1325
53735	30-May-16	1141	15-Jul-19	374	600
53736	30-May-16	1141	15-Jul-19	398	900
53737	29-May-16	1141	14-Jul-19	508	1625
53738	31-May-16	1141	16-Jul-19	522	1875
53739	31-May-16	1141	16-Jul-19	480	1300
53740	31-May-16	1141	16-Jul-19	482	1400
53741	30-May-16	1141	15-Jul-19	404	975
53742	30-May-16	1141	15-Jul-19	452	1250
53743	31-May-16	1141	16-Jul-19	469	1450
53744	31-May-16	1141	16-Jul-19	405	750
53745	31-May-16	1141	16-Jul-19	453	1200
53746	31-May-16	1141	16-Jul-19	467	1380
53747	31-May-16	1141	16-Jul-19	520	1600
53748	31-May-16	1141	16-Jul-19	442	975
53749	31-May-16	1141	16-Jul-19	411	750
53750	31-May-16	1141	16-Jul-19	531	1800
53751	31-May-16	1141	16-Jul-19	422	825
53752	31-May-16	1141	16-Jul-19	468	1400
53753	31-May-16	1141	16-Jul-19	488	1325
53754	31-May-16	1141	16-Jul-19	475	1375
53755	31-May-16	1141	16-Jul-19	506	1475

Table A4-2: Tag and biological information for each Walleye acoustically tagged upstream of Gull Rapids in 2016 (continued).

Tag ID	Date tagged	Tag Life (days)	Expiry date	Fork Length (mm)	Weight (g)
53756	01-Jun-16	1141	17-Jun-19	495	1800
53757	01-Jun-16	1141	17-Jul-19	530	1750
53808	01-Jun-16	1141	17-Jul-19	360	600
53809	01-Jun-16	1141	17-Jul-19	468	1300
53810	01-Jun-16	1141	17-Jul-19	532	-
53811	01-Jun-16	1141	17-Jul-19	405	-
53812	01-Jun-16	1141	17-Jul-19	451	-