



Keeyask Generation Project Aquatic Effects Monitoring Plan

Adult Lake Sturgeon Movement Monitoring Report AEMP-2020-01



KEEYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2020-01

ADULT LAKE STURGEON MOVEMENT MONITORING IN THE NELSON RIVER BETWEEN CLARK LAKE AND THE LIMESTONE GENERATING STATION, OCTOBER 2018 TO OCTOBER 2019: YEAR 6 CONSTRUCTION

Prepared for

Manitoba Hydro

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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 instream structures map below). 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. This opening was closed in spring 2018, and the area was dewatered. The spillway was commissioned in August 2018. The South Dam Cofferdam was completed in fall 2018, blocking the channel and forcing the entire flow of the river through the spillway. Almost all work in 2019 was in the dry. The construction activities included the excavation of the tailrace, construction of the tailrace spawning shoal, and completion of the dams and dykes.

Lake Sturgeon were identified as one of the key species for monitoring. They were chosen because they are culturally important to partner First Nations, local sturgeon populations have been previously impacted, and construction and operation of the GS will change or negatively impact important habitat. The plan to monitor the impacts of GS construction and operation on sturgeon includes several types of studies:

- Estimating the number of adults;
- Estimating the number and growth of juveniles (less than 800 millimetres [mm] in length);
- Identifying spawning locations and numbers of spawning fish; and
- Recording seasonal habitat use and long distance movements (*i.e.*, over GSs or rapids) through movement studies.

The movements of Lake Sturgeon over Birthday and Gull rapids were monitored prior to 2011, but because different methods were used from 2011 and onward, the results of the two monitoring periods are not directly comparable. While pre-2011 studies did not record detailed fish movement patterns between Clark Lake and Stephens Lake, the data indicated that the majority of Lake Sturgeon 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. No fish moved downstream over the Kettle GS.

This report provides the results of adult sturgeon movement monitoring conducted from October 2018 to October 2019. This monitoring was initiated in June 2011 when 59 adult Lake Sturgeon were tagged with acoustic transmitters with a 10-year battery life. Movements of these fish were monitored for approximately three years before any changes to the river occurred, and four years and three months since the start of construction. An additional 51 adult Lake Sturgeon were tagged with acoustic transmitters in spring, 2019. These fish will be tracked for a full year before reservoir impoundment and for nine years after.



Adult Lake Sturgeon.

Why is the study being done?

Monitoring during construction is being done to answer three questions:

Is construction affecting the area that adult Lake Sturgeon occupy upstream and downstream of the construction site?

Monitoring sturgeon movement shows what areas of the river the sturgeon are using and where they are choosing to stay relative to the construction site.

Are there adult Lake Sturgeon close to the construction site?

If sturgeon 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 adult Lake Sturgeon are moving through and/or away from Gull Rapids during construction and how far are they going?

Movement studies tell us how many sturgeon 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 adult sturgeon were tracked using acoustic telemetry. Fish are captured using a gill net and then a tag is surgically implanted inside each fish. Tags are implanted through a small incision which is then closed with sutures. Each tag sends out a sound signal (called a “ping”) that is picked up by receivers placed along the Nelson River between Clark Lake and the Kettle GS (see study area map below). Access conditions have prevented receivers from being placed in the Long Spruce and Limestone Reservoirs since 2018. Each fish is given a transmitter

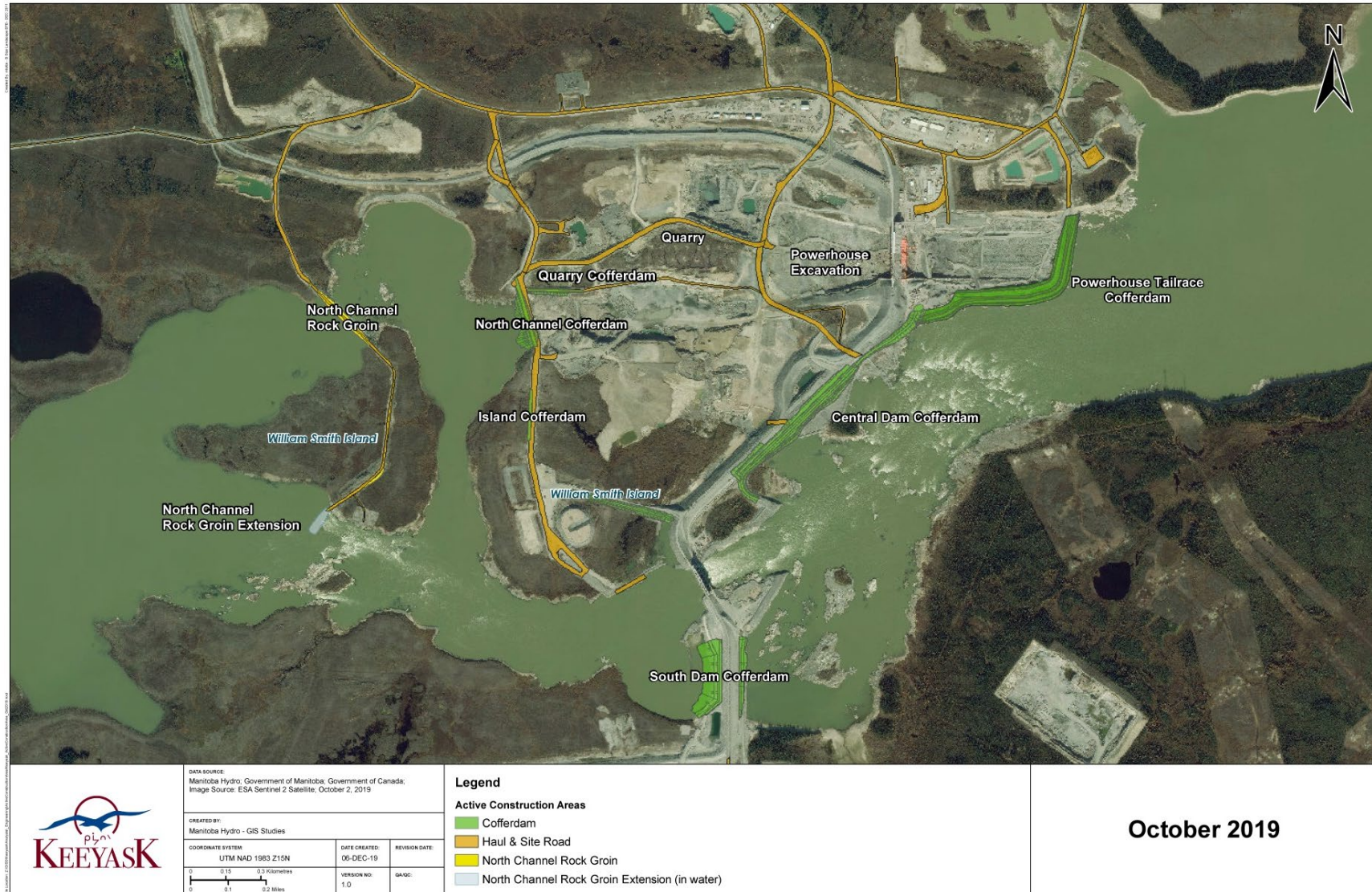
that sends out a unique ping, which can be detected up to 1 kilometre (km) from a receiver. By looking at the detections that were recorded by different receivers, the movements of each fish can be tracked.

Fifty-nine adult Lake Sturgeon were tagged in 2011 and 2012, 30 upstream and 29 downstream of Gull Rapids. The transmitters are powered by batteries with a 10-year life-span. By the end of 2013, some fish were considered missing so 11 more tags were applied in 2014 (four upstream of Gull Rapids and seven in Stephens Lake) to return the number of tagged fish to the original sample size. One additional tag was applied in spring 2018 to a female sturgeon used for broodstock (eggs) in a stocking program. This tag was applied to track her survival after egg collection.

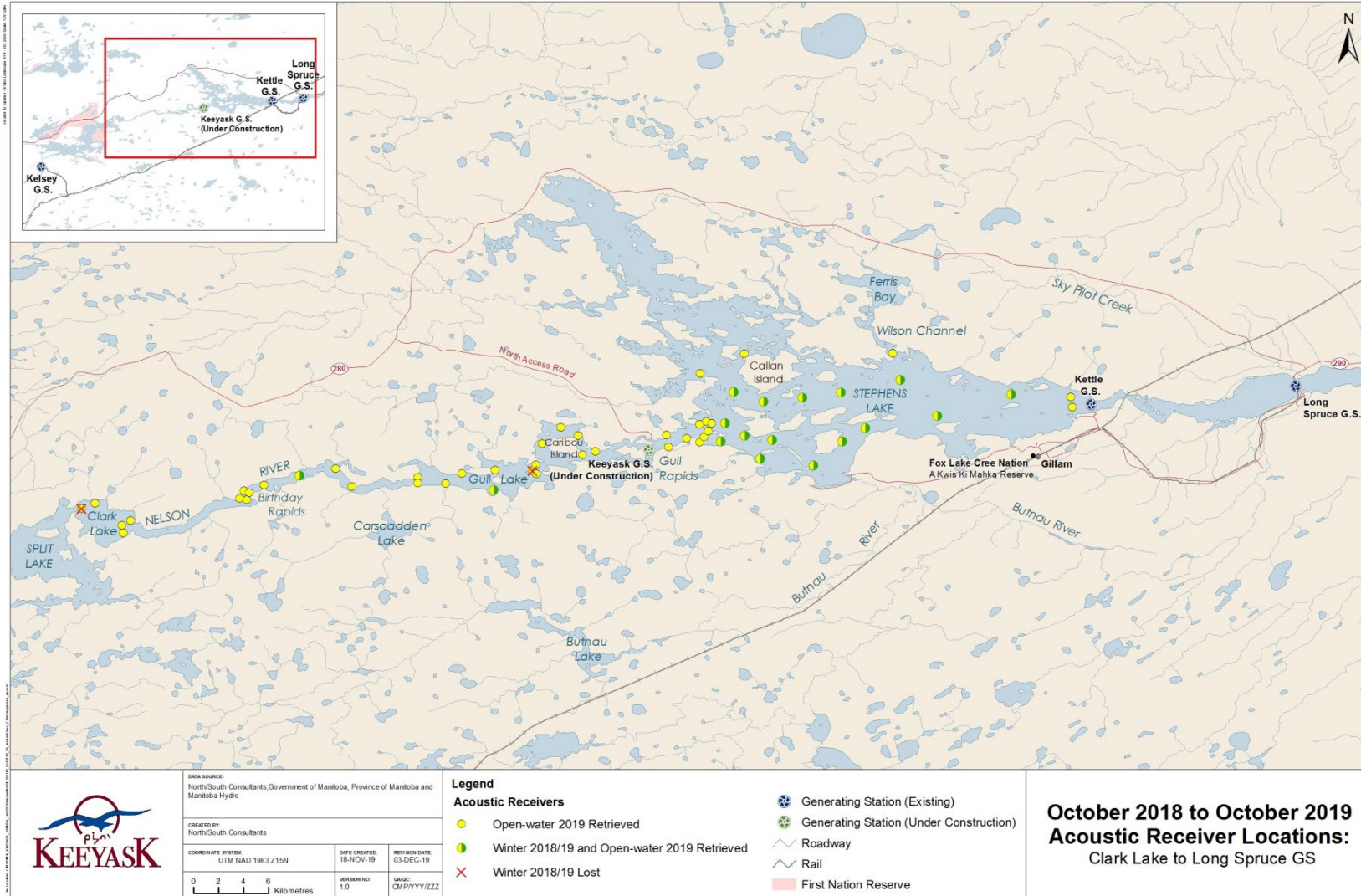
Fifty-one new adult Lake Sturgeon were tagged in spring 2019, 26 upstream and 25 downstream of the Keeyask GS. These fish will be tracked both before and after reservoir impoundment.



Adult Lake Sturgeon being held in a tank prior to surgery (left). Acoustic tag being implanted in an adult Lake Sturgeon (middle). Adult Lake Sturgeon released into the river after acoustic surgery (right).



Map illustrating instream structures at the Keeyask Generating Station site, October 2019.



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?

Sturgeon are unique fish in Manitoba because they can live for a long time (100 or more years), become adults when they are 20 to 25 years old, and only spawn every two to five years. This means that where an individual sturgeon moves may change between years depending on how old it is, whether it is spawning, and what its individual habits are. Sturgeon spawn in spring in the fast-flowing water of large rapids, and spend the rest of the open-water season feeding in areas of rivers or lakes. During the winter, they move to areas where they are protected from ice and fast water.

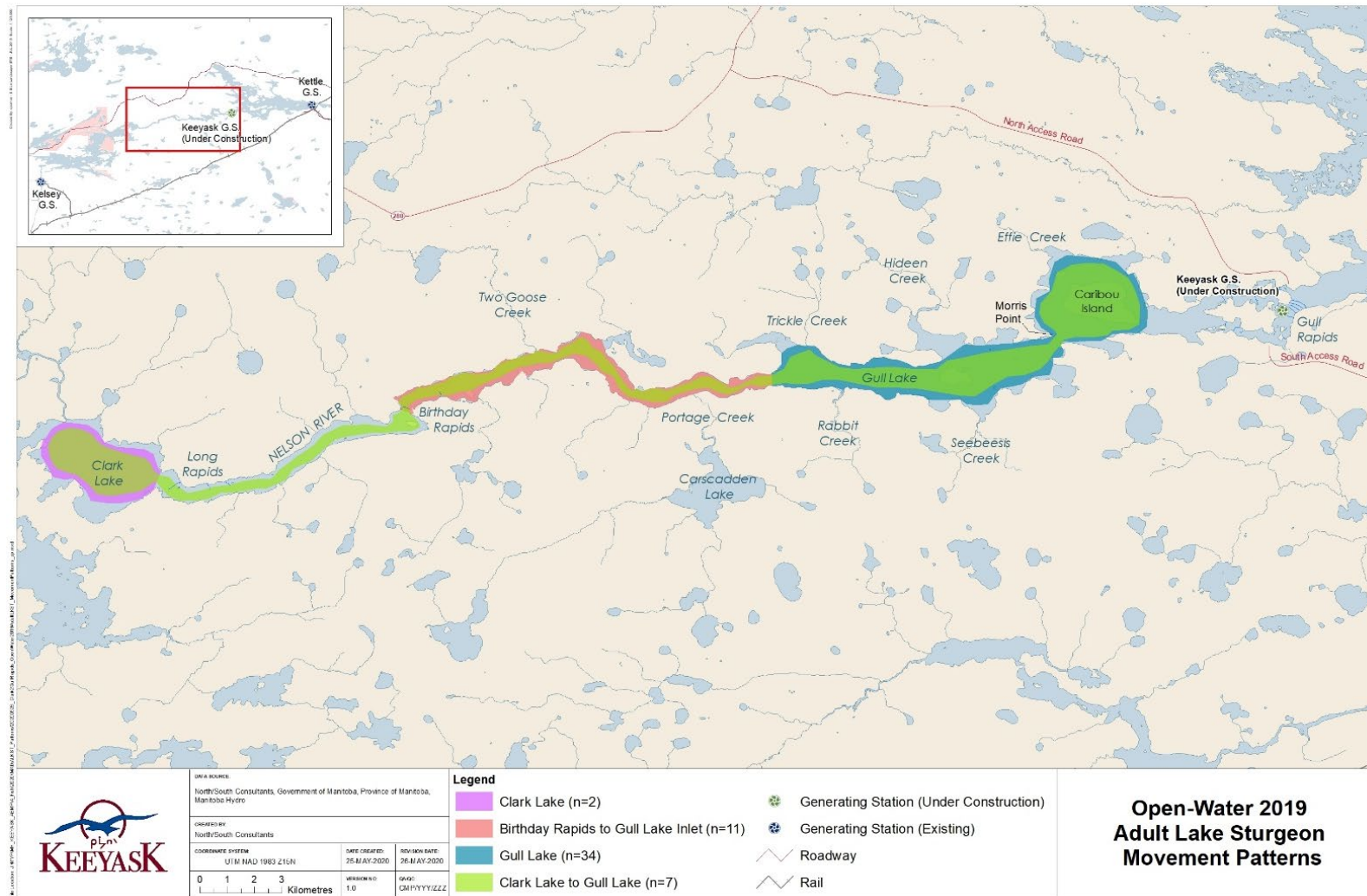
During this study, movements of the tagged fish were monitored year-round including the winter when the river is covered with ice. Monitoring movements in winter is challenging because the ice conditions can damage or move the receivers. For this reason, receivers are left in only a few locations over the winter, making it less likely that sturgeon will be detected.

After eight-and-a-half years of monitoring, the sturgeon that were tagged in Gull Lake continue to be divided into three groups: those that usually live in Gull Lake (sometimes these fish leave for short periods of time then return); those that usually stay in the channel of the Nelson River between Birthday Rapids and Gull Lake; and those that usually stay in Clark Lake. The Lake Sturgeon that were tagged in 2019 showed the same movement patterns.

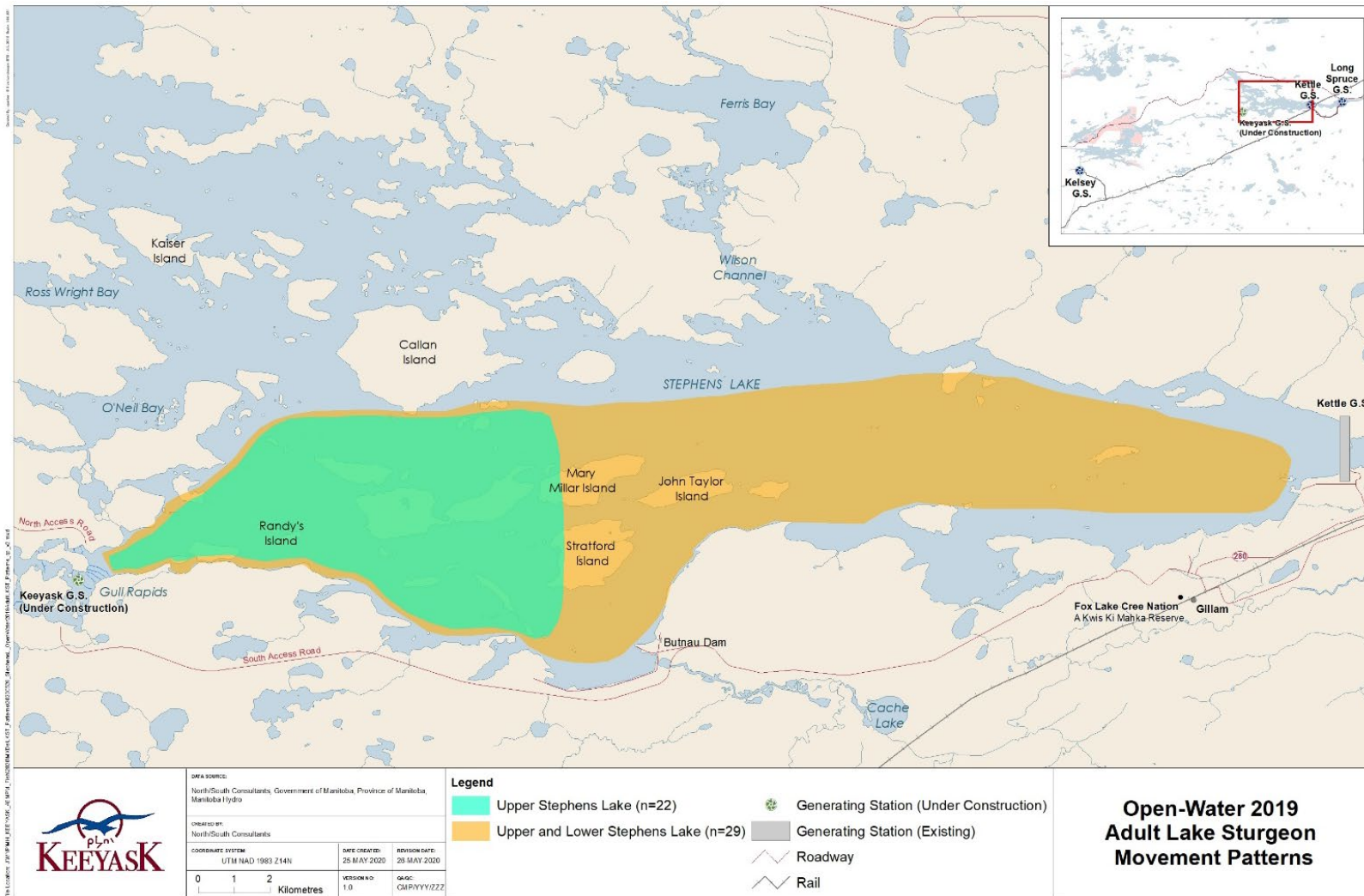
Adult Lake Sturgeon tagged in Stephens Lake tend to stay in the main river channel, specifically the part of Stephens Lake where the river channel was flooded when the Kettle GS was built. Fish tagged in Stephens Lake continue to be split into two groups: those that remain in upper Stephens Lake within about 10 km of Gull Rapids; and those that periodically move downstream into lower Stephens Lake (as far as 40 km downstream of Gull Rapids). The Lake Sturgeon that were tagged in 2019 show the same movement patterns.

No adult Lake Sturgeon (either those tagged in 2011 or 2019) moved downstream through the Keeyask GS in 2019. Since studies began in 2011, six fish moved upstream (one in 2011, four in 2012, one in 2013; all prior to 2014 when construction began) and six moved downstream (two in 2014 prior to construction, one in 2015, two in 2016, and one in 2017). No adults moved upstream through Gull Rapids since construction started, but four have moved downstream. In August 2018, the river channel was completely blocked off and the Keeyask GS spillway was opened for the first time. Because of this, fish are no longer able to move upstream.

Since 2011, four sturgeon have moved downstream out of Stephens Lake into the Long Spruce Reservoir after passing through the Kettle GS (one is known to have moved through a turbine, while the other three either moved over the spillway or went through a turbine). Two of these fish moved past the Long Spruce GS in 2016. No receivers could be set downstream of the Kettle or Long Spruce GSs in 2018 or 2019 due to low water levels, but one fish is suspected to have moved downstream through the station because it was last detected upstream in 2018 and was not detected in 2019.



Map Summarizing movements of adult Lake Sturgeon in the Clark Lake to Keeyask Generating Station Area. Shaded areas represent movement patterns of sturgeon (numbers of sturgeon displaying each pattern are in legend).



Map Summarizing movements of adult Lake Sturgeon in the Stephens Lake Area. Shaded areas represent movement patterns of sturgeon (numbers of sturgeon displaying each pattern are in legend).

What does it mean?

So far, monitoring has shown that each sturgeon has a place where it likes to live. At times each fish may move to a different habitat, particularly if it is spawning. So far we have seen that sturgeon usually do not move great distances and that most prefer to live in similar locations year after year. Movement monitoring from 2014 – 2019 indicates construction of the Keeyask GS has not affected the movements of adult sturgeon upstream or downstream of the site to date. Many sturgeon use habitat immediately downstream of the construction site in Stephens Lake. They do not seem to be disturbed by construction activity.

The number of sturgeon moving upstream past Clark Lake or downstream past the Kettle GS does not seem to have increased during construction. However, sturgeon can no longer move upstream from Stephens Lake to Gull Lake since the Keeyask GS spillway was opened in 2018.

What will be done next?

The tags that were implanted in 2011 will last until 2021 and the tags that were implanted in 2019 will last until 2029. Following the movements of individual fish over such a long time will give us a better idea of what kinds of habitats these fish need to use over many years and whether construction and operation of the GS is changing their movement patterns. Following movements during and after large habitat changes (such as reservoir impoundment, scheduled for fall of 2020) help us understand how sturgeon will adapt to their new environment. Movement monitoring will continue until 2031.

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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, adult Lake Sturgeon movement, for the construction and operation phases of the Project.

One of the main objectives associated with radio and acoustic telemetry studies conducted prior to 2011 (*i.e.*, in support of the Keeyask Generation Project EIS) was detecting upstream and downstream movements of fish over rapids in the study area (Birthday Rapids and Gull Rapids). Pre-Project movement data revealed that the majority of Lake Sturgeon 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. Movement data collected from telemetry studies conducted prior to 2011 are not directly comparable to those described herein given that receiver coverage has improved considerably; the pre-Project acoustic receiver array was comprised of 20 receivers, while the array used after 2011 consists of as many as 60 receivers. Also, radio telemetry has not been used since 2004.

This report provides one year of results (October 2018 to October 2019) from the multi-year adult Lake Sturgeon movement monitoring program described in the AEMP. The report also discusses what has been learned since adult Lake Sturgeon movement monitoring began in 2011. In 2011, 59 fish (measuring > 796 mm fork length) were tagged with acoustic transmitters with a 10-year battery lifespan. Thirty-one fish were captured and tagged upstream of Gull Rapids, and 28 fish were captured and tagged downstream of Gull Rapids. An additional fish was tagged in Stephens Lake in 2013 to replace a tag returned by a local resource user. By 2013, 11 tags were either missing or lost. To compensate for this loss, additional tags were implanted in 2014 to restore the sample size to 59 fish. Results from all studies dating back to 2011 are presented in Hrenchuk and McDougall (2012); Hrenchuk and Barth (2013); Hrenchuk *et al.* (2014); Hrenchuk and Barth (2015); Hrenchuk and Barth (2016); Hrenchuk and Barth (2017); Hrenchuk *et al.* (2018), and Hrenchuk and Lacho (2019). An additional 51 adult Lake Sturgeon were tagged in 2019 to track changes before and up to nine years after reservoir impoundment.

Adult Lake Sturgeon movement monitoring during the construction phase is being conducted between Clark Lake and the upper portion of the Limestone Reservoir (Map 1) to determine if disturbances associated with construction alter habitat use and coarse-scale movement patterns upstream and downstream of the Project (Map 2). Results assist in identifying:

- The use of key habitats (*i.e.*, spawning, rearing, and foraging) during construction;
- The potential vulnerability of sturgeon to activities at the construction site (*i.e.*, if sturgeon use the area in the immediate vicinity of the construction site they may be vulnerable to construction effects such as stranding during dewatering, releases of suspended sediment); and
- The potential for increased emigration or avoidance of the construction site due to disturbance (*i.e.*, blasting, suspended sediment inputs, *etc.*).

The key questions for adult movement monitoring during the construction phase are as follows:

- Do disturbances associated with construction alter coarse-scale movement/habitat use upstream and/or downstream of the construction site?
- Are sturgeon using habitat in the immediate vicinity of the construction site?
- Does the frequency of long-distance movements (and subsequent downstream emigration/entrainment) by adult Lake Sturgeon increase during construction?

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 the Keeyask GS (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 the Keeyask GS (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 the Keeyask GS 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 the Keeyask GS. 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, now the site of the Keeyask GS, was located approximately 3 km downstream of Caribou Island on the Nelson River (Map 1). Prior to construction, the rapids were approximately 2 km in length, and the river elevation dropped approximately 11 m along the 2 km length. Two large islands and several small islands occurred within the rapids, prior to the river narrowing; these features are within the Project footprint and have now been either dewatered, incorporated into the GS or will be flooded after impoundment (Map 2). A summary of construction activities is provided in Section 2.1.

Just below the Keeyask GS, the Nelson River enters Stephens Lake (Maps 1 and 7). 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. After August 2018, all flow has been passed through the Keeyask GS spillway (see Section 2.1).

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 the Keeyask GS.

The Long Spruce reservoir was formed in 1979 by the construction of the Long Spruce GS. It is a 16 km reach of the Nelson River extending from Long Spruce GS upstream to Kettle GS (Manitoba Hydro Public Affairs 1999). Kettle River and Boots Creek are the only major tributaries flowing into Long Spruce reservoir, with both tributaries entering the reservoir on the south shore (Maps 1 and 6).

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 (SWCD), which extends into the south channel of Gull Rapids, was completed in 2015. The rock placement for the inner and outer groins of the Tailrace Cofferdam (TRCD) started in late 2016 and the impervious fill placement was completed in fall 2017. An opening was created to allow fish to move freely over the winter of 2017–2018. The opening was closed in spring 2018 and dewatering of the TRCD occurred in July, at which time a fish salvage was completed. In preparation for commissioning of the spillway, the SWCD was watered-up on both sides of the structure in June 2018. Removal of the SWCD started in early July and continued into August. The spillway was commissioned between August 3 and 7, 2018. Closing the south channel with the upstream South Dam Cofferdam (SDCD) commenced at the beginning of August and river closure was achieved on August 16. This closure and the work that continued to seal the cofferdam forced the entire river flow through the spillway. The downstream SD CD was completed in September and the area between the two cofferdams was dewatered, allowing for fish salvage to be completed by late September 2018. Work continued on the upstream SD CD until it was complete in late fall 2018. Almost all work in 2019 was in the dry. The construction activities included the excavation of the tailrace, construction of the tailrace spawning shoal, and completion of the dams and dykes.

2.2 FLOWS AND WATER LEVELS

From October 2018 to October 2019, calculated Split Lake outflows ranged from about 2,600 to 3,700 m³/s. However, over most of the period, outflows ranged from approximately 3,000 to 3,500 m³/s and were near the historical annual median flow of approximately 3,300 m³/s. Outflow increased from about 2,600 to 3,600 m³/s from October to December 2018, and then was variable through the remainder of the winter period. Between June and September 2019, the flow generally ranged from 3,300 to 3,500 m³/s. Flows dropped to about 2,900 m³/s in early October 2019 before rising again to almost 3,700 m³/s by the end of the month. Water levels varied in conjunction with flows, ranging from about 153.2–155.0 m ASL on Gull Lake.

3.0 METHODS

3.1 ACOUSTIC TELEMETRY

Acoustic telemetry involves tracking movements of fish surgically implanted with internal acoustic transmitters (tags). Each transmitter emits a unique signal, recognizable by stationary receivers. When tagged fish come into the detection range of a receiver (generally within 500 m to 1 km, depending on conditions), the transmitter code number, as well as the date and time, are stored in the receiver. Initially, the receiver array was designed to monitor adult Lake Sturgeon (the focus of this report); however, the same array is also used to monitor movements of juvenile Lake Sturgeon (Hrenchuk 2020a), Walleye (Hrenchuk 2020b), and Lake Whitefish (Hrenchuk 2020c).

3.1.1 ACOUSTIC TRANSMITTER APPLICATION

Acoustic transmitters (VEMCO V16-4x, estimated 3,650-day battery life) were first applied to 59 fish in 2011 and 2012: 31 upstream and 28 downstream of Gull Rapids (Table 1). A single transmitter was reapplied to a fish in Stephens Lake in 2013 after being returned by a local resource user. At the beginning of the 2014 open-water period, it was suspected that 11 fish had either shed their tags, suffered mortality, or were captured by local resource users. In order to return the number of tagged fish to the original sample size, additional acoustic transmitters were applied to adult Lake Sturgeon upstream of Gull Rapids ($n = 4$) and in Stephens Lake ($n = 7$) in June 2014 (Hrenchuk and Barth 2015) (Table 1).

One additional fish was tagged with an acoustic transmitter (VEMCO V13-1x, estimated 1,735-day battery life) upstream of the Keeyask GS (rkm -26.0) on June 6, 2018 (Table 2). This fish was a female used as broodstock for the Project's stocking program (details can be found in Klassen *et al.* 2019). The acoustic transmitter was applied to monitor survival post egg collection.

Acoustic transmitters (VEMCO V16-4x, estimated 3,650-day battery life) were applied to an additional 51 fish in 2019: 26 upstream and 25 downstream of the Keeyask GS (Table 1). These transmitters will allow tracking of Lake Sturgeon through GS construction and reservoir impoundment.

Following capture, Lake Sturgeon receiving tags were placed in a 76 L nesting fish tub fitted with an aquarium aerator for transport. All tagging was conducted on shore near the site of capture. Prior to transmitter implantation, Lake Sturgeon were anaesthetized in a solution of clove oil and ethanol, adapted from Anderson *et al.* (1997). When the Lake Sturgeon became immobile, they were placed in a surgery cradle ventral side up. Because the anesthetic renders a fish unable to ventilate on its own, freshwater was continuously pumped over the gills. A small incision was made through the ventral body wall using a sterilized scalpel. An acoustic transmitter was inserted into the body cavity and the incision was closed with sutures. Lake Sturgeon were monitored in a

recovery tank until they were able to maintain equilibrium and had regained their strength. They were released in off-current areas near the original capture site.

3.1.2 ACOUSTIC RECEIVERS

Since 2011, stationary acoustic receivers (VEMCO model VR2 and VR2W) have been used to continuously monitor tagged adult Lake Sturgeon in the Nelson River between Clark Lake and the Long Spruce GS. In spring 2016, the receiver array was extended to the upper Limestone Reservoir, with the placement of two receivers downstream of the Long Spruce GS. The intent of adding these receivers was to determine whether fish that had moved into the Long Spruce Reservoir had continued to move downstream.

During the first five years of the construction phase of the Project (beginning in July 2014), receivers were deployed at the same sites as those established during the pre-construction phase (2011–2013). During the open-water period, receivers were deployed in calm water with a flat bottom free of large debris to maximize detection range, and spaced along the main river channel throughout the study area to maximize spatial coverage. In Stephens Lake, receivers were placed at locations within pre-flood river channels, based on the observation that 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 several were lost in previous winters, likely moved by ice (Hrenchuk and Barth 2013). Because it appears that receivers will only remain safe from ice if deployed in calm areas at depths greater than 10 m, the number of possible receiver locations during winter is limited, especially in Gull Lake.

3.1.2.1 WINTER 2018/2019

The stationary acoustic receiver array for the winter 2018/2019 (October 11, 2018, to April 30, 2019) period consisted of 19 receivers. Four were set upstream of the Keeyask GS and 15 throughout Stephens Lake (Maps 3 and 4). Low water levels prevented boat access to the river section between Kettle GS and Long Spruce GS, and therefore, an acoustic receiver could not be set downstream of the Kettle GS during winter 2018/2019. A receiver set in this area in October 2017 has not yet been retrieved, however, it is unlikely that this receiver recorded data during winter 2018/2019 due to a lack of battery life. Other than this receiver, the winter 2018/2019 array did not differ from that used in winter 2017/2018.

3.1.2.2 OPEN-WATER 2019

An array of 57 acoustic receivers was used during the 2019 open-water period (defined as May 1 to October 7, 2019). Twenty-seven were set upstream of the Keeyask GS and 30 were set in

Stephens Lake (Maps 5 and 6). The 2019 open-water array differed slightly from the array used in 2018. One receiver (#125101) was set in a new location in Stephens Lake, closer to the construction site, at rkm 0.6 (Map 6).

As in 2018, receivers could not be set in the Long Spruce or Limestone reservoirs during the 2019 open-water period due to low water levels. Receivers will be set in both locations during open-water 2020 provided conditions are suitable.

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

Four gates were established between Clark Lake and the Keeyask GS (44.0, 34.0, 19.0, and 10.0 rkms upstream of the GS), and two were established in Stephens Lake (4.5 and 40.0 rkms downstream of the GS) (Maps 5 and 6). The area upstream of the Keeyask GS was divided into five zones (Map 5; Zones 1–5), while Stephens Lake was divided into two zones (Map 6; Zones 6 and 7). The Long Spruce Reservoir is referred to as Zone 8 and the Limestone Reservoir as Zone 9; however, monitoring did not occur in these areas in 2019. The location of the “gates” has remained consistent since initiation of the study in 2013.

Water temperature within the Nelson River mainstem was recorded with a HOBO Water Temperature Pro data logger from October 11, 2018, to October 5, 2019. Lake Sturgeon generally spawn in the spring when water temperature ranges from 8–13°C (KHLP 2014). Thus, data collected during this temperature range was considered as “spawning period”.

On October 7, 2019, the majority of receivers were removed and a subset ($n = 21$) were redeployed to monitor movements during winter 2019/2020.

3.1.3 DATA ANALYSIS

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

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

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

3.1.3.1 MAXIMUM LIKELIHOOD APPROACH

A maximum likelihood approach was used to compare pre- and post-construction movements, both between river zones and through Gull Rapids (now the Keeyask GS), Kettle GS, and Long Spruce GS. This method is broadly applicable and simple to apply.

A standard binomial coefficient was used to assess the probability of movement estimators.

$$f(y|N, p) = \binom{N}{n} p^y (1 - p)^{(N-y)}$$

Where:

$$\binom{N}{n} = \frac{N!}{n! (N - n)!}$$

A simple example is the chance of observing 5 heads in 20 coin tosses, if $p = 0.50$, would be:

$$f(5|20, 0.5) = \binom{20}{5} 0.5^5 (1 - 0.5)^{(20-5)} = 0.0148$$

For any observed set of results, the binomial coefficient is constant so we can ignore it when evaluating p . The values of p were evaluated using the maximum likelihood approach given the observed data for the following:

- Movement or no movement between zones;
- Upstream movement from zone to zone;

- Downstream movement from zone to zone; and
- Movement past barriers.

4.0 RESULTS

Section 4.1 provides a summary of movements observed for all fish tagged since inception of the study in June 2011 to the end of the 2018 open-water period (October 11, 2018). Numbers of fish tagged upstream of the Keeyask GS and in Stephens Lake, by year, are provided in Table 1. Tables 2 and 3 provide acoustic tag and biological information associated with each tagged fish. Table 4 summarizes the proportional distribution of tagged fish upstream and downstream of the construction site (2013–2019). Table 5 summarizes all movements through Gull Rapids by fish tagged during the current (2011–2019) and previous (2001–2004) telemetry studies. Figure 3 provides water temperatures measured in the Nelson River mainstem from October 11, 2018, to October 5, 2019. Figures 4 to 24 illustrate movement range and proportional distribution of tagged fish both upstream and downstream of the Keeyask GS by season. Appendix A1 provides furthest upstream and downstream detection locations by river kilometre for each tagged fish (2011–2019) while Appendices A2 to A4 provide movement summaries, by river kilometre, for each tagged sturgeon since the study began in June 2011.

4.1 2011–2018 RESULTS SUMMARY

4.1.1 UPSTREAM OF THE KEEYASK GS

Thirty-one fish were tagged upstream of Gull Rapids (now referred to as the Keeyask GS) in 2011 and 2012, four additional transmitters were applied in June 2014, and one in June 2018 (Table 1). Since being applied, several tags have gone missing:

- #16042 was tagged at the outlet of Clark Lake on June 5, 2011. It was detected regularly within Clark Lake until August 8, 2014 and has not been detected since (Appendix A2-4).
- #16045 has not been detected since August 18, 2011. It moved downstream immediately after being tagged in Gull Lake on June 10, 2011, and displayed few upstream movements (Appendix A2-5).
- #16057 was tagged in Gull Lake on June 16, 2011. It remained in this area until June 17, 2014, when it moved upstream through Birthday Rapids into Clark Lake and has not been detected since (Appendix A2-11).
- #16064 was tagged downstream of Birthday Rapids on June 12, 2011 (Appendix A2-18). It moved downstream into Gull Lake, where it was detected until June 21, 2012. It was next detected briefly in Gull Lake on two days in June and July, 2016. It is likely that this fish largely remains outside of the detection range of the receiver array.
- #16077 moved downstream immediately after tagging on June 10, 2011. It was last detected on June 21, 2011, (Appendix A2-31).

- #32177 was tagged in Gull Lake on June 18, 2014. It remained in Gull Lake and was last detected here on June 14, 2015 (Appendix A2-35).

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

Prior to winter 2018/2019, six fish had moved upstream from Stephens Lake into Gull Lake, two of which returned to Stephens Lake during the 2014 open-water period:

- #16025 was tagged in Stephens Lake on June 16, 2012, and moved upstream through Gull Rapids on August 22, 2012. This fish subsequently moved back downstream into Stephens Lake, where it was first located on June 18, 2014 (Appendix A3-7).
- #16029 was tagged in Stephens Lake on June 21, 2011, and moved upstream through Gull Rapids between July 29 and August 2, 2011 (Appendix A3-10).
- #16033 was tagged in Stephens Lake on June 18, 2011, and moved upstream through Gull Rapids on July 28, 2012. However, shortly after it was captured by a local resource user and the tag was returned and reapplied to another fish in Stephens Lake in 2013.
- #16037 was tagged in Stephens Lake on June 8, 2011, and moved upstream through Gull Rapids between September 3 and 6, 2013. It then moved downstream and was detected in Stephens Lake on July 1, 2014 (Appendix A3-17).
- #16038 was tagged in Stephens Lake on June 12, 2011, and moved upstream through Gull Rapids on September 13, 2012. It continues to be detected in Gull Lake (Appendix A3-18).
- #16046 was tagged in Stephens Lake on June 11, 2011, and moved upstream through Gull Rapids between June 27 and July 4, 2012. This fish was detected in Gull Lake until 2013, but has not been located since (Appendix A3-23).
 - This fish is now considered missing and is not discussed in the remainder of the report.

Four fish have moved downstream through Gull Rapids into Stephens Lake:

- #16048 was tagged in Gull Lake on June 7, 2011. It moved downstream through Gull Rapids on June 28, 2015 (Appendix A2-6).
- #16060 was tagged in Gull Lake on June 21, 2011. It was detected exclusively within Gull Lake (rkm -14.8 to -9.5) between 2011 and 2016. It moved downstream through Gull Rapids and was detected in Stephens Lake on July 2, 2016 (Appendix A2-14).
- #16076 was tagged in Gull Lake on June 6, 2011. It moved downstream through Gull Rapids between June 6 and 9, 2017 (Appendix A2-30).
- #32174 was tagged in Gull Lake on June 18, 2014. It moved downstream through Gull Rapids and was detected in Stephens Lake on August 6, 2016 (Appendix A2-32).

In summary, 36 adult Lake Sturgeon were tagged upstream of the Keeyask GS between 2011 and 2018. Six fish are considered missing, six moved upstream from Stephens Lake (one of which

is considered missing), six fish moved downstream into Stephens Lake, and one was harvested. Therefore, a total of 28 tagged sturgeon were available to be detected upstream of the Keeyask GS during winter 2018/2019.

4.1.2 STEPHENS LAKE

Twenty-eight fish were originally tagged in Stephens Lake in 2011 and 2012. Additional tags were applied in 2013 ($n = 1$) and 2014 ($n = 7$) (Table 1). Five tags are considered missing due to a lack of detections:

- #16018 moved downstream immediately after being tagged on June 13, 2012. It was last detected on July 2, 2012, immediately upstream of Kettle GS (Appendix A3-1).
- #16024 moved downstream immediately after being tagged on June 13, 2012. It was last detected in Stephens Lake on June 25, 2012 (Appendix A3-6).
- #16044 moved downstream immediately after being tagged on June 9, 2011. It was last detected in Stephens Lake on September 17, 2012 (Appendix A3-22).
- #16047 moved downstream immediately after being tagged on June 26, 2011. It was last detected in Stephens Lake on June 28, 2011 (Appendix A3-24).
- #32170 was tagged immediately downstream of Gull Rapids on June 11, 2014. It was regularly detected moving throughout Stephens Lake until October 30, 2016 (Appendix A3-32).
 - This fish was captured twice during adult Lake Sturgeon population monitoring conducted during spring 2018 (at rkms 1.2 and 1.3 on June 4 and 8, respectively). Capture details can be found in Holm and Hrenchuk 2019. Due to its proximity to a receiver but lack of detections since 2016, it is likely that the tag has malfunctioned.

These five fish are not discussed in the remainder of the report.

Three fish are known to have moved downstream out of Stephens Lake through the Kettle GS into the Long Spruce Reservoir:

- #16021 was tagged in Stephens Lake on September 28, 2011, and moved downstream through the Kettle GS on September 16, 2012. As the Kettle GS spillway was open on this day, it is unknown whether the Lake Sturgeon moved through the spillway or passed through a turbine. It was last detected in the Long Spruce Reservoir on September 18, 2012 (Appendix A3-4).
- #16025 was tagged in Stephens Lake on June 15, 2012. It moved upstream into Gull Lake in 2012 but returned to Stephens Lake in 2014 (Section 4.1.1). This fish subsequently moved downstream through Kettle GS between June and July, 2014. The Kettle GS spillway was open during June and July 2014, so it is not possible to determine if the fish

moved through either the turbines or spillway. It was last detected in the Long Spruce Reservoir on July 14, 2014 (Appendix A3-7).

- #16034 was tagged in Stephens Lake on June 18, 2011, and moved downstream through the Kettle GS between October 9, 2012, and June 10, 2013. This fish must have passed downstream through one of the Kettle GS turbines as the spillway was closed between October 2012 and June 2013. It was detected in the Long Spruce Reservoir in open-water 2015 (Appendix A3-15).

Six fish have moved upstream out of Stephens Lake into Gull Lake (as discussed in Section 4.1.1); however, one of these fish (#16033) was captured by a local resource user and the tag was reapplied to a fish in Stephens Lake (#16033b). Two (#16025 and #16037) returned to Stephens Lake in 2014; however, #16025 moved downstream through the Kettle GS into the Long Spruce Reservoir (discussed above). An additional four fish (#16048, #16060, #16076, and #32174) initially tagged in Gull Lake moved downstream through Gull Rapids into Stephens Lake (Section 4.1.1).

To summarize, 35 adult Lake Sturgeon were tagged in Stephens Lake between 2011 and 2014. Five are considered missing, three moved downstream through Kettle GS, three moved upstream into Gull Lake and did not return to Stephens Lake, and four moved downstream from Gull Lake. Therefore, 28 fish were available to be detected in Stephens Lake during winter 2018/2019.

4.1.3 LONG SPRUCE AND LIMESTONE RESERVOIRS

One adult Lake Sturgeon (#16025) was last detected in the Long Spruce Reservoir on July 14, 2014 (Appendix A3-7). Two adult Lake Sturgeon were last detected in the Limestone Reservoir, one (#16021) in 2017 and one (#16034) in 2016 (Appendices A3-4 and A3-15). Because no receivers have been set in either area since open-water 2017, these three fish are not discussed further. Provided conditions are suitable, receivers will be set in both reservoirs in 2020.

4.2 WINTER 2018/2019

4.2.1 UPSTREAM OF THE KEEYASK GS

The 2018/2019 winter receiver array consisted of four receivers deployed in the Nelson River between Clark Lake and the Keeyask GS at rkms -48.2, -29.4, -12.4, and -10.3 (Figure 1). Two of the four acoustic receivers were retrieved; the receivers at rkm -48.2 and -10.3 could not be located and were likely moved by ice (Map 3).

Five of 28 adult Lake Sturgeon (18%) were located a total of 31,707 times (range: 4–26,037 detections per individual) (Appendix A1-1). Fish were detected on two to 95 days of the 202 day winter period (0–47% of the time) for an average of 38 days, or for 19% of the study period

(standard deviation [StDev] = 36.8 days). Detections were logged only at rkm -12.4 (Figures 4 and 5; Appendix A1-1). No fish were located by the receiver downstream of Birthday Rapids (rkm -29.4) (Figure 5; Map 3).

Individual movement graphs can be found in Appendix 2.

4.2.2 STEPHENS LAKE

Fifteen receivers were deployed in Stephens Lake during the 2018/2019 winter period, between rkms 5.2 and 36.1 (Figure 1). All of the 15 receivers were retrieved at the end of the study period.

Twenty-three of 28 fish (82%) were located a total of 714,897 times (range: 461–79,145 detections per individual) (Appendix A1-2). On average, fish were detected for 141 days of the 202 day winter period (70%) (range: 5–202 days). The farthest upstream detections occurred at rkm 5.2 (by 16 fish; 33%), while the farthest downstream occurred at rkm 16.8 (by one fish; 4%) (Appendix A1-2). The average movement range was 4.9 rkm (range 0.0–8.7 rkm) (Figure 6; Appendix A1-2).

4.2.2.1 MOVEMENTS

The majority of detections were logged by receivers located in the southern portion of Stephens Lake between rkm 5.2 and 13.9 ($n = 714,642$; 99.96%; Figure 7). Movements were as follows:

- Twelve (#16022, #16027, #16028, #16030, #16037, #16040, #16048, #16049, #16060, #16076, #32171, and #32173) were detected exclusively in the upstream portion of Stephens Lake, moving no farther downstream than rkm 10.3.
- Ten (#16019, #16020, #16031, #16032, #16041, #16050, #16052, #16053, #32167, and #32168) moved as far downstream as rkm 13.9.
- A single fish (#16043) moved farther downstream, as far as rkm 16.8.

Individual movement graphs can be found in Appendix 3.

4.3 OPEN-WATER 2019

4.3.1 ACOUSTIC RECEIVER RETRIEVAL

All stationary acoustic receivers deployed upstream of the Keeyask GS ($n = 27$) and in Stephens Lake ($n = 30$) during the 2019 open-water period were successfully retrieved (Maps 5 and 6). The receiver array was the same as in 2018, however, an additional receiver was deployed in Stephens Lake 0.6 km downstream of the Keeyask GS spillway on the south shore (#125101; Map 6).

Water temperature, as measured in the Nelson River mainstem, reached 8°C on June 1, 2019, and increased to 13°C by June 17 (Figure 3). Based on these water temperatures, the time between June 1 and 17 is referred to as the spawning period.

4.3.2 UPSTREAM OF THE KEEYASK GS

Twenty-eight adult Lake Sturgeon were available to be detected upstream of the Keeyask GS during the 2019 open-water period (Section 4.1.1). All 28 were detected between 2,030 and 61,112 times for 23–137 days of the 160 day open-water period (14–86% of the time; Appendix A1-3). The average total movement range was 12.5 rkm (StDev = 9.0 rkm; range: 1.0–37.6 rkm) (Figure 8; Appendix A1-3). The farthest upstream detections occurred in Clark Lake between rkm -44.8 and -46.9 (by five fish; 18%), while the farthest downstream occurred in lower Gull Lake at rkm -4.8 (by ten fish; 36%). No fish moved downstream through the Keeyask GS spillway.

4.3.2.1 PROPORTIONAL DISTRIBUTION

As in previous years, individual Lake Sturgeon used Zones 4 (upper basin of Gull Lake) and 5 (lower basin of Gull Lake) most often, spending a total of 50% (StDev = 39%; range: 0–100%) and 25% (StDev = 32%; range: 0–100%) of the study period in these areas, respectively (Table 4; Figures 9 and 10). Zones 1 (Clark Lake), 2 (river reach from Clark Lake to Birthday Rapids), and 3 (river reach from Birthday Rapids to Gull Lake) were used less frequently:

- Zone 1 at 15% (StDev = 34%; range: 0–100%);
- Zone 2 at 0.1% (StDev = 0.2%; range: 0–0.6%); and
- Zone 3 at 10% (StDev = 27%; range: 0–100%) of the study period.

4.3.2.2 MOVEMENT PATTERNS

During the 2019 open-water period, the majority of detections were logged in Gull Lake or downstream of rkm -10.2 ($n = 272,094$; 71%) (Figure 11). As described in previous reports,

individual Lake Sturgeon in this study area exhibit habitual movement patterns. In 2019, 26 of the 28 detected fish continued to display the same general pattern of movement observed in previous years:

- Eighteen remained exclusively within Gull Lake, making multiple upstream and downstream movements, as far upstream as rkm -19.5 and as far downstream as rkm -4.8.
 - Four (#16065, #16071, #16073, and #32176) made distinct upstream movements to a small set of rapids at rkm -19.5 during the spawning period (June 1 to 17, 2019).
- Three were located within Gull Lake for the majority of the study period, but made brief upstream movements during the spawning period:
 - One (#16051) was detected as far upstream as rkm -24.7, one (#16056) as far as -29.4, and one (#16068) as far as -32.3.
- Two (#16026 and #16069) remained within the riverine area between Birthday Rapids and Gull Lake (rkm -33.8 to -26.5).
- Two (#16058 and #16074) were detected exclusively within Clark Lake (rkm -48.2 to -44.3). Both fish were tagged downstream of Birthday Rapids, but have been detected exclusively within Clark Lake since 2015 (#16074) and 2016 (#16058).
- One (#16054) has displayed two different patterns of movement:
 - From 2011 to 2014, this fish was detected exclusively within Gull Lake, moving between rkm -19.5 and -7.5.
 - From 2015 to 2019, it moved back and forth from Clark Lake to the riverine area downstream of Birthday Rapids.

The remaining two fish displayed movements that differed from movements exhibited during previous years:

- #16063 was tagged on June 11, 2011 in Gull Lake (rkm -12.3). It remained exclusively within Gull Lake until 2019. On June 30, 2019 it moved upstream out of Gull Lake, continuing to Clark Lake. It was last detected within Clark Lake at rkm -46.9 on July 2, 2019.
- #16067 was tagged on June 19, 2011 in Gull Lake (rkm -9.9). It moved upstream through Birthday Rapids during open-water 2012, after which it was presumed missing due to a lack of detections.
 - It was relocated on May 31, 2018 at the inlet of Clark Lake (rkm -48.2). It moved downstream and was detected in the riverine area between Birthday Rapids and Gull Lake (rkm -33.8 to -26.5) from June 9 to August 6. It then continued to move downstream into Gull Lake, where it remained until the end of the study period.

- It moved upstream to Clark Lake in 2019, leaving Gull Lake on June 14. It was last detected in Clark Lake at rkm -46.9 on June 24. It is likely this fish continued to move upstream past the receiver array.

Individual movement graphs can be found in Appendix 2.

4.3.3 STEPHENS LAKE

Twenty-eight adult Lake Sturgeon were available to be detected in Stephens Lake during the 2019 open-water period (Section 4.1.2). Twenty-six fish (93%) were detected between 8,865 and 33,008 times over 90–149 days of the 160 day study period (56–93% of the time; Appendix A1-4). Mean movement range was 18.4 rkm (StDev = 7.4 rkm; range: 9.7–40.3 rkm) (Figure 12; Appendix A1-4). The farthest upstream detections occurred immediately downstream of the Keeyask GS spillway at rkm 0.6 (by 25 fish; 96%), while the farthest downstream detections occurred near the Kettle GS at rkm 40.9 (by one fish; 4%) (Figure 12; Appendix A1-4).

Of the two fish that were not detected during open-water 2019:

- One (#16032) was last detected during winter 2018/2019 (on January 21, 2019) in upper Stephens Lake (rkm 7.9) (Appendix A3-13).
- One (#16035) was last detected during open-water 2018 (June 2, 2018) immediately upstream of the Kettle GS at rkm 40.8. It is likely that this fish moved downstream through the Kettle GS (Appendix A3-16).

4.3.3.1 PROPORTIONAL DISTRIBUTION

As in the majority of past study years (*i.e.*, 2013 and 2015–2018), Lake Sturgeon used Zone 7 slightly more frequently than Zone 6, spending 52% (StDev = 21%; range: 3–84%), and 48% (StDev = 21%; range: 16–97%) of the time in each zone, respectively (Table 4; Figures 9 and 13). However, utilization of the zones during the open-water period has continued to change over time, with a greater proportion of fish detected close to the Keeyask GS during the beginning and middle of the study period than at the end (Figure 9).

4.3.3.2 MOVEMENT PATTERNS

As in 2017 and 2018, the majority of detections ($n = 484,468$; 97%) were logged by receivers located in the southern portion of Stephens Lake between rkm 0.6 and 13.9 during the 2019 open-water period (Figure 14).

Two general movement patterns were displayed:

- Nine (#16027, #16033b, #16048, #16050, #16053, #16060, #32171, #32172, and #32173) remained in the upstream portion of Stephens Lake, moving only as far downstream as rkm 13.9.

- The remaining 17 fish moved farther downstream into Stephens Lake:
 - Ten (#16030, #16031, #16037, #16040, #16041, #16043, #16052, #16076, #32169, and #32174) made regular upstream and downstream movements, moving as far downstream as rkm 18.6.
 - Six moved farther downstream into lower Stephens Lake.
 - Five (#16019, #16022, #16028, #32167, and #32168) moved as far downstream as rkm 24.7.
 - One (#16020) moved as far downstream as rkm 36.1
 - One (#16049) was detected immediately upstream of Kettle GS at rkm 40.9 on July 23 and 24. It returned upstream and was located moving between rkm 1.2 and 10.3 for the remainder of the open-water period.
 - This fish displayed the same pattern of movement in the majority of previous study years.

Individual movement graphs can be found in Appendix 3.

4.4 ADULT LAKE STURGEON DISTRIBUTION

Proportional distributions of fish detected consistently since 2013 ($n = 39$) were compared, and the likelihood of fish movements between zones both before and after construction were calculated (Figures 15, 16, and 17). The overall likelihood of a movement (either upstream or downstream) between zones was 12.2% prior to construction and 14.7% after construction (Figure 15). The likelihood of a fish moving upstream from one zone to another was 43.4% prior to the onset of construction, and 43.5% after (Figure 16). The likelihood of a fish moving downstream from one zone to another was 56.6% before construction and 56.5% after (Figure 17).

4.5 MOVEMENTS THROUGH BARRIERS

Since the inception of the study in 2011, 12 movements through Gull Rapids have occurred: six upstream, and six downstream (Table 5).

- Four (#16029, #16033, #16038, and #16046) tagged in Stephens Lake moved upstream and remained upstream in Gull Lake.
- Four (#16048, #16060, 16076, and #32174) tagged in Gull Lake moved downstream into Stephens Lake and remained in Stephens Lake.
- Two (#16025 and #16037) tagged in Stephens Lake moved upstream into Gull Lake and then returned to Stephens Lake.

Additionally, three (#16021, #16025, and #16034) moved downstream through the Kettle GS. Two of these (#16021 and #16034) have since moved downstream through the Long Spruce GS. One additional fish (#16035) is suspected to have moved downstream through the Kettle GS in 2018.

Four downstream movements through Gull Rapids (#16060, #16048, #16076, and #32174) occurred following the start of Keeyask GS construction. Upstream movements through Gull Rapids have not been observed since 2013 and, since spillway commissioning in 2018, are no longer possible.

The likelihood of a fish moving through Gull Rapids (now the Keeyask GS), Kettle GS, or the Long Spruce GS was calculated both pre- and post-construction. Prior to construction, there was a 2.1% chance that a fish would move past the rapids or a generating station, compared to a 1.0% chance after the onset of construction (Figure 18).

4.6 2019 TAGGING

4.6.1 ACOUSTIC TRANSMITTER APPLICATION

As previously discussed (Section 3.1.1), 26 tags were applied to adult Lake Sturgeon upstream of the Keeyask GS between May 25 and June 9, 2019 (Table 2). These fish had a mean fork length of 1,016 mm (StDev = 140 mm; range: 825–1,317 mm) and a mean weight of 7,592 g (StDev = 3,179 g; range: 3,629–17,237 g). Two fish were tagged and released at Birthday Rapids (rkm -33.4), one in the riverine area downstream of Birthday Rapids (rkm -26.7), 19 on the south shore at the upstream end of Gull Lake (rkm -19.5), and four south-east of Caribou Island (rkm -9.6) (Map 7).

Twenty-two tags were applied to adult Lake Sturgeon in Stephens Lake between May 31 and June 3, and an additional three were applied between September 12 and 15, 2019 (Table 3). These fish had a mean fork length of 981 mm (StDev = 126 mm; range: 820–1,371 mm) and a mean weight of 8,030 g (StDev = 3,759 g; range: 3,402–19,504 g). Four were released on the north shore 1.1 rkm downstream of the Keeyask GS, 18 on the south shore at rkm 1.3, and three at rkm 5.8 (Map 7).

4.6.2 UPSTREAM OF THE KEEYASK GS

All 26 Lake Sturgeon tagged upstream of the Keeyask GS in 2019 were detected between 4,253 and 22,714 times for 46–117 days (38–97% of potential detection days; Appendix A1-5). The average total movement range was 17.8 rkm (StDev = 10.1 rkm; range: 7.3–37.0 rkm) (Figure 19). The farthest upstream detections occurred in Clark Lake at rkm -46.9 (by four fish; 15%), while the farthest downstream occurred in lower Gull Lake at rkm -4.8 (by six fish; 23%). No fish moved downstream through the Keeyask GS spillway.

4.6.2.1 PROPORTIONAL DISTRIBUTION

Adult Lake Sturgeon tagged in 2019 used Zones 4 (upper basin of Gull Lake) and 5 (lower basin of Gull Lake) most often, spending a total of 74% (StDev = 33%; range: 0–100%) and 13% (StDev = 26%; range: 0–85%) of the study period in these areas, respectively (Table 4; Figures 9 and 20). Zones 1 (Clark Lake), 2 (river reach from Clark Lake to Birthday Rapids), and 3 (river reach from Birthday Rapids to Gull Lake) were used less frequently:

- Zone 1 at 0.4% (StDev = 1.2%; range: 0–3%);
- Zone 2 at 0.2% (StDev = 0.4%; range: 0–0.5%); and
- Zone 3 at 12% (StDev = 26%; range: 0–100%) of the study period.

4.6.2.2 MOVEMENT PATTERNS

As with fish tagged in 2011, the majority of detections of fish tagged in 2019 were logged in Gull Lake or downstream of rkm -10.2 ($n = 190,346$; 65%) (Figure 21). Fish displayed four general movement patterns:

- Thirteen remained exclusively within Gull Lake, making multiple upstream and downstream movements
 - Eight (#7019, #7031, #7032, #7033, #7056, #7059, #7066, and #7067) moved throughout Gull Lake, as far upstream as rkm -19.5 and as far downstream as rkm -14.8.
 - Five (#7027, #7028, #7029, #7030, and #7053) remained in upper Gull Lake, moving only as far downstream as rkm -9.9.
- Two (#7021 and #7022) remained in the riverine area between Birthday Rapids and Gull Lake (rkm -33.4 to -26.5) for the entire open-water period.
- Seven moved between the riverine area between Birthday Rapids and Gull Lake and Gull Lake proper.
 - Four (#7020, #7024, #7034, #7061) made single upstream movements out of Gull Lake (between June 8 and 25), likely related to spawning.
 - Three (#7023, #7064, and #7065) made multiple movements out of Gull Lake throughout the open-water period.
- Four moved upstream into Clark Lake and were located briefly (1–9 days) before returning downstream.
 - #7017 was tagged on June 8 immediately downstream of Birthday Rapids. It moved upstream into Clark Lake on June 17 and returned downstream on June 22. It moved between the riverine area downstream of Birthday Rapids and Gull Lake for the remainder of the open-water period.

- #7018 was tagged on June 5 at the inlet of Gull Lake (rkm -19.5). It moved into Clark Lake on June 11 and returned downstream on June 19. It moved between the riverine area downstream of Birthday Rapids and Gull Lake for the remainder of the open-water period.
- #7025 was tagged June 7 immediately downstream of Birthday Rapids. Following tagging, it moved downstream into Gull Lake, subsequently moving to Clark Lake on June 16. It returned to Gull Lake on June 20, where it was located for the remainder of the open-water period.
- #7026 was tagged on June 6 at the inlet of Gull Lake at rkm -19.5. It remained in this area until June 20 when it moved upstream into Clark Lake. It remained for a single day, returning to Gull Lake on June 21. It was located in Gull Lake for the remainder of the open-water period.

Individual movement graphs can be found in Appendix 4.

4.6.3 STEPHENS LAKE

All 25 Lake Sturgeon tagged in Stephens Lake in 2019 were detected between 3,795 and 30,588 times for 22–127 days (60–100% of potential detection days; Appendix A1-6). The average total movement range was 14.1 rkm (StDev = 4.4 rkm; range: 6.7–24.1 rkm) (Figure 22). The farthest upstream detections occurred immediately downstream of the Keeyask GS spillway at rkm 0.6 (by 20 fish; 80%), while the farthest downstream occurred in lower Stephens Lake at rkm -24.7 (by one fish; 4%).

4.6.3.1 PROPORTIONAL DISTRIBUTION

Adult Lake Sturgeon tagged in 2019 used Zone 6 slightly more frequently than Zone 7, spending 54% (StDev = 22%; range: 14–92%) and 46% (StDev = 22%; range: 8–86%) of the study period in each zone, respectively (Table 4; Figures 9 and 23). As with fish tagged in 2011, utilization of the zones during the open-water period has continued to change over time, with a greater proportion of fish detected close to the Keeyask GS during the beginning and middle of the study period than at the end (Figure 9).

4.6.3.2 MOVEMENT PATTERNS

As with fish tagged in 2011, the majority of detections ($n = 404,847$; 98%) were logged by receivers located in the southern portion of Stephens Lake between rkm 0.6 and 13.9 during the 2019 open-water period (Figure 24). Fish displayed two general movement patterns.

- Thirteen remained in upper Stephens Lake.
 - Nine (#7035, #7036, #7038, #7046, #7055, #7057, #7060, #7062, and #7063) moved as far downstream as rkm 10.3.

- Four (#7045, #7047, #7048, and #7050) moved as far downstream as rkm 13.9.
- Twelve moved farther downstream into Stephens Lake.
 - Eleven (#7037, #7039, #7040, #7041, #7042, #7043, #7044, #7049, #7051, #7054, and #7058) moved as far downstream as rkm 18.6.
 - One (#7052) moved as far downstream as rkm 24.7 multiple times during the 2019 open-water period.

Individual movement graphs can be found in Appendix 5.

5.0 DISCUSSION

Adult Lake Sturgeon movement monitoring was initiated in 2011 to describe movements during the pre-construction (2011–2013) and construction phases (beginning July 2014) of the Keeyask Project and to determine if disturbances associated with construction would alter habitat use and coarse-scale movement patterns upstream and downstream of the Project. As discussed in the AEMP and the Keeyask EIS, potential impacts include increased emigration from the population, mortality at the GS structure, and the loss of critical habitats. The discussion below highlights movement patterns that have been observed and discusses the key questions (presented in the AEMP) with respect to potential impacts of construction on Lake Sturgeon and their movements. Monitoring conducted in 2019 marks the final year of construction monitoring.

5.1 EVALUATION OF METHODOLOGY

Acoustic telemetry continues to be an effective method for monitoring movements and habitat use patterns of adult Lake Sturgeon in the study area. During the 2019 open-water period, the majority of tagged fish remaining in the study area were located. Fish tagged in 2011 were detected, on average, for 62% of the 2019 open-water study period upstream of the Keeyask GS (22–63% in previous years) and 77% in Stephens Lake (34–73% in previous years). Fish tagged in 2019 were also detected frequently. All 26 fish tagged upstream of the Keeyask GS were detected for, on average, 79% of potential detection days (*i.e.*, between the date of tagging and the end of the 2019 open-water period). Similarly, all 25 fish tagged in Stephens Lake in 2019 were detected for 87% of potential detection days. Due to the frequency of detection in both Gull and Stephens lakes, a good understanding of coarse scale movement and habitat use patterns during the open-water period has been established.

Frequency of detection during winter is lower relative to the open-water period given that fewer receivers are used (only four upstream of the Keeyask GS and 15 in Stephens Lake). After winter 2018/2019, only two of the four receivers deployed upstream of the Keeyask GS were retrieved; however, 18% of fish tagged were detected for 19% of the winter 2018/2019 period. In Stephens Lake, receiver coverage is more extensive and, as a result, fish are detected more regularly (82% of fish tagged in Stephens Lake were detected for 70% of the 2018/2019 winter period). Although adult Lake Sturgeon are detected less frequently during winter relative to the open-water period (especially in Gull Lake), the objectives of the study are not compromised given that Lake Sturgeon tend to remain in the same area during winter and not undertake long distance movements during this period.

5.2 KEY QUESTIONS

The key questions described in the AEMP for adult movement monitoring during construction were:

Will disturbances associated with construction alter coarse-scale movements upstream and/or downstream of the construction site?

Adult Lake Sturgeon movement patterns have changed little since the study began in 2011. Fish tend to display habitual movements, with a few fish making movements each year that do not fit into their previous patterns. Upstream of the Keeyask GS, fish continue to remain in distinct portions of the study area: a) Clark Lake; b) the riverine portion of the Nelson River between Birthday Rapids and Gull Lake; and c) Gull Lake. Within Stephens Lake, Lake Sturgeon tend to remain in the main river channel, specifically the part of Stephens Lake where the river channel was flooded when the Kettle GS was built. Some fish tend to remain in the upper portion of Stephens Lake, while others use both the upper and lower portions. Fish tagged in 2019 continued to display the same general movement patterns.

Based on the maximum likelihood analysis comparing data from the pre-construction and post-construction periods, the frequency of Lake Sturgeon movement between zones has not changed since construction began. The likelihood that an adult Lake Sturgeon would move between zones was similar (2.5% difference), and generally low, during both time periods. If a movement was made between zones, the likelihood of an upstream movement or a downstream movement was very similar (0.1% difference) between the two time periods.

Are sturgeon using habitat in the immediate vicinity of the construction site?

Lake Sturgeon continued to use the area immediately upstream and downstream of the Keeyask GS construction site in 2019. Upstream, fish tagged in 2011 spent an average of 25% of the study period in lower Gull Lake, while those tagged in 2019 spent 13% of the study period in this area. Ten fish tagged in 2011 (36%) and six tagged in 2019 (21%) were located by the receiver closest to the Keeyask GS (rkm -4.8). One fish was located at the two receivers closest to the construction site (rkms -5.8 and -4.8) for the entire study period.

In Stephens Lake, fish tagged in 2011 spent an average of 48% of the study period within 5.0 rkm of the Keeyask GS. Fish tagged in 2019 spent an average of 54% of the open-water period in the same area. Further, 25 fish tagged in 2011 (96%), and 20 fish tagged in 2019 (80%) were detected at the receiver closest to the construction site (rkm 0.6). The amount of time adult Lake Sturgeon have spent in the area surrounding the Keeyask construction site has changed little since receiver gates were put in place in 2013.

One additional receiver was added to the receiver array during the 2019 open-water period. A receiver was deployed at rkm 0.6 (0.6 km downstream of the Keeyask GS spillway) to monitor movements in close proximity to the Keeyask GS spillway. During open-water 2019, 25 fish tagged in 2011 (96%), and 20 fish tagged in 2019 (80%) were detected by this receiver. Although fish were detected here throughout the open-water period, 45% of detections occurred in June, and may be related to spawning or post-spawning movements. This receiver will continue to be deployed as part of the Stephens Lake receiver array.

Will the frequency of long-distance movements (and subsequent downstream emigration/entrainment) by Lake Sturgeon increase during construction and operation of the Project?

No adult Lake Sturgeon tagged in 2011 or 2019 moved downstream through the Keeyask GS in 2019. Since the study began in 2011, six fish have moved downstream through Gull Rapids: two before construction began in 2014, and four after. Six fish have moved upstream through Gull Rapids, all prior to construction. Based on maximum likelihood estimates, the chance of an adult Lake Sturgeon moving out (upstream or downstream) of the area upstream of the Keeyask GS or out of Stephens Lake was marginally lower during construction (1.0%) than prior to construction (2.1%). The Keeyask GS spillway was commissioned in August, 2018, after which upstream movement was no longer possible. No downstream movements have been observed since commissioning.

It does not appear that any adult Lake Sturgeon moved downstream through the Kettle GS in 2019, however, based on a lack of detections in 2018, one fish that was last detected immediately upstream of the Kettle GS in 2018 may have moved downstream. This fish represents the fourth movement through the Kettle GS. Three additional fish moved downstream through the GS prior to construction. Data suggest that adult Lake Sturgeon prefer upper Stephens Lake and rarely use habitat in proximity to the Kettle GS.

6.0 SUMMARY AND CONCLUSIONS

- Acoustic telemetry continues to be an effective method for monitoring adult Lake Sturgeon movement and habitat use. In the Keeyask Study Area, movement monitoring is more effective during the open-water period relative to the winter period.
- Positions were obtained from 28 of 56 Lake Sturgeon available to be detected during the 2018/2019 winter period. Only two of four acoustic receivers could be retrieved upstream of the Keeyask GS after winter, limiting detections in the area.
- In 2019, an additional 51 transmitters were applied to adult Lake Sturgeon (26 upstream and 25 downstream of the Keeyask GS). These tags will allow for a full open-water and winter period of tracking before reservoir impoundment.
- Upstream of the Keeyask GS, fish continue to remain in distinct portions of the study area: a) Clark Lake; b) the riverine portion of the Nelson River between Birthday Rapids and Gull Lake; and c) Gull Lake.
- Within Stephens Lake, Lake Sturgeon tend to remain in the main river channel, specifically the part of Stephens Lake where the river channel was flooded when the Kettle GS was built. Some fish tend to remain in the upper portion of Stephens Lake, while others use both the upper and lower portions.
- The key questions, as described in the AEMP, for adult Lake Sturgeon movement monitoring during construction of the Keeyask GS were as follows:

- *Will disturbances associated with construction alter coarse-scale movements upstream and/or downstream of the construction site?*

Quantitatively and qualitatively, there have been no changes in adult Lake Sturgeon movement patterns since the onset of Keeyask GS construction. Fish tagged in 2019 displayed similar movement patterns to those tagged in 2011.

- *Are adult sturgeon using habitat in the immediate vicinity of the construction site?*

During the 2019 open-water period, adult Lake Sturgeon continued to use the areas immediately upstream and immediately downstream of the Keeyask GS.

- *Will the frequency of long-distance movements (and subsequent downstream emigration/entrainment) by adult Lake Sturgeon increase during construction and operation of the Project?*

No adult Lake Sturgeon moved downstream through the Keeyask GS between October 2018 and October 2019. Since the inception of study in 2011, twelve movements through Gull Rapids have occurred: six upstream and six downstream. All upstream movements occurred during the pre-construction phase (one in 2011, four in 2012, and one in 2013). The Keeyask GS spillway was commissioned in August, 2018, after which upstream movements were no longer possible. Downstream movements occurred both during the pre-

construction (2014; $n = 2$) and construction phase ($n = 4$). No adult Lake Sturgeon moved downstream through the Kettle GS between October 2018 and October 2019. However, based on a lack of detections in 2019, it is likely that one Lake Sturgeon moved downstream through the Kettle GS in open-water 2018. Three movements occurred previously, all prior to construction.

Data collected during the pre-construction phase (2011–June 2014) suggest that the probability of moving through a barrier (either Gull Rapids or the Kettle GS) was 2.1%. Data collected after the onset of construction (July 2014–October 2019), suggest that the probability is slightly lower (1.0%).

- The acoustic tags that were implanted in 2011 will last until 2021 and the tags that were implanted in 2019 will last until 2029. Movements will continue to be monitored through GS construction, impoundment, and operation.

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TABLES

Table 1: Number of acoustic transmitters applied, missing tags, immigrants and emigrants, and harvested adult Lake Sturgeon upstream of Gull Rapids and in Stephens Lake, indicating the number of fish remaining in the area at the end of each study period between June 2011 and October 2019.

Year	Upstream of Gull Rapids ¹						Stephens Lake						
	Tags Applied	Missing Tags	In ²	Out ³	Harvest	# Active Tags	Tags Applied	Missing Tags	In ⁴	Out (Gull Rapids) ⁵	Out (Kettle GS) ⁶	Harvest	# Active Tags
2011	30	-	1	-	-	31	19	-	-	1	-	-	18
2012	1	-	4	-	1	35	9	-	-	4	2	-	21
2013	0	-	1	-	-	36	1	-	-	1	-	-	21
2014	4	6	-	2	-	32	7	4	2	-	1	-	25
2015	0	6	-	1	-	31	0	4	1	-	-	-	26
2016	0	5	-	2	-	30	0	4	2	-	-	-	28
2017	0	5	-	1	-	29	0	4	1	-	-	-	29
2018	1	6	-	-	-	28	0	5	-	-	1	-	27
2019	26	6	-	-	-	54	25	5	-	-	-	-	52

1. Referred to as the Keeyask GS after spillway commissioning in 2018.

2. Immigration from Stephens Lake.

3. Emigration to Stephens Lake.

4. Immigration from upstream of Gull Rapids.

5. Emigration to upstream of Gull Rapids.

6. Emigration to downstream of the Kettle GS.

Table 2: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters upstream of the Keeyask GS between 2011 and 2019.

Tag ID	Date Tagged	Expiry Date	Floy Tag	Fork Length(mm)	Total Length (mm)	Weight (g)
16026	19-Jun-12	17-Jun-22	100450	955	1070	7711
16036	5-Jun-11	2-Jun-21	74400	1313	1414	20185
16039	5-Jun-11	2-Jun-21	48596	1425	1530	27216
16042	5-Jun-11	2-Jun-21	74399	956	1060	8165
16045	10-Jun-11	7-Jun-21	77516	1379	1533	21773
16048	7-Jun-11	4-Jun-21	94396	967	1103	9299
16051	10-Jun-11	7-Jun-21	74394	1386	1510	24494
16054	6-Jun-11	3-Jun-21	74398	816	915	5023
16055	6-Jun-11	3-Jun-21	74396	872	974	6350
16056	10-Jun-11	7-Jun-21	77515	1020	1120	9526
16057	16-Jun-11	13-Jun-21	77509	900	1024	7711
16058	9-Jun-11	6-Jun-21	82631	867	953	6124
16059	16-Jun-11	13-Jun-21	64718	1260	1385	16783
16060	21-Jun-11	18-Jun-21	80188	1060	1170	10433
16061	21-Jun-11	18-Jun-21	77503	1305	1443	14515
16062	12-Jun-11	9-Jun-21	77510	1176	1284	12247
16063	11-Jun-11	8-Jun-21	77514	1124	1229	10660
16064	12-Jun-11	9-Jun-21	80370	1066	1148	9072
16065	12-Jun-11	9-Jun-21	77511	958	1058	7484
16066	20-Jun-11	17-Jun-21	77507	1310	1405	25855
16067	19-Jun-11	16-Jun-21	50826	1090	1210	11340
16068	19-Jun-11	16-Jun-21	80368	1140	1254	11794
16069	17-Jun-11	14-Jun-21	48909	1400	1570	32659
16070	16-Jun-11	13-Jun-21	77508	1072	1195	10886
16071	16-Jun-11	13-Jun-21	76484	1026	1133	7711
16072	21-Jun-11	18-Jun-21	77506	850	967	6350
16073	12-Jun-11	9-Jun-21	77512	1169	1284	15422
16074	13-Jun-11	10-Jun-21	94030	915	1016	6804
16075	10-Jun-11	7-Jun-21	50888	1610	1700	43092
16076	16-Jun-11	13-Jun-21	50808	1260	1375	19958
16077	10-Jun-11	7-Jun-21	80265	1143	1245	12247
32174	18-Jun-14	15-Jun-24	94117	1172	1296	17690
32175	18-Jun-14	15-Jun-24	105480	843	951	4082
32176	18-Jun-14	15-Jun-24	50853	1236	1370	22226
32177	18-Jun-14	15-Jun-24	105479	886	1001	5443
7017	08-Jun-19	05-Jun-29	114771	949	1160	7257
7018	05-Jun-19	02-Jun-29	114248	825	907	3629

Table 2: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters upstream of the Keeyask GS between 2011 and 2019 (continued).

Tag ID	Date Tagged	Expiry Date	Floy Tag	Fork Length(mm)	Total Length (mm)	Weight (g)
7019	05-Jun-19	02-Jun-29	76330	1172	1293	14061
7020	09-Jun-19	06-Jun-29	105417	1000	1112	5443
7021	06-Jun-19	03-Jun-29	91388	971	1080	7257
7022	07-Jun-19	04-Jun-29	114774	1020	1142	7257
7023	08-Jun-19	05-Jun-29	114770	955	1075	5897
7024	08-Jun-19	05-Jun-29	103456	953	1070	6350
7025	07-Jun-19	04-Jun-29	114773	902	1000	5443
7026	09-Jun-19	06-Jun-29	114769	1070	1173	8165
7027	09-Jun-19	06-Jun-29	50836	1280	1325	13154
7028	08-Jun-19	05-Jun-29	79711	1285	1413	17236
7029	09-Jun-19	06-Jun-29	114768	1135	1259	9525
7030	09-Jun-19	06-Jun-29	64705	1065	1167	9072
7031	08-Jun-19	05-Jun-29	114772	920	1040	6804
7032	09-Jun-19	06-Jun-29	101388	890	1000	4990
7033	05-Jun-19	02-Jun-29	114777	868	981	4990
7034	05-Jun-19	02-Jun-29	77504	968	1090	6577
7053	25-May-19	22-May-29	114648	866	994	4800
7056	25-May-19	22-May-29	64726	1217	1346	-
7059	25-May-19	22-May-29	86137	923	1042	6400
7061	05-Jun-19	02-Jun-29	114776	930	1058	5897
7064	29-May-19	26-May-29	114643	1016	1128	7938
7065	28-May-19	25-May-29	107113	1034	1145	8165
7066	29-May-19	26-May-29	91376	880	1010	5897
7067	29-May-19	26-May-29	46424	1317	1445	-

Table 3: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters in Stephens Lake between 2011 and 2019.

Tag ID	Date Tagged	Expiry Date	Floy Tag	Fork Length (mm)	Total Length (mm)	Weight (g)
16018	13-Jun-12	11-Jun-22	93923	1024	1145	8618
16019	13-Jun-12	11-Jun-22	93922	850	951	6577
16020	08-Jun-12	06-Jun-22	55557	992	1100	-
16021	28-Sept-11	25-Sept-21	91705	880	977	6804
16022	13-Jun-12	11-Jun-22	81628	810	900	5443
16024	13-Jun-12	11-Jun-22	74416	960	1081	8391
16025	15-Jun-12	13-Jun-22	80374	1120	2350	10433
16027	13-Jun-12	11-Jun-22	93921	894	991	6804
16028	13-Jun-12	11-Jun-22	93924	884	976	5216
16029	21-Jun-11	18-Jun-21	56202	1208	1316	16556
16030	21-Jun-11	18-Jun-21	56152	1004	1103	7711
16031	13-Jun-12	11-Jun-22	92925	906	1011	6804
16032	11-Jun-11	08-Jun-21	46892	1064	1159	11340
16033	18-Jun-11	15-Jun-21	74419	881	974	5443
16033b	16-Sept-13	14-Sept-23	103230	755	842	-
16034	18-Jun-11	15-Jun-21	74418	796	904	4082
16035	26-Sept-11	23-Sept-21	69868	941	1040	8165
16037	08-Jun-11	05-Jun-21	-9999	826	911	-
16038	12-Jun-11	09-Jun-21	74415	1116	1239	11793
16040	09-Jun-11	06-Jun-21	74411	1006	1105	8391
16041	26-Jun-11	23-Jun-21	74421	903	1001	7257
16043	10-Jun-11	07-Jun-21	88788	790	885	4536
16044	09-Jun-11	06-Jun-21	56208	1161	1296	14969
16046	11-Jun-11	08-Jun-21	74413	1085	1209	9979
16047	26-Jun-11	23-Jun-21	88789	920	1020	6577
16049	24-Sept-11	21-Sept-21	91174	1070	1182	10886
16050	13-Jun-11	10-Jun-21	74415	922	1041	6577
16052	26-Sept-11	23-Sept-21	69865	1190	1337	16329
16053	26-Sept-11	23-Sept-21	69867	919	1021	8618
32167	11-Jun-14	08-Jun-24	-9999	910	1015	4990
32168	11-Jun-14	08-Jun-24	94234	884	980	4990
32169	13-Jun-14	10-Jun-24	-9999	810	908	4082
32170	11-Jun-14	08-Jun-24	46844	1095	2000	9525
32171	13-Jun-14	10-Jun-24	-9999	880	976	4536
32172	13-Jun-14	10-Jun-24	86136	904	1050	5897
32173	13-Jun-14	10-Jun-24	-9999	842	936	4082

Table 3: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters in Stephens Lake between 2011 and 2019 (continued).

Tag ID	Date Tagged	Expiry Date	Floy Tag	Fork Length (mm)	Total Length (mm)	Weight (g)
7035	31-May-19	28-May-29	115802	1086	1206	9072
7036	31-May-19	28-May-29	100151	890	996	5897
7037	31-May-19	28-May-29	114626	896	994	5670
7038	31-May-19	28-May-29	114627	1032	1153	8618
7039	03-Jun-19	31-May-29	46844	1115	1230	11340
7040	03-Jun-19	31-May-29	114780	1050	1174	9072
7041	31-May-19	28-May-29	56152	1090	1211	10886
7042	03-Jun-19	31-May-29	114778	965	1074	6804
7043	15-Sept-19	12-Sept-29	116091	1060	1182	-
7044	31-May-19	28-May-29	88477	850	936	4536
7045	12-Sept-19	09-Sept-29	116010	830	921	4850
7046	14-Sept-19	11-Sept-29	91714	950	1100	-
7047	31-May-19	28-May-29	100162	830	917	4536
7048	03-Jun-19	31-May-29	69834	990	1114	9072
7049	03-Jun-19	31-May-29	114781	931	1035	6350
7050	01-Jun-19	29-May-29	114791	935	1043	6577
7051	03-Jun-19	31-May-29	50808	1371	1510	19504
7052	03-Jun-19	31-May-29	93921	980	1075	7938
7054	03-Jun-19	31-May-29	110710	1003	1123	8618
7055	01-Jun-19	29-May-29	114790	930	1040	5443
7057	03-Jun-19	31-May-29	115843	893	1021	5443
7058	03-Jun-19	31-May-29	115740	1135	1277	14515
7060	03-Jun-19	31-May-29	112911	820	910	3402
7062	03-Jun-19	31-May-29	110716	1065	1181	12020
7063	03-Jun-19	31-May-29	101041	830	951	4536

Table 4: Average proportion of time spent in each river zone by adult Lake Sturgeon tagged upstream of the Keeyask GS and in Stephens Lake 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), 2017 (June 7 to October 16), 2018 (June 6 to October 10), and 2019 (June 2 to October 7) open-water periods.

Tagging Year	Study Year	Upstream of Gull Rapids					Stephens Lake	
		1	2	3	4	5	6	7
2011	2013	6.4	0.1	12.4	72.5	8.6	45.0	55.0
	2014	9.0	0.1	10.8	52.3	27.7	38.2	61.8
	2015	4.7	0.1	9.9	43.6	41.7	55.6	44.9
	2016	7.3	0.1	12.1	56.5	24.1	41.8	59.2
	2017	5.3	0.0	10.7	62.6	21.4	47.6	52.9
	2018	7.4	0.1	14.8	48.5	29.2	47.4	53.3
	2019	15.2	0.0	10.0	50.2	24.6	48.5	51.9
2019	2019	0.4	0.2	12.3	73.8	13.3	53.6	46.4

Table 5: Number of Lake Sturgeon tagged with acoustic and radio tags that moved upstream or downstream through Gull Rapids during studies conducted in 2001–2004 and 2011–2019.

Life Stage	Year ¹	# Tagged Fish		# Fish Detected		Downstream Movements			Upstream Movements			Total # Move	% Tagged Fish Moved	% Detected Fish Moved
		U/S ²	D/S ³	U/S	D/S	#	% of total	% of detected	#	% of total	% of detected			
Adult⁴	2001	21	11	21	11	1	4.8	4.8	0	0.0	0.0	1	3.1	3.1
	2002	19	12	19	10	0	0.0	0.0	3	25.0	30.0	3	9.7	10.3
	2003	21	9	20	4	1	4.8	5.0	0	0.0	0.0	1	3.3	4.2
	2004	19	9	16	4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2011	30	19	28	19	0	0.0	0.0	1	5.3	5.3	1	2.0	2.1
	2012	32	27	30	27	0	0.0	0.0	4	14.8	14.8	4	6.8	7.0
	2013	35	22	28	19	0	0.0	0.0	1	4.5	5.3	1	1.8	2.1
	2014	34	24	33	24	2	5.9	6.1	0	0.0	0.0	2	3.4	3.5
	2015	32	25	28	25	1	3.1	3.6	0	0.0	0.0	1	1.8	1.9
	2016	32	26	29	26	2	6.3	6.9	0	0.0	0.0	2	3.4	3.6
	2017	30	28	26	27	1	3.3	3.8	0	0.0	0.0	1	1.7	1.9
	2018	28	28	28	28	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2019	54	53	54	51	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Juvenile⁵	2013	20	20	18	20	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2014	20	20	20	19	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2015	20	20	19	19	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2016	20	20	19	19	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2017	20	18	18	13	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2018	20	19	20	14	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2019	20	14	17	13	1	0.0	0.0	0	0.0	0.0	1	0.03	0.03

1. Includes data from the current study (2011–2016), a study conducted between 2001 and 2004 (Barth and Mochacz 2004; Barth 2005; Barth and Murray 2005; Barth and Ambrose 2006), and the juvenile Lake Sturgeon acoustic telemetry study initiated in Gull and Stephens Lake in 2013 (Hrenchuk and Barth 2014; Lacho *et al.* 2015, Lacho and Hrenchuk 2016; Lacho and Hrenchuk 2017; Lacho *et al.* 2018; Lacho and Hrenchuk 2019a).
2. Upstream of Gull Rapids (between Clark Lake and Gull Rapids).
3. Downstream of Gull Rapids (in Stephens Lake between Gull Rapids and the Kettle GS).
4. Refers to fish greater than 800 mm fork length.
5. Refers to fish less than 800 mm fork length.

FIGURES

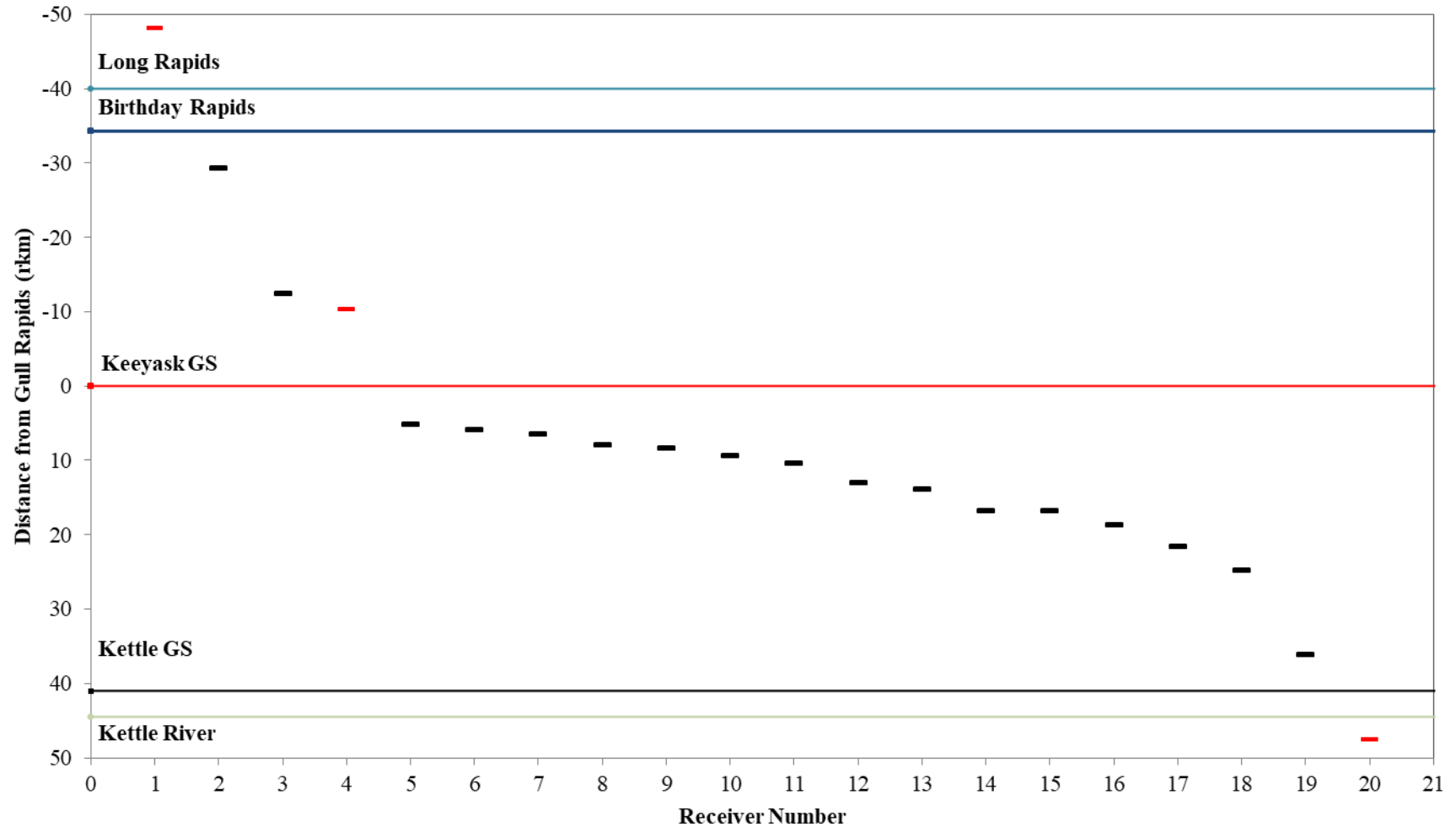


Figure 1: Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Limestone GS between October, 2018 and June, 2019. A red dash indicates a receiver that was lost.

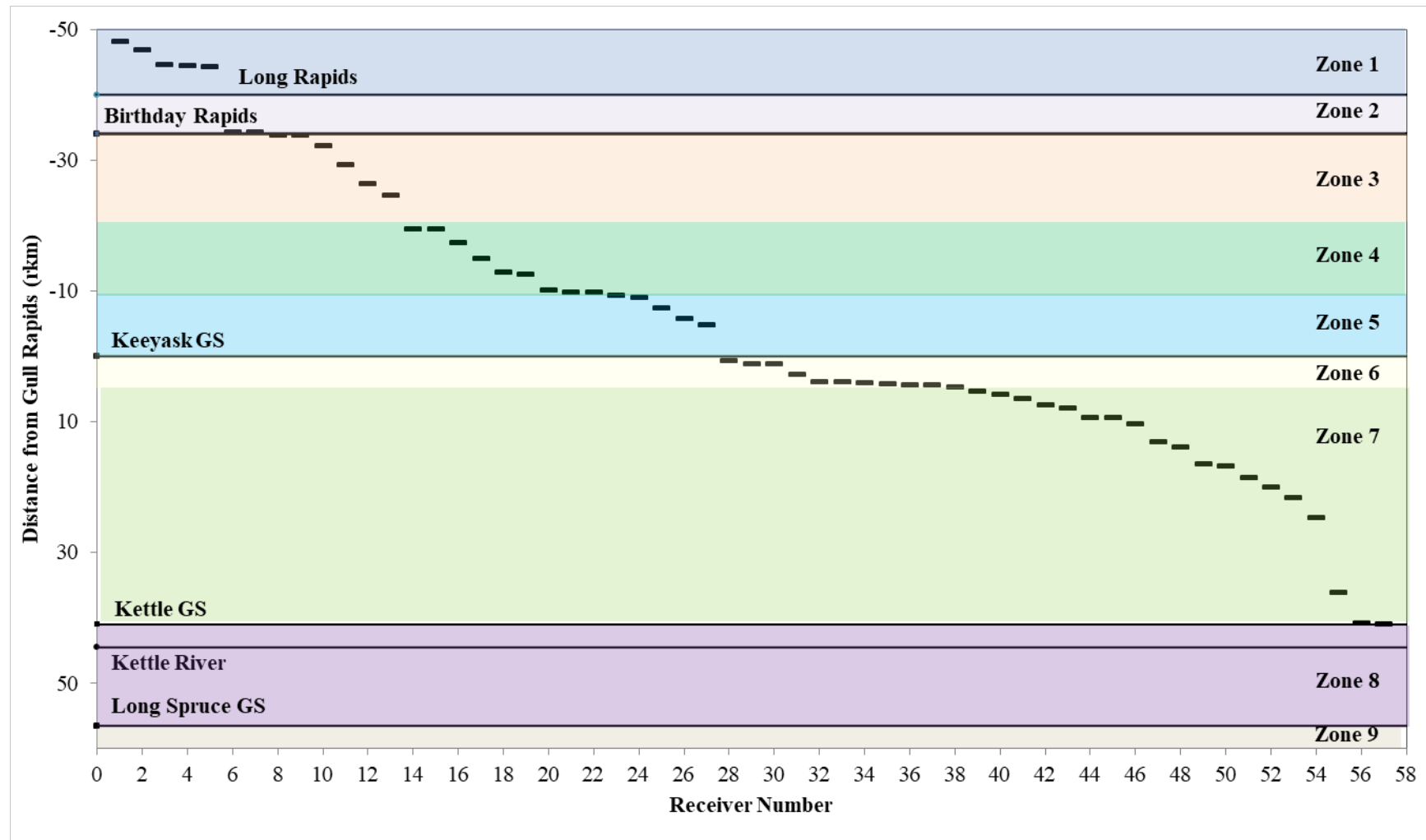


Figure 2: Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Limestone GS between June and October, 2019. River zones upstream and downstream of Gull Rapids are indicated by shading. A red dash indicates a receiver was lost.

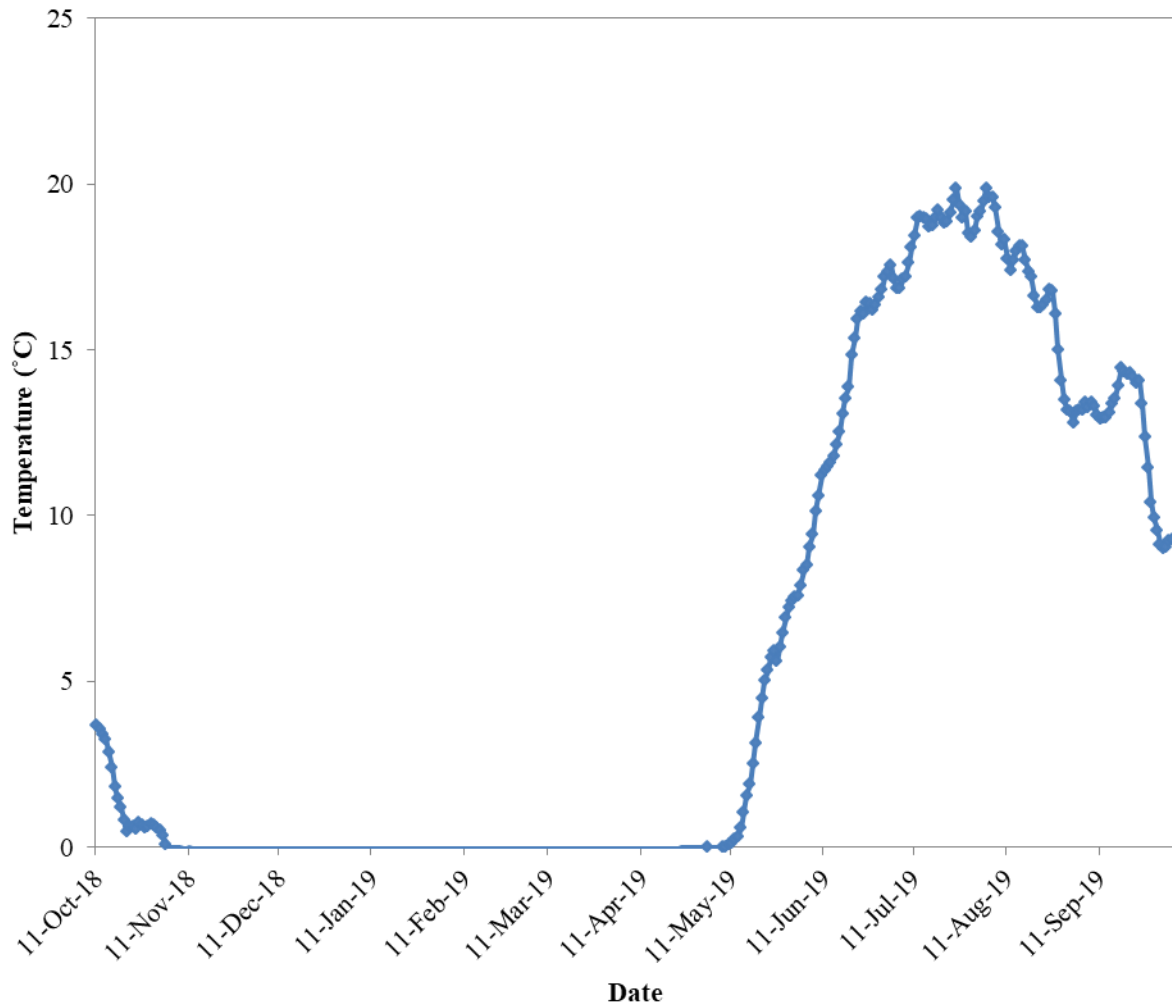


Figure 3: Water temperature in the Nelson River mainstem from October 11, 2018, to October 5, 2019.

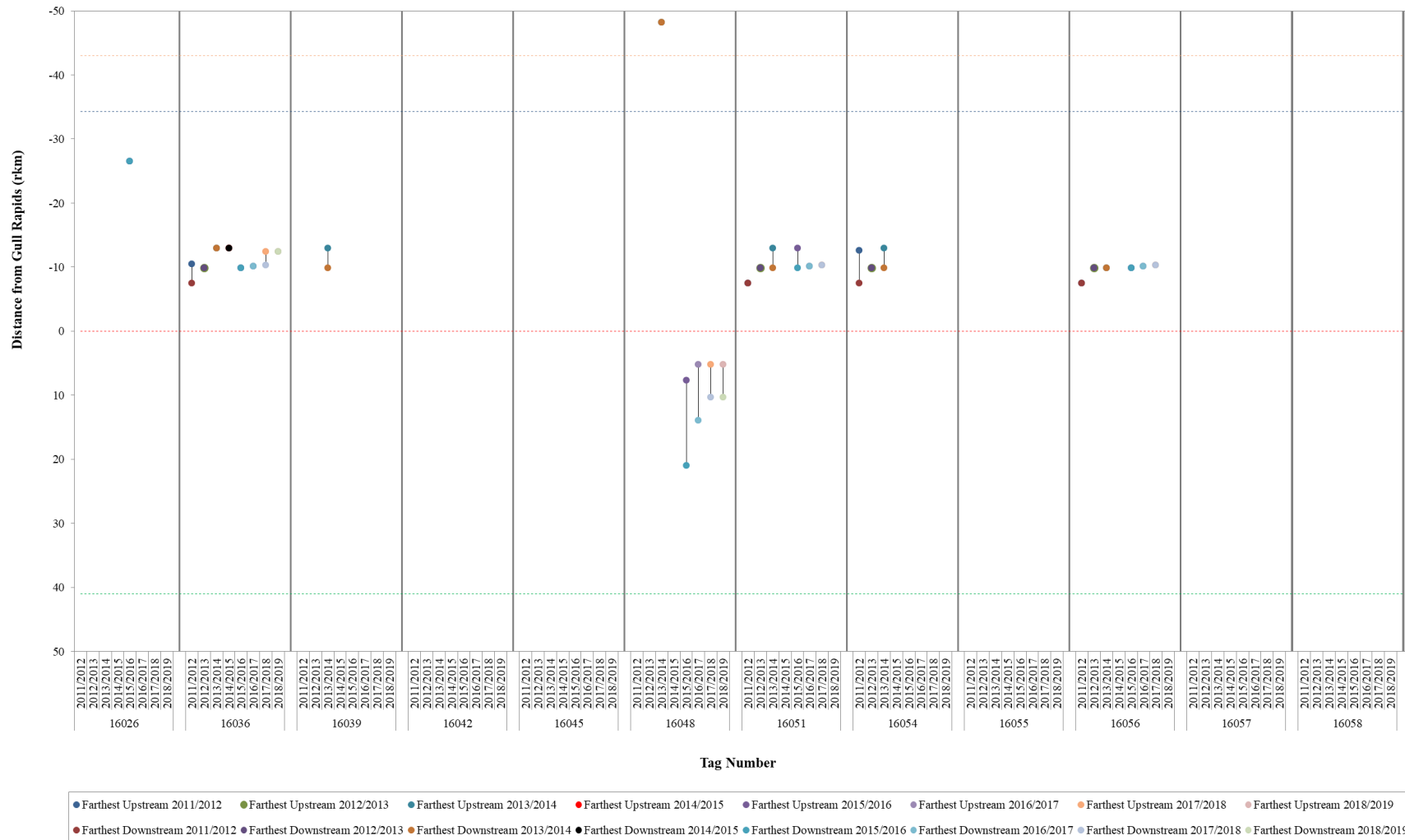


Figure 4: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keyeyask GS during the winter period (2011–2019). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids; green = Kettle GS).

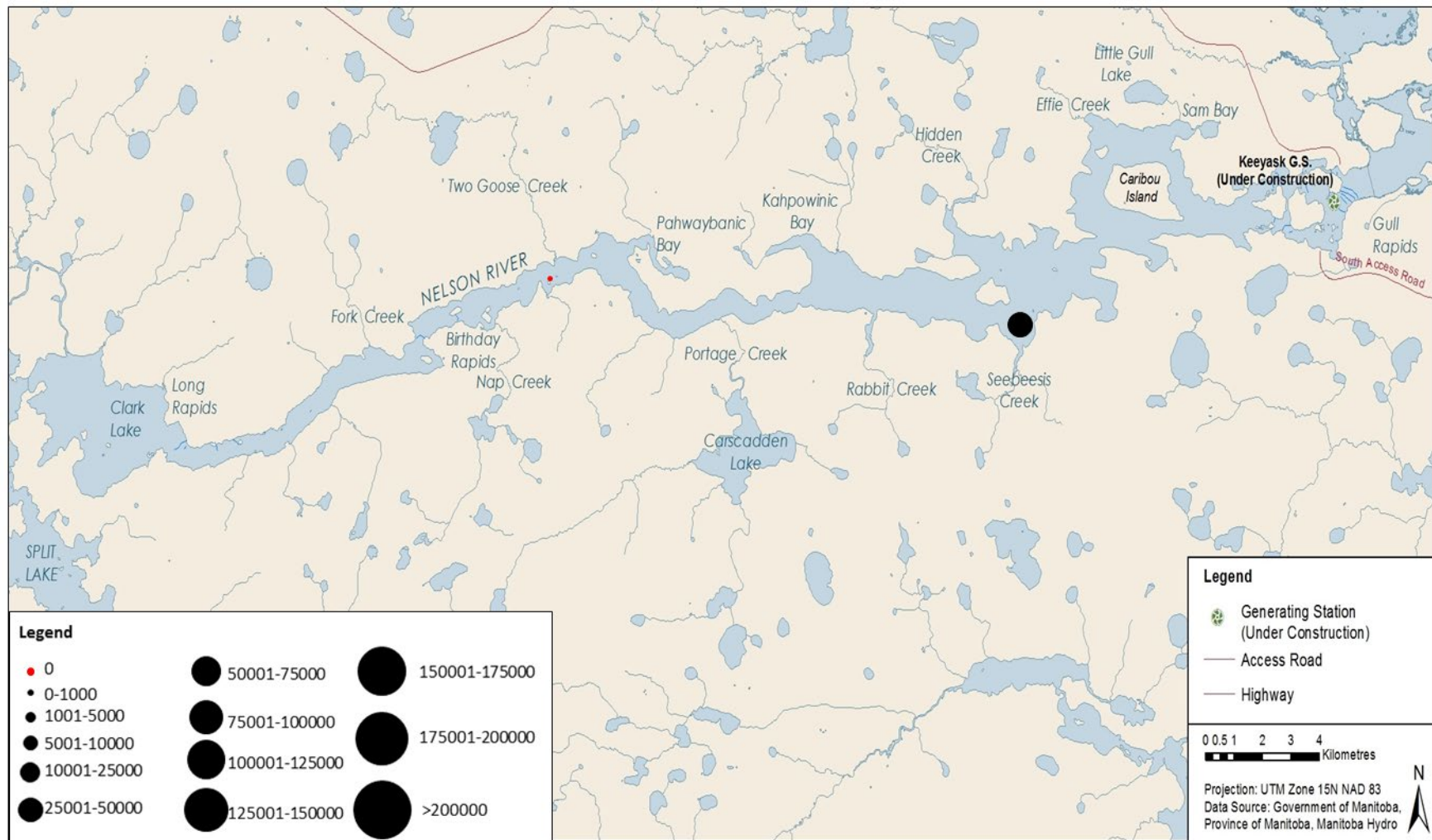


Figure 5: Relative number of detections at each acoustic receiver set between Clark Lake and the Keeyask GS during winter 2018/2019 (October 11, 2018, to April 30, 2019). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

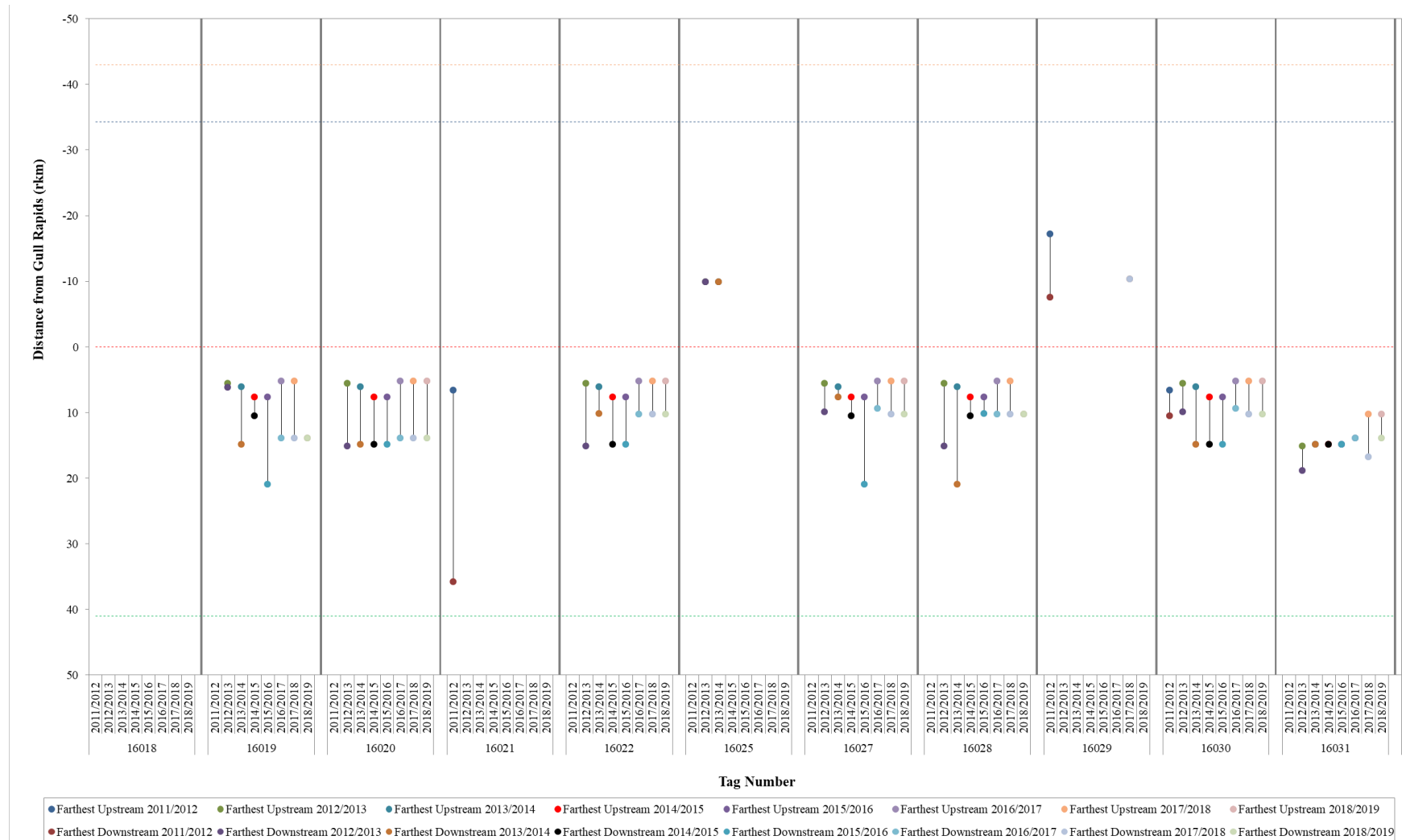


Figure 6: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the winter period (2011–2019). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS).

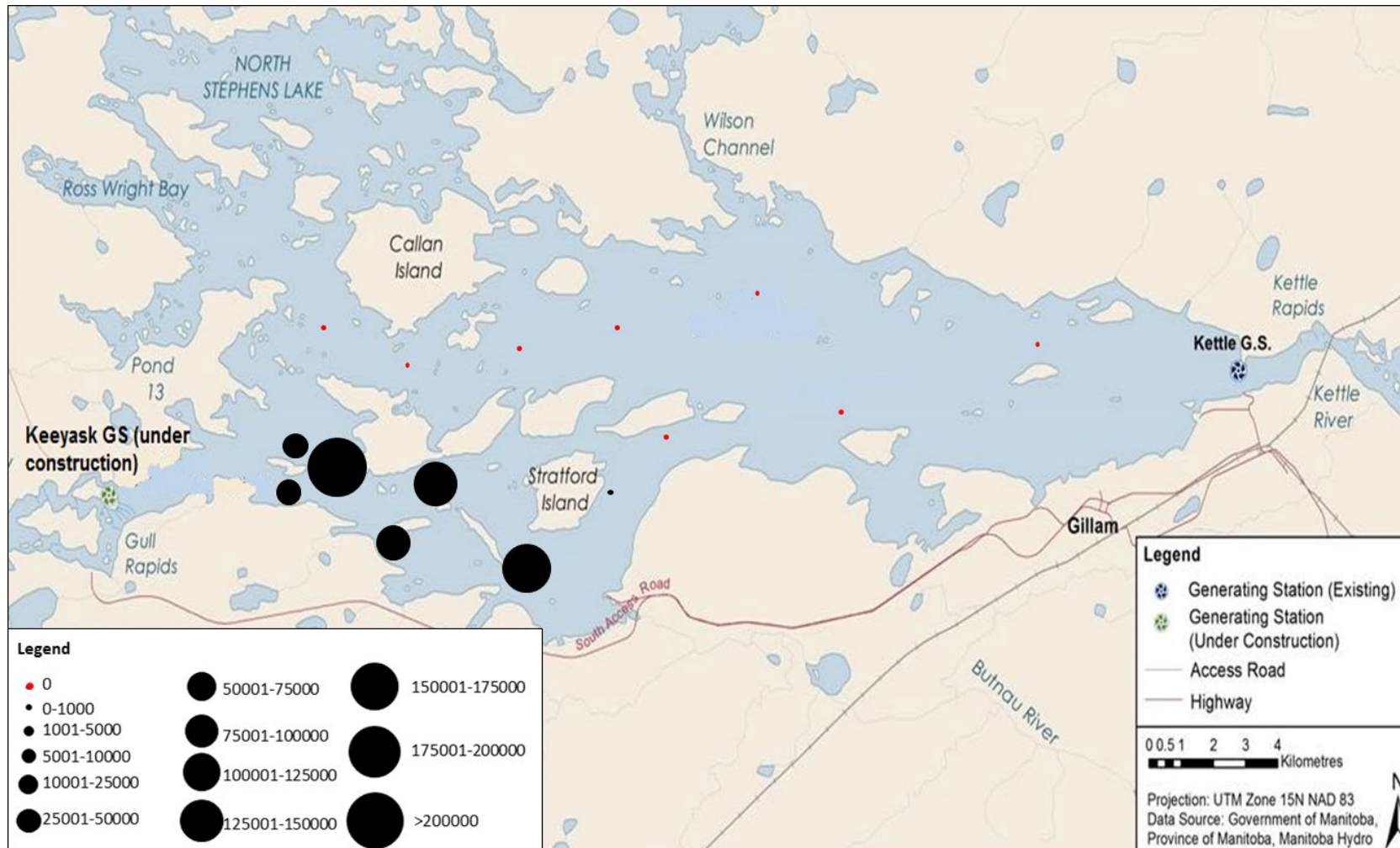


Figure 7: Relative number of detections at each acoustic receiver set in Stephens Lake during winter 2018/2019 (October 11, 2018, to April 30, 2019). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

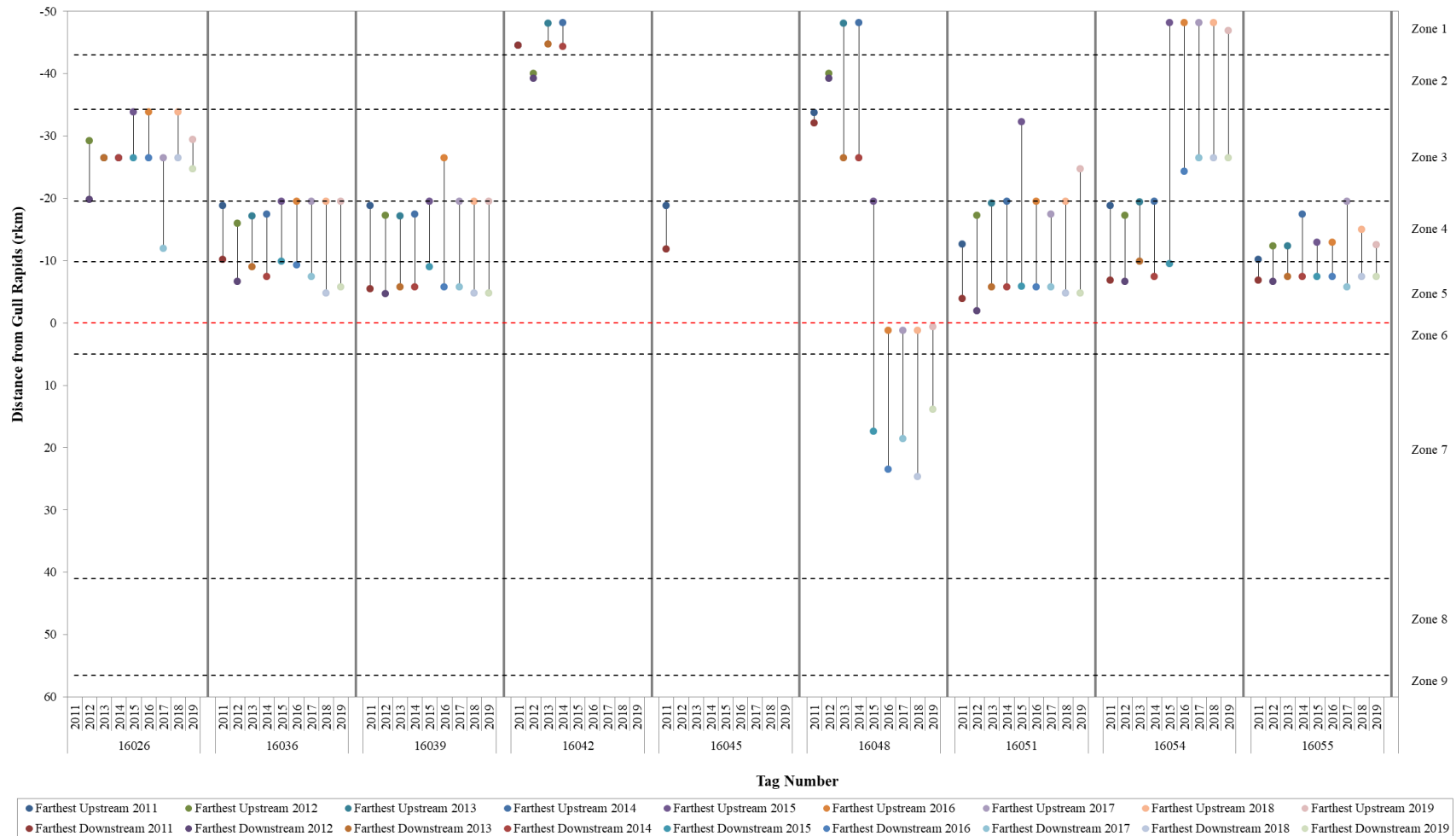


Figure 8: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the open-water period (2011–2019). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS.

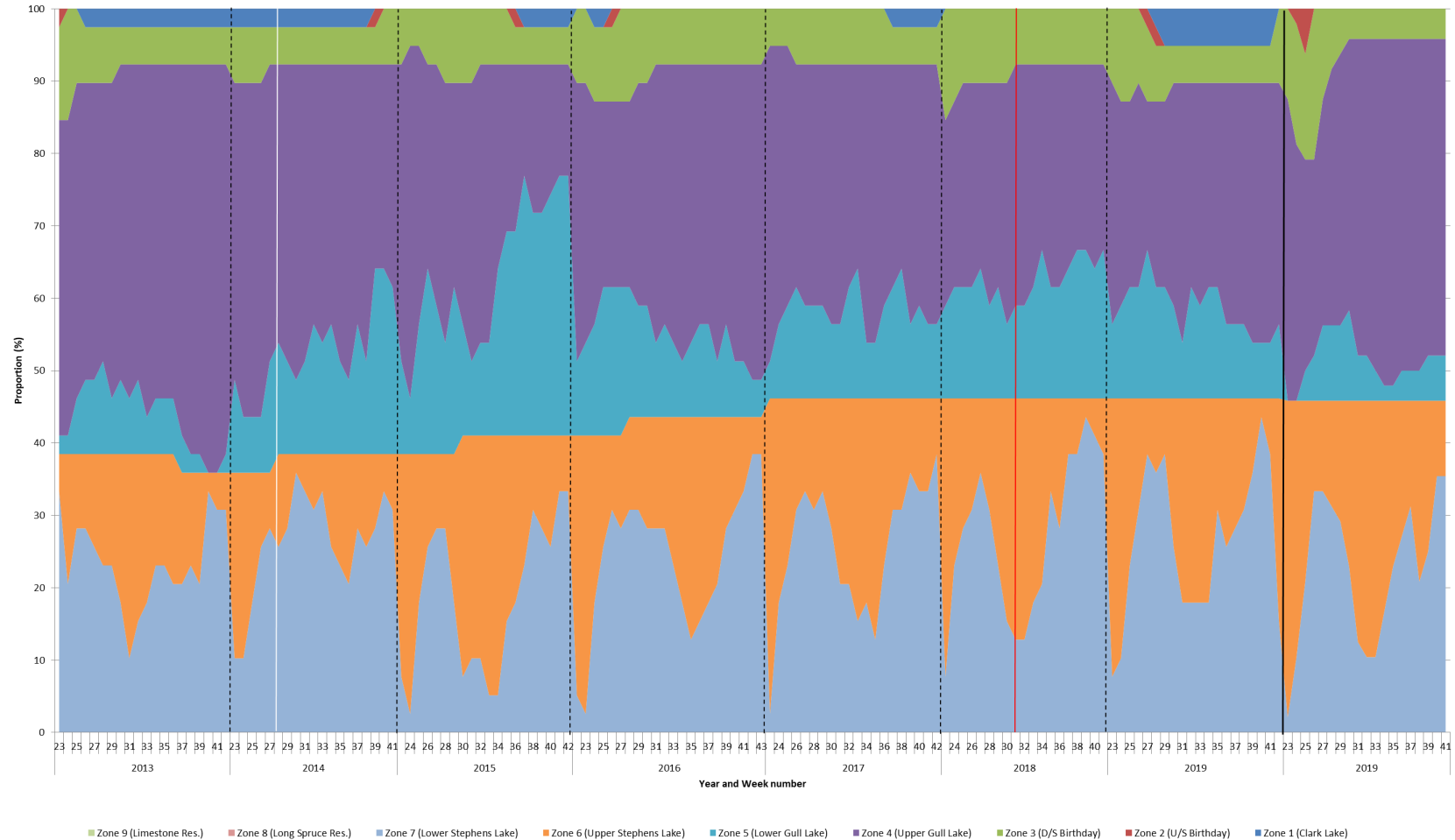


Figure 9: Proportional distribution by zone, for adult Lake Sturgeon tagged with acoustic transmitters in the Keeyask GS Area during a portion of the 2013 (June 4 to October 15), 2014 (June 4 to October 3), 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16) 2018 (June 6 to October 10), and 2019 (June 2 to October 7) open-water periods. Black dashed lines indicate study years. Solid black line indicates new fish tagged. White line indicates start of Keeyask construction. Red line indicates start of Keeyask spillway commissioning.

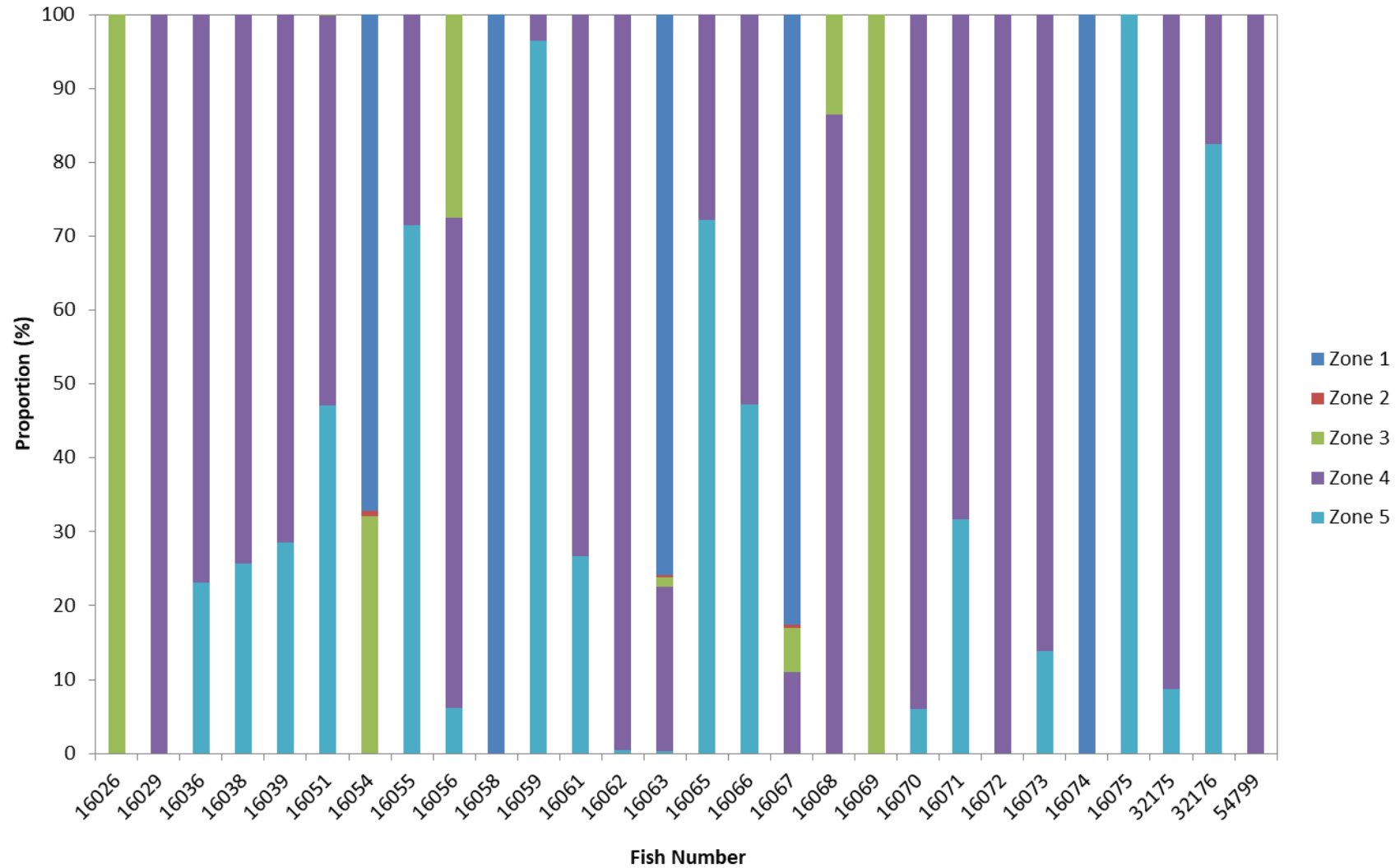


Figure 10: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of Keeyask GS during a portion of the 2019 open-water period (June 2 to October 7).

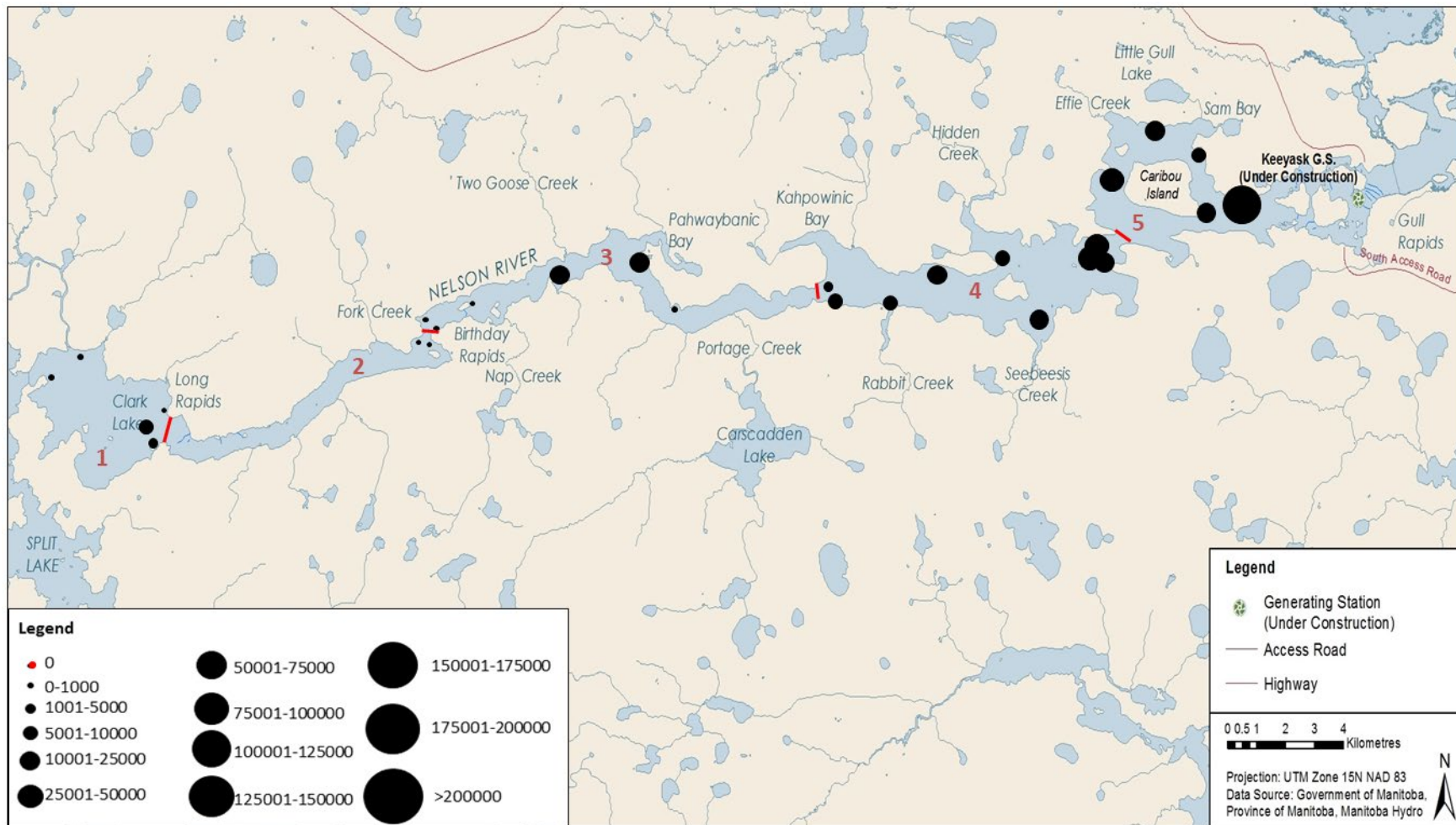


Figure 11: Relative number of detections at each acoustic receiver set in the Nelson River between Clark Lake and the Keeyask GS during the 2019 open-water period (May 1 to October 7). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into five "zones" based on placement of receiver "gates."

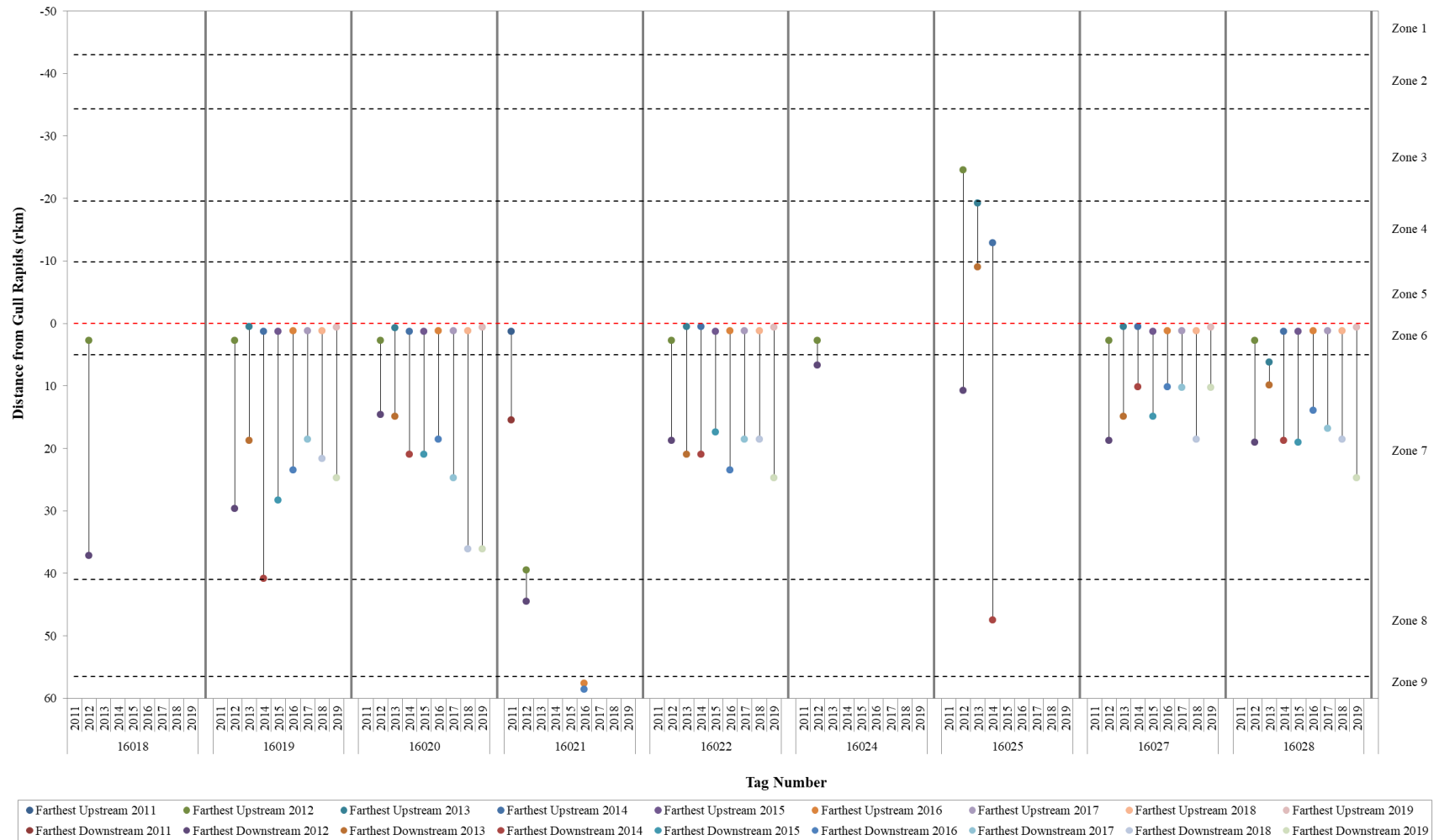


Figure 12: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the open-water period (2011–2019). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS.

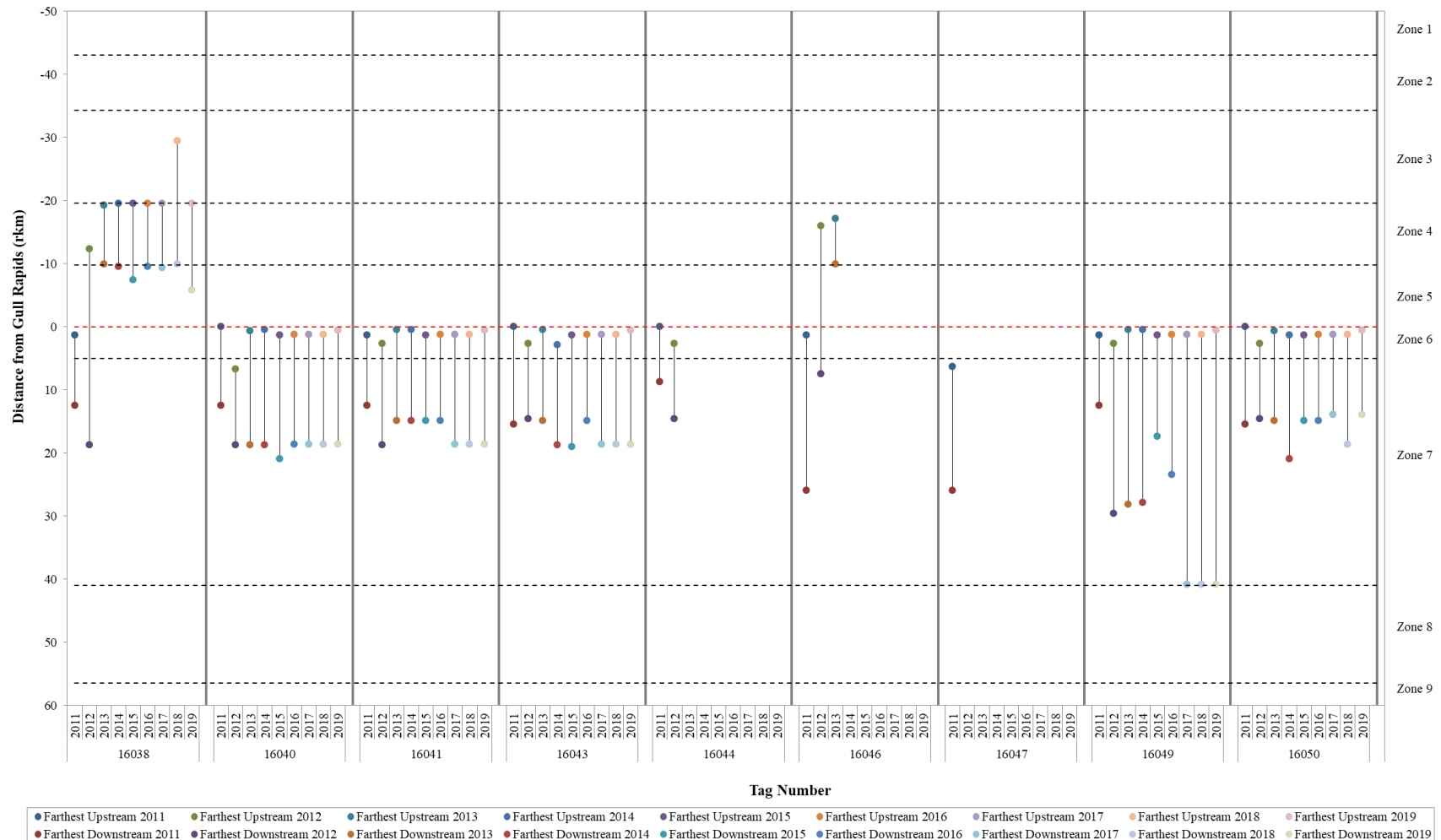


Figure 12: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the open-water period (2011–2019). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).

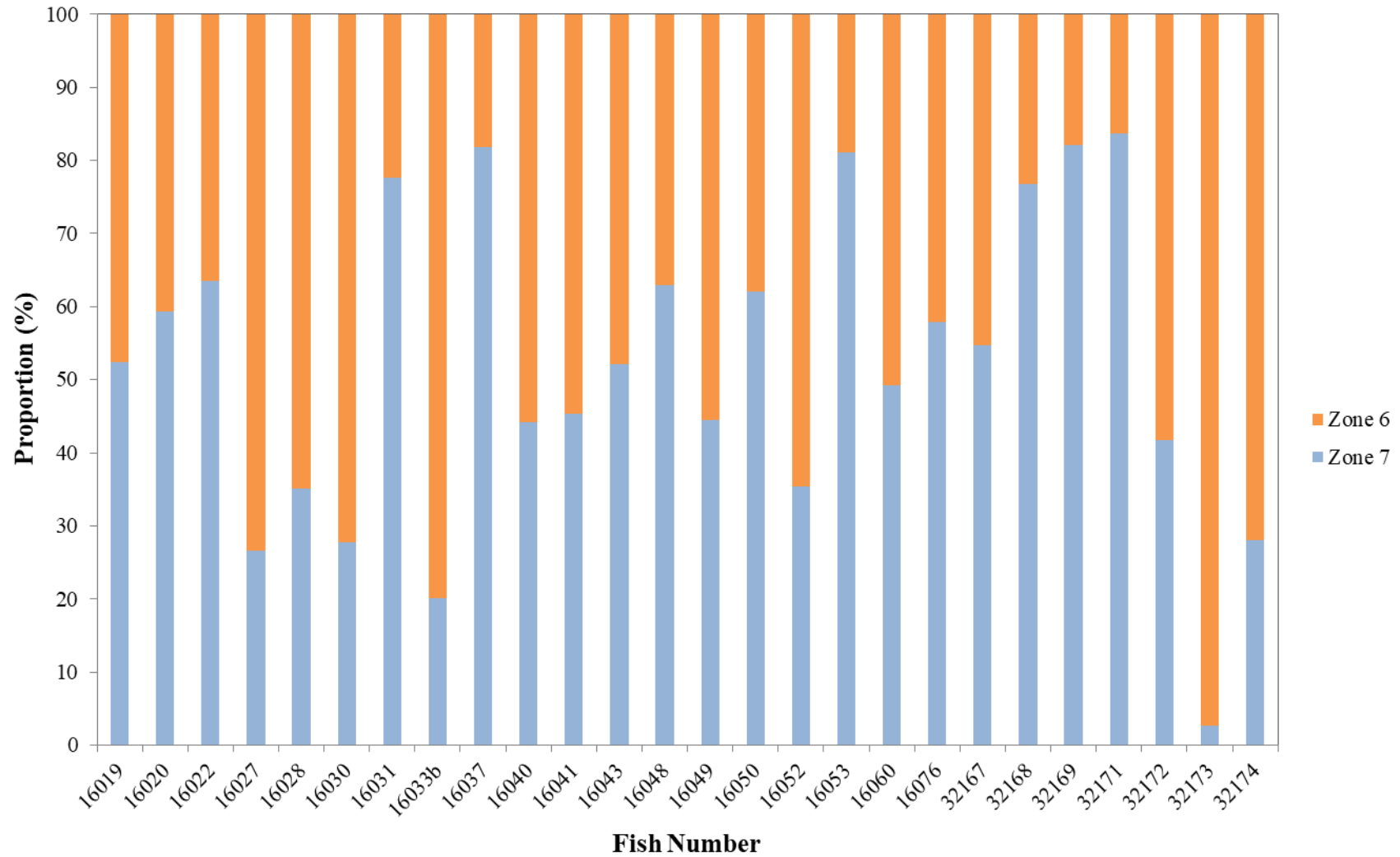


Figure 13: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during a portion of the 2019 open-water period (June 2 to October 7).

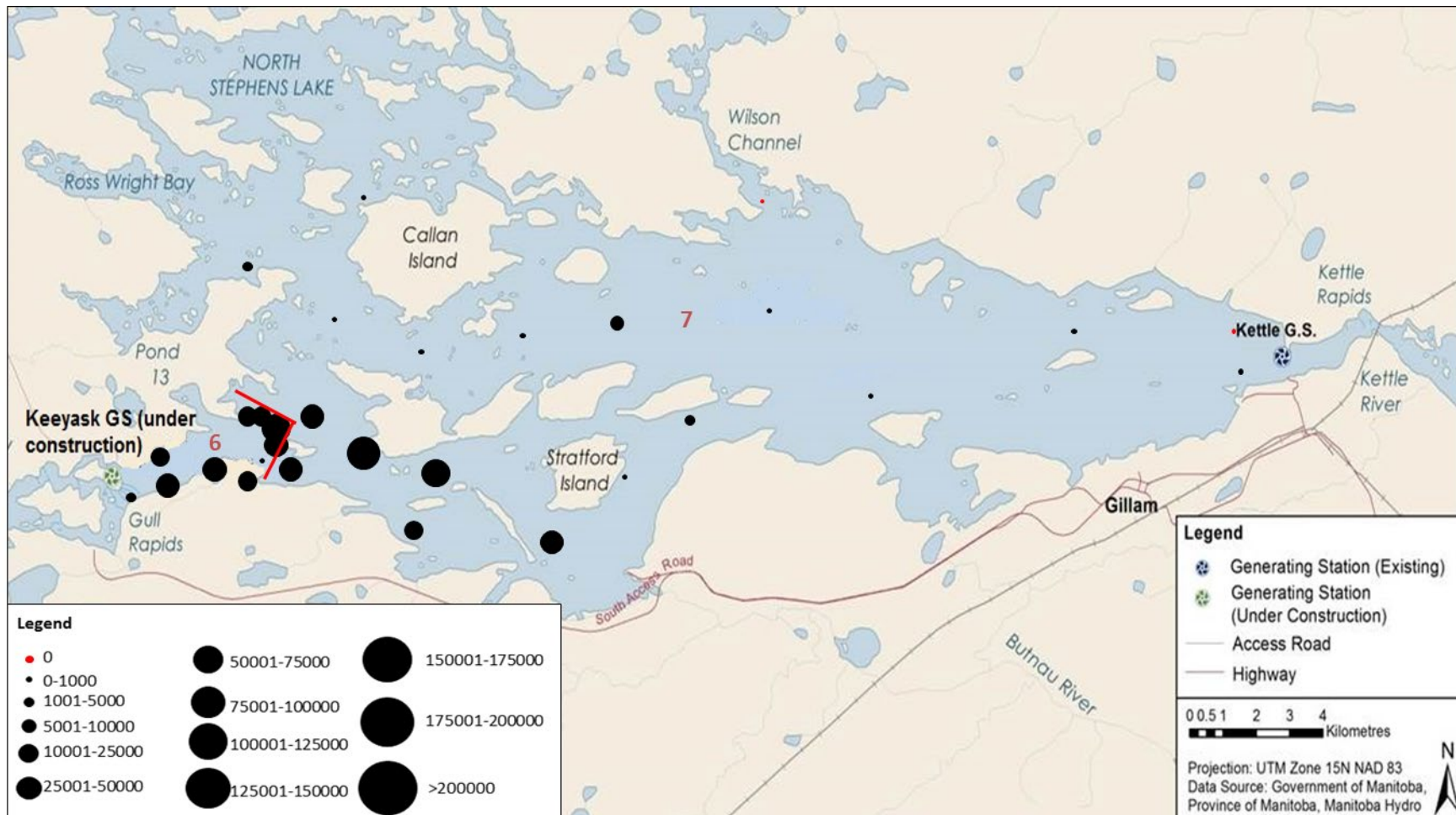


Figure 14: Relative number of detections at each acoustic receiver set in Stephens Lake during the 2019 open-water period (May 1 to October 7). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into two "zones" based on placement of receiver "gates."

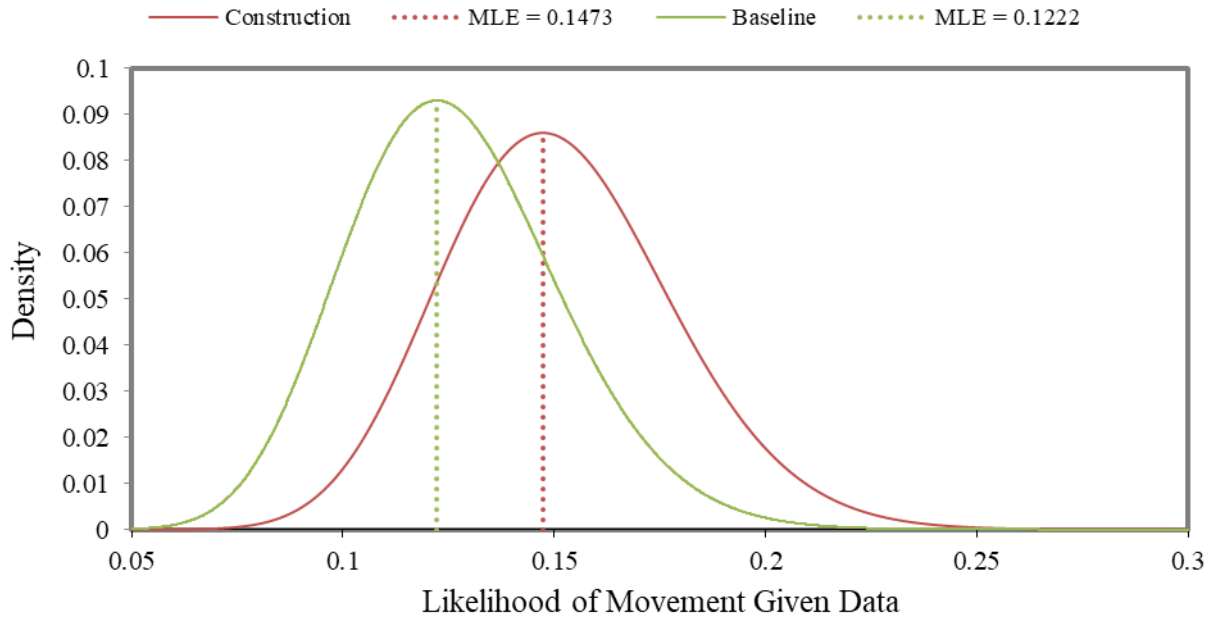


Figure 15: Likelihood of an adult Lake Sturgeon moving between river zones (either upstream or downstream) both before and after the onset of Keeyask construction.

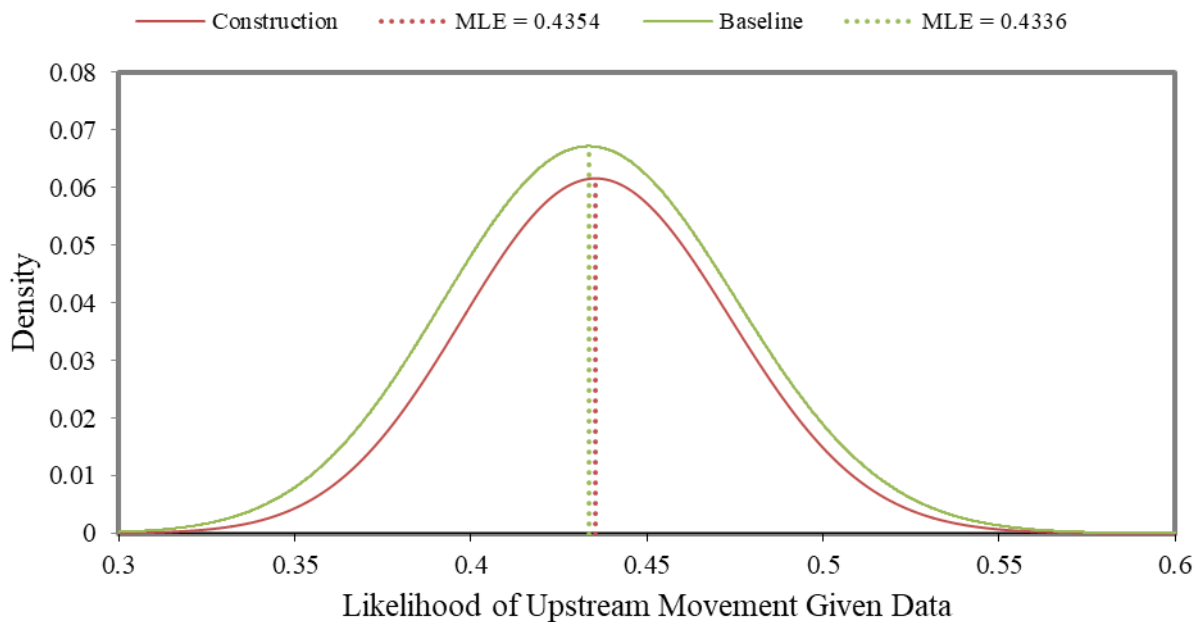


Figure 16: Likelihood that, if an adult Lake Sturgeon moves between river zones, the movement will be upstream both before and after the onset of Keeyask construction.

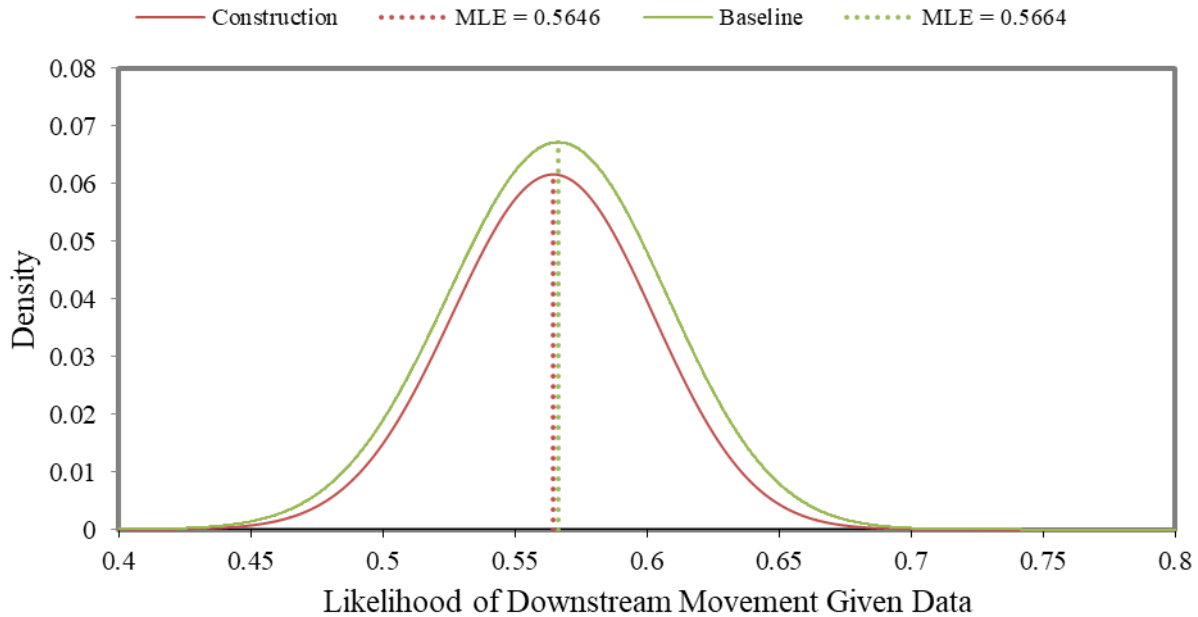


Figure 17: Likelihood that, if an adult Lake Sturgeon moves between river zones, the movement will be downstream both before and after the onset of Keeyask construction.

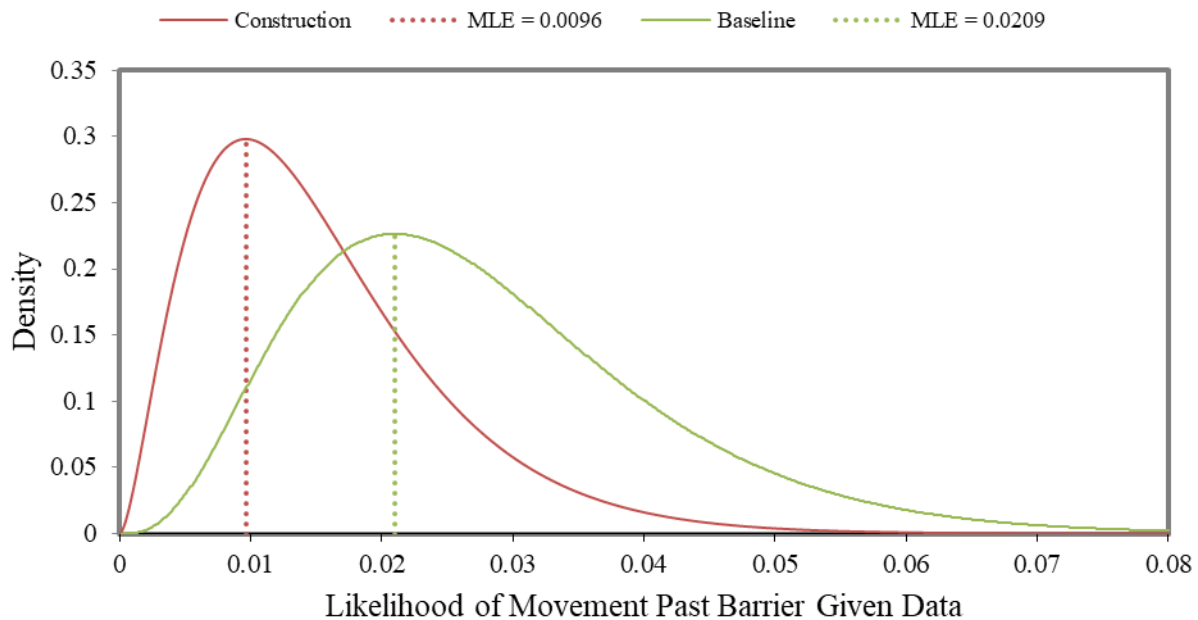


Figure 18: Likelihood of an adult Lake Sturgeon moving past a barrier (either Gull Rapids/the Keeyask GS, Kettle GS, or Long Spruce GS) before and after the onset of Keeyask construction.

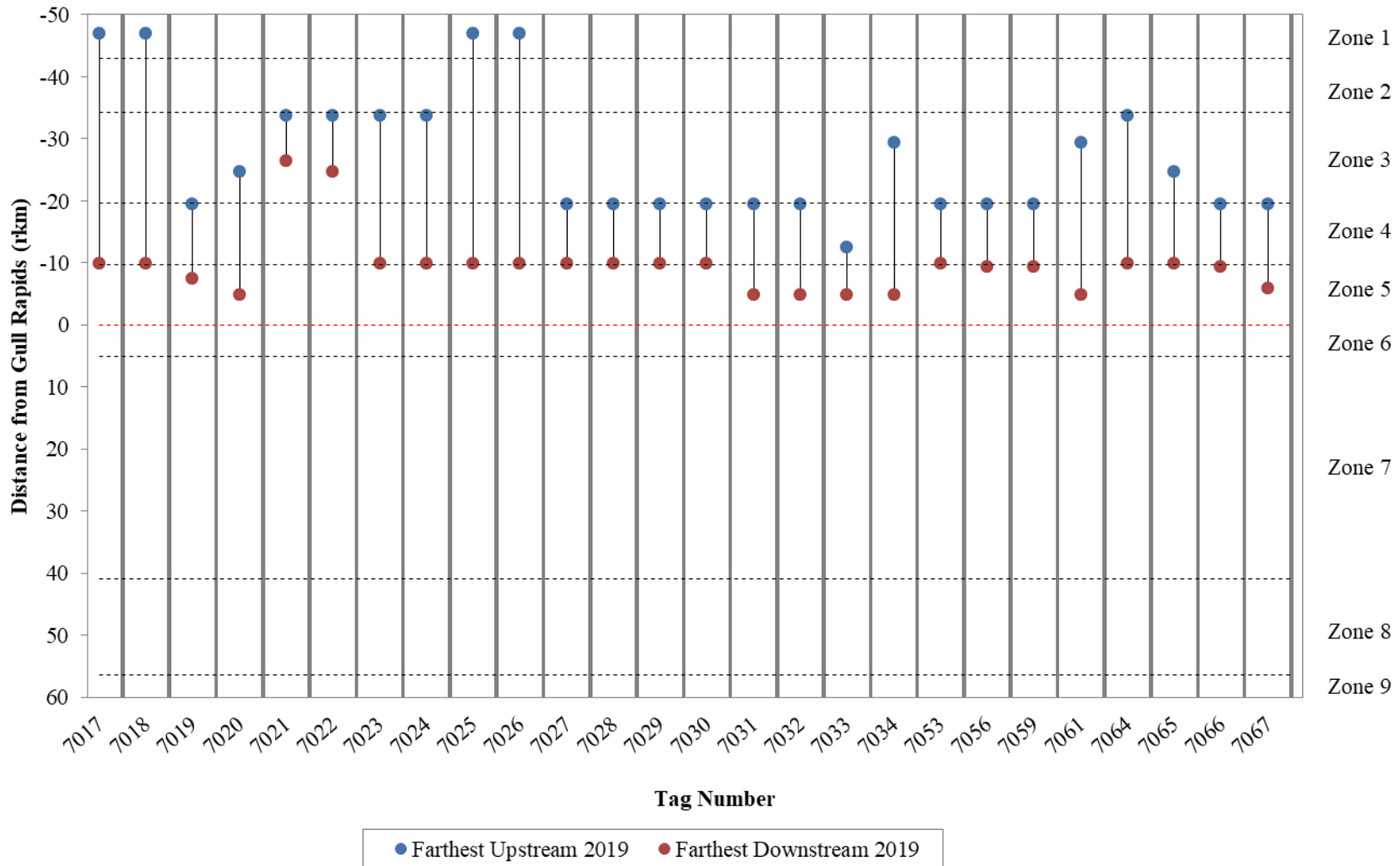


Figure 19: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keyyask GS in 2019 during the open-water period. Horizontal dotted lines demarcate zones with the red line representing the Keyyask GS.

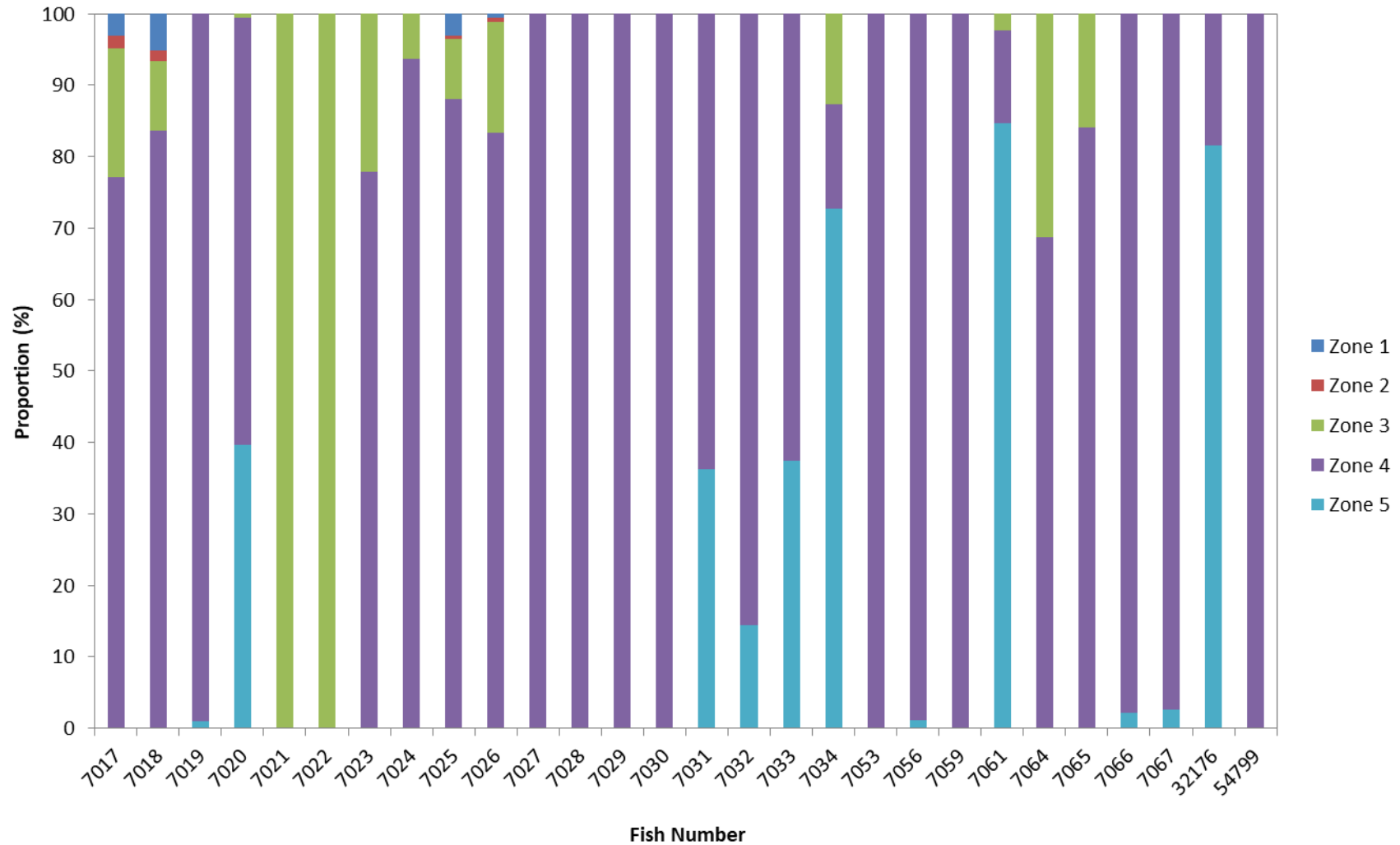


Figure 20: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS in 2019 during a portion of the 2019 open-water period (June 2 to October 7).

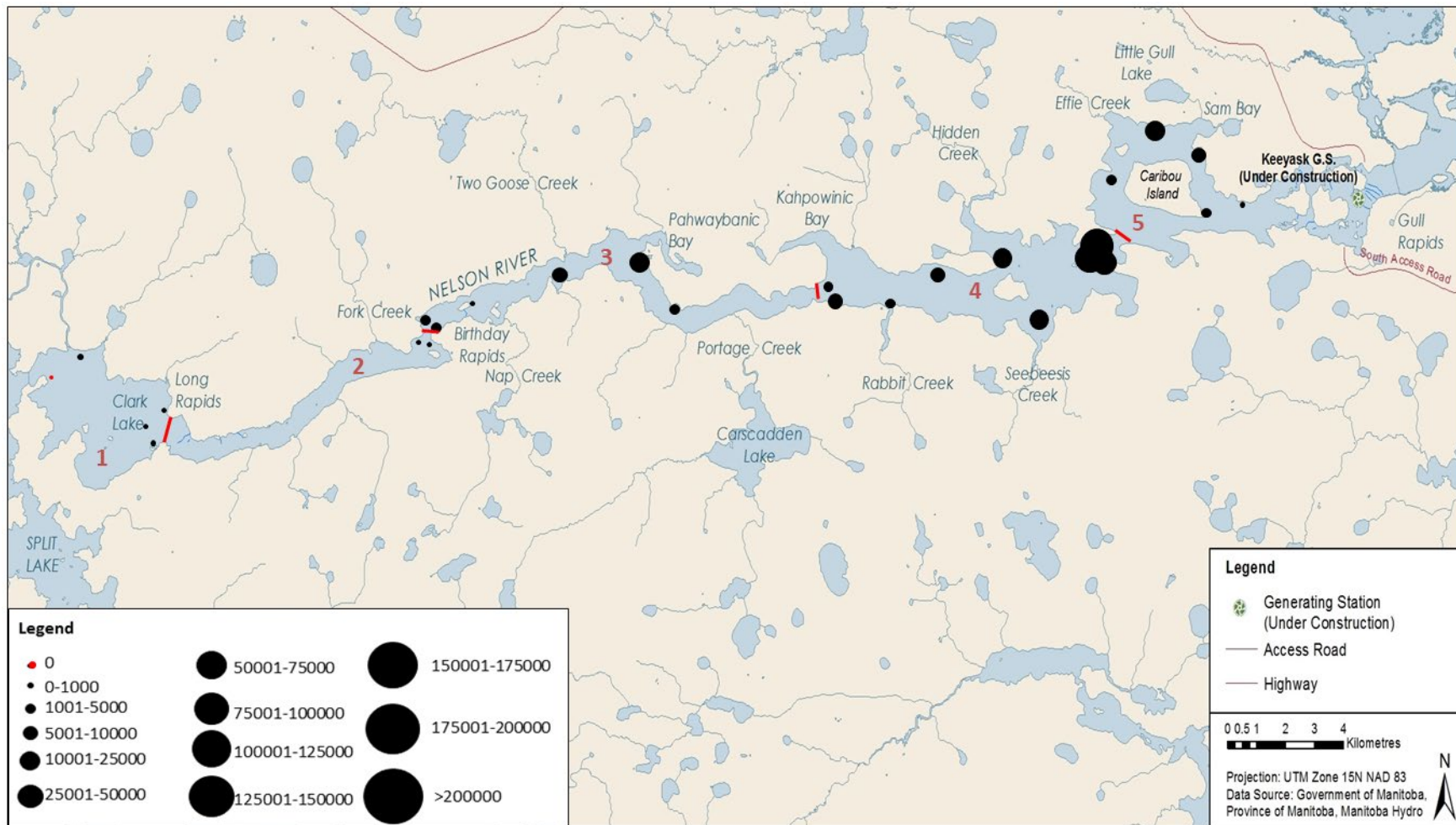


Figure 21: Relative number of detections of adult Lake Sturgeon tagged in 2019 at each acoustic receiver set upstream of the Keeyask GS during the 2019 open-water period (May 1 to October 7). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into five "zones" based on placement of receiver "gates."

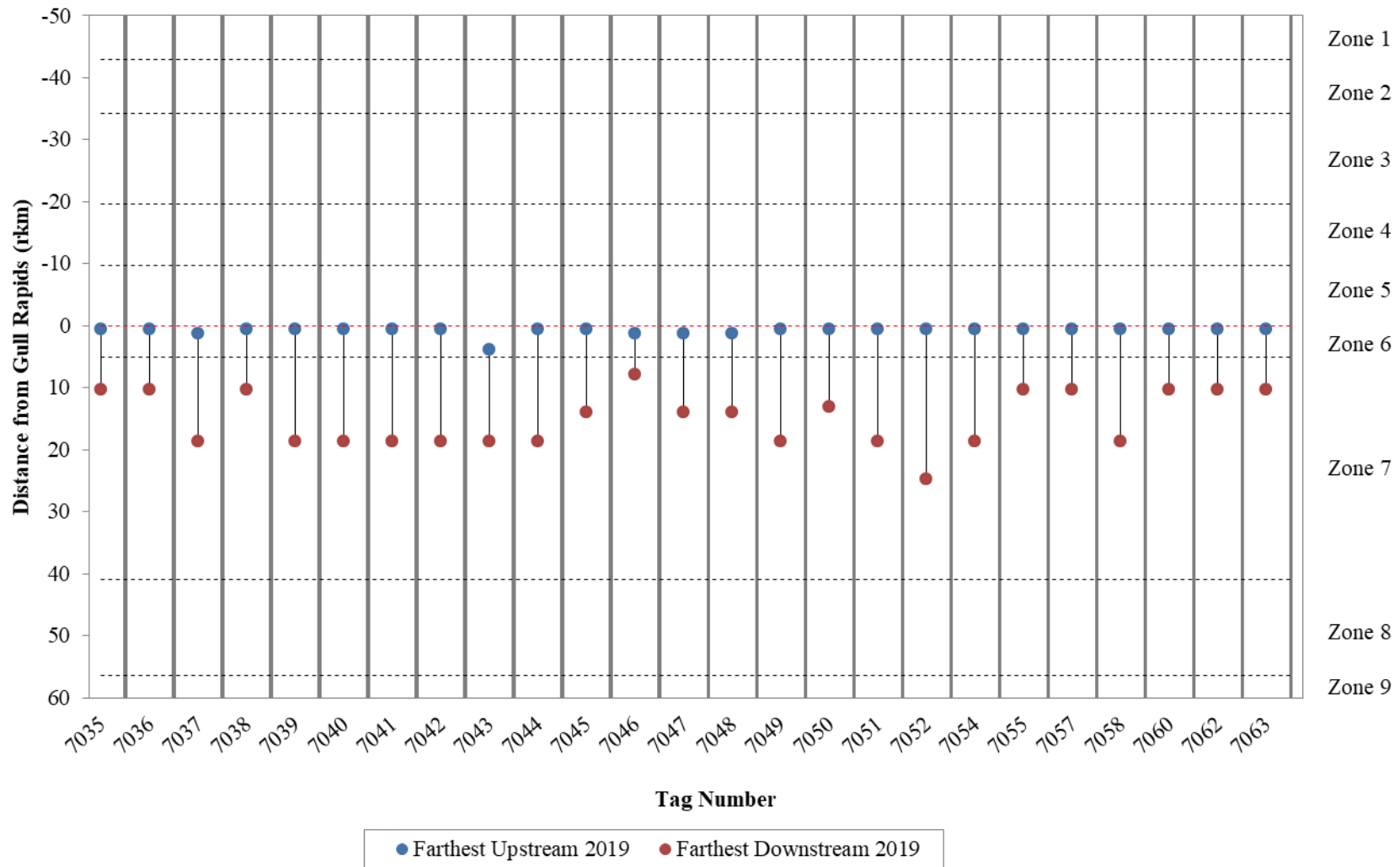


Figure 22: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake in 2019 during the open-water period. Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS.

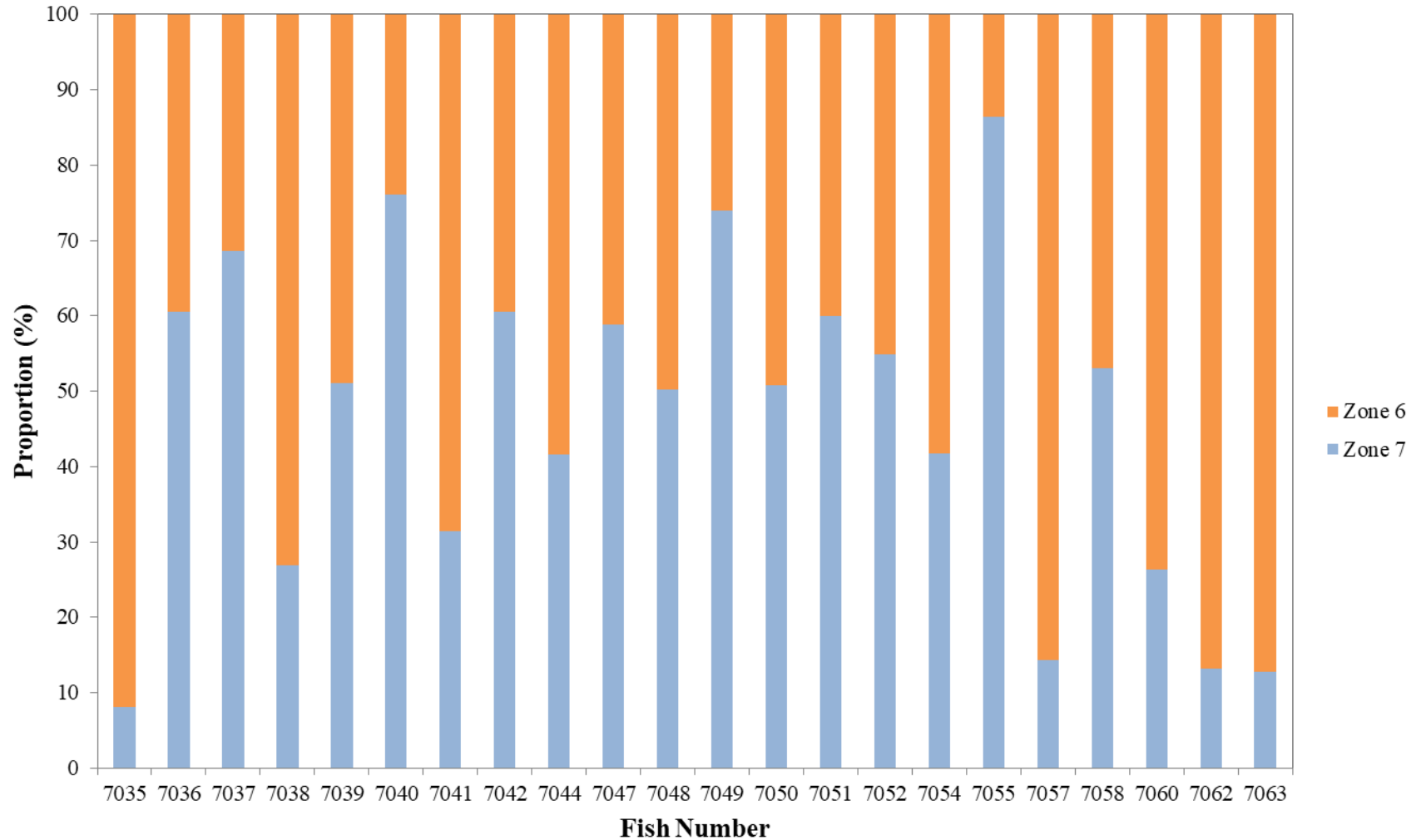


Figure 23: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake in 2019 during a portion of the 2019 open-water period (June 2 to October 7).

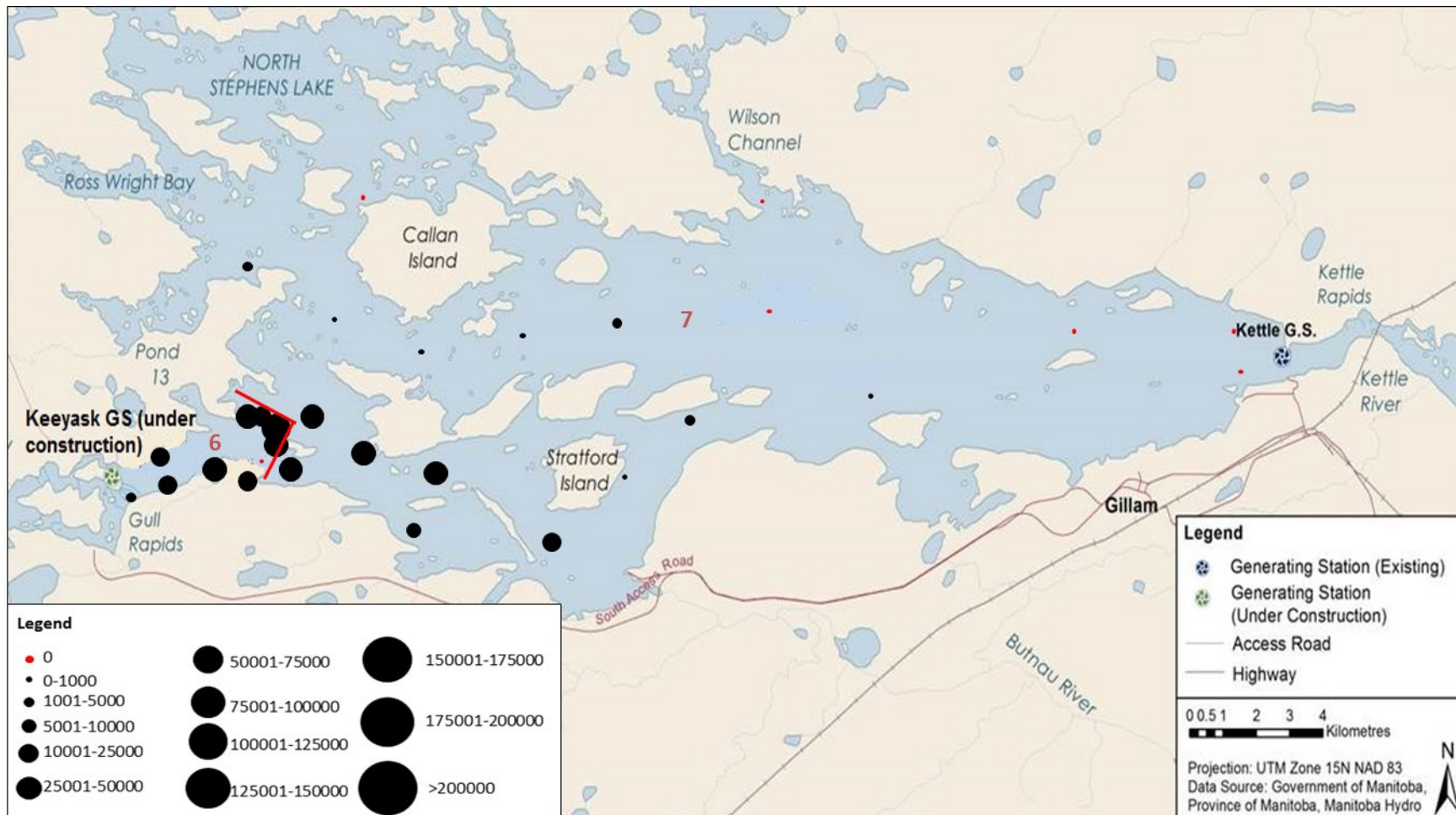
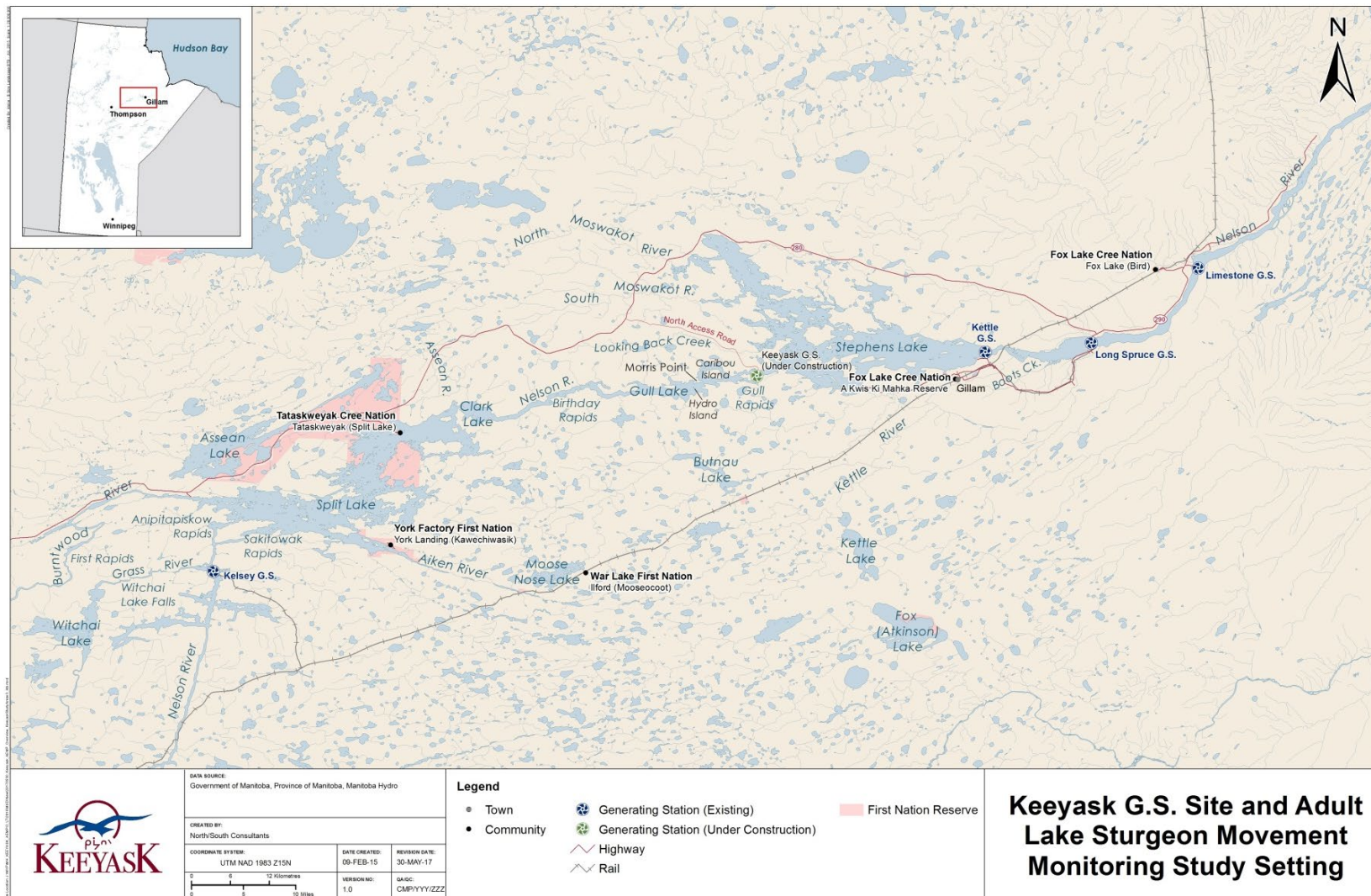
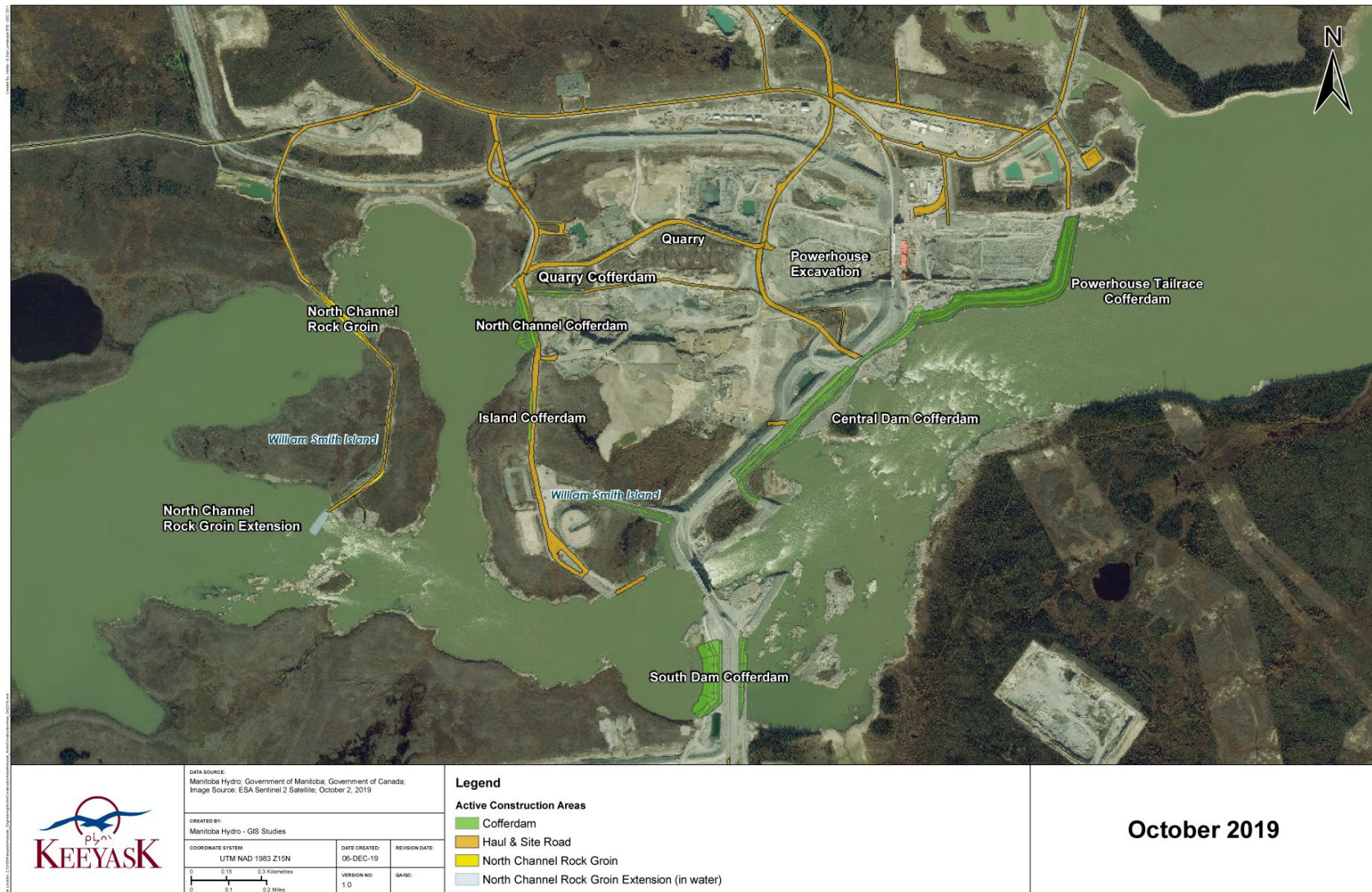


Figure 24: Relative number of detections of adult Lake Sturgeon tagged in 2019 at each acoustic receiver set in Stephens Lake during the 2019 open-water period (May 1 to October 7). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into two "zones" based on placement of receiver "gates."

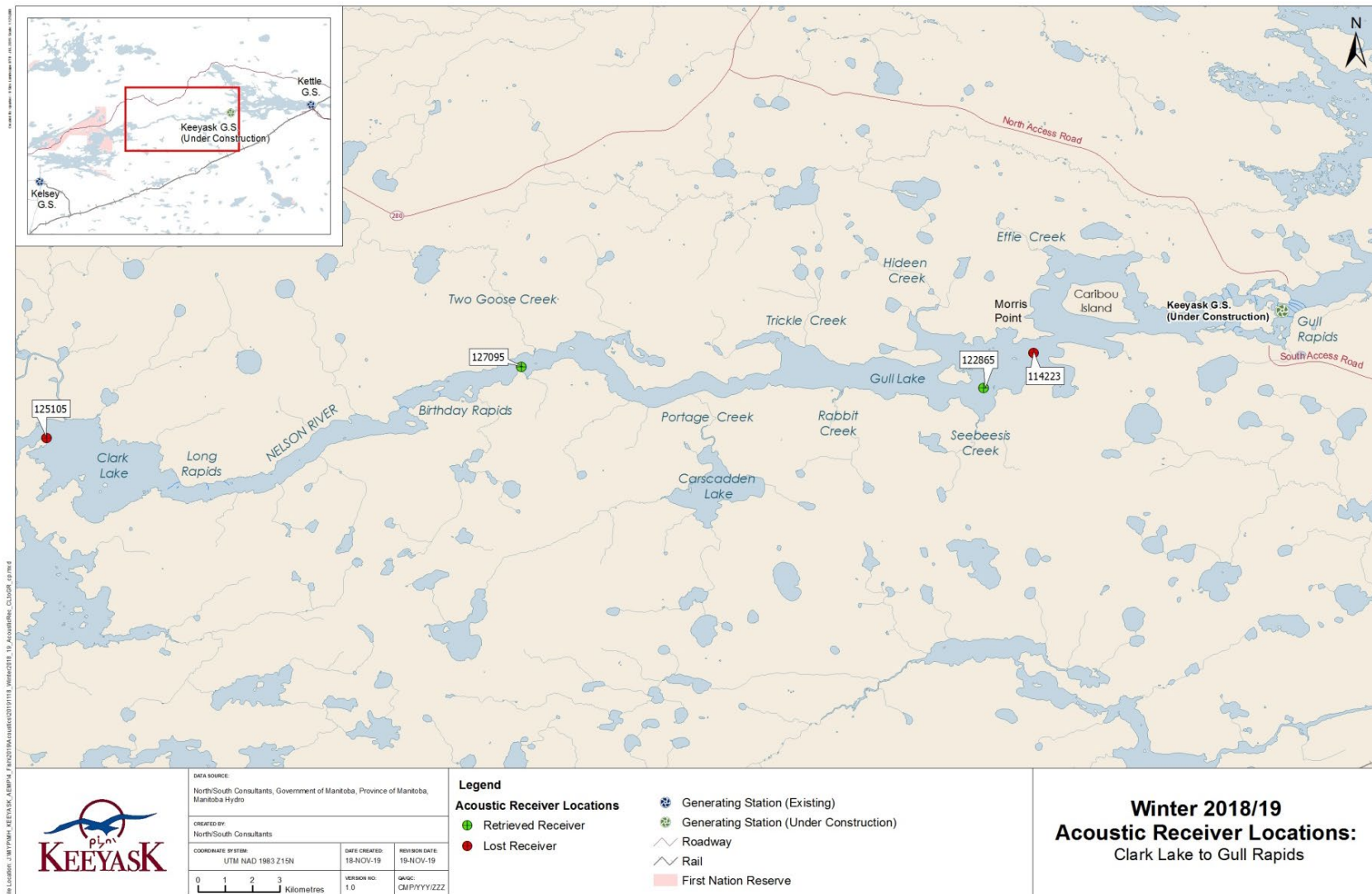
MAPS



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



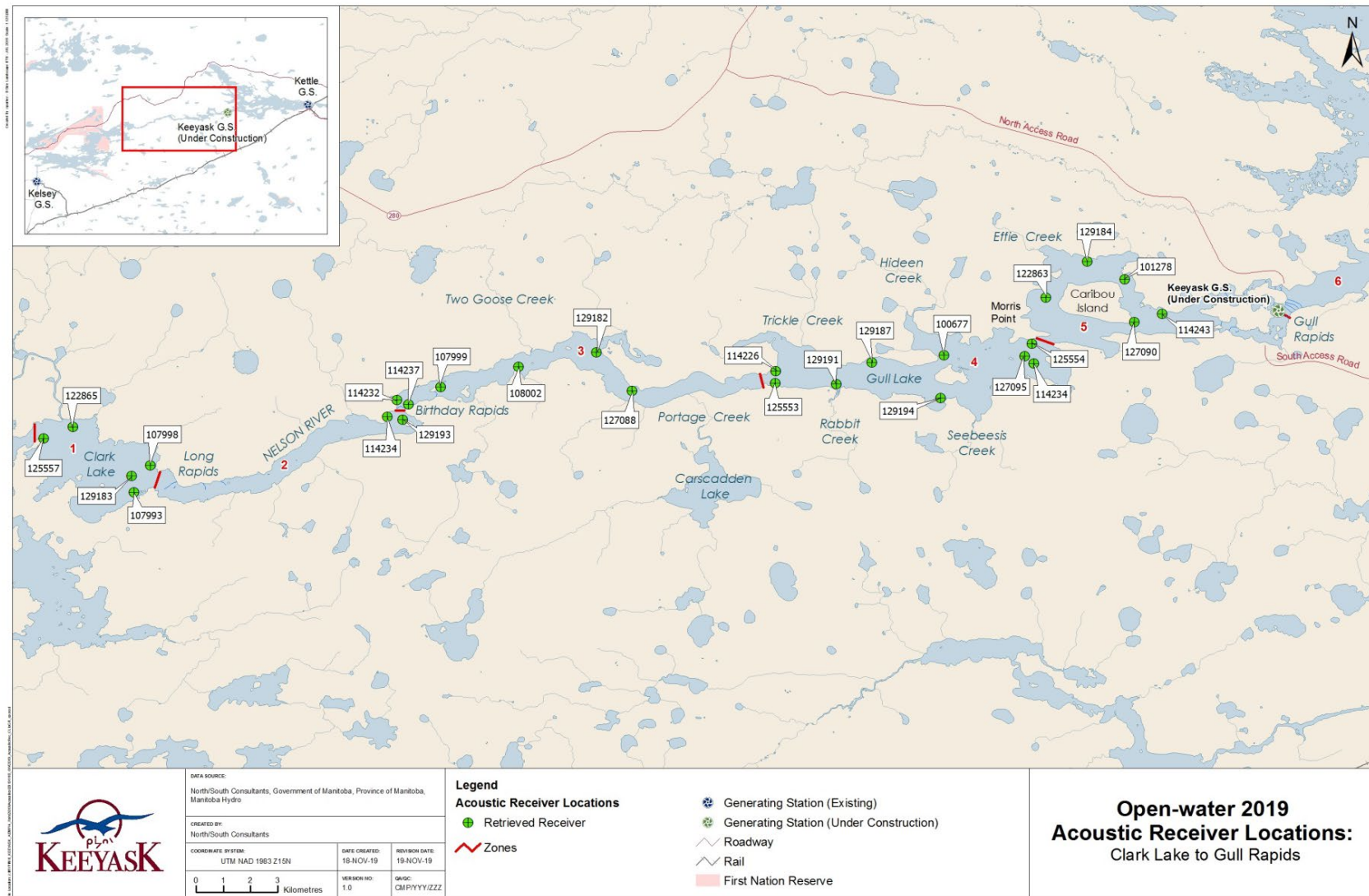
Map 2: Map of instream structures at the Keeyask Generating Station site, October 2019.



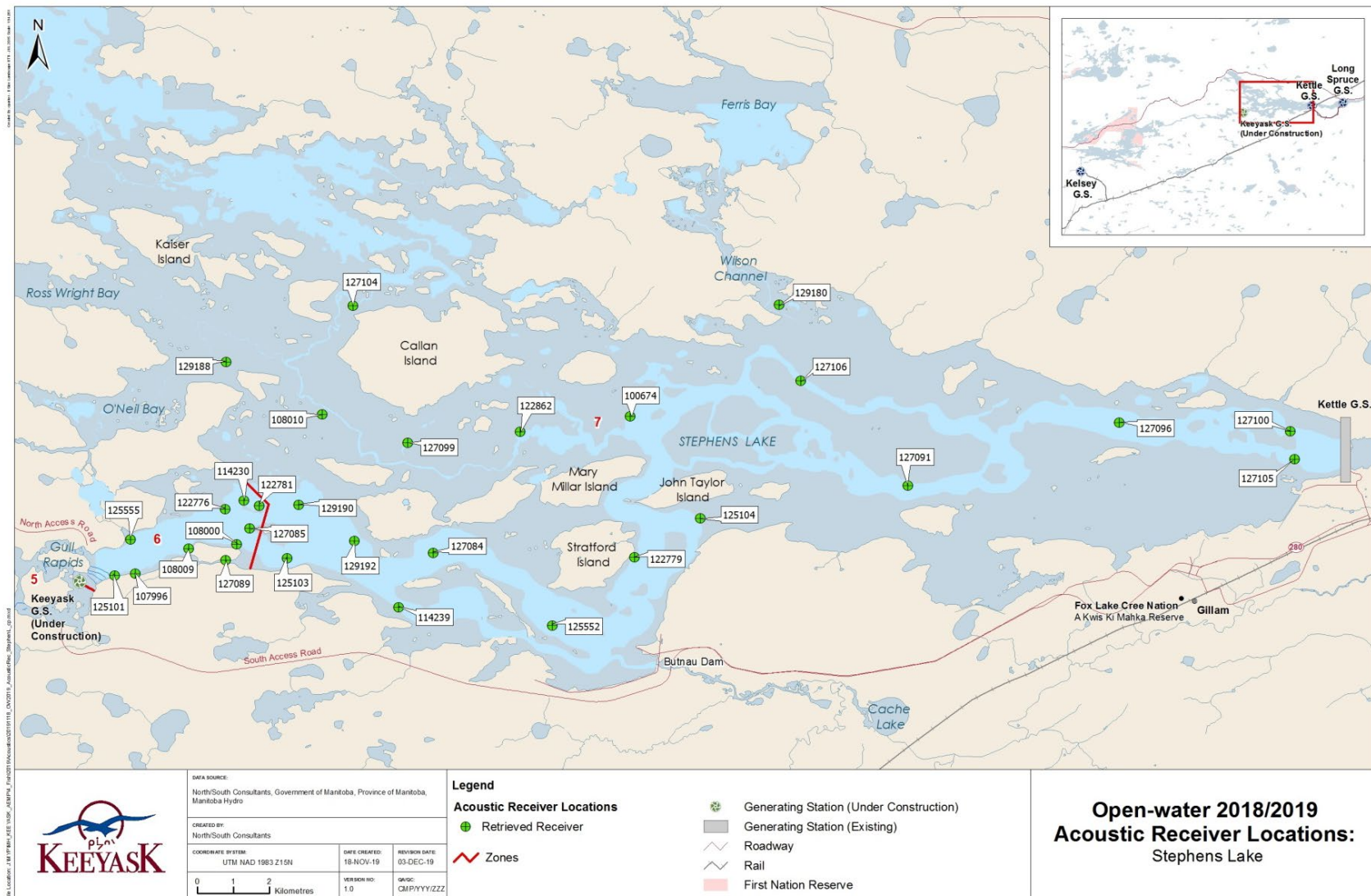
Map 3: Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between October 2018 and June 2019.



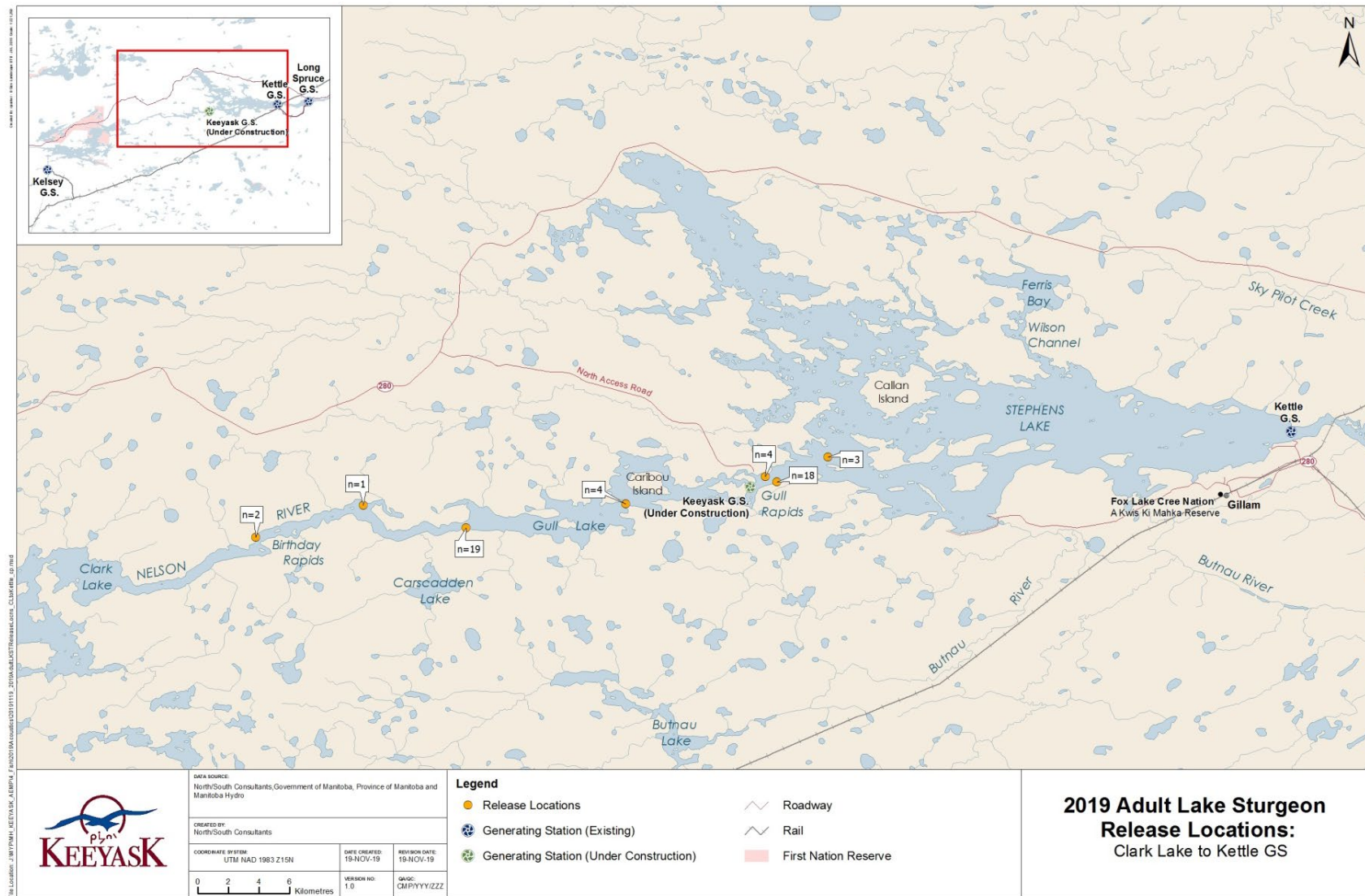
Map 4: Locations of stationary receivers set in Stephens Lake from the Keeyask GS to Kettle GS between October 2018 and June 2019. The former (pre-impoundment) river channel is shown in light blue.



Map 5: Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between June and October 2019. The river is divided into five "zones" based on placement of receiver "gates."



Map 6: Locations of stationary receivers set in Stephens Lake between June and October 2019. The river is divided into two "zones" based on placement of receiver "gates." The pre-impoundment river channel is shown in light blue.



Map 7: Release locations for adult Lake Sturgeon tagged upstream of the Keeyask GS (n = 26) and in Stephens Lake (n = 25) in 2019.

APPENDICES

APPENDIX 1:

DETECTION SUMMARIES FOR LAKE STURGEON TAGGED AND MONITORED BETWEEN 2011 AND 2019

Table A1-1:	Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored upstream of Keeyask GS during the winter 2011/2012 (October 20, 2011 to April 30, 2012), 2012/2013 (October 16, 2012 to April 30, 2013), 2013/2014 (October 16, 2013 to April 30, 2014), 2014/2015 (October 13, 2014 to April 30, 2015), 2015/2016 (October 12, 2015 to April 30, 2016), 2016/2017 (October 20, 2015 to April 30, 2017), 2017/2018 (October 17, 2017 to April 30, 2018), and 2018/2019 (October 11, 2018 to April 30, 2019) periods.....	75
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Table A1-1: Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored upstream of Keeyask GS during the winter 2011/2012 (October 20, 2011 to April 30, 2012), 2012/2013 (October 16, 2012 to April 30, 2013), 2013/2014 (October 16, 2013 to April 30, 2014), 2014/2015 (October 13, 2014 to April 30, 2015), 2015/2016 (October 12, 2015 to April 30, 2016), 2016/2017 (October 20, 2015 to April 30, 2017), 2017/2018 (October 17, 2017 to April 30, 2018), and 2018/2019 (October 11, 2018 to April 30, 2019) periods. Tag id highlighted yellow = lost tags. Tag id highlighted purple = moved downstream through Gull Rapids/the Keeyask GS.

Tag ID	2011/2012			2012/2013			2013/2014			2014/2015			2015/2016			2016/2017			2017/2018			2018/2019				
	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
16026	0	-	-	0	-	-	0	-	-	0	-	-	811	3	0.0	0	-	-	0	-	-	0	-	-	-	-
16036	2537	118	3.0	43	12	0.0	2326	52	0.0	362	16	0.0	4663	44	0.0	19532	105	0.0	716	32	2.1	1515	19	-12.4	-12.4	0.0
16039	0	-	-	0	-	-	502	10	3.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16042	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16045	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16048	0	-	-	0	-	-	2932	66	0.0	0	-	-	11672	60	13.3	28566	172	8.7	43161	190	5.1	39113	195.0	5.2	10.3	5.1
16051	2475	51	0.0	7088	93	0.0	14618	92	3.0	0	-	-	13958	92	3.0	8873	101	0.0	18985	112	0.0	0	-	-	-	-
16054	2772	40	5.1	4027	66	0.0	10807	83	3.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16055	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16056	8711	176	0.0	1893	63	0.0	13493	87	0.0	0	-	-	12493	70	0.0	6661	102	0.0	16905	103	0.0	0	-	-	-	-
16057	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16058	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16059	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16060	11406	138	0.0	4354	75	0.0	25171	137	0.0	0	-	-	12623	76	0.0	8361	82	2.7	281	5	4.2	14080	125.0	5.2	7.9	2.7
16061	13225	94	4.3	1157	71	0.0	18018	115	0.0	140	11	0.0	16584	98	0.0	911	26	0.0	2403	34	2.1	0	-	-	-	-
16062	5943	148	0.0	2495	48	0.0	9079	120	0.0	0	-	-	12485	88	0.0	12753	107	0.0	17968	107	0.0	0	-	-	-	-
16063	7905	134	5.1	3650	60	0.0	6098	84	0.0	739	10	0.0	17893	101	0.0	14630	106	0.0	12976	80	2.1	2127	21	-12.4	-12.4	0.0
16064	6717	139	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16065	3485	129	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16066	0	-	-	0	-	-	0	-	-	0	-	-	12928	84	0.0	0	-	-	0	-	-	0	-	-	-	-
16067	4542	149	3.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16068	272	15	3.0	5623	73	0.0	22744	129	0.0	0	-	-	32671	142	0.0	17400	106	0.0	20418	116	0.0	0	-	-	-	-
16069	0	-	-	0	-	-	678	4	0.0	0	-	-	20	2	0.0	0	-	-	0	-	-	0	-	-	-	-
16070	12833	184	0.0	2	1	0.0	33086	118	0.0	0	-	-	2	1	0.0	23	6	0.0	144	14	2.1	2024	53	-12.4	-12.4	0.0
16071	7247	122	0.0	2351	38	0.0	11439	95	0.0	0	-	-	21854	118	0.0	7883	102	0.0	18505	100	0.0	0	-	-	-	-
16072	11220	174	0.0	11687	96	0.0	27653	142	3.0	958	5	0.0	10157	74	0.0	17250	108	0.0	22681	115	0.0	0	-	-	-	-
16073	2647	51	3.0	3284	66	0.0	1213	18	0.0	800	6	3.4	761	17	0.0	170	15	0.0	1629	83	0.0	4	2	-12.4	-12.4	0.0
16074	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16075	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16076	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	11940	102	0	51871	187	5.1	53681	200	5.2	10.3	5.1
16077	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
32174	-	-	-	-	-	-	-	-	-	0	-	-	988	36	0.0	0	-	-	0	-	-	0	-	-	-	-
32175	-	-	-	-	-	-	-	-	-	0	-	-	0	-	-	6228	75	0	7739	101	0.0	0	-	-	-	-
32176	-	-	-	-	-	-	-	-	-	0	-	-	13046	87	0.0	13507	103	0.0	25715	118	0.0	0	-	-	-	-
32177	-	-	-	-	-	-	-	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-

Table A1-2: Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored in Stephens Lake during the winter 2011/2012 (October 20, 2011 to April 30, 2012), 2012/2013 (October 16, 2012 to April 30, 2013), 2013/2014 (October 16, 2013 to April 30, 2014), 2014/2015 (October 13, 2014 to April 30, 2015), 2015/2016 (October 12, 2015 to April 30, 2016), 2016/2017 (October 20, 2015 to April 30, 2017), 2017/2018 (October 17, 2017 to April 30, 2018), and 2018/2019 (October 11, 2018 to April 30, 2019) periods. Tag id highlighted green = moved upstream over Gull Rapids and harvested. Tag id highlighted blue = moved upstream over Gull Rapids. Tag id highlighted yellow = lost tags. Tag id highlighted red = moved downstream through Kettle GS. Tag id highlighted purple = moved downstream through Gull Rapids/the Keeyask GS. Tag id highlighted orange = moved downstream through Long Spruce GS.

Tag ID	2011/2012			2012/2013			2013/2014			2014/2015			2015/2016			2016/2017			2017/2018			2018/2019				
	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
16018	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16019	0	-	-	887	39	0.6	2959	33	8.8	8761	79	2.8	14035	107	13.3	34307	144	8.7	49386	193	8.7	46504	201	13.9	13.9	0.0
16020	0	-	-	3625	25	9.5	24335	102	8.8	6183	36	7.2	36598	188	7.2	40522	181	8.7	43215	188	8.7	42253	177	5.2	13.9	8.7
16021	16475	79	29.2	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16022	0	-	-	1227	15	9.5	7508	83	4.1	10649	55	7.2	45870	197	7.2	21329	149	5.1	32696	193	5.1	51590	195	5.2	10.3	5.1
16024	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16025	0	-	-	1974	47	0.0	20670	114	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16027	0	-	-	3398	70	4.3	2111	24	1.6	23369	120	2.8	50070	189	13.3	17718	175	4.2	32484	177	5.1	35350	188	5.2	10.3	5.1
16028	0	-	-	733	7	9.5	2123	8	14.9	21803	84	2.8	59177	199	2.5	5377	104	5.1	52456	184	5.1	79145	202	10.3	10.3	0.0
16029	1937	39	9.7	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	16781	85	0.0	0	-	-	-	-
16030	12583	70	3.9	13733	89	4.3	2887	63	8.8	8872	97	7.2	24440	160	7.2	29177	156	4.2	49491	192	5.1	461	5	5.2	10.3	5.1
16031	0	-	-	7414	26	3.8	45513	147	0.0	36654	117	0.0	58954	198	0.0	537	26	0.0	40104	140	6.5	14016	92	10.3	13.9	3.6
16032	48676	67	3.1	2284	23	2.4	3780	48	8.8	4759	53	2.5	36289	190	4.7	39506	164	6.0	2367	21	8.7	7144	51	5.2	13.9	8.7
16033	125	3	2.3	-	-	-	-	-	-	-	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16033b	-	-	-	-	-	-	15689	104	7.3	3243	42	7.2	34665	149	7.2	17885	68	5.1	0	-	-	0	-	-	-	-
16034	39927	61	20.2	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16035	7225	84	3.1	22099	113	2.4	29174	179	12.6	14317	83	2.8	60418	202	7.2	26922	190	4.2	43778	194	5.1	0	-	-	-	-
16037	36948	77	3.9	991	18	4.3	24601	133	3.0	10762	61	2.8	4277	21	2.5	1551	17	8.7	0	-	-	16566	107	5.2	7.9	2.7
16038	14187	69	10.5	9	2	0.0	106	8	0.0	4	2	0.0	0	-	-	0	-	-	11575	61	0.0	26037	95	-12.4	-12.4	0.0
16040	18814	85	3.9	23113	104	2.4	4436	21	12.6	5033	26	2.5	29413	189	2.5	39264	189	4.2	38059	189	4.2	30871	110	5.2	10.3	5.1
16041	135	11	0.0	4328	25	3.8	16656	153	4.1	16912	74	2.5	30740	174	0.0	22473	119	6.0	48061	196	5.1	7027	121	10.3	13.9	3.6
16043	6989	49	17.1	10520	95	16.0	16074	114	10.8	36372	188	10.8	17192	188	13.3	10142	166	13.4	18030	176	6.5	11163	81	10.3	16.8	6.5
16044	9036	57	21.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16046	6972	85	3.1	248	25	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16047	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16049	20859	75	3.9	32364	157	4.3	24241	140	8.8	9993	101	2.8	18078	144	7.2	31523	176	8.7	16474	90	5.1	60739	199	5.2	10.3	5.1
16050	345	3	0.0	18070	65	3.8	2920	50	10.8	8473	55	6.1	44567	169	4.7	23677	172	0.0	14296	93	6.5	37082	155	13.9	13.9	0.0
16052	143	4	9.6	6505	78	7.6	34688	173	0.0	18189	165	11.0	49267	186	13.3	13313	124	0.0	4096	69	3.6	7370	89	5.2	13.9	8.7
16053	2960	31	3.1	776	10	11.4	2209	20	14.9	7018	46	2.5	68422	200	2.5	26653	140	4.5	49211	184	5.1	26479	180	7.9	13.9	6.0
32167	-	-	-	-	-	-	-	-	-	293	14	0.0	37839	187	7.2	30174	143	6.0	38220	144	8.9	27516	128	5.2	13.9	8.7
32168	-	-	-	-	-	-	-	-	-	19931	142	13.3	47809	189	2.5	24622	74	8.7	22658	121	4.2	63772	194	5.2	13.9	8.7
32169	-	-	-	-	-	-	-	-	-	444	6	2.5	51598	201	7.2	4141	22	8.7	42584	165	8.7	0	-	-	-	-
32170	-	-	-	-	-	-	-	-	-	3328	69	2.8	0	-	-	47	2	2.7	0	-	-	0	-	-	-	-
32171	-	-	-	-	-	-	-	-	-	3275	24	13.3	53443	182	7.2	30627	156	5.1	65428	196	5.1	27162	176	5.2	10.3	5.1
32172	-	-	-	-	-	-	-	-	-	8293	37	11.0	1455	13	7.2	9761	68	2.7	17548	93	2.7	0	-	-	-	-
32173	-	-	-	-	-	-	-	-	-	3843	49	2.5	45871	157	2.5	46475	145	4.2	4357	69	4.2	15813	75	5.2	9.4	4.2

Table A1-3: Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored upstream of Keeyask GS during the open-water 2011 (June 1 to October 20), 2012 (May 1 to October 16), 2013 (May 1 to October 16), 2014 (May 1 to October 13), 2015 (May 1 to October 11), 2016 (May 1 to October 19), 2017 (May 1 to October 16), 2018 (May 1 to October 10), and 2019 (May 1 to October 7) periods. Tag id highlighted yellow = lost tags. Tag id highlighted purple = moved downstream through Gull Rapids/the Keeyask GS.

Tag ID	2011			2012			2013			2014			2015			2016			2017			2018			2019					
	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	
16026	-	-	-	23195	83	9.4	12588	83	0.0	13090	103	0.0	29896	103	7.3	28343	128	7.3	18137	119	14.6	29052	129	7.3	15615	107	-29.4	-24.7	4.7	
16036	2152	32	8.6	6980	86	9.4	5328	82	8.1	12362	112	10.0	20379	132	9.6	16678	140	10.2	11145	102	12.1	9722	90	14.7	13154	121	-19.5	-5.8	13.7	
16039	2260	42	13.3	5250	66	12.5	16487	107	11.3	12670	120	11.6	18372	119	10.5	15797	120	13.7	17882	110	13.7	23403	134	14.7	16641	116	-19.5	-4.8	14.7	
16042	1914	54	0.0	576	11	0.8	2626	30	3.4	6660	54	3.9	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16045	786	13	7.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16048	383	6	1.6	1773	37	0.8	10796	119	21.6	7527	93	21.7	20784	116	36.9	14738	108	22.3	15301	109	17.4	22386	128	23.5	27308	128	0.6	13.9	13.3	
16051	1935	76	8.7	5804	105	15.3	8015	115	13.4	10404	57	13.7	10706	126	26.5	8157	96	13.7	8451	85	11.6	15291	135	14.7	9992	112	-24.7	-4.8	19.9	
16054	2697	49	12.0	4278	101	10.6	11062	105	9.5	7102	93	12.1	17220	90	38.7	9099	114	23.9	5602	33	21.7	14850	85	21.7	4142	30	-46.9	-26.5	20.4	
16055	1140	9	3.4	1384	27	5.7	8271	89	4.9	7657	86	10.0	5005	104	5.5	12401	92	5.5	8824	108	13.7	9709	88	7.6	15077	127	-12.5	-7.4	5.1	
16056	234	12	19.1	4665	87	10.6	12862	96	19.5	17163	115	10.0	18319	113	20.4	29142	135	23.6	16839	88	20.1	14370	110	29.0	8398	87	-29.4	-9.3	20.1	
16057	475	25	4.2	524	29	8.5	0	-	-	2	1	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16058	549	16	9.3	1071	4	9.7	0	-	-	0	-	-	0	-	-	418	13	3.9	1169	38	3.9	544	18	3.7	2030	90	-48.2	-44.3	3.9	
16059	599	5	3.4	1696	32	10.4	13935	78	11.3	10991	57	5.1	4708	85	13.7	7570	59	3.5	6223	64	4.3	2903	91	14.7	14404	121	-10.2	-4.8	5.4	
16060	1759	43	7.1	4065	95	8.7	16366	124	7.1	13228	108	7.1	19911	115	7.4	8653	73	28.5	18575	115	11.8	12355	55	8.2	19060	132	0.6	13.9	13.3	
16061	711	37	2.4	4444	108	13.6	11503	114	5.5	7437	95	3.4	13771	111	13.7	15840	120	13.7	8642	79	13.7	11533	87	14.7	11202	107	-12.9	-4.8	8.1	
16062	142	14	8.6	5624	86	12.4	16854	109	24.4	18336	129	7.9	19949	120	10.0	26029	145	10.0	18277	117	13.7	18684	137	24.6	15990	111	-17.4	-5.8	11.6	
16063	2617	59	10.4	9474	105	5.7	21588	126	9.3	23121	127	7.9	24981	137	10.0	28915	163	10.0	24788	121	10.0	14228	115	14.7	4478	36	-46.9	-9.3	37.6	
16064	1910	27	19.1	573	26	1.2	0	-	-	0	-	-	0	-	-	5	2	0.0	0	-	-	0	-	-	0	-	-	-	-	-
16065	931	36	4.5	6192	109	17.9	2581	38	5.1	3101	38	5.1	14349	104	28.0	7730	73	4.3	3061	62	13.7	4711	71	5.4	3448	90	-19.5	-4.8	14.7	
16066	772	39	1.8	4615	105	10.6	2322	36	8.1	8898	73	12.1	1884	20	7.9	6940	104	13.7	10910	94	6.1	10160	115	12.6	13197	127	-12.9	-4.8	8.1	
16067	1640	34	1.6	2516	39	31.7	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	19167	114	38.3	2314	23	-46.9	-12.4	34.5	
16068	1046	27	2.4	5882	105	10.6	10402	111	23.9	13158	121	10.0	16490	123	10.0	20273	135	13.7	13842	118	10.0	12545	121	16.6	3126	89	-32.3	-9.9	22.4	
16069	0	-	-	17495	85	4.5	13288	100	7.3	14172	66	2.9	8287	80	10.0	24559	122	5.1	18718	92	7.3	19345	102	2.9	12791	93	-29.4	-26.5	2.9	
16070	1080	40	8.6	14691	106	17.0	7943	89	9.6	9967	83	9.6	12593	101	10.0	4083	80	13.7	3202	80	10.0	4014	78	14.7	5686	83	-19.5	-4.8	14.7	
16071	1403	43	8.6	9124	89	10.6	11285	130	9.3	17413	102	12.1	39272	131	13.7	37521	151	9.9	31215	124	13.7	21205	139	11.6	16737	122	-19.5	-4.8	14.7	
16072	2839	58	12.9	4031	91	10.6	16638	129	19.5	19306	112	7.9	15866	127	10.0	6608	129	10.0	16299	127	3.3	10676	115	22.4	8895	114	-12.9	-9.9	3.0	
16073	1025	35	2.4	4432	102	12.4	6885	94	9.3	13884	127	10.0	4500	73	13.7	25145	151	13.7	10316	113	13.7	14231	124	14.7	9649	114	-19.5	-5.8	13.7	
16074	0	-	-	13006	67	4.7	11803	78	2.9	3105	23	7.3	655	13	15.9	2889	25	3.9	2957	24	3.7	3174	20	3.9	7540	77	-48.2	-44.3	3.9	
16075	462	10	6.3	0	-	-	0	-	-	0	-	-	865	35	4.3	0	-	-	0	-	-	61208	134	0.0	61112	137	-5.8	-4.8	1.0	
16076	1040	35	6.3	2225	56	9.4	9270	81	11.3	9075	84	11.6	12474	79	11.6	27013	118	9.0	16851	94	24.0	21817	127	23.5	18015	128	0.6	18.6	18.0	
16077	282	5	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
32174	-	-	-	-	-	-	-	-	-	9705	98	28.5	20042	118	42.4	15062	82	28.9	11336	60	12.7	1751	18	15.6	17944	90	0.6	18.6	18.0	
32175	-	-	-	-	-	-	-	-	-	9186	90	6.0	22601	114	5.3	48213	134	3.4	32547	133	5.3	11208	84	3.6	31761	117	-12.9	-9.3	3.6	
32176	-	-	-	-	-	-	-	-	-	22630	106	11.6	15054	109	26.5	23822	111	7.1	32410	125	7.0	23353	141	10.2	45707	134	-19.5	-4.8	14.7	
32177	-	-	-	-	-	-	-	-	-	20678	109	5.5	265	15	0.6	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
54799	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16229	111	21.7	17416	132	-19.5	-9.9	9.6	

Table A1-4: Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored in Stephens Lake during the open-water 2011 (June 1 to October 20), 2012 (May 1 to October 16), 2013 (May 1 to October 16), 2014 (May 1 to October 13), 2015 (May 1 to October 11), 2016 (May 1 to October 19), 2017 (May 1 to October 16), 2018 (May 1 to October 10), and 2019 (May 1 to October 7) periods. Tag id highlighted green = moved upstream over Gull Rapids and harvested. Tag id highlighted blue = moved upstream over Gull Rapids. Tag id highlighted yellow = lost tags. Tag id highlighted red = moved downstream through Kettle GS. Tag id highlighted purple = moved downstream through Gull Rapids/the Keeyask GS. Tag id highlighted orange = moved downstream through Long Spruce GS.

Tag ID	2011			2012			2013			2014			2015			2016			2017			2018			2019				
	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
16018	0	-	-	341	5	34.5	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16019	0	-	-	9272	70	26.9	15039	116	18.2	13297	76	39.5	20832	129	27.0	17331	117	22.3	18192	117	17.4	19589	99	20.4	17756	128	0.6	24.7	24.1
16020	0	-	-	7450	101	11.9	13664	99	14.2	8592	111	19.7	25808	137	19.7	29291	155	17.4	19304	150	23.5	13674	104	34.9	8865	97	0.6	36.1	35.5
16021	2770	21	14.2	4530	30	5.0	0	-	-	0	-	-	0	-	-	1331	18	1.0	0	-	-	0	-	-	0	-	-	-	-
16022	0	-	-	9845	100	16.0	7248	71	20.5	10957	101	20.5	18858	127	16.1	12608	124	22.3	13393	120	17.4	19908	126	17.4	17340	141	0.6	24.7	24.1
16024	0	-	-	398	9	4.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16025	0	-	-	2316	67	35.2	9668	119	10.2	1572	23	60.4	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16027	0	-	-	8249	87	16.0	15717	109	14.4	10960	72	9.7	14083	114	13.6	22348	148	9.0	22812	125	9.1	14092	119	17.4	16367	142	0.6	10.3	9.7
16028	0	-	-	9063	92	16.3	98	8	3.7	6174	58	17.4	16344	108	17.7	19657	109	12.7	29657	142	15.6	22350	126	17.4	16146	125	0.6	24.7	24.1
16029	3801	62	58.1	6087	102	19.9	4940	83	10.2	13325	102	16.0	8716	94	10.2	5821	101	20.1	12873	85	10.2	4030	80	10.2	3475	56	-19.5	-9.3	10.2
16030	7733	86	15.5	6414	86	14.4	13494	86	25.5	16498	104	27.4	15935	94	17.7	10843	118	34.9	16302	127	34.9	18034	120	17.4	21071	113	0.6	18.6	18.0
16031	0	-	-	12814	104	16.3	10315	106	14.4	12775	99	13.6	17780	125	13.6	18745	141	15.6	14795	131	12.7	19537	128	17.4	10698	123	0.6	18.6	18.0
16032	5801	56	14.2	13833	120	16.0	17055	115	19.7	16765	118	18.2	11985	106	16.1	18322	116	17.5	29122	157	17.4	23612	107	15.6	0	-	-	-	-
16033	5144	44	14.2	3001	43	37.5	0	-	-	-	-	-	-	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16033b	-	-	-	-	-	-	3505	30	12.4	13578	101	17.4	28621	127	16.1	21058	118	17.4	27766	127	12.7	20613	108	9.1	26564	129	0.6	10.3	9.7
16034	15378	75	11.2	15394	61	2.2	38582	117	0.8	25117	99	4.8	30925	119	0.8	10170	70	15.9	13	2	0.0	0	-	0.0	0	-	-	-	-
16035	1547	12	10.9	8767	91	14.4	19324	116	20.3	16298	121	19.7	23142	119	17.7	19523	133	23.5	27311	149	17.4	6244	35	39.6	0	-	-	-	-
16037	8375	50	7.4	13685	108	11.9	21481	125	44.3	13636	91	47.2	17230	113	16.1	13411	89	17.4	15203	109	17.4	19431	114	15.6	18611	126	1.2	18.6	17.4
16038	5777	45	11.2	3402	87	31.0	7973	124	9.3	3975	76	10.0	10827	75	12.1	15190	103	10.0	13109	131	10.2	12193	97	19.5	10310	99	-19.5	-5.8	13.7
16040	9602	70	12.5	8598	109	12.0	21959	128	18.0	4833	62	18.2	15041	122	19.7	15740	117	17.4	12642	92	17.4	16018	114	17.4	13386	90	0.6	18.6	18.0
16041	15169	88	11.2	9437	81	40.7	8915	81	14.4	13556	111	14.4	15807	101	16.1	14398	113	13.7	20805	136	17.4	19091	126	17.4	12752	115	0.6	18.6	18.0
16043	20429	92	15.5	13049	98	11.9	12476	115	14.4	13303	118	15.8	20525	131	17.7	22234	122	13.7	18103	135	17.4	13235	102	17.4	23678	143	0.6	18.6	18.0
16044	1582	36	8.7	3932	53	11.9	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16046	8350	72	24.7	199	68	23.5	360	10	7.2	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16047	131	2	19.7	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16049	1919	12	11.2	11705	102	26.9	24320	123	27.7	11319	83	27.4	20752	132	16.1	16056	127	22.3	22073	140	39.7	23304	115	39.7	21421	149	0.6	40.9	40.3
16050	6519	57	15.5	7755	85	11.9	14411	88	14.2	7019	69	19.7	13783	98	13.6	17742	93	13.7	18778	72	12.7	12123	103	17.4	14718	124	0.6	13.9	13.3
16052	1920	17	11.2	4785	80	16.0	9791	65	20.5	8323	68	19.7	10937	96	17.4	13008	113	17.4	19047	127	17.4	14140	110	15.6	11608	122	0.6	16.8	16.2
16053	2740	18	12.5	13416	114	16.0	17049	126	18.2	13586	95	20.5	26058	130	16.1	29704	139	15.6	27363	150	12.7	29144	145	12.7	16622	138	0.6	13.9	13.3
32167	-	-	-	-	-	-	-	-	-	10421	91	20.5	33420	126	16.1	26260	130	22.3	27586	142	17.4	24579	138	17.4	12795	107	0.6	24.7	24.1
32168	-	-	-	-	-	-	-	-	-	18169	100	20.5	34961	140	16.1	27764	134	22.3	35684	132	17.4	26784	129	17.4	28311	138	1.2	24.7	23.5
32169	-	-	-	-	-	-	-	-	-	614	20	2.4	24873	131	15.2	26025	131	17.4	24410	124	17.4	16832	100	17.4	22173	118	0.6	18.6	18.0
32170	-	-	-	-	-	-	-	-	-	5151	77	20.5	17310	127	16.1	13320	103	17.4	0	-	-	0	-	-	0	-	-	-	-
32171	-	-	-	-	-	-	-	-	-	36691	103	17.4	22567	111	16.1	27226	134	17.4	26214	120	12.7	34797	129	17.4	28597	138	0.6	10.3	9.7
32172	-	-	-	-	-	-	-	-	-	19105	86	9.7	17221	108	9.7	19907	110	13.7	23914	93	8.2	18285	92	9.1	23516	110	0.6	13.9	13.3
32173	-	-	-	-	-	-	-	-	-	24278	103	9.7	28920	117	9.7	26056	107	9.1	32014	127	9.1	36522	119	9.1	33008	128	0.6	10.3	9.7

Table A1-5: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored upstream of the Keeyask GS during the 2019 open-water period (June 1 to October 7).

Tag ID	Date Tagged	n	Potential Detection Days	# Days Detected	% of Potential Detection Days	U/S (rkm)	D/S (rkm)	Range (rkm)
7017	08-Jun-19	10934	121	113	93.4	-46.9	-9.9	37
7018	05-Jun-19	8505	124	88	71.0	-46.9	-9.9	37
7019	05-Jun-19	9944	124	102	82.3	-19.5	-7.4	12.1
7020	09-Jun-19	11960	120	94	78.3	-24.7	-4.8	19.9
7021	06-Jun-19	7937	123	51	41.5	-33.8	-26.5	7.3
7022	07-Jun-19	22714	122	105	86.1	-33.8	-24.7	9.1
7023	08-Jun-19	7212	121	82	67.8	-33.8	-9.9	23.9
7024	08-Jun-19	6599	121	80	66.1	-33.8	-9.9	23.9
7025	07-Jun-19	17574	122	114	93.4	-46.9	-9.9	37
7026	09-Jun-19	6780	120	46	38.3	-46.9	-9.9	37
7027	09-Jun-19	10611	120	112	93.3	-19.5	-9.9	9.6
7028	08-Jun-19	18216	121	108	89.3	-19.5	-9.9	9.6
7029	09-Jun-19	7705	120	94	78.3	-19.5	-9.9	9.6
7030	09-Jun-19	6345	120	100	83.3	-19.5	-9.9	9.6
7031	08-Jun-19	18594	121	117	96.7	-19.5	-4.8	14.7
7032	09-Jun-19	9883	120	114	95.0	-19.5	-4.8	14.7
7033	05-Jun-19	18839	124	116	93.5	-12.5	-4.8	7.7
7034	05-Jun-19	13573	124	98	79.0	-29.4	-4.8	24.6
7053	25-May-19	8500	135	106	78.5	-19.5	-9.9	9.6
7056	25-May-19	4253	135	89	65.9	-19.5	-9.3	10.2
7059	25-May-19	9639	135	97	71.9	-19.5	-9.3	10.2
7061	05-Jun-19	12007	124	93	75.0	-29.4	-4.8	24.6
7064	29-May-19	13665	131	104	79.4	-33.8	-9.9	23.9
7065	28-May-19	7891	132	107	81.1	-24.7	-9.9	14.8
7066	29-May-19	12321	131	108	82.4	-19.5	-9.3	10.2
7067	29-May-19	8705	131	109	83.2	-19.5	-5.8	13.7

Table A1-6: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored in Stephens Lake during the 2019 open-water period (June 1 to October 7).

Tag ID	Date Tagged	n	Potential Detection Days	# Days Detected	% of Potential Detection Days	U/S (rkm)	D/S (rkm)	Range (rkm)
7035	31-May-19	19933	129	119	92.2	0.6	10.3	9.7
7036	31-May-19	19903	129	109	84.5	0.6	10.3	9.7
7037	31-May-19	21304	129	127	98.4	1.2	18.6	17.4
7038	31-May-19	12726	129	78	60.5	0.6	10.3	9.7
7039	03-Jun-19	10752	126	109	86.5	0.6	18.6	18
7040	03-Jun-19	5823	126	89	70.6	0.6	18.6	18
7041	31-May-19	20381	129	108	83.7	0.6	18.6	18
7042	03-Jun-19	18735	126	119	94.4	0.6	18.6	18
7043	15-Sep-19	3795	22	22	100.0	3.9	18.6	14.7
7044	31-May-19	10107	129	94	72.9	0.6	18.6	18
7045	12-Sep-19	5079	25	23	92.0	0.6	13.9	13.3
7046	14-Sep-19	4188	23	22	95.7	1.2	7.9	6.7
7047	31-May-19	11770	129	101	78.3	1.2	13.9	12.7
7048	03-Jun-19	19411	126	107	84.9	1.2	13.9	12.7
7049	03-Jun-19	17017	126	113	89.7	0.6	18.6	18
7050	01-Jun-19	20573	128	116	90.6	0.6	13	12.4
7051	03-Jun-19	13163	126	108	85.7	0.6	18.6	18
7052	03-Jun-19	16243	126	106	84.1	0.6	24.7	24.1
7054	03-Jun-19	30588	126	96	76.2	0.6	18.6	18
7055	01-Jun-19	18411	128	112	87.5	0.6	10.3	9.7
7057	03-Jun-19	27099	126	110	87.3	0.6	10.3	9.7
7058	03-Jun-19	13394	126	113	89.7	0.6	18.6	18
7060	03-Jun-19	16679	126	120	95.2	0.6	10.3	9.7
7062	03-Jun-19	27646	126	122	96.8	0.6	10.3	9.7
7063	03-Jun-19	27802	126	111	88.1	0.6	10.3	9.7

APPENDIX 2:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, UPSTREAM OF THE KEEYASKGS, JUNE 2011 TO OCTOBER 2019

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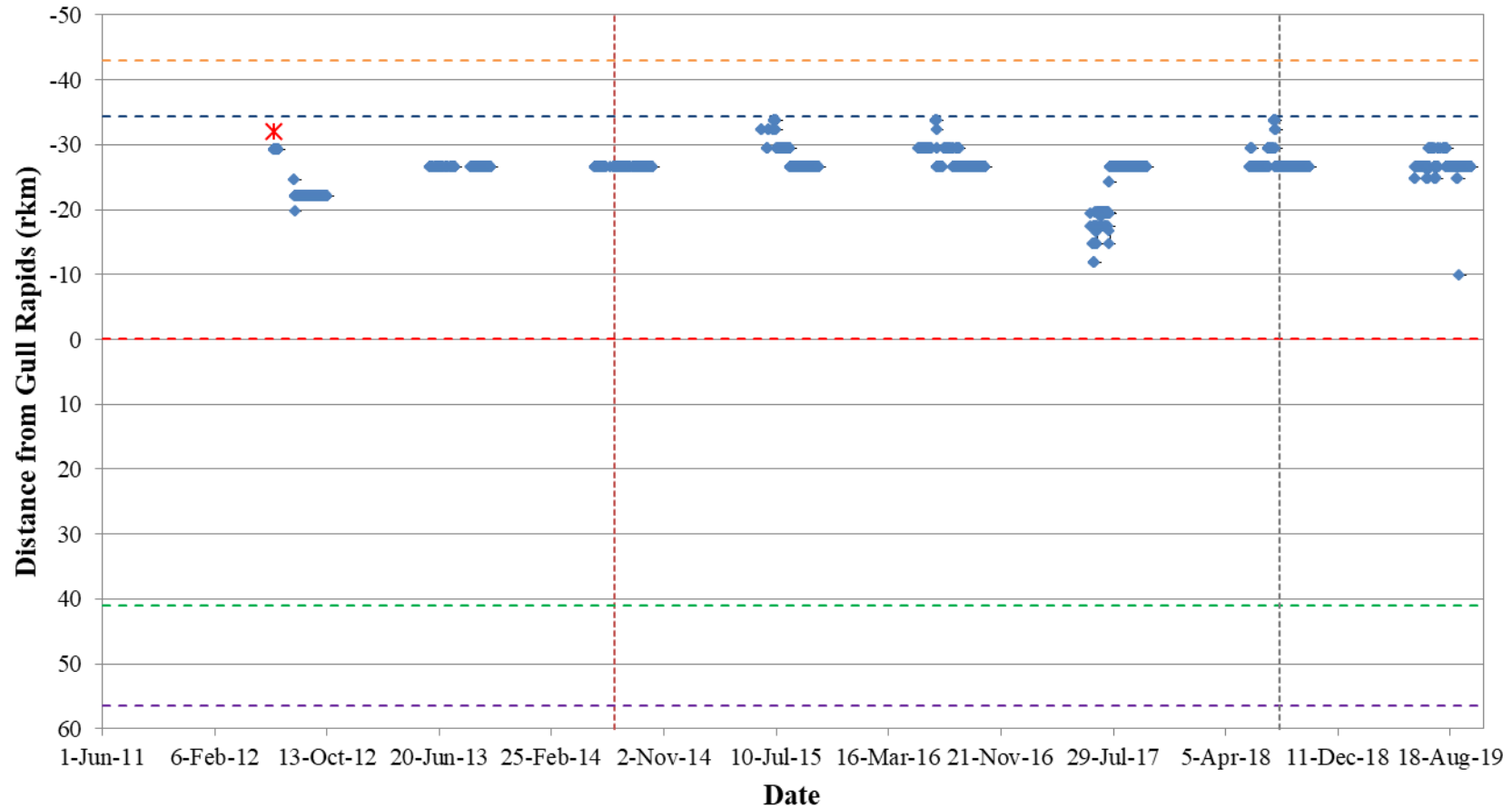


Figure A2-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16026) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

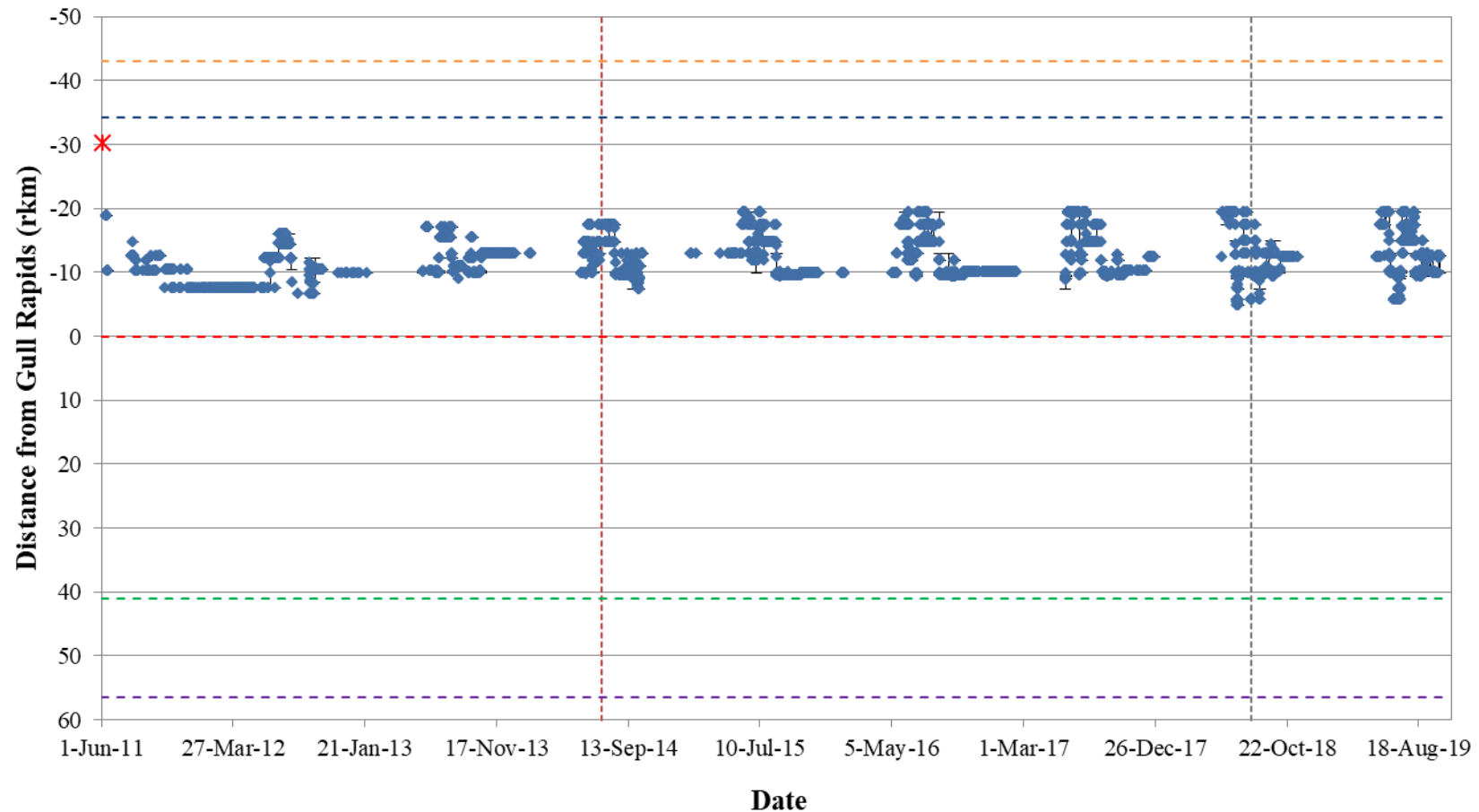


Figure A2-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16036) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

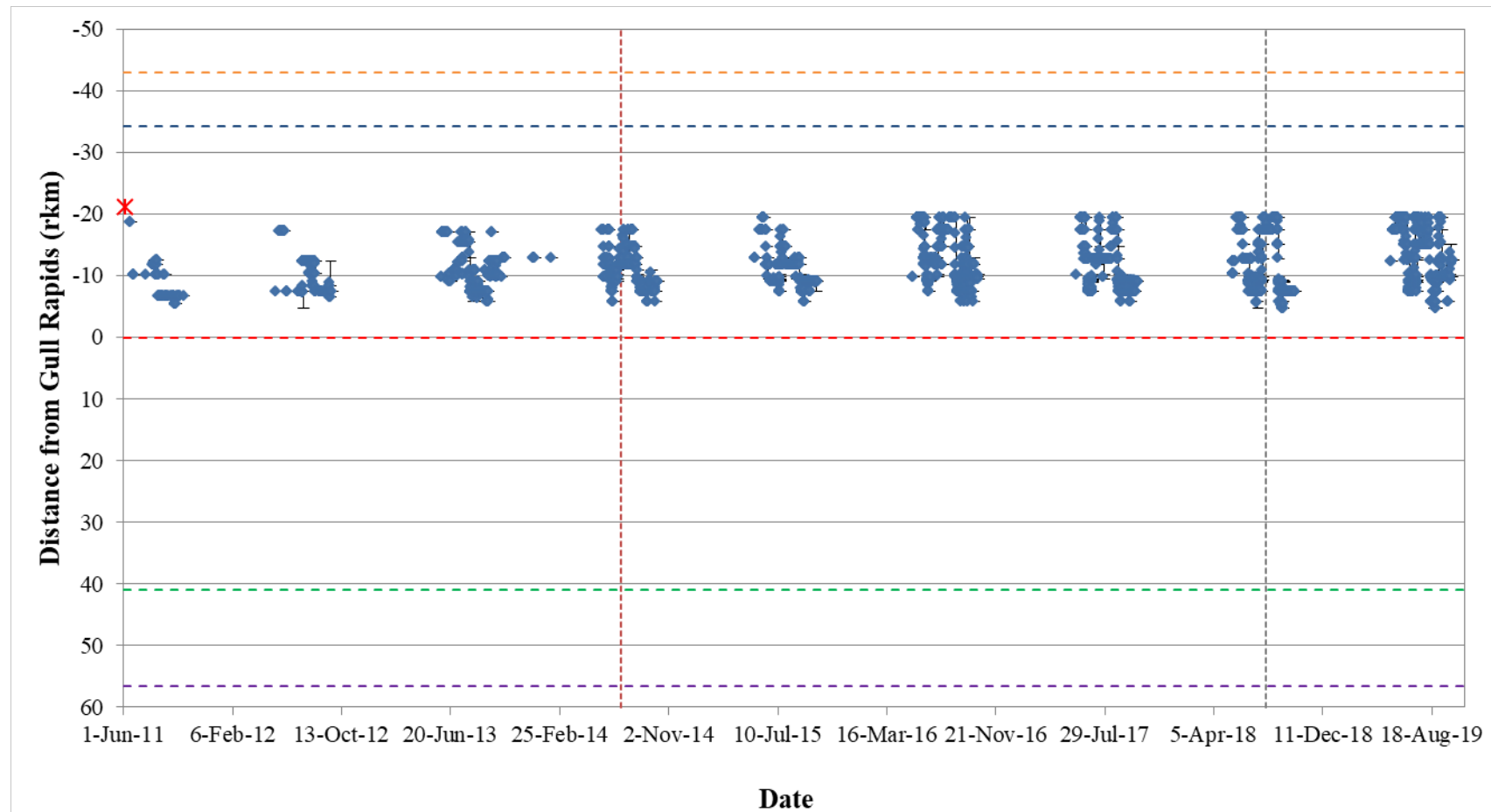


Figure A2-3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16039) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

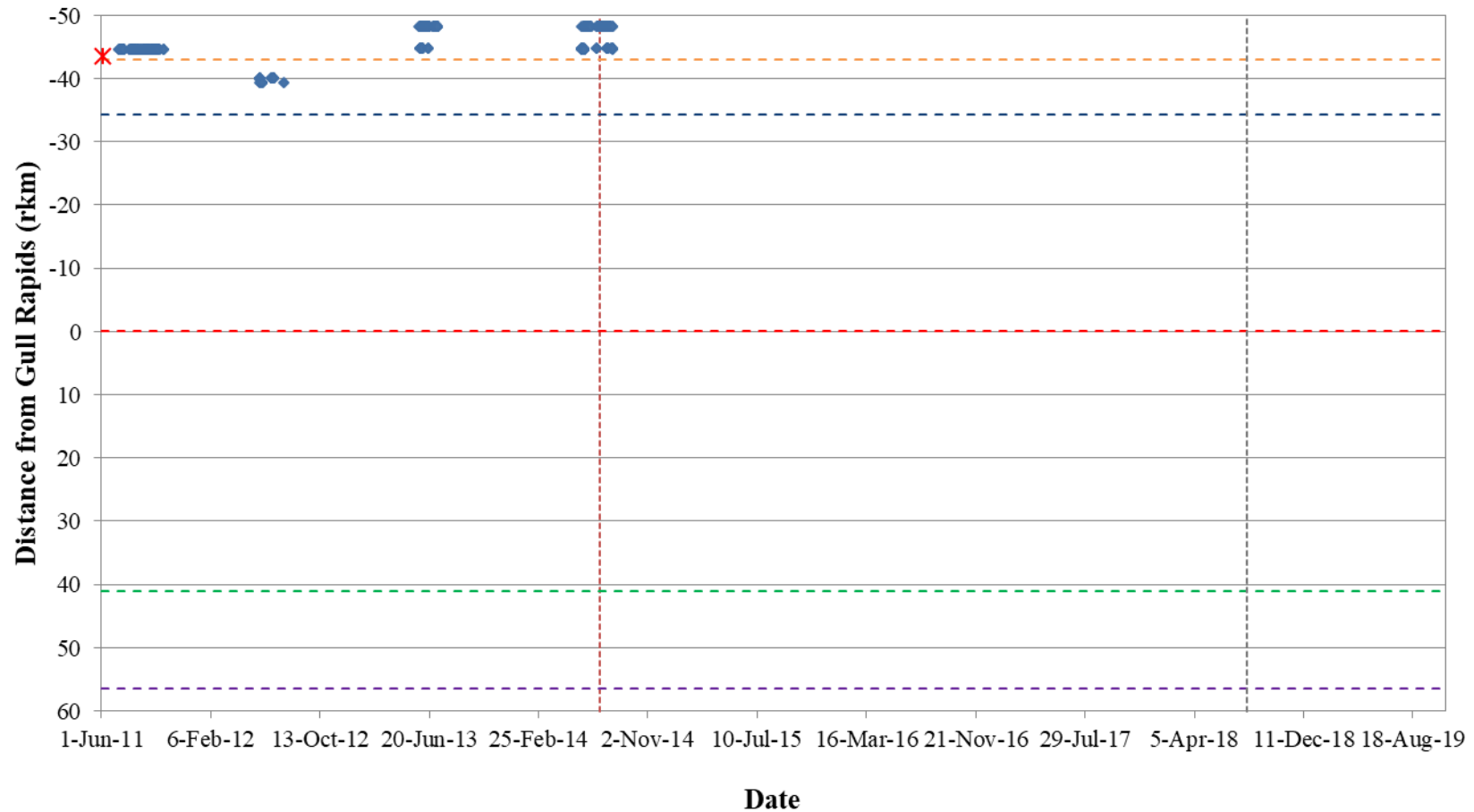


Figure A2-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16042) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

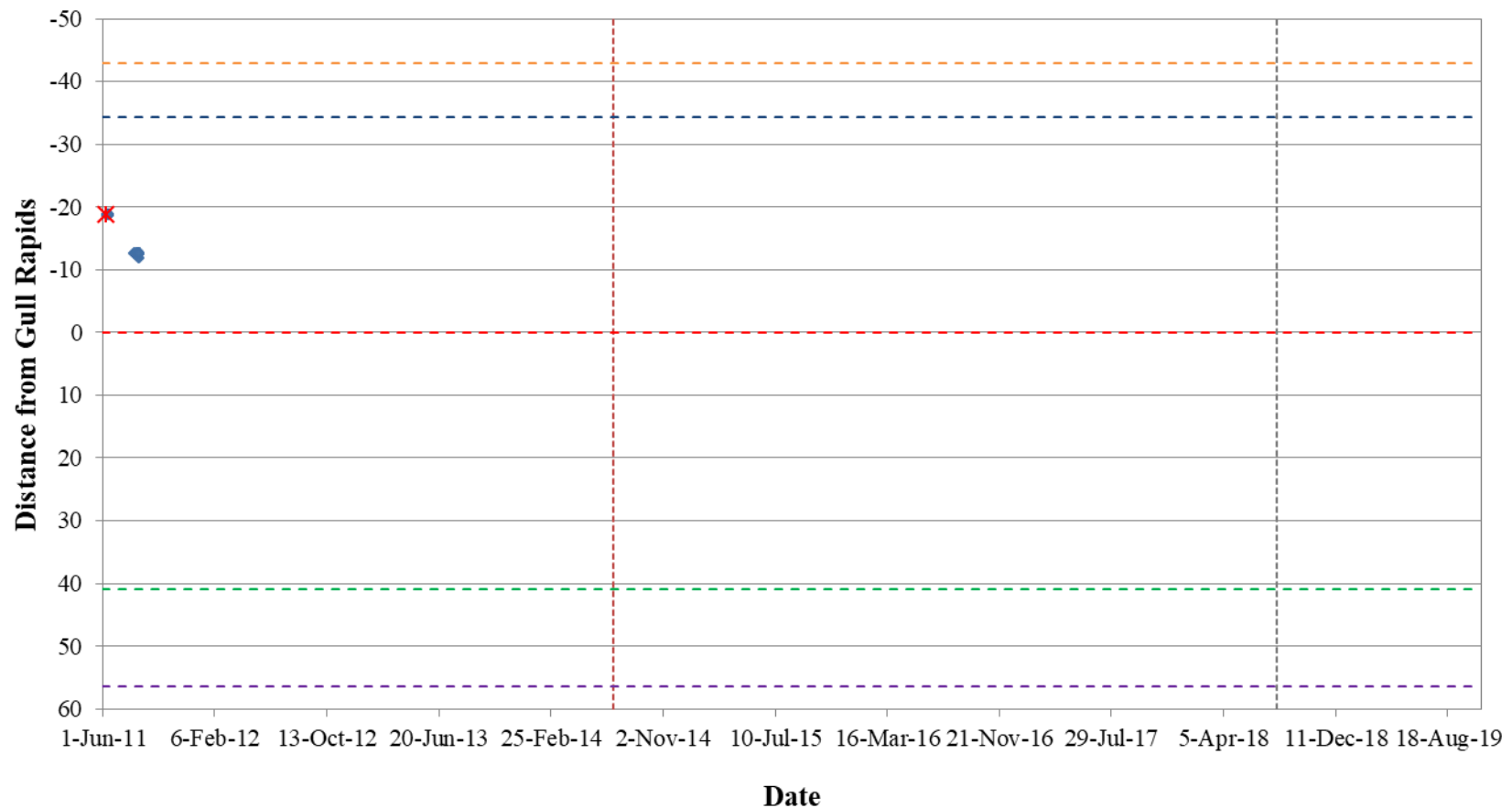


Figure A2-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16045) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

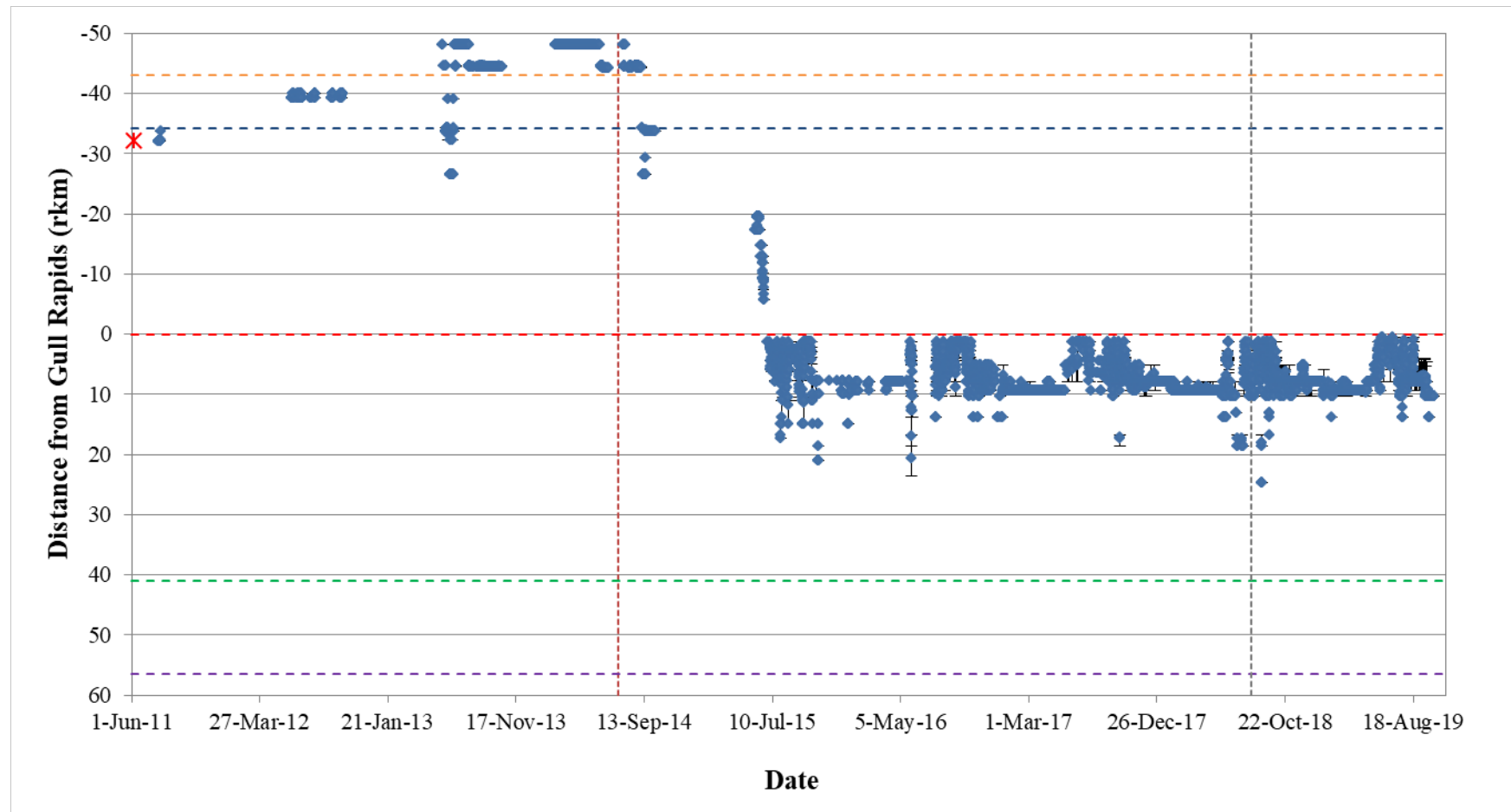


Figure A2-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16048) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

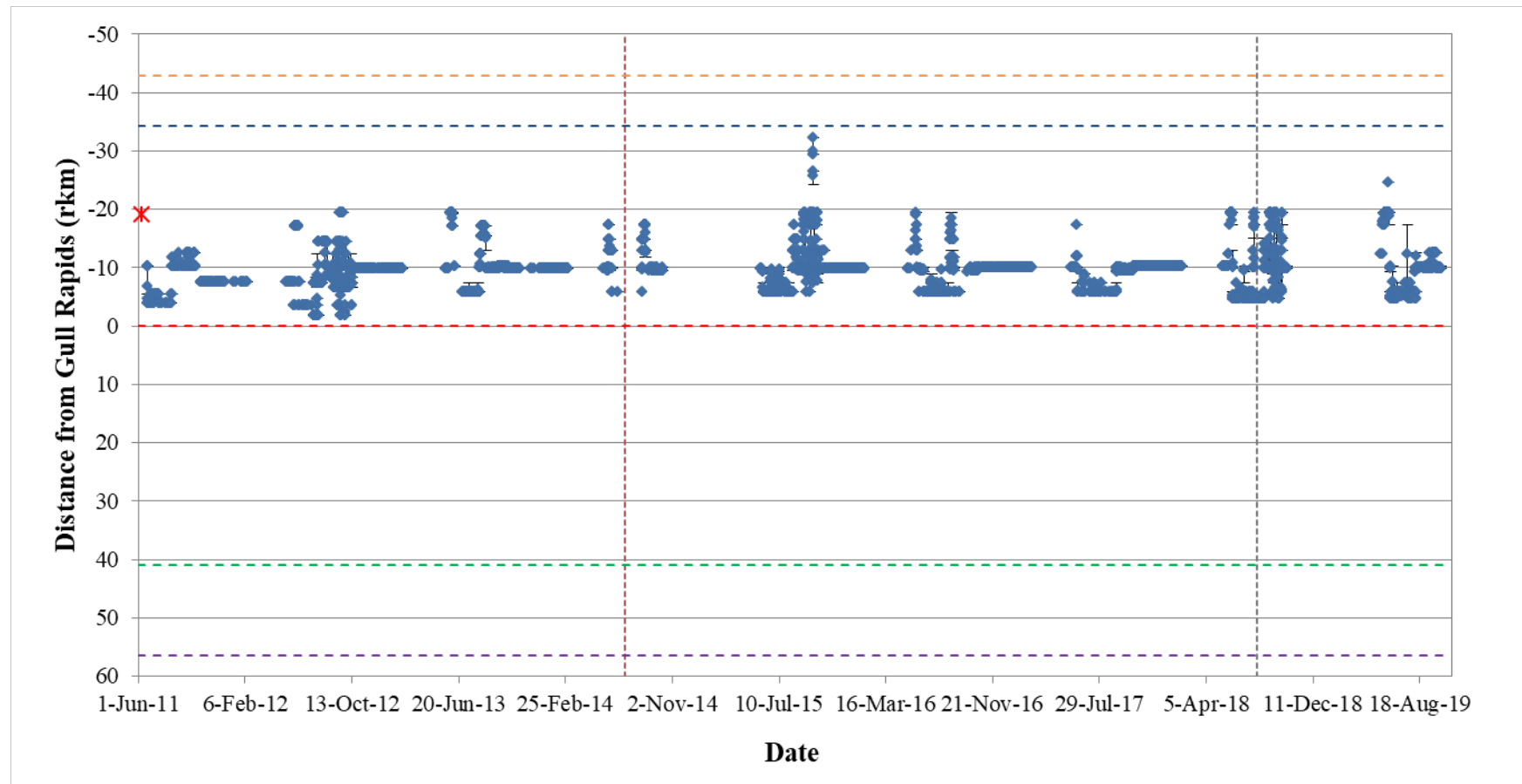


Figure A2-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16051) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

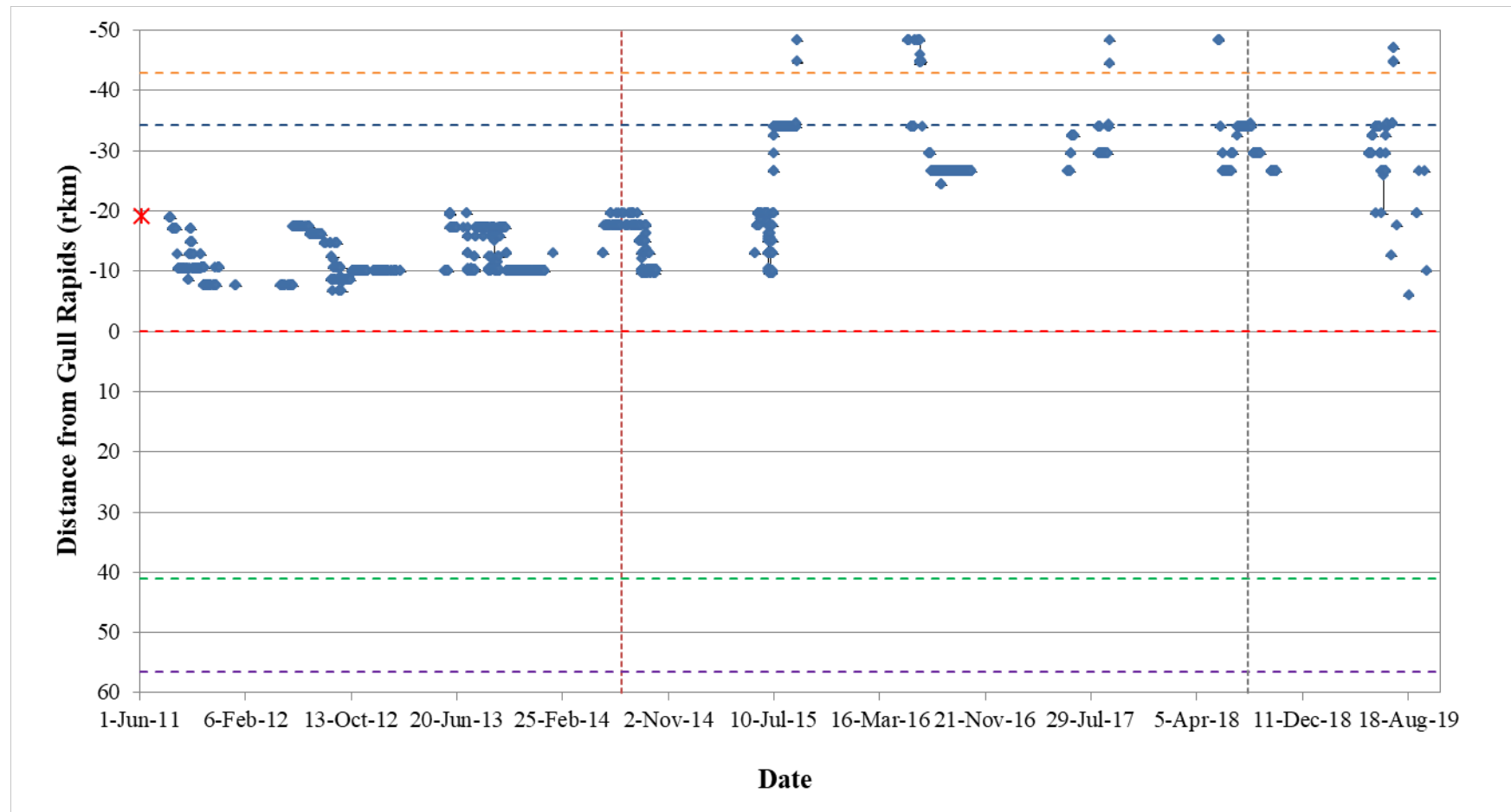


Figure A2-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16054) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

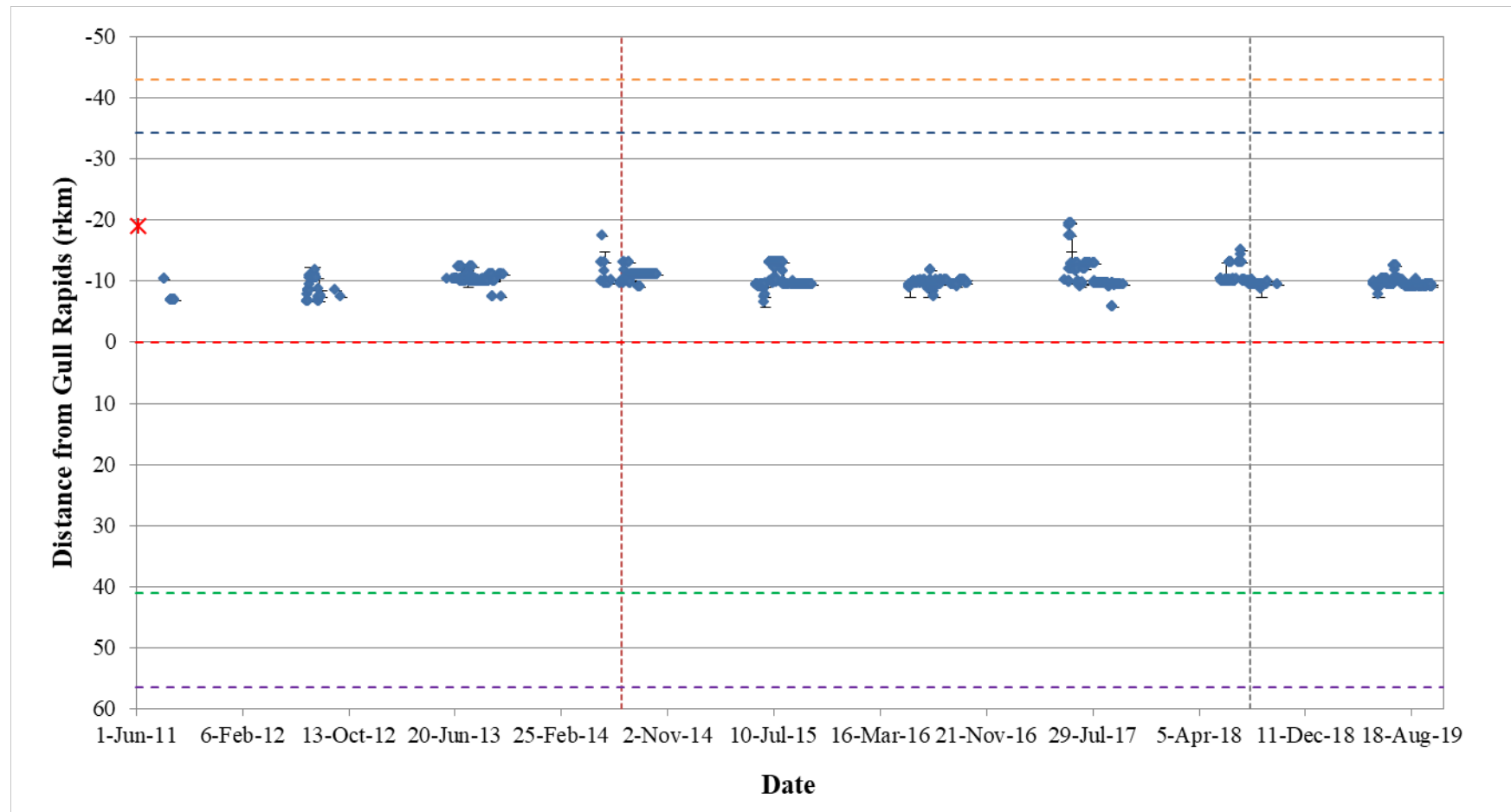


Figure A2-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16055) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

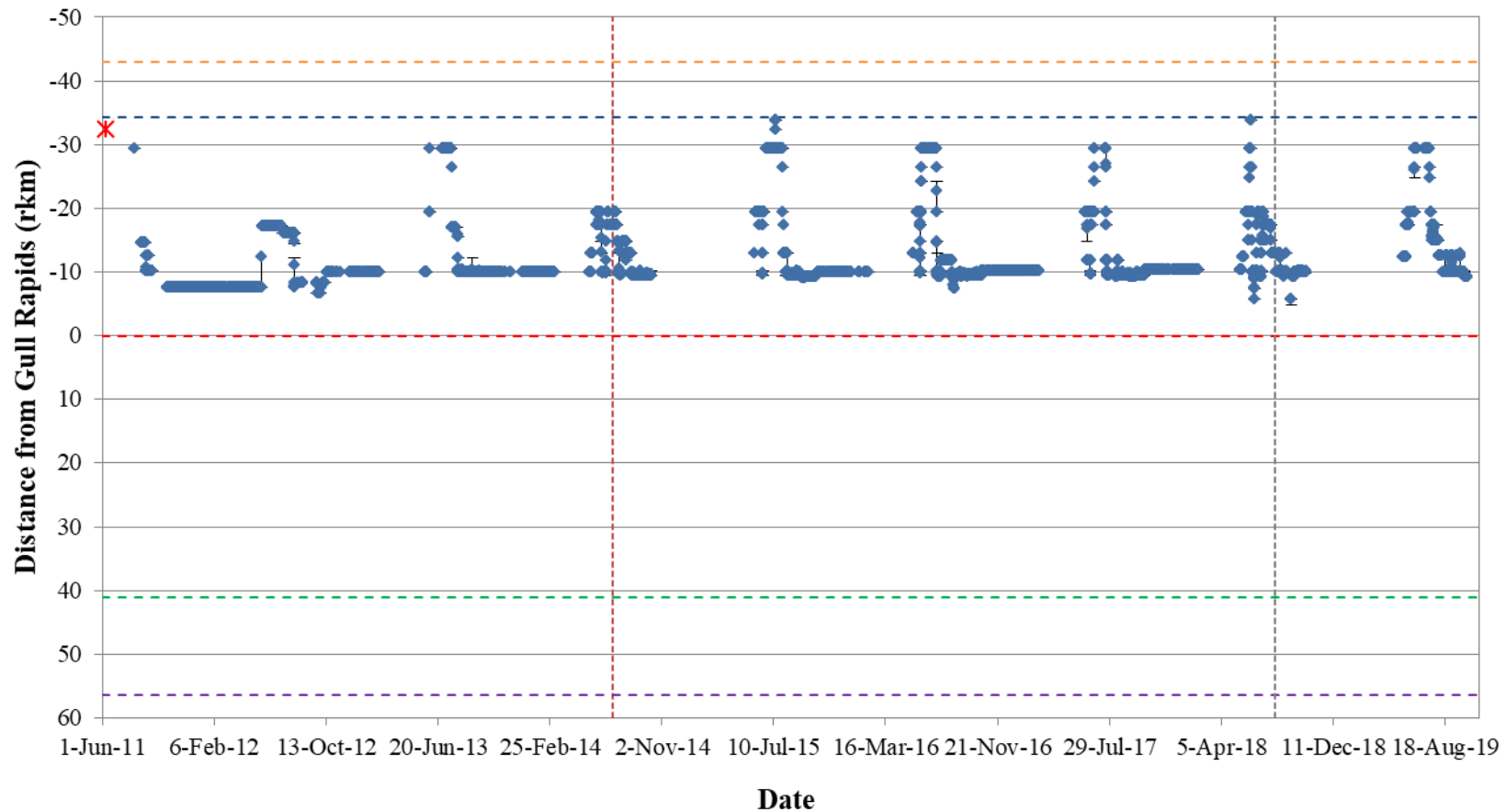


Figure A2-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16056) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

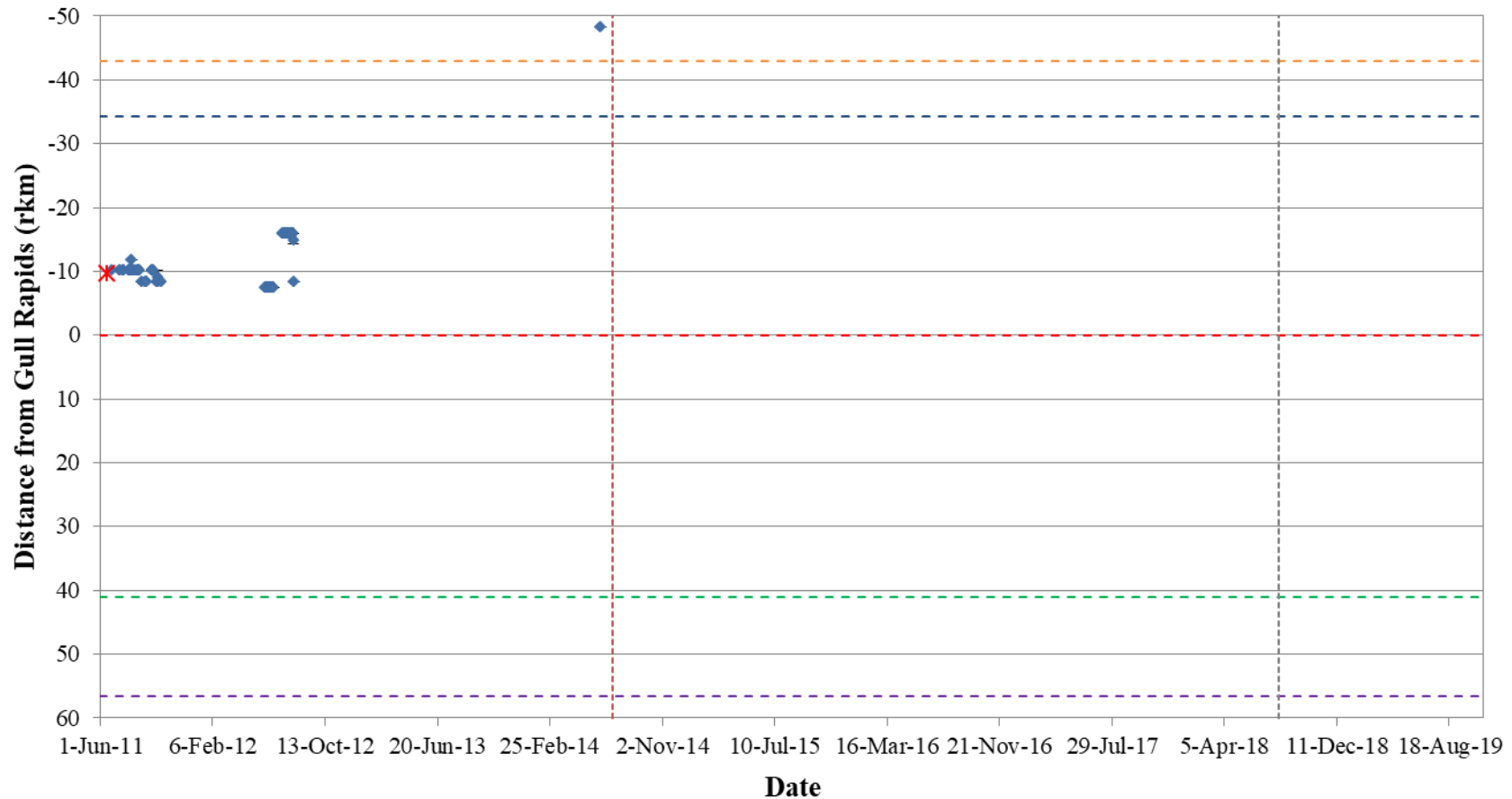


Figure A2-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16057) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

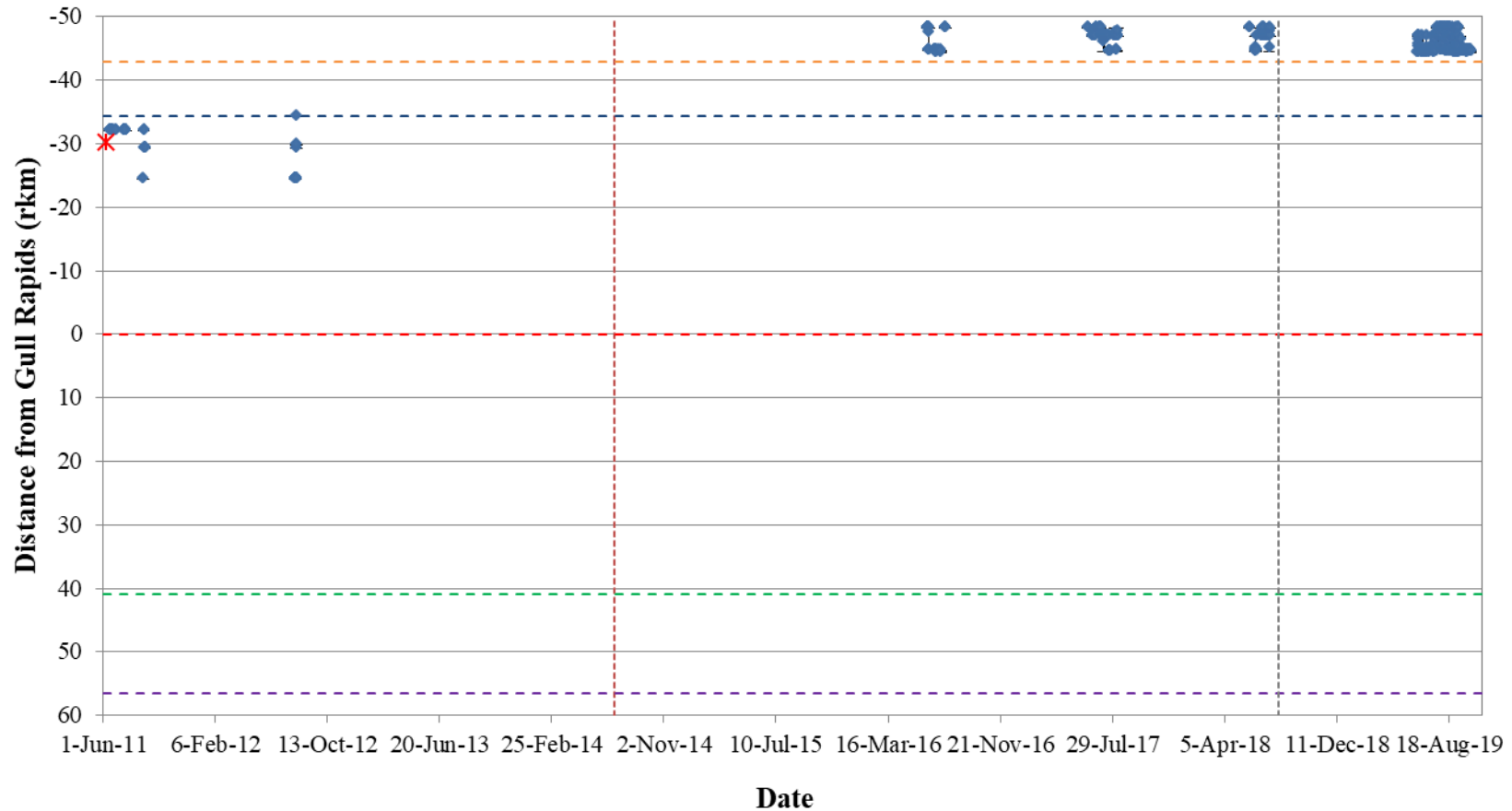


Figure A2-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16058) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

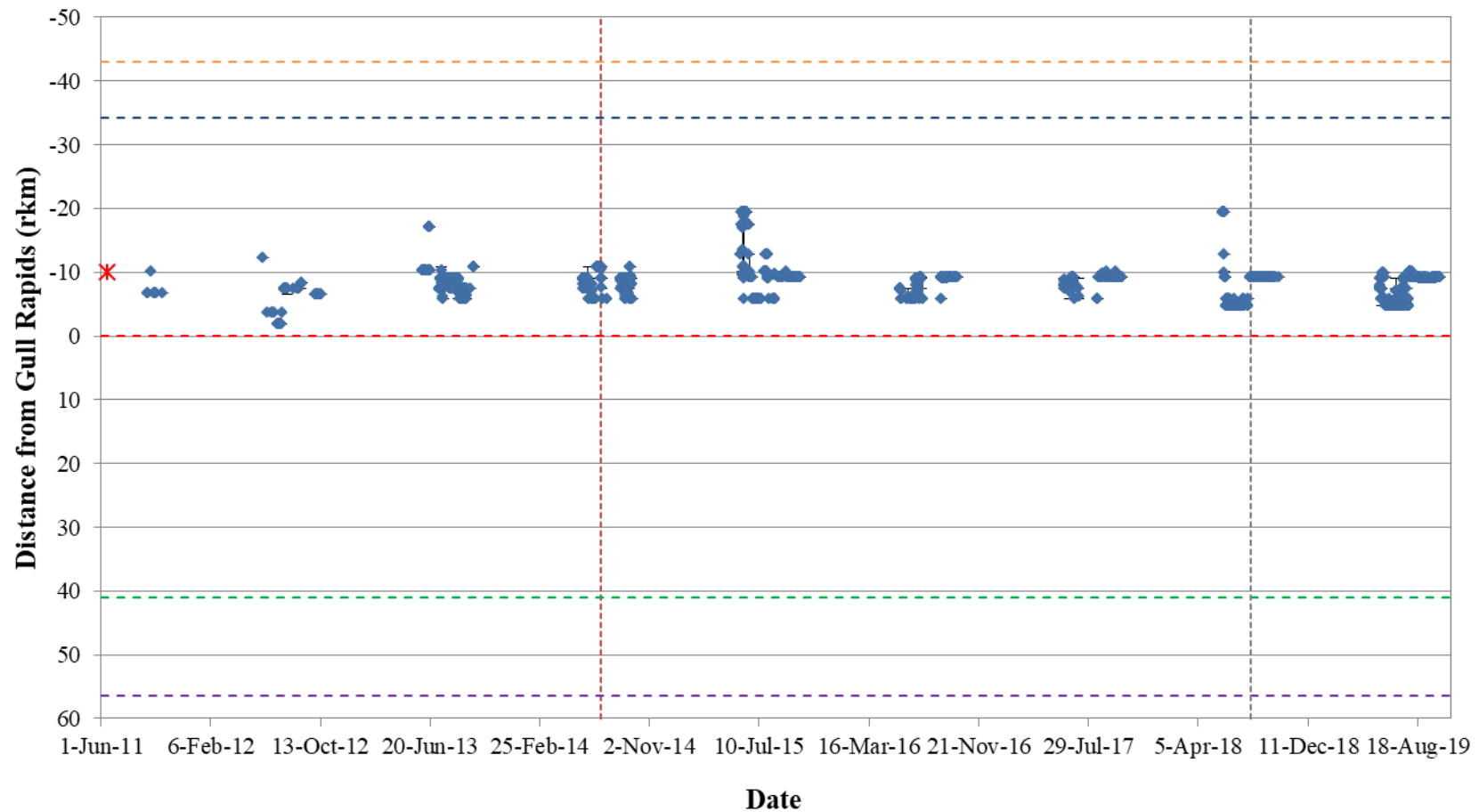


Figure A2-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16059) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

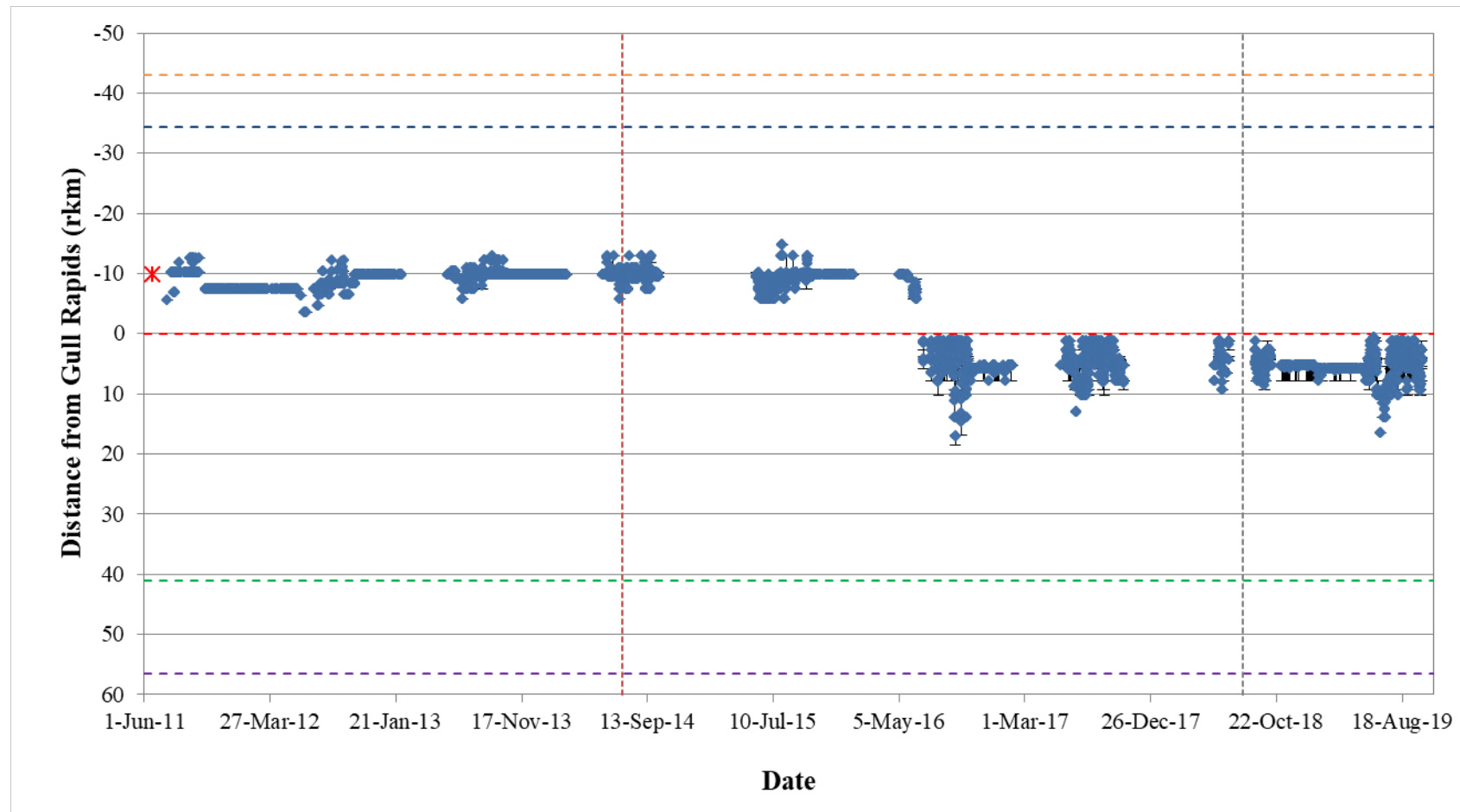


Figure A2-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16060) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

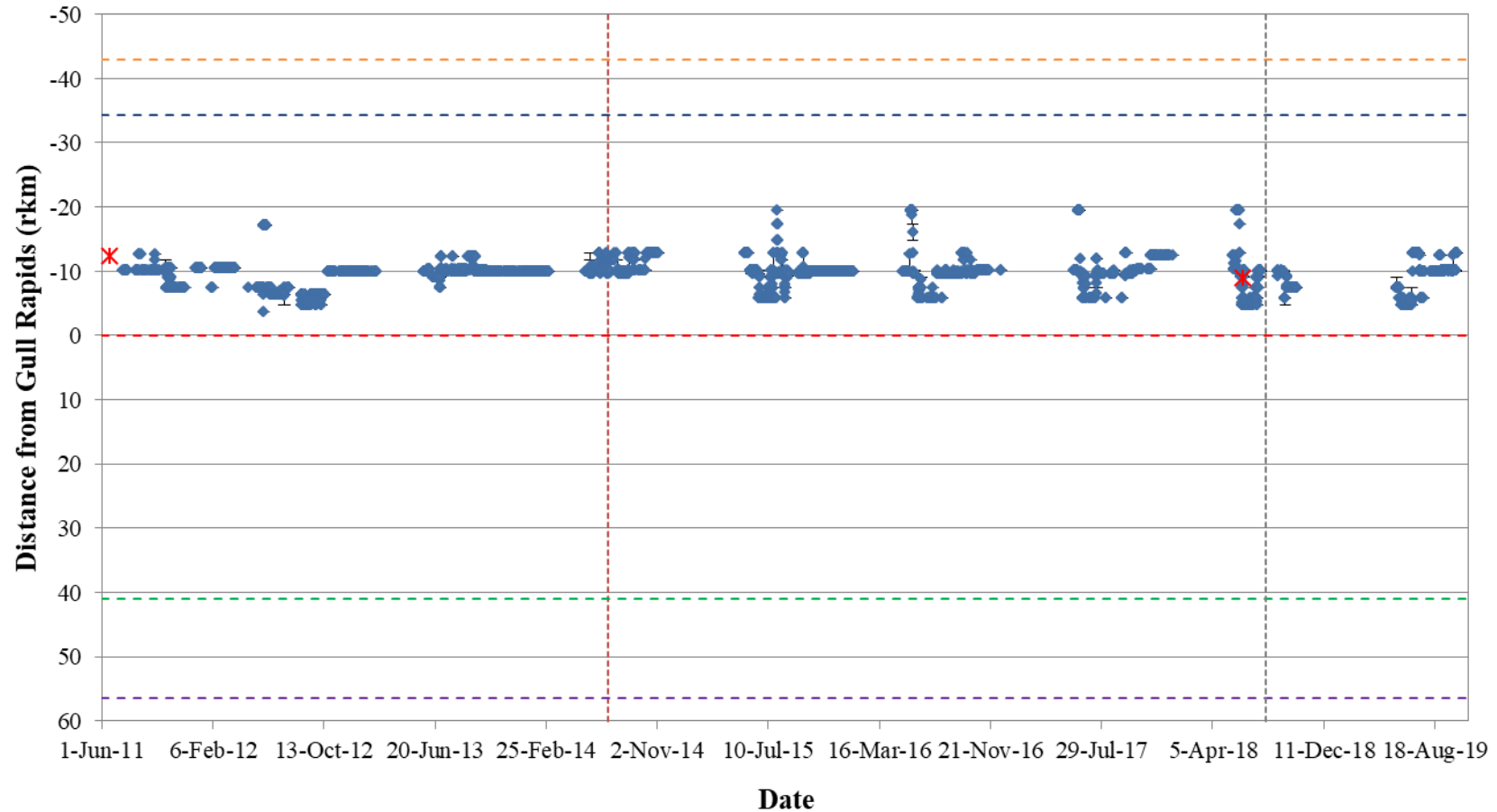


Figure A2-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16061) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

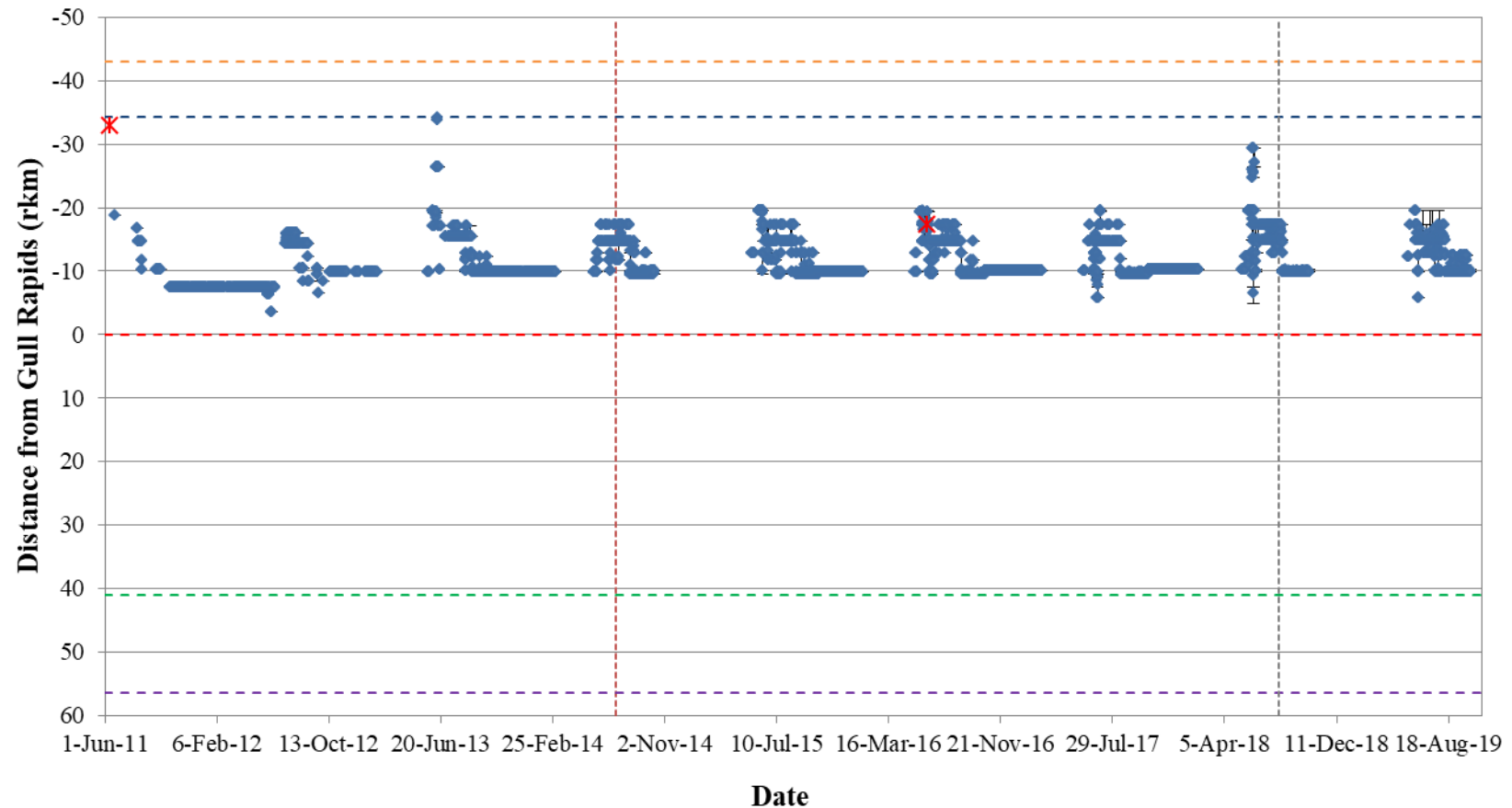


Figure A2-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16062) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

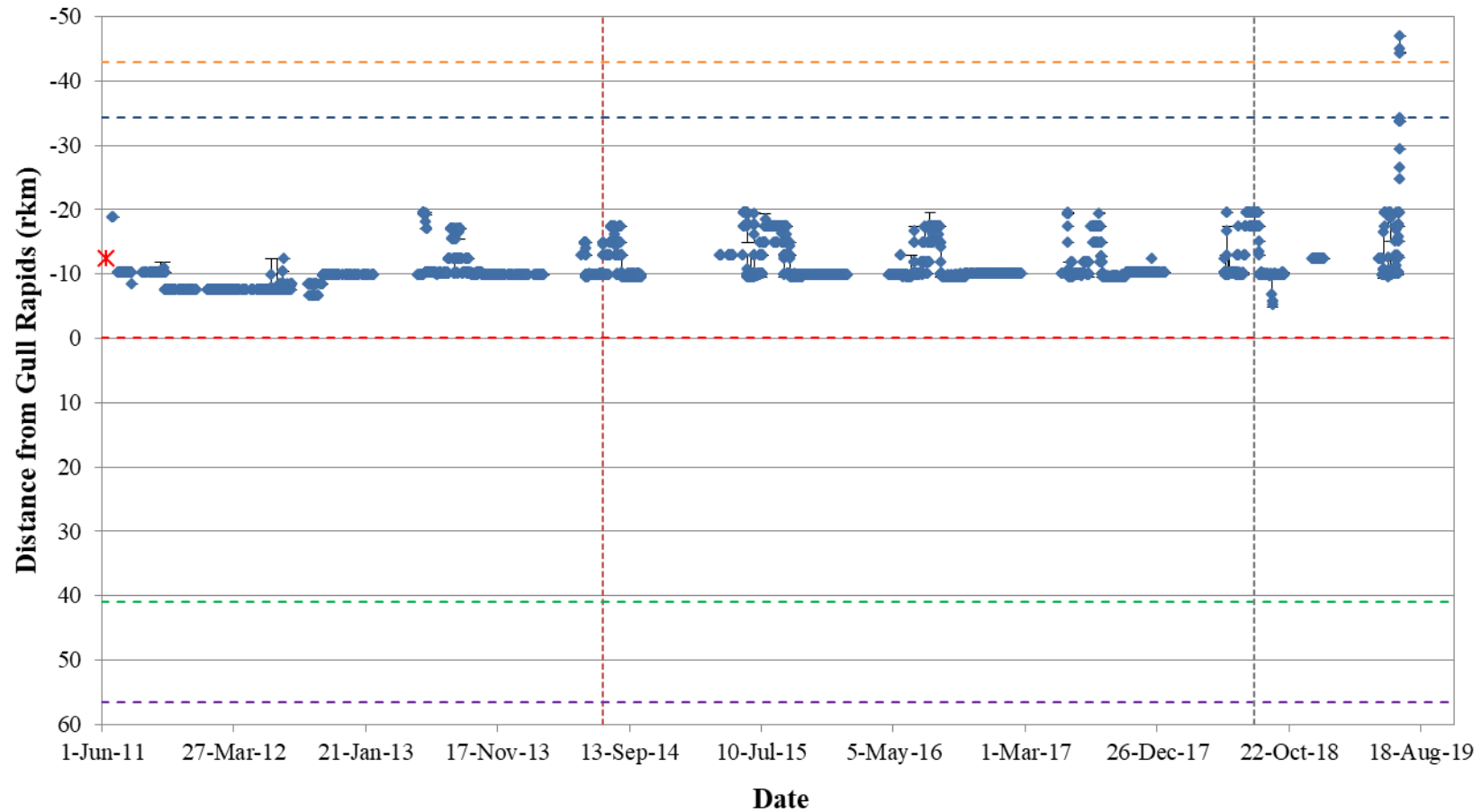
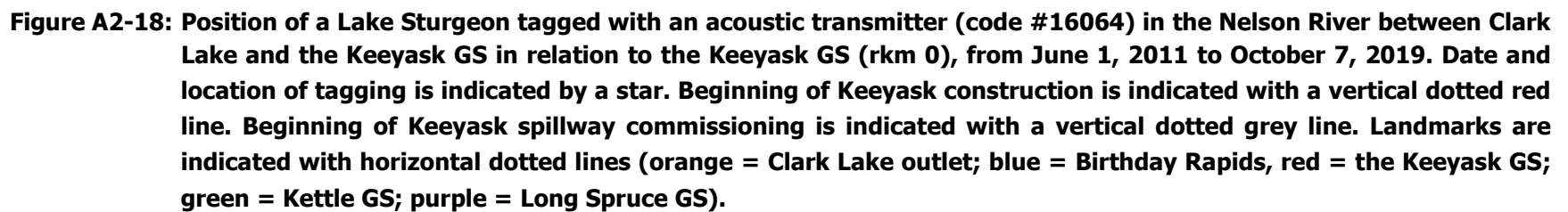


Figure A2-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16063) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).



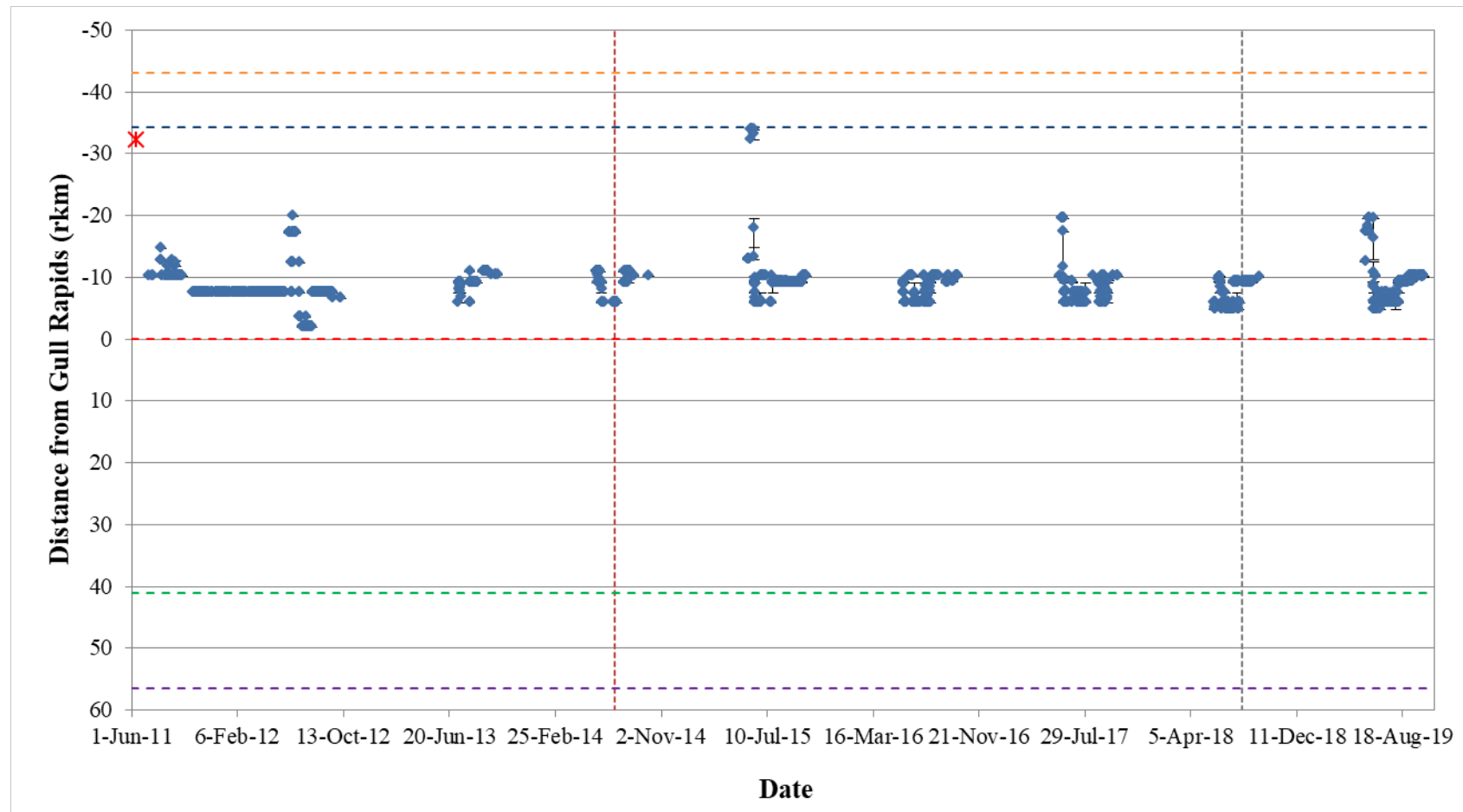


Figure A2-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16065) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

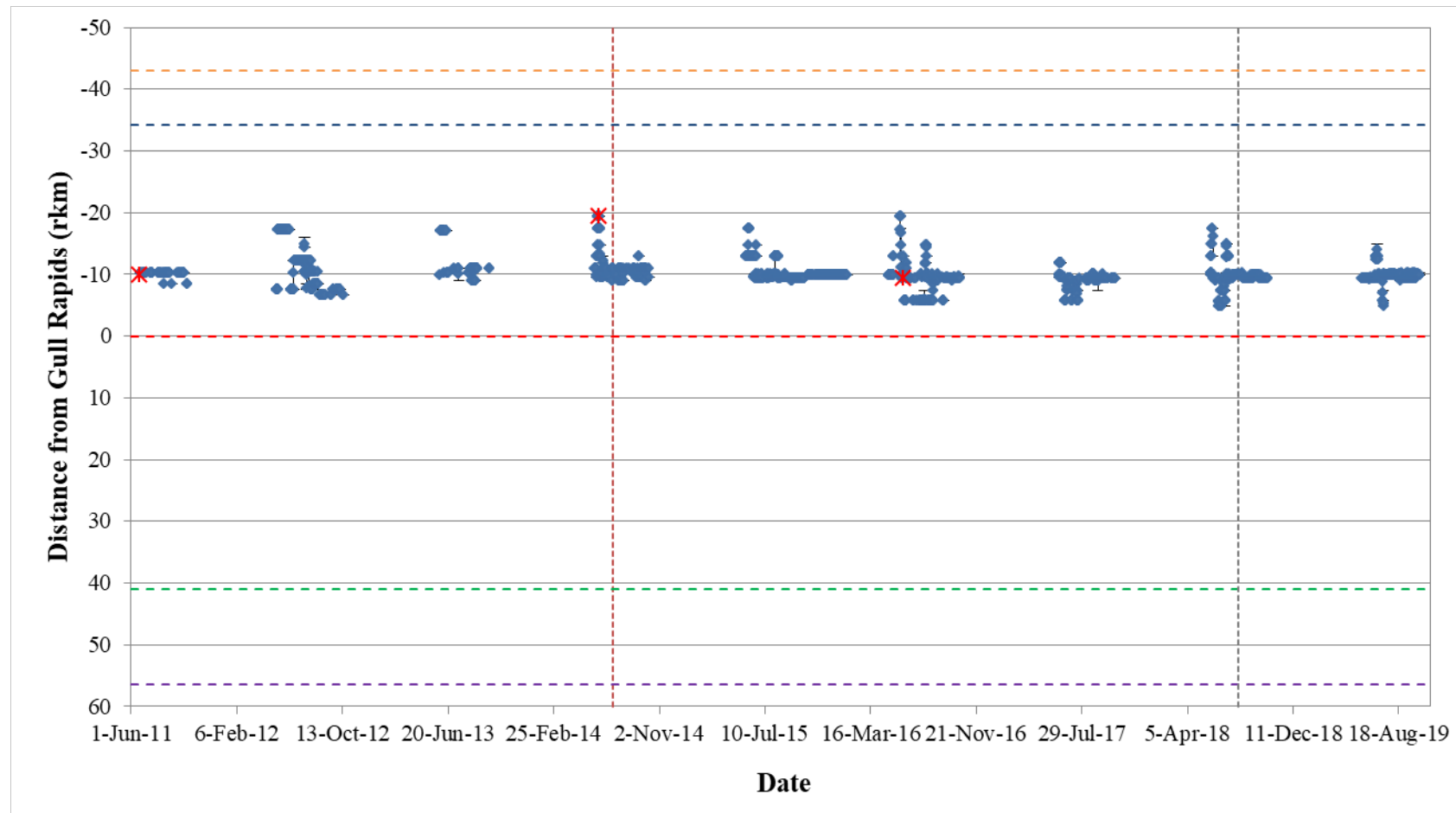


Figure A2-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16066) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

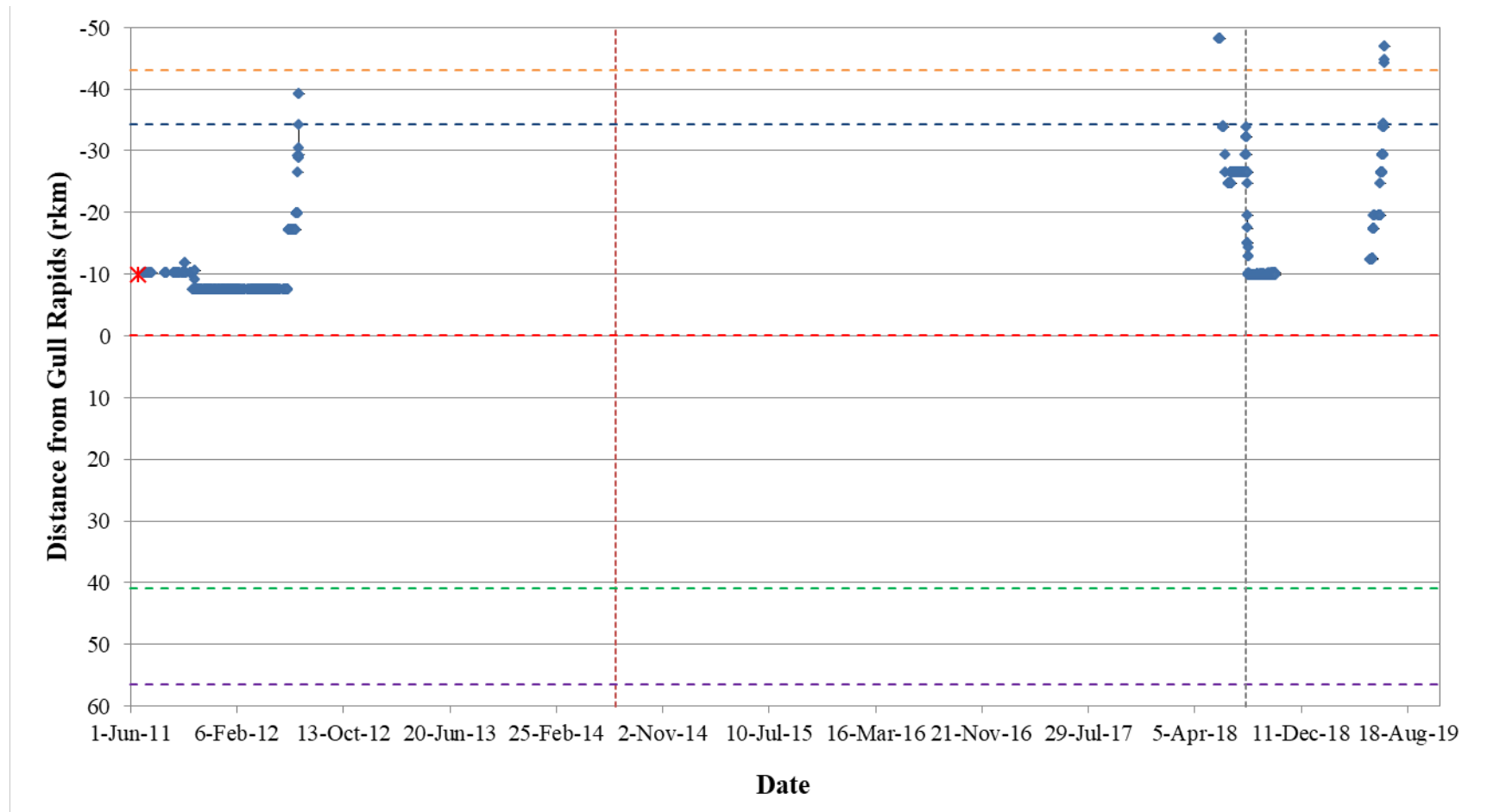


Figure A2-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16067) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

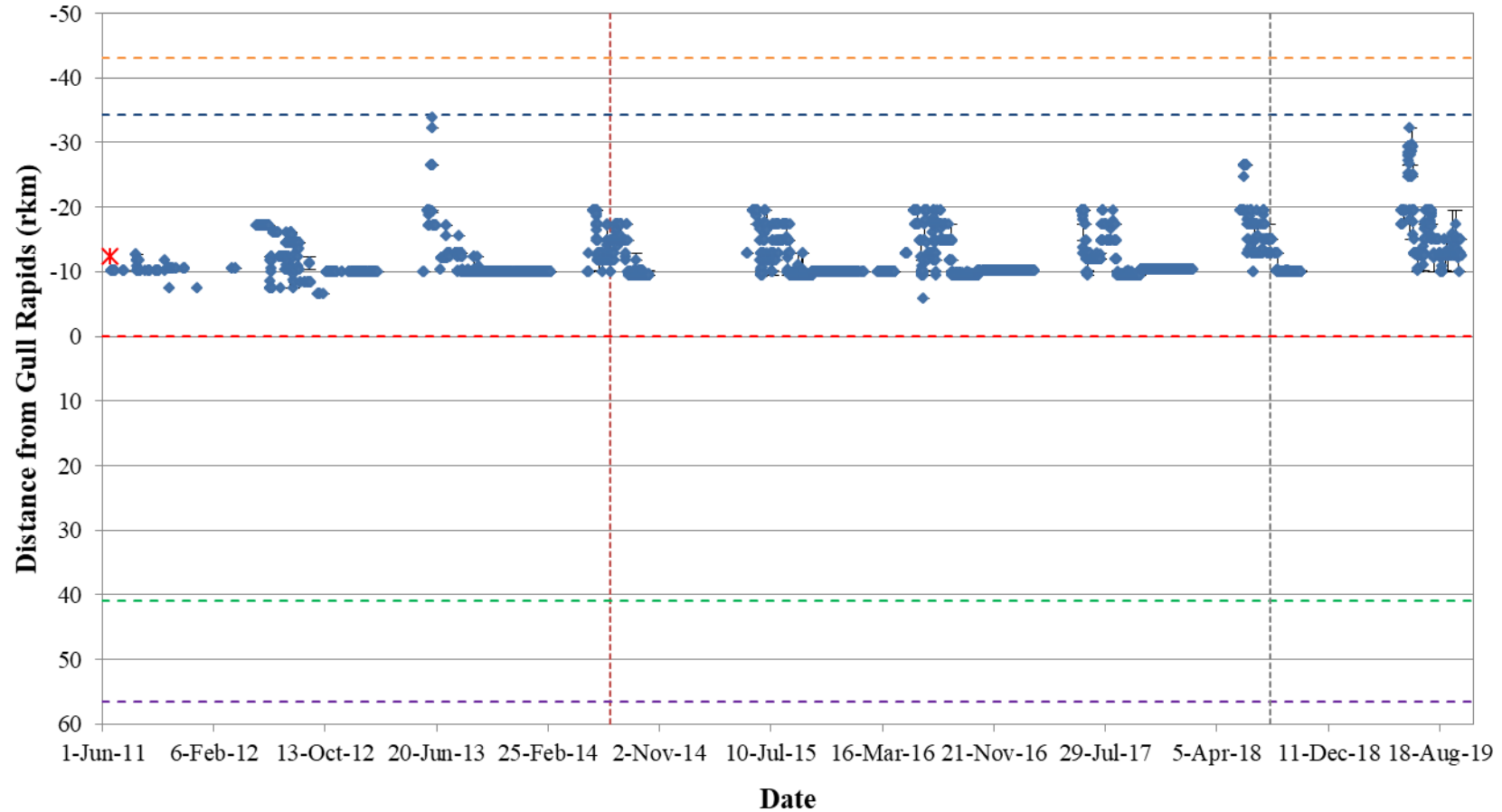


Figure A2-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16068) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

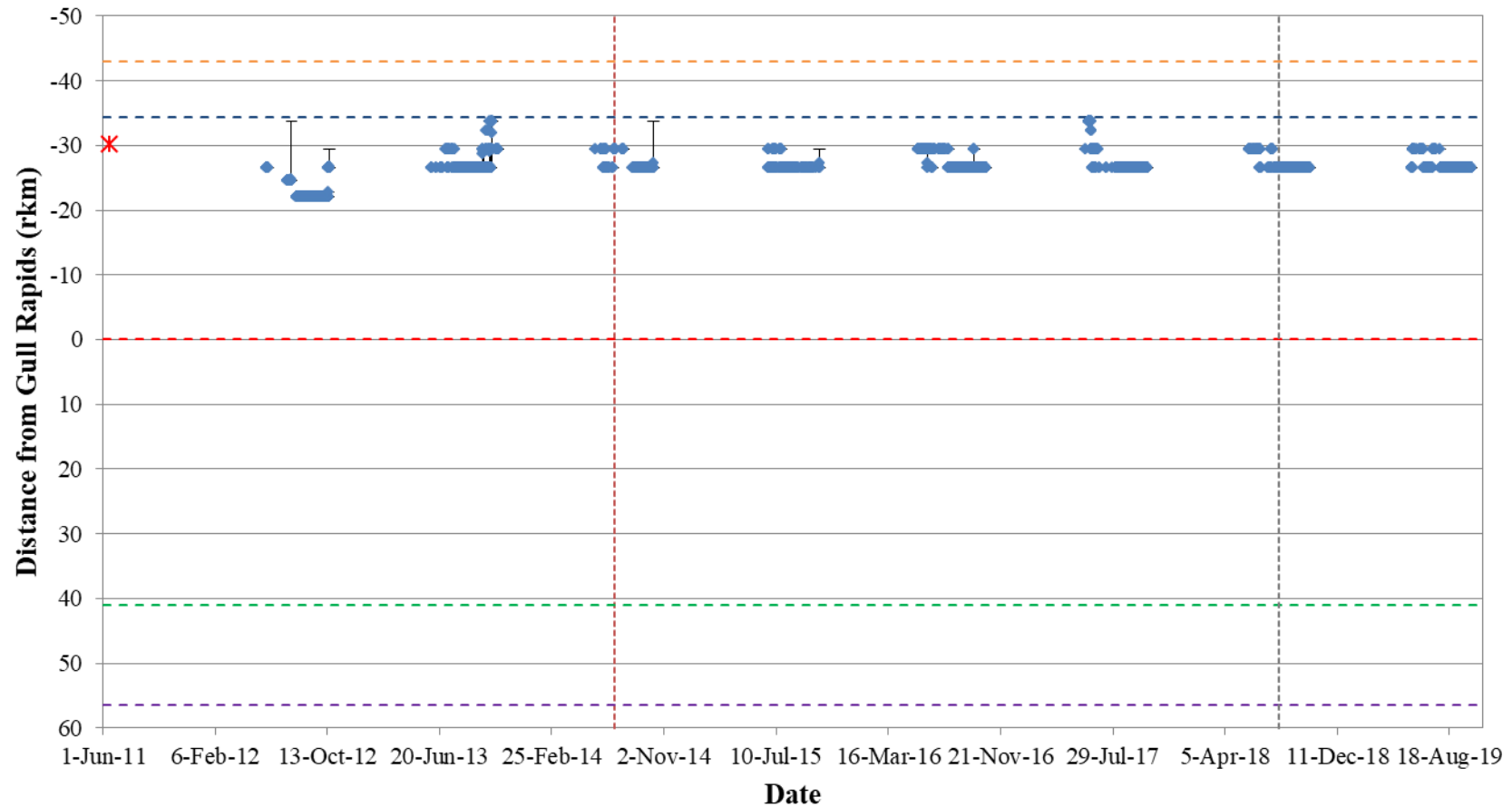


Figure A2-23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16069) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

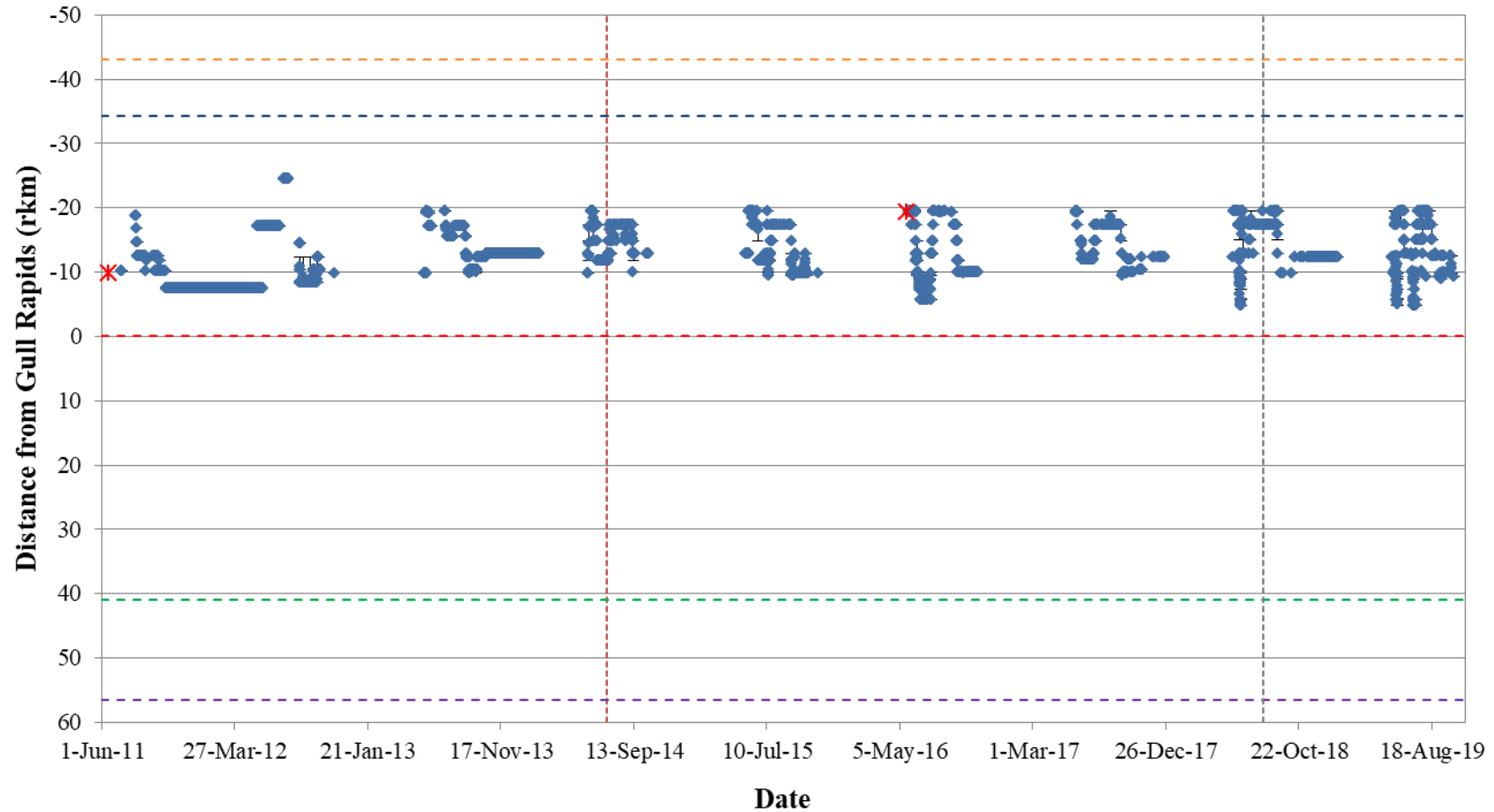


Figure A2-24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16070) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

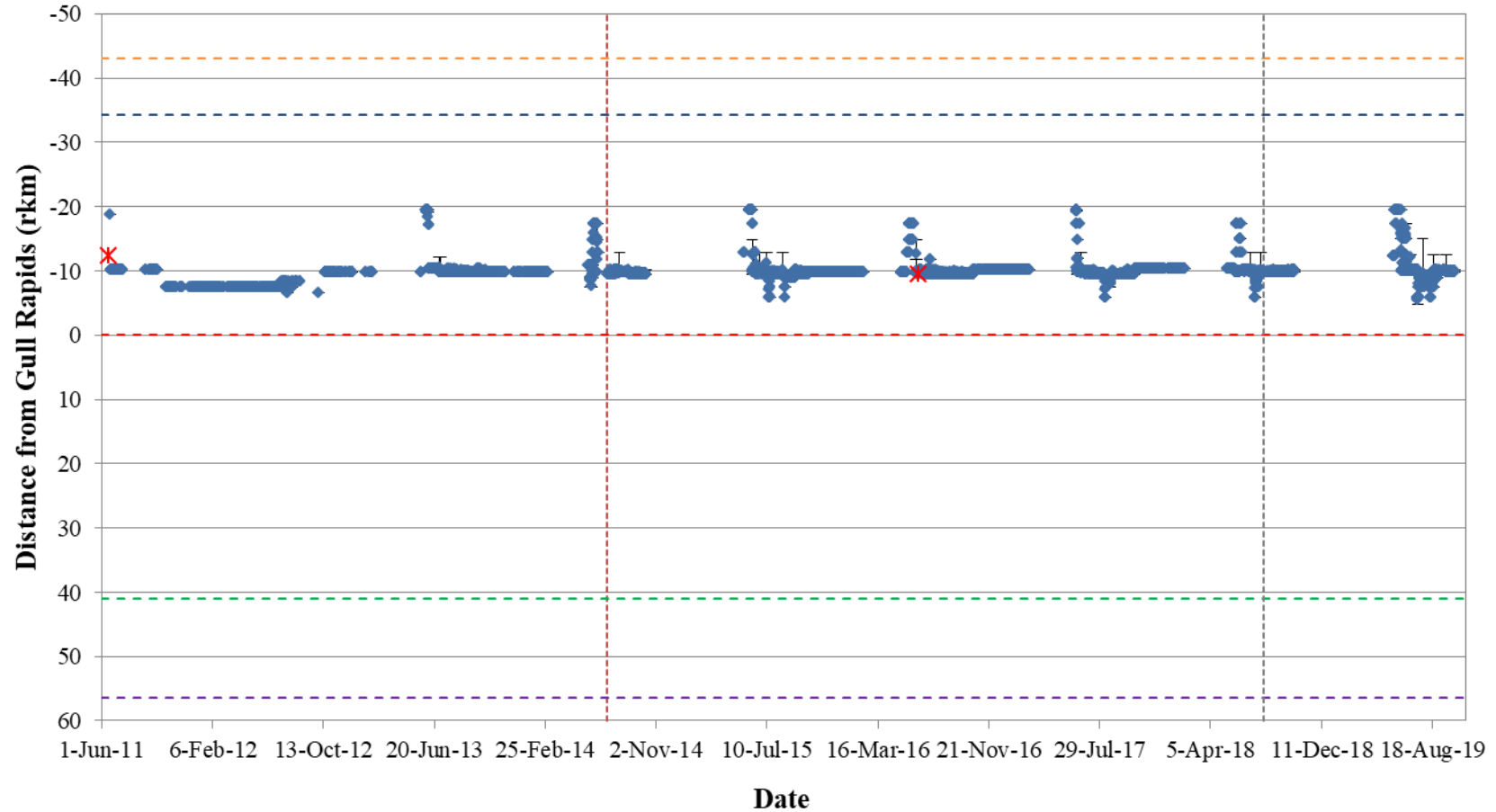


Figure A2-25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16071) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

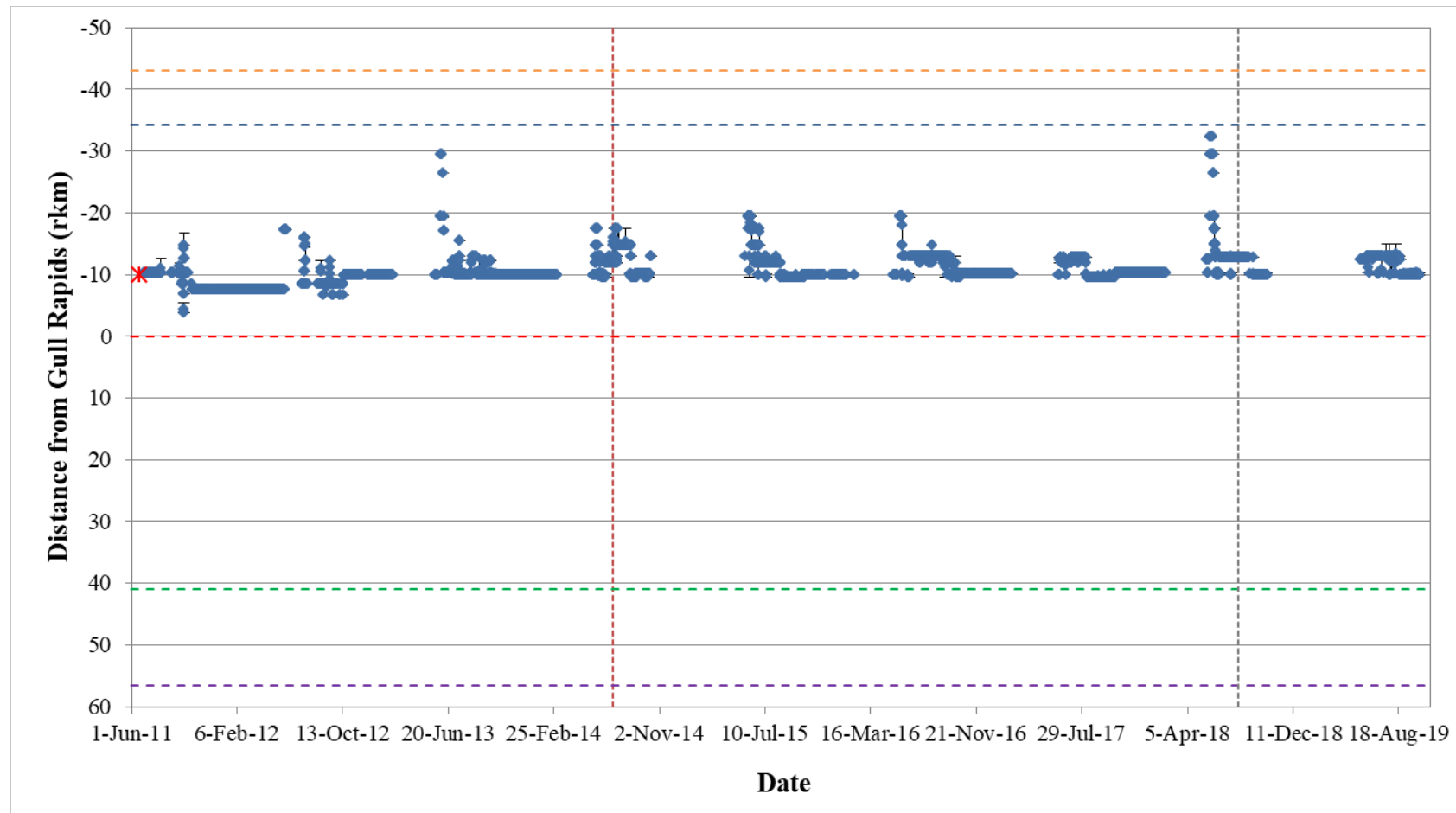


Figure A2-26: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16072) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

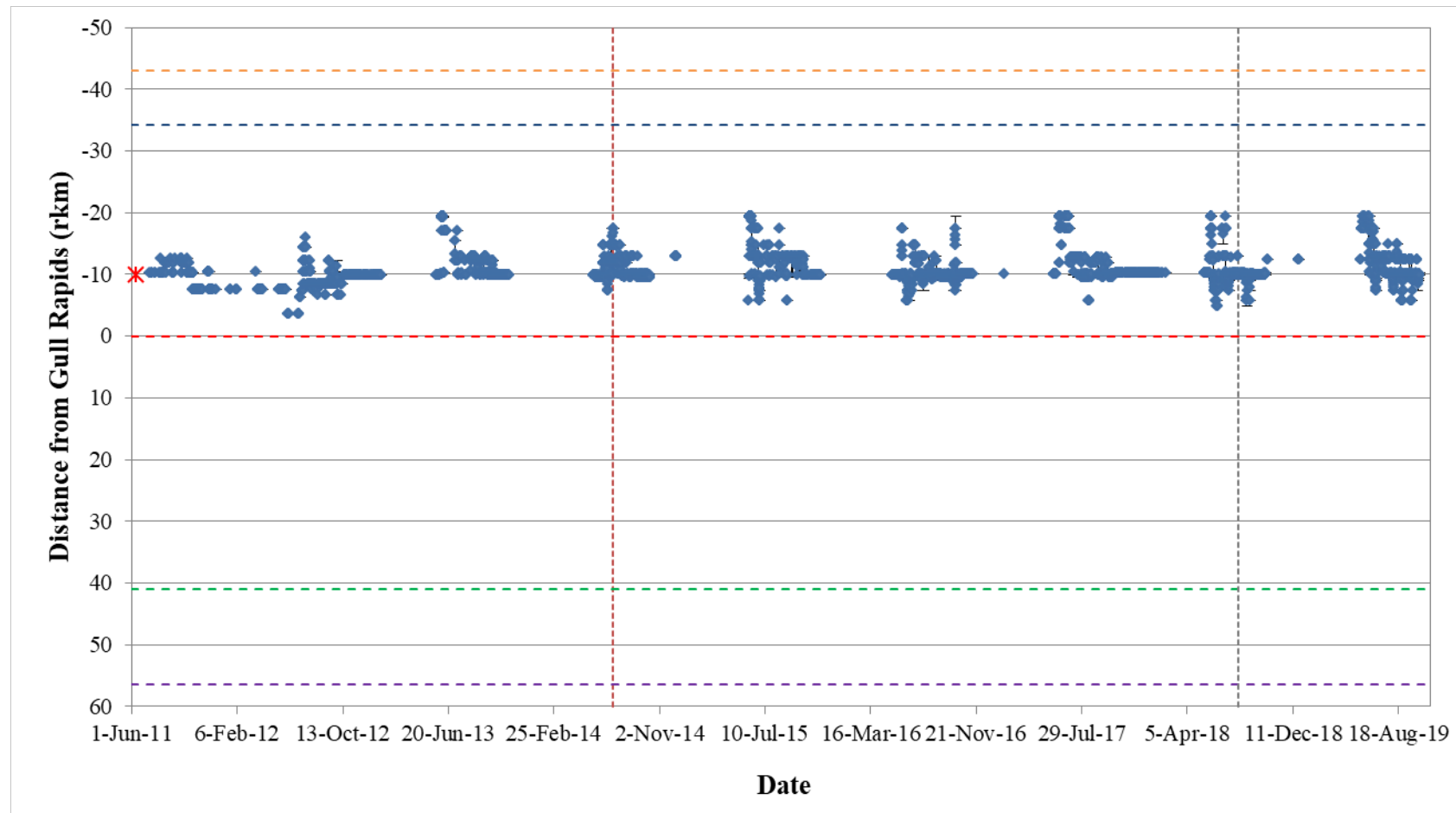


Figure A2-27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16073) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

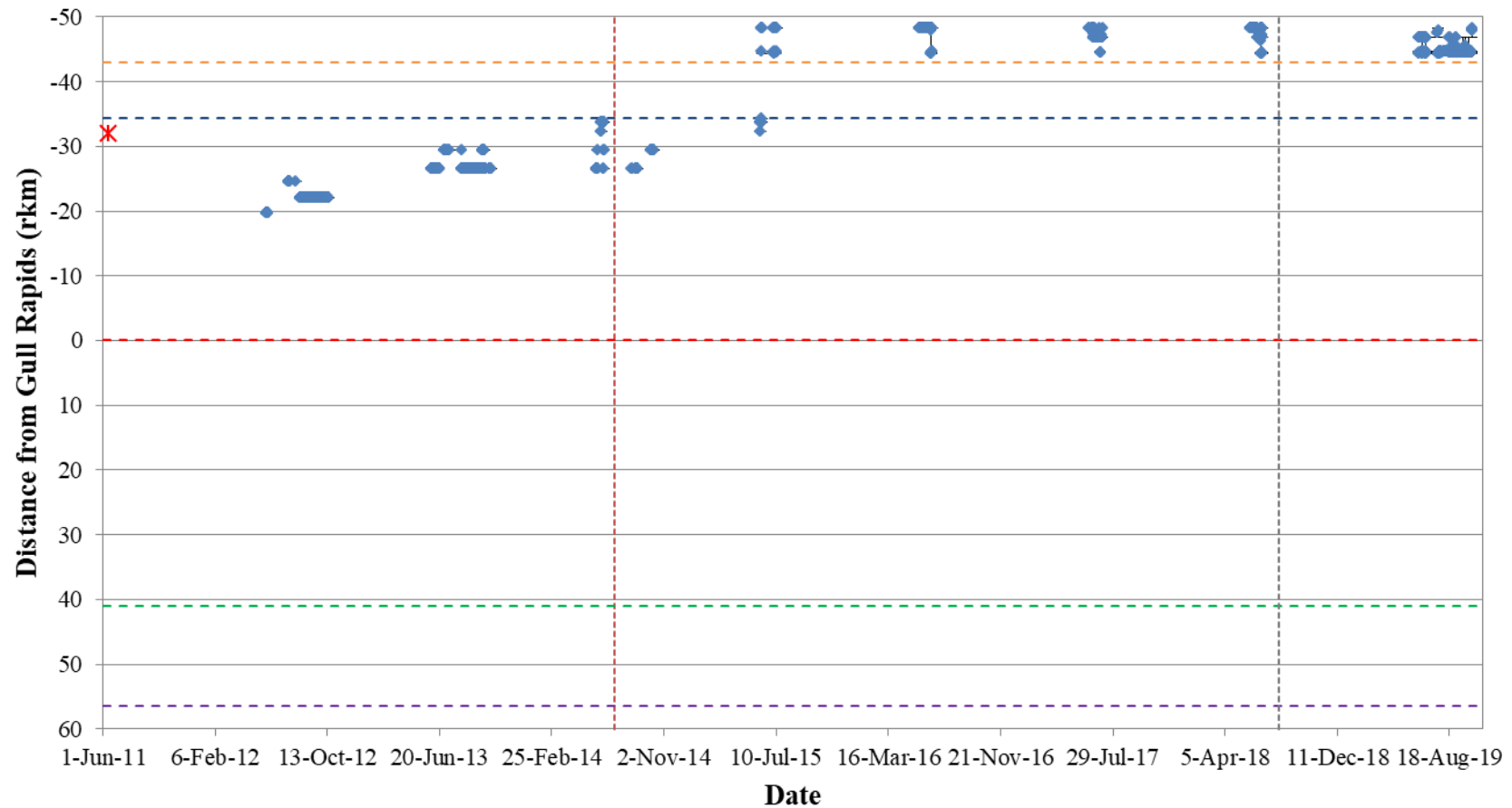


Figure A2-28: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16074) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

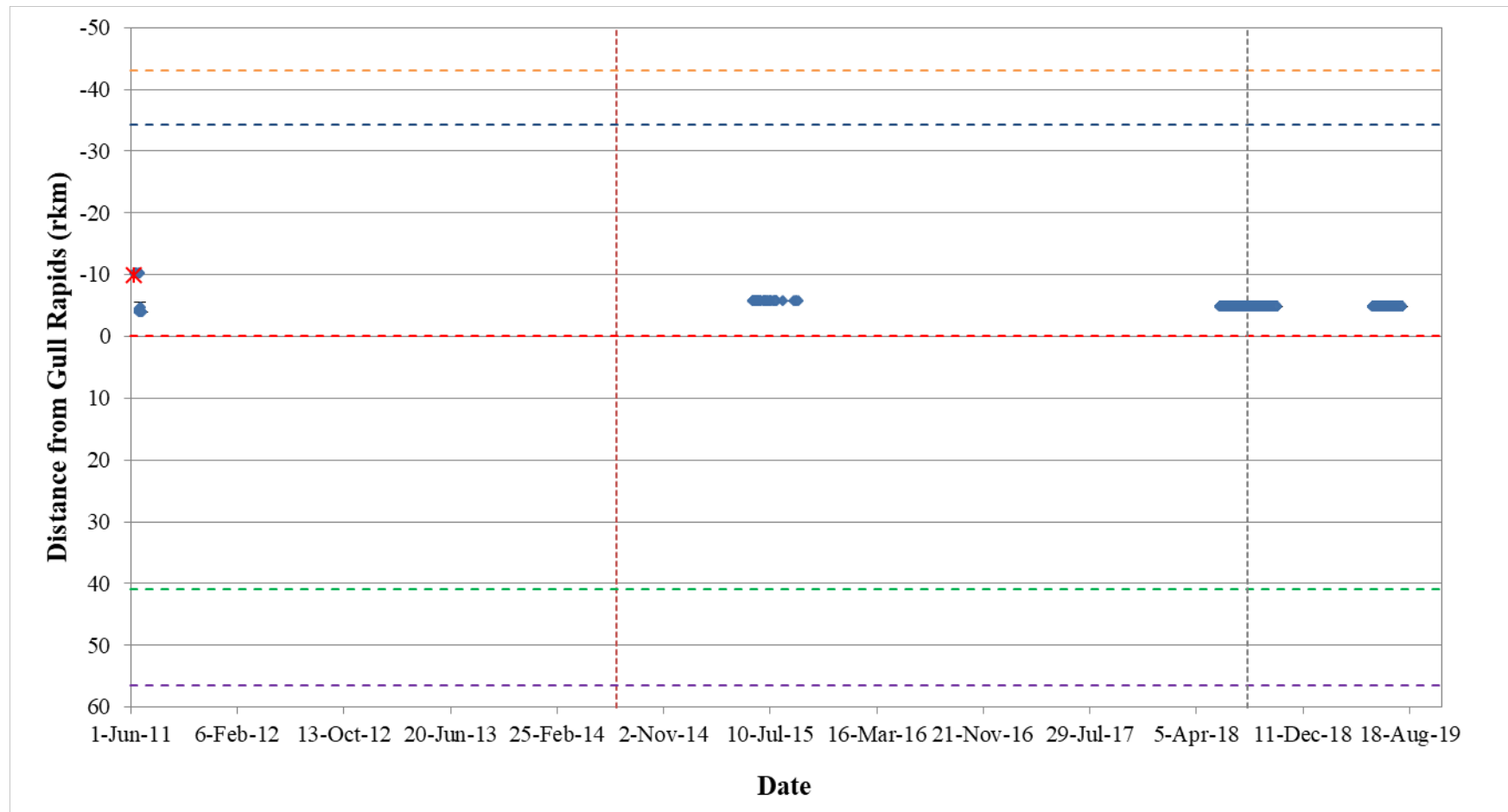


Figure A2-29: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16075) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

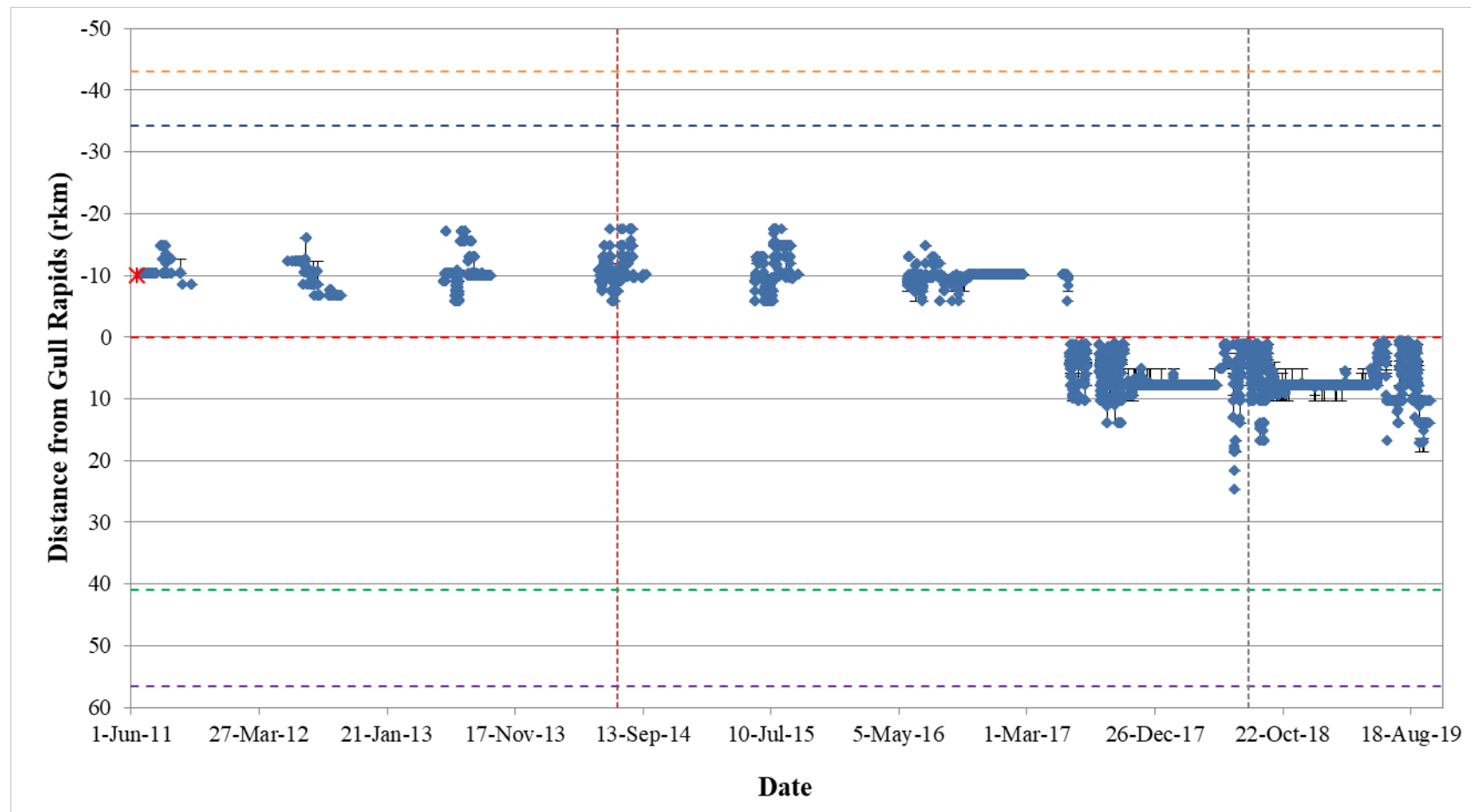


Figure A2-30: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16076) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

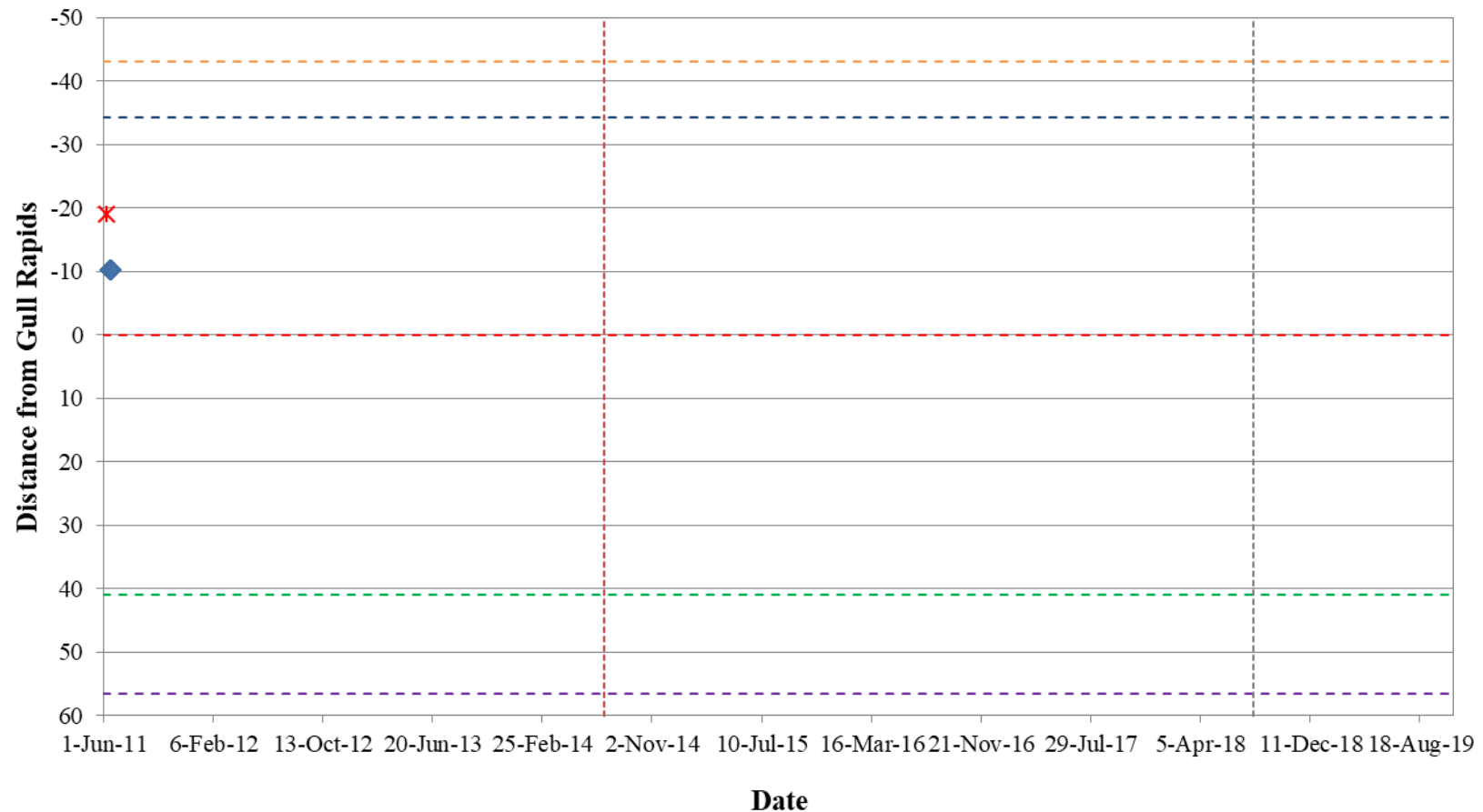


Figure A2-31: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16077) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

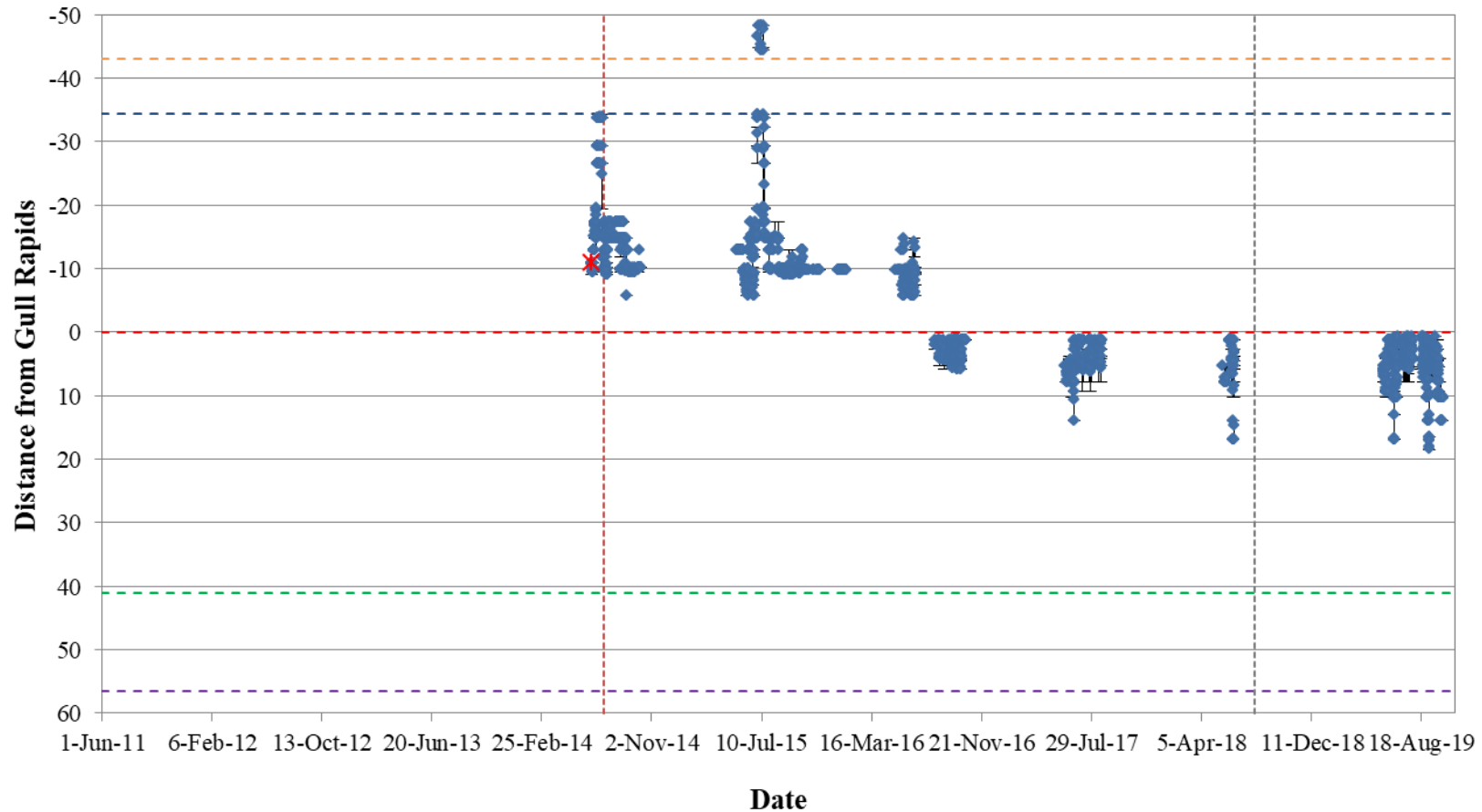


Figure A2-32: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32174) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

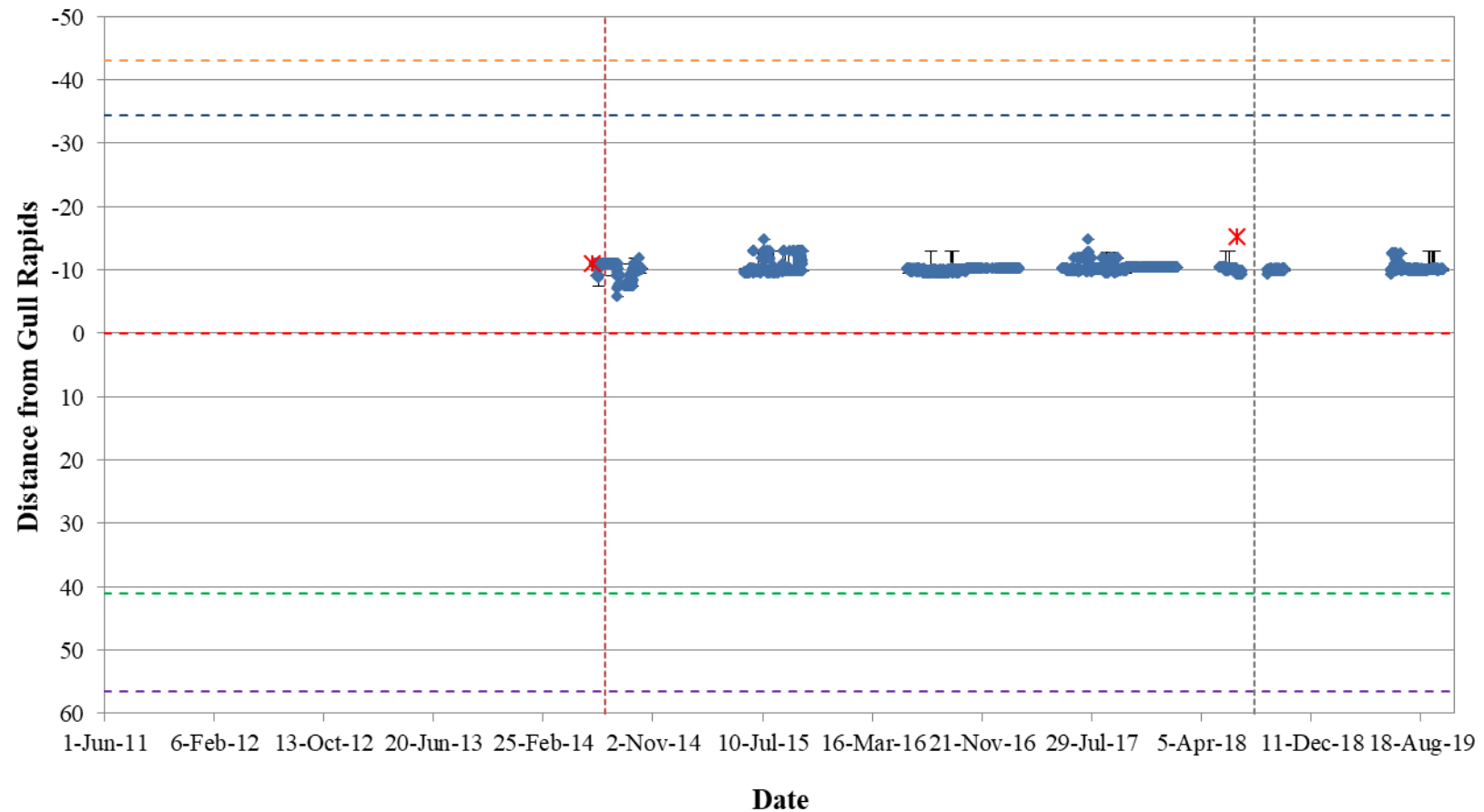


Figure A2-33: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32175) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

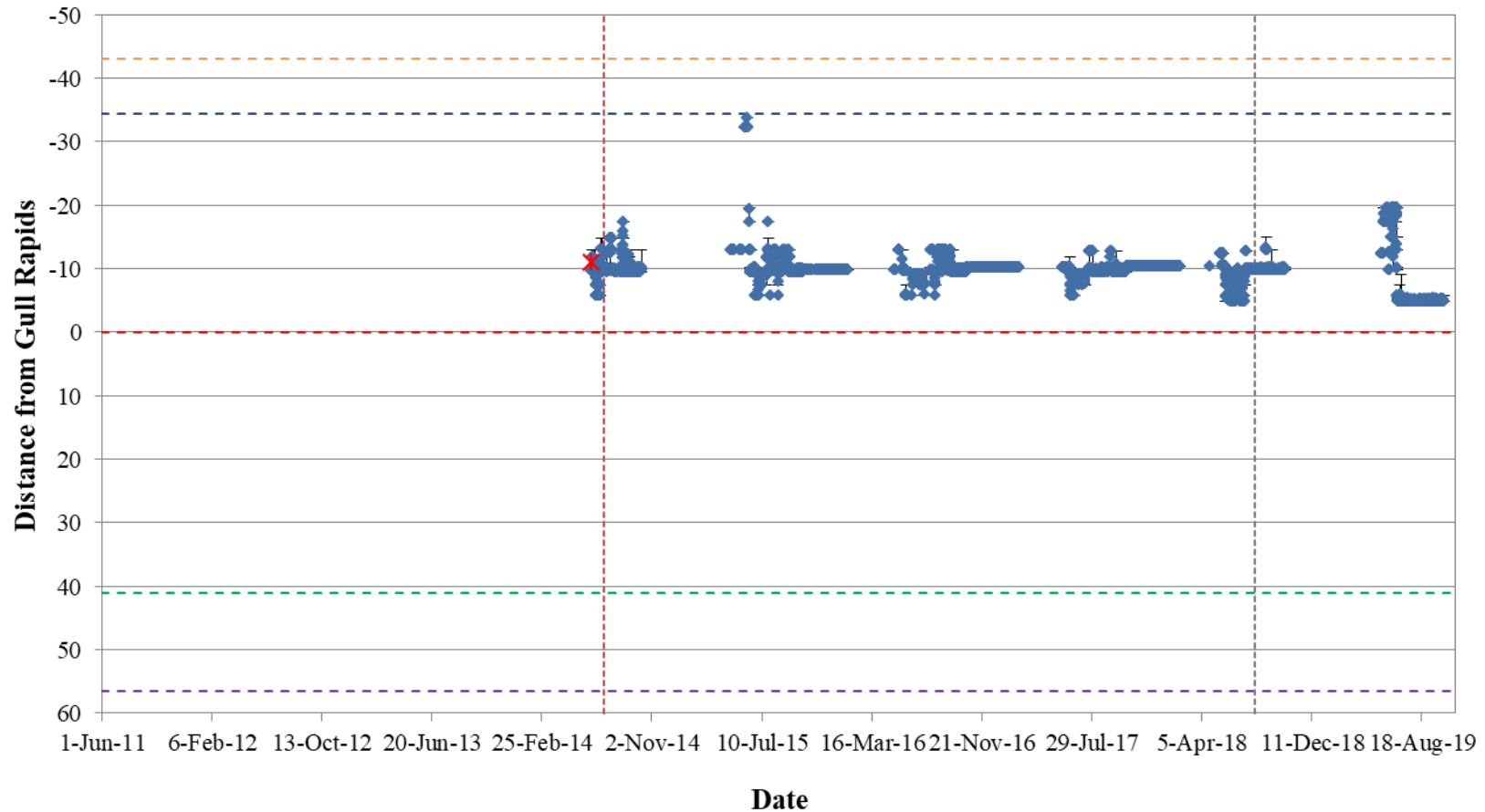


Figure A2-34: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32176) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

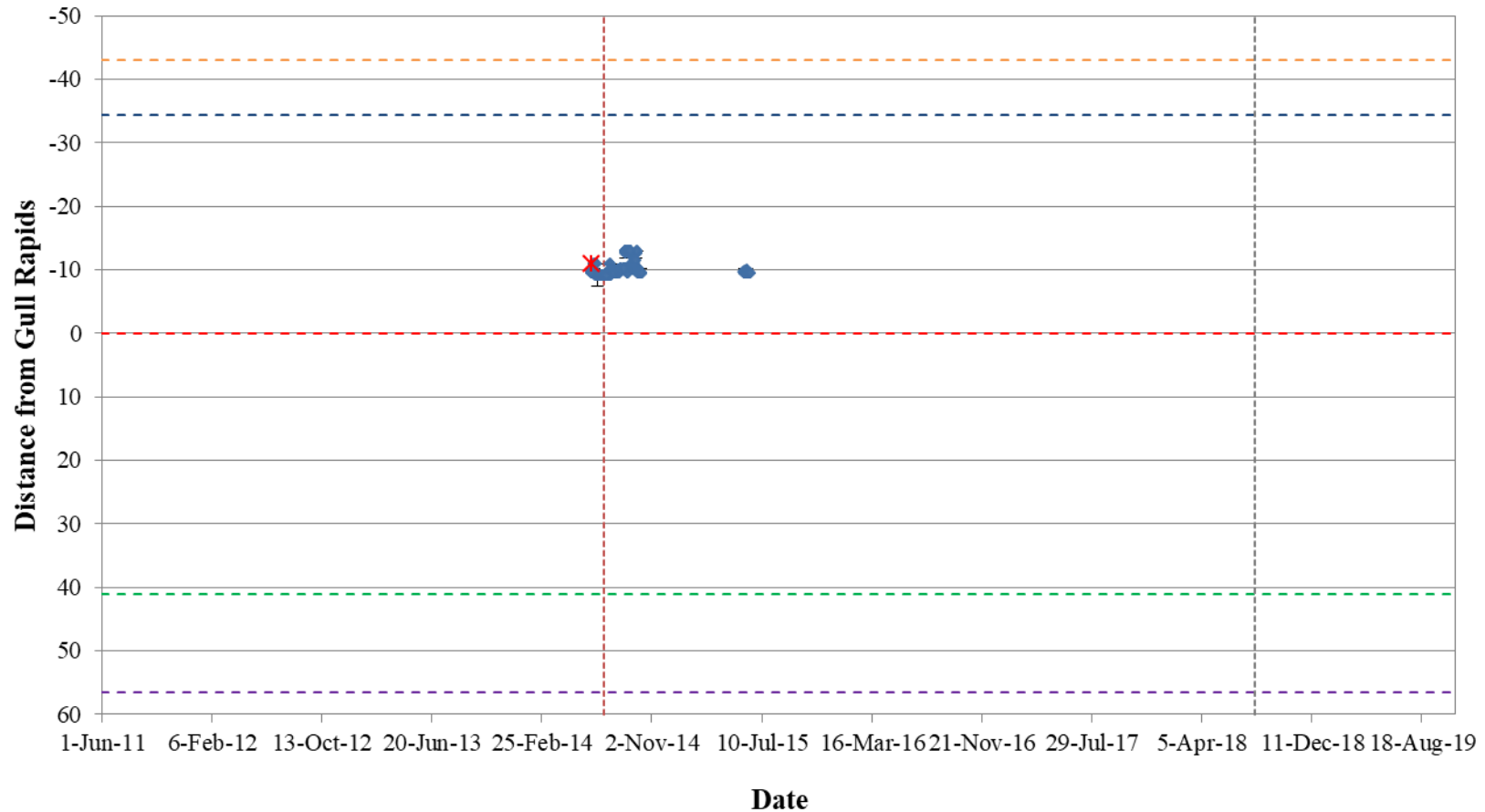


Figure A2-35: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32177) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

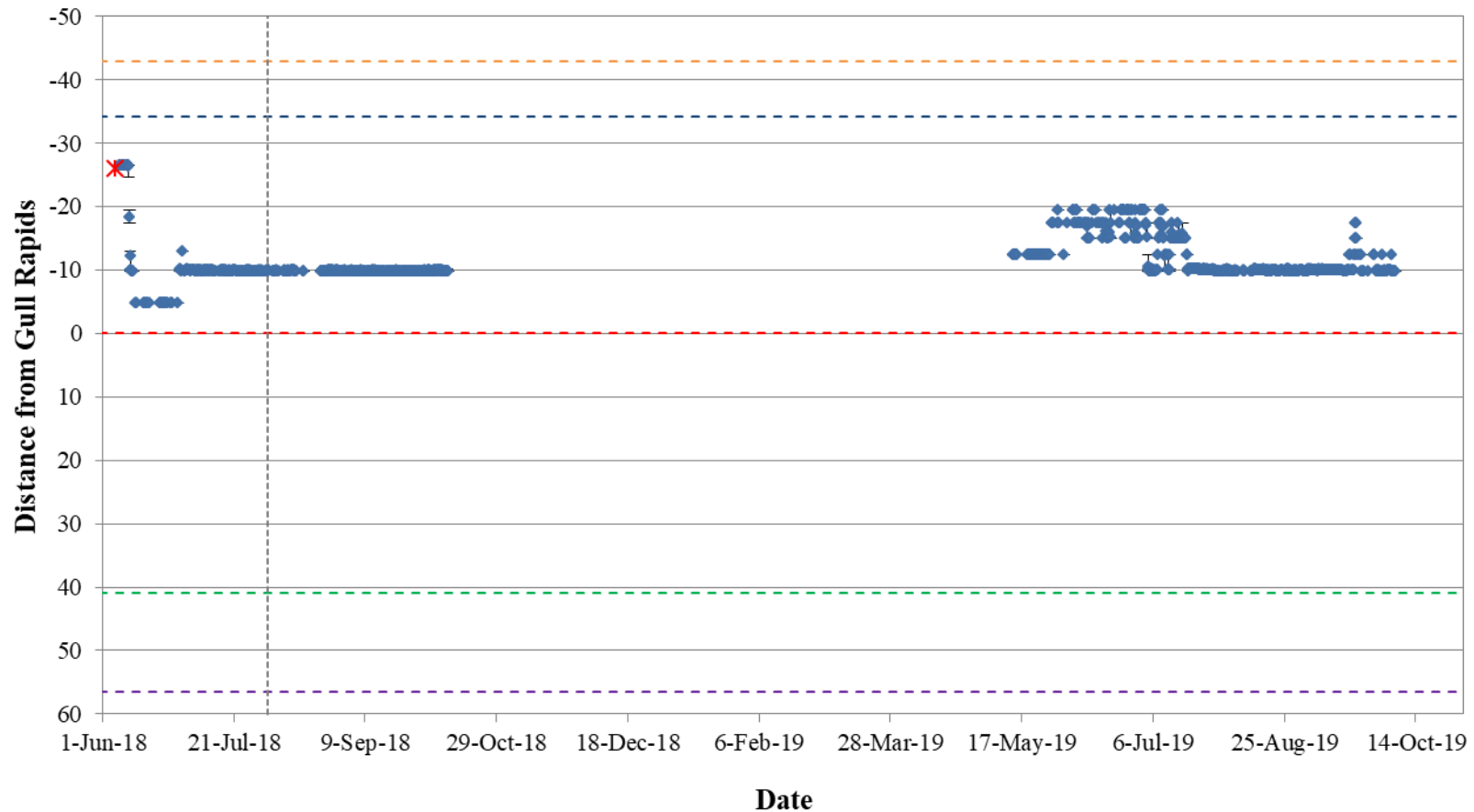


Figure A2-36: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #54799) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2018 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

APPENDIX 3:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, STEPHENS LAKE, JUNE 2011 TO OCTOBER 2019

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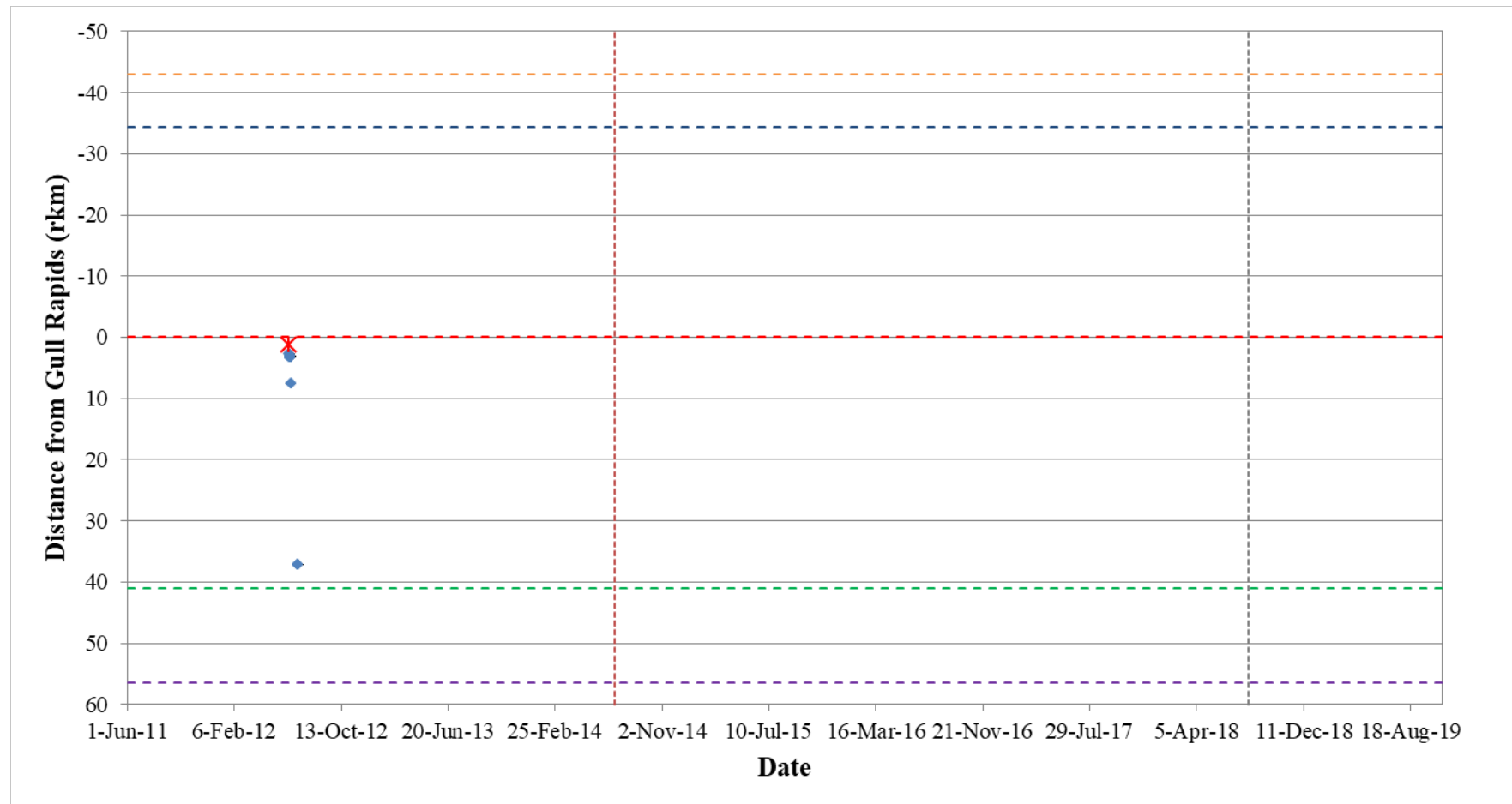


Figure A3-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16018) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

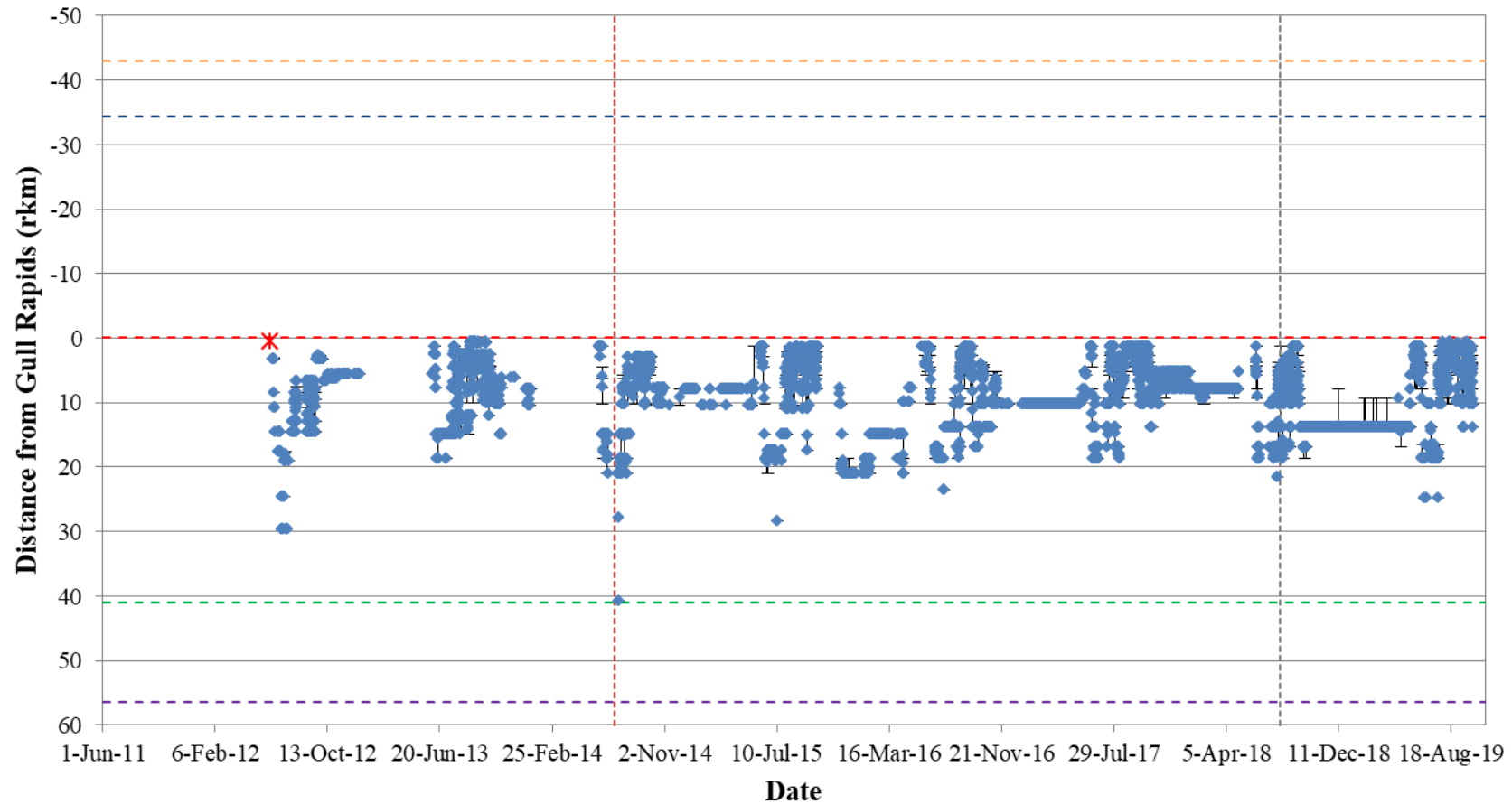


Figure A3-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16019) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

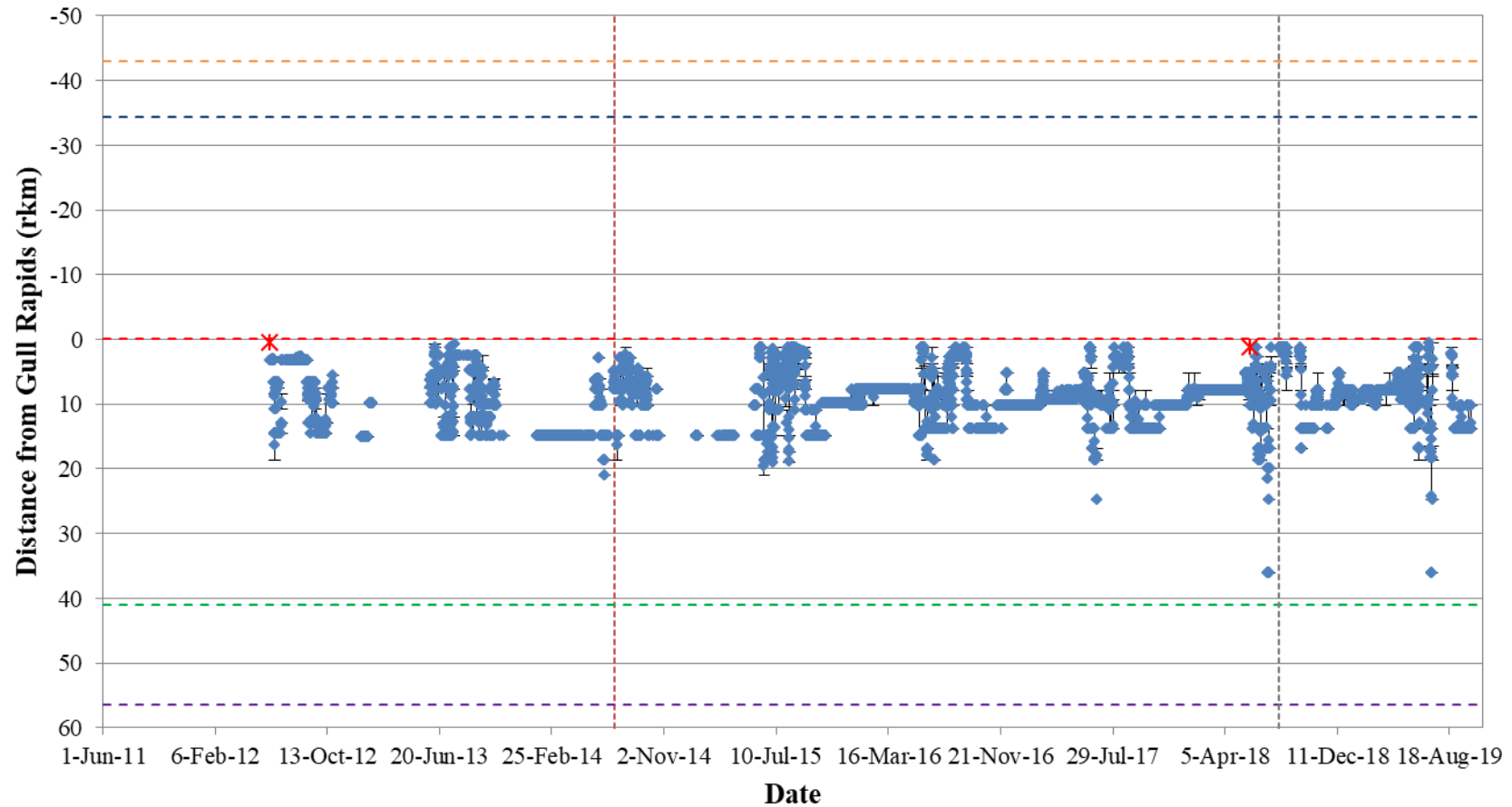


Figure A3-3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16020) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

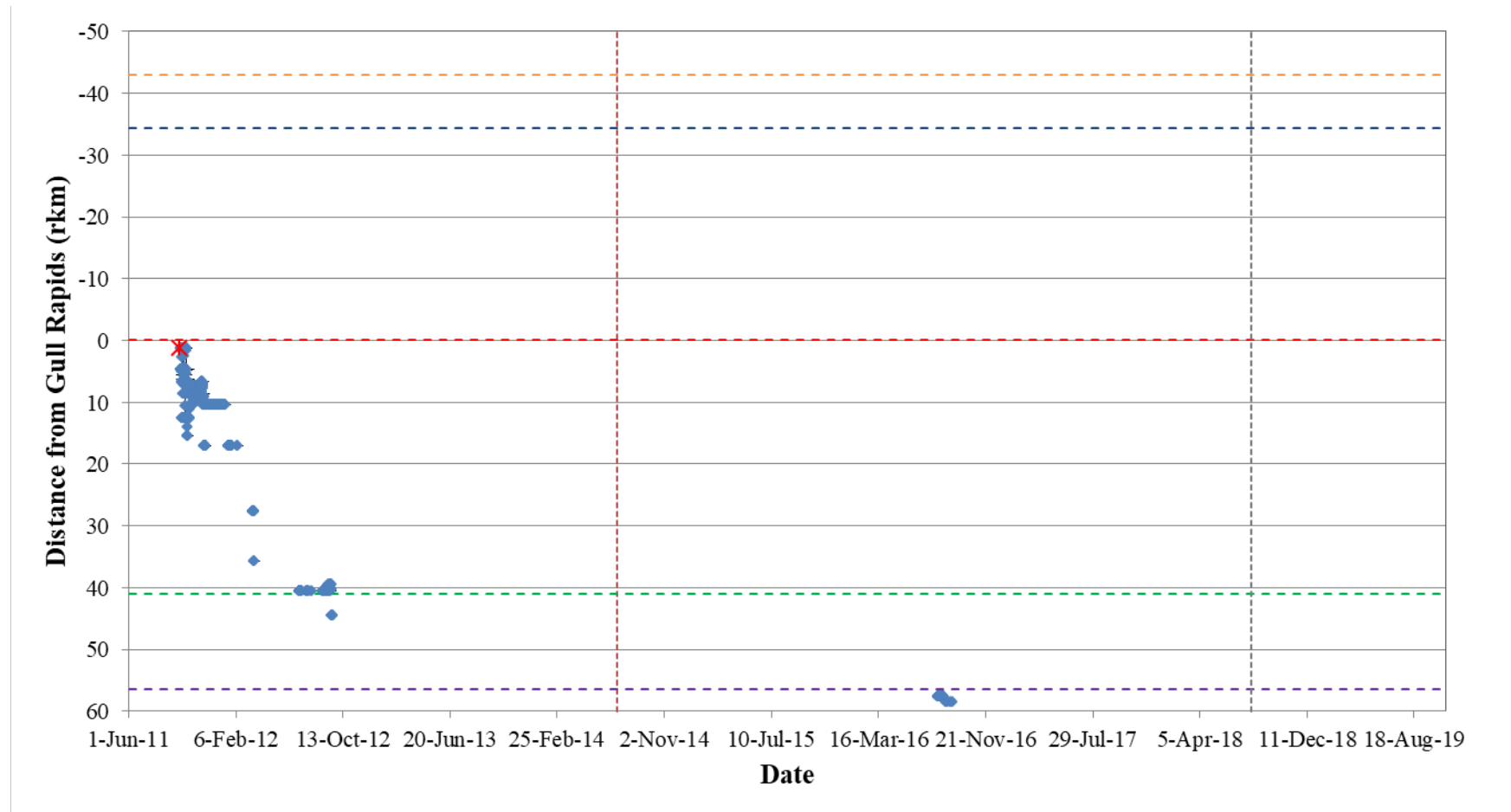


Figure A3-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16021) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

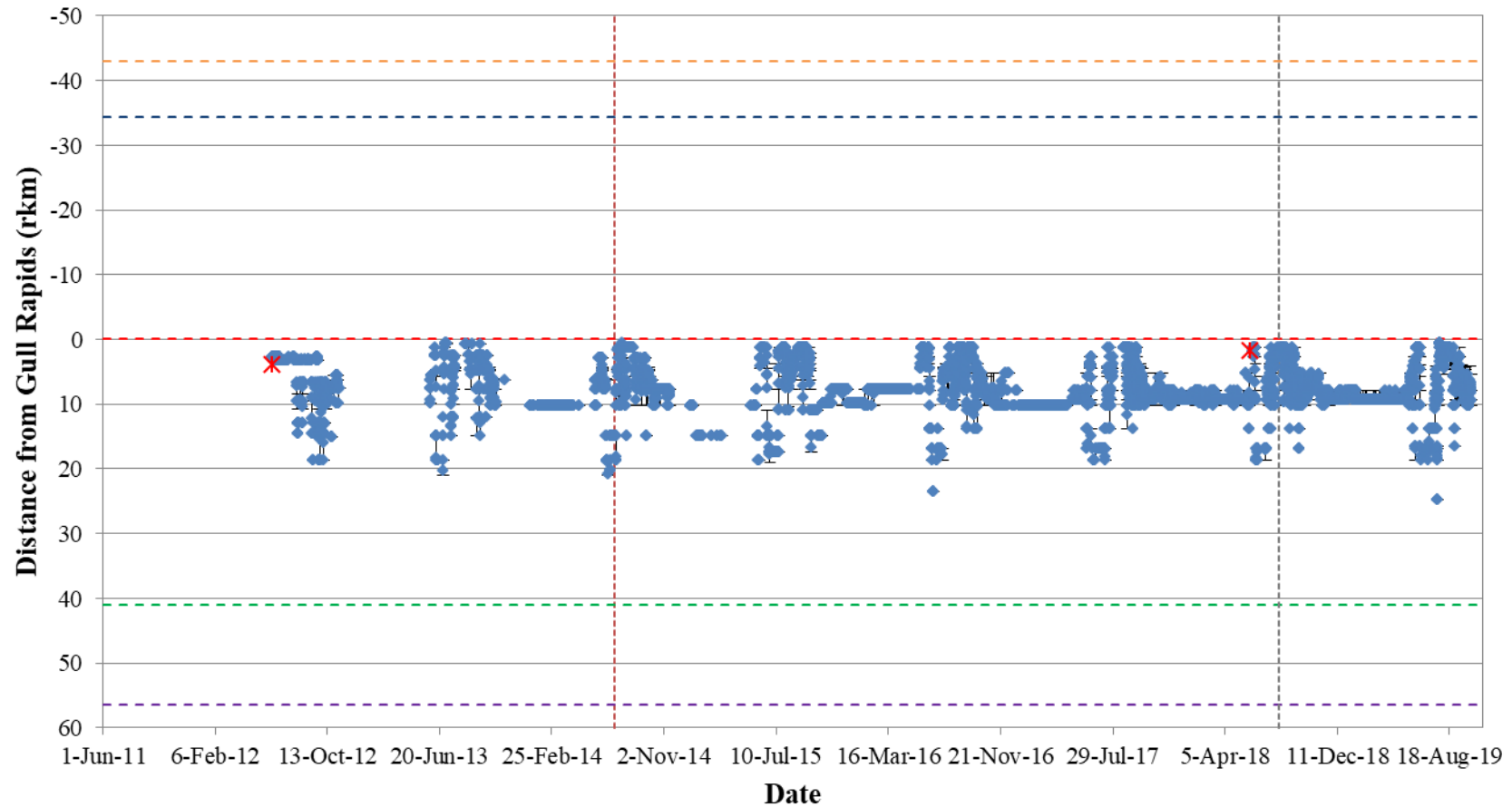


Figure A3-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16022) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

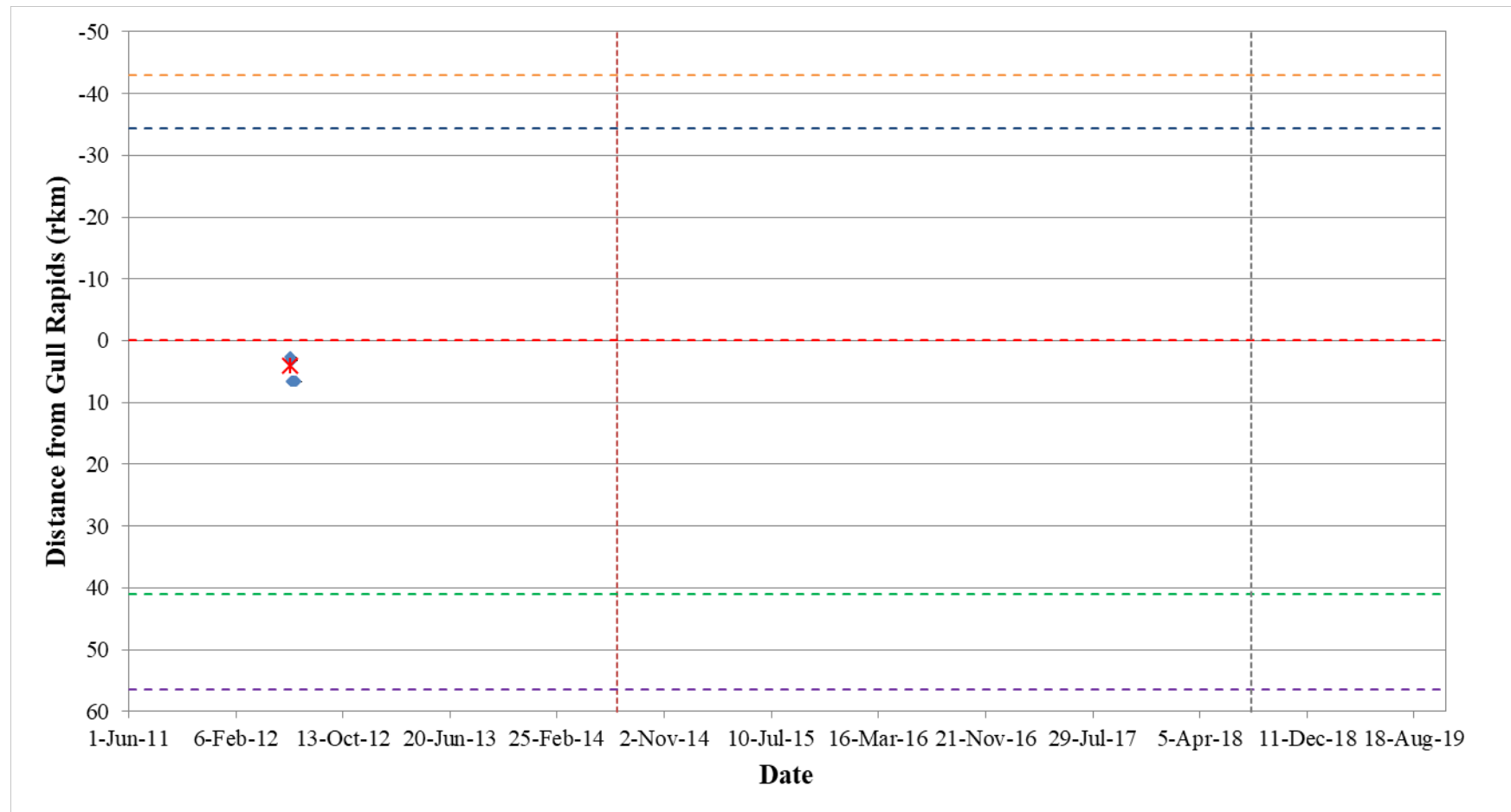


Figure A 3-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16024) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

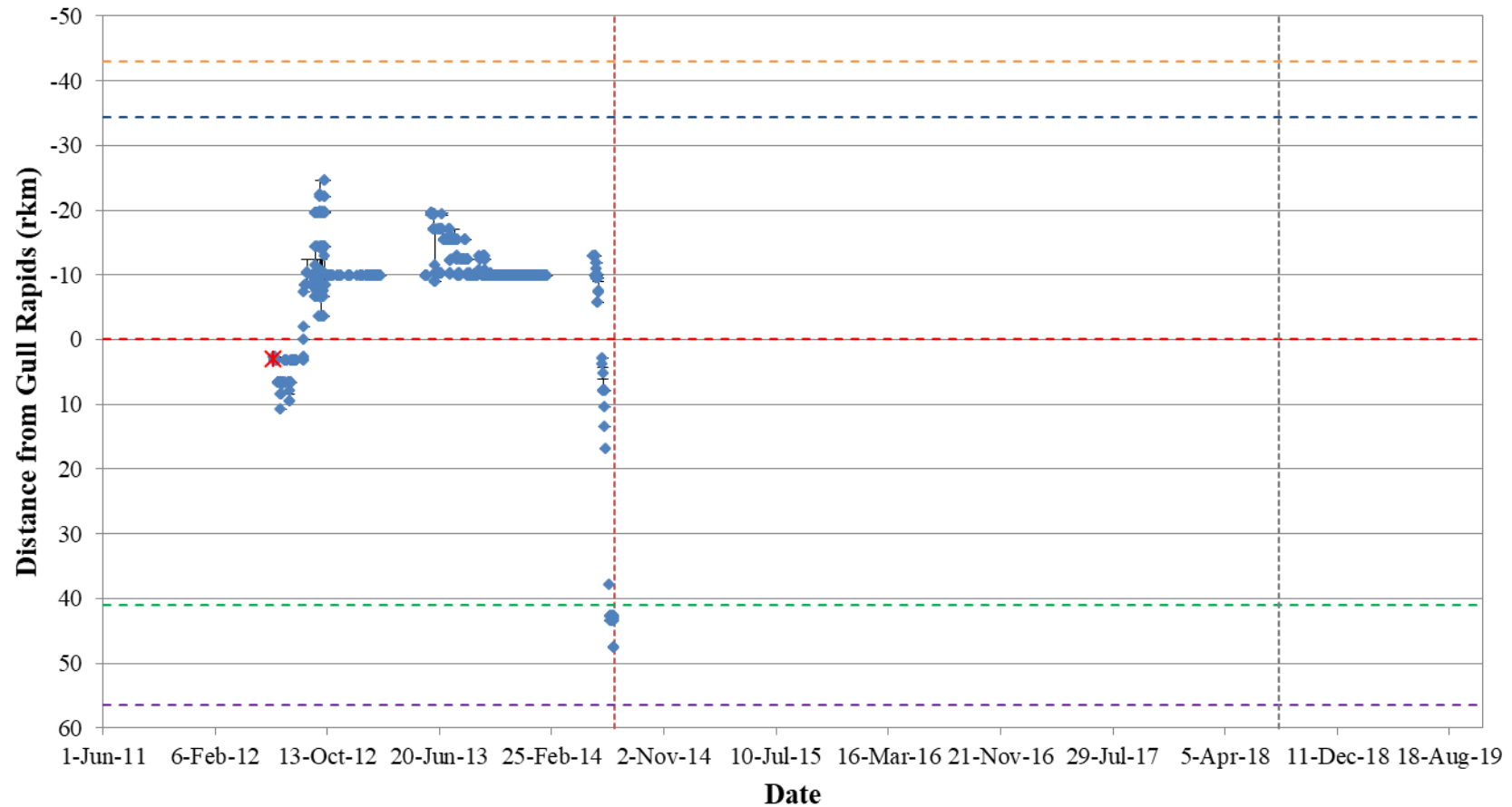


Figure A3-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16025) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

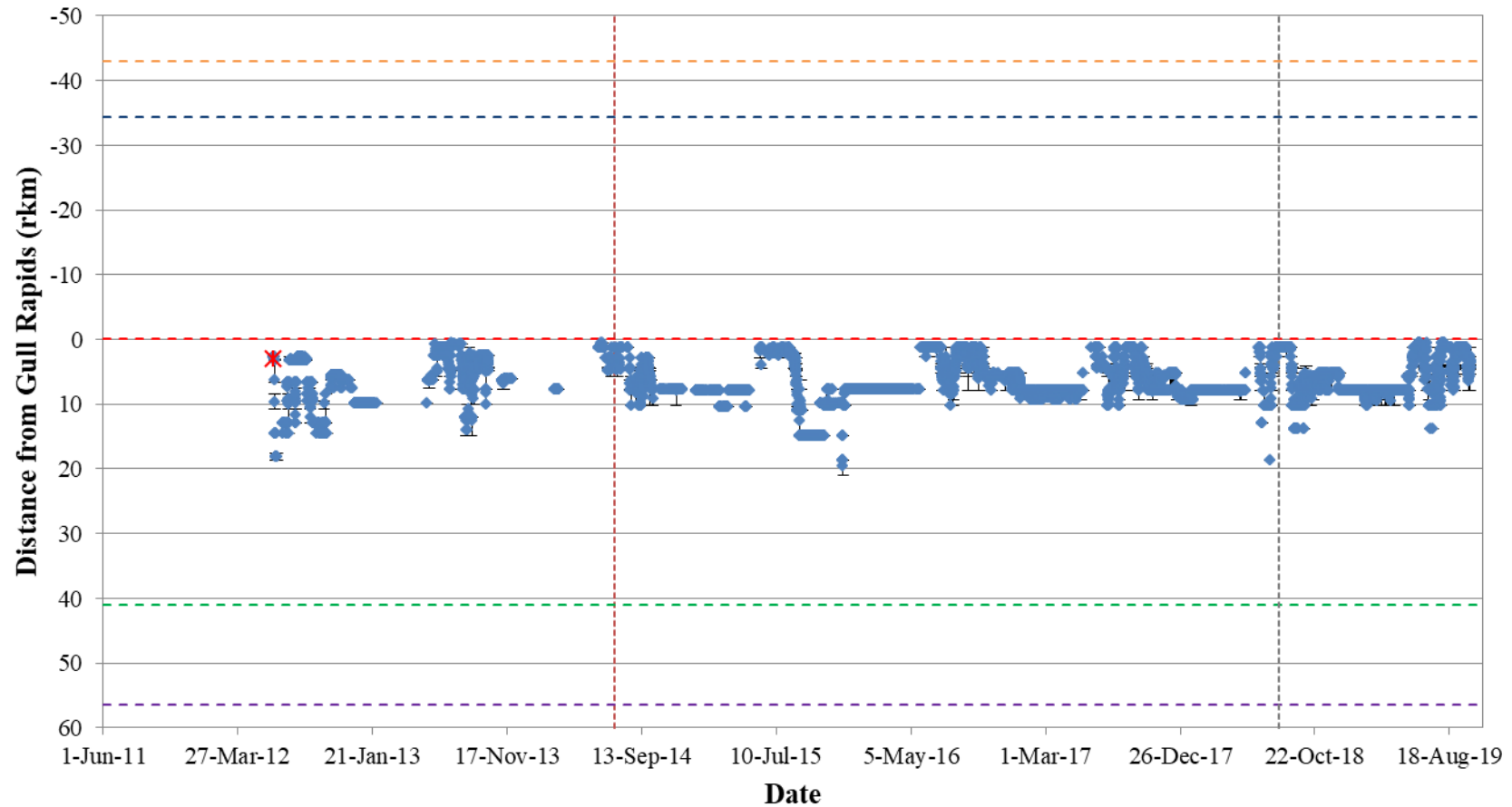


Figure A3-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16027) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

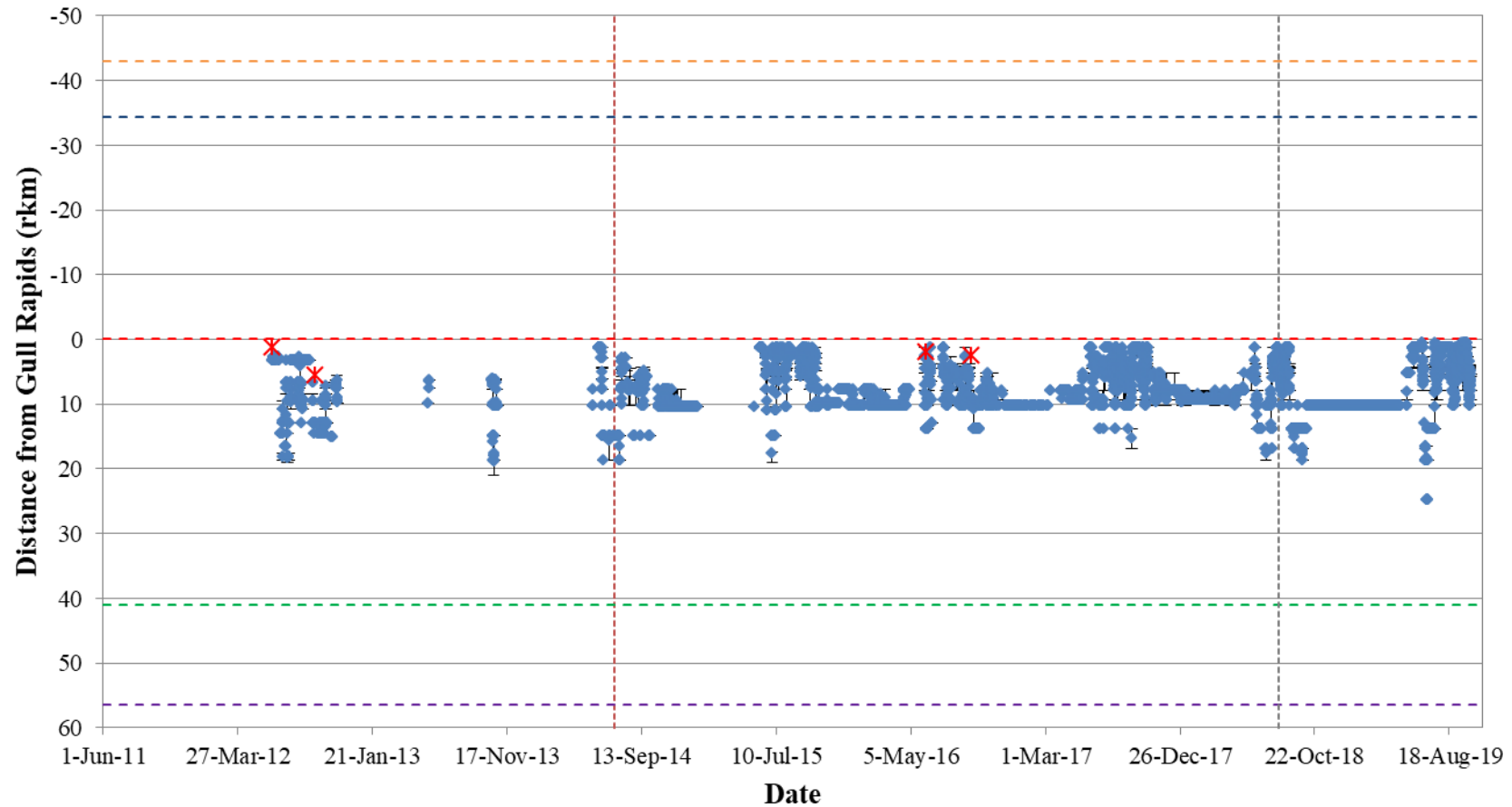


Figure A3-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16028) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

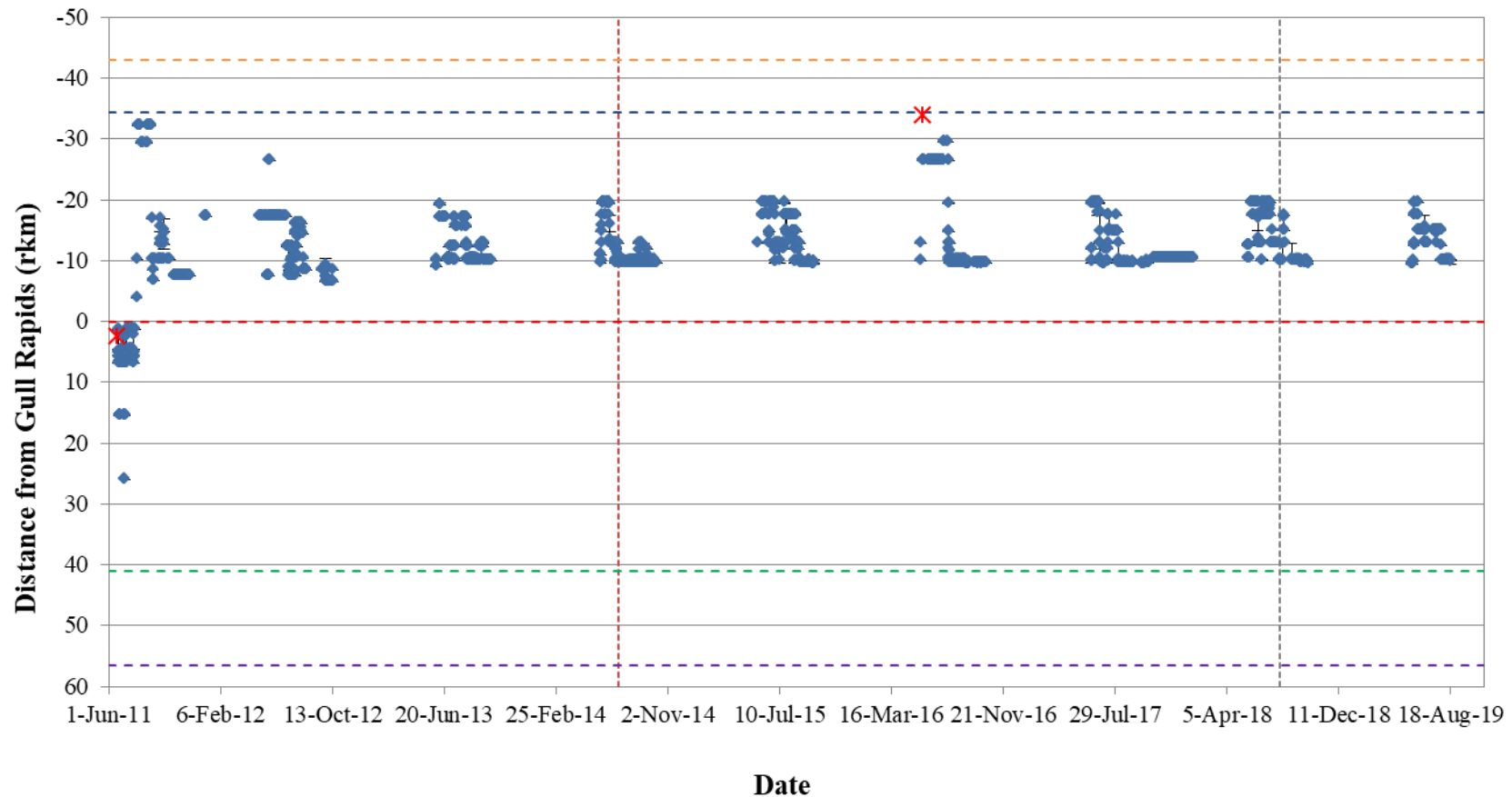


Figure A3-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16029) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

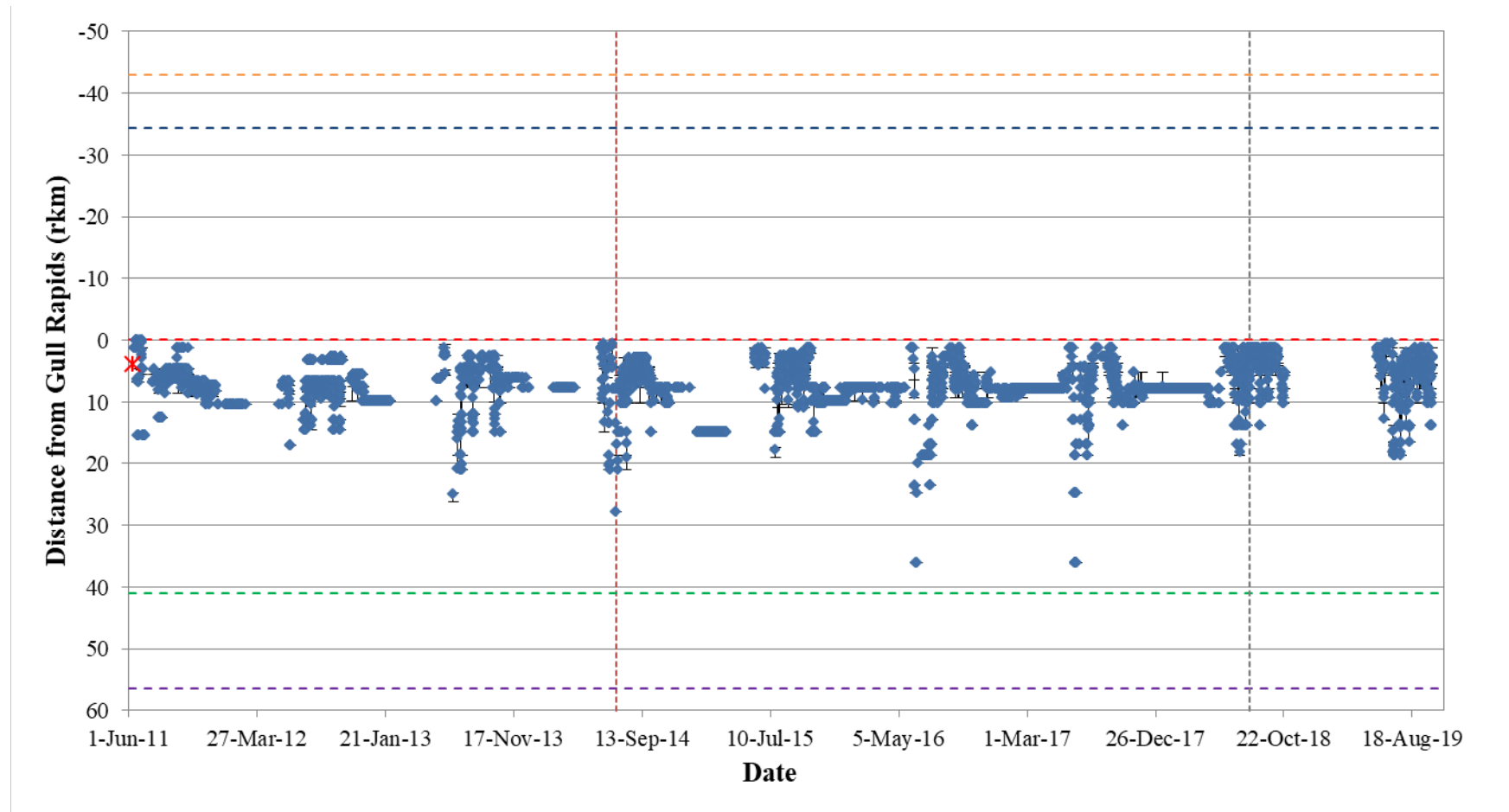


Figure A3-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16030) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

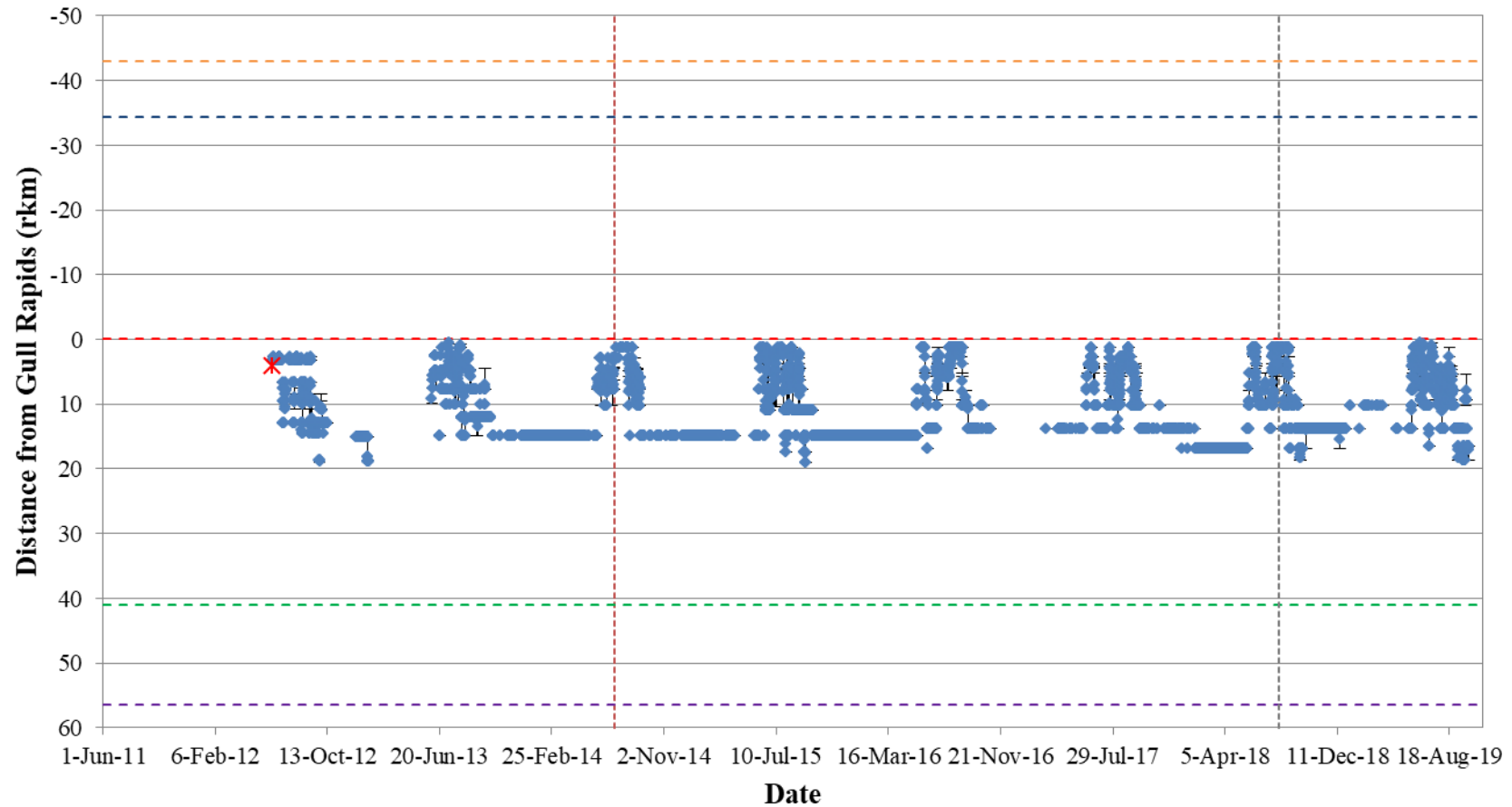


Figure A3-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16031) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

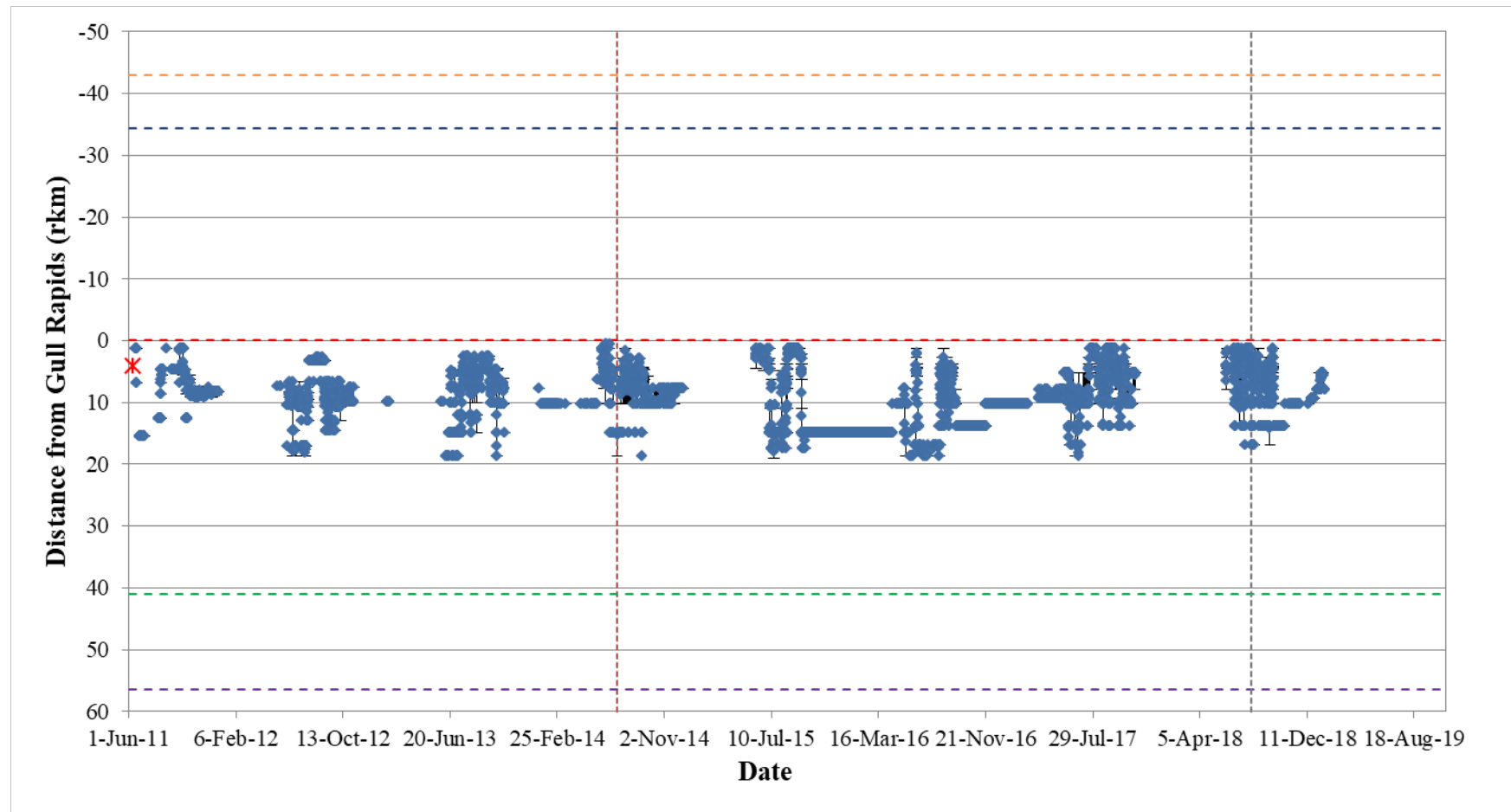


Figure A3-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16032) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

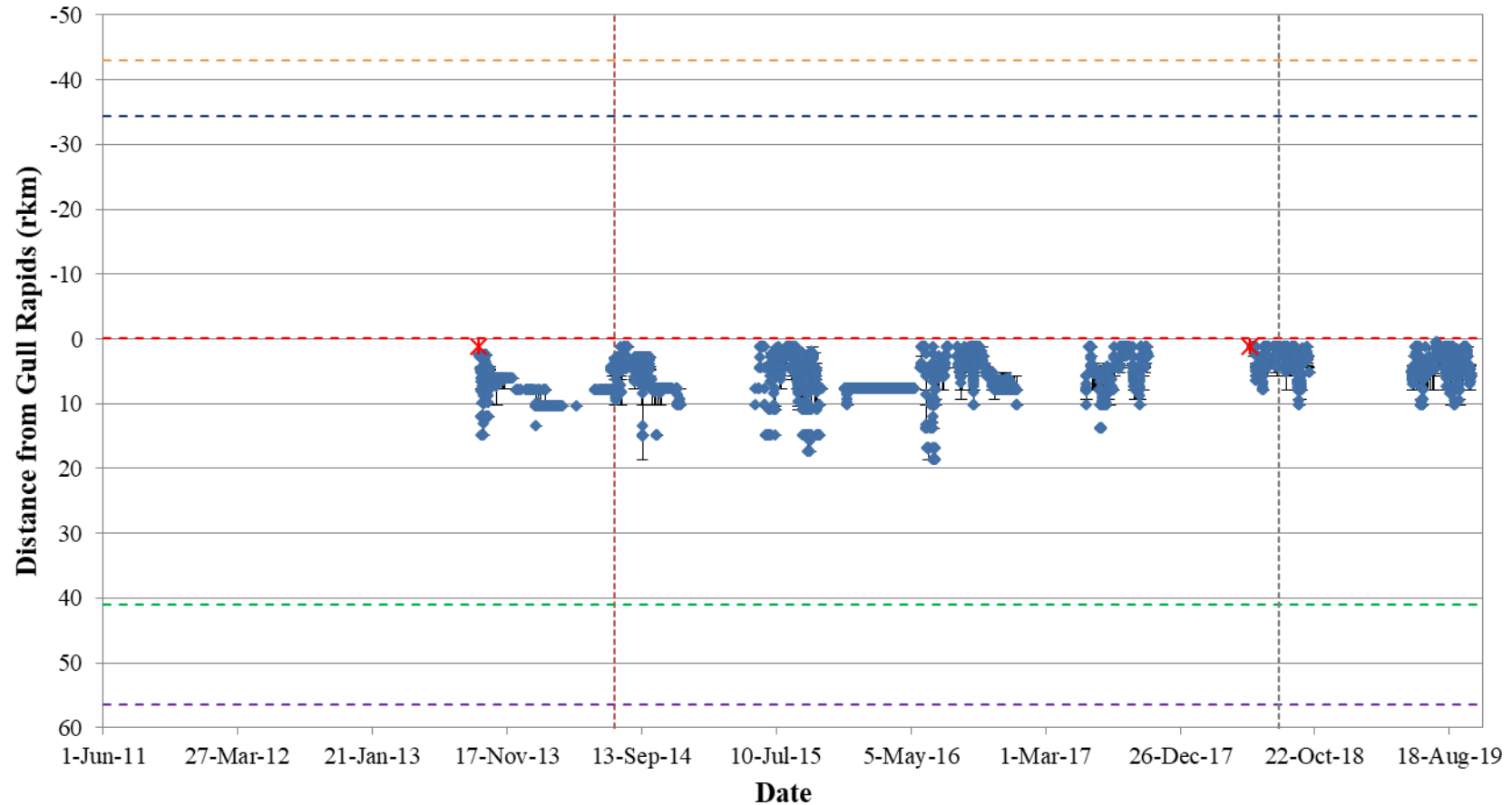


Figure A3-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16033b) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recapture is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

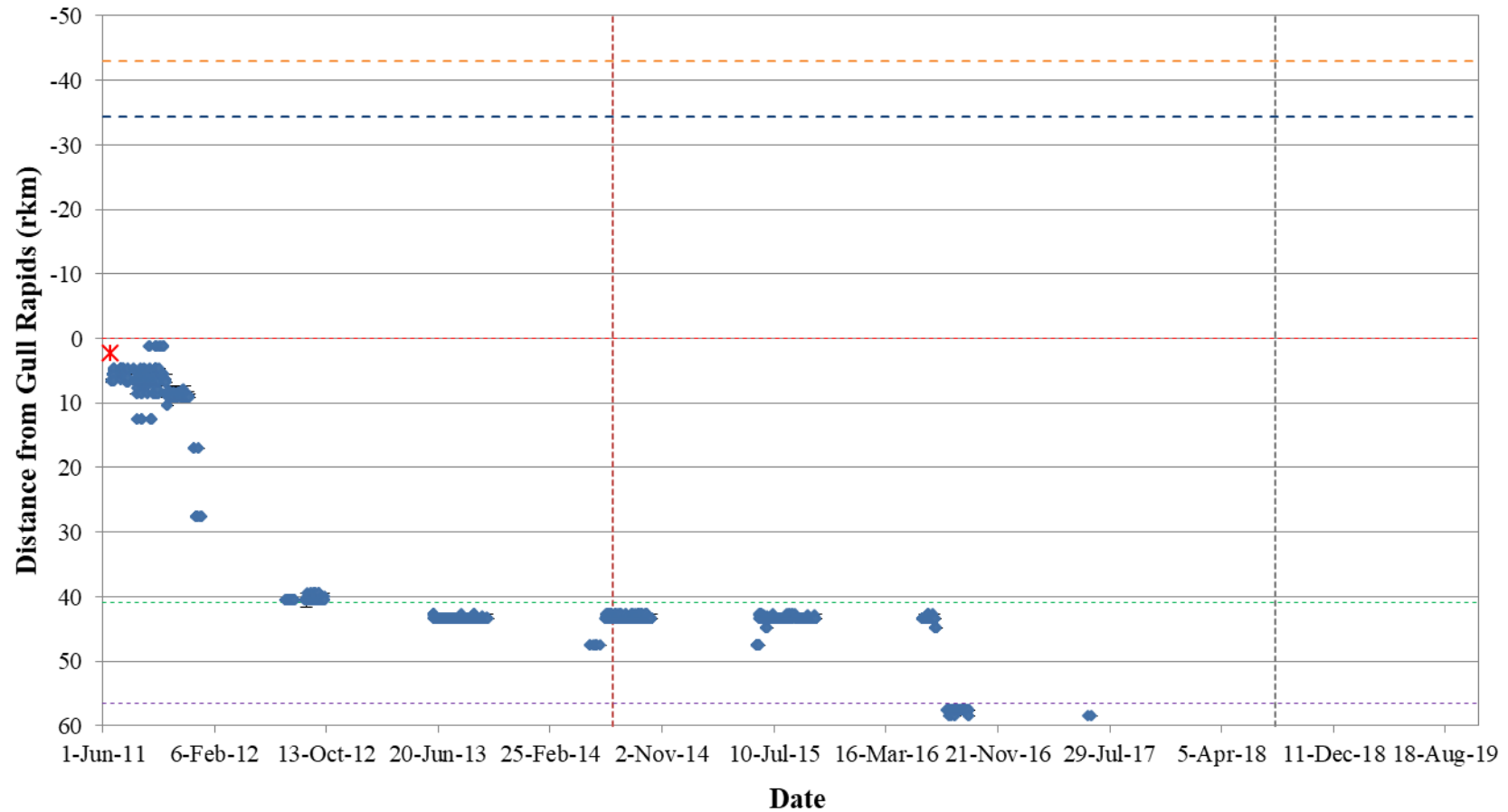


Figure A3-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16034) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

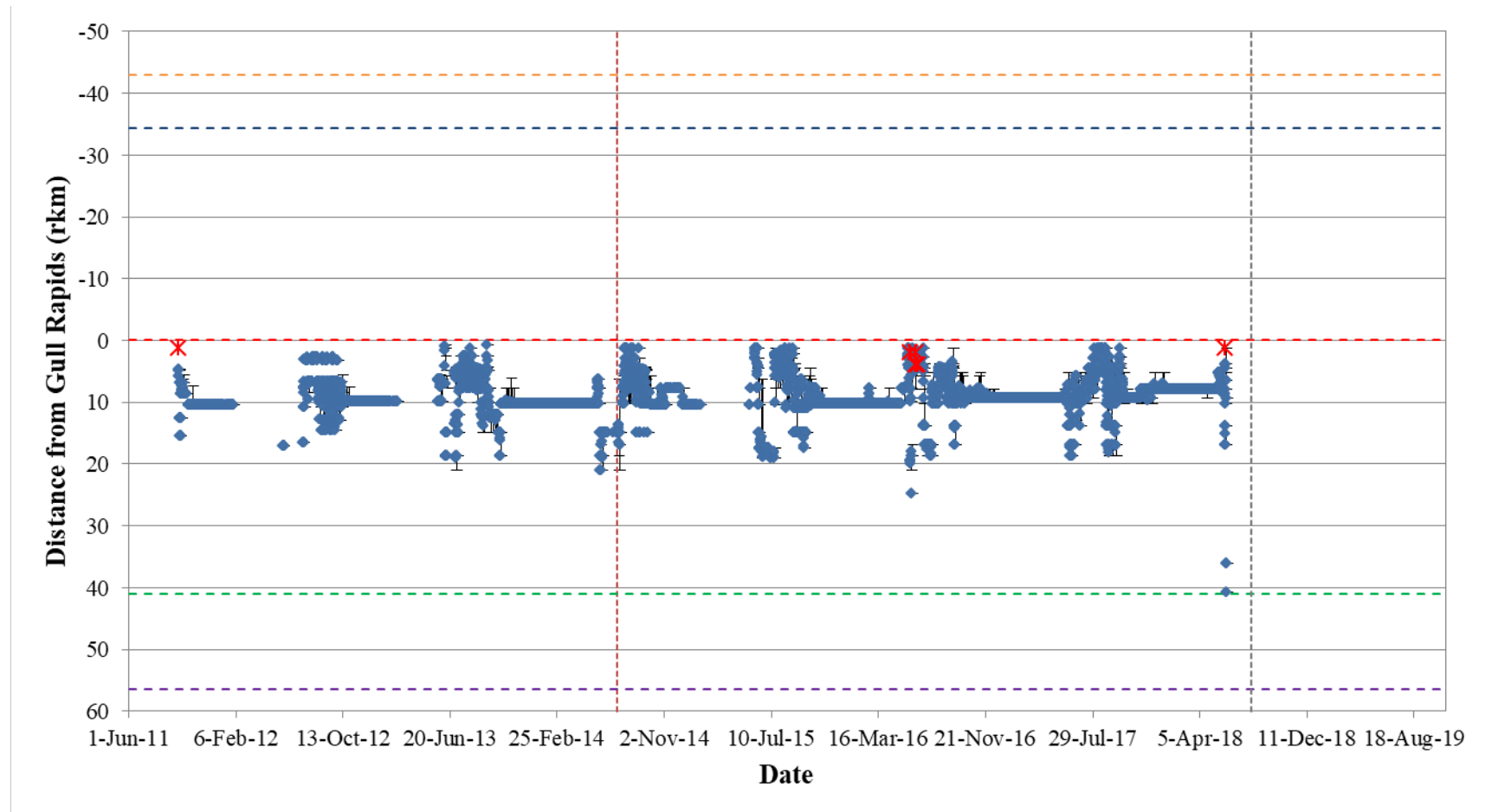


Figure A3-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16035) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

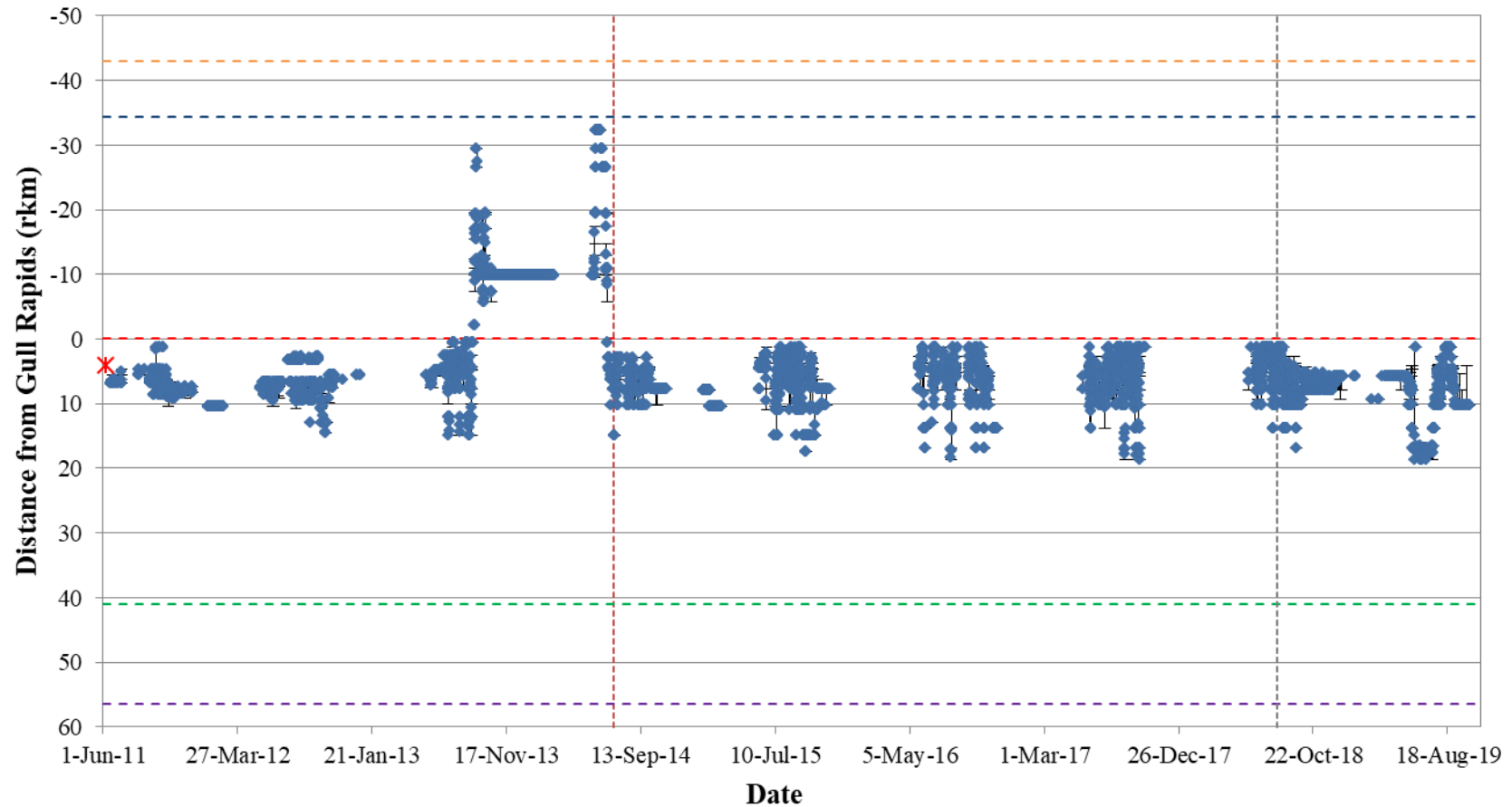


Figure A3-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16037) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

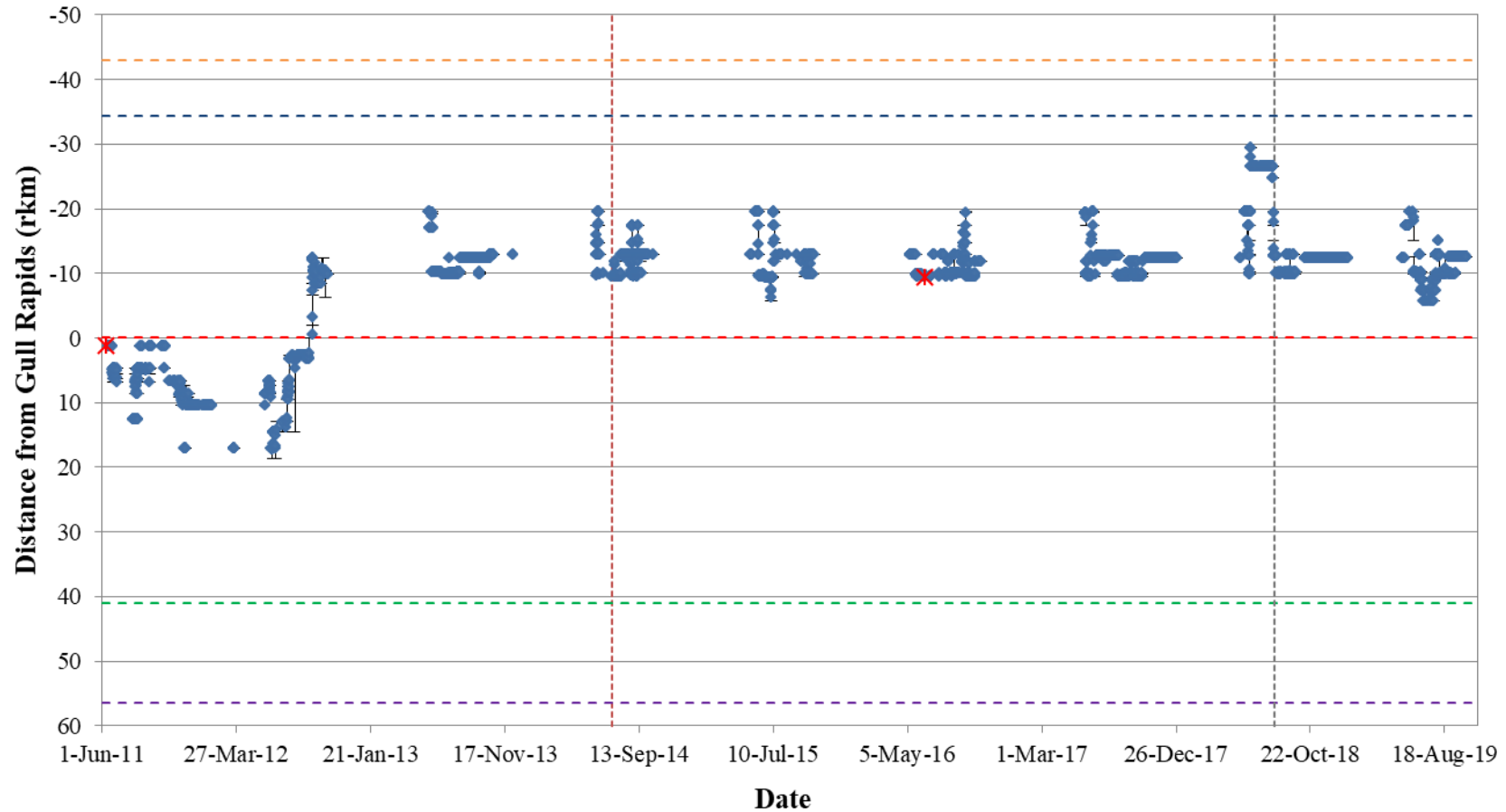


Figure A3-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16038) in Stephens Lake in relation to the Keyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keyask construction is indicated with a vertical dotted red line. Beginning of Keyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keyask GS; green = Kettle GS; purple = Long Spruce GS).

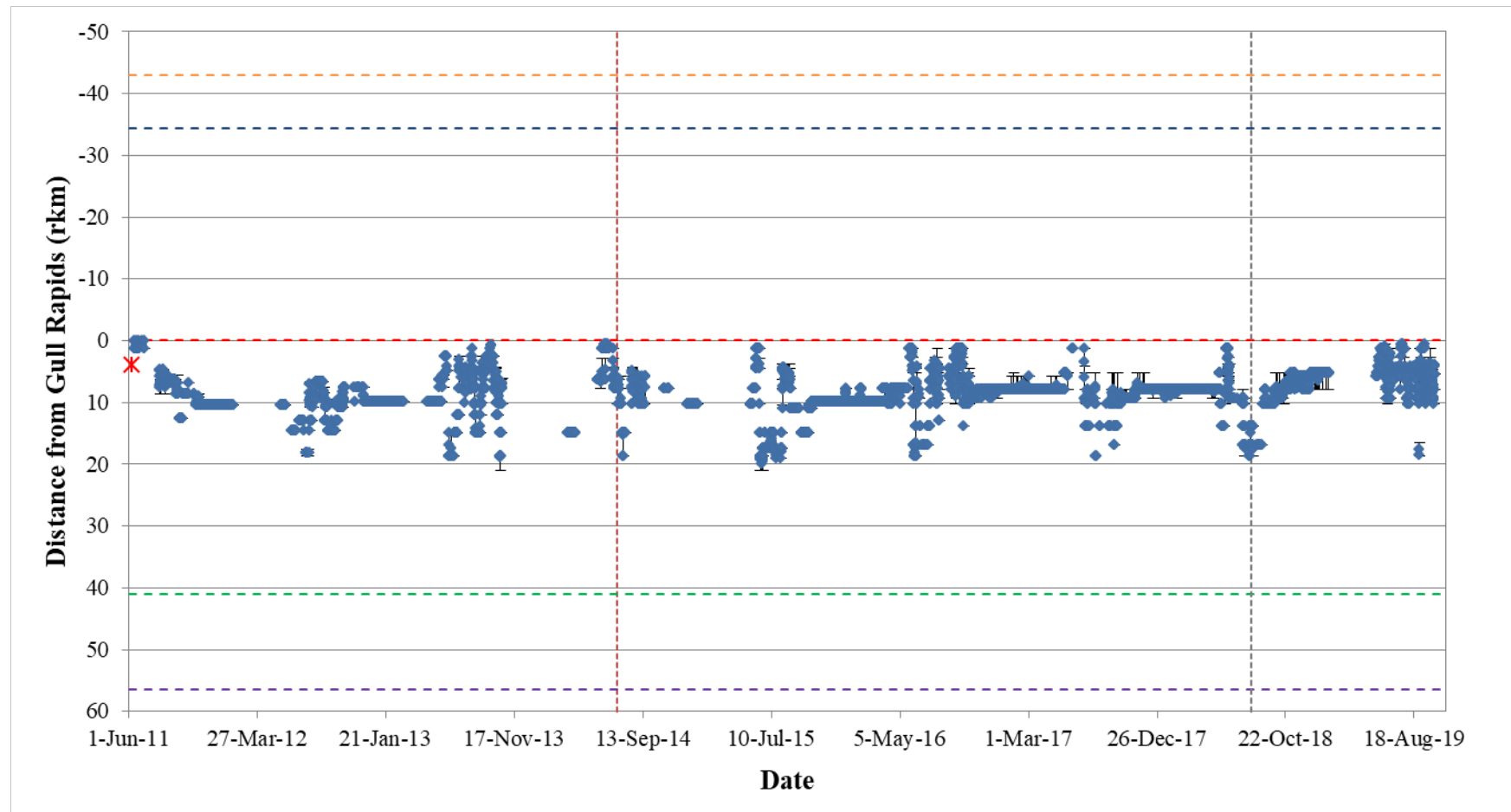


Figure A3-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16040) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

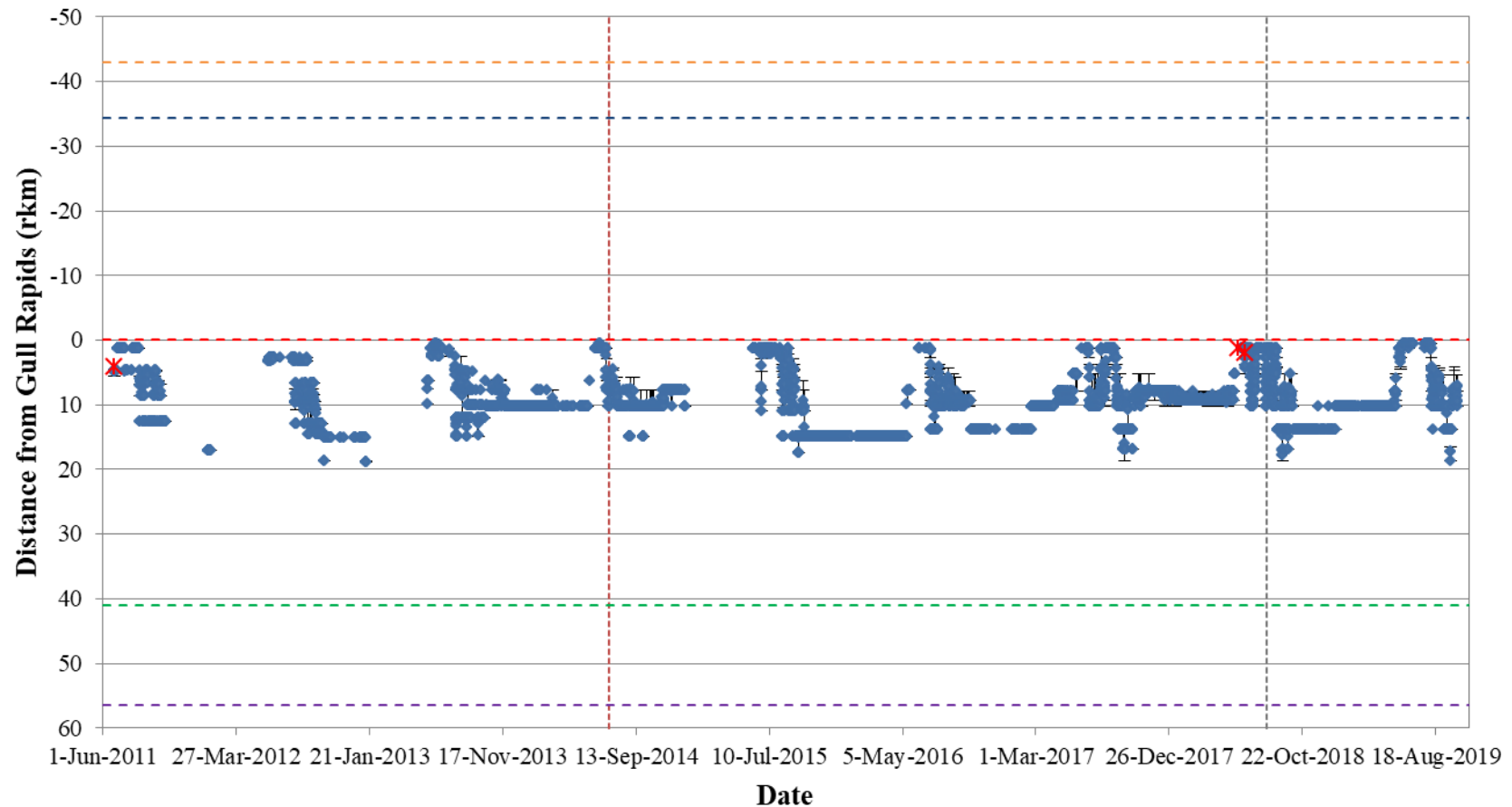


Figure A3-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16041) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

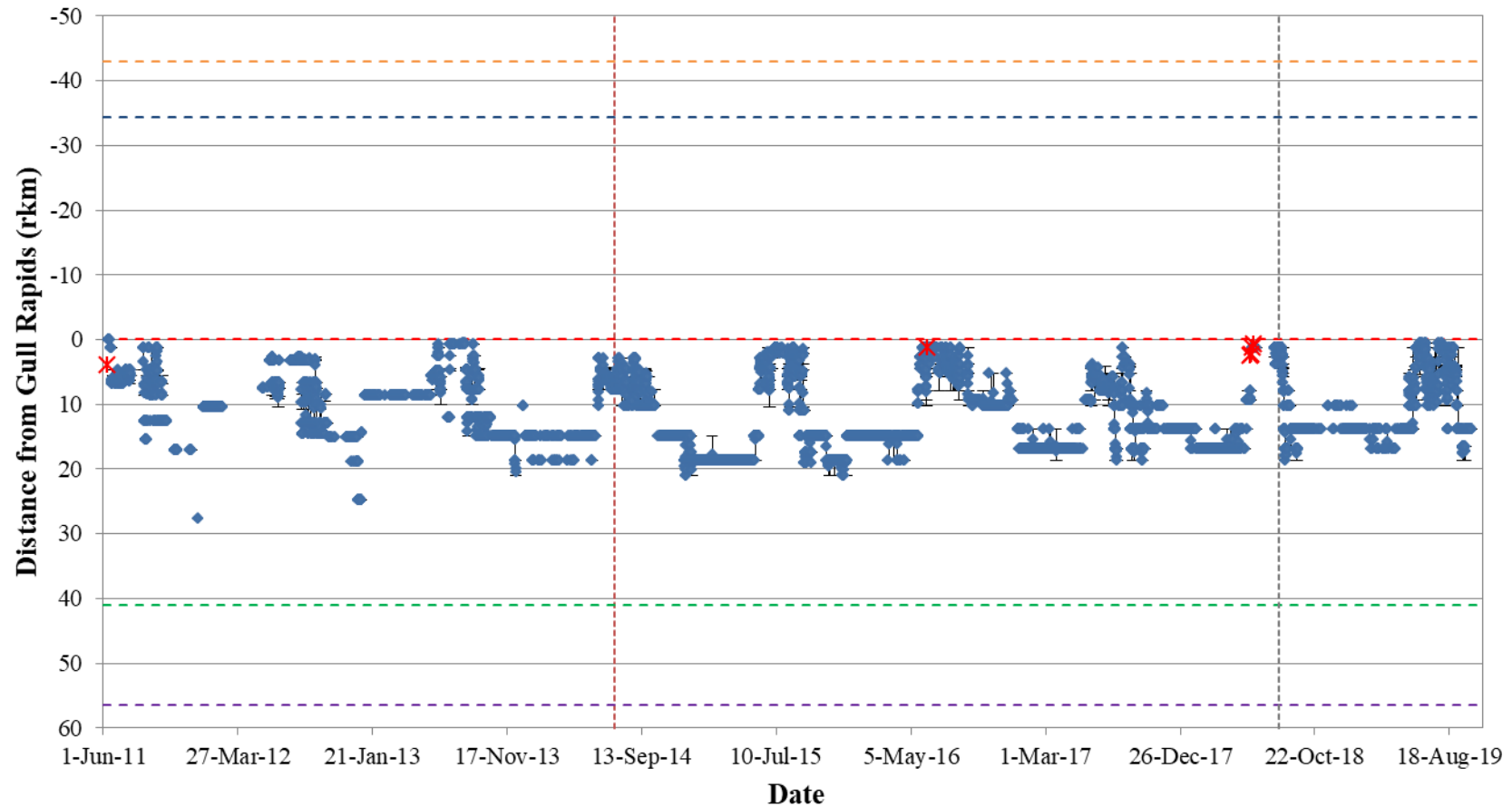


Figure A3-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16043) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

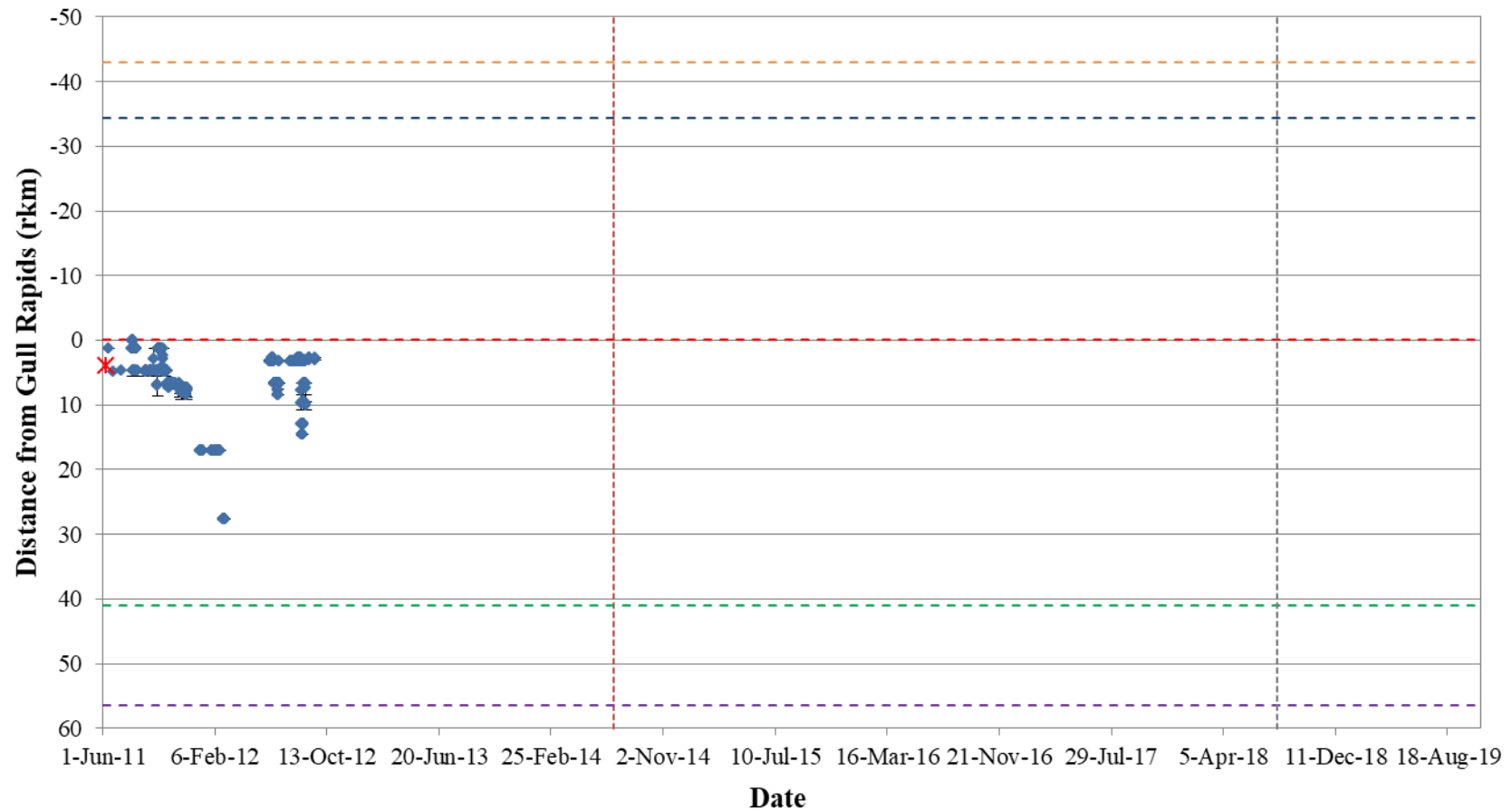


Figure A3-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16044) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

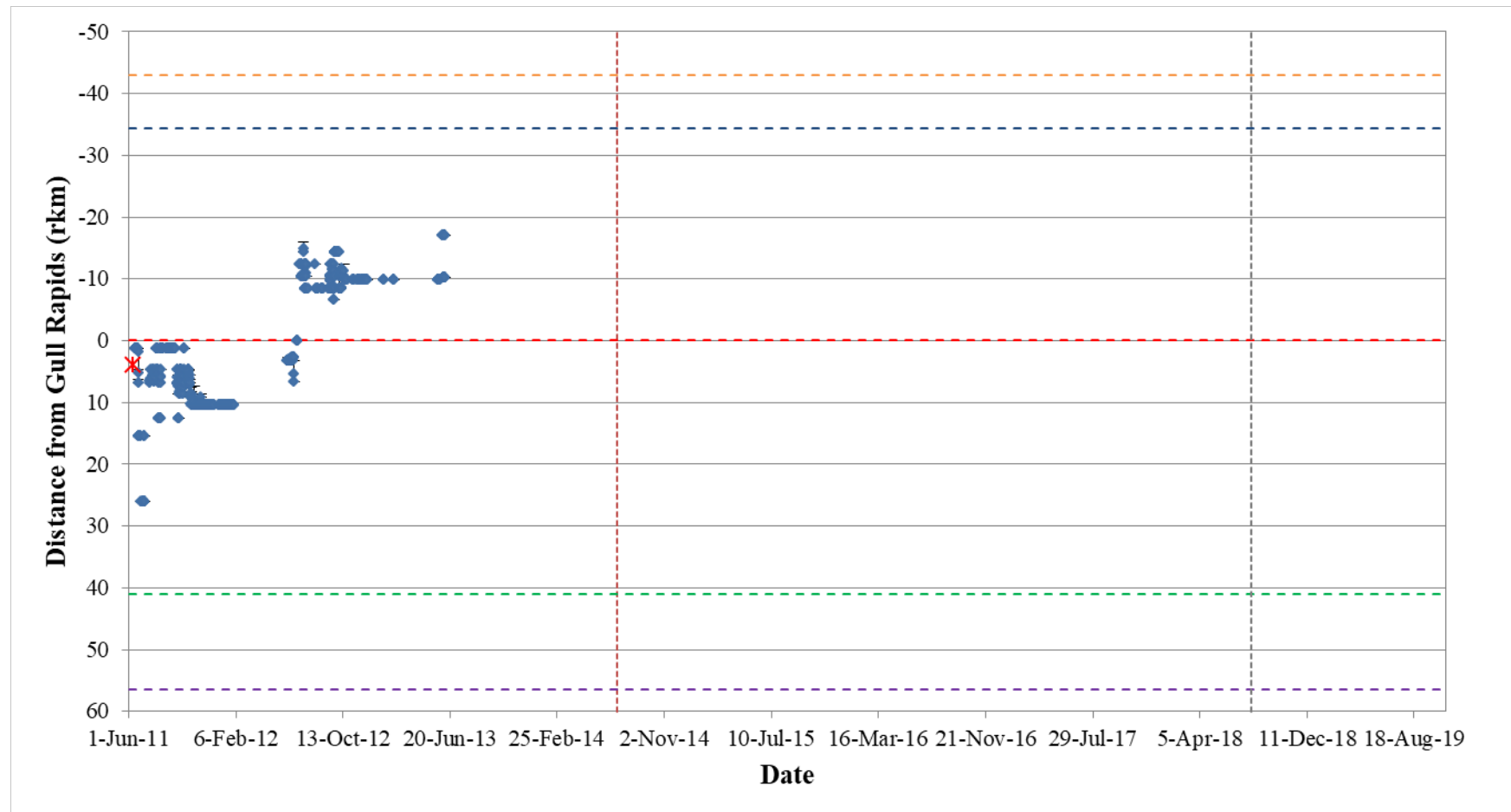


Figure A3-23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16046) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

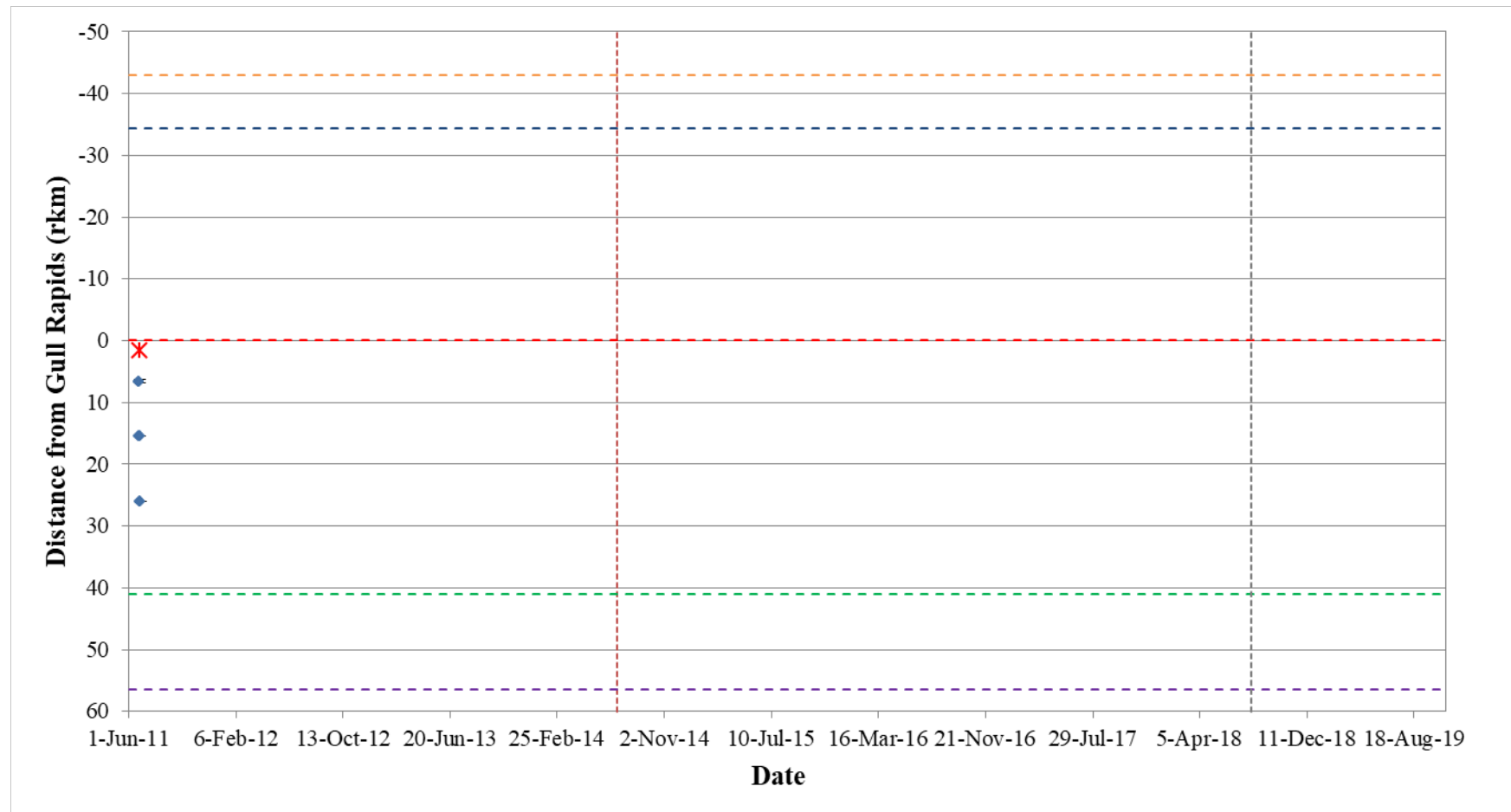


Figure A3-24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16047) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

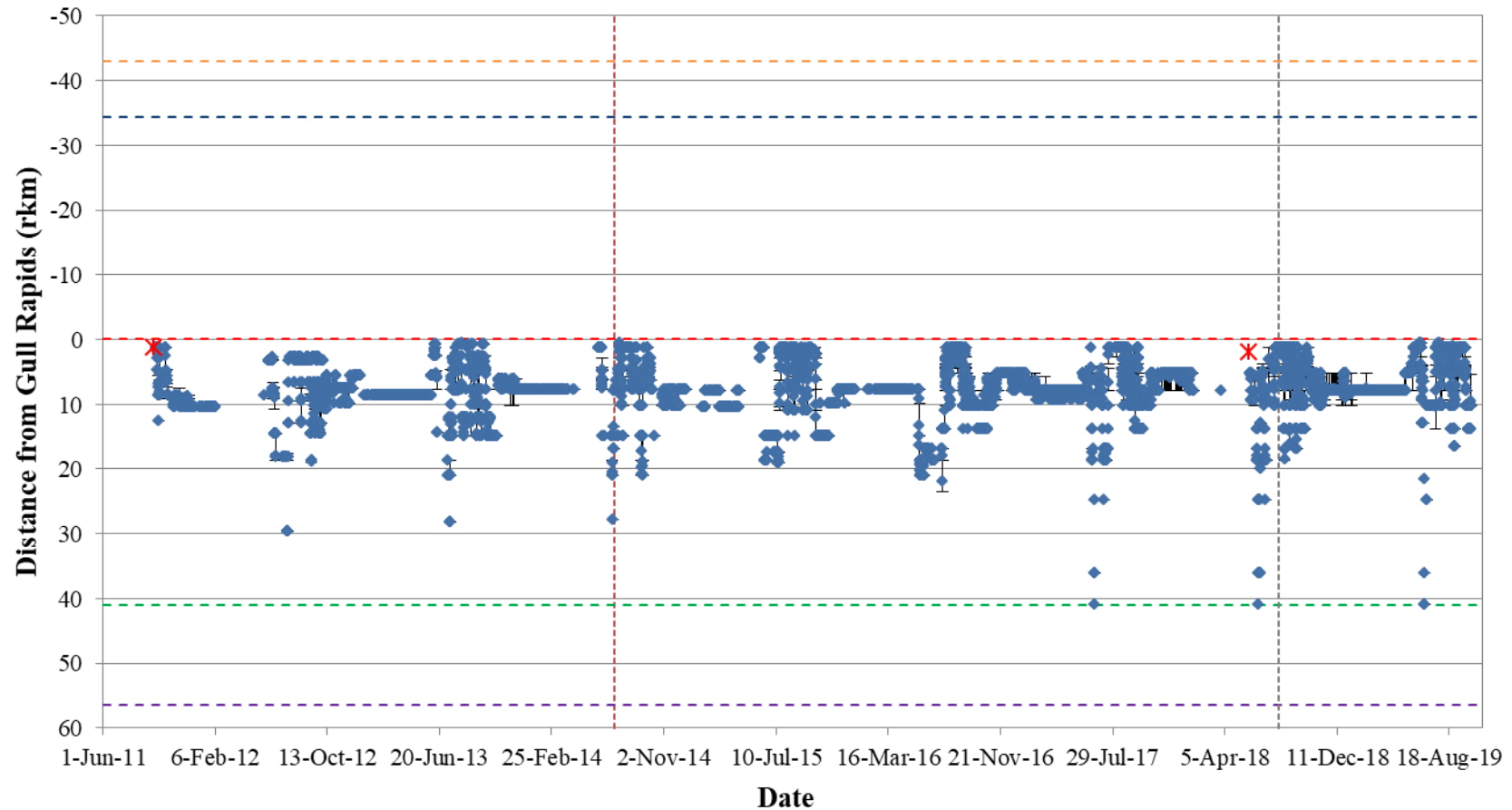


Figure A3-25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16049) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

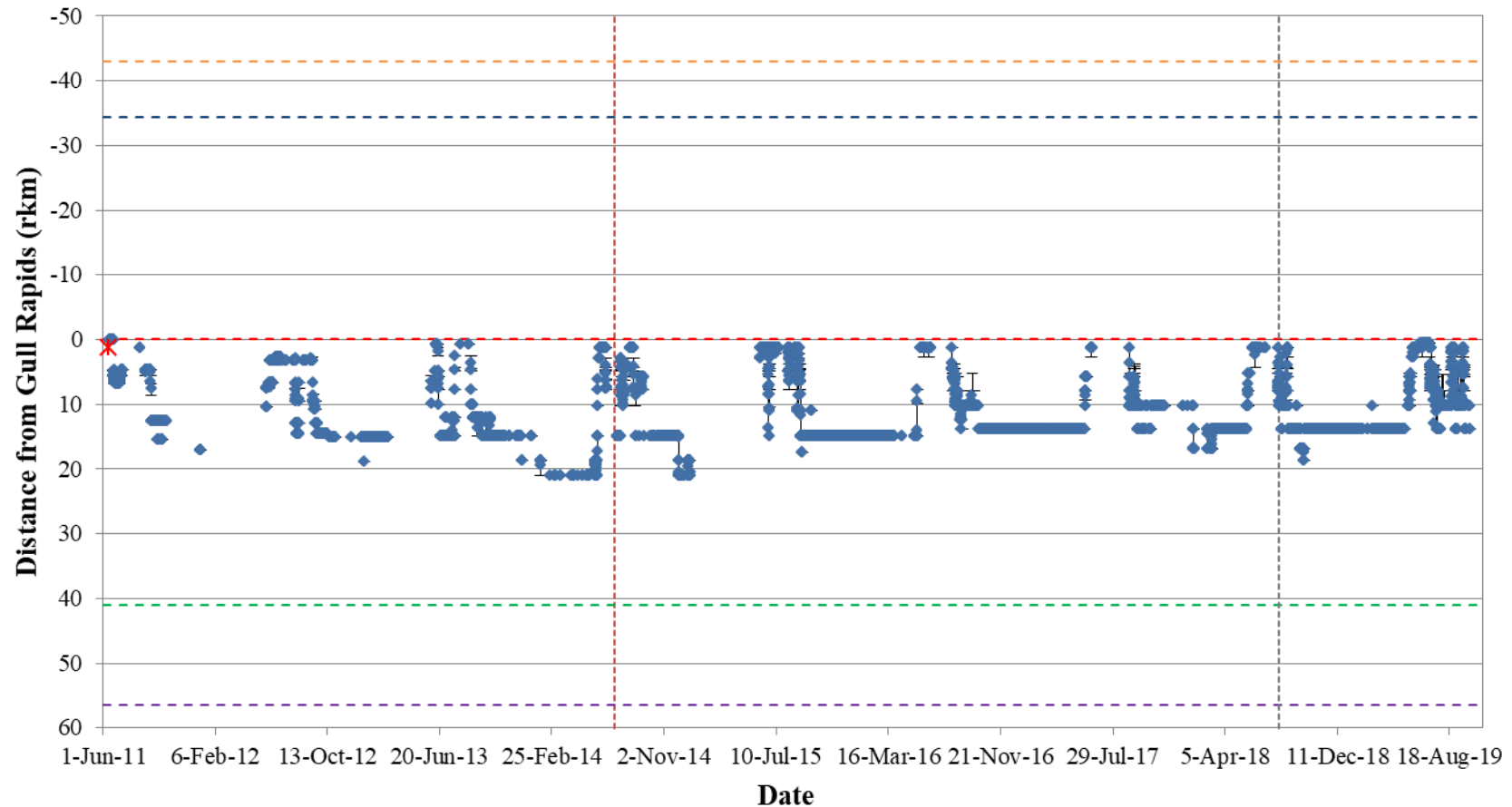


Figure A3-26: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16050) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

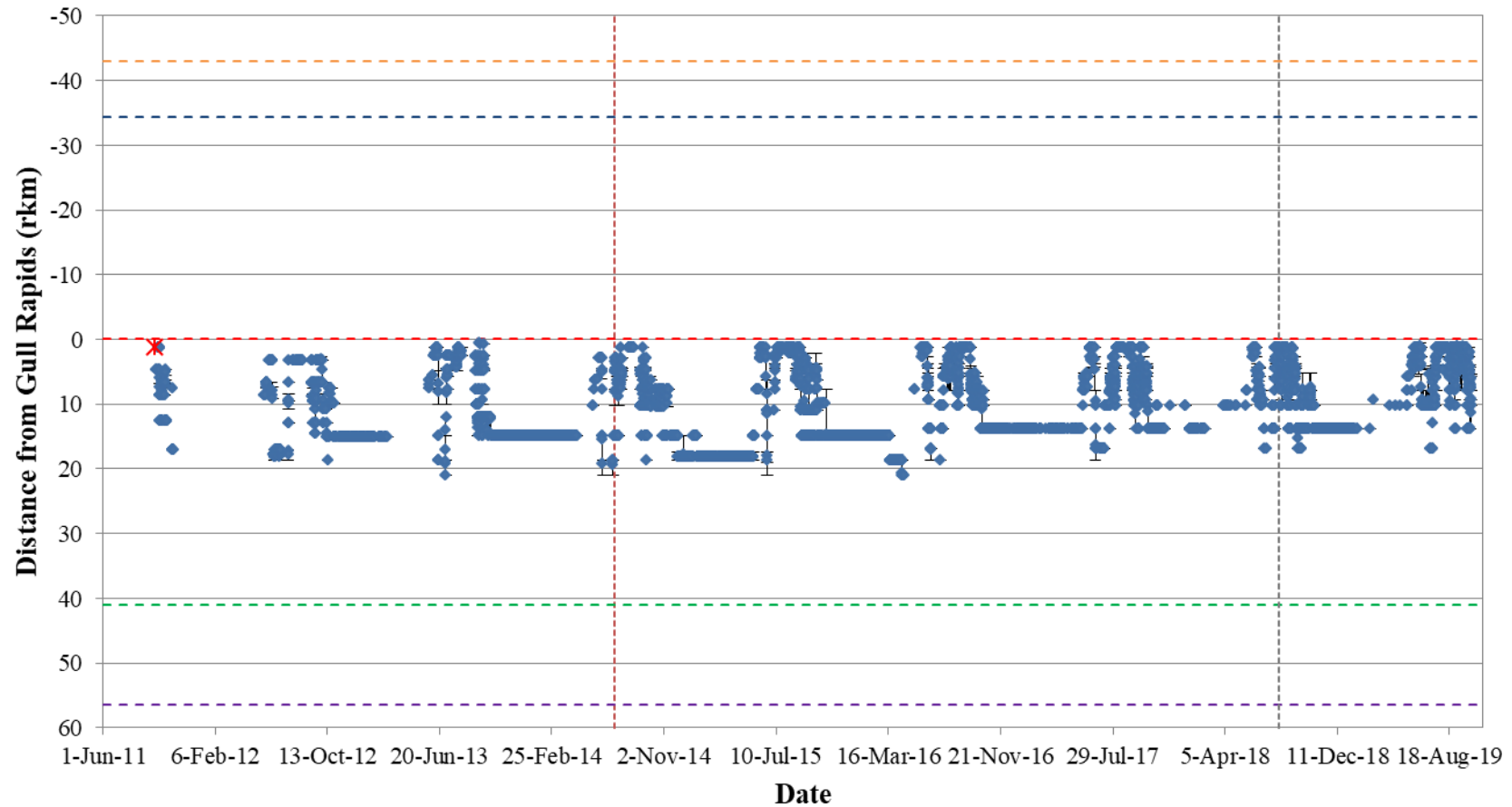


Figure A3-27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16052) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

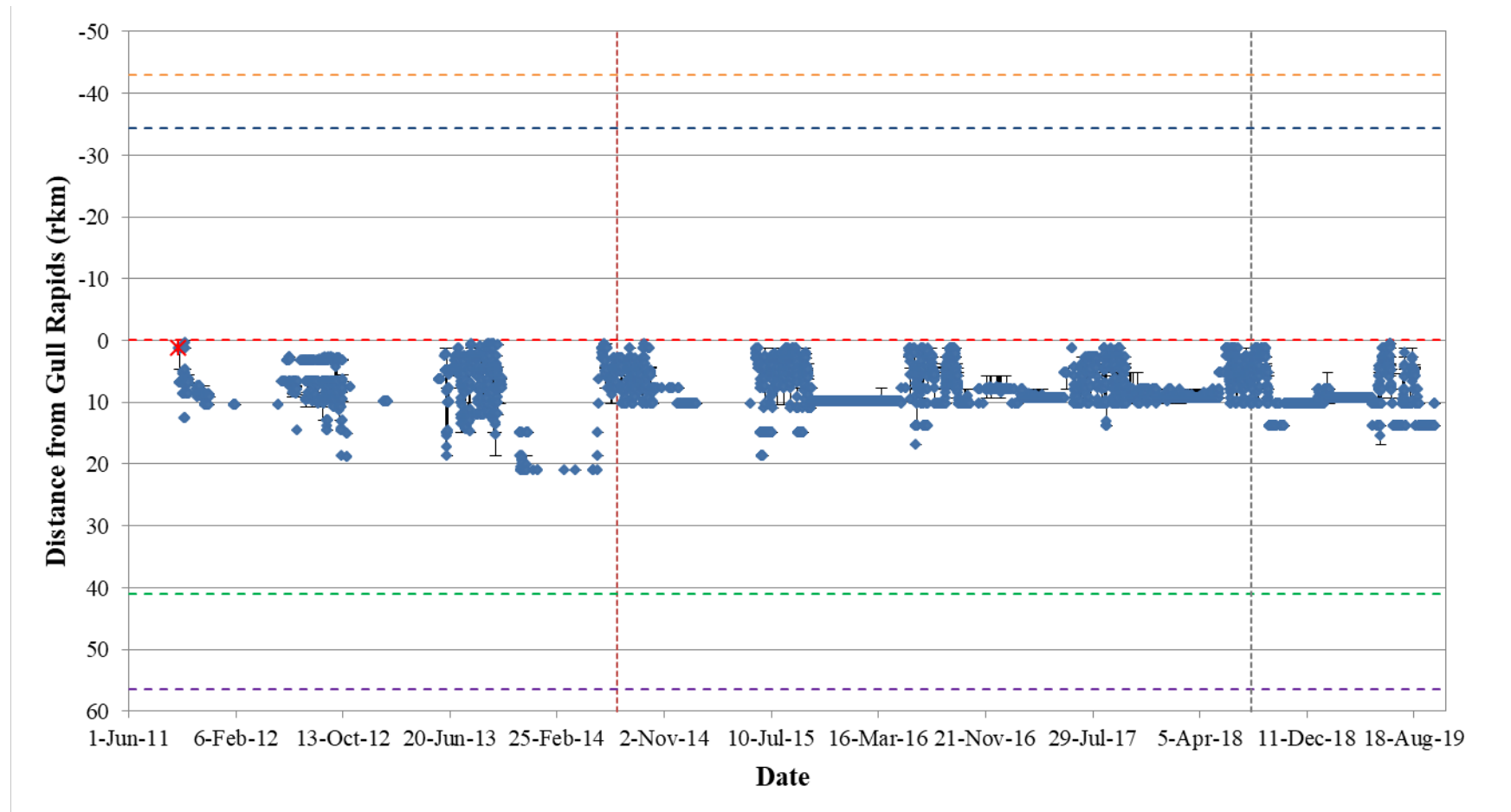


Figure A3-28: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16053) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

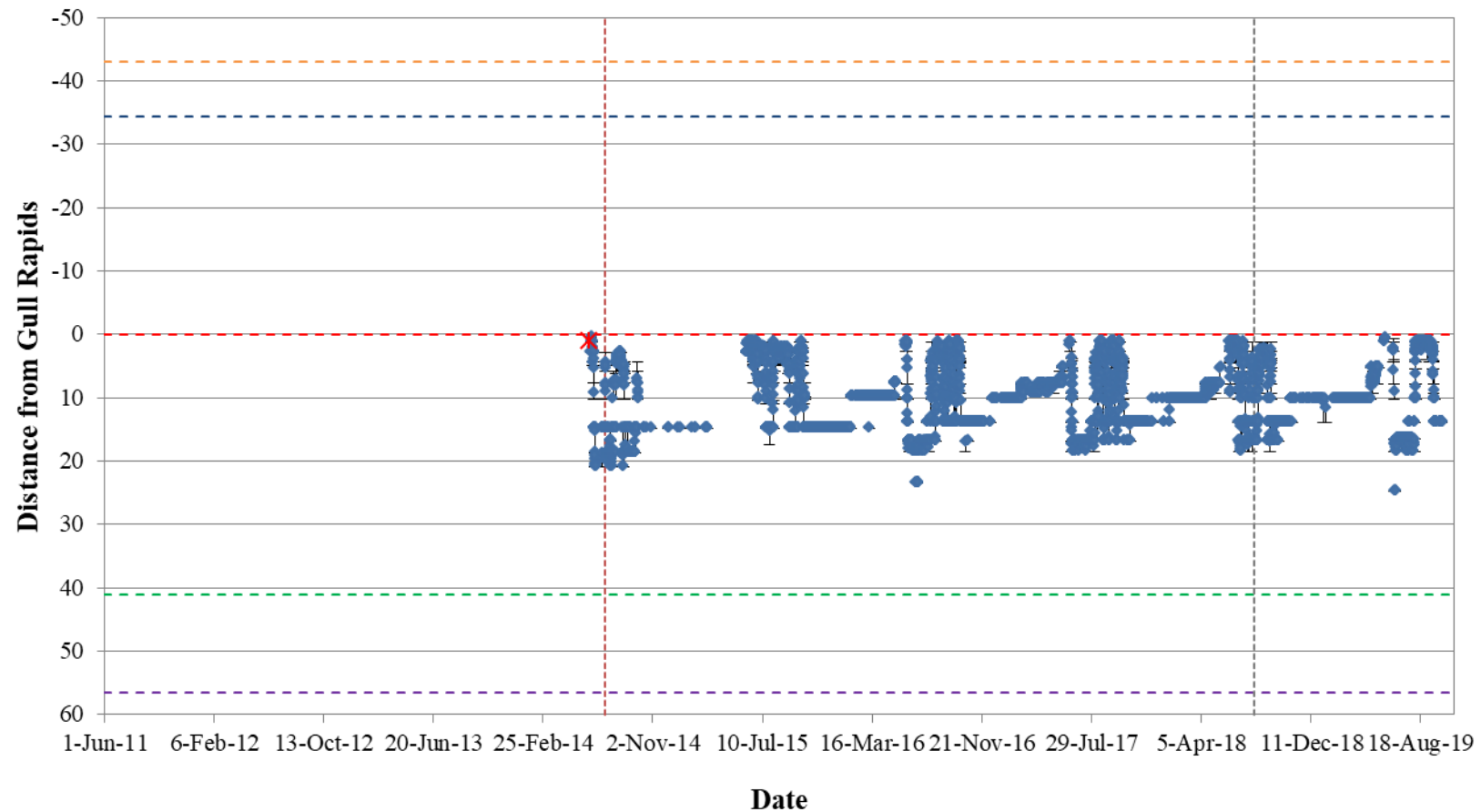


Figure A3-29: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32167) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

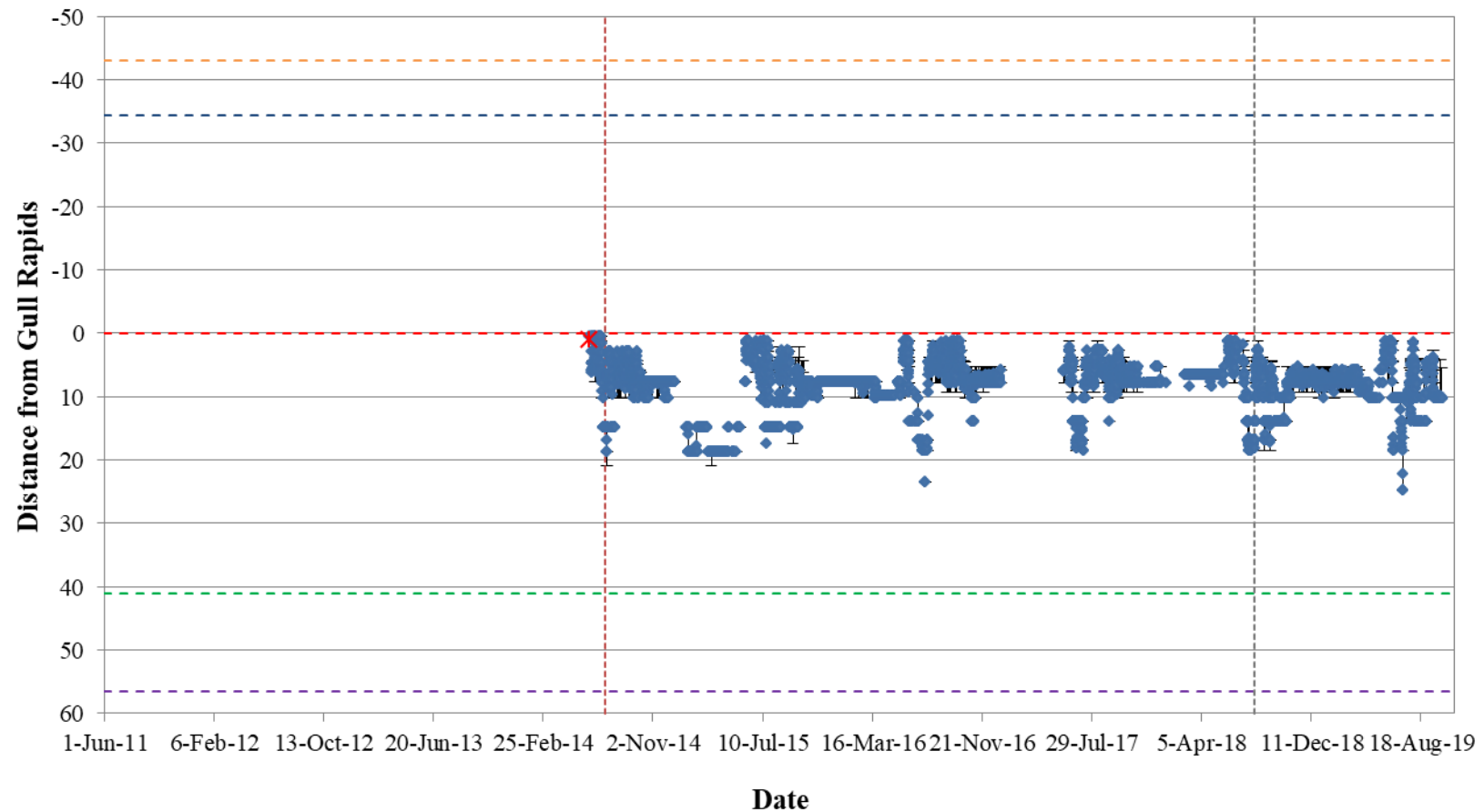


Figure A3-30: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32168) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

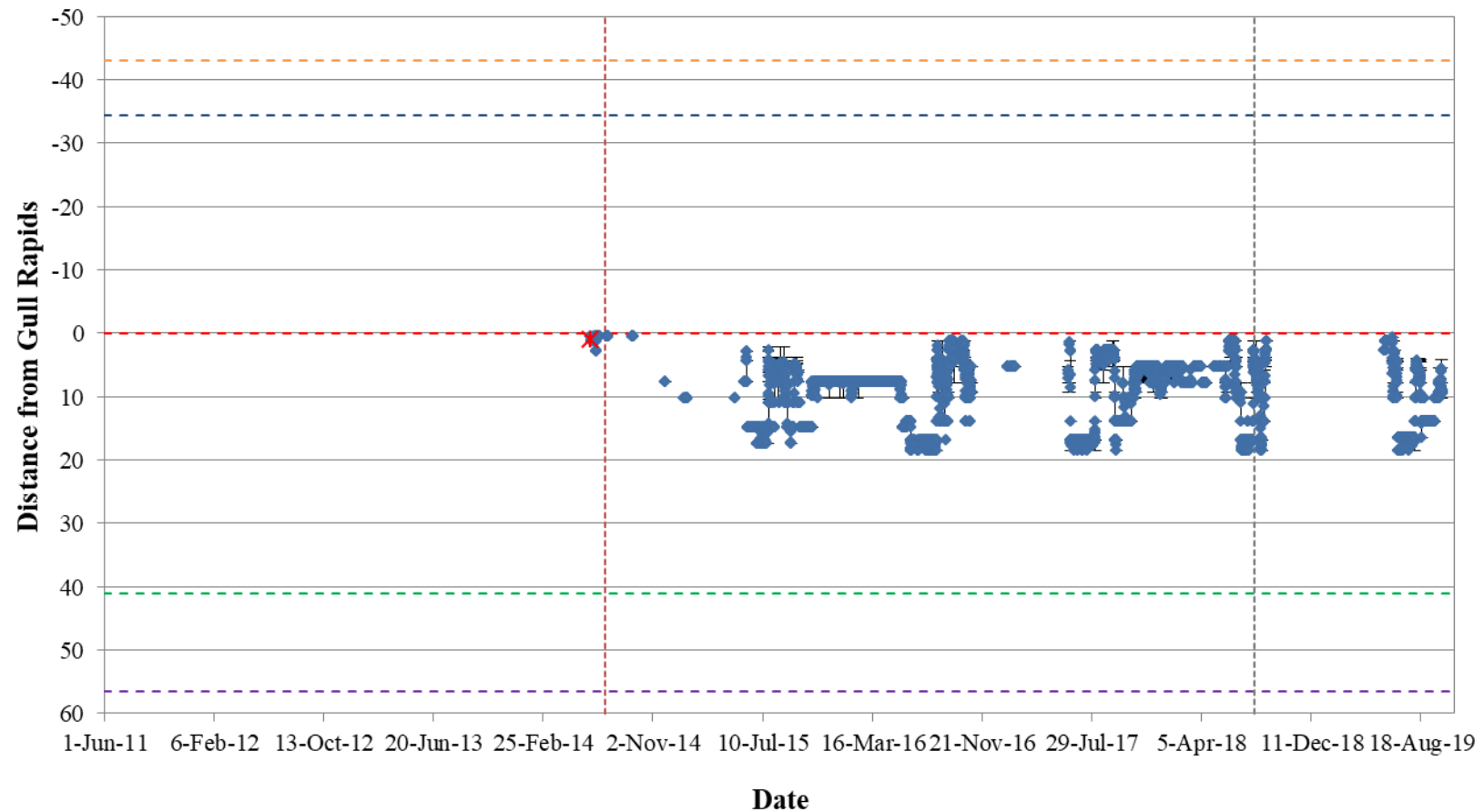


Figure A3-31: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32169) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

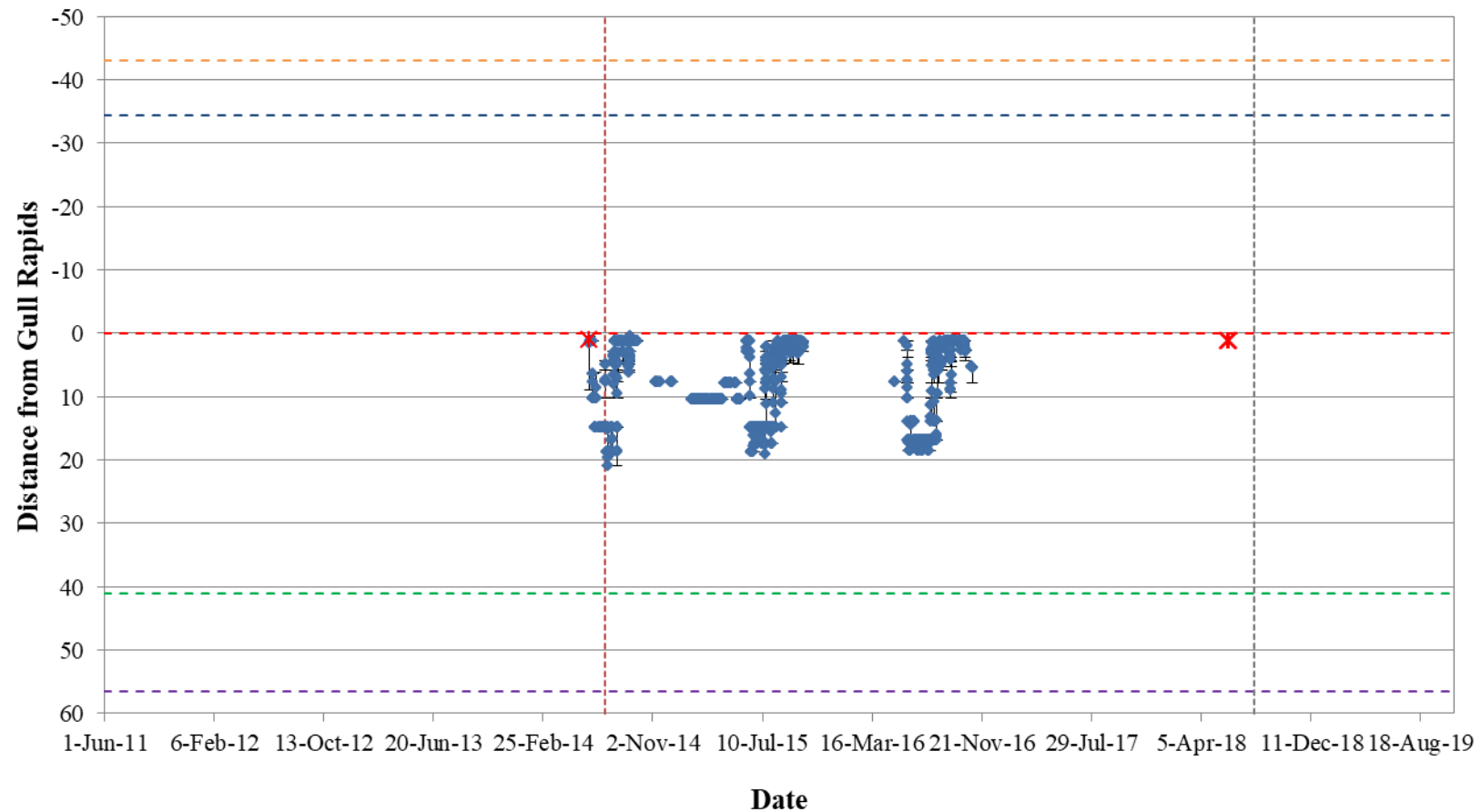


Figure A3-32: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32170) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

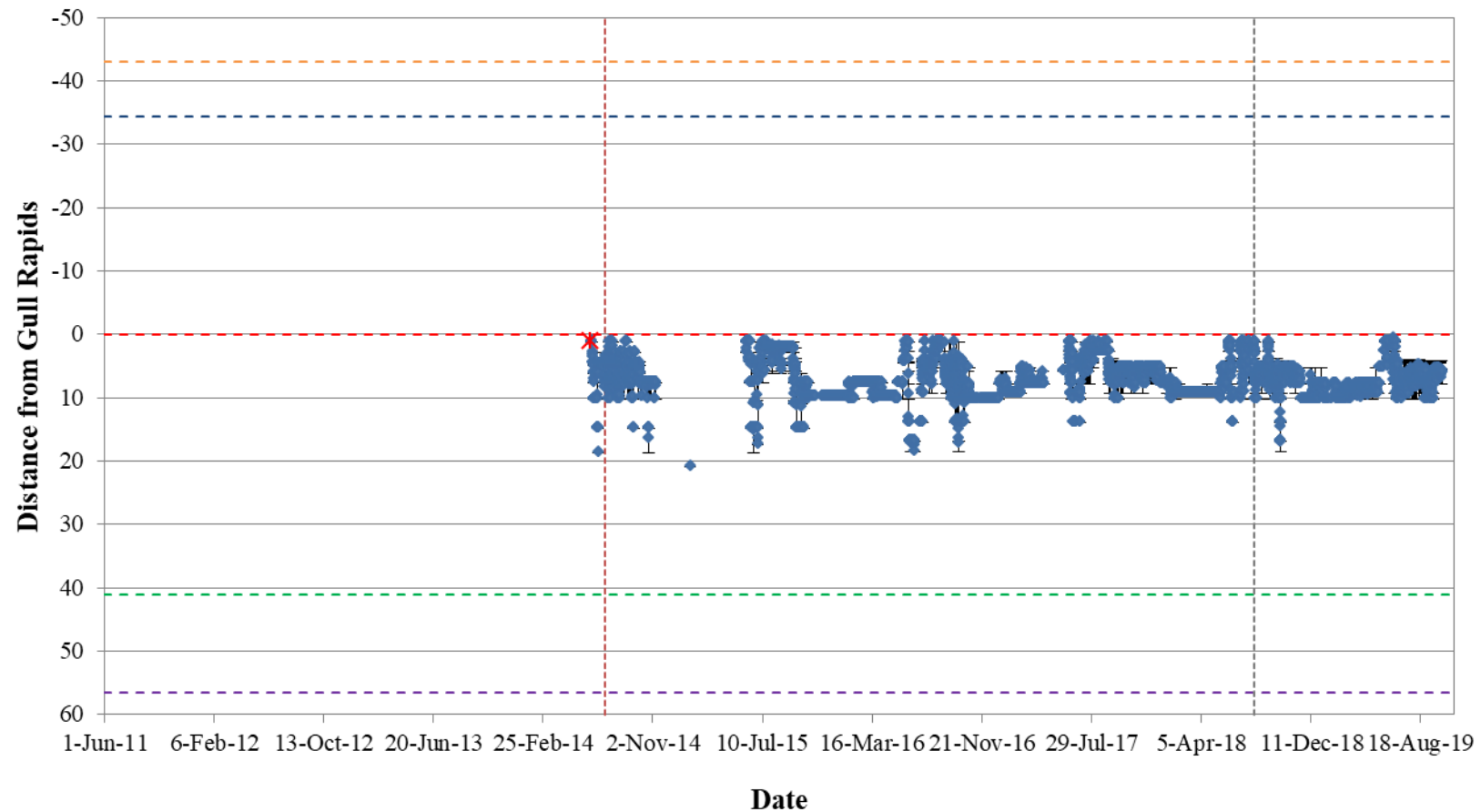


Figure A3-33: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32171) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

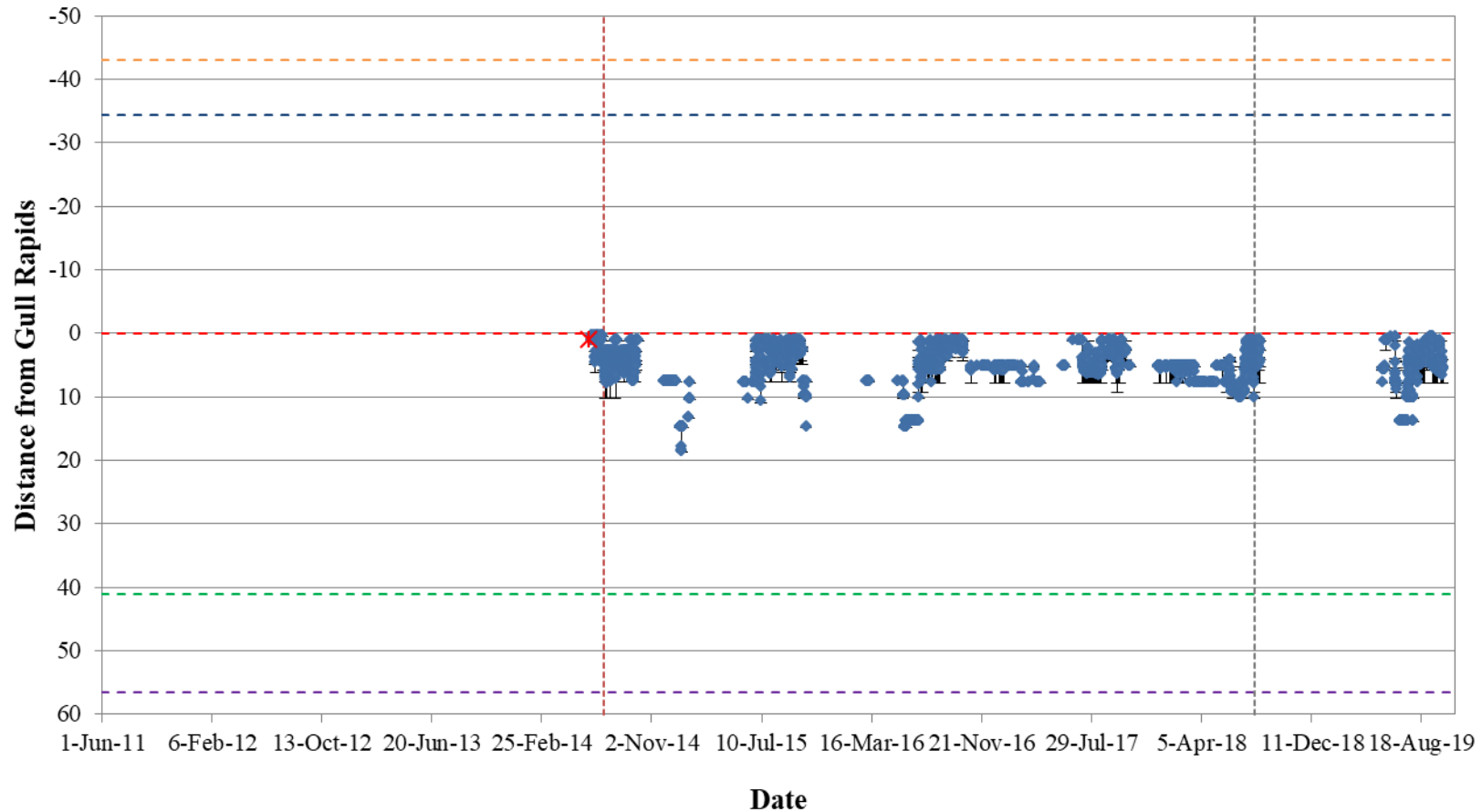


Figure A3-34: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32172) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).



Figure A3-35: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32173) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 7, 2019. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line. Beginning of Keeyask spillway commissioning is indicated with a vertical dotted grey line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

APPENDIX 4:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, UPSTREAM OF THE KEEYASK GS, MAY TO OCTOBER 2019

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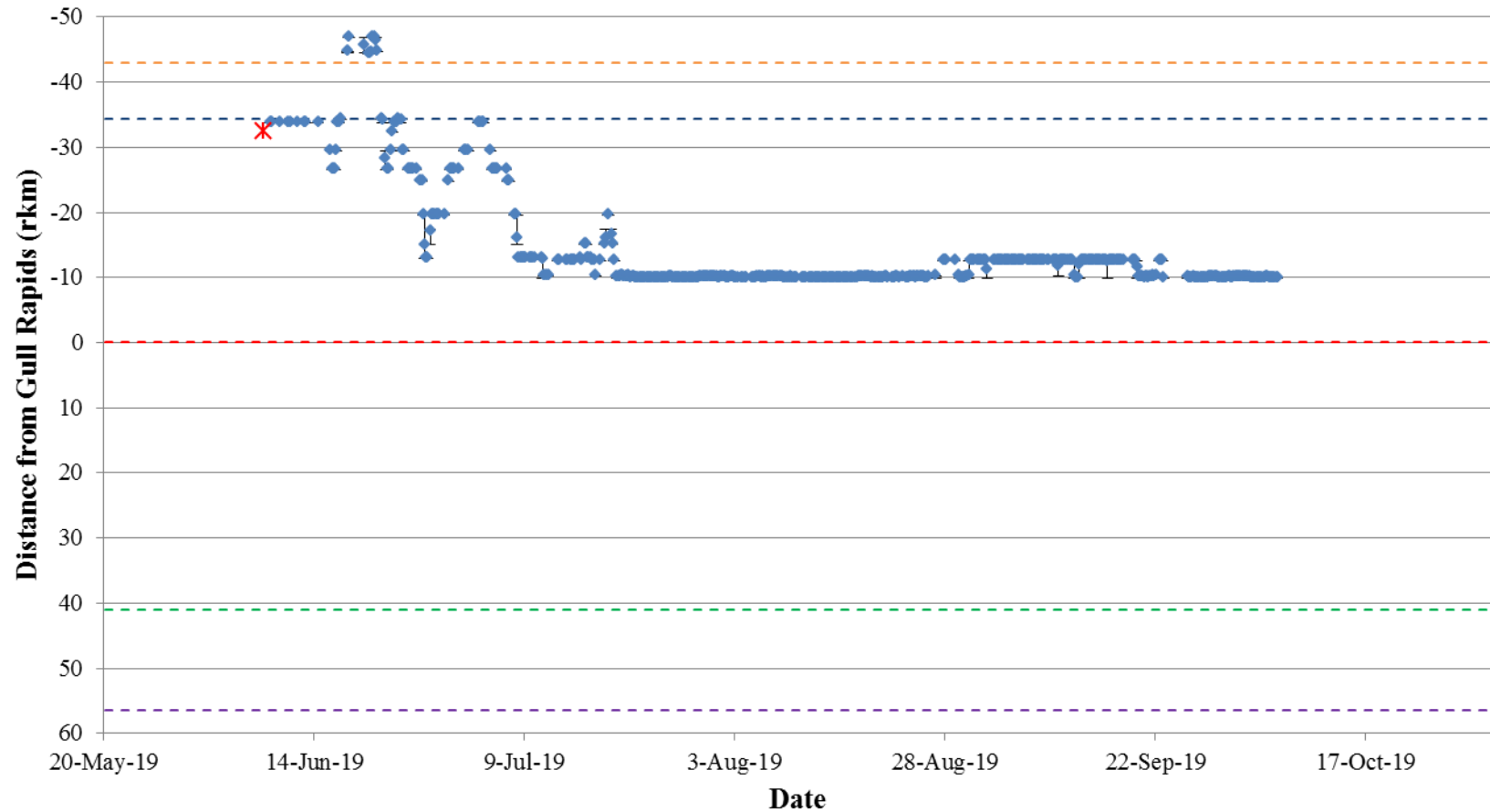


Figure A4-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7017) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

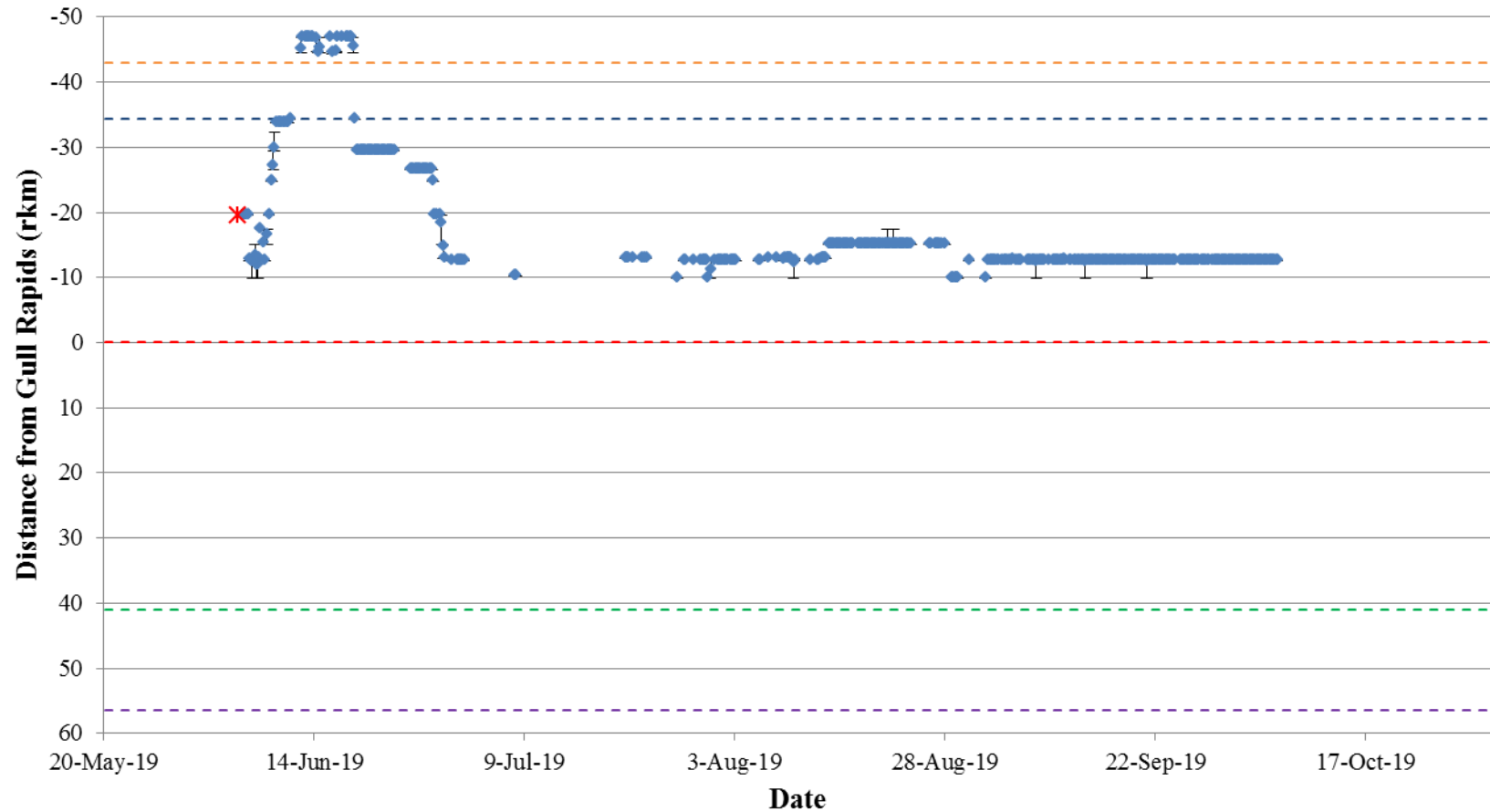


Figure A4-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7018) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

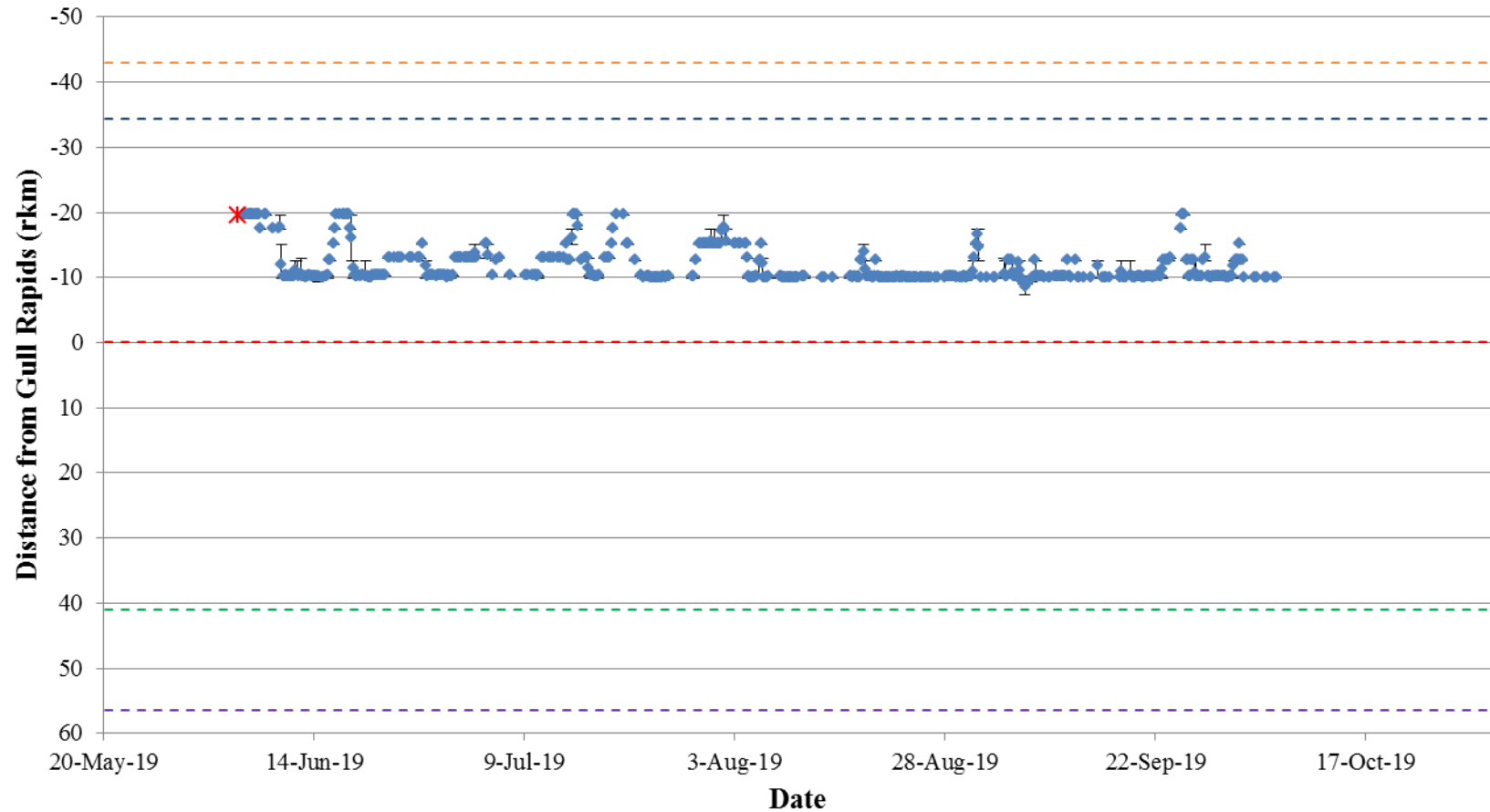


Figure A4-3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7019) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

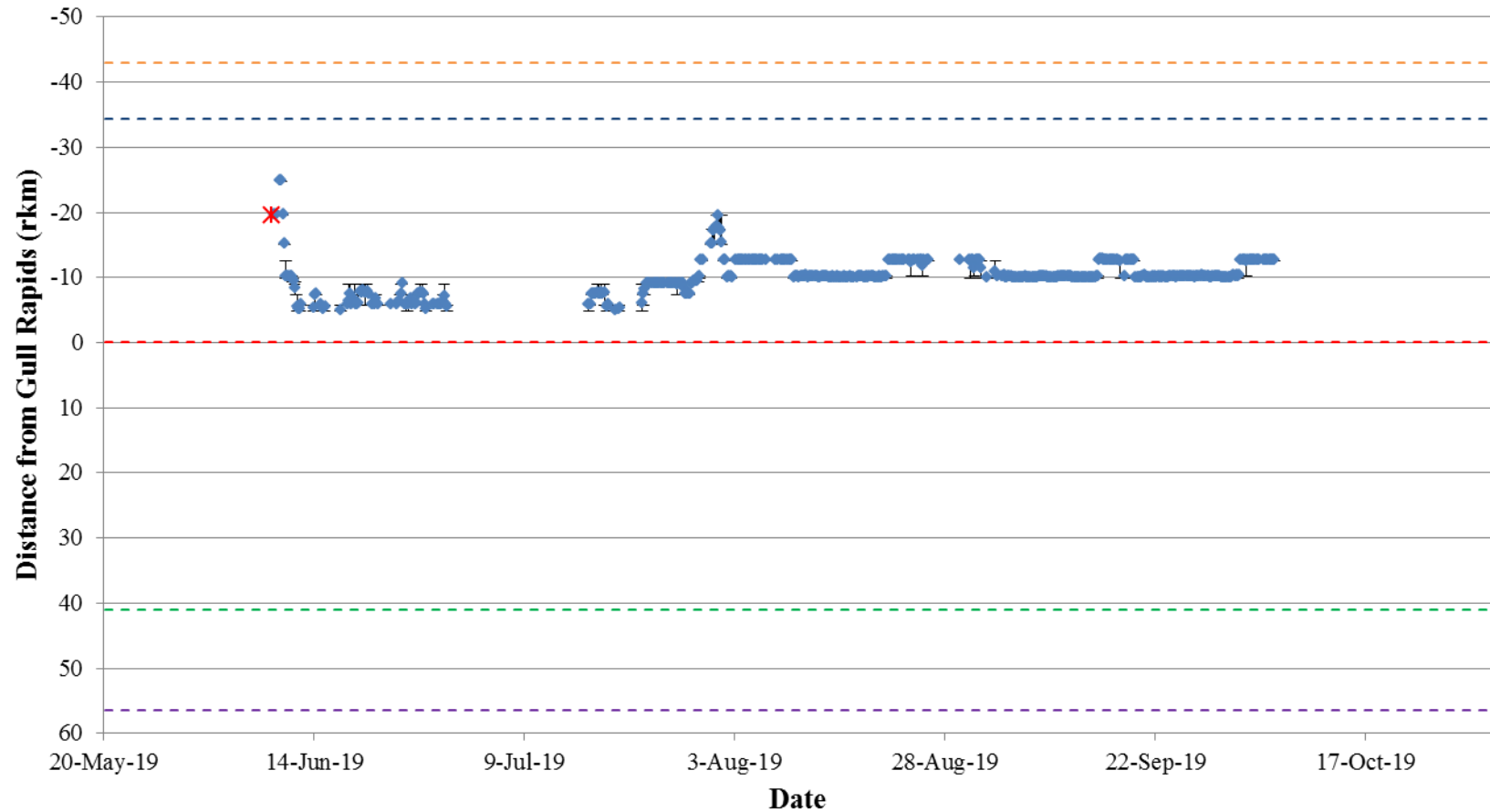


Figure A4-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7020) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

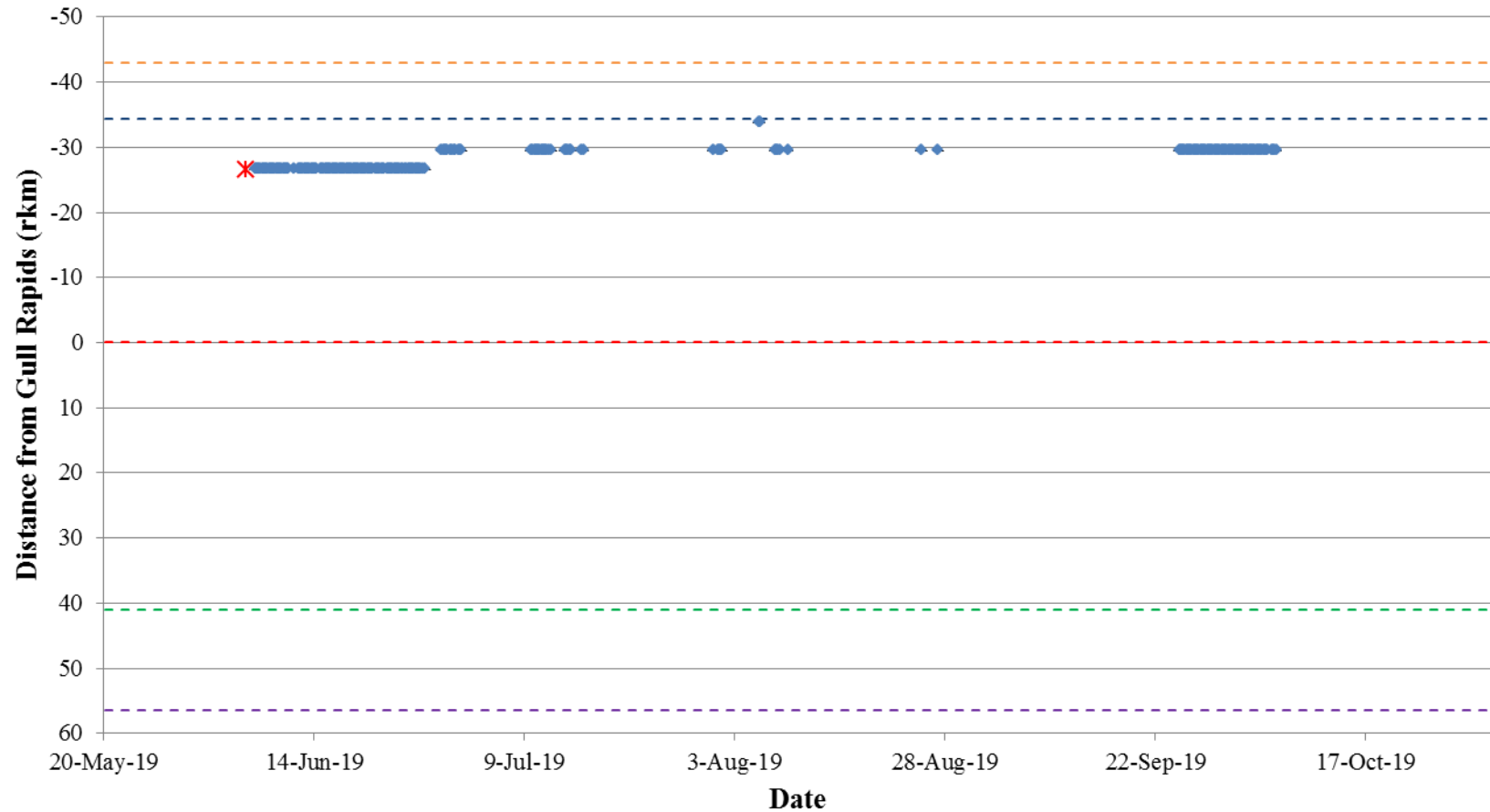


Figure A4-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7021) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

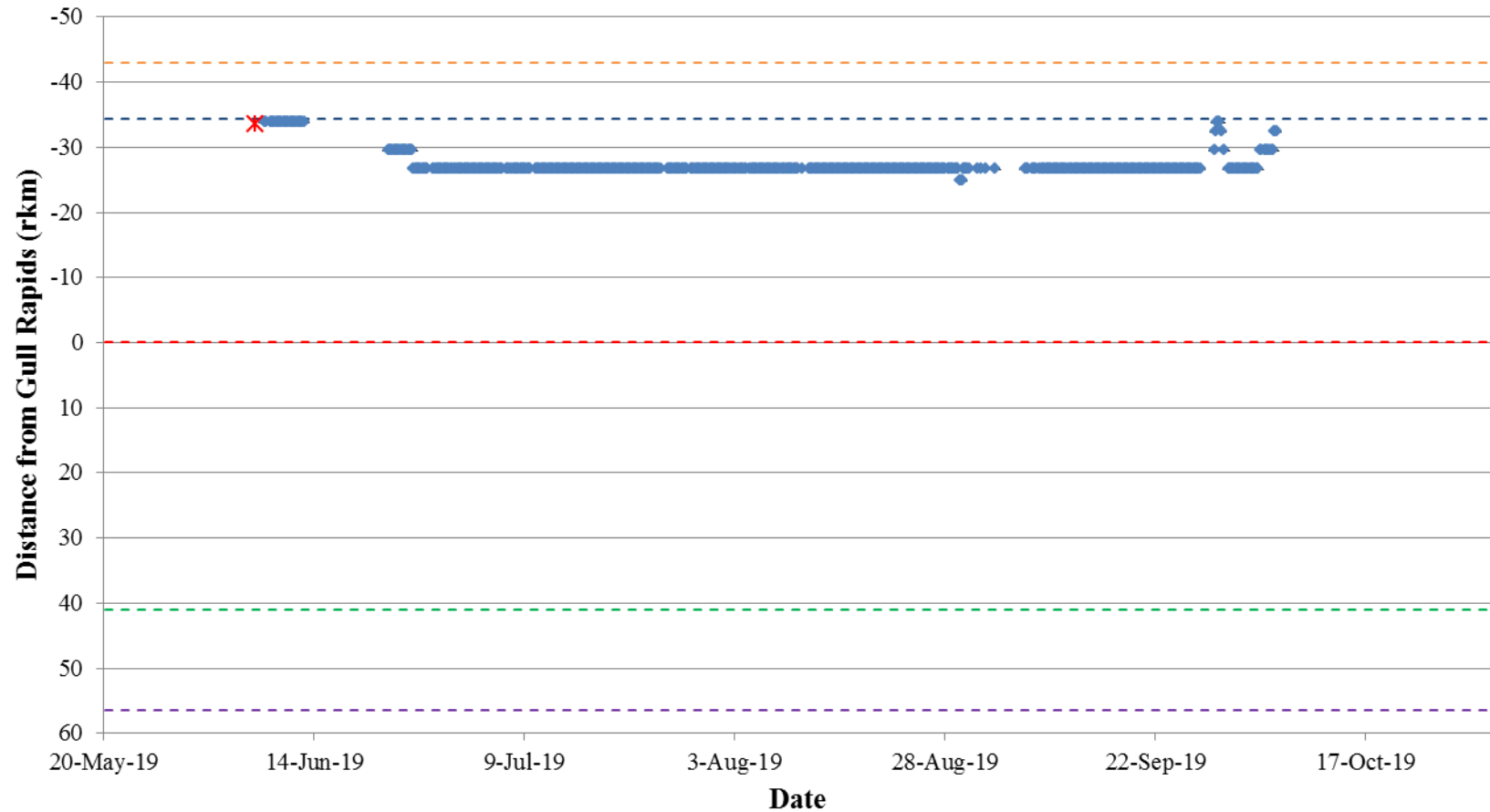


Figure A4-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7022) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

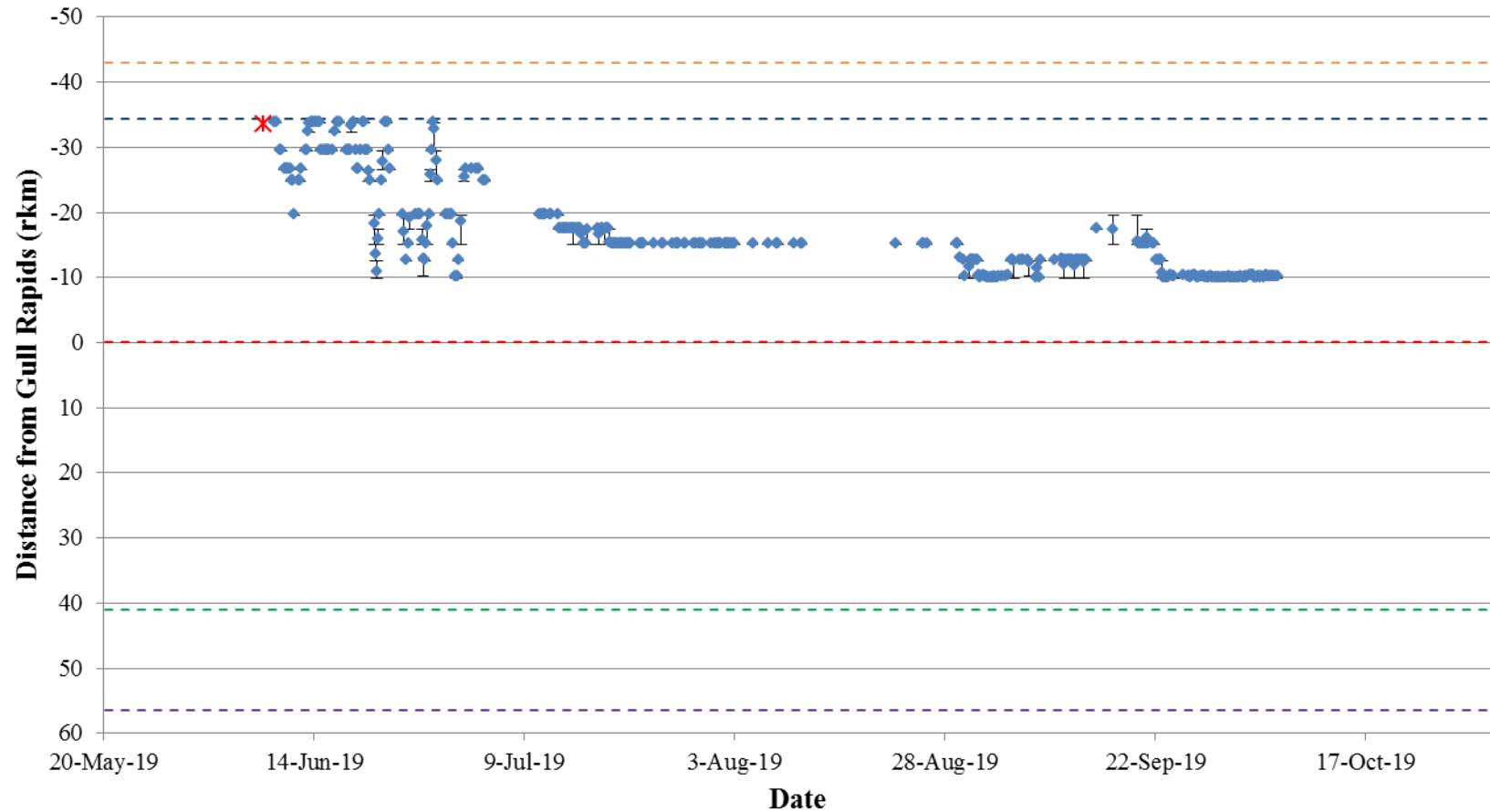


Figure A4-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7023) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

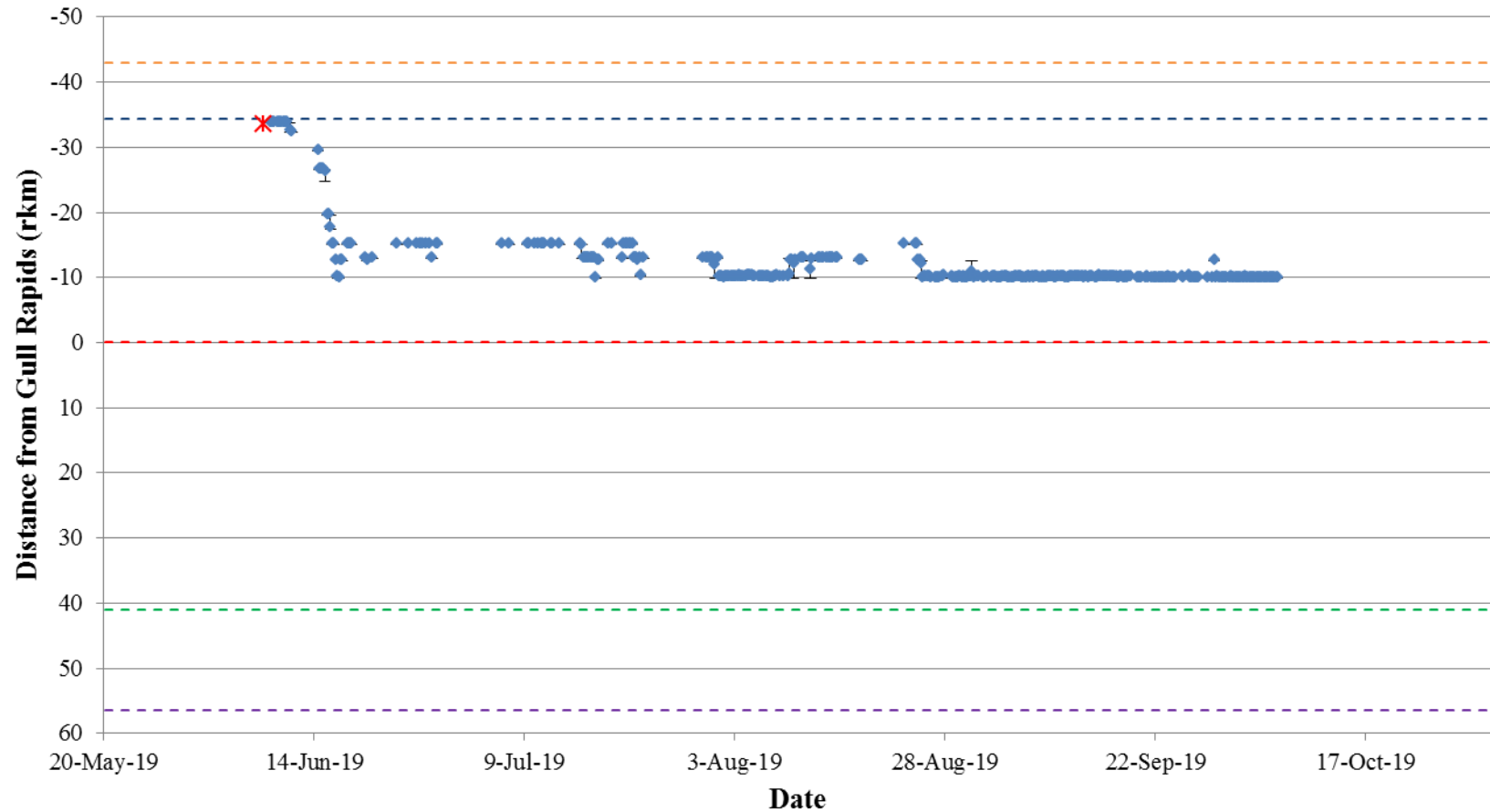


Figure A4-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7024) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

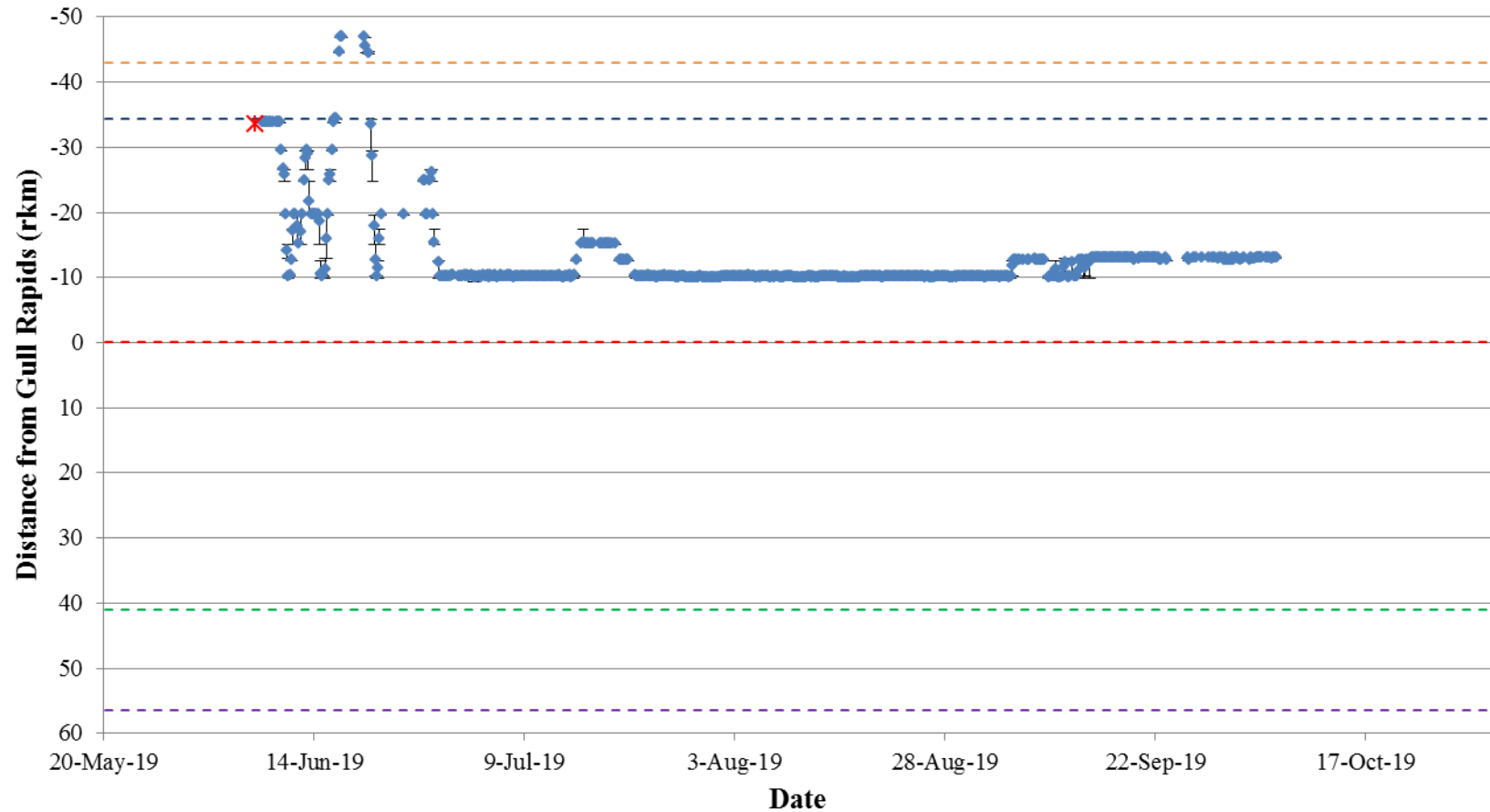


Figure A4-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7025) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

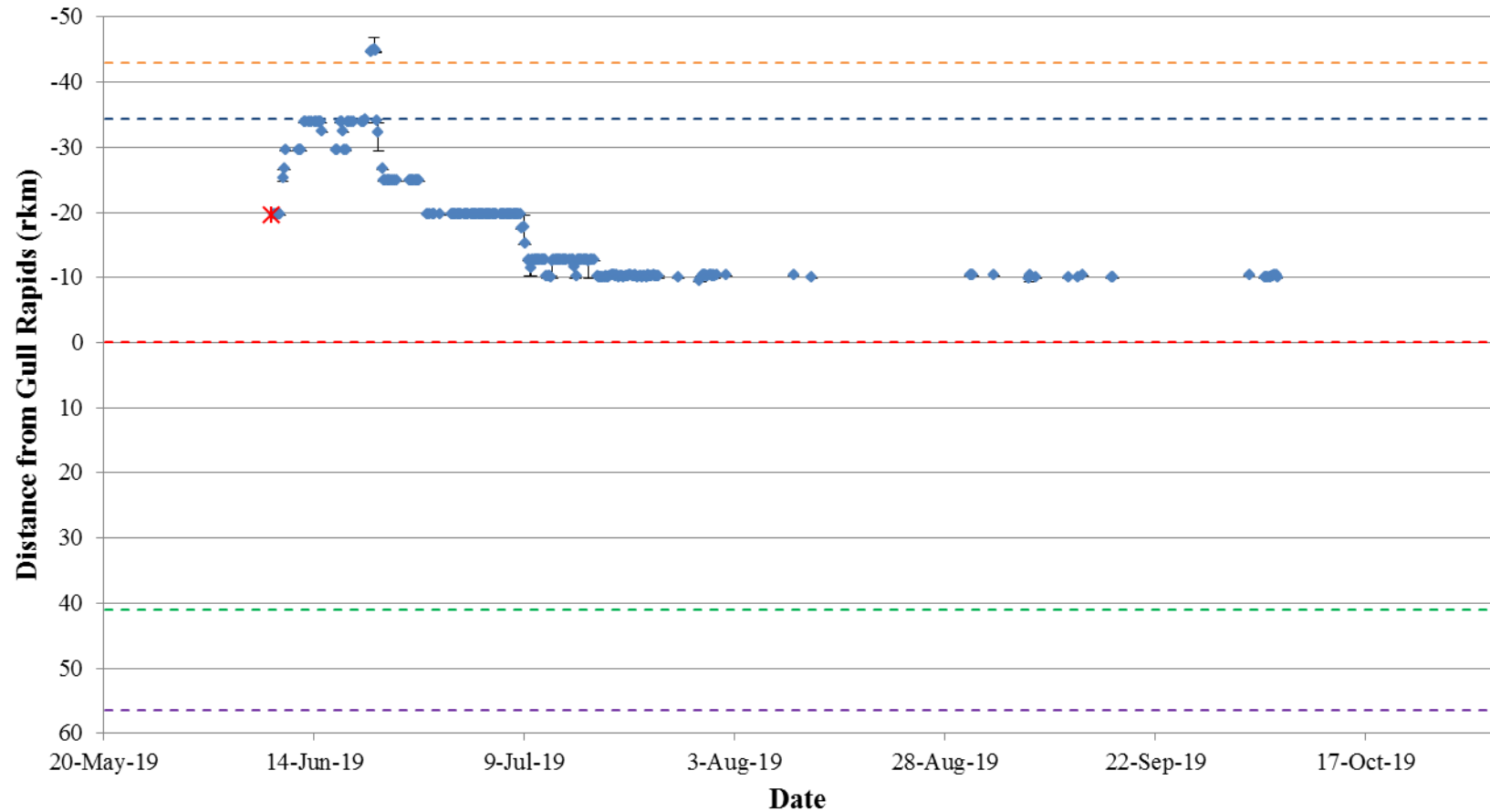


Figure A4-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7026) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

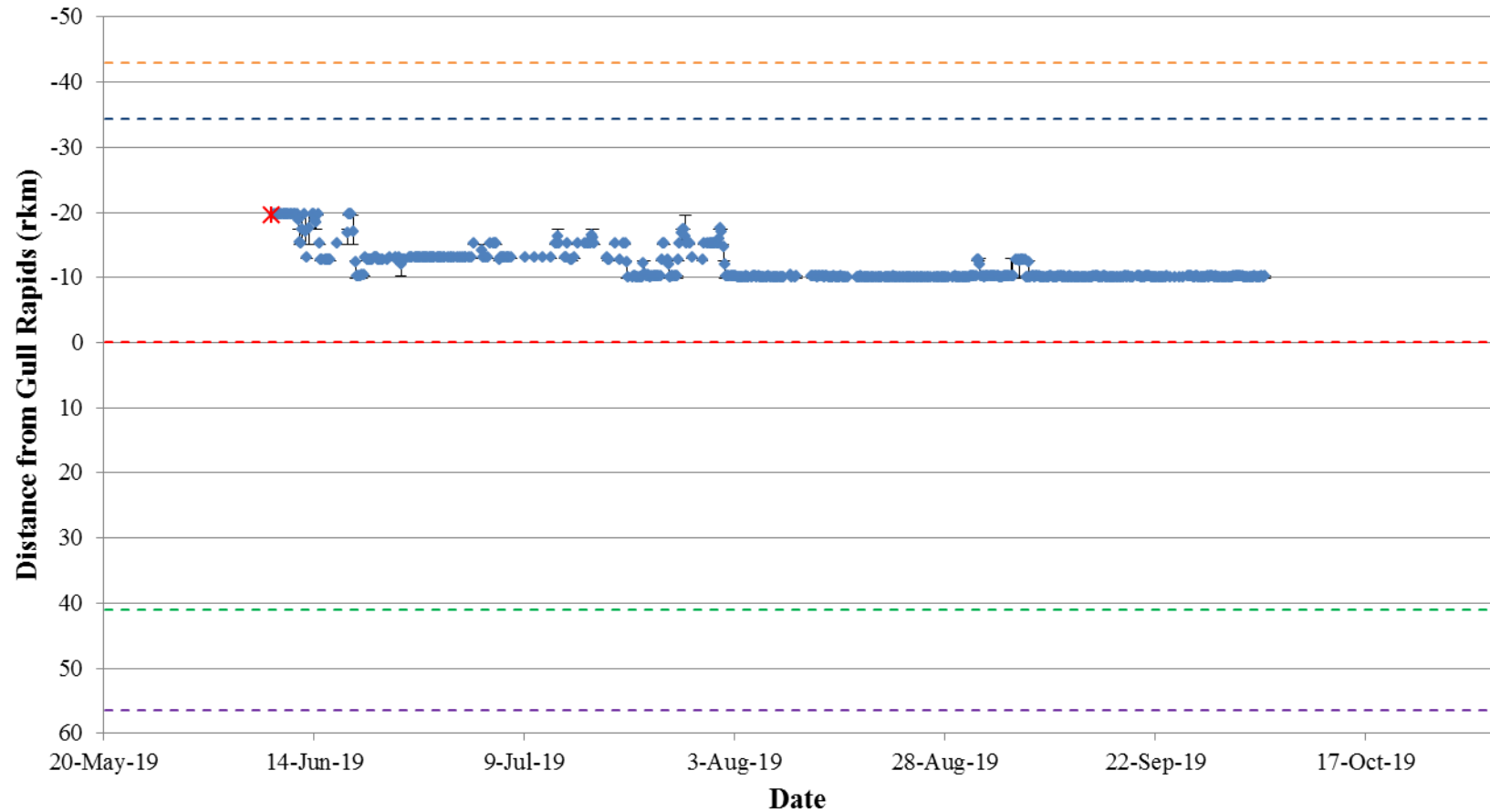


Figure A4-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7027) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

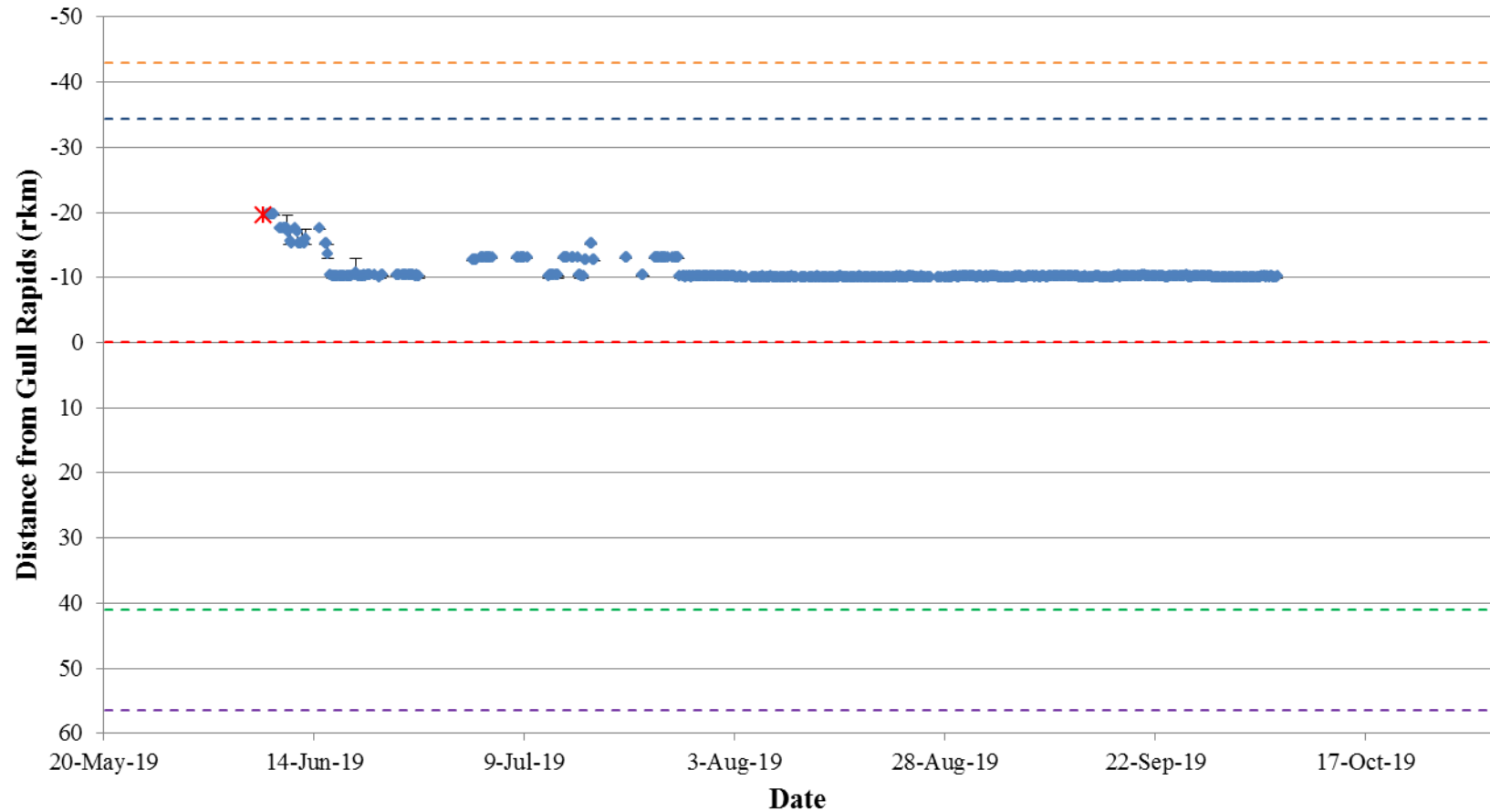


Figure A4-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7028) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

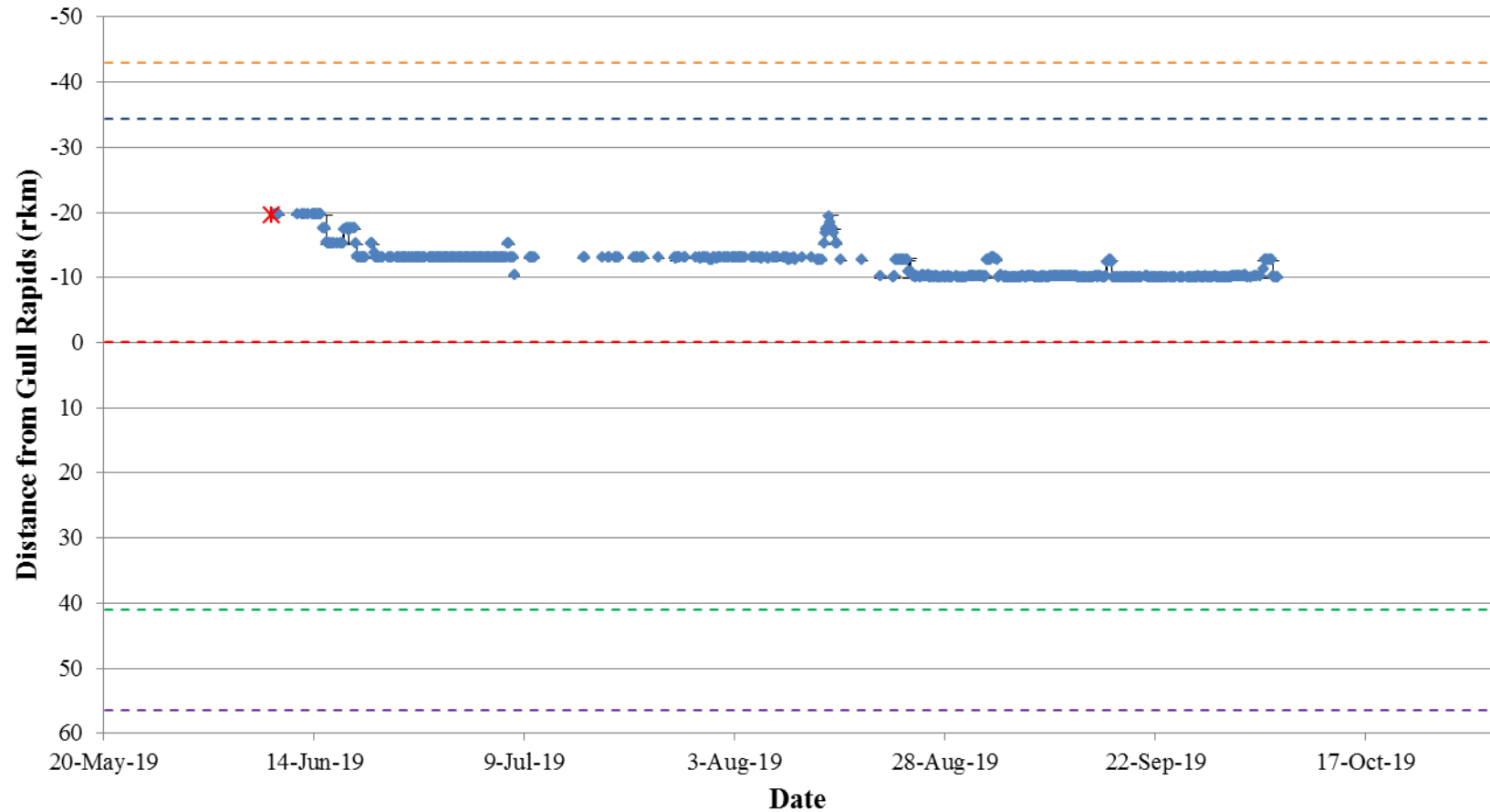


Figure A4-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7029) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

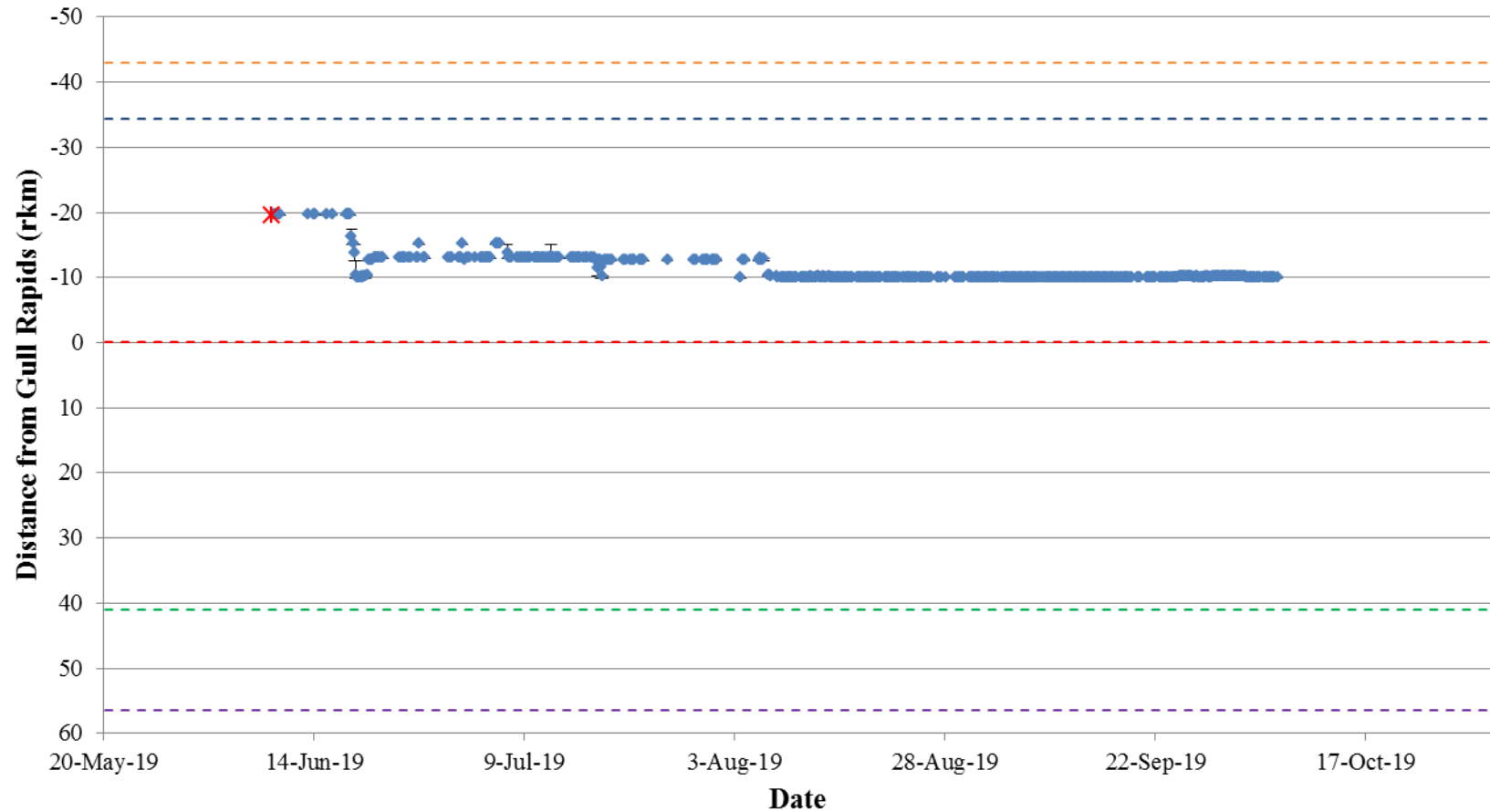


Figure A4-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7030) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

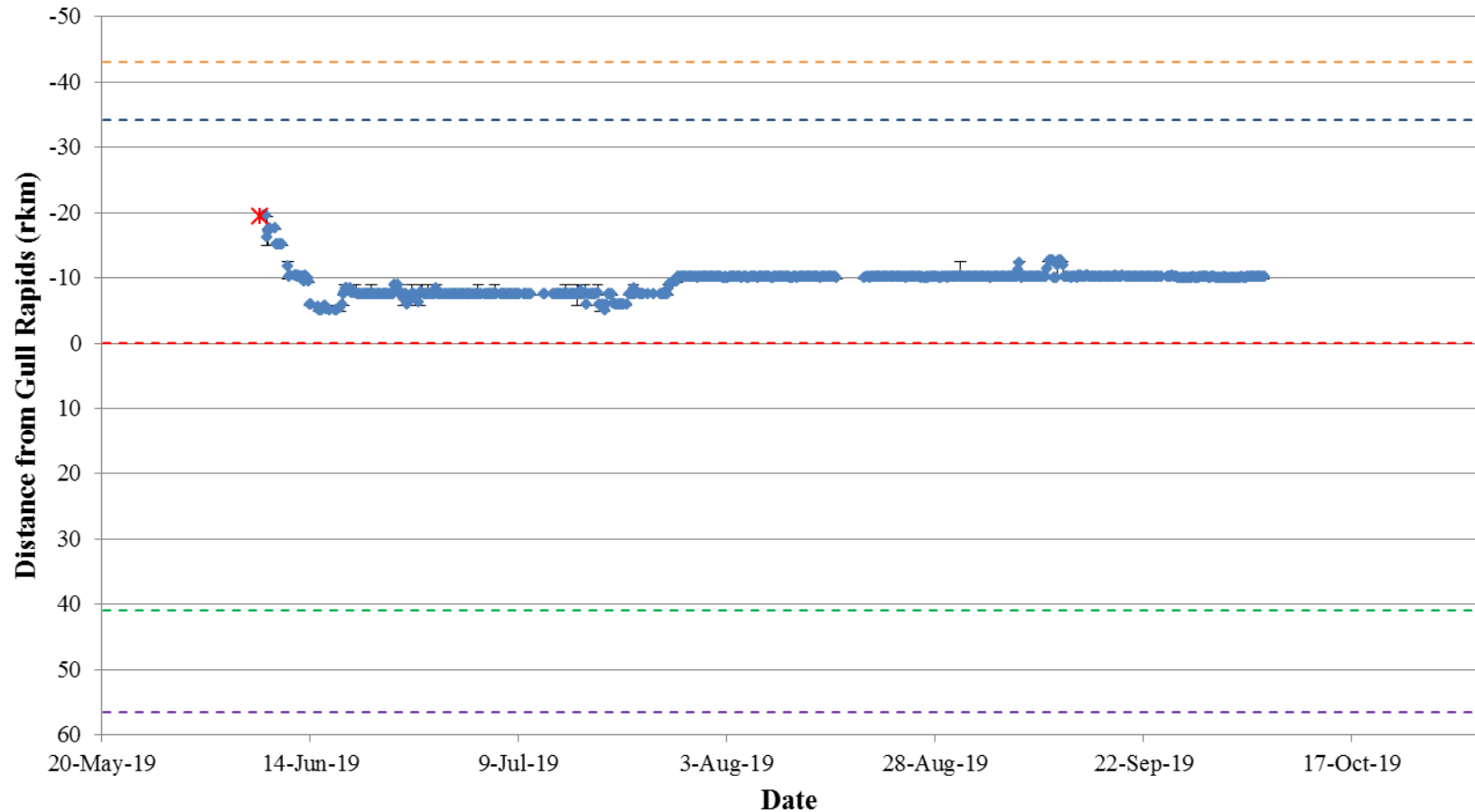


Figure A4-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7031) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

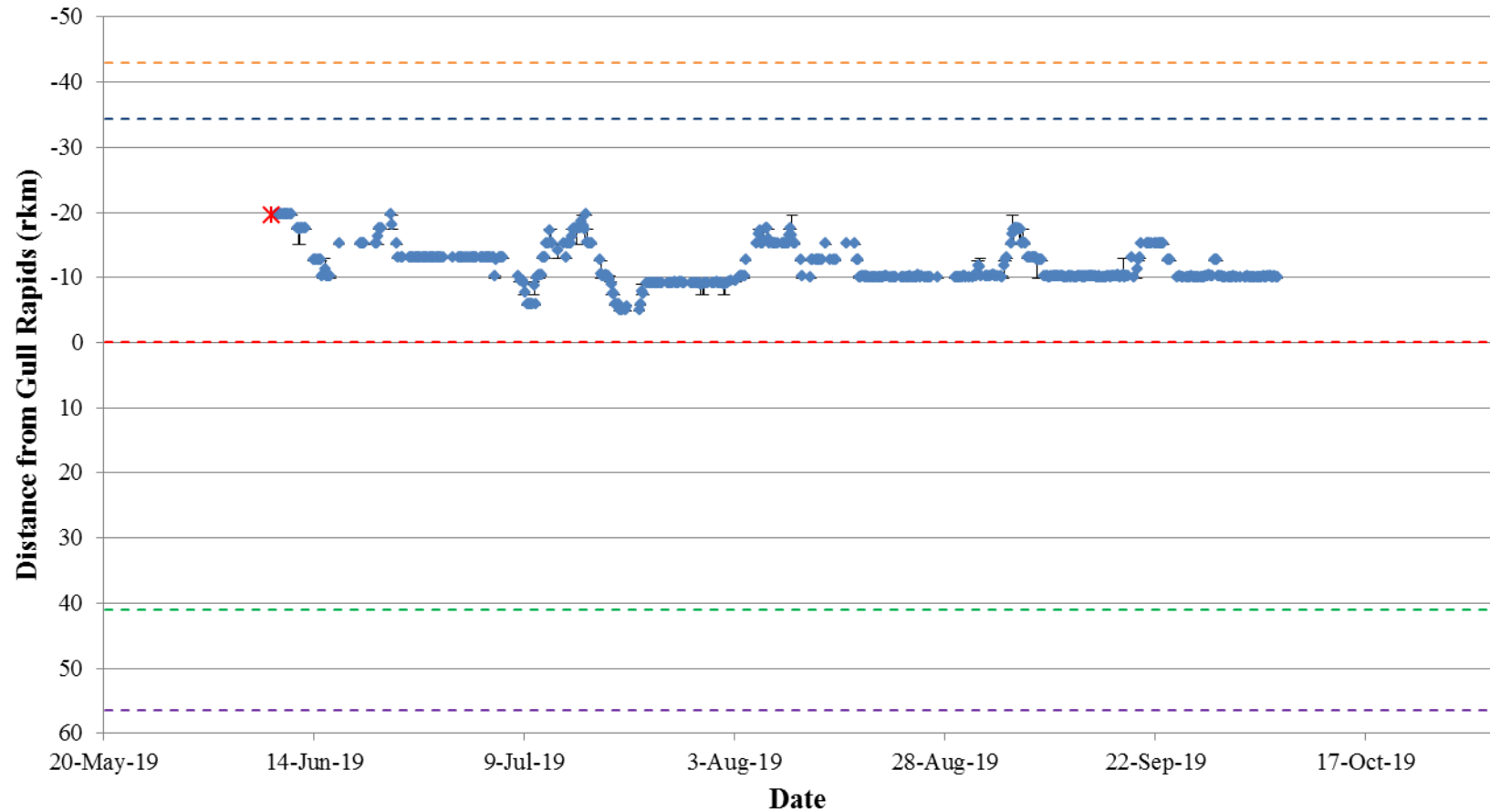


Figure A4-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7032) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

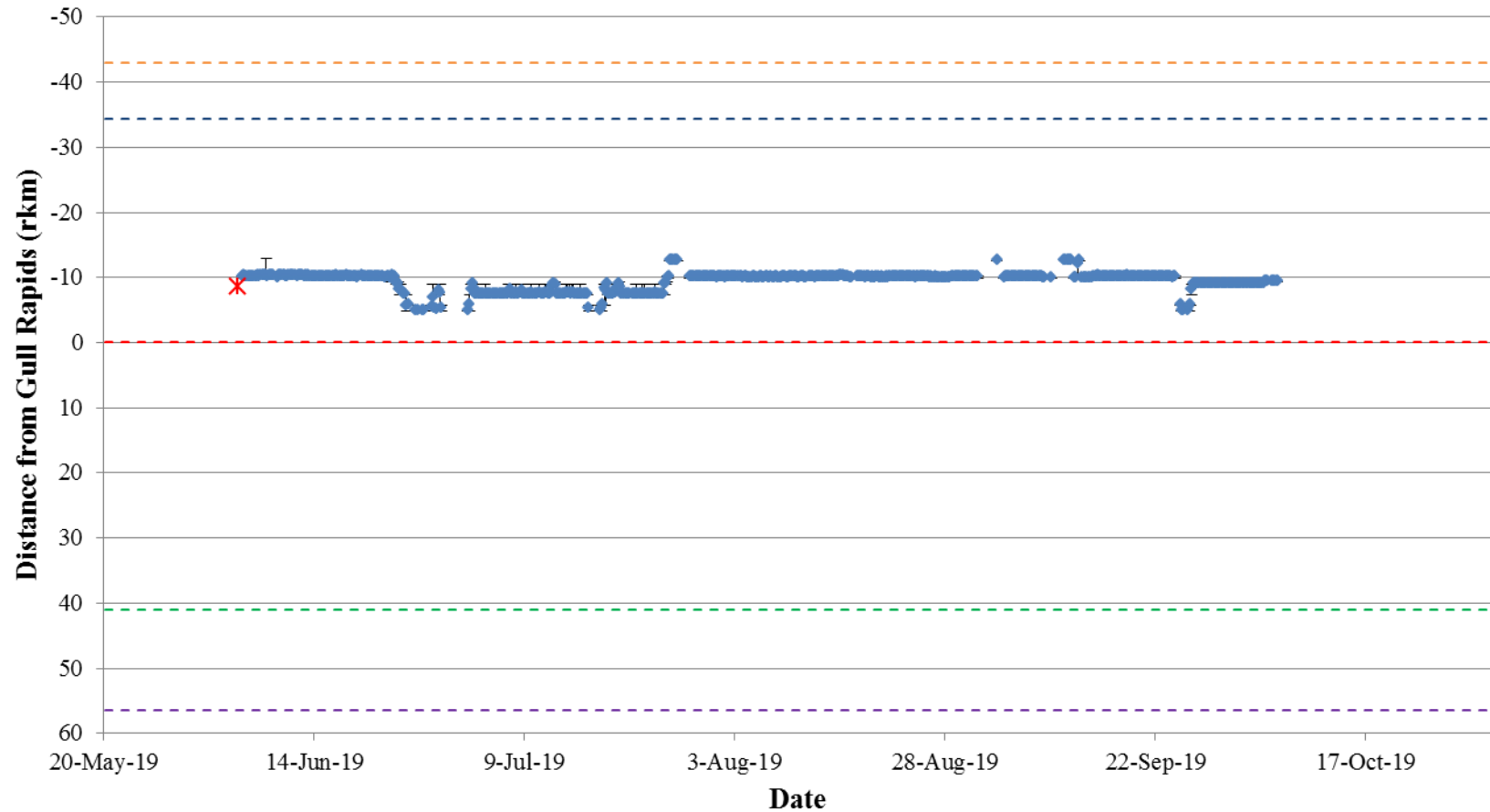


Figure A4-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7033) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

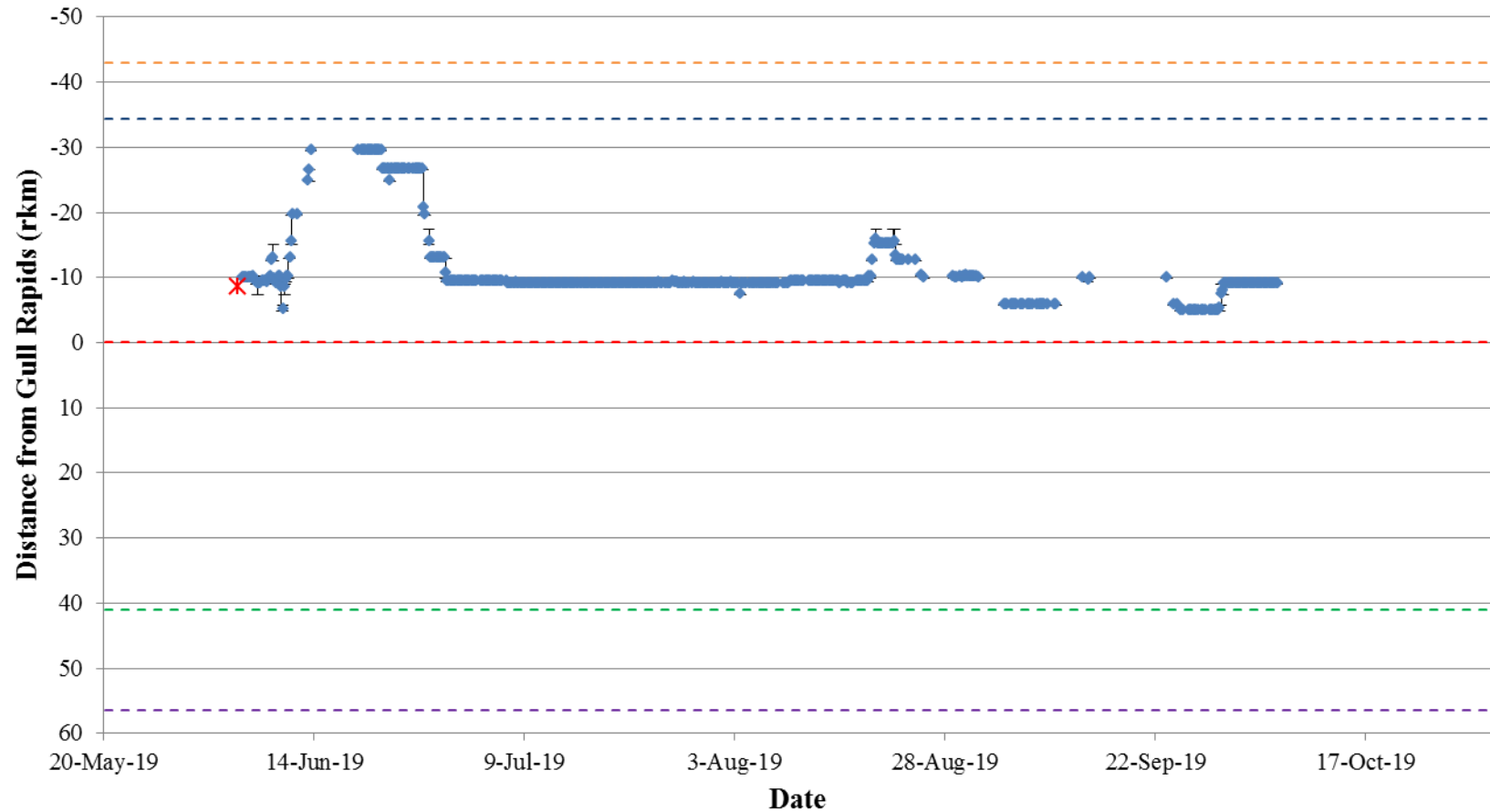


Figure A4-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7034) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

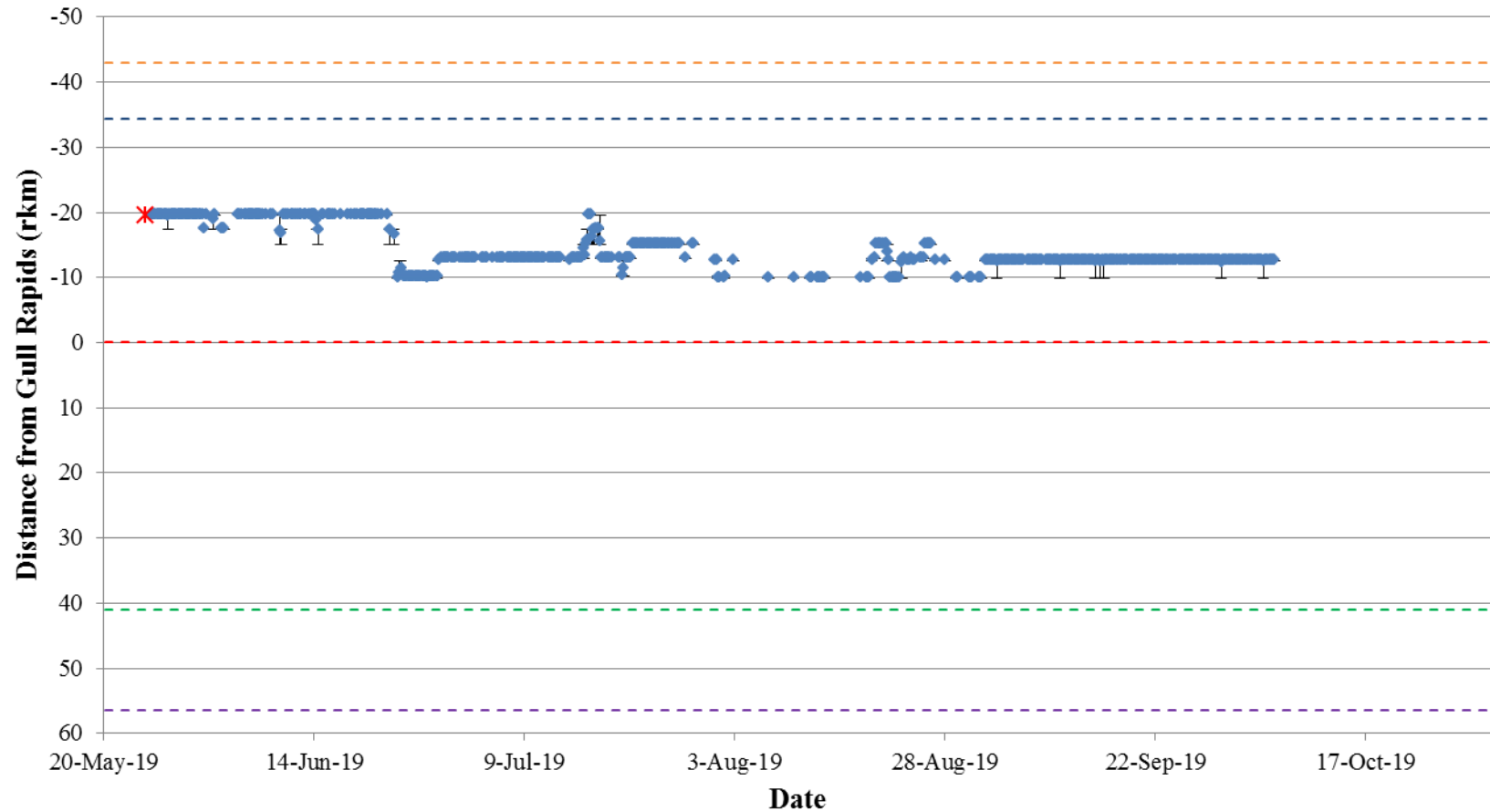


Figure A4-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7053) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

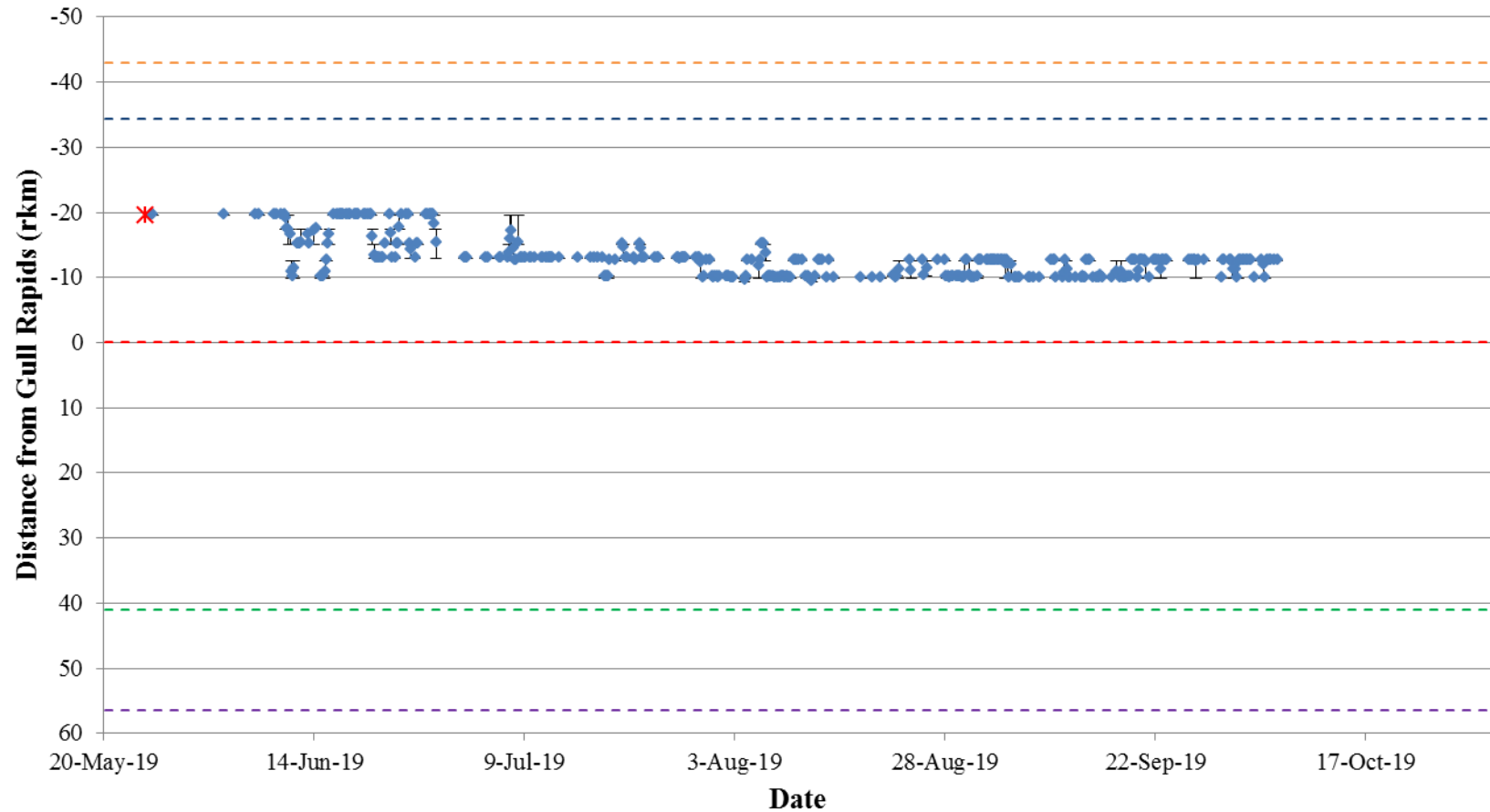


Figure A4-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7056) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

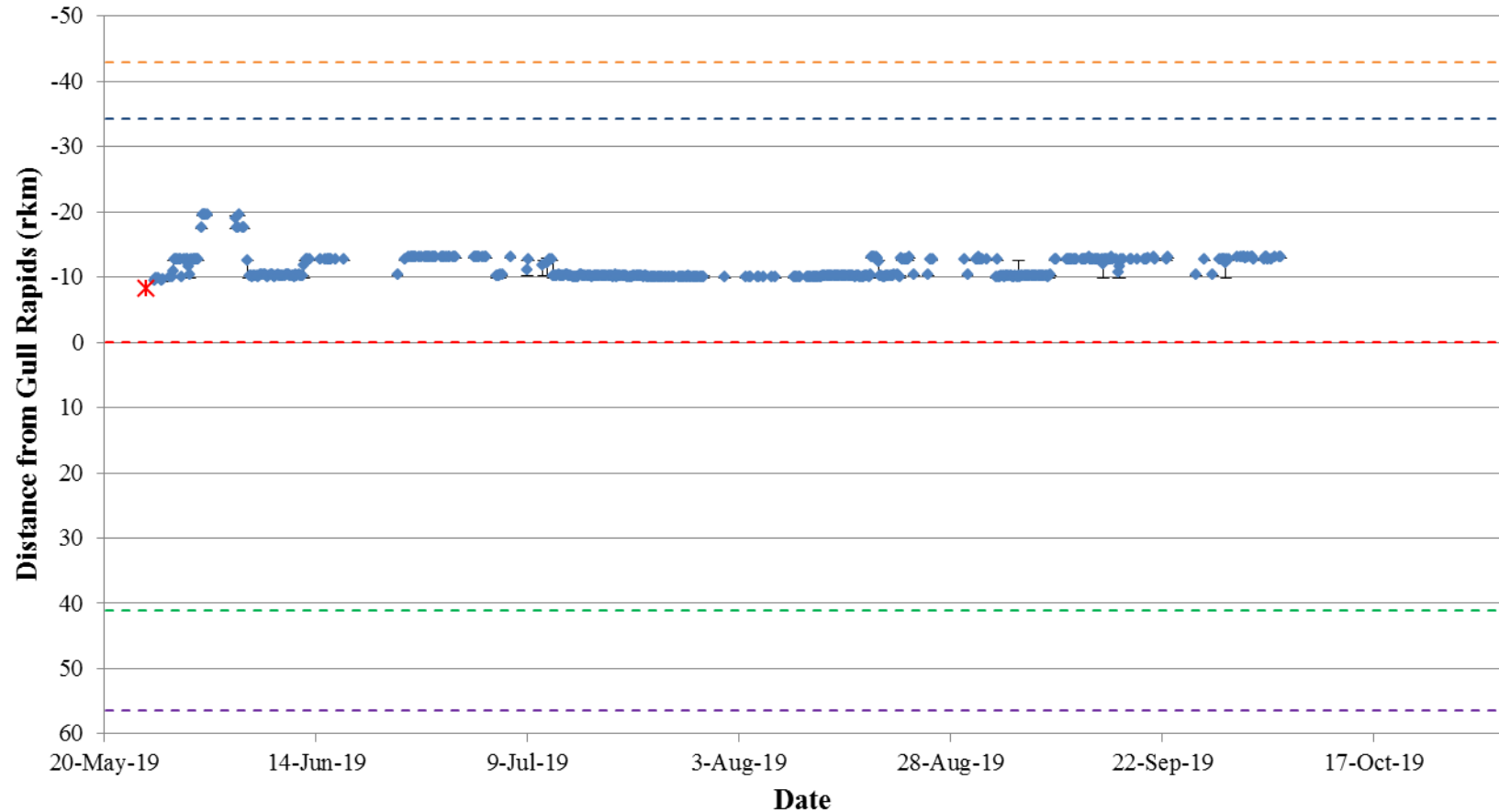


Figure A4-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7059) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

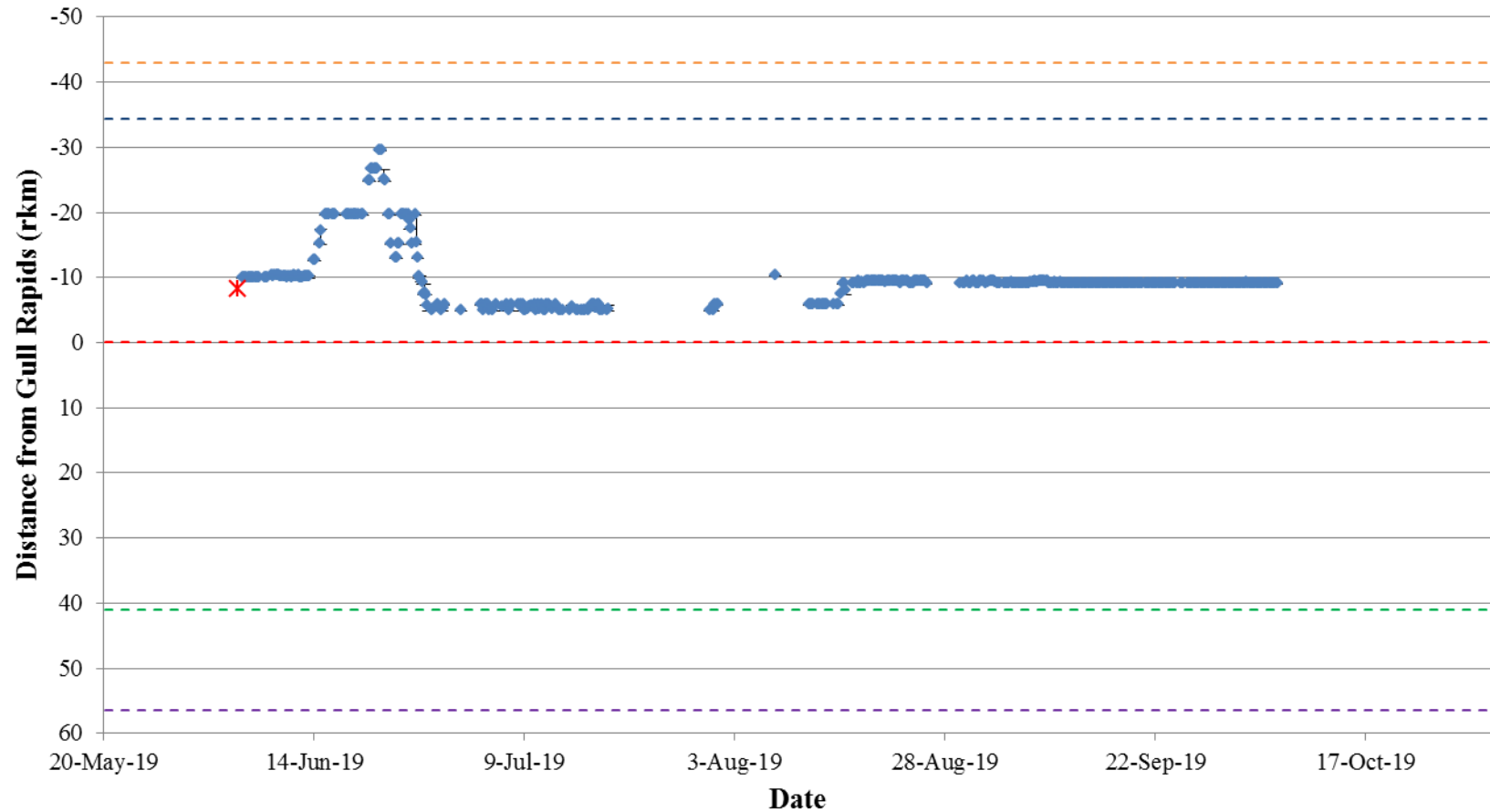


Figure A4-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7061) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

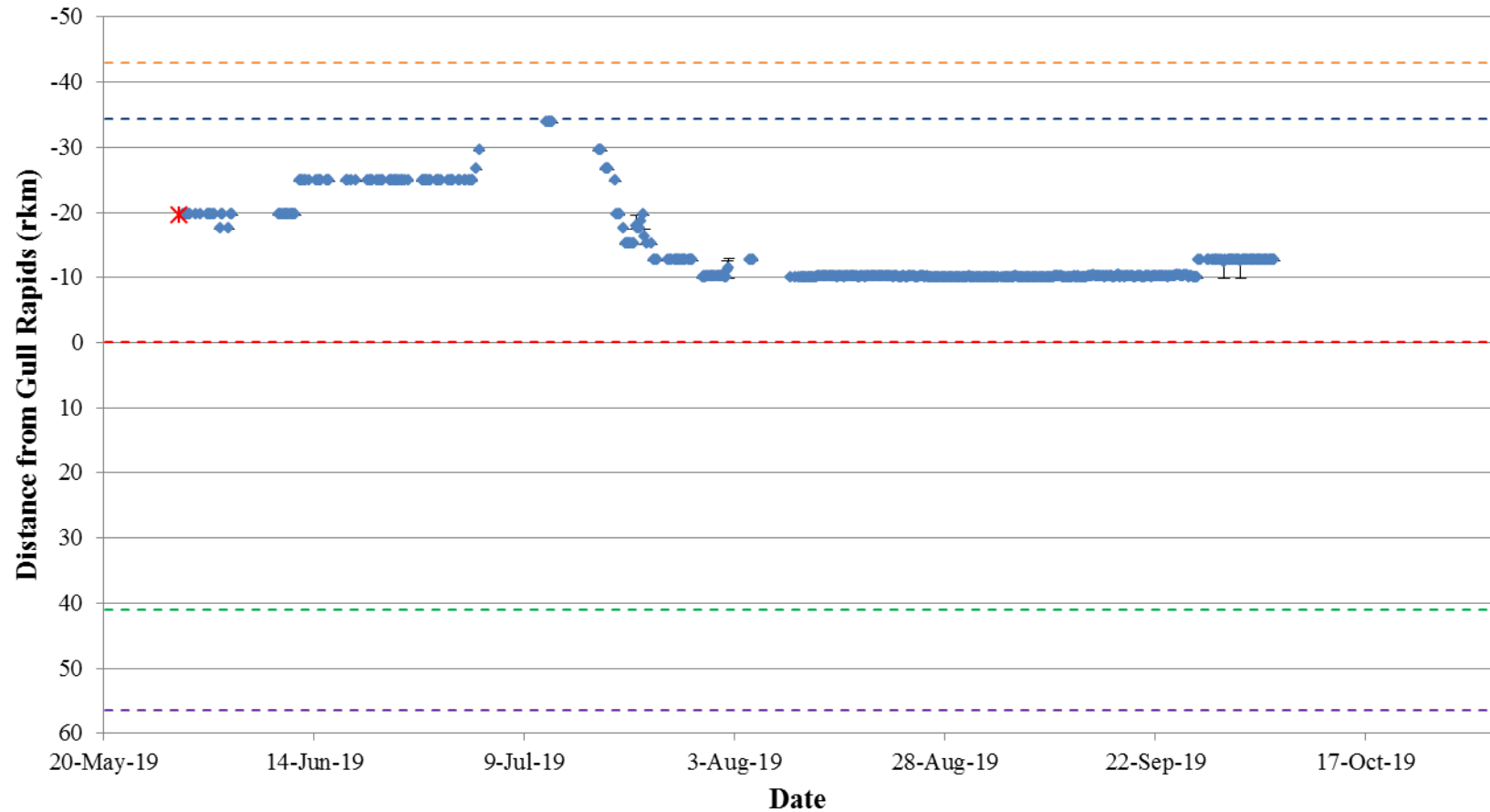


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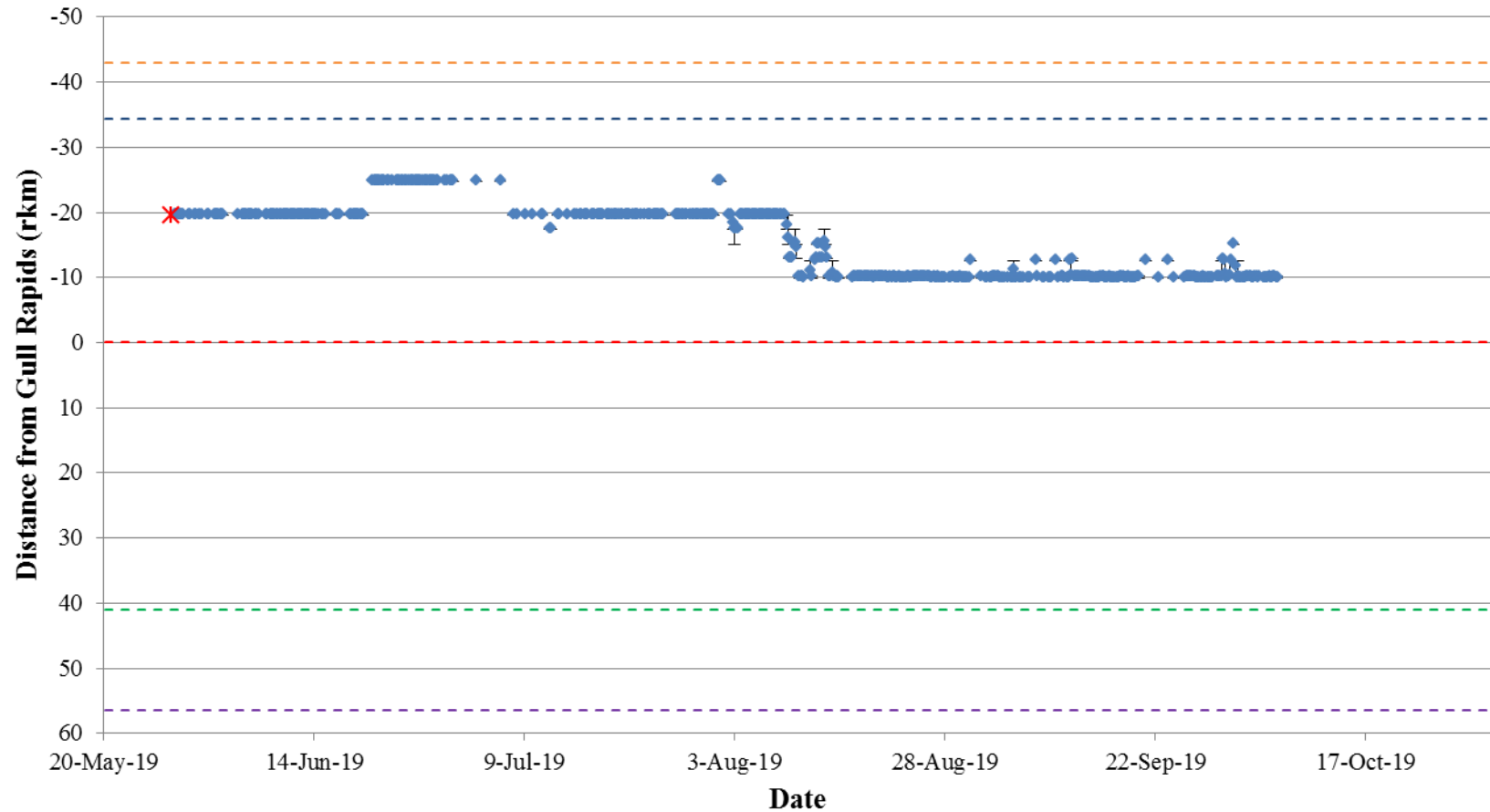


Figure A4-24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7065) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

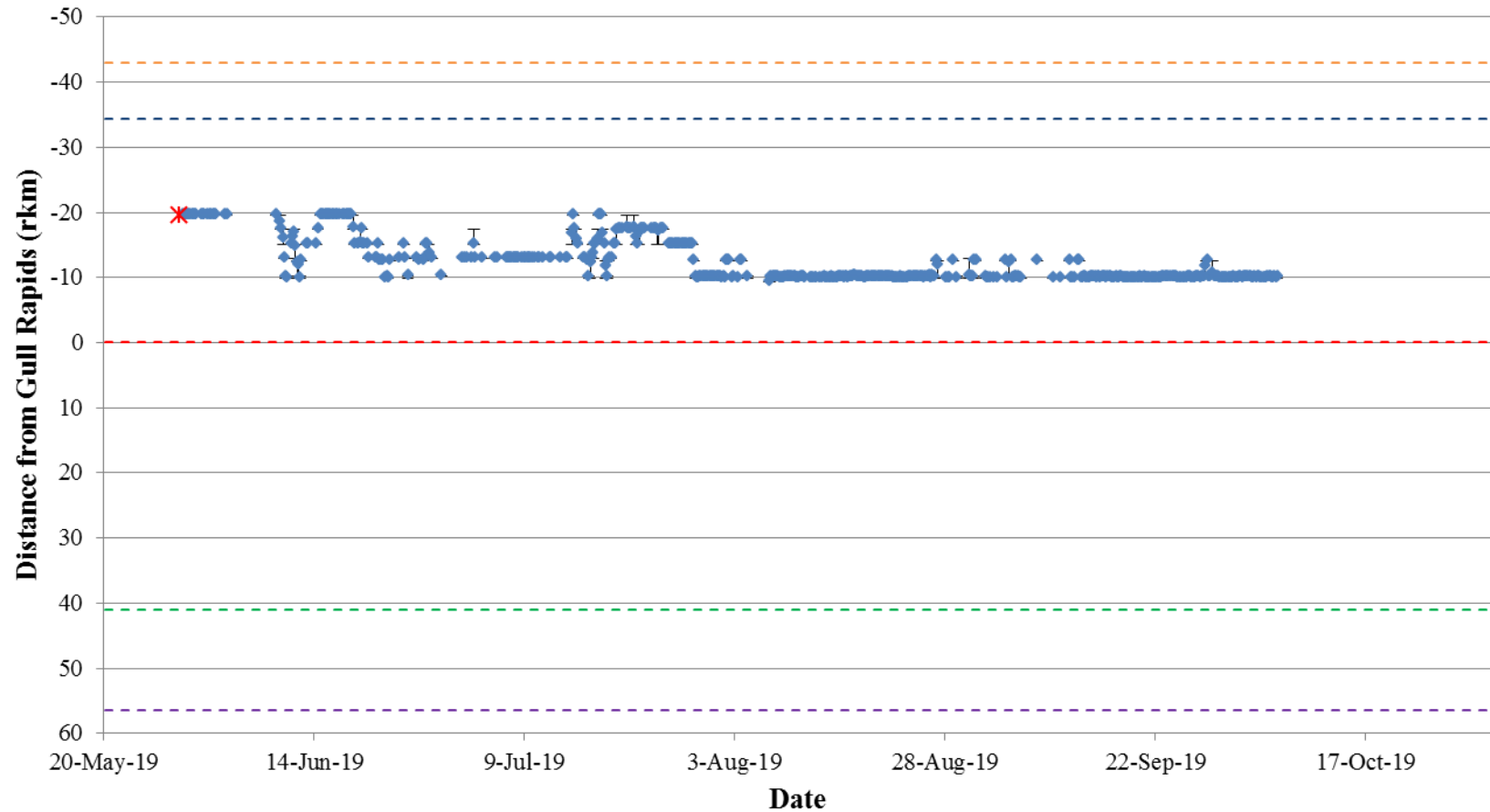


Figure A4-25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7066) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

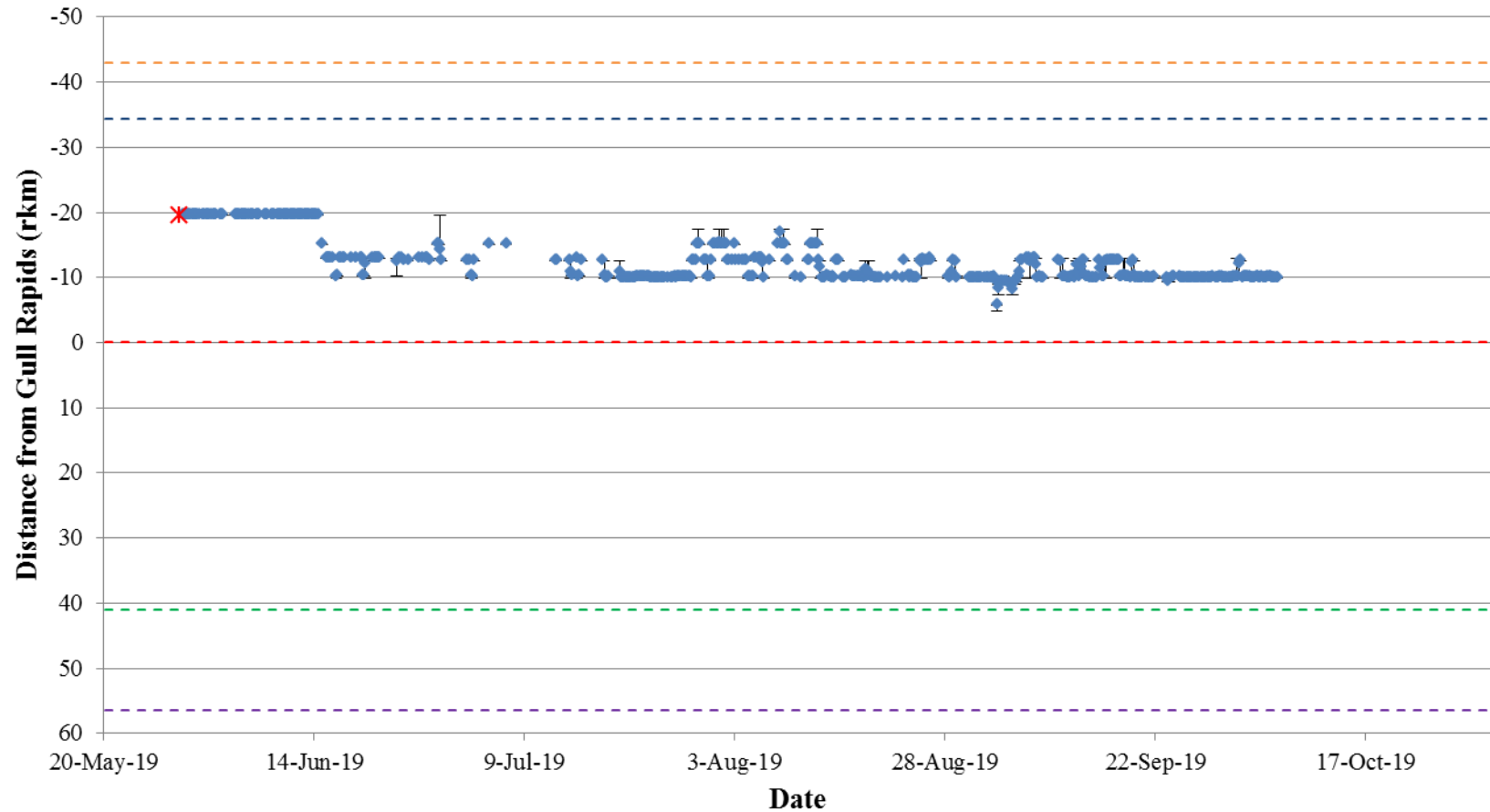


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APPENDIX 5:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, STEPHENS LAKE, MAY TO OCTOBER 2019

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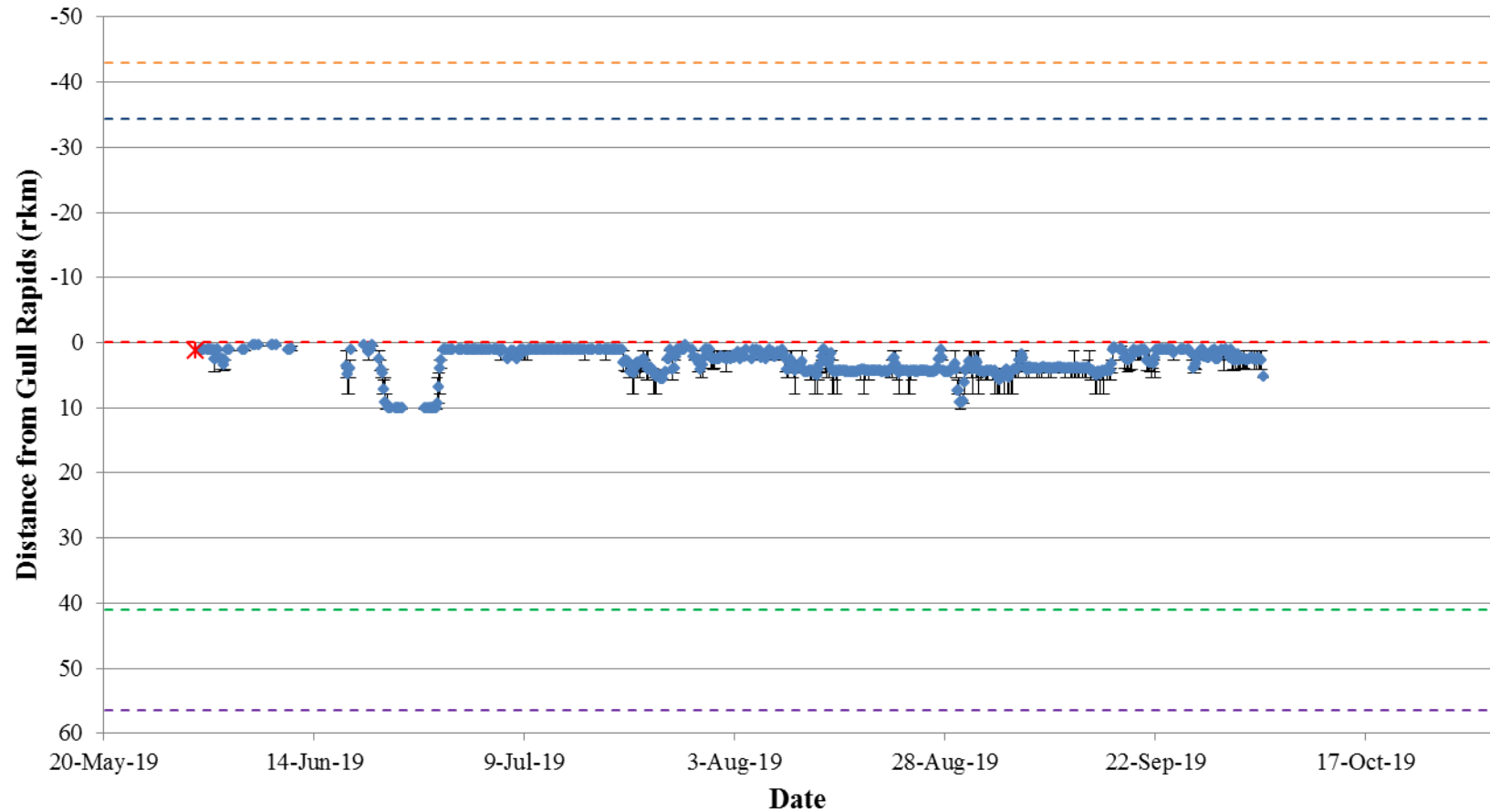


Figure A5-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7035) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

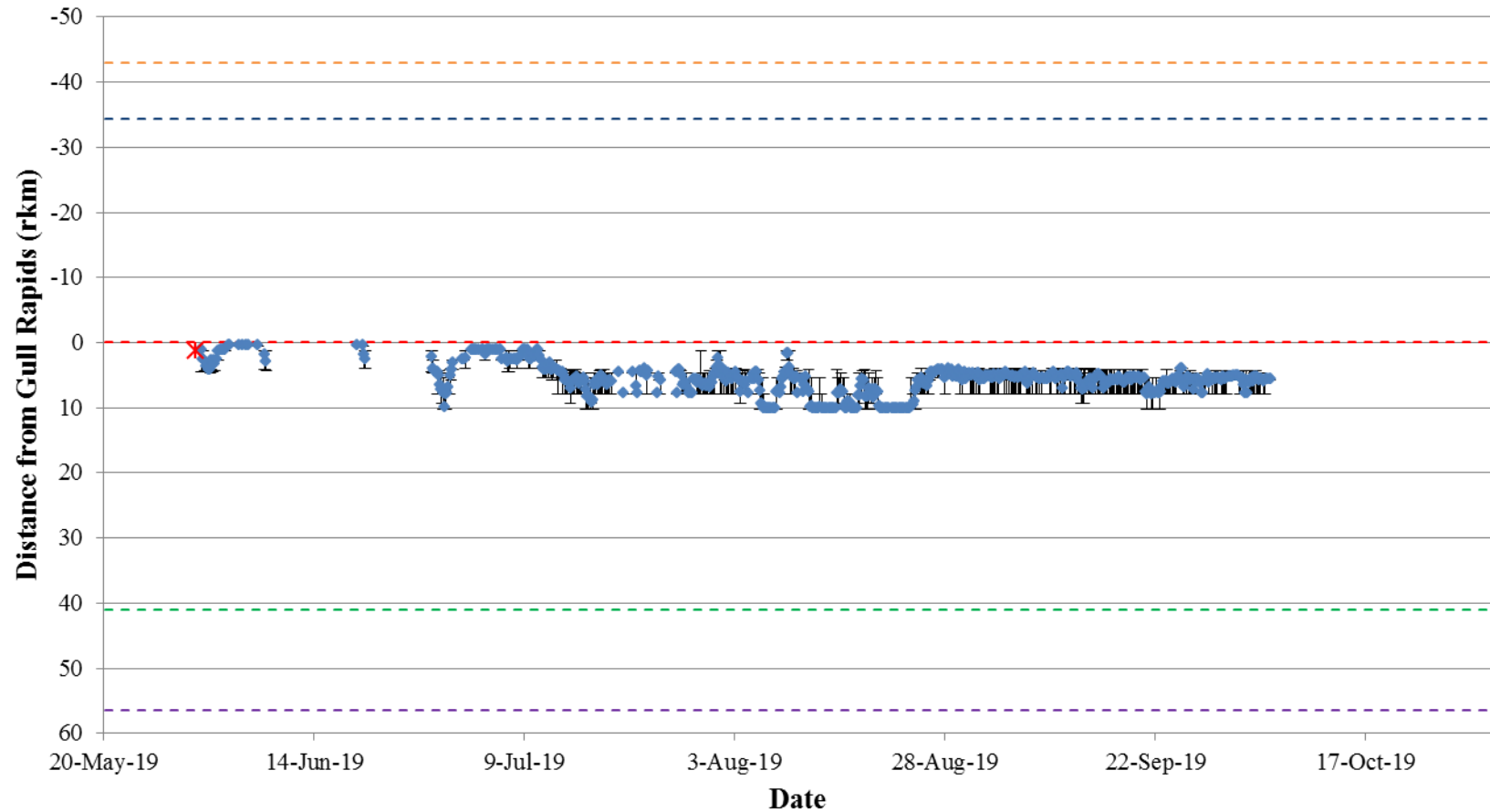


Figure A5-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7036) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

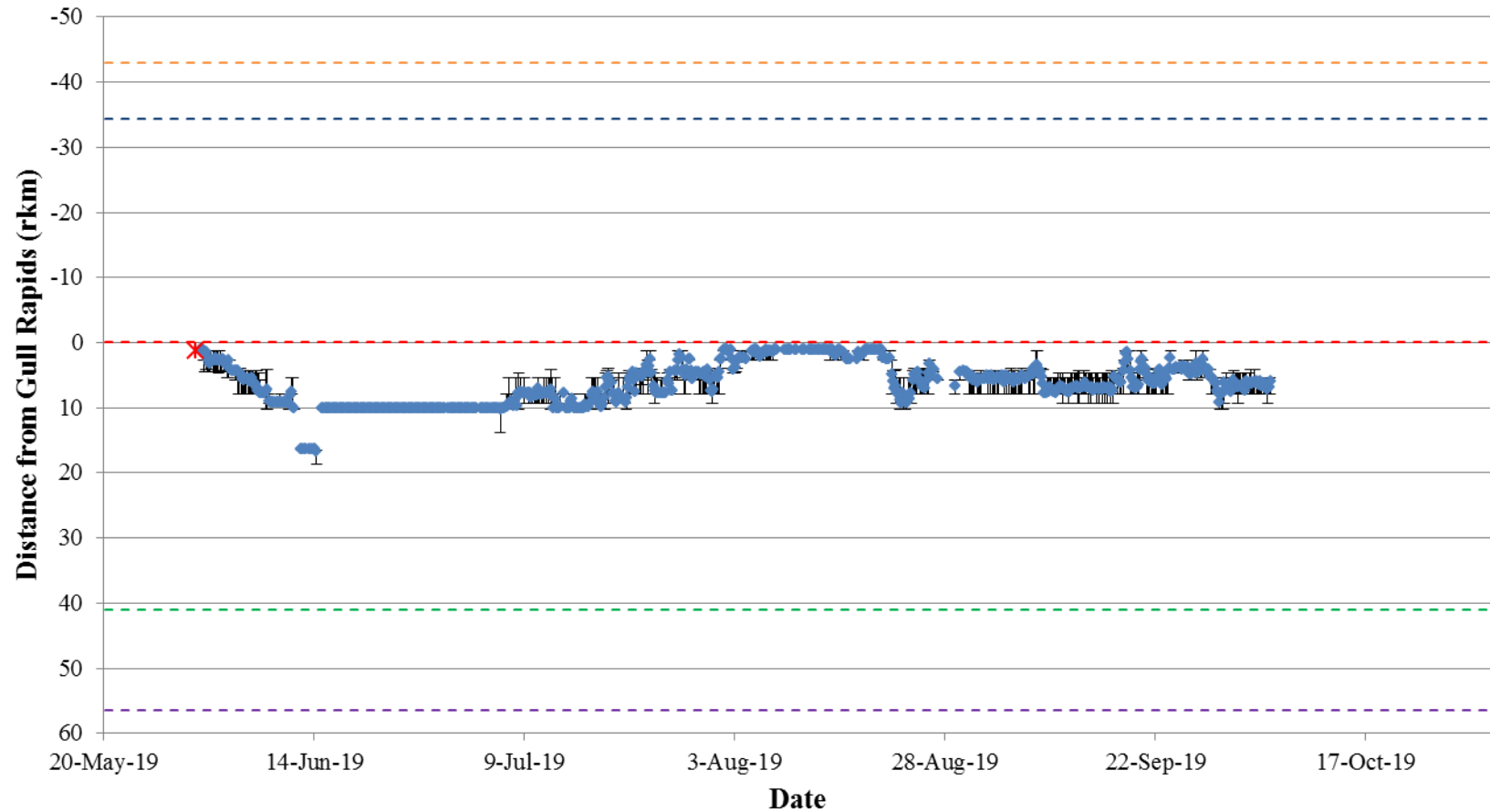


Figure A5-3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7037) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

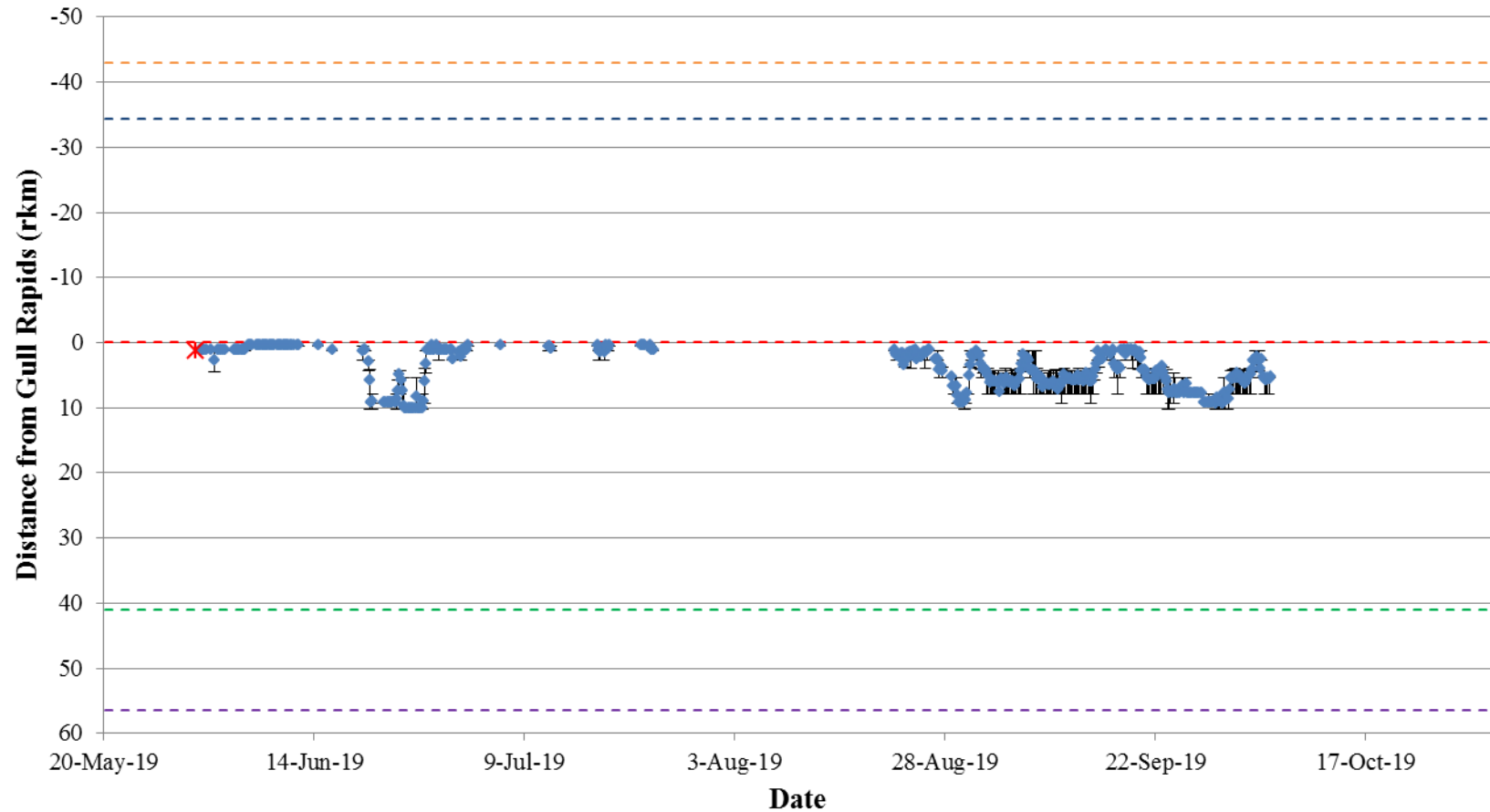


Figure A5-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7038) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

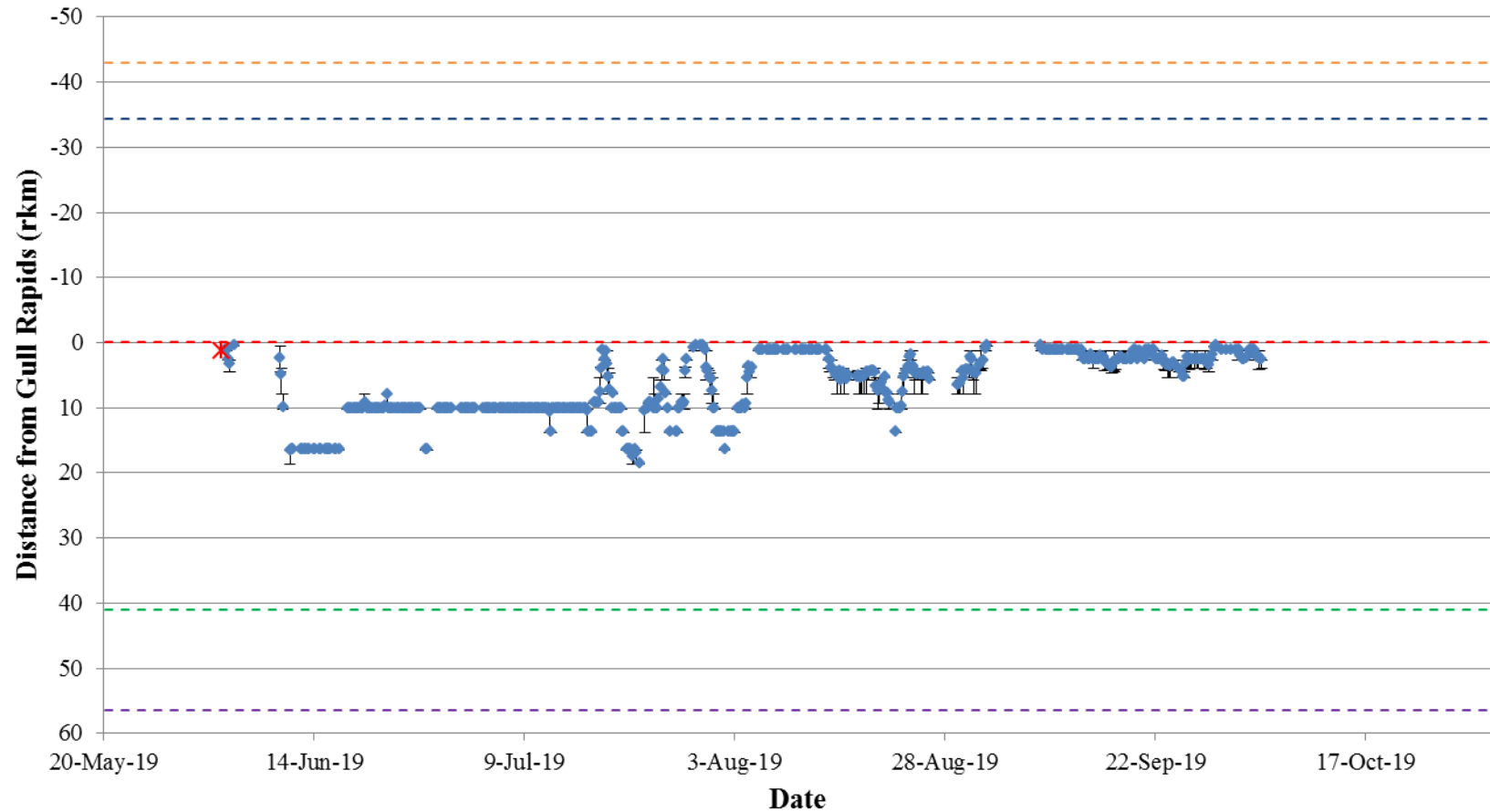


Figure A5-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7039) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

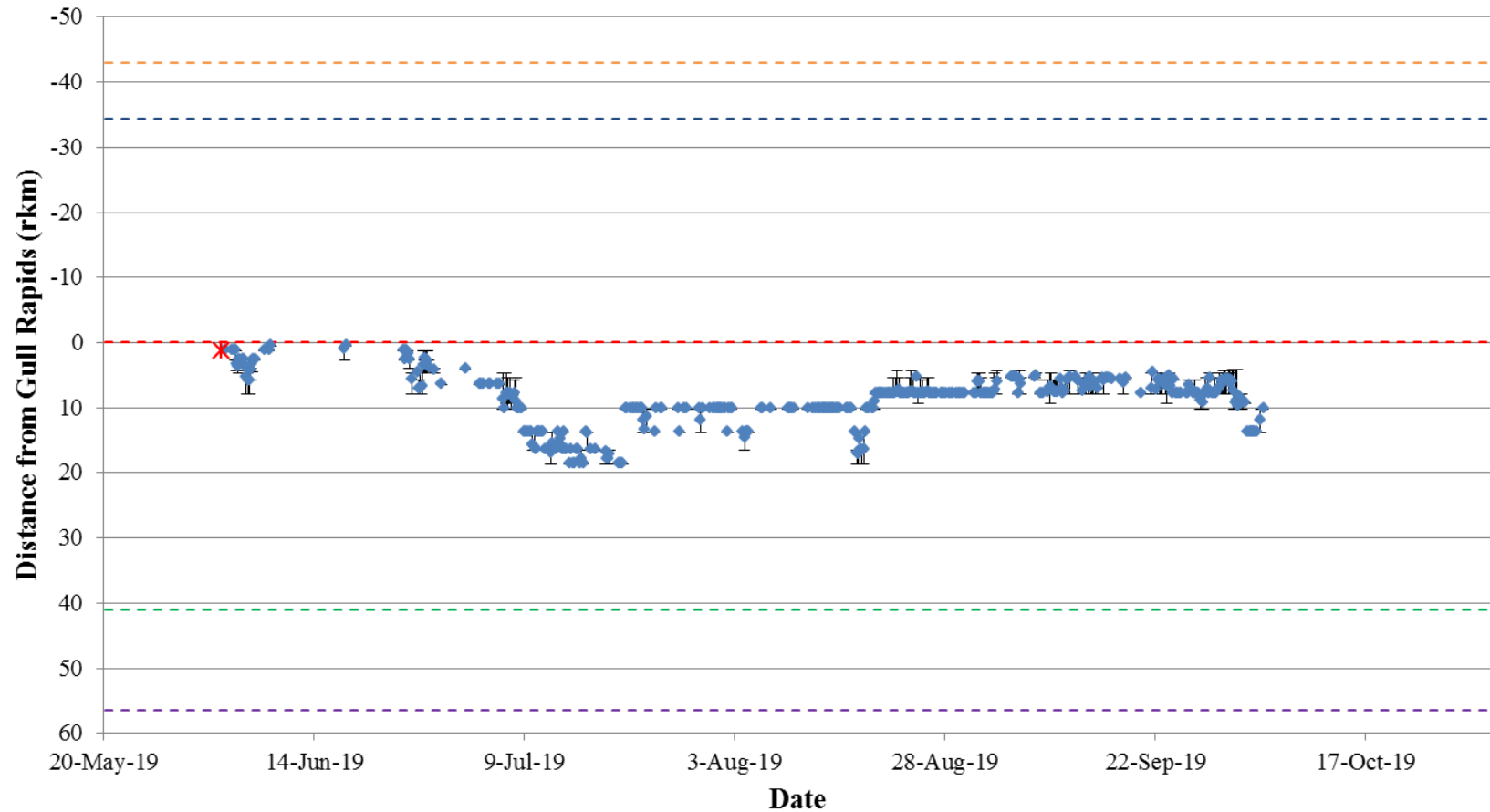


Figure A5-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7040) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

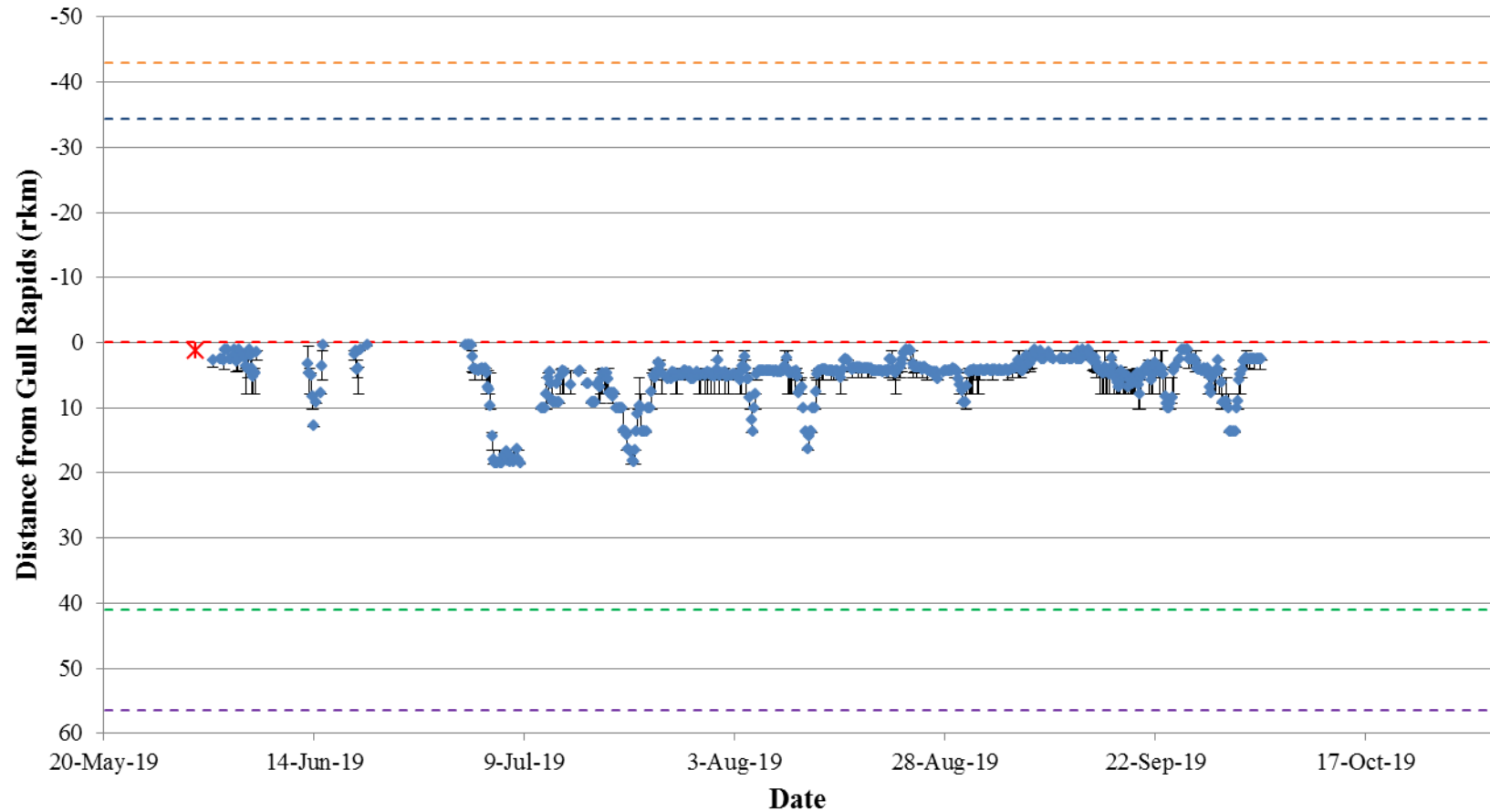


Figure A5-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7041) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

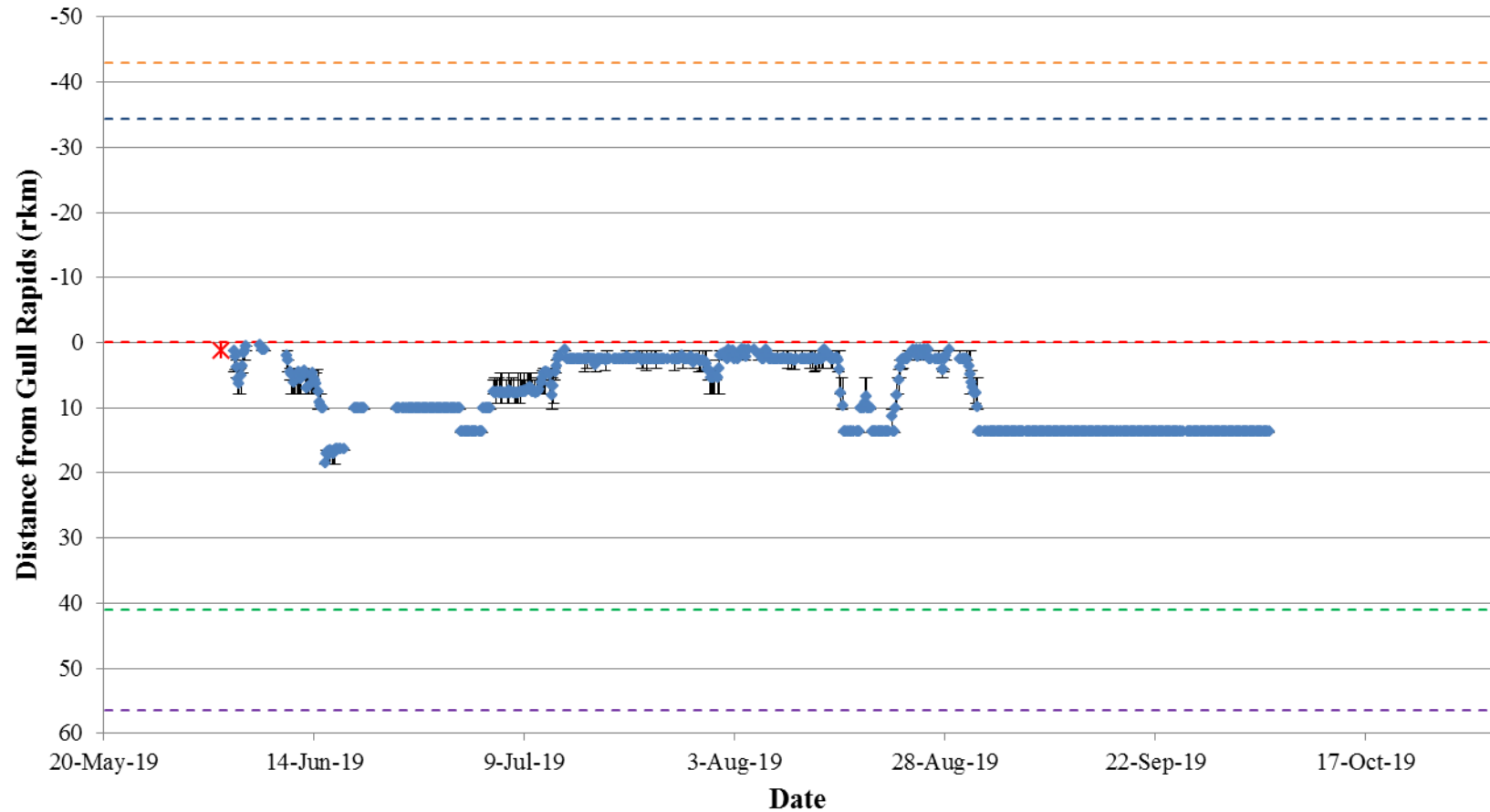


Figure A5-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7042) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

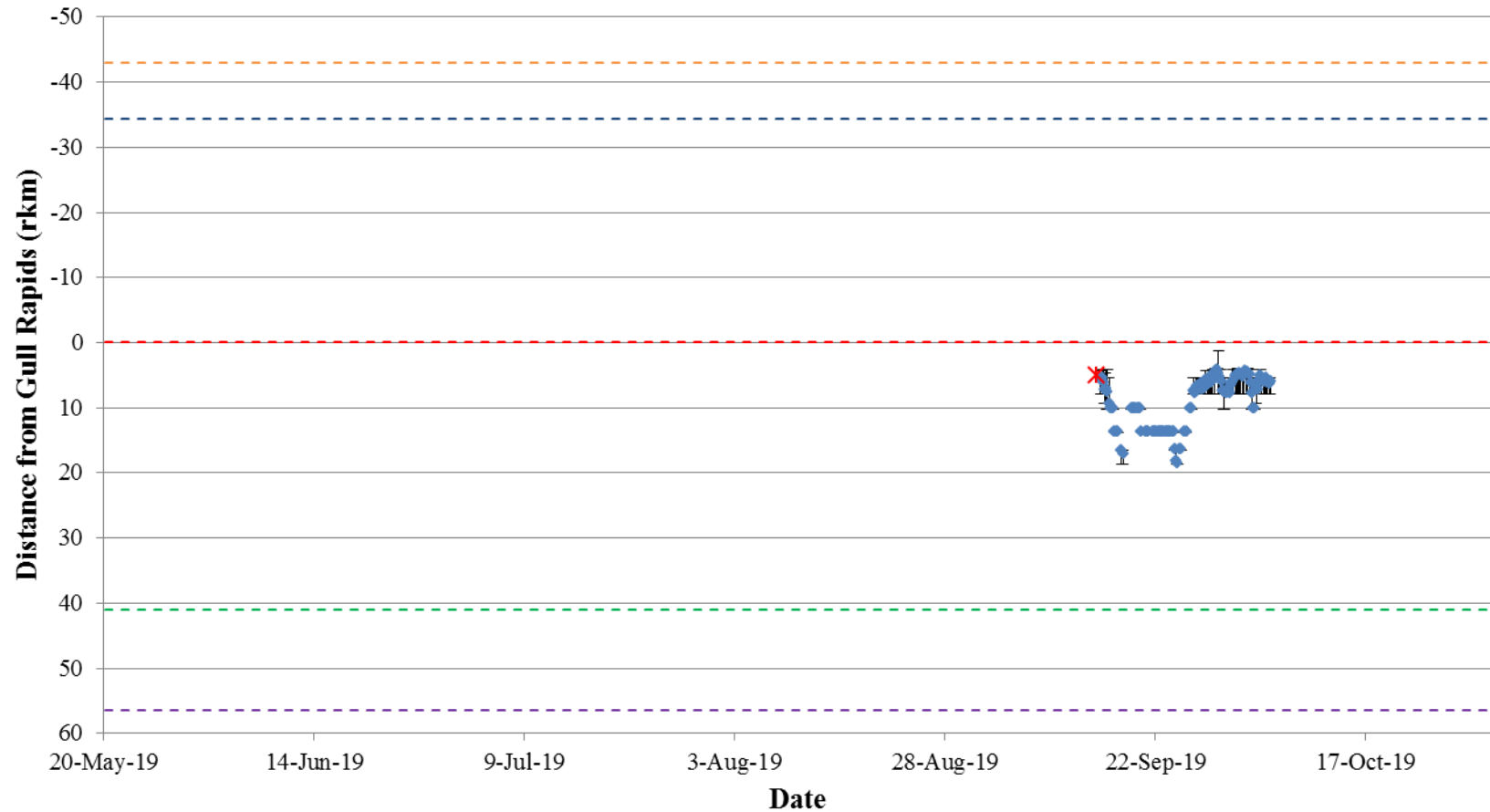


Figure A5-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7043) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

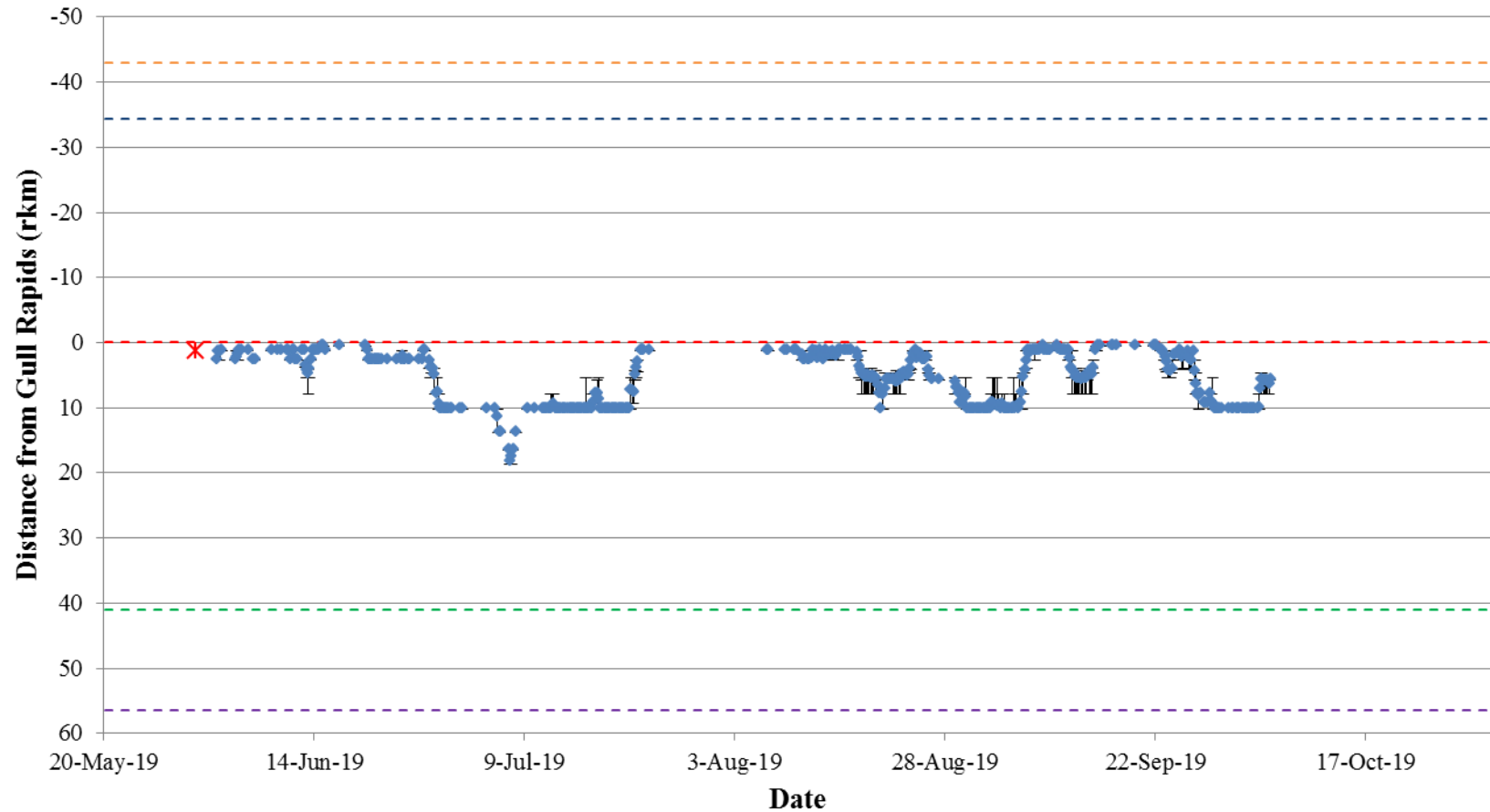


Figure A5-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7044) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

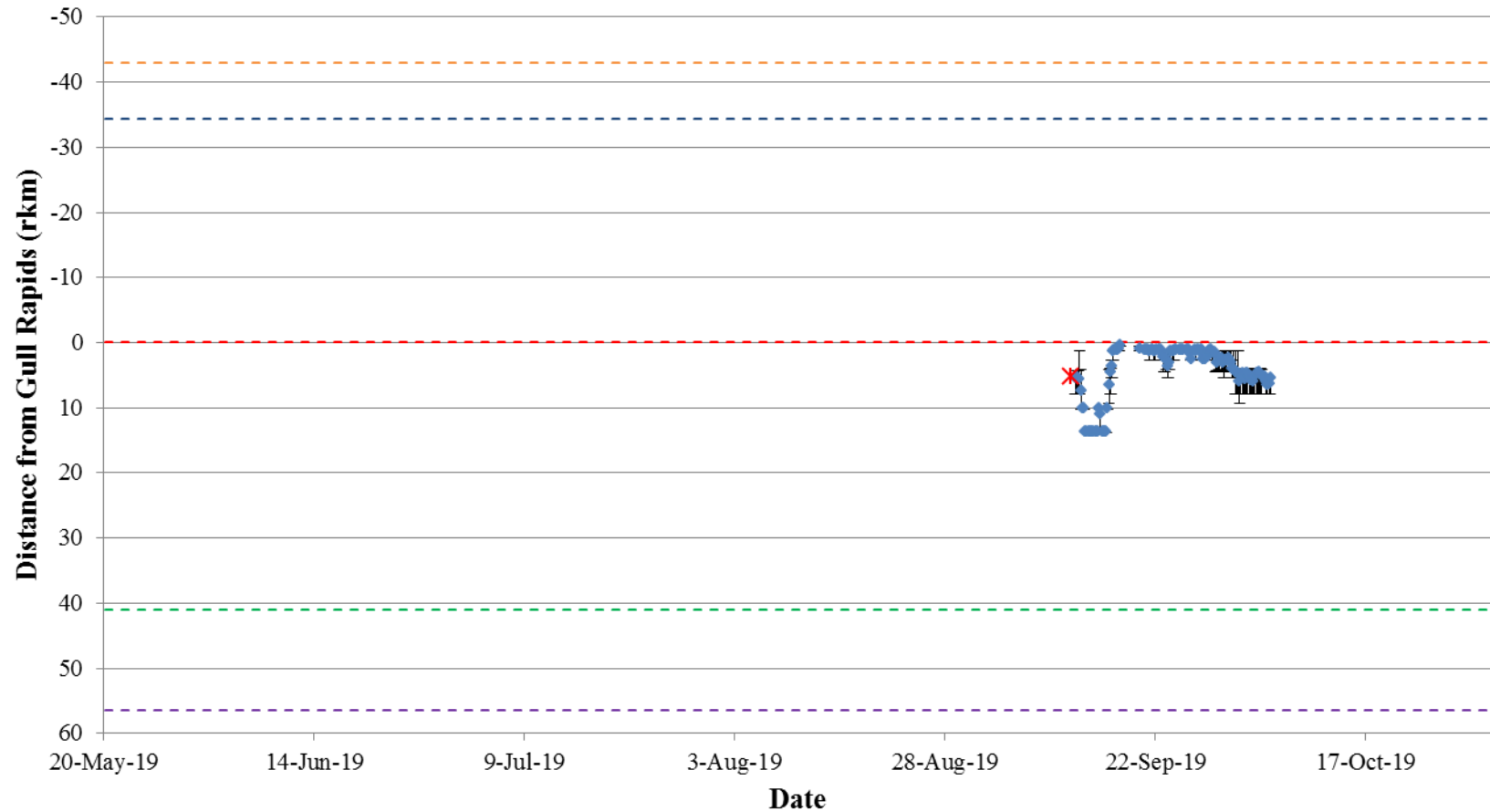


Figure A5-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7045) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

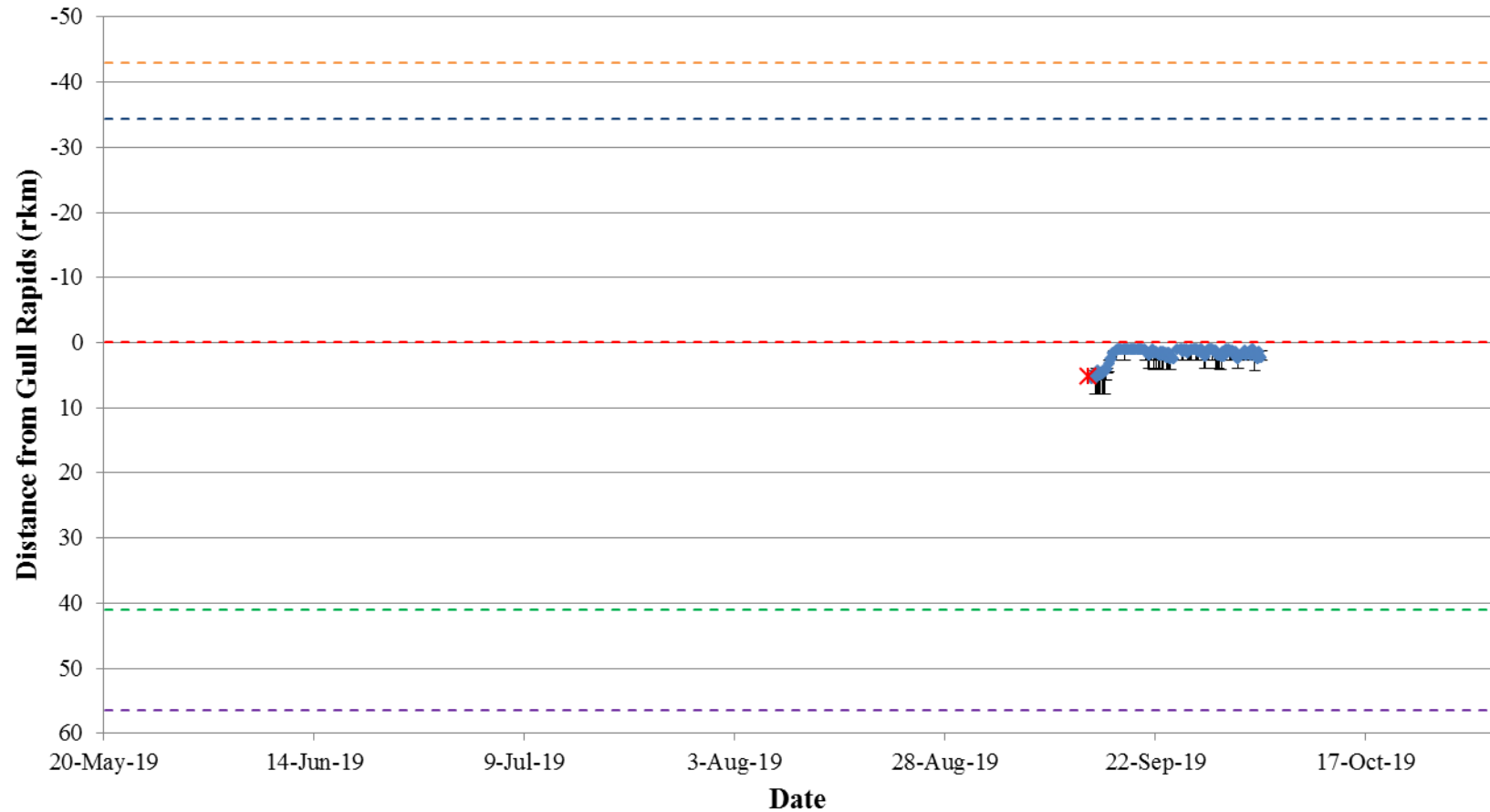


Figure A5-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7046) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

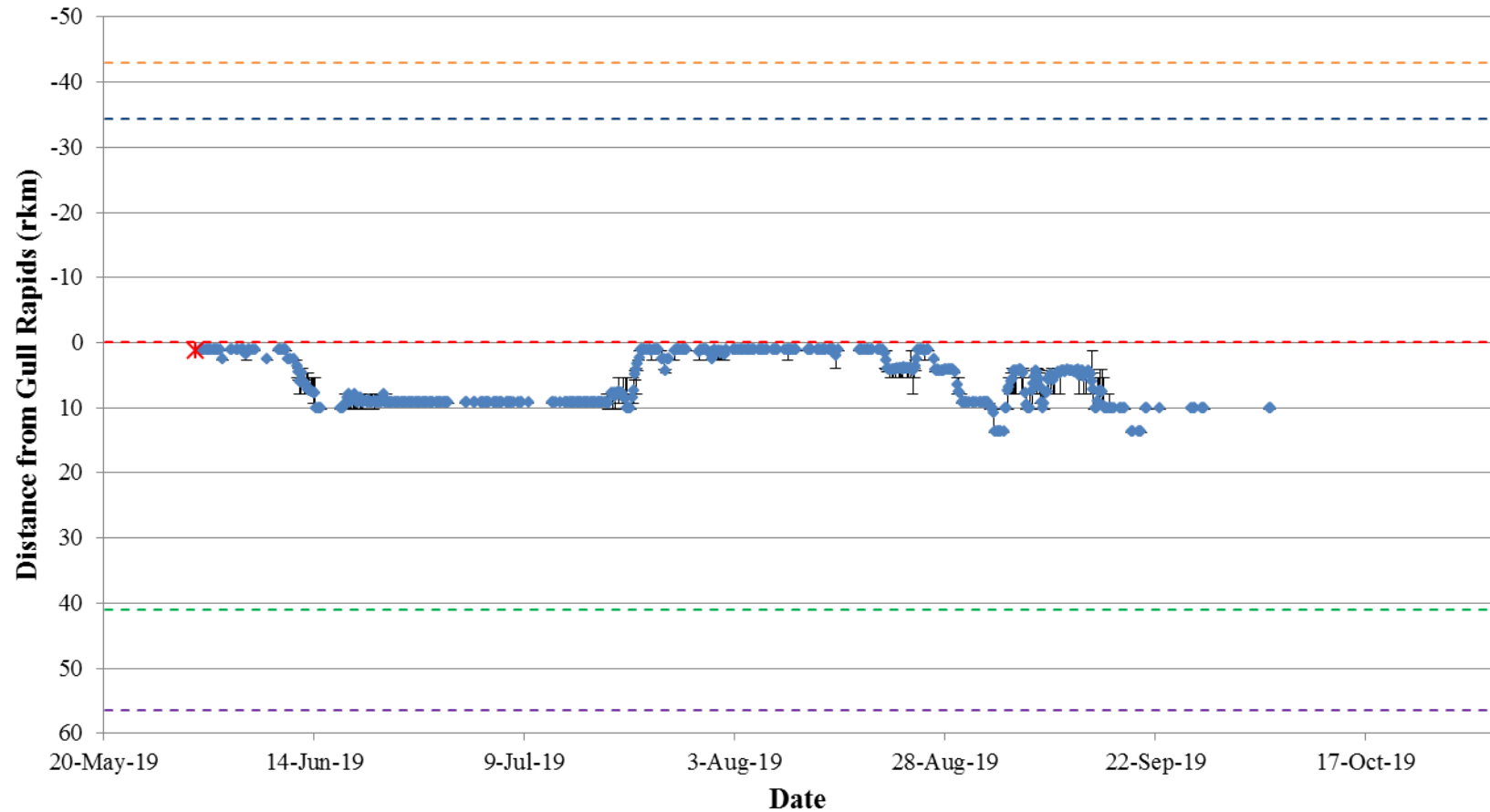


Figure A5-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7047) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

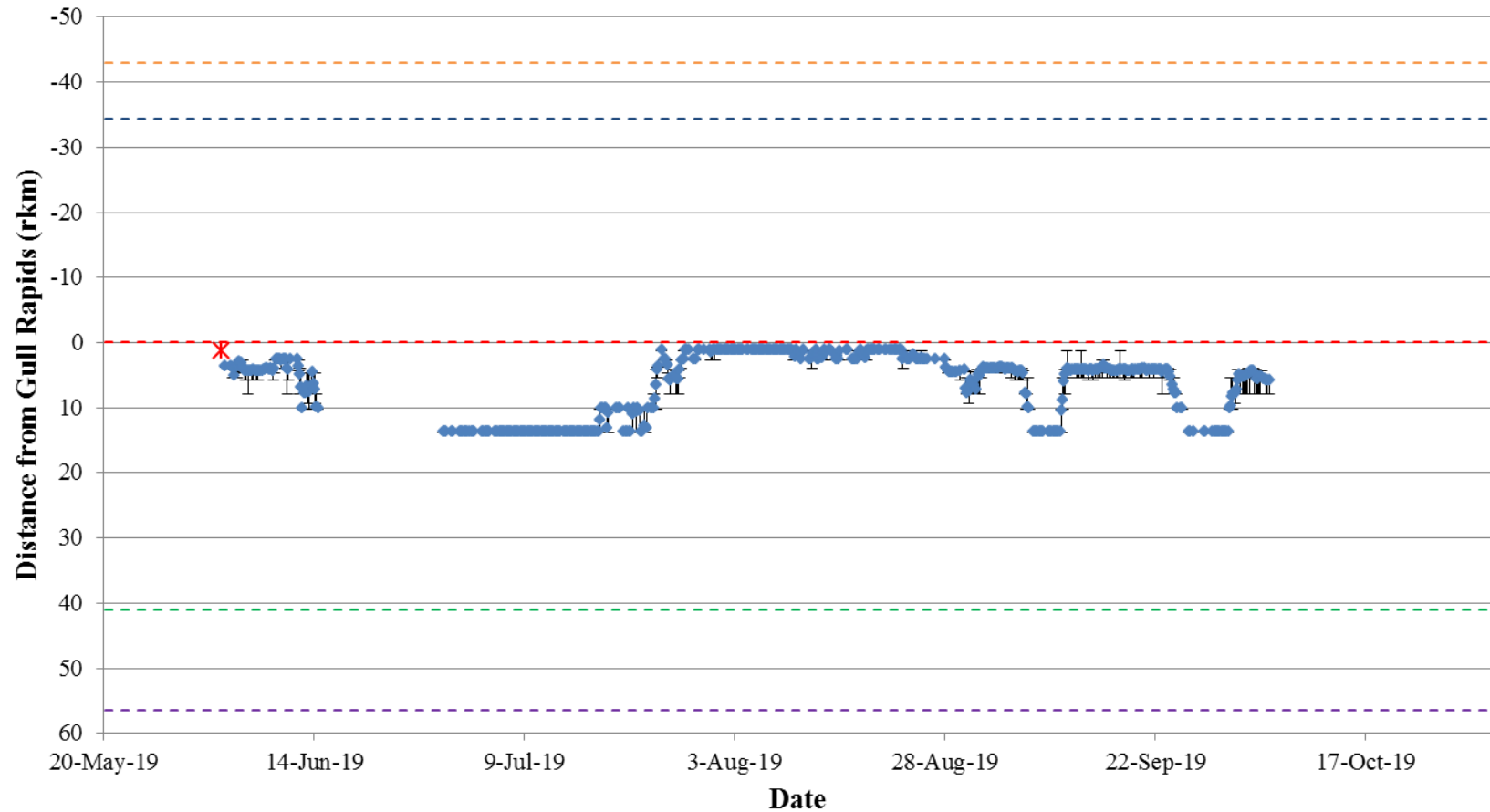


Figure A5-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7048) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

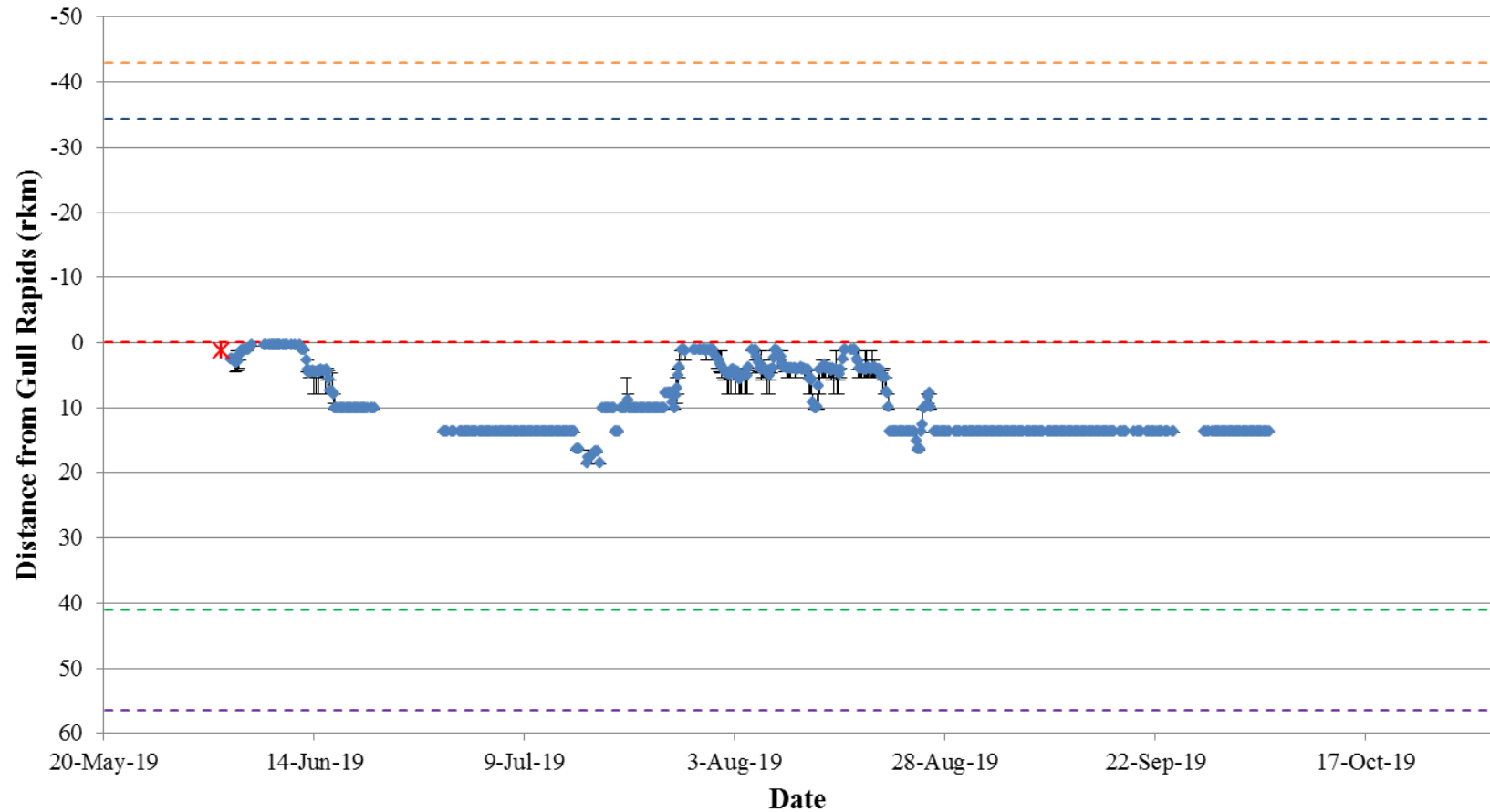


Figure A5-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7049) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

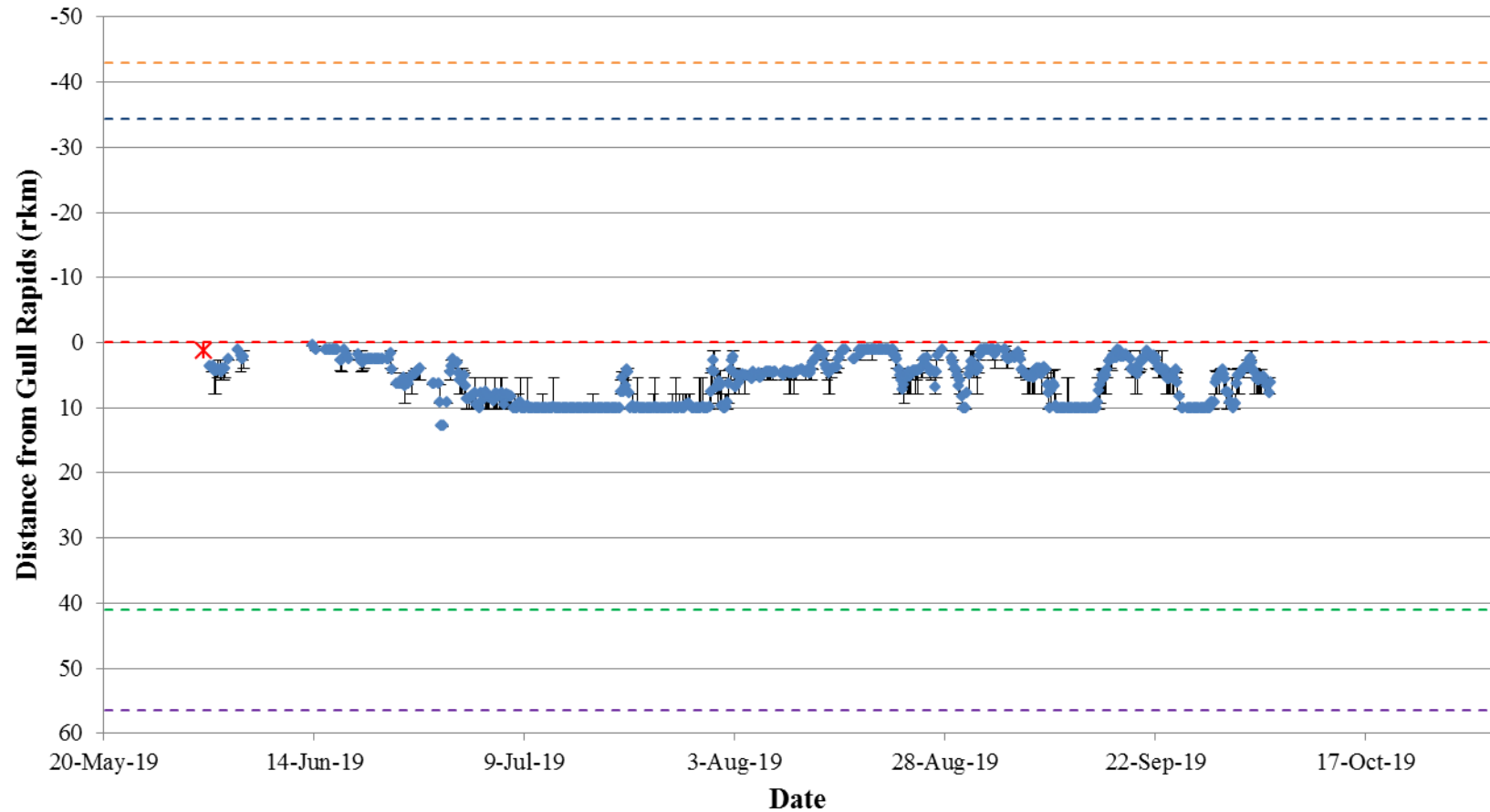


Figure A5-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7050) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

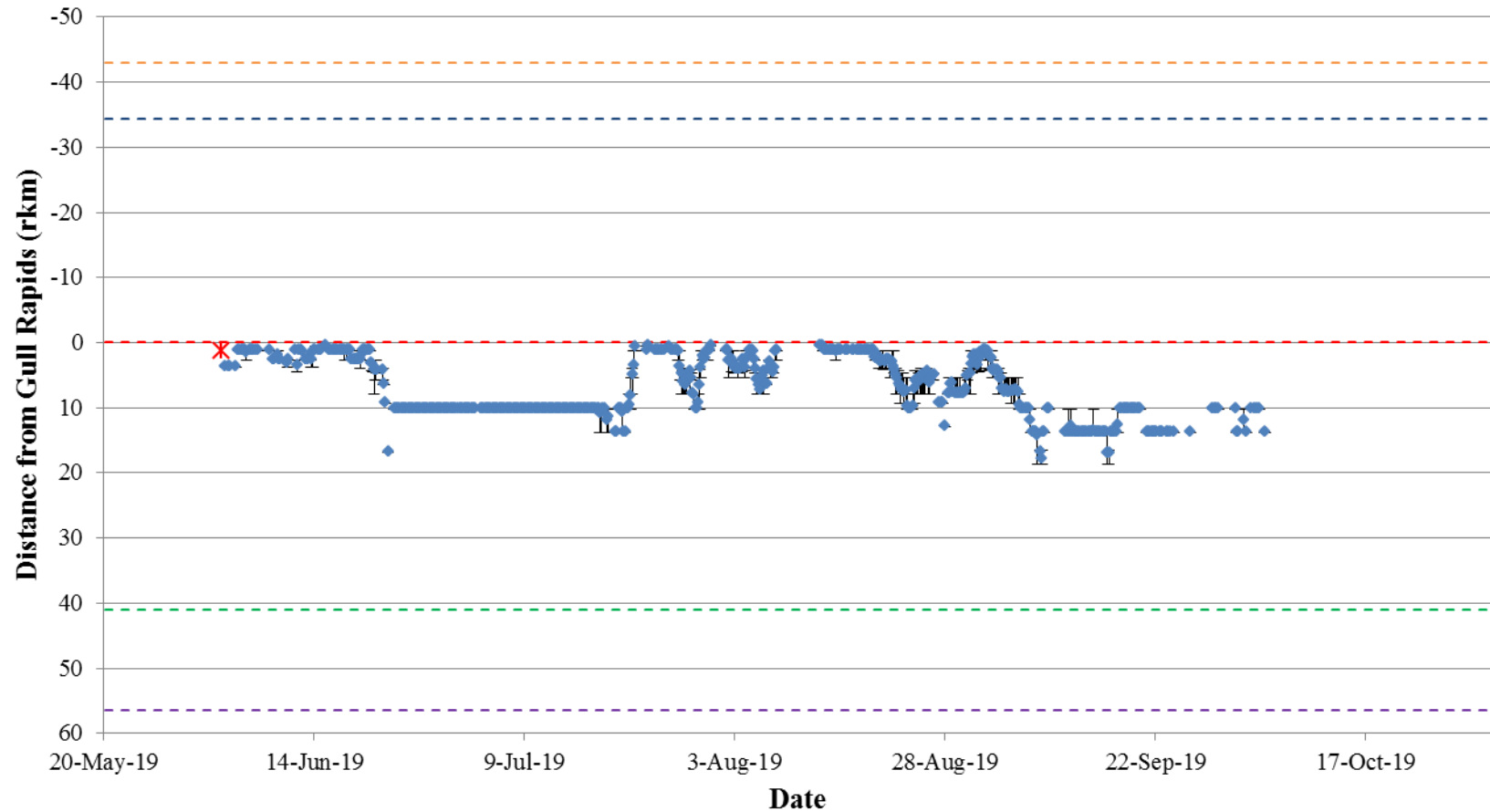


Figure A5-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7051) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

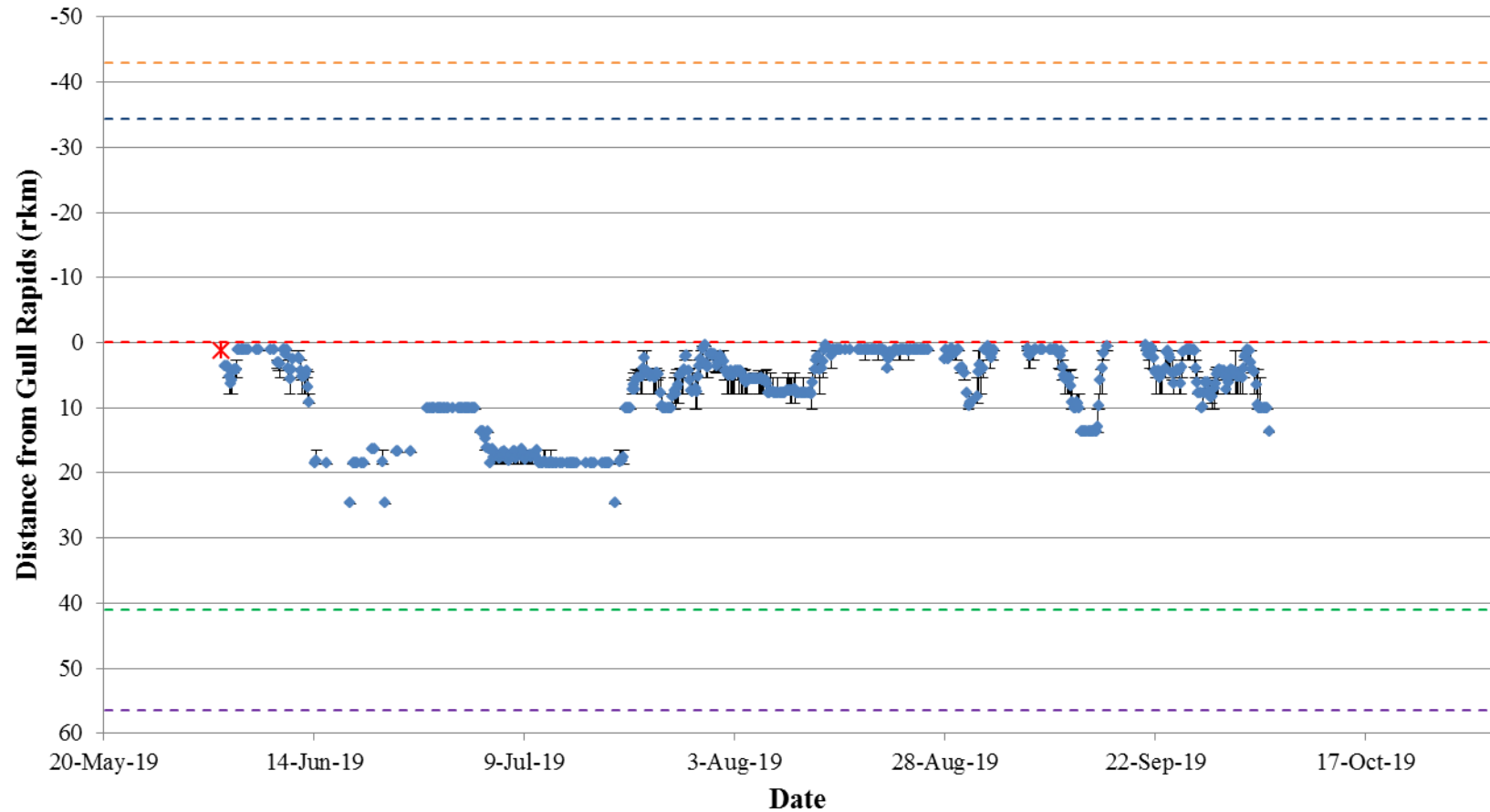


Figure A5-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7052) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

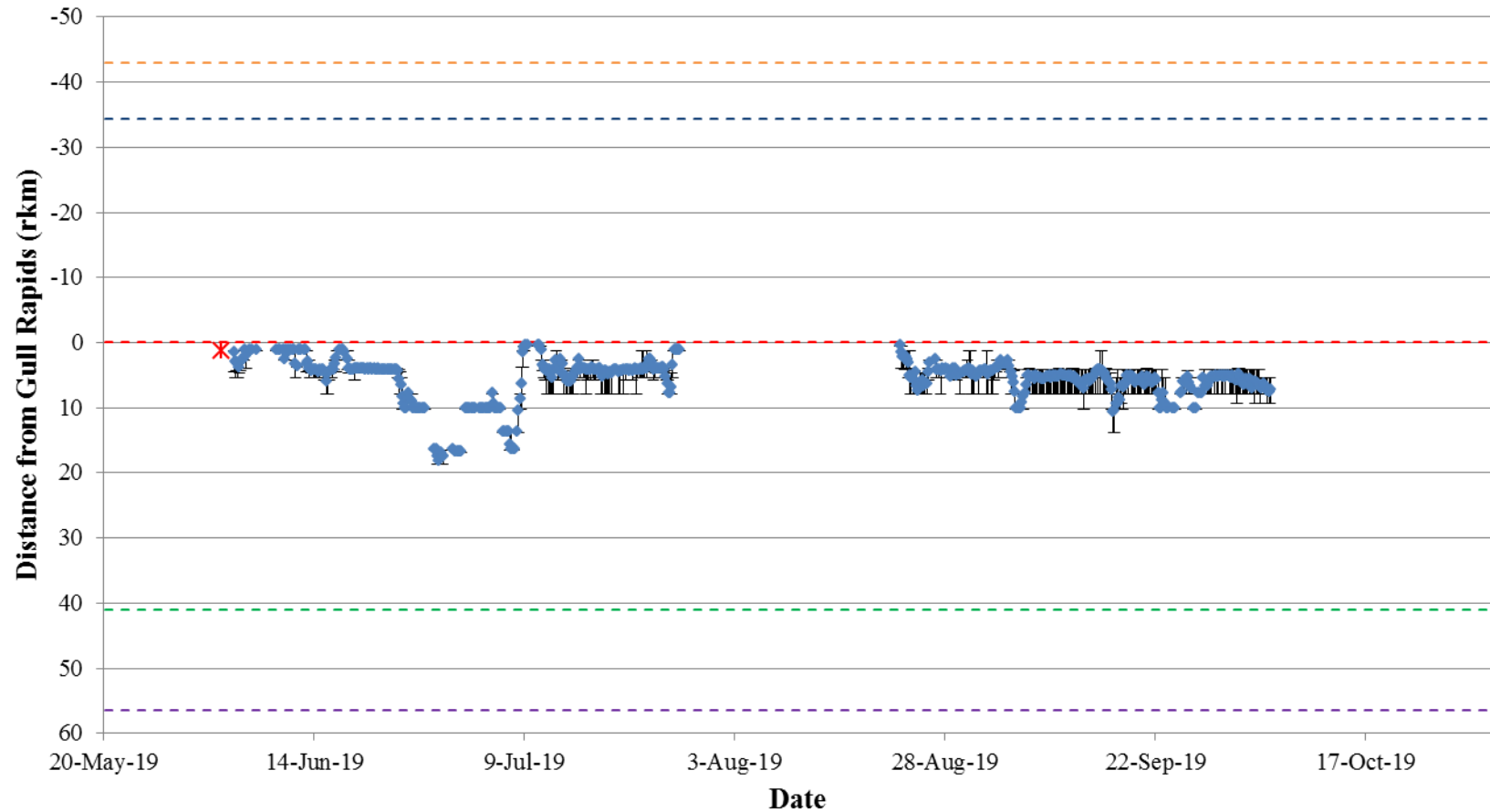


Figure A5-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7054) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

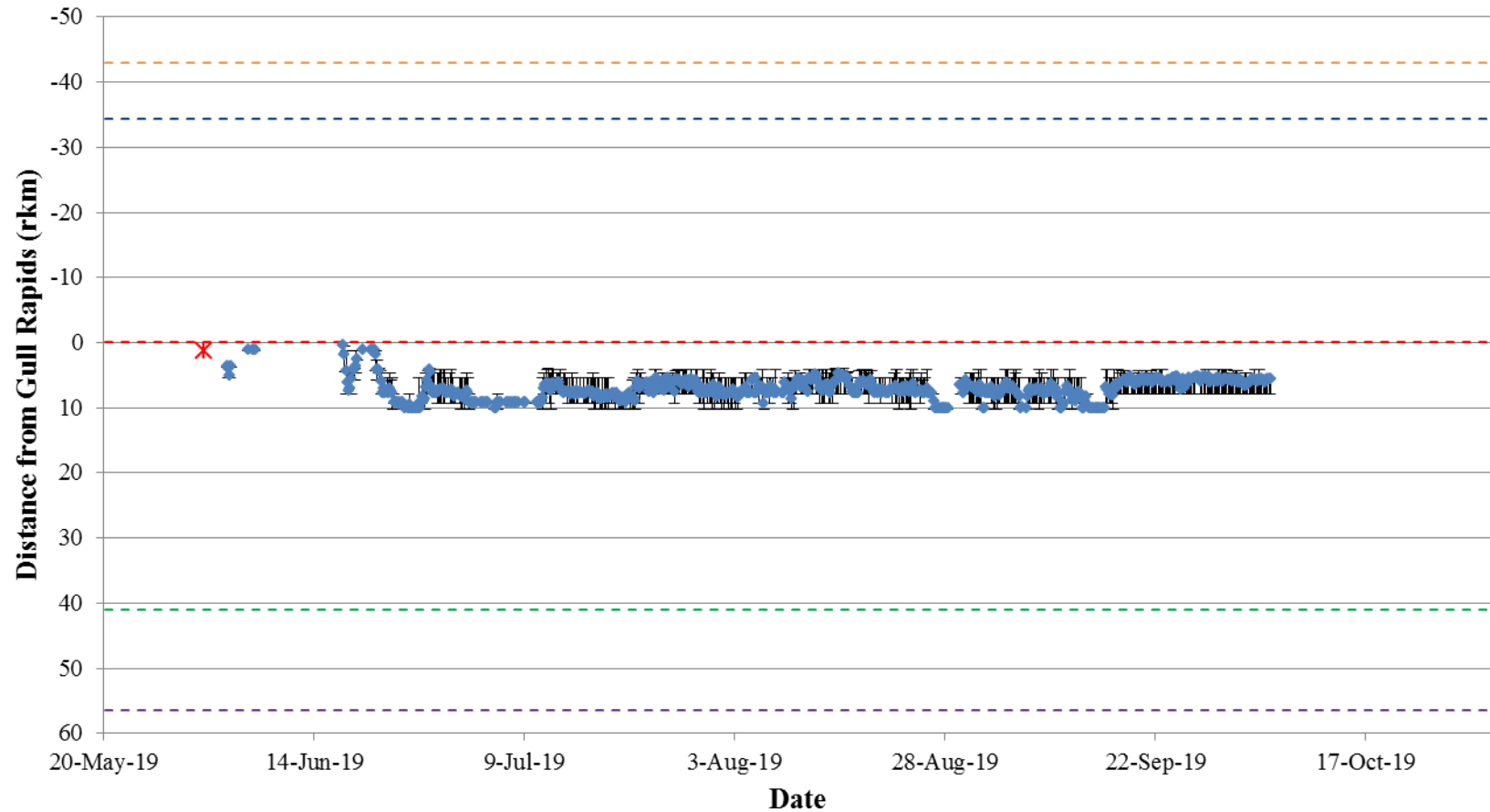


Figure A5-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7055) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

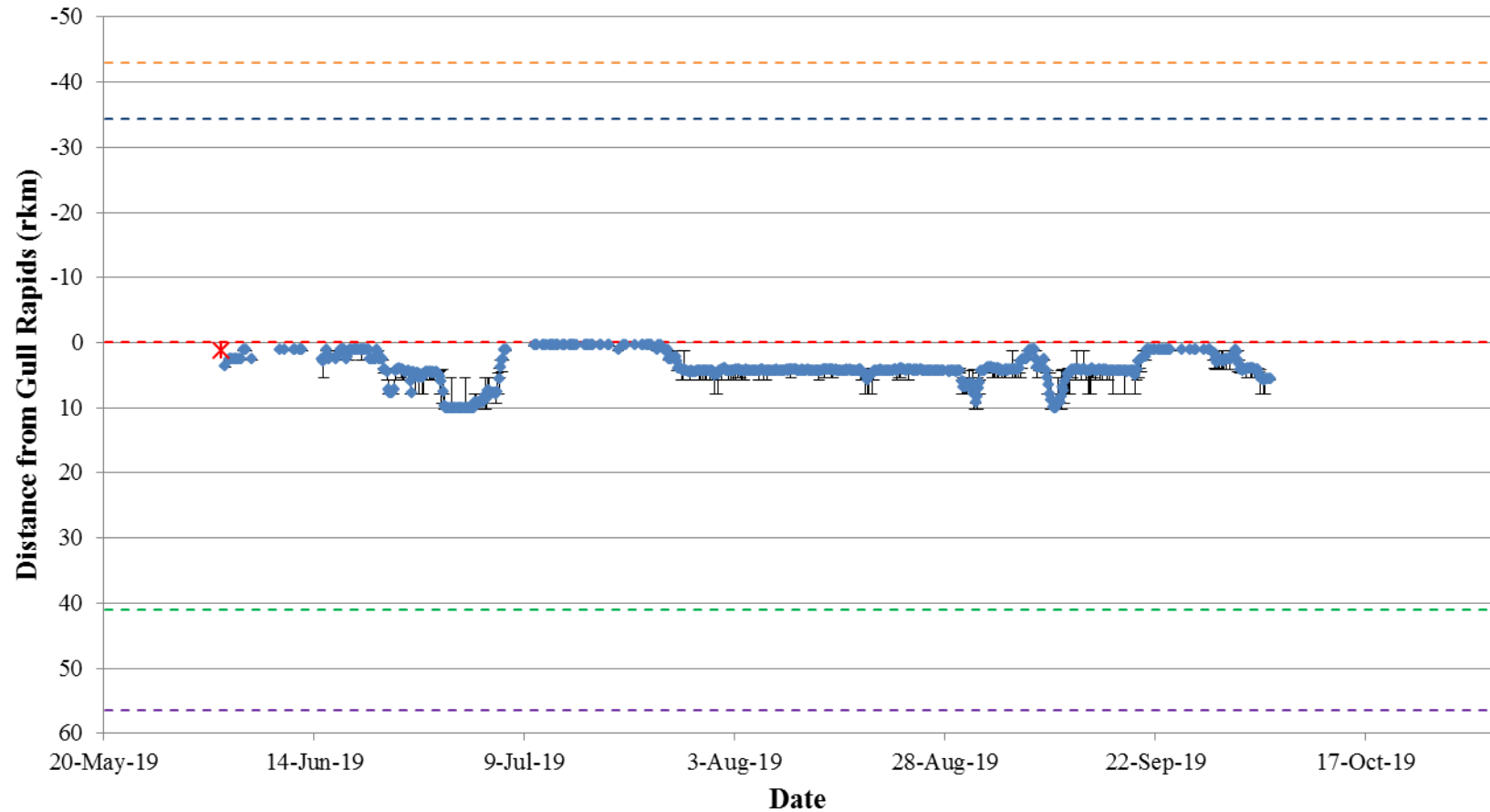


Figure A5-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7057) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

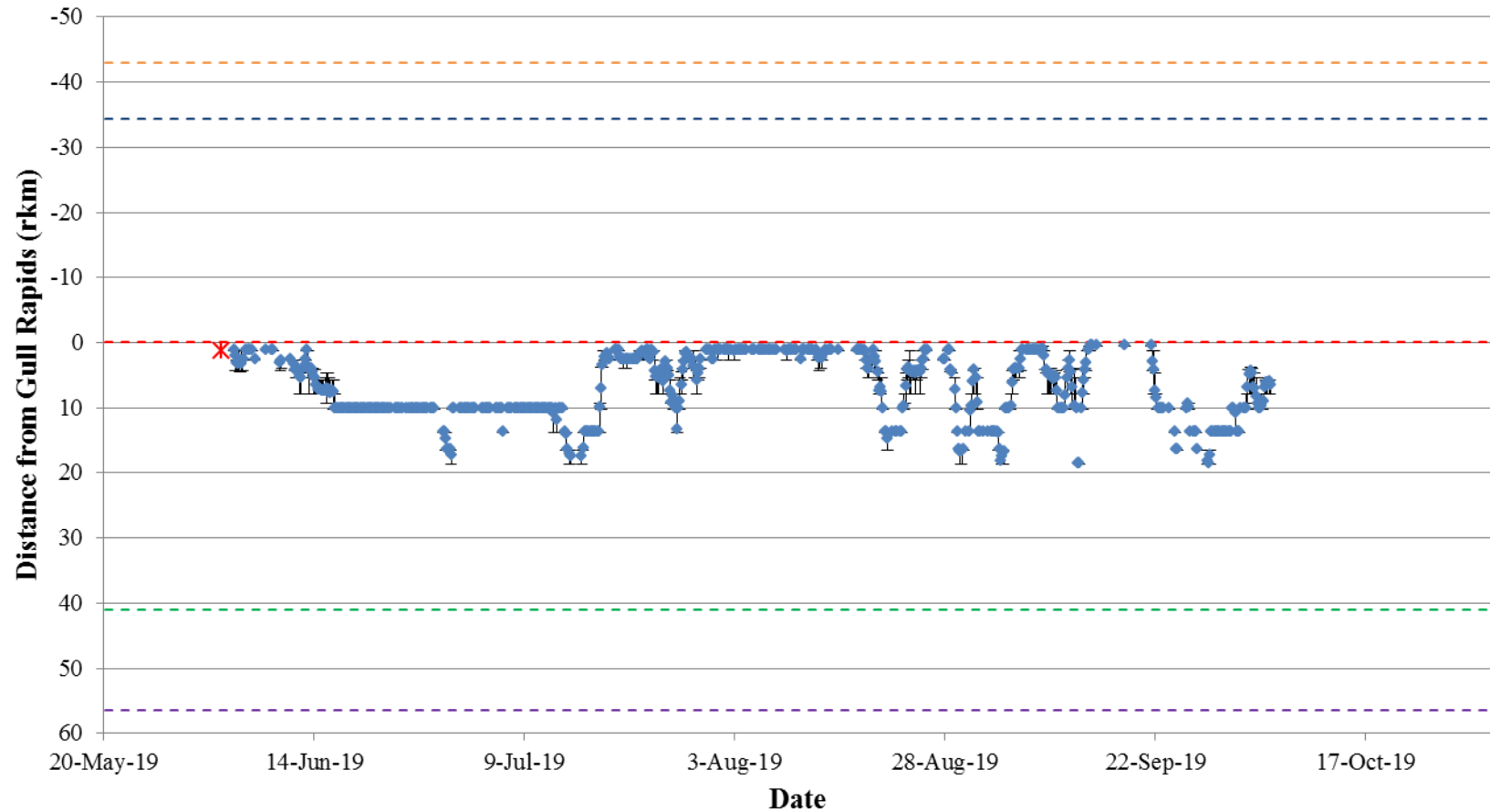


Figure A5-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7058) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

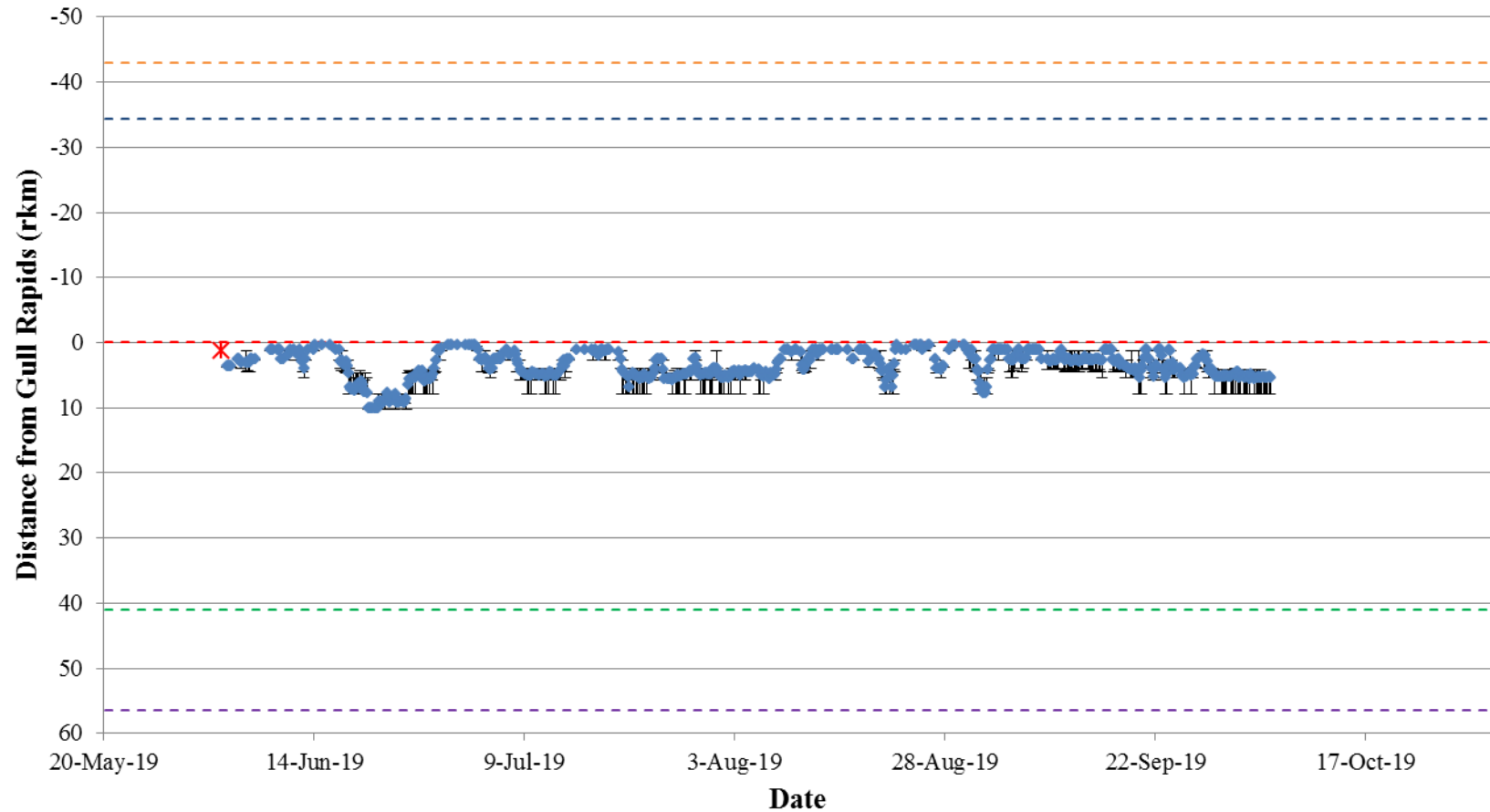


Figure A5-23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7060) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

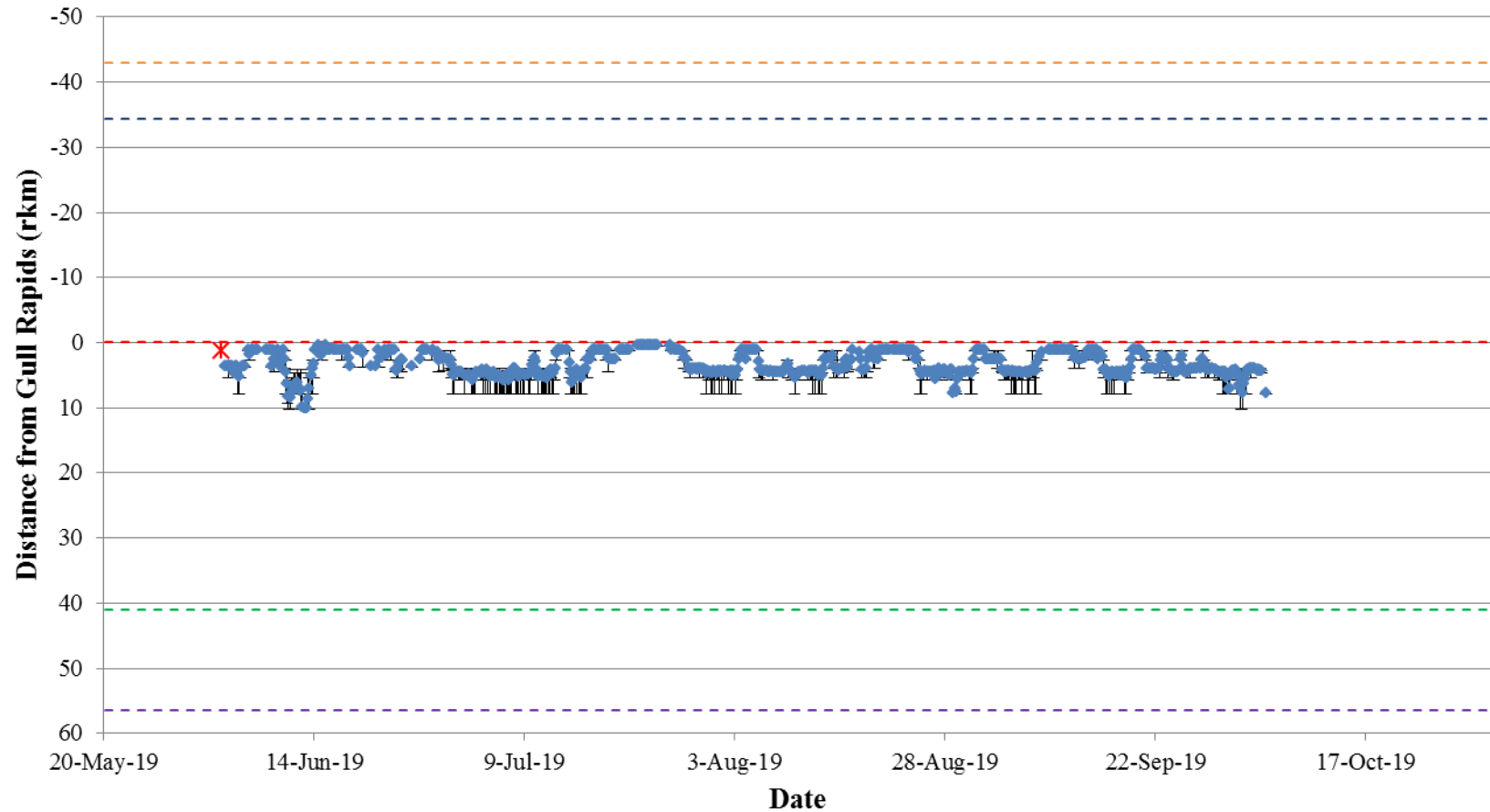


Figure A5-24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7062) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

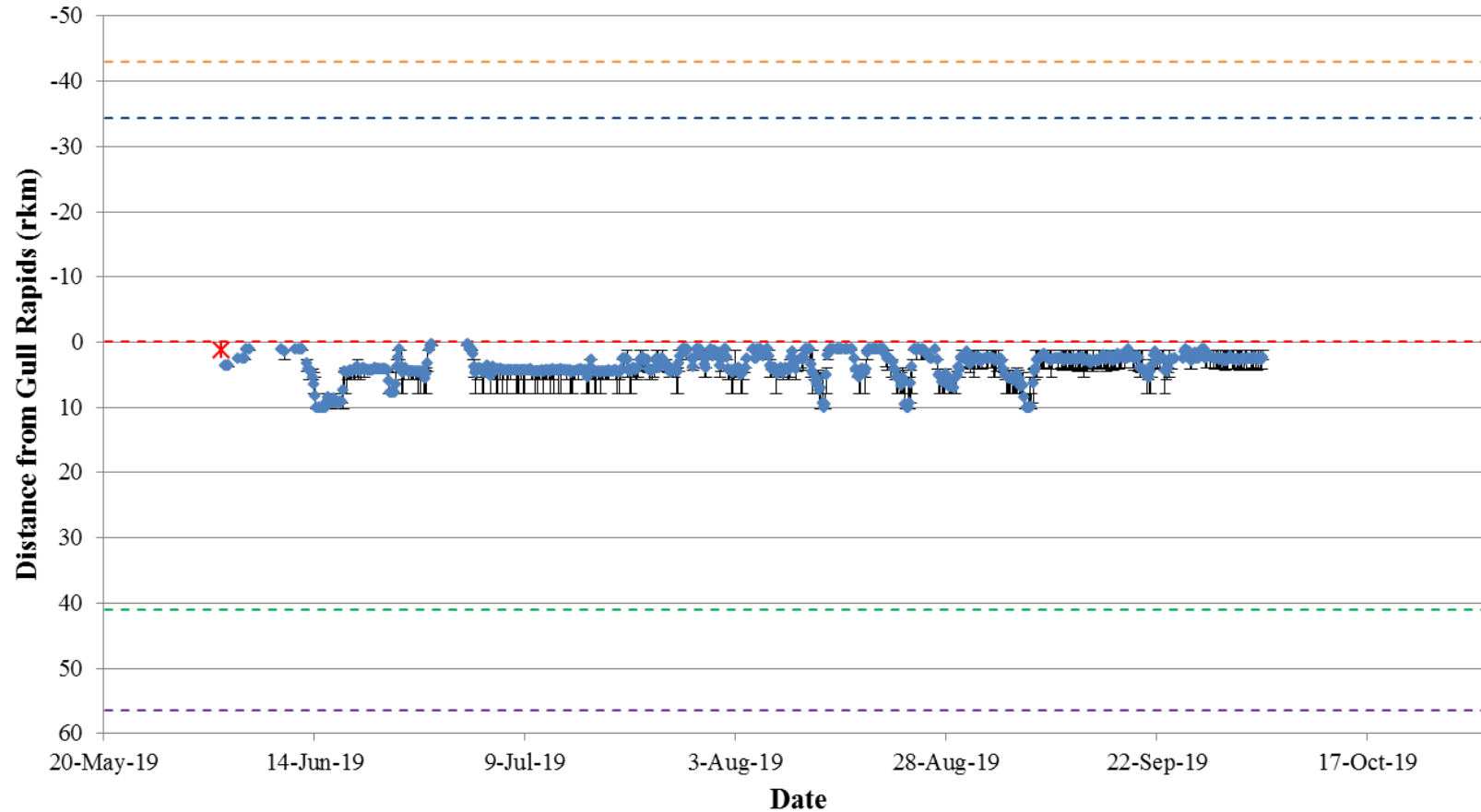


Figure A5-25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7063) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 7, 2019. Date and location of tagging is indicated by a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).