KEEYASK PROJECT

Generating Station

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Report # 04-05

Lake Sturgeon Investigations in the Keeyask Study Area, 2004

Draft

ENVIRONMENTAL STUDIES PROGRAM

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LAKE STURGEON INVESTIGATIONS IN THE KEEYASK STUDY AREA, 2004

Draft Report Prepared for Manitoba Hydro

by
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OVERVIEW

Manitoba Hydro and its potential partners (Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation, and York Factory Cree Nation) are currently looking into building a hydroelectric generating station at Gull Rapids on the Nelson River. Studies are being done to support predictions of possible effects of this generating station on the environment. This information is required to prepare an Environmental Impact Statement (EIS), a document required by government for its consideration when deciding about licensing the generating station. The aquatic part of these studies is looking at the water, algae (microscopic plants in the water), weeds, bugs, and fish. The area being studied includes Split, Stephens, Clark, Gull, and Assean lakes and adjoining parts of the rivers (Burntwood, Nelson, Aiken, and Assean) and the streams that flow into them. Separate reports are being issued on each topic and for each different area.

This report presents information collected during the fourth year of lake sturgeon investigations in the Keeyask Study Area. The 2004 investigations were conducted in the Nelson River between lower Split Lake and Stephens Lake. For the purposes of this report, data were analyzed separately for four areas: 1) the Nelson River between lower Split Lake and Birthday Rapids; 2) the Nelson River between Birthday and Gull rapids; 3) within Gull Rapids; and 4) Stephens Lake (within 3 km of the base of Gull Rapids). Gill nets and larval drift nets were used to sample lake sturgeon and lake sturgeon eggs and larvae, respectively. To provide information on lake sturgeon movements, radio and acoustic transmitters that were applied to lake sturgeon in 2001 continued to be monitored throughout 2004. Additional lake sturgeon studies were conducted in 2005.

TECHNICAL SUMMARY

Manitoba Hydro and its potential partners (Tataskweyak Cree Nation, War Lake First Nation, Fox Lake Cree Nation, and York Factory Cree Nation) are currently investigating the feasibility of developing a **hydroelectric generating station*** at Gull Rapids located at the upstream end of Stephens Lake on the Nelson River (Figure 1). An Environmental Studies Program has been developed to provide the data and information required for an **environmental impact assessment** of the above-mentioned hydroelectric **Project**, should a decision be made to proceed with a licensing submission to **regulatory authorities**. Manitoba Hydro and the potential partners have established a cooperative approach to assessing the potential effects of future development on the **environment** and for producing the information required for regulatory review and impact **monitoring**.

The Keeyask **aquatic monitoring** and impact assessment program was designed to investigate and document interrelated components of the Burntwood, Nelson, Aiken, and Assean rivers as well as the associated lake (Split, Stephens, Clark, Gull, and Assean) aquatic **ecosystems**. Investigations of physical **habitat**, **water quality**, **detritus**, **algae**, aquatic **macrophytes**, **aquatic invertebrates**, and fish were to be undertaken. Individual reports are being prepared and issued on each topic and for specific waterbodies.

The following report presents information collected during lake sturgeon (*Acipenser fulvescens*) investigations conducted in the Keeyask Study Area in 2004. For the purposes of this report, data from four areas were analyzed separately: 1) Nelson River between lower Split Lake and Birthday **Rapids**; 2) Nelson River between Birthday and Gull rapids; 3) Gull Rapids; and 4) Stephens Lake (within 3 km of the base of Gull Rapids). Gill nets were used to capture lake sturgeon at each location. In addition, drift nets were used to sample **larval** lake sturgeon and eggs in the Nelson River between Split Lake and Stephens Lake.

Objectives common to all areas studied in 2004 included the following:

- to gain a better understanding of lake sturgeon biology;
- to identify lake sturgeon spawning areas;
- to better describe lake sturgeon abundance and habitat use;
- to identify any critical habitats; and
- to better understand the timing and spatial extent of lake sturgeon movements.

* *Definitions for words appearing in bold are provided in the glossary (see Section 5.0).*

Sixty-two lake sturgeon were captured in gill nets set in the Keeyask Study Area during spring 2004. The majority were captured in the Nelson River between Birthday and Gull rapids (n=51), followed by Stephens Lake and the Nelson River between Split Lake and Birthday Rapids (n=5 each), and within Gull Rapids (n=1). In terms of catch-per-unit-effort (CPUE), the highest was recorded from the Nelson River between Birthday and Gull rapids (0.18), followed by the Nelson River between lower Split Lake and Birthday Rapids (0.04), Stephens Lake (0.03) and Gull Rapids (0.01).

Although numbers were low, lake sturgeon in spawning condition were captured in the Nelson River near the outlet of Clark Lake and near Birthday Rapids. The presence of these fish suggests that spawning is occurring at those locations or nearby.

Eleven drift nets (five floating and six bottom set) were set in the Nelson River between Birthday and Gull rapids between 5 and 23 July, 2004. In total, two larval lake sturgeon were captured in DN-1S (the drift net set approximately 750 m upstream of Birthday Rapids). These are the first ever recorded captures of larval lake sturgeon in the Nelson River mainstem. The first lake sturgeon larva was captured on 9 July, and the other one day later (10 July). Both had completely absorbed their yolk sacs and measured 17.1 mm and 18.1 mm in length. The capture of these larval fish demonstrates that sturgeon spawned successfully above Birthday Rapids in 2004.

Ten drift nets (five floating and five bottom set) were set in the Nelson River within Gull Rapids and downstream of the rapids in Stephens Lake between 7 and 23 July, 2004. Larval lake sturgeon were not captured in drift nets set in and below Gull Rapids in 2004 and have not been captured in this area since studies began in 2001.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

Manitoba Hydro and its potential partners (Tataskweyak Cree Nation [TCN], War Lake First Nation [WLFN], Fox Lake Cree Nation [FLCN], and York Factory Cree Nation [YFCN]) are currently investigating the feasibility of developing a **hydroelectric generating station**[*] at Gull Rapids located at the upstream end of Stephens Lake on the Nelson River (Figure 1). An Environmental Studies Program has been developed to provide the data and information required for an **environmental impact assessment** of the above-mentioned hydroelectric **Project** (hereafter referred to as the Project), should a decision be made to proceed with a licensing submission to **regulatory authorities**. Manitoba Hydro and the potential partners have established a cooperative approach to assessing the potential effects of the Project on the **environment** and for producing the information required for regulatory review and impact **monitoring**.

The broad objectives of the Environmental Studies Program are the following:

- to describe the **existing environment** of the Study Area using an **ecosystem**-based approach;
- to provide data and information to assist in the planning of the Project;
- to provide data and information to enable assessment of the potential adverse effects that may result from the Project; and
- to provide the basis for monitoring environmental change resulting from development, should the Project proceed.

The following report presents the results of lake sturgeon (*Acipenser fulvescens*) investigations conducted in the Keeyask Study Area during 2004. It is one of a series of reports produced from the Keeyask Environmental Studies Program.

1.1 AQUATIC ECOSYSTEMS MONITORING AND ASSESSMENT

The collection of **baseline information** on the **aquatic environment** was initiated at the Project site in 1999. Manitoba Hydro expanded the program in 2001, and again in 2002, in response to requests from the Cree Nations to include a broader geographic area to better characterize all aspects of the environment that may be affected by development at Gull Rapids. This included the **reach** of the Nelson River between, and including, Split Lake to Stephens Lake, the Burntwood, Aiken, and Assean rivers, as well as the associated lake

[*] *Definitions for words appearing in bold are provided in the glossary (see Section 5.0).*

(Split, Clark, Gull, and Assean) aquatic ecosystems. Biological investigations included measurements of physical **habitat**, **water quality**, **detritus**, **algae**, aquatic **macrophytes**, **aquatic invertebrates**, and fish.

Individual reports are being prepared and issued on each of these topics and for specific waterbodies. These reports will describe the existing environment, provide information to assist in Project planning, and provide the basis for predicting and assessing the significance of potential adverse effects that may result from construction and operation of the Project.

Baseline studies that focused primarily on lake sturgeon began in the Keeyask Study Area in 2001. These were the first lake sturgeon studies conducted in the area, with the exception of a gillnetting study conducted in Gull Lake in 1995 by Manitoba Conservation that aimed at providing an initial estimate of abundance and information on the size and age structure of the lake sturgeon population in the area. As such, when the 2001 studies began, very little biological information had been collected on lake sturgeon in the Study Area.

The 2001 and 2002 lake sturgeon studies were conducted in the Nelson River between Birthday **Rapids** and Stephens Lake (the area to be most affected by development of the Project), but also included the Burntwood River (downstream of First Rapids) and the Nelson and Grass rivers downstream of Kelsey GS; two areas that are outside of the water level effects of the proposed Keeyask development. The objectives of these studies were very broad, and among other objectives, focused on providing an indication of lake sturgeon abundance and to determine if, and where, lake sturgeon spawned in these areas.

Upon completion of the 2001 and 2002 studies it was determined that several objectives (in some of the areas studied [i.e., in the Burntwood River and in the Nelson River in the vicnity of the Kelsey GS]) had been fulfilled. Therefore, the objectives of the Keeyask sturgeon program were revisited. Upon examination of the data, it was determined that sufficient information had been collected in some of the areas studied, while some data gaps were identified in areas that had not yet been investigated (i.e., in Gull Rapids and in the Nelson River between Clark Lake and Birthday Rapids). As a result, both of these areas were studied in 2003, while studies in the Burntwood River and in the Nelson River downstream of the Kelsey GS were discontinued.

In 2004, a second year of data was collected from the Nelson River between Clark Lake and Birthday Rapids and within Gull Rapids. As well, the fourth year of data were collected from the Nelson River between Birthday Rapids and Stephens Lake, the area to be impacted most by the potential construction of the Keeyask GS.

The following report presents information collected during lake sturgeon investigations conducted in the Keeyask Study Area in 2004. For the purposes of this report, data were analyzed separately for four areas: 1) the Nelson River between lower Split Lake and Birthday Rapids; 2) the Nelson River between Birthday and Gull rapids; 3) in Gull Rapids; and 4) in Stephens Lake downstream of Gull Rapids. Objectives of the lake sturgeon investigations were:

- to gain a better understanding of lake sturgeon biology;
- to identify lake sturgeon spawning areas;
- to better describe lake sturgeon abundance and habitat use;
- to identify any critical habitats; and
- to better understand the timing and spatial extent of lake sturgeon movements.

2.0 THE KEEYASK STUDY SETTING

2.1 STUDY AREA

The Keeyask Study Area includes the reach of the Nelson River from Kelsey GS to Kettle GS, including Split, Clark, Gull, and Stephens lakes; the Burntwood River downstream of First Rapids; the Grass River downstream of Witchai Lake Falls; the Assean River **watershed**, including Assean Lake; and all other **tributaries** to the above stated reach of the Nelson River (Figure 1).

The entire Study Area lies within the High **Boreal** Land Region characterized by a mean annual temperature of –3.4ºC and an annual precipitation range of 415 to 560 mm. **Topography** is bedrock controlled overlain with fine-grained **glacio-lacustrine deposits** of clays and gravels. Depressional areas have **peat** plateaus and patterned **fens** with **permafrost** present. Black spruce/moss/sedge associations are the dominant vegetation (Canada-Manitoba Soil Survey 1976).

Split Lake, which is immediately downstream of the Kelsey GS at the **confluence** of the Burntwood and Nelson rivers, is the second largest waterbody in the Study Area. Due to the large inflows from the Nelson and Burntwood rivers, the lake has detectable current in several locations. Split Lake has maximum and mean depths of 28.0 m and 3.9 m, respectively, at a water surface elevation of 167.0 m **ASL** (Lawrence et al. 1999). The surface area of Split Lake was determined to be 26,100 ha (excluding islands), with a total shoreline length, including islands, of 940.0 km (Lawrence et al. 1999). The numerous islands in Split Lake represent 411.6 km of the total shoreline.

The reach of the Nelson River between Split Lake and Stephens Lake is characterized by: i) narrow sections with swiftly flowing water (including Birthday and Gull rapids); and ii) wider more **lacustrine** sections, including Clark and Gull lakes. Mean winter flow in the reach is 3,006 m^3/s and mean summer flow is 2,812 m^3/s (Manitoba Hydro 1996a).

The Assean River system is north of Split Lake and drains into Clark Lake (Figure 1). Except for the mouth of the Assean River, the **hydrology** of the watershed has not been affected by hydroelectric development.

Stephens Lake, the largest lake in the Study Area, is located downstream of Gull Rapids and was created through the development of the Kettle GS. Stephens Lake has a surface area of 29,930 ha (excluding islands) and a total shoreline length, including islands, of 740.8 km. The numerous islands encompass an area of 3,340 ha and 336.2 km of shoreline. There is no

detectable current throughout most of this large lake, except for the old Nelson River channel.

Communities in the Study Area include the First Nations communities of Split Lake (TCN) and York Landing (YFCN), both located on Split Lake (Figure 1). Members of WLFN reside in Ilford south of the Nelson River while some members of FLCN reside in Gillam on the south shore of Stephens Lake. Gillam, the largest community in the Study Area, is the regional headquarters for Manitoba Hydro's northern operations.

The names assigned to some of the features described in Section 2.3 and illustrated in Figure 1 may be inconsistent with local names, topographic maps, and/or the Gazetteer of Canada. When field programs were initiated in spring, 2001, names of several features within the Study Area were unknown to North/South Consultants Inc. (NSC) biologists and First Nation assistants. Therefore, some features for which no name was known were assigned names by field personnel. Chief and council of TCN, YFCN, WLFN, and FLCN or the Canadian Permanent Committee on Geographical Names have not approved names of features described within this document.

2.2 PREVIOUS HYDROELECTRIC DEVELOPMENT

The Study Area is bounded by two Manitoba Hydro hydroelectric generating stations on the Nelson River: the Kelsey GS just upstream of Split Lake and Kettle GS downstream of Stephens Lake. The Kelsey GS came into service in 1961 and is operated as a **run-of-river plant** with very little storage or re-regulation of flows (Manitoba Hydro 1996a).

The Kettle GS was completed in 1974, which raised the water level at the structure by 30.0 m and created a backwater effect upstream to Gull Rapids. Approximately 22,055 ha of land were flooded in creating Stephens Lake (Manitoba Hydro 1996a). Kettle GS is operated as a **peaking-type plant**, cycling its **forebay** on a daily, weekly, and seasonal basis. The forebay is operated within an annual water level range from 141.1 m to 139.5 m ASL (Manitoba Hydro 1996a).

Since 1976, two water management projects, the Churchill River Diversion (CRD) and Lake Winnipeg Regulation (LWR), have influenced water levels and flows within the Study Area. These two projects augment and alter flows to generating stations on the lower Nelson River by diverting additional water into the drainage from the Churchill River (CRD) (Manitoba Hydro 1996b) and managing outflow from Lake Winnipeg (LWR). The CRD and LWR projects reversed the Nelson River pre-Project seasonal water level and flow patterns in the Keeyask Study Area by increasing water levels and flow during periods of ice cover and

reducing flows during the open-water period. Overall, there has been a net increase of 246 m^3/s in average annual flow at Gull Rapids since CRD and LWR (Manitoba Hydro 1996a). The historic and current flow regimes are described in "History and First Order Effects, Split Lake Cree Post-Project Environmental Review", Volume Two (Manitoba Hydro 1996a).

2.3 REPORT-SPECIFIC STUDY AREA

2.3.1 Split Lake to Birthday Rapids

Split Lake is located along the Nelson River approximately 7 km downstream of Kelsey GS (Figure 1). Immediately downstream of the Kelsey GS, the Grass River flows into the Nelson River and the Burntwood River flows into Split Lake in the western portion of the lake. The Aiken (Landing) River enters Split Lake in the southern-most portion of the lake adjacent to the community of York Landing. The Ripple and Mistuska rivers enter Split Lake along the southern shore west of the Aiken River.

Split Lake is situated in a landscape with poor drainage, dominated by black spruce forest in upland areas, and black spruce **bogs**, peatlands, and fens in lowland areas. The shoreline is stable and largely bedrock controlled interspersed with bog and marsh areas. **Riparian** vegetation includes willow, alder, black spruce, and trembling aspen. Riparian vegetation extends to the water line along portions of the shoreline. Mineral and **organic soils** occur adjacent to Split Lake, with **sporadically** distributed permafrost (Agriculture and Agri-Food Canada 2003). Lake **substrates** are primarily composed of fine mineral **sediments** (clay and **silt**) with small amounts of organic material. Ice typically forms on the lake during November and break-up occurs in April. Following break-up, the surface of the lake warms to 20°C by mid-July.

As discussed in Section 2.2, Split Lake hydrology has been affected by both LWR and by CRD. Split Lake receives its largest inflow from the Nelson River, with an annual average discharge at Kelsey GS of 2,150 m^3/s, about 68% of the total inflow for Split Lake. Inflow from the Burntwood River prior to CRD was estimated at 90.0 m^3/s at First Rapids, and following CRD increased nearly 10-fold to 849.0 m^3/s or about 29% of inflow to Split Lake (Manitoba Hydro 1996b). This large increase in river discharge resulted in extensive **erosion** of clay and silt sediments along the existing shoreline at First Rapids, as well as an increase in the surface area of Split Lake by approximately 100 ha (Environment Canada and Department of Fisheries and Oceans 1992; Manitoba Hydro 1996b). The Grass River watershed, not affected by hydroelectric development, has an average annual discharge of 66.5 m^3/s at Standing Stone Falls (approximately 40 km upstream of Witchai Lake Falls).

The remainder of the inflow to Split Lake is from the Aiken River and other small tributaries such as the Ripple and Mistuska rivers.

The land adjacent to Clark Lake and the Nelson River downstream to Birthday Rapids is well-drained and dominated by black spruce forest, with stands of trembling aspen distributed sporadically. Mineral soils are predominant in the area with permafrost distributed sporadically and bedrock outcrops near Birthday Rapids (Agriculture and Agri-Food Canada 2003).

Clark Lake is located immediately downstream of Split Lake, and approximately 42 km upstream of Gull Rapids on the Nelson River (Figure 1). Current is restricted to the main section of the lake, with off-current bays outside the main channel. Lake substrates are composed of fine mineral sediments and areas of bedrock. The shoreline is stable and largely bedrock with areas of mineral and organic sediments. Riparian vegetation includes willow, alder, and black spruce. Aquatic vegetation is restricted to, and abundant in, shallow off-current bays. The Assean River is the only major tributary to Clark Lake, flowing into the north side of the lake. Two small **ephemeral** creeks also flow into the north shore of Clark Lake.

Downstream from the outlet of Clark Lake, the Nelson River narrows and water **velocity** increases significantly for a 3 km stretch, with numerous rapids that are largely confined within bedrock shorelines. The substrate and shoreline features of this section of the river are largely bedrock and boulder/cobble. For the next 7 km the river widens, velocity decreases, and fine sediments become predominant. Five small ephemeral creeks drain into the Nelson River between Clark Lake and Birthday Rapids.

2.3.2 Nelson River: Birthday Rapids to Gull Lake

The majority of the reach of the Nelson River between Birthday Rapids and Gull Lake lies within a landscape of well-drained mineral soils, dominated by black spruce forest. Immediately upstream of Gull Lake, the land adjacent to the south shore of the Nelson River is generally poorly drained, and is dominated by organic soils, and black spruce bogs, peatlands, and fens. Trembling aspen occurs occasionally along the shores of the Nelson River in areas that are well-drained. Exposed bedrock occurs along the north shore and upstream portions of the south shore of the Nelson River, particularly within the first 2 km downstream of Birthday Rapids. Permafrost is discontinuous to sporadic adjacent to this section of the river (Agriculture and Agri-Food Canada 2003).

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream of Gull Rapids on the Nelson River (Figure 1). The drop in elevation from the upstream to downstream side of Birthday Rapids is approximately 5 m. The 14 km reach of the Nelson River between Birthday Rapids and Gull Lake is characterized as a large, somewhat uniform channel with medium to high water velocity. A series of exposed shoals and boulders are located within the first 7 km downstream of Birthday Rapids, after which **run** habitat dominates the river. There are a few large bays with reduced water velocity and a number of small tributaries that drain into the Nelson River between Birthday Rapids and Gull Lake. River substrates are typically bedrock, boulder, cobble, and sand, with some fine sediment in areas with reduced current. The shoreline in this section of the river contains large sections of bedrock and some areas of fine sediments. Riparian vegetation includes willow, alder, black spruce, tamarack, and trembling aspen. Aquatic vegetation is restricted to bays that are removed from the major river current.

2.3.3 Nelson River: Gull Lake

Gull Lake is situated within a landscape of well-drained mineral soils, dominated by black spruce forest. Trembling aspen occurs sporadically along the shores of Gull Lake and in areas that are well drained. Permafrost is sporadically distributed along this section of the river (Agriculture and Agri-Food Canada 2003).

Gull Lake is a section of the Nelson River where the river widens, is lacustrine in nature with moderate to low water velocity, and features numerous bays. Gull Lake is herein defined as the reach of the Nelson River beginning approximately 17 km upstream of Gull Rapids and 14 km downstream of Birthday Rapids, where the river widens to the north into a bay around a large point of land (Figure 1), and extending to the downstream end of Caribou Island, approximately 3 km upstream of Gull Rapids. Gull Lake has three distinct **basins**, the first extending from the upstream end of the lake downstream approximately 6 km to a large island; the second extending from the large island to Morris Point (a constriction in the river immediately upstream of Caribou Island); and the third extending from Morris Point to the downstream end of Caribou Island. Water velocity in the third basin is somewhat faster than in the first two, particularly under low flow scenarios, as the river channel flows around Caribou Island. Gull Lake has numerous small tributaries, with the majority being ephemeral. Lake substrates are predominantly silt and sand with some cobble and boulder in the first two basins where current is slow, and predominantly cobble, boulder, and bedrock in the third basin, with soft substrates in off-current areas. Riparian vegetation includes willow, alder, black spruce, tamarack, and trembling aspen. Aquatic vegetation is restricted to bays that are removed from the major river channel.

2.3.4 Nelson River: Gull Lake to Gull Rapids

The landscape between Gull Lake and Gull Rapids consists of well-drained mineral soils with bedrock outcrops. Black spruce is the dominant forest cover, with trembling aspen occurring sporadically along the shore. Permafrost is sporadically distributed adjacent to this section of the river (Agriculture and Agri-Food Canada 2003).

This 3 km reach of the Nelson River is characterized by a steep gradient with high water velocity. The river channel is separated into two by a large island at the upstream end of Gull Rapids (Figure 1). The substrate is bedrock, boulder, and cobble with small amounts of clay and silt in off-current bays. Aquatic vegetation is restricted to a bay on the south shore.

2.3.5 Nelson River: Gull Rapids

Gull Rapids is located approximately 3 km downstream of Caribou Island on the Nelson River (Figure 1). Two large islands and several small islands are located within the rapids, prior to the river narrowing. The rapids are approximately 2 km in length, and the river elevation drops approximately 19 m from the downstream end of Gull Lake to the downstream end of Gull Rapids. The substrate and shoreline of Gull Rapids are composed of bedrock and boulders. Gull Rapids Creek is a small tributary that flows into the south side of Gull Rapids, approximately 1 km downstream from the upstream end of Gull Rapids. This tributary is approximately 2.5 km long, and is fed by bogs and fens.

2.3.6 Stephens Lake

The land bordering Stephens Lake includes areas of poor, moderate, and well-drained soils, dominated by black spruce forest in upland areas and black spruce bogs, peatlands, and fens in lowland areas. Trembling aspen occurs sporadically along the shoreline of Stephens Lake in areas that are well-drained. Soils are predominantly organic along the north shore, but include a section of mineral soil surrounding the north arm, and both mineral and organic soils along the south shore. Permafrost is discontinuous and sporadic, and exposed bedrock occurs at the west end of the lake (Agriculture and Agri-Food Canada 2003).

As discussed in Section 2.2, construction of the Kettle GS resulted in extensive flooding immediately upstream of the GS. Moose Nose Lake (north arm) and several other small lakes that had previously drained into the Nelson River became continuous with the Nelson River to form Stephens Lake. Flooded **terrestrial** habitats compose a large portion of the existing lake substrates, and include organic sediments as well as areas of clay and silt. Woody **debris** is abundant due to the extensive flooding of the treed areas. Outside the flooded terrestrial areas, substrates are dominated by fine clay and silt. Sand, gravel, cobble,

and areas of organic material dominate the shoreline, with much of the shoreline being prone to erosion. Riparian vegetation includes willow, alder, black spruce, tamarack, and scattered stands of trembling aspen.

Major tributaries of Stephens Lake include the North and South Moswakot rivers that enter the north arm of the lake. The only other major tributary of Stephens Lake was the Butnau River. However, during construction of the Kettle GS, an earth dyke was constructed at the inlet of the Butnau River at Stephens Lake, and a channel developed to divert the Butnau River through Cache Lake into the Kettle River (Manitoba Hydro 1996a). Looking Back Creek is a second order ephemeral stream that drains into the north arm of Stephens Lake.

3.0 METHODS

In 2004, lake sturgeon investigations were conducted in the Nelson River between lower Split Lake and Stephens Lake. For the purposes of this report, data are presented separately for the following locations: 1) the Nelson River between lower Split Lake and Birthday Rapids (Figure 2); 2) the Nelson River between Birthday Rapids and Gull Rapids (figures 2 and 3); 3) within Gull Rapids (Figure 3) and Stephens Lake (from the base of Gull Rapids to approximately 3 km downstream) (Figure 4). The studies were conducted using similar sampling methodologies and gear types as those employed during the 2001, 2002, and 2003 investigations. Gill nets were used to capture lake sturgeon at each location. Sampling for lake sturgeon eggs and larvae was conducted with larval drift nets at several locations in the Nelson River between the outlet of Clark Lake and Stephens Lake. A summary of the start and completion date of each sampling program is provided in Table 1.

3.1 PHYSICAL MONITORING

Water temperature of the Nelson River was measured (± 0.2°C) within Gull Rapids, at the base of Gull Rapids, and in an off-current area of Gull Lake at 6.0 hour intervals with a HOBO Water Temperature Pro data logger. Data loggers were set approximately 1-2 m below the surface. Prior to deployment, the launch date, time, and measurement interval was set using a desktop computer. Data loggers were set on 10 June and retrieved on 18 October. A fourth data logger had been set downstream of Birthday Rapids, but was lost prior to retrieval.

A comparison of temperature data from the loggers set at the three locations in the Nelson River in 2004 indicated that water temperatures differed slightly between the areas. This was similar to what was observed in 2003 (Barth and Murray 2005). In the current report, the data from the temperature logger closest to the sampling site was used during data analysis.

3.2 SAMPLING GEAR

3.2.1 Gill nets

3.2.1.1 Nelson River between Split Lake and Birthday Rapids

Nine gillnetting sites between lower Split Lake and Birthday Rapids were fished from 9 June to 2 July, 2004 (Table 1; Figure 5). Between two and four gillnet gangs, each consisting of two 22.9 m (25 yd) long, 2.5 m (2.7 yd) deep panels of 203 and 254 mm (8 and 10 inch) twisted nylon stretched mesh were used daily to capture lake sturgeon. Weather permitting, gill nets were checked approximately every 24 hours. Gillnetting sites were selected based

on their suitability for capturing lake sturgeon that may be spawning in the area. Gill nets were set in eddies or along current breaks to maximize capture efficiency.

3.2.1.2 Nelson River between Birthday Rapids and Gull Rapids

A total of 17 gillnetting sites were fished in the Nelson River between Birthday Rapids and Gull Rapids from 9 June to 19 July, 2004 (Table 1; Figure 6). Each gillnet gang consisted of two 22.9 m (25 yd) long, 2.5 m (2.7 yd) deep panels of any combination of 203, 229, 254, or 305 mm (8, 9, 10, or 12 inch) twisted nylon stretched mesh. Gill nets were checked approximately every 24 hours, weather permitting. Gillnetting sites were selected based on: a) proximity to potential spawning areas; and b) locations known to yield high numbers of lake sturgeon based on previous sites fished during 2001, 2002, and 2003 investigations.

3.2.1.3 Gull Rapids

Fourteen gillnetting sites were fished in Gull Rapids from 16 June to 3 July, 2004 (Table 1; Figure 7). Each gillnet gang was 45.8 m (50 yd) long, 2.5 m (2.7 yd) deep, and consisted of two 22.9 m (25 yd) long panels of 203 mm, 229 mm, 254 mm, or 305 mm (8, 9, 10, or 12 inch) twisted nylon stretched mesh. Each gang was checked approximately every 24 hours, weather permitting. Because Gull Rapids is characterized by highly turbulent water, high water velocities, and hard substrates, gill nets were located behind islands or along current breaks to maximize efficiency.

3.2.1.4 Stephens Lake

Eight gillnetting sites were fished in Stephens Lake, downstream of Gull Rapids, from 10 June to 19 July, 2004 (Table 1; Figure 8). Each gillnet gang was 45.8 m (50 yd) long, 2.5 m (2.7 yd) deep, and consisted of two 22.9 m (25 yd) long panels of 203 mm, 229 mm, 254 mm, or 305 mm (8, 9, 10, or 12 inch) twisted nylon stretched mesh. Each gang was checked approximately every 24 hours. Because the area immediately downstream of Gull Rapids can be characterized by highly turbulent water and high water velocities, gill nets were set along current breaks, in eddies, or angled back with the current adjacent to shore.

3.2.2 Drift nets

Drift nets were set in the Nelson River between the outlet of Clark Lake and Stephens Lake downstream of Gull Rapids between 5 and 23 July, 2004 (Table 1). Drift nets were located in suspected lake sturgeon spawning areas in attempts to capture lake sturgeon eggs and larvae. In 2004, two types of drift nets were used: 1) bottom-set drift nets (set on the river bottom); and 2) surface set drift nets (floated at the surface of the water).

3.2.2.1 Bottom-set drift nets

Bottom-set drift nets consisted of a 3 m long, 954 µm Nitex screen bag with a 43 cm by 85 cm opening that tapered into a 9 cm diameter removable ABS pipe cod-end (Figure 9). The opening of each drift net was inserted into a metal frame weighing approximately 25 kg, which kept it anchored to the river bottom and open facing the current. Drift nets were set in either shallow or deep water. For shallow water sets, drift net frames were anchored to shore with approximately 5 m of rope tied to the lower edge of the drift net frame. To retrieve the drift net, the rope attached to shore was pulled in, and the contents of the drift net were emptied. For deep water sets, each drift net frame was attached to a large anchor that was tied to the lower edge of the frame by approximately 20 m of sideline and two large floats were tied through two loops on either side of the metal drift net frame with at least 10 m of excess line, depending on depth of the drift net (Figure 10). To retrieve the drift net, a boat was positioned near the floats and each float was then grabbed by a study team member and the lines were pulled into the boat at similar speeds. As the lines were retrieved, the frame raised upward and pivoted on the anchor. Once at the surface, the drift net frame was placed on the bow of the boat and the contents of the Nitex screen bag were washed towards the cod-end. The ABS cod-end container was emptied into a sample jar and was rinsed at least once before the drift net was reset.

3.2.2.2 Floating drift nets

Floating drift nets were designed after D'Amours *et al*. (2001) who used floating drift nets to capture larval lake sturgeon downstream of a hydroelectric facility in Québec.

The drift nets consisted of two 1.83 m (6 ft) long by 15.24 cm (6 inch) diameter L-shaped ABS pontoons attached to each side of the opening of the drift net with sideline (Figure 11). The pontoons were attached to one another by two crossbars and the opening of the drift net was in line with the 90 degree angle of each of the pontoons, with the cod-end floating freely at the far end. Pontoons were anchored to the river bottom using either a king anchor or a cinder block to ensure the nets remained in position. Similar to the bottom-set nets, the floating nets were positioned to face into the current. To retrieve the floating nets, the boat approached the crossbar at the anterior end of the pontoons. With the boat continuing to move forward toward the pontoons, study team members grabbed the crossbar and hauled both pontoons and the drift net into the bow of the boat. The ABS cod-end container was emptied into a sample jar and was rinsed at least once before the drift net was reset.

3.2.2.3 Drift net sampling

Weather permitting, all drift nets were emptied approximately every 24 hours. All drift samples were preserved in 10% formalin and shipped to the North/South Consultants Inc. laboratory in Winnipeg for processing. In Winnipeg, samples were sieved using a 355 µm mesh, rinsed with water, and sorted under a magnifying lamp. Samples were stored in 70% ethanol if they could not be processed immediately after rinsing and sorting. Each sample was checked in its entirety for larval lake sturgeon and lake sturgeon eggs. Samples were retained at North/South Consultants Inc. in Winnipeg should further analysis be required.

3.2.2.4 Nelson River (between Clark Lake and Gull Rapids)

Drift nets were set at eleven sites in the reach of the Nelson River between Clark Lake and Gull Rapids between 5 and 23 July, 2004 (Figure 12). Of these, six were bottom-set nets and five were floating-set nets. Sites were selected based on suitable water velocity and proximity to potential lake sturgeon spawning areas.

3.2.2.5 Gull Rapids

Drift nets were set at 10 sites in or at the base of Gull Rapids between 7 and 23 July, 2004 (Figure 13). Of these, five were bottom sets and five were floating sets. Sites were selected based on suitable water velocity and proximity to potential lake sturgeon spawning areas.

3.3 LAKE STURGEON SAMPLING

All lake sturgeon captured in gill nets were enumerated, measured for fork length and total length (±1 mm), weighed (with a hand-held scale ± 1 pound; converted to kg for data analysis), and marked with an individually numbered plastic 'Floy' FD-94 T-bar anchor tag. Floy-tags were inserted between the **basal pterygiphores** of the dorsal fin using a Dennison Mark II tagging gun. To minimize fish injury, ageing structures were not collected from lake sturgeon.

Where possible, sex and maturity were determined for individual lake sturgeon by applying pressure to the ventral surface of the fish to express **gametes**. If no gametes were expressed, sex and maturity codes were not assigned. The following sexual maturity codes were used:

Females (F)	Males (M)
2 – maturing to spawn	7 – maturing to spawn
3 – **ripe**	8 – ripe
4 – **spent**	9 – spent

Each lake sturgeon recaptured during the study was re-examined for sex and maturity and the Floy-tag was inspected to confirm its security and to ensure it was not causing any damage to the fish around the attachment area.

All other fish species captured incidentally during lake sturgeon investigations were measured for fork length (±1 mm) and weight (± 25 g). Northern pike, walleye, and lake whitefish greater than 250 mm in fork length were marked with a Floy-tag before being released.

3.4 ACOUSTIC AND RADIO TELEMETRY

3.4.1 Acoustic telemetry

Acoustic transmitters were applied to 20 lake sturgeon captured in the Study Area during 2001. Five of these transmitters were applied to lake sturgeon downstream of Gull Rapids, and 15 of the transmitters were applied in the Nelson River between Birthday Rapids and Gull Rapids. Transmitters have been monitored since their date of application in 2001. For a description of transmitter specifications, transmitter application, biological information and relocation positions in 2001, 2002, and 2003, refer to Barth and Mochnacz (2004), Barth (2005), and Barth and Murray (2005), respectively.

3.4.1.1 Acoustic-transmitter relocation

Movements of lake sturgeon tagged with acoustic transmitters were monitored via two methods: a) stationary VR1 or VR2 receivers; and b) manual tracking with a VR-60 ultrasonic receiver.

Stationary (VR1 or VR2) receivers

Three stationary VR1 and six stationary VR2 submersible acoustic receivers manufactured by VEMCO LTD. were used during the 2004 investigation. The VR1 and VR2 submersible receivers are similar in their mode of operation, but VR2 receivers have a greater memory capacity. The VR1 and VR2 receivers are equipped with an omni-directional hydrophone and internal data logger. The omni-directional hydrophone detects signals emitted from active transmitters within its range of detection. The transmitter code number, as well as the date and time of each detection, are stored in the data logger. Data are retrieved by downloading each receiver with an IBM/PC/AT computer, operating with a VR1PC computer interface, also manufactured by VEMCO LTD. Data were downloaded from each receiver on a weekly to bi-weekly basis.

The stationary receivers were arranged in the Study Area as illustrated in Figure 14. Although the receivers detect the presence of a transmitter in the area, they do not discern direction.

Three stationary VR1 receivers and three stationary VR2 receivers were deployed on 18 June, and one stationary VR1 receiver and two stationary VR2 receivers were deployed on 21 June. Stationary receivers were completely submersed in water, anchored to the bottom, and held vertically in the water column (above the river bottom) with a float attached to the hydrophone end (Figure 15). Each stationary receiver was removed from the water on 18 October to avoid being damaged by ice.

Manual tracking

Manual tracking was conducted from a boat using a battery powered VR-60 ultrasonic receiver and omni-directional hydrophone. The boat was stopped and its motor turned off at fixed points between Birthday Rapids and Gull Rapids and allowed to drift downstream with the current. The omni-directional hydrophone was lowered approximately 1 m into the water and held there for 1.0 to 1.5 minutes. Upon detection, the code number of the transmitter was displayed on an LCD screen on the face of the VR-60 and attempts were made to find the area with the strongest signal. The date, time, and location of each detection were recorded. During testing, the range of the VR-60 was estimated at 500 m, but could vary depending on environmental conditions. The optimal conditions for tracking occurred on days with little or no wind. Consequently, manual tracking was conducted on calm days at 9 – 12 day intervals. No tracking was conducted during winter.

3.4.2 Radio telemetry

Individually coded radio transmitters operating on one of five frequencies were implanted in 12 lake sturgeon during spring, 2001. Six of the transmitters were applied to fish caught in the Nelson River between Birthday Rapids and Gull Rapids, and the remaining six were applied to fish captured in Stephens Lake downstream of Gull Rapids. For details of radio transmitter application refer to Barth and Mochnacz (2004). For relocation positions of radio-tagged lake sturgeon in 2001, 2002, and 2003, refer to Barth and Mochnacz (2004), Barth (2005) and Barth and Murray (2005), respectively.

3.4.2.1 Radio tracking

Radio tracking was conducted from a helicopter using a Lotek SRX-400 receiver equipped with a single ‘yagi’ antenna. When a fish was located, tag number (tag frequency and code) and location were recorded.

3.5 DATA ANALYSIS

The maps provided in figures 2-4 were divided into separate geographical zones (red lettering) to differentiate between areas within waterbodies in the Keeyask Study Area and to facilitate discussion of lake sturgeon movements.

Mean length, weight, and condition factor (K) were calculated for all lake sturgeon captured in gill nets. Condition factor was calculated for individual fish based on the following equation (after Fulton 1911, in Ricker 1975):

$K = W \times 10^5 / L^3$

where: W = round weight (g); and
L = fork length (mm).

Length-frequency distributions were plotted by 50 mm length intervals (e.g., 1,000-1,049 mm) for lake sturgeon captured at each sampling location.

Weight-length relationships were calculated for the lake sturgeon catch at each location using least squares regression analysis on logarithmic transformations of fork lengths and round weights according to the following relationship:

$Log_{10}W = a + b\ (Log_{10}L)$

where: W = round weight (g);
L = fork length (mm);
a = Y-intercept; and
b = slope of the regression line.

Catch-per-unit-effort (CPUE) was expressed as the number of lake sturgeon caught in a 45.8 m long net set for a 24 hour period.

4.0 RESULTS AND DISCUSSION

In total, 274 fish, comprising seven fish species, were captured in gill nets during lake sturgeon studies conducted at four locations in the Keeyask Study Area between 9 June and 19 July, 2004 (tables 2 and 3). The greatest number of fish were captured in the Nelson River between Birthday and Gull rapids (n=152), followed by Stephens Lake (n=97), the Nelson River between Split Lake and Birthday Rapids (n=13), and within Gull Rapids (n=12) (Table 3). Data collected during these studies pertaining to species other than lake sturgeon are discussed in separate reports: Holm (2005) for fish captured in Clark Lake, Johnson (2006) for fish captured in the Nelson River between the outlet of Clark Lake and Gull Rapids; and Macdonald and Pisiak (2006) for fish captured in Gull Rapids and Stephens Lake.

Sixty-two lake sturgeon were captured in gill nets set in the Keeyask Study Area during spring. The majority were captured in the Nelson River between Birthday and Gull rapids (n=51), followed by Stephens Lake and the Nelson River between Split Lake and Birthday Rapids (n=5 each), and within Gull Rapids (n=1) (Table 3). The largest lake sturgeon was captured in the Nelson River between Birthday and Gull rapids and measured 1,590 mm in total length and weighed 31.3 kg (Appendix 1). The smallest lake sturgeon was also captured in the Nelson River between Birthday and Gull rapids and measured 870 mm in fork length and weighed 5 kg (Appendix 1). Date of capture, biological information and Floy-tag information for all lake sturgeon captured in 2004 are presented in Appendix 1.

4.1 GILL NETS

4.1.1 Nelson River between lower Split Lake and Birthday Rapids

Nine sites were fished with gill nets between Lower Split Lake and Birthday Rapids from 9 June to 2 July, for a total of 2,703.03 hours (Table 4). Five lake sturgeon were captured producing an overall CPUE of 0.04 lake sturgeon/45.8 m net/24 h.

Mean fork length for the lake sturgeon catch was 1,018 mm (range: 940 – 1,137 mm), mean weight was 8,210 g (range: 5,670 – 11,793 g), and mean condition factor was 0.77 (range: 0.62 – 0.93) (Table 5). The length frequency histogram is provided in Figure 16. A weight-length regression equation for lake sturgeon captured between Split Lake and Birthday Rapids is provided in Appendix 2.

Gillnetting commenced on 9 June when the water temperature of the Nelson River measured 10.0ºC (Figure 17). The first lake sturgeon was captured on 18 June, two sturgeon were captured on 20 June, one on 22 June, and one on 1 July. Of the five lake sturgeon captured,

four were classified as spawning fish; one was a pre-spawn male and three were ripe males (Table 6). The ripe males were captured on 18 and 20 June and the pre-spawn male was captured on 22 June (Table A1-1) during which time the water temperature was 11-12ºC. All of the spawning fish were captured in the Nelson River near the outlet of Clark Lake, suggesting that some sturgeon spawn in the vicinity of the Clark Lake outlet.

Two of the five lake sturgeon captured in 2004 had been previously marked with a Floy-tag (Appendix 3). One lake sturgeon (Floy-tag #46845) was originally tagged on 28 May, 2001 in Stephens Lake. This fish subsequently moved over both Gull Rapids and Birthday Rapids, a distance of approximately 45 km between capture and recapture locations. The other lake sturgeon recapture (Floy-tag #50845) was originally tagged 8 June, 2003 downstream of Birthday Rapids. This fish moved over Birthday Rapids at some point between June 2003 and June 2004, moving a distance of approximately 25 km between capture and recapture locations.

4.1.2 Nelson River between Birthday and Gull Rapids

Seventeen gillnetting sites were fished in the Nelson River between Birthday and Gull rapids from 9 June to 19 July for a total of 6906.95 hours (Table 4). During this time, 51 lake sturgeon were captured, producing an overall CPUE of 0.18 lake sturgeon/45.8 m net/24 h (Table 4). Twenty-two of the lake sturgeon were captured in Zone BR-D, followed by zone GL-C (n=11), and GL-A and GL-B (n=9 each) (Appendix 1; figures 2 and 3).

Mean fork length for the lake sturgeon catch was 1,149 mm (range: 870 - 1,468 mm), mean weight was 14,115 g (range: 5,443 - 31,298 g) and mean condition factor was 0.87 (range: 0.67 - 1.10) (Table 5). The length-frequency distribution was unimodal at 1,000 – 1,099 mm (Figure 18). The mean fork length and weight from the 2004 lake sturgeon catch were notably higher than those from the 2001-2003 catches (Table 5). A weight-length regression for lake sturgeon captured in the Nelson River between Birthday and Gull rapids is provided in Appendix 2.

Gill nets were first set on 9 June when the water temperature of the Nelson River measured 9.0ºC. At least one lake sturgeon was captured each day between 14 and 30 June when the water temperature ranged between 10.0ºC and 15.0ºC (Figure 19). The catch peaked on 28 June when five fish were captured. Of the 51 lake sturgeon captured, five were classified as spawning fish and consisted of two ripe males and three pre-spawn males (Table 6). The first of these five fish was captured on 17 June and the last on 28 June. Water temperatures during this period ranged between 12ºC and 14ºC.

For two consecutive years, less than six spawning sturgeon have been captured in the Nelson River between Birthday Rapids and Gull Rapids (Table 6), lower than the 2001 (n=19) and 2002 (n=14) catches. In previous studies it was shown that spawning male sturgeon were susceptible to capture and were normally captured on more than one occasion during a given year (Barth and Mochnacz 2004, Barth 2005). This was not observed in 2003 (Barth and Murray (2005) or during the present study.

Two male lake sturgeon (Floy-tag #47115 and Floy-tag #48807) originally captured and classified as spawning fish during spring 2001and 2002, respectively, were recaptured and classified as spawning fish in 2004. This indicates a minimum of a two year spawning periodicity for male lake sturgeon in the area (Appendix 3).

Due to the low number of spawning fish captured, the 2004 data provide limited information on the identification of a lake sturgeon spawning site. However, four of the five male lake sturgeon in spawning condition were captured within 2 km of Birthday Rapids. Male lake sturgeon in spawning condition were also captured in this general area in 2002 and 2003.

Fifteen of the 51 lake sturgeon captured in this reach of the Nelson River in 2004 had been previously marked with a Floy-tag during 2001 (n=3), 2002 (n=6), 2003 (n=5), or 1995 (n=1) studies (Appendix 3). If we consider only the fish that were previously marked during the North/South studies conducted from 2001 - 2003, then approximately 27% of the lake sturgeon captured in 2004 had been tagged in previous years. Movements associated with these recaptures are discussed in a subsequent section (Section 4.4).

4.1.3 Gull Rapids

Fourteen gillnetting sites were fished in Gull Rapids between 16 June and 3 July, 2004, for a total of 2,327.04 hours (Table 4). One lake sturgeon was captured, producing an overall CPUE of 0.01 lake sturgeon/45.8 m net/24 h. The relatively low catch (in comparison with 2003) may have been a result of high debris levels that fouled nets set within Gull Rapids in 2004. The high debris levels were not observed in 2003.

The one lake sturgeon captured in Gull Rapids had a fork length of 1,299 mm, a weight of 20,412 g, and a condition factor of 0.93. This lake sturgeon (Floy-tag #47183) was originally tagged in Gull Lake on 9 July, 2001. It has since been recaptured three times, once on 30 May 2003 downstream of Gull Rapids, on 16 June, 2003 in Gull Rapids, and again in Gull Rapids on 3 July, 2004 (Appendix 3).

Gillnetting was initiated in Gull Rapids on 16 June when the water temperature of the Nelson River measured 12ºC. The lake sturgeon was captured on 3 July when the water temperature measured 15ºC. This fish showed no signs of spawning during the current year.

4.1.4 Stephens Lake

Eight gillnetting sites were fished in Stephens Lake downstream of Gull Rapids between 10 June and 19 July for a total of 4,637.50 gillnet hours (Table 4). In total, five lake sturgeon were captured, producing an overall CPUE of 0.03 lake sturgeon/45.8 m net/24 h.

Lake sturgeon captured in Stephens Lake had a mean fork length of 1,180 mm (range: 1,025 -1,324 mm), a mean weight of 15,347 g (range: 9,450 – 20,412 g), and a mean condition factor of 0.97 (range 0.72 - 1.32) (Table 5). The length frequency histogram for the catch is provided in Figure 20. The modal length interval was 1,150 – 1,199 mm. A weight-length regression equation for lake sturgeon captured in Stephens Lake is provided in Appendix 2.

Gillnetting was initiated downstream of Gull Rapids on 10 June when the water temperature of the Nelson River measured 10ºC (Figure 21). The first lake sturgeon was not captured until 16 June when the water temperature measured 12ºC. None of the lake sturgeon captured in 2004 were classified as fish preparing to spawn (Table 6).

Three fish that had been Floy-tagged previously in 2001 or 2003 in Stephens Lake were recaptured downstream of Gull Rapids in 2004. Lake sturgeon with Floy-tag #46826 and Floy-tag #49040 were originally captured in Stephens Lake during spring and fall 2001 respectively, at which time Floy-tag #49040 was tagged with an acoustic transmitter (AT #33). Another sturgeon (Floy-tag #56324) was originally tagged downstream of Gull Rapids during spring 2003 (Appendix 3).

4.2 LARVAL DRIFT

4.2.1 Nelson River between Clark Lake and Gull Rapids

Eleven drift nets (five floating and six bottom-set) were set in the Nelson River between Birthday and Gull rapids between 5 and 23 July, 2004, for a total of 4,322.74 hours (Table 7). In total, two larval lake sturgeon were captured in drift net 1S (the drift net set approximately 750 m upstream of Birthday Rapids) (Figure 12). These are the first ever recorded captures of larval lake sturgeon in the Nelson River mainstem. The first lake sturgeon larva was captured on 9 July, and the other the following day. Both had completely absorbed their yolk sacs and measured 17.1 mm and 18.1 mm in length.

Data collected from larval drift nets set at this location for species other than lake sturgeon are presented in Johnson (2006) and Gill (2006).

4.2.2 Gull Rapids and Stephens Lake

Ten drift nets (five floating and five bottom-set) were set in the Nelson River within Gull Rapids and downstream of the rapids in Stephens Lake between 7 and 23 July, 2004 for a total of 2,992.60 hours (Table 8). Larval lake sturgeon were not captured in drift nets set in and below Gull Rapids in 2004 and have not been captured in this area since studies began in 2001. The data collected from these drift nets is presented in Gill (2006) and Macdonald and Pisiak (2006).

4.3 RADIO AND ACOUSTIC TELEMETRY

Twenty acoustic and 12 radio transmitters were applied to lake sturgeon in the Keeyask Study Area during 2001. Twenty-one of the transmitters (15 acoustic and 6 radio) were applied to lake sturgeon in the Nelson River between Birthday Rapids and Gull Rapids, and 11 (6 radio and 5 acoustic) were applied downstream of Gull Rapids in Stephens Lake. Biological details, site specific tagging locations, and subsequent relocation dates for individual lake sturgeon from 30 May, 2001 to 30 April, 2002 are provided in Barth and Mochnacz (2004); relocations of tagged lake sturgeon from 1 May, 2002 to 30 April, 2003 are provided in Barth (2005); and relocations from 1 May, 2003, to 31 October 2003, are provided in Barth and Murray (2005). This report includes lake sturgeon relocations from 1 November, 2003 to 18 October, 2004.

Prior to 1 January, 2005, six acoustic transmitters (AT #31, AT #34, AT #36, AT #37, AT #41, and AT #46) and one radio-transmitter were returned to North/South Consultants[1], representing a fishing mortality rate of 29% for the acoustic tagged fish and 8% for radio tagged fish since transmitters were applied in 2001. A summary of tag status is provided in Appendix 4 and relocations of lake sturgeon from 1 November, 2003 to 18 October, 2004 are provided on maps in Appendix 5.

The acoustic transmitters applied to lake sturgeon in 2001 were expected to last until late spring or early summer 2004. By 1 October, 2004, at least seven acoustic transmitters remained active in the Study Area. Should additional information be collected in 2005 it will be included in a subsequent report.

[1] AC#31 was returned to North/South Consultants in 2001 and reapplied to a lake sturgeon in Stephens Lake later that year.

4.4 LAKE STURGEON MOVEMENTS

The following section provides a summary of movements observed in 2004 and a brief discussion of movement information gathered during studies that occurred from 2001 to 2004.

4.4.1 Nelson River between lower Split Lake and Birthday Rapids

Although catches of lake sturgeon have been low (n=6; combined 2003 and 2004 catch) during both years of spring gillnetting studies conducted in this reach of the Nelson River, the majority of lake sturgeon that have been captured (n=4) have been classified as spawning fish. This, combined with the capture of two larval lake sturgeon upstream of Birthday Rapids, suggests that lake sturgeon spawned successfully in this reach of the Nelson River in 2004. Most of the spawning sturgeon were captured near the outlet of Clark Lake and therefore, it is likely that some sturgeon spawn in this area. The physical characteristics of this area suggest that suitable spawning habitat for lake sturgeon is available since it contains high water velocities, hard substrates, and a range of water depths (1 -5 m).

Two lake sturgeon, one initially marked in Stephens Lake and one initially marked in Gull Lake, were recaptured in this river reach in 2004. Both were classified as spawning fish. These data suggest that lake sturgeon may move into this area to spawn, but do not provide information on the timing of these movements (i.e., did they move into this river reach during the summer, fall, or winter of the previous year, or during spring of the current year?).

Since fishing for lake sturgeon has only been conducted during spring, little else is known about sturgeon abundance, movements or seasonal use of this reach of the Nelson River.

4.4.2 Movement over Birthday Rapids

Of the 15 lake sturgeon tagged with acoustic transmitters between Birthday Rapids and Gull Rapids in 2001, at least seven (47%) (AT #39, AT #40, AT #41, AT #43, AT #45, AT #48, AT #49) have moved upstream over Birthday Rapids. Two of these fish (AT #45 and AT #48) remained upstream of the rapids during 2002, but moved back downstream to Gull Lake in 2003. Four of the lake sturgeon (AT #39, AT #40, AT #41 and AT #43) moved upstream over Birthday Rapids for only short periods of time before moving back downstream over Birthday Rapids. One lake sturgeon (AT #49) moved upstream during fall 2003 and was subsequently relocated downstream of Birthday Rapids during spring 2004. Of the six lake sturgeon tagged with radio transmitters between Birthday and Gull rapids, one (RT #149.720 Code 4) moved upstream over Birthday Rapids. It was located upstream of the

rapids during fall 2001, and the next location was downstream of the rapids during spring 2002.

The telemetry data suggest that a substatial proportion of the lake sturgeon population in the area may utilize the Nelson River between Clark Lake and Birthday Rapids. Gillnetting and larval drift data indicate that the river reach is used for spawning, while the telemetry data suggest that some sturgeon may utilize this river reach for feeding.

4.4.3 Nelson River between Birthday Rapids and Gull Rapids

Barth and Murray (2005) provided a generalization of lake sturgeon movements in the Nelson River (between Birthday Rapids and Stephens Lake) based on data collected in 2001, 2002 and 2003. This generalization suggested that during spring, lake sturgeon (both spawners and non-spawners) in this reach of the Nelson River are generally attracted to areas of higher water velocity (e.g., the inlet of Gull Lake). Spawning fish appear to move upstream to potential spawning areas that may be located within 3 km of Birthday Rapids. Additional information collected in 2004 suggests that some fish may move upstream as far as the outlet of Clark Lake during spring. While some non-spawning sturgeon appear to accompany spawning fish up-river to spawning sites, data also showed that some non-spawning sturgeon remain near the inlet to Gull Lake for the majority of the spring. Once spawning is completed, and with the onset of summer, most lake sturgeon in the area move downstream to deep, lower water velocity habitats (e.g., Gull Lake). During summer, relocation data indicated that sturgeon made frequent localized movements, often moving distances between 1 and 20 km (or more). These movements are most likely associated with feeding. However, a review of information collected over a four-year period also shows that some lake sturgeon moved large distances during summer or early fall, often to areas of high water velocity. The reasons for these movements (although poorly understood) are also most likely related to feeding. At the end of summer when water temperatures begin to cool, lake sturgeon move to deep, medium velocity habitats. An area of Gull Lake has been identified as an important overwintering location where many lake sturgeon congregate (Barth and Murray 2005).

After monitoring movements of individual lake sturgeon for four years it appears as though many of the sturgeon exhibit site fidelity. Although the lake sturgeon in this area move frequently, most have shown a “preference” for a certain area or areas. For example, two of the acoustic tagged fish (AT #43 and AT #45) were most frequently located in the more riverine portions of the Nelson River between Birthday Rapids and the inlet to Gull Lake over the four year monitoring period. Similarly, with few exceptions, most of the other sturgeon tagged between Birthday Rapids and Gull Rapids preferred similar areas of Gull

Lake during summer and especially fall. Similar findings of sturgeon core areas or selection of a home range has been reported by Borkholder et al. (2002) and Knights et al. (2002).

For the fourth consecutive year a high proportion of the tagged lake sturgeon were relocated in Gull Lake approximately 4 -6 km upstream of Gull Rapids during fall. In 2004, five lake sturgeon (AT #38, AT #42, AT #47, AT #48, and AT #49) were relocated in this area. The high frequency of sturgeon relocations each fall suggests that sturgeon overwinter in this area.

4.4.4 Gull Rapids and Stephens Lake

Data collected during previous studies have indicated that lake sturgeon pass both upstream and downstream through Gull Rapids. In 2003, data were collected from within Gull Rapids which suggested that lake sturgeon utilize Gull Rapids for spawning and feeding (Barth and Murray 2005). Low water levels in 2003, coupled with high water levels in 2004, increased debris in the water column to levels not seen in the previous three years of gillnetting. This debris severely hampered gillnetting efforts and reduced catches. For this reason, very little information was collected on lake sturgeon utilization of Gull Rapids or Stephens Lake during 2004.

Movement data from previous years has suggested that lake sturgeon utilize Gull Rapids for spawning and feeding and may remain in the vicinity of the rapids for extended periods of time during spring, summer, and fall. For the fourth consecutive year, two fish tagged with acoustic transmitters were frequently relocated by the stationary receivers downstream of Gull Rapids. In 2004, AT#31b (June, August, and September - 16 days detected) and AC#32 (June, July, and August - 43 days detected) were located for extended periods downstream of the rapids (Appendix 5).

Two radio-tagged lake sturgeon (RT#149.560 Code 1 and RT#149.560 Code 2) were relocated in a similar area of Stephens Lake approximately 4 km downstream of Gull Rapids on 7 February 2004 (Appendix 5). This is the same area that radio-tagged sturgeon have been relocated during previous winters suggest that this area may be utilized as an overwintering location for lake sturgeon in the area.

5.0 GLOSSARY

Algae (a; al) − a group of simple plant-like ***aquatic organisms*** possessing ***chlorophyll*** and capable of ***photosynthesis***; they may be attached to surfaces or free-floating; most freshwater ***species*** are very small in size.

Aquatic – living or found in water.

Aquatic monitoring – the primary goal of long term ***monitoring*** of lakes and rivers is to understand how ***aquatic*** communities and ***habitats*** respond to natural processes and to be able to distinguish differences between human-induced disturbance effects to aquatic ***ecosystems*** and those caused by natural processes.

ASL − Above Sea Level.

Aquatic environment − areas that are permanently under water, or that are under water for a sufficient period to support ***organisms*** that remain for their entire lives, or a significant portion of their lives, totally immersed in water.

Aquatic invertebrate (s) − an animal lacking a backbone that lives, at least part of its life, in the water (e.g., ***aquatic*** insect, mayfly, clam, aquatic earthworm, crayfish).

Basal pterygiophores – form the base of support for the dorsal and anal fin rays.

Baseline information − information about an area, over a period of time, that is used as background for detecting and/or comparing potential future changes.

Basin – a distinct section of a lake, separated from the remainder of the lake by a constriction.

Bog – wetland ***ecosystem*** characterized by an accumulation of ***peat***, acid conditions, and a plant community dominated by sphagnum moss.

Boreal − of or relating to the forest areas of the North Temperate Zone, dominated by coniferous trees such as spruce, fir, and pine.

Catch-per-unit-effort (CPUE) – the number or weight of fish caught in a given time period with a specific length of net.

Chlorophyll – a group of green pigments present in plant and ***algal*** cells that are necessary in the trapping of light energy during ***photosynthesis***.

Confluence – the meeting place of two streams or rivers.

Debris – any material, including floating or submerged items (e.g., driftwood, plants), suspended ***sediment***, or bed load, moved by flowing water.

Detritus − particulate and dissolved ***organic*** matter that is produced by the decomposition of plant and animal matter.

Ecosystem − all living ***organisms*** in an area and the non-living parts of the ***environment*** upon which they depend, as well as all interactions, both among living and non-living components of the ecosystem.

Environment − 1) the total of all the surrounding natural conditions that affect the existence of living ***organisms*** on earth, including air, water, ***soil***, minerals, climate, and the

organisms themselves; and 2) the local complex of such conditions that affects a particular organism and ultimately determines its physiology and survival.

Environmental impact assessment − an evaluation of the likely adverse environmental effects of a project that will contribute to decisions about whether to proceed with a project.

Ephemeral − a stream that flows only in direct response to precipitation, and thus discontinues its flow during dry seasons.

Erosion – the wearing away of the Earth's surface by the action of water, wind, current, etc.

Existing environment − the present condition of a particular area; generally assessed prior to the construction of a proposed project.

Fen (s) – a peatland with the water table usually at or just above the surface; often stagnant and alkaline.

Forebay – the portion of a reservoir immediately upstream of a ***hydroelectric*** facility.

Gamete – mature male or female reproductive cell (i.e., sperm, egg).

Glacio-lacustrine deposits − ***soil*** that originates from lakes that were formed by melting glaciers.

Habitat − the place where a plant or animal lives; often related to a function such as spawning, feeding, etc.

Hydroelectric generating station − a generating station that converts the potential energy of elevated water or the kinetic energy of flowing water into electricity.

Hydrology – the branch of physical geography that deals with the waters of the Earth, their distribution, characteristics, and effects relative to human activities.

Lacustrine − referring to freshwater lakes; ***sediments*** generally consisting of stratified fine sand, ***silt***, and clay deposits on a lake bed.

Larva (ae; al) – the early, immature form of an animal when more or less of a ***metamorphosis*** takes place, before the assumption of the mature shape.

Macrophyte (s) − multi-celled ***aquatic*** and ***terrestrial*** plants.

Metamorphosis – a change in the form or function of a living organism, by a natural process of growth or development.

Monitoring − measurement or collection of data to determine whether change is occurring in something of interest.

Organic – the compounds formed by living ***organisms***.

Organism (s) – an individual living thing.

Peaking-type plant – a ***hydroelectric generating station*** that is designed to supply power during high demand periods and is generally operated to serve that purpose.

Peat − material consisting of non-decomposed and only slightly decomposed ***organic*** matter found in extremely moist areas.

Permafrost − sub***soil*** that remains below the freezing point throughout the year, as in an Arctic environment.

Photosynthesis – a process which occurs in plants and ***algae*** where, in the presence of light, carbon dioxide and water are turned into a useable form of energy (sugar) and oxygen.

Project − proposed ***hydroelectric generating station*** on the Nelson River, upstream of Stephens Lake.

Rapids – a section of shallow, fast moving water in a stream made turbulent by totally or partially submerged rocks.

Reach − any length of river under study, often with similar features along its length.

Regulatory authorities − a decision-making body such as a government department.

Riparian – along the banks of rivers and streams.

Ripe – running male (M8) or female (F3) fish ready to spawn immediately.

Run – an area of a stream with uniform, swiftly flowing water without surface breaks.

Run-of-river plant – a ***hydroelectric generating station*** that has no upstream storage capacity and must pass all water flows as they come.

Sediment (s) – material, usually ***soil*** or ***organic detritus***, which is deposited in the bottom of a waterbody.

Silt – a very small rock fragment or mineral particle, smaller than a very fine grain of sand and larger than coarse clay; usually having a diameter of 0.002 to 0.06 mm; the smallest ***soil*** material that can be seen with the naked eye.

Soil – 1) all loose, unconsolidated, weathered, or otherwise altered rock material above bedrock; and 2) a natural accumulation of ***organic*** matter and inorganic rock material that is capable of supporting the growth of vegetation.

Species – a group of ***organisms*** that can interbreed to produce fertile offspring.

Spent – male (M9) or female (F4) fish that has just finished spawning.

Sporadic(ally) – the occurrence of isolated patches of ***permafrost***, 10-35% of a geographic region.

Standard deviation (Std) – the square root of the variance of a collection of numbers.

Substrate – the material forming the streambed; also solid material upon which an ***organism*** lives or to which it is attached.

Terrestrial – belonging to, or inhabiting the land or ground.

Topography − a graphic representation of the surface features of a place or region on a map, indicating their relative positions and elevations.

Tributary (ies) – a river or stream flowing into a lake or a larger river or stream.

Velocity – a measurement of speed of flow.

Water quality − measures of substances in the water such as nitrogen, phosphorus, oxygen, and carbon.

Watershed − the area within which all water drains to collect in a common channel or lake.

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TABLES AND FIGURES

Table 1. Summary of start and completion dates, by gear type, for lake sturgeon investigations conducted at four locations in the Keeyask Study Area, 2004.

Location	Gill nets		Drift nets	
	Start date	Completion date	Start date	Completion date
Nelson River (SPL-BR)	09-Jun	02-Jul	-	-
Nelson River (BR-GR)	09-Jun	19-Jul	05-Jul	23-Jul
Gull Rapids	16-Jun	03-Jul	-	-
Stephens Lake	10-Jun	19-Jul	07-Jul	23-Jul

SPL-BR = Split Lake to Birthday Rapids
BR-GR = Birthday Rapids to Gull Rapids

Table 2. List of fish species captured during lake sturgeon gillnetting studies conducted at four locations in the Keeyask Study Area, 2004.

Common Name	Scientific Name	Abbreviation
Freshwater drum	*Aplodinotus grunniens*	FRDR
Lake sturgeon	*Acipenser fulvescens*	LKST
Lake whitefish	*Coregonus clupeaformis*	LKWH
Northern pike	*Esox lucius*	NRPK
Sauger	*Sander canadensis*	SAUG
Walleye	*Sander vitreus*	WALL
White sucker	*Catostomus commersoni*	WHSC

Table 3. Number of fish, by species, and sampling location, that were captured in gill nets during lake sturgeon studies conducted in the Keeyask Study Area, 9 June - 19 July, 2004.

Species	Nelson River (SPL-BR)	Nelson River (BR-GR)	Gull Rapids	Stephens Lake	Total
Freshwater drum	-	-	-	6	**6**
Lake sturgeon*	5	51	1	5	**62**
Lake whitefish	-	3	-	1	**4**
Northern pike*	6	67	11	70	**154**
Sauger	-	1	-	2	**3**
Walleye*	2	29	-	13	**44**
White sucker	-	1	-	-	**1**
Total	**13**	**152**	**12**	**97**	**274**

BR-GR = Birthday Rapids to Gull Rapids
SPL-BR = Split Lake to Birthday Rapids
* - includes previous year recaptures - not current year recaptures

Table 4. Catch-per-unit-effort (CPUE) (# lake sturgeon/45.8 m net/24 hours) at each of the four locations fished for lake sturgeon in the Keeyask Study Area, 2001-2004.

Location	Year	Season	Number of sites	*Total number lake sturgeon	Total gillnet hours	CPUE
Burntwood River	2001	spring	26	23	3950.03	0.14
	2002	spring	30	16	2048.26	0.19
Kelsey (GS)	2001	spring	44	13	5626.70	0.06
	2002	spring	26	5	3856.25	0.03
Nelson River (SPL-BR)	2003	spring	12	1	1465.60	0.02
	2004	**spring**	**9**	**5**	**2703.03**	**0.04**
Nelson River (BR-GR)*	2001	spring	37	60	4537.57	0.32
	2002	spring	19	59	4917.72	0.29
	2002	fall	7	3	700.99	0.10
	2003	spring	30	85	7564.65	0.27
	2003	fall	3	0	479.80	0.00
	2004	**spring**	**17**	**51**	**6906.95**	**0.18**
Gull Rapids	2003	spring	9	10	1868.74	0.13
	2004	**spring**	**14**	**1**	**2327.04**	**0.01**
Stephens Lake	2001	spring	18	24	6253.60	0.09
	2002	spring	15	4	3249.48	0.03
	2003	spring	29	24	9638.07	0.06
	2004	**spring**	**8**	**5**	**4637.50**	**0.03**

GS = generating station
BR - GR = Birthday Rapids to Gull Rapids
SPL - BR = Split Lake to Birthday Rapids
*Excludes index gillnetting catches

Table 5. Mean fork length, weight, and relative condition factor (K), by location for lake sturgeon captured in gill nets in the Keeyask Study Area between 9 June and 19 July, 2004.

Location	Year	Length (mm)				Weight (g)				K		
		n	Mean	Std	Range	n	Mean	Std	Range	n	Mean	Range
Nelson River (CL-BR)	2003	1	-	-	-	1	-	-	-	-	-	-
Nelson River (SPL-BR)	**2004**	**5**	**1018**	**83**	**940-1137**	**5**	**8210**	**2359**	**5670-11793**	**5**	**0.77**	**0.62-0.93**
Nelson River (BR-GR)	2001	79	1022	148	739-1355	78	9984	5059	3500-24000	78	0.88	0.64-1.26
	2002	67	1055	149	680-1415	66	12198	6367	2722-34020	66	0.97	0.73-1.44
	2003	92	1067	148	700-1540	87	11949	6681	3000-54431	87	0.94	0.67-1.49
	2004	**51**	**1149**	**152**	**870-1468**	**51**	**14115**	**6747**	**5443-31298**	**51**	**0.87**	**0.67-1.10**
Gull Rapids	2003	10	1120	150	931-1339	10	12853	5437	6750-22000	23	0.87	0.81-0.99
	2004	**1**	**1299**	**-**	**-**	**1**	**20412**	**-**	**-**	**1**	**0.93**	**-**
Stephens Lake	2001	24	1077	181	792-1447	24	13148	9499	4400-40000	24	0.94	0.71-1.56
	2002	4	1045	51	1001-1100	4	10888	2995	8050-15000	4	0.94	0.80-1.13
	2003	24	1018	206	555-1340	23	11212	7205	1700-26000	23	0.90	0.61-1.20
	2004	**5**	**1180**	**112**	**1025-1324**	**4**	**15347**	**4577**	**9450-20412**	**4**	**0.97**	**0.72-1.32**

Std - standard deviation
BR-GR = Birthday Rapids to Gull Rapids
SPL-BR = Split Lake to Birthday Rapids
CL-BR = Clark Lake to Birthday Rapids

Table 6. Number of lake sturgeon classified as sexually mature during lake sturgeon studies conducted in the Keeyask Study Area, 2001 - 2004.

Location	Year	Map Areas	Sex						# Spawning Per Year	Unknown Maturity	Total
			Male			Female					
			MS	R	SP	MS	R	SP			
Nelson River (CL-BR)	2003	CL-A, BR-U	-	-	-	-	-	-	-	1	1
Nelson River (SPL-BR)	**2004**	**SPL-E, CL-A, BR-U**	**1**	**3**	**-**	**-**	**-**	**-**	**4**	**1**	**5**
Nelson River (BR-GR)	2001	BR-D, GL (A-C)	5	10	1	3	-	-	19	41	60
Nelson River (BR-GR)	2002	BR-D, GL (A-C)	8	1	5	-	-	-	14	46	60
Nelson River (BR-GR)	2003	BR-D, GL (A-C)	3	-	-	1	-	-	4	89	93
Nelson River (BR-GR)	**2004**	**BR-D, GL (A-C)**	**3**	**2**	**-**	**-**	**-**	**-**	**5**	**46**	**51**
Gull Rapids	2003	GR-A	1	-	3	-	-	-	4	6	10
Gull Rapids	**2004**	**GR-A**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**
Stephens Lake	2001	STL (A-F)	5	-	-	3	-	-	8	16	24
Stephens Lake	2002	STL (A-F)	3	-	-	-	-	-	3	1	4
Stephens Lake	2003	STL (A-F)	2	-	-	1	-	-	3	21	24
Stephens Lake	**2004**	**STL (A-F)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5**	**5**
Total			**31**	**16**	**9**	**8**	**-**	**-**	**64**	**274**	**338**

CL-BR = Clark Lake to Birthday Rapids
SPL-BR = Split Lake to Birthday Rapids
BR-GR = Birthday Rapids to Gull Rapids
MS = Maturing to spawn
R = Ripe
SP = Spent

Table 7. Summary of set and pull date and total set duration for drift nets set between the outlet of Clark Lake and Gull Rapids, 2004.

Drift net number	Type	Set date	Pull date	Duration (hrs)	# lake sturgeon larvae
1F	F	05-Jul-04	22-Jul-04	407.56	-
1S	S	05-Jul-04	22-Jul-04	407.69	2
2S	S	06-Jul-04	23-Jul-04	405.53	-
3S	S	06-Jul-04	23-Jul-04	356.81	-
4F	F	05-Jul-04	23-Jul-04	427.31	-
4S	S	05-Jul-04	23-Jul-04	427.33	-
5F	F	07-Jul-04	22-Jul-04	363.80	-
6F	F	05-Jul-04	23-Jul-04	425.77	-
7F	F	07-Jul-04	23-Jul-04	383.39	-
8S	S	07-Jul-04	23-Jul-04	382.90	-
9S	S	09-Jul-04	23-Jul-04	334.65	-
Total				**4322.74**	**2**

S - denotes bottom-set drift net
F - denotes floating drift net
* Duration was included for all traps that collected a sample (independent of size of sample)

Table 8. Summary of set and pull date and total set duration for drift net, set in and below Gull Rapids, 2004.

Drift net number	Type	Set date	Pull date	Duration (hrs)	# lake sturgeon larvae
1S	S	07-Jul-04	17-Jul-04	214.89	-
2S	S	07-Jul-04	23-Jul-04	333.25	-
3F	F	07-Jul-04	23-Jul-04	310.72	-
4F	F	07-Jul-04	23-Jul-04	382.81	-
5F	F	07-Jul-04	23-Jul-04	192.82	-
6F	F	07-Jul-04	22-Jul-04	336.61	-
7F	F	07-Jul-04	16-Jul-04	172.07	-
8S	S	07-Jul-04	23-Jul-04	334.52	-
9S	S	07-Jul-04	23-Jul-04	381.43	-
10S	S	07-Jul-04	23-Jul-04	333.48	-
Total				**2992.60**	**-**

S - denotes bottom-set drift net
F - denotes floating drift net
* Duration was included for all traps that collected a sample (independent of size of sample)

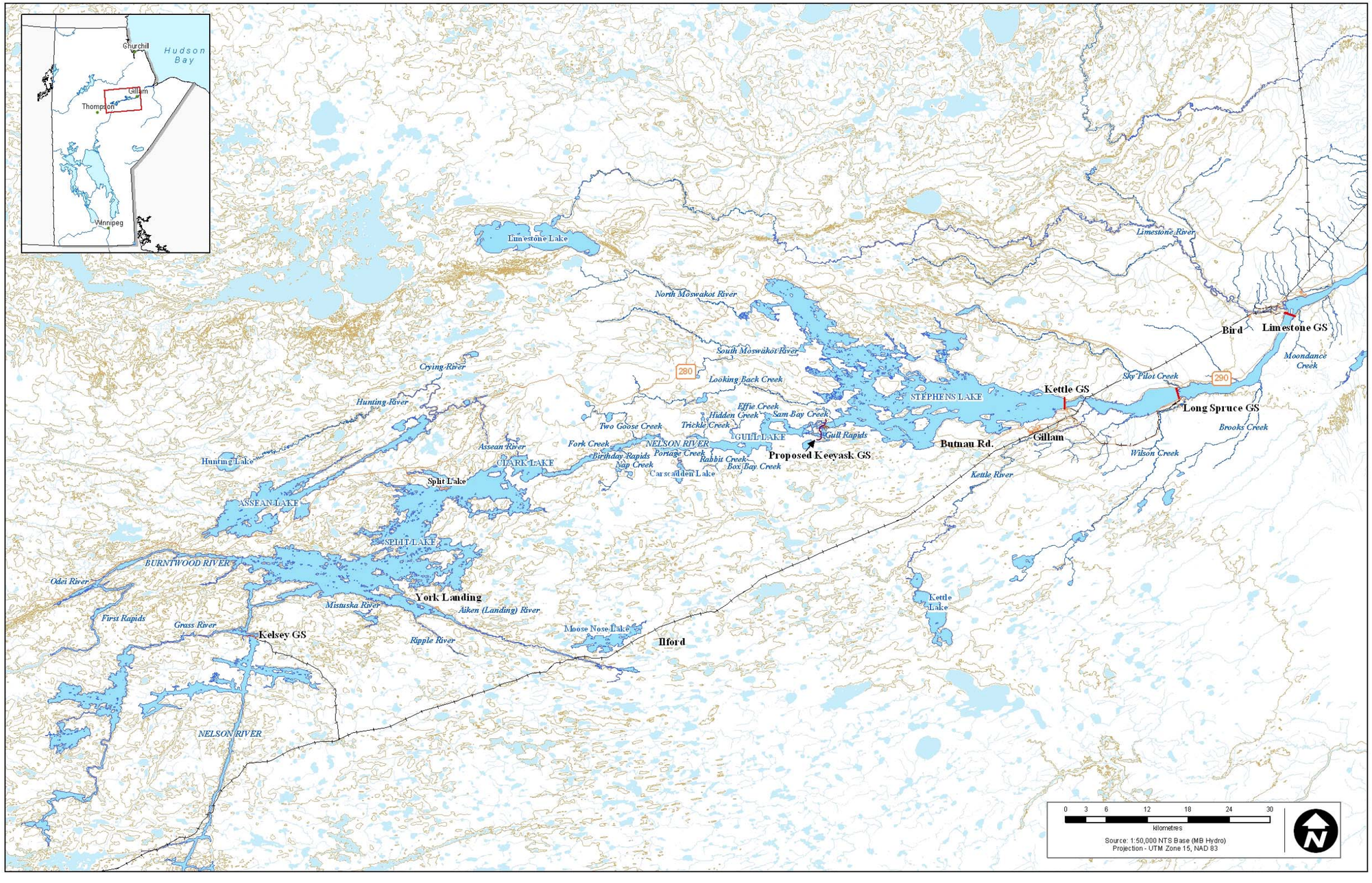

Figure 1. Map of the Keeyask Study Area showing proposed and existing hydroelectric development.

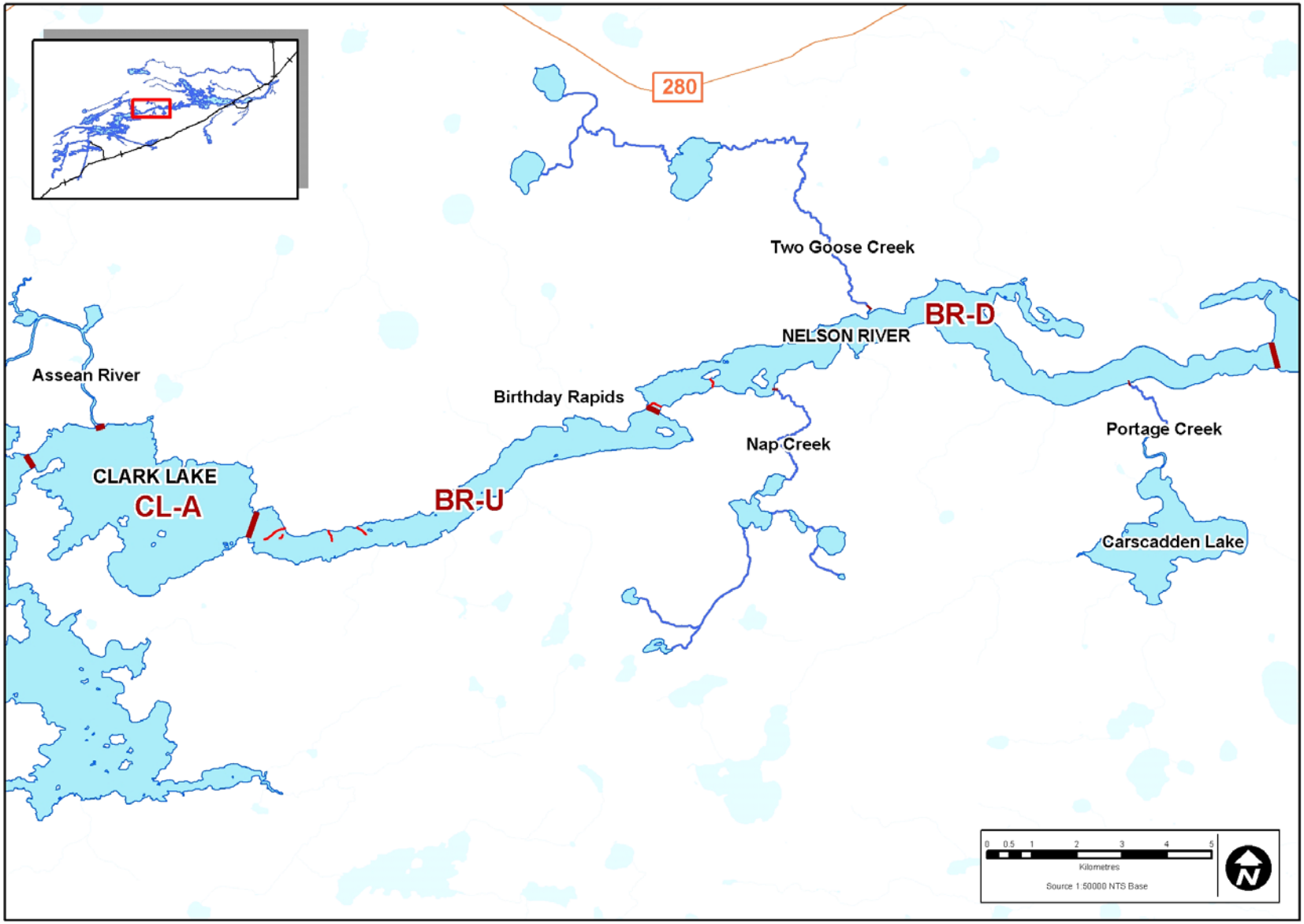

Figure 2. Map of the Nelson River and Clark Lake in the vicinity of Birthday Rapids illustrating zones CL-A, BR-U, and BR-D.

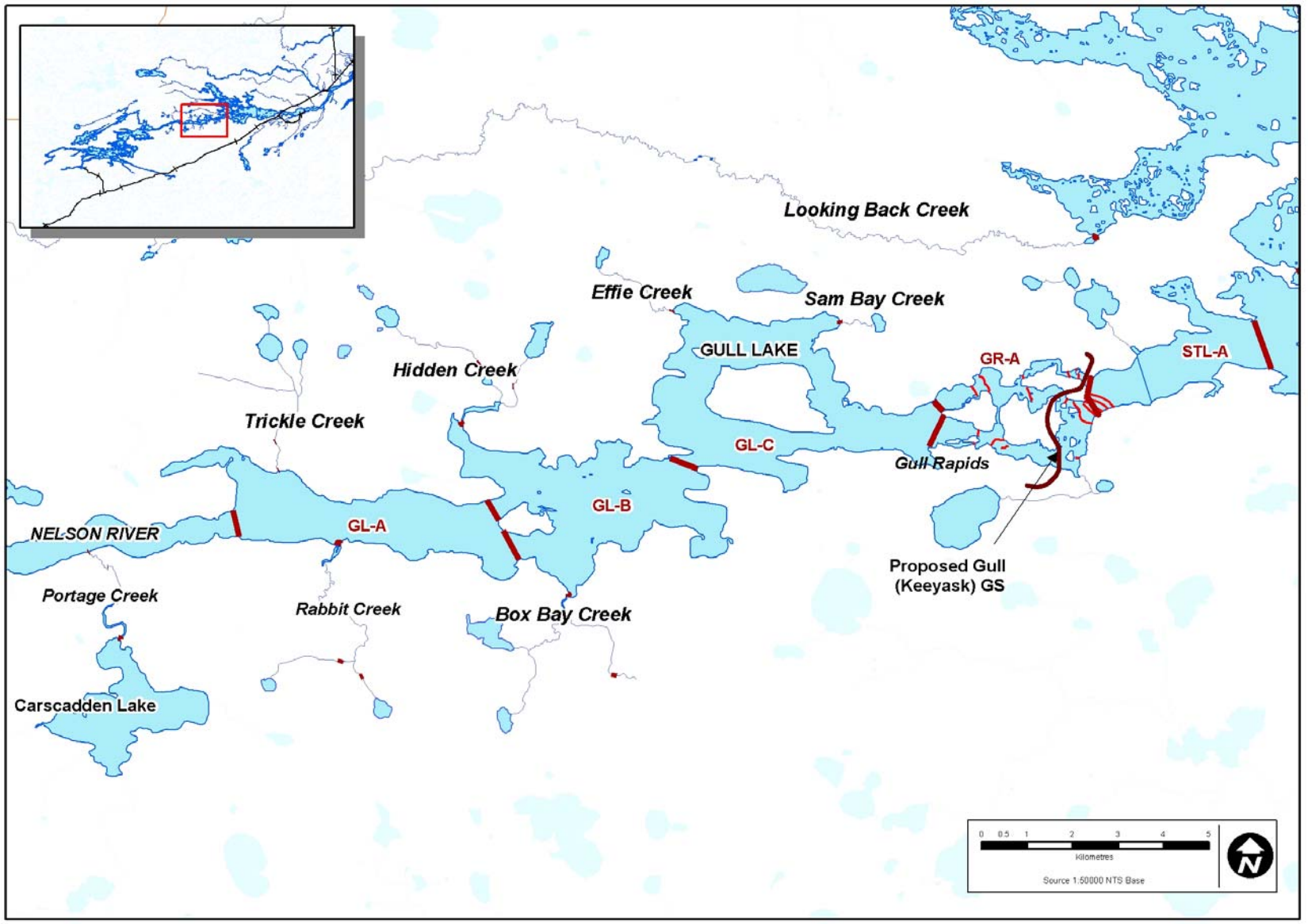

Figure 3. Map of Gull Lake illustrating zones GL-A, GL-B, and GL-C.

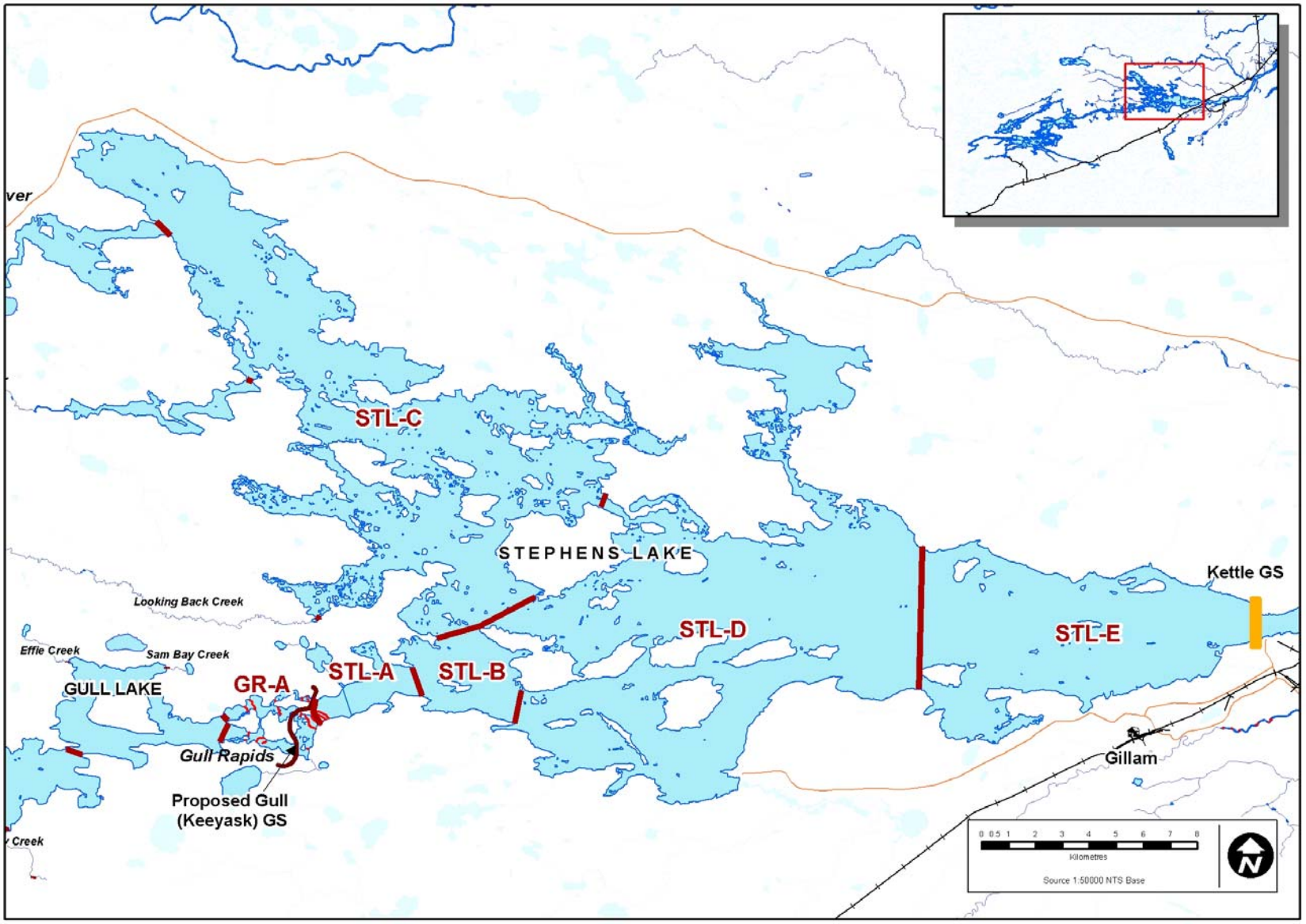

Figure 4. Map of Stephens Lake illustrating zones STL-A to STL-E, and GR-A.

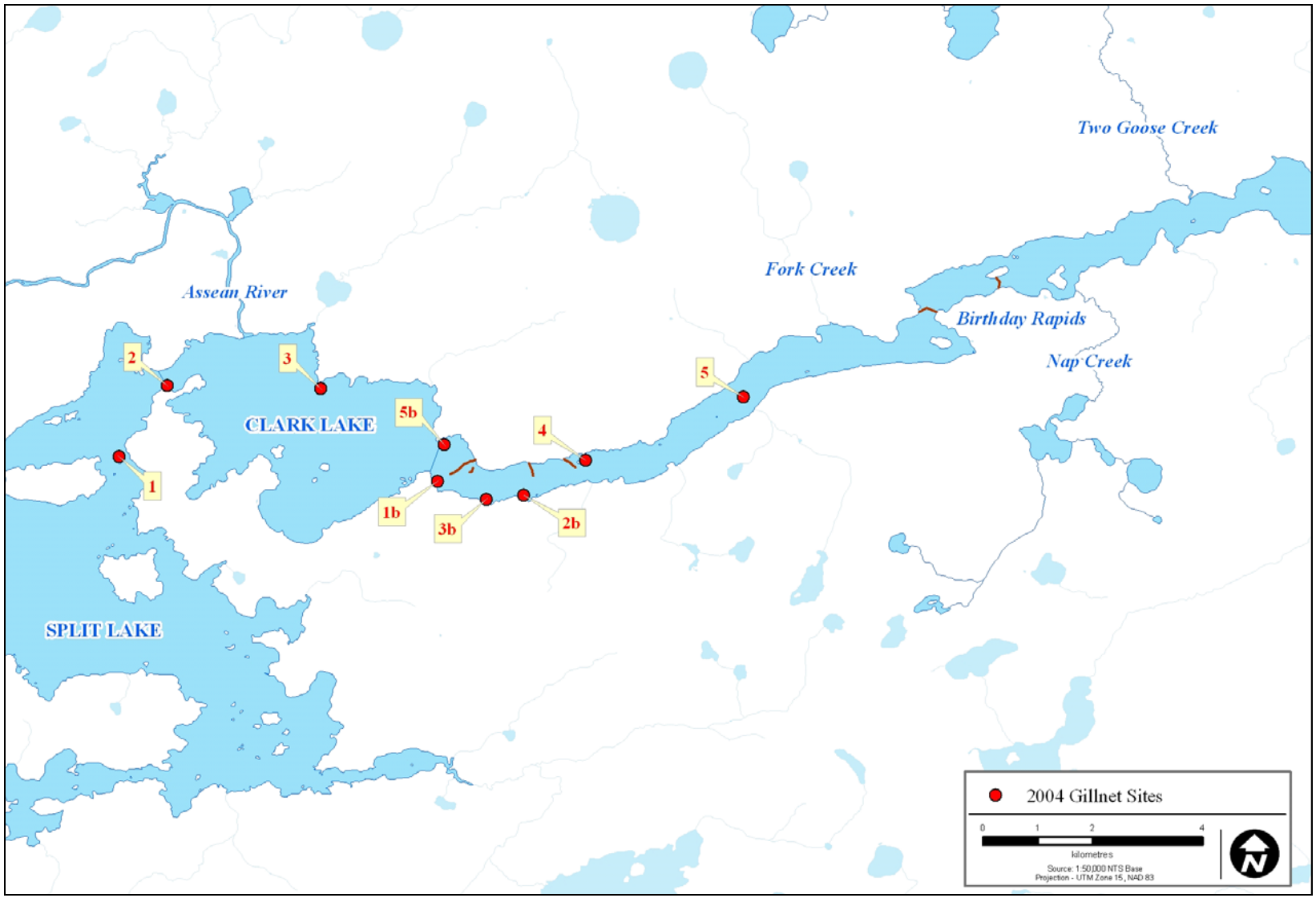

Figure 5. Gillnetting sites fished for lake sturgeon in the Nelson River between lower Split Lake and Birthday Rapids between 9 June and 2 July, 2004.

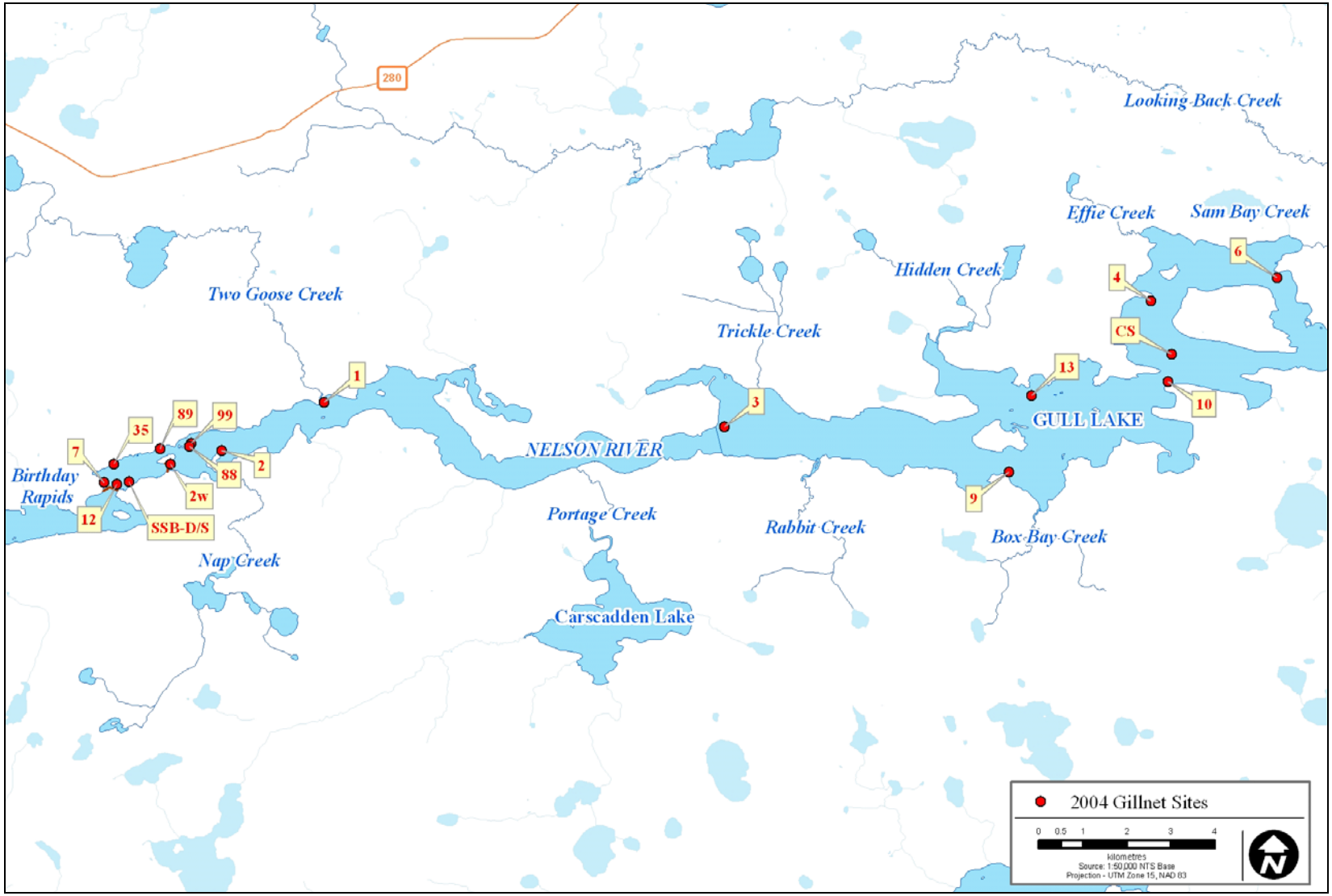

Figure 6. Gillnetting sites fished for lake sturgeon in the Nelson River between Birthday and Gull rapids between 9 June and 19 July, 2004.

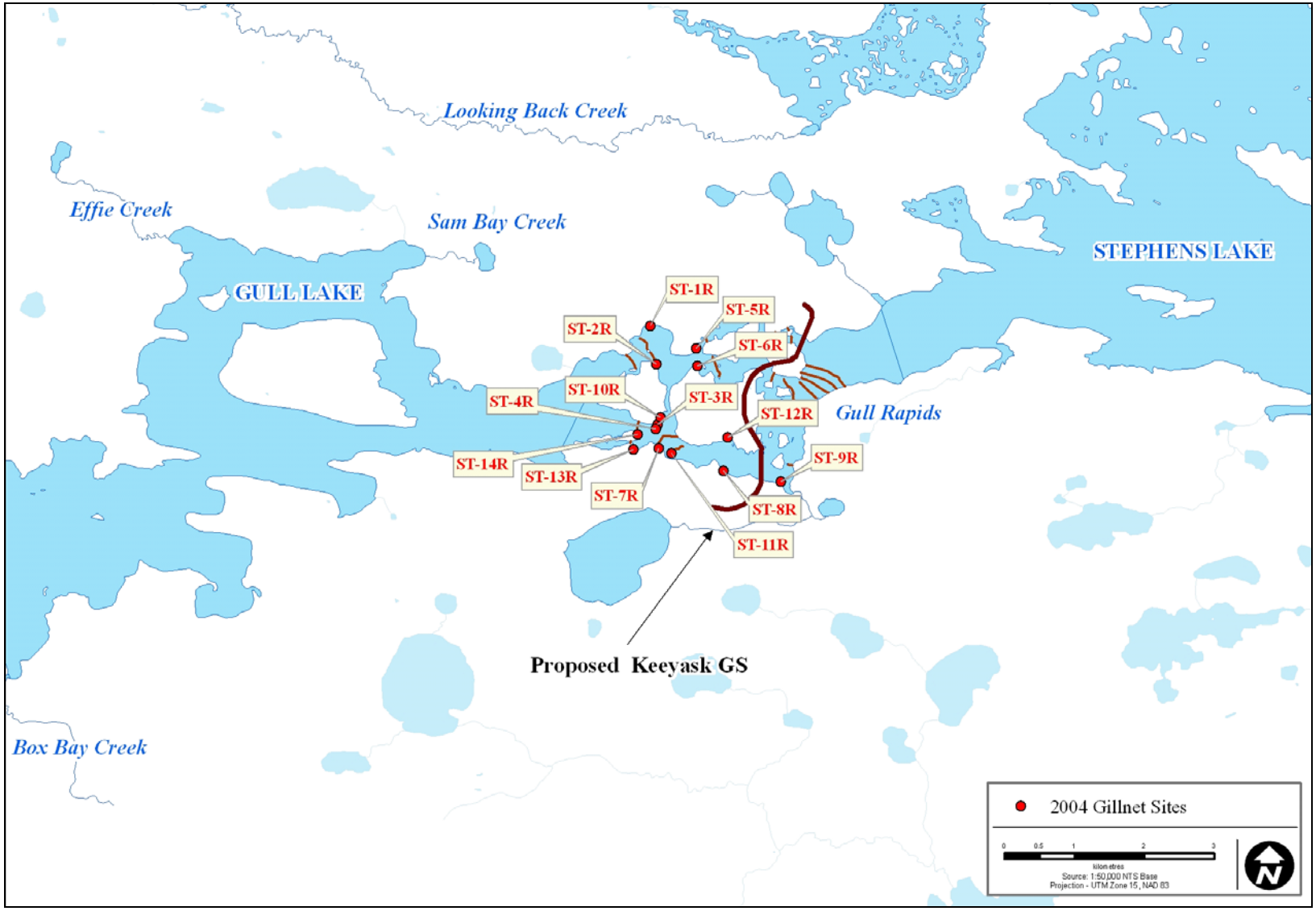

Figure 7. Gillnetting sites fished for lake sturgeon in Gull Rapids between 16 June and 3 July, 2004.

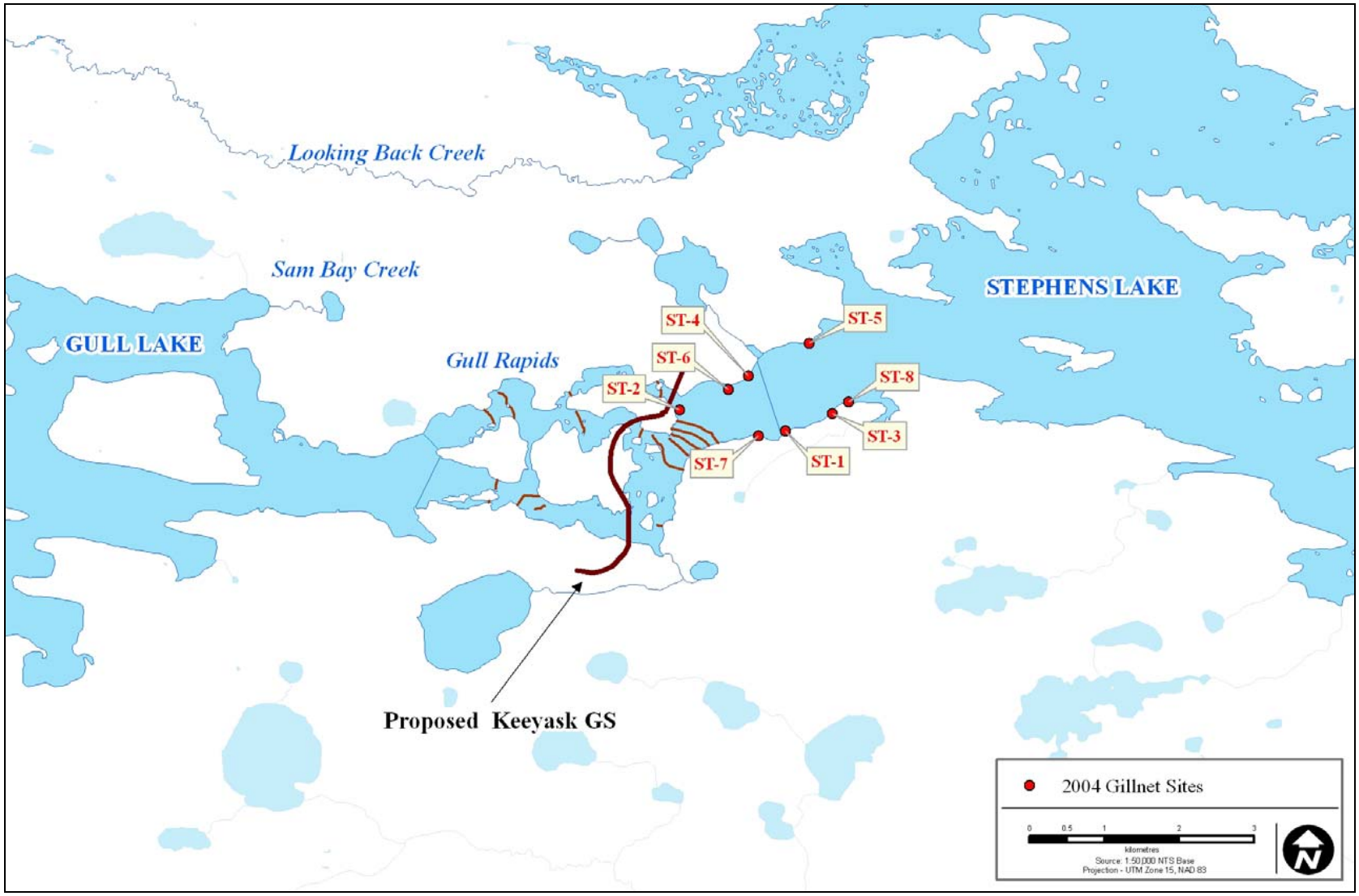

Figure 8. Gillnetting sites fished for lake sturgeon in Stephens Lake between 10 June and 19 July, 2004.

Figure 9. Photograph of drift nets used during lake sturgeon investigations in the Keeyask Study Area, 2004.

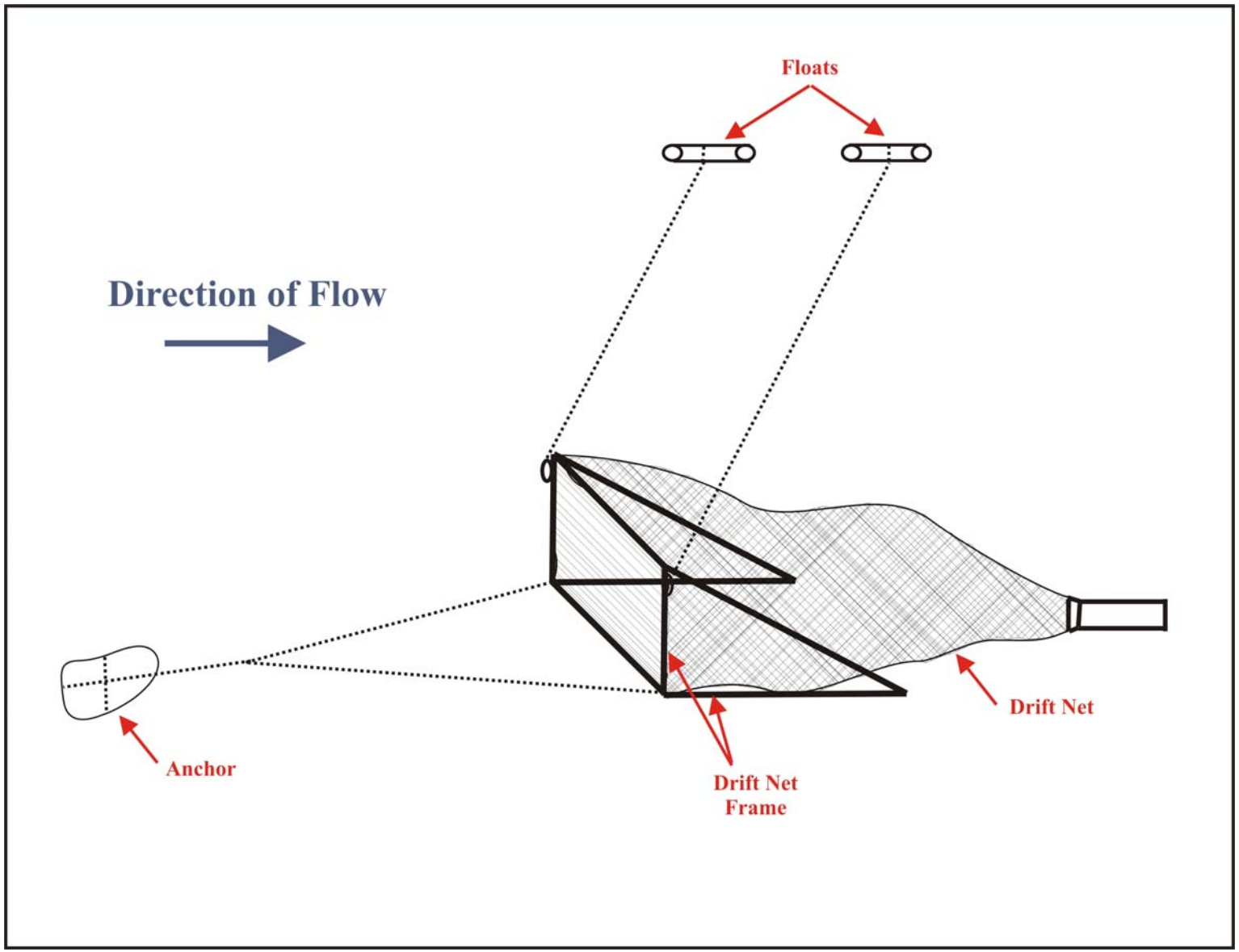

Figure 10. Diagram of bottom-set drift net assembly used during lake sturgeon investigations in the Keeyask Study Area, 2004.

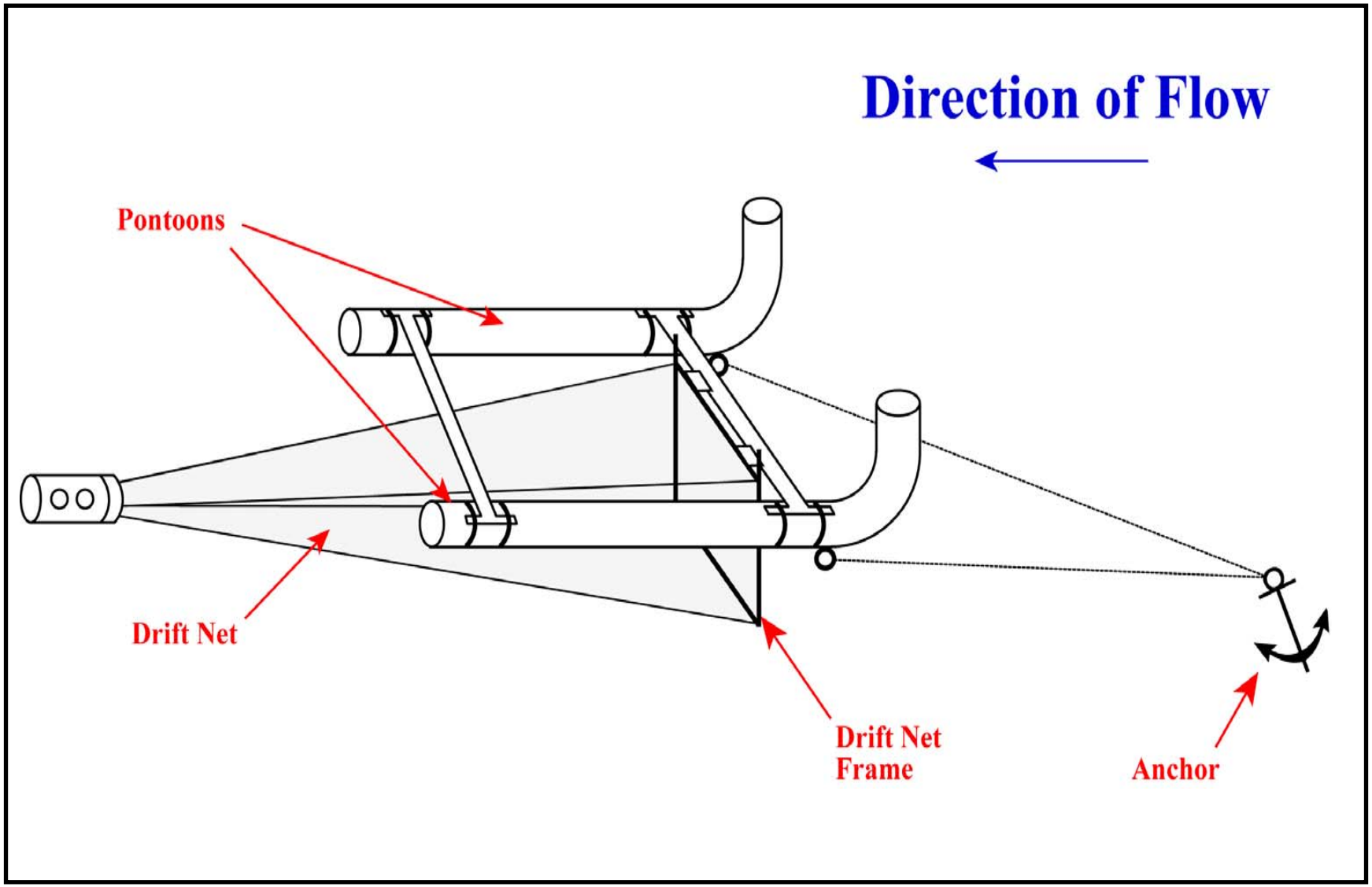

Figure 11. Diagram of floating drift net assembly used during lake sturgeon investigations in the Keeyask Study Area, 2004.

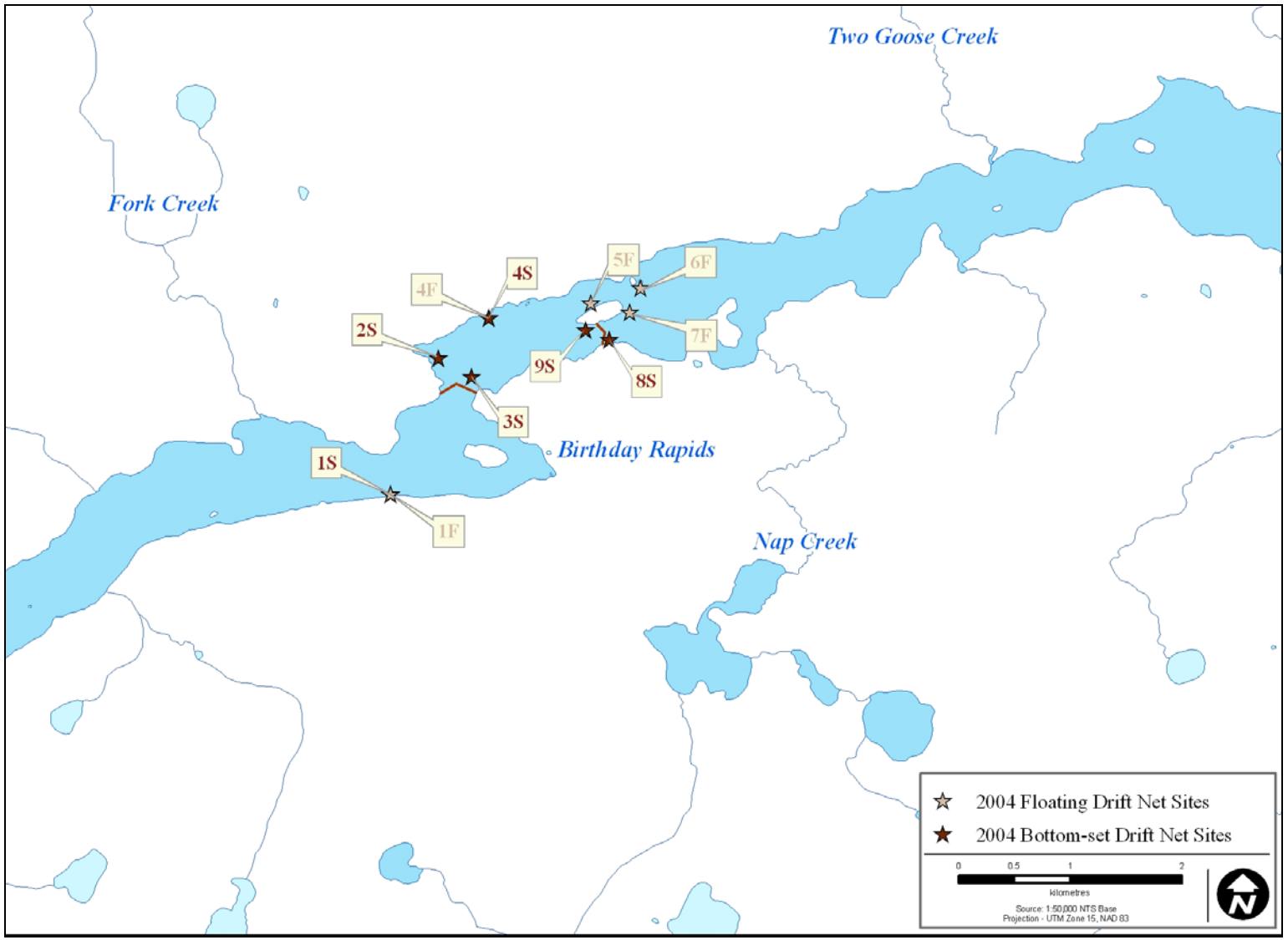

Figure 12. Map of drift net sites sampled in the Nelson River between Birthday and Gull rapids between 5 and 23 July, 2004.

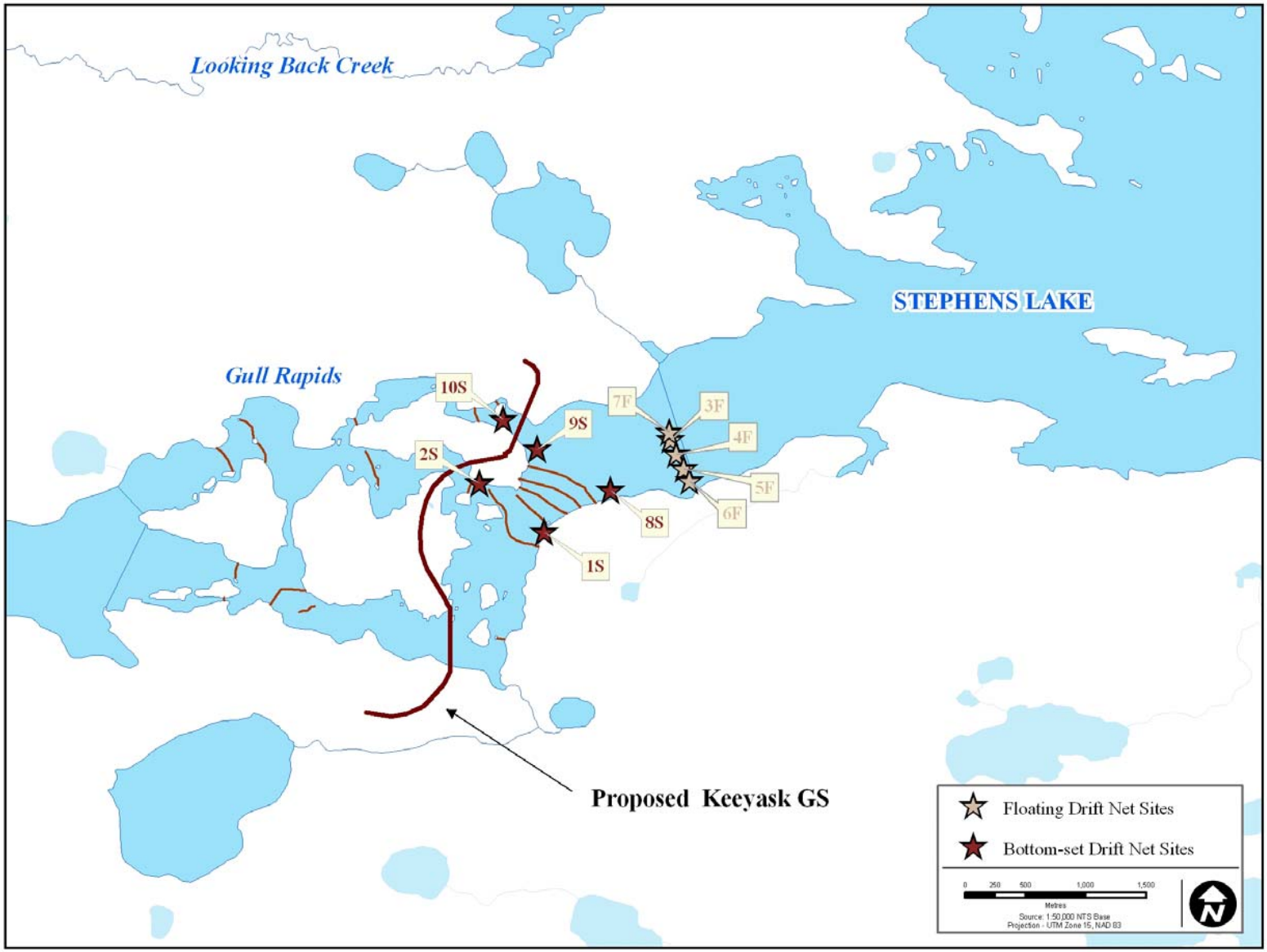

Figure 13. Map of drift net sites sampled in Gull Rapids and immediately downstream in Stephens Lake between 7 and 23 July, 2004.

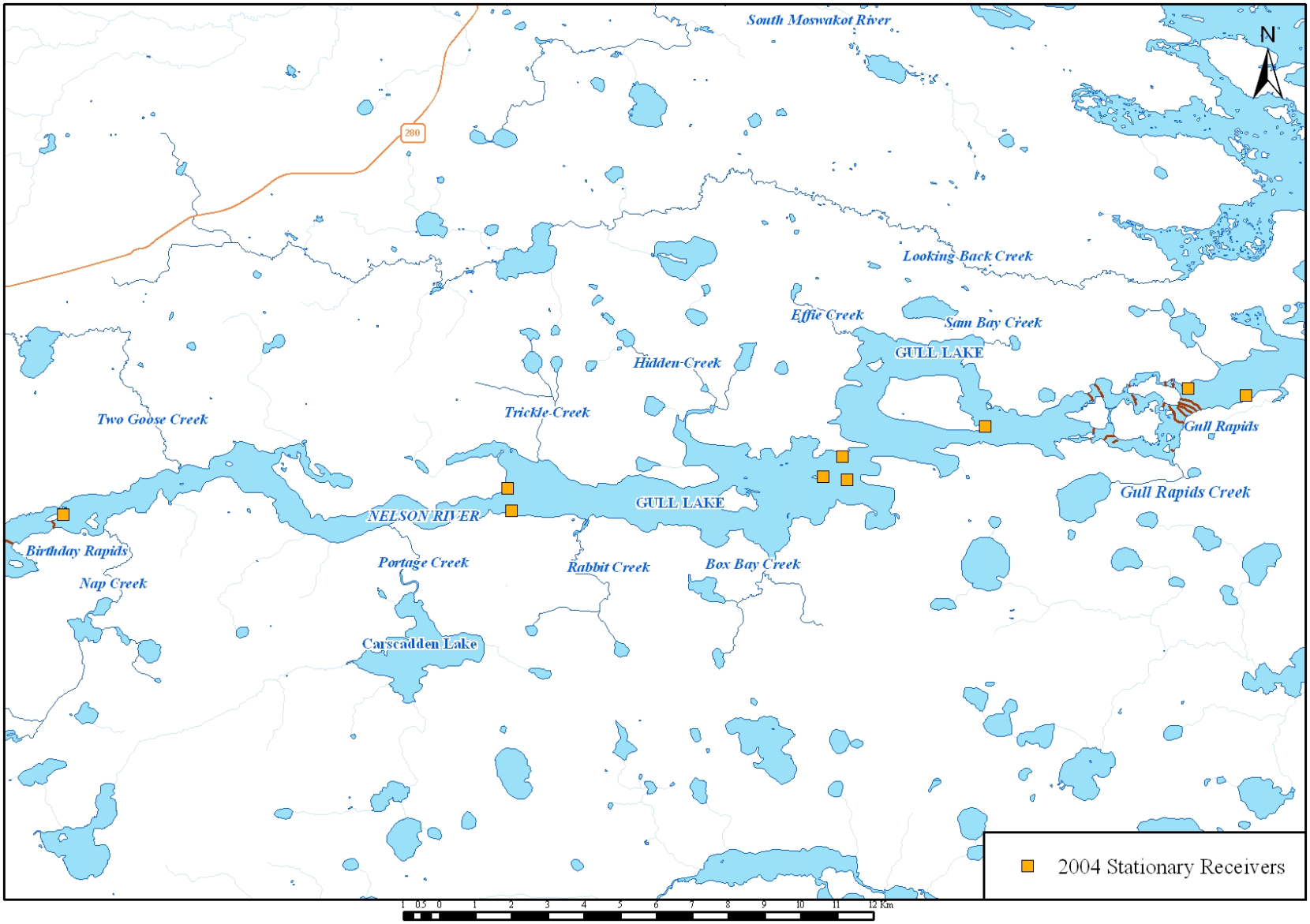

Figure 14. Location of stationary receivers in the Keeyask Study Area, 2004.

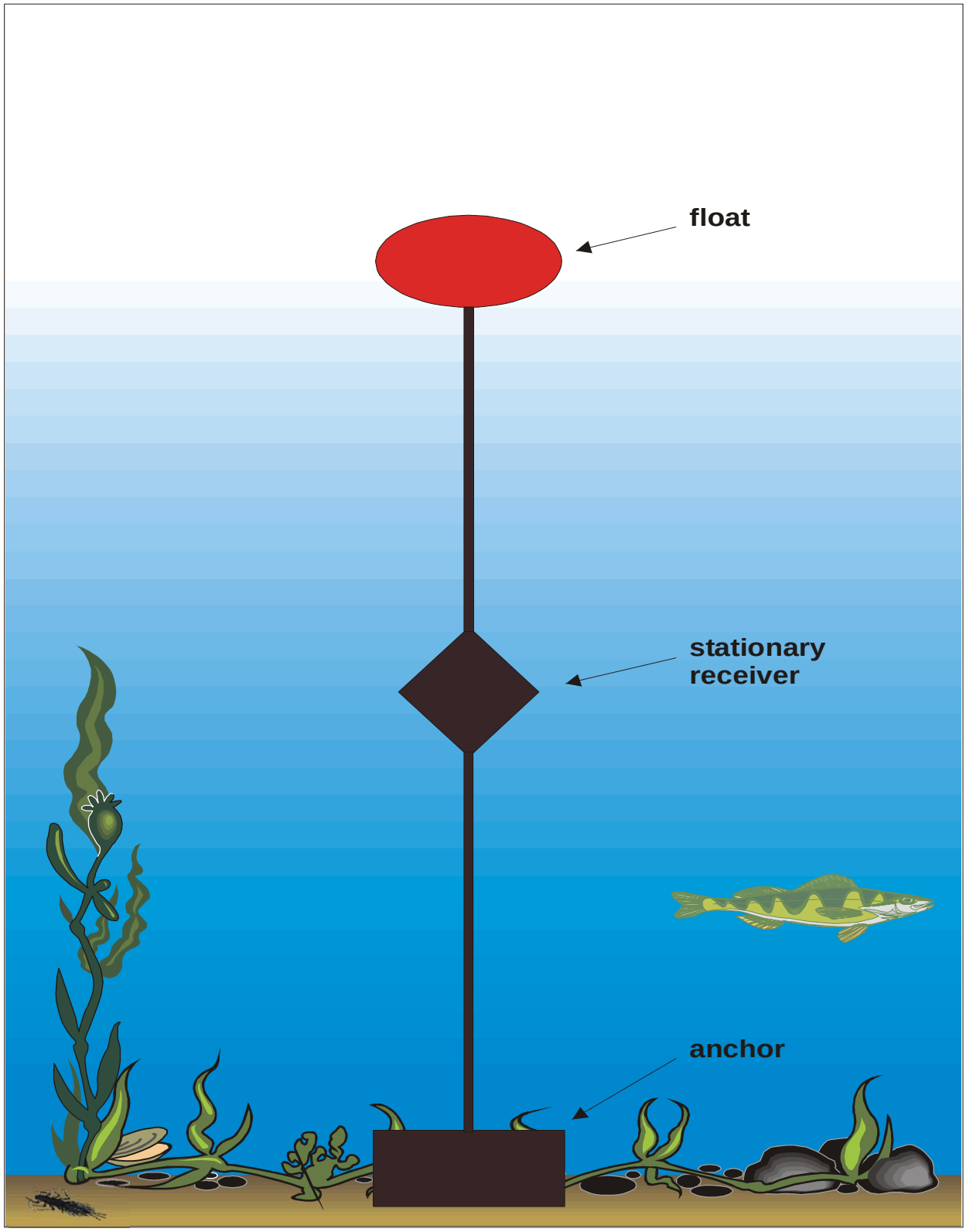

Figure 15. Diagram of a stationary acoustic receiver used during telemetry studies in the Keeyask Study Area, 2004.

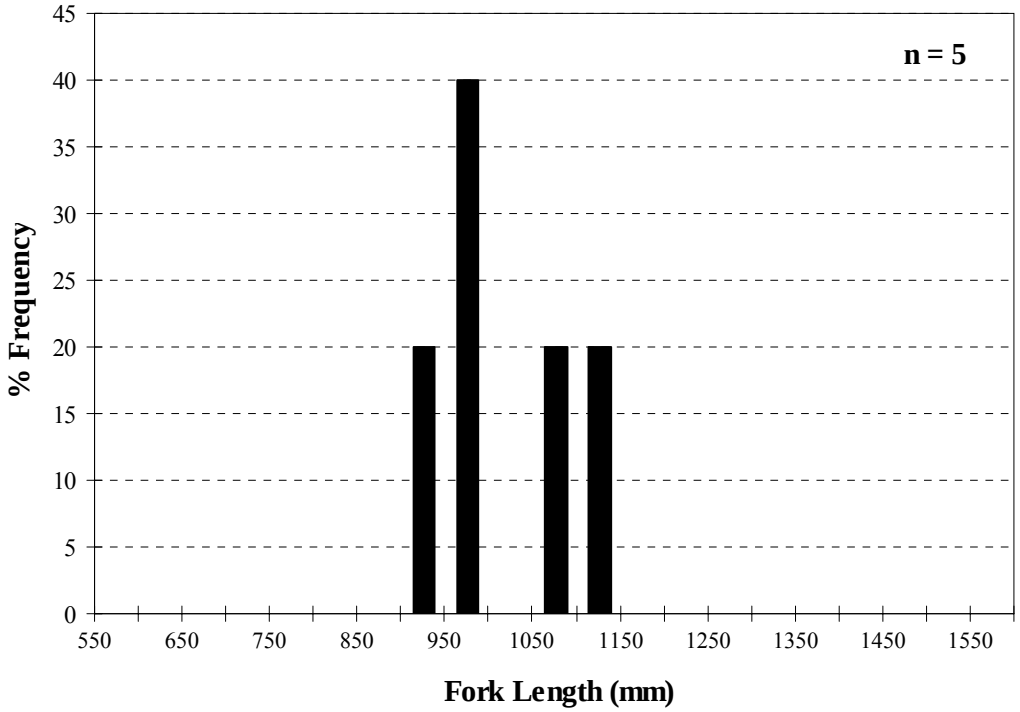

Figure 16. Length-frequency distribution for lake sturgeon captured in the Nelson River between lower Split Lake and Birthday Rapids, spring 2004.

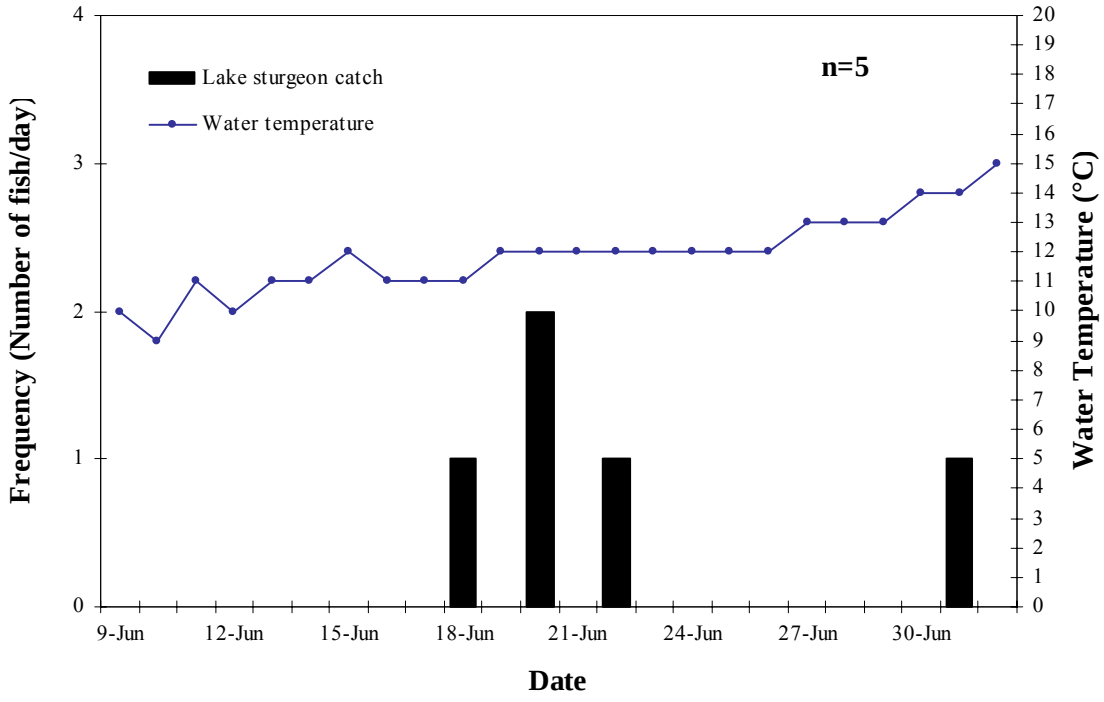

Figure 17. Daily frequency of lake sturgeon captured in gill nets set in the Nelson River between lower Split Lake and Birthday Rapids, spring 2004.

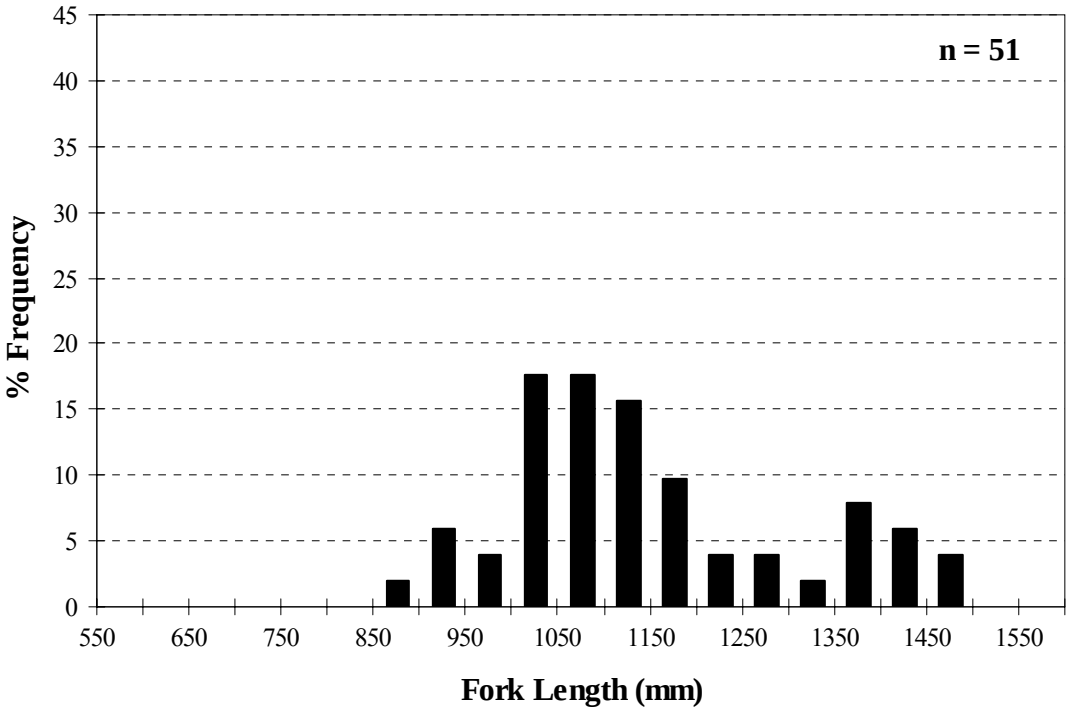

Figure 18. Length-frequency distribution for lake sturgeon captured in the Nelson River between Birthday Rapids and Gull Rapids, spring 2004.

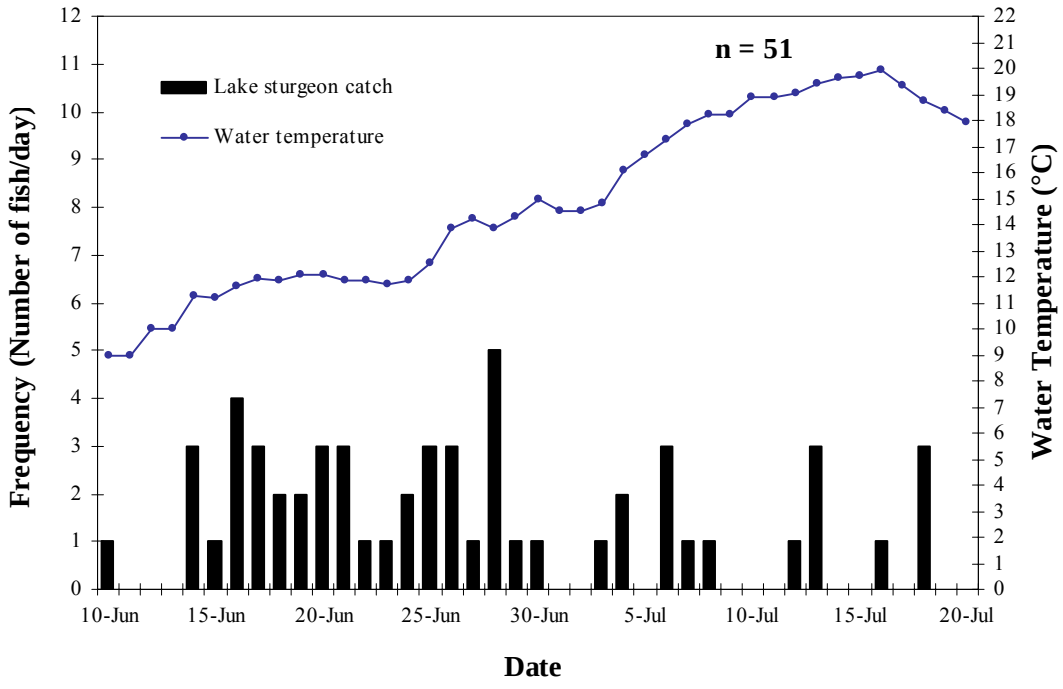

Figure 19. Daily frequency of lake sturgeon captured in the Nelson River between Birthday Rapids and Gull Rapids, spring 2004. *Note: Does not include lake sturgeon that were captured more than once in 2004.*

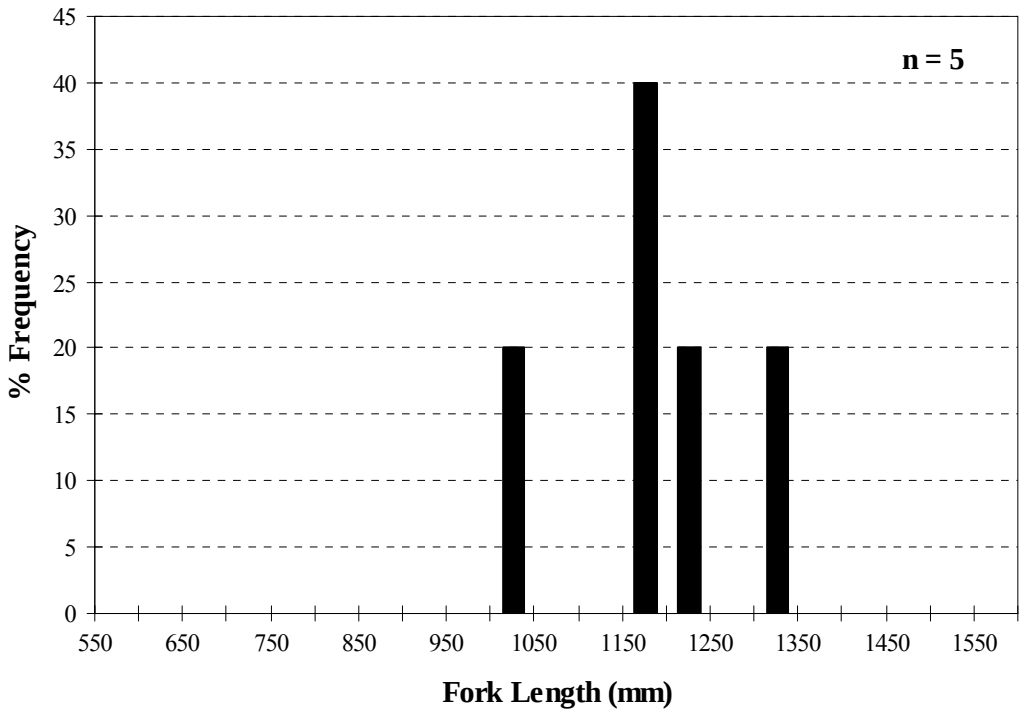

Figure 20. Length-frequency distribution for lake sturgeon captured in Stephens Lake, spring 2004.

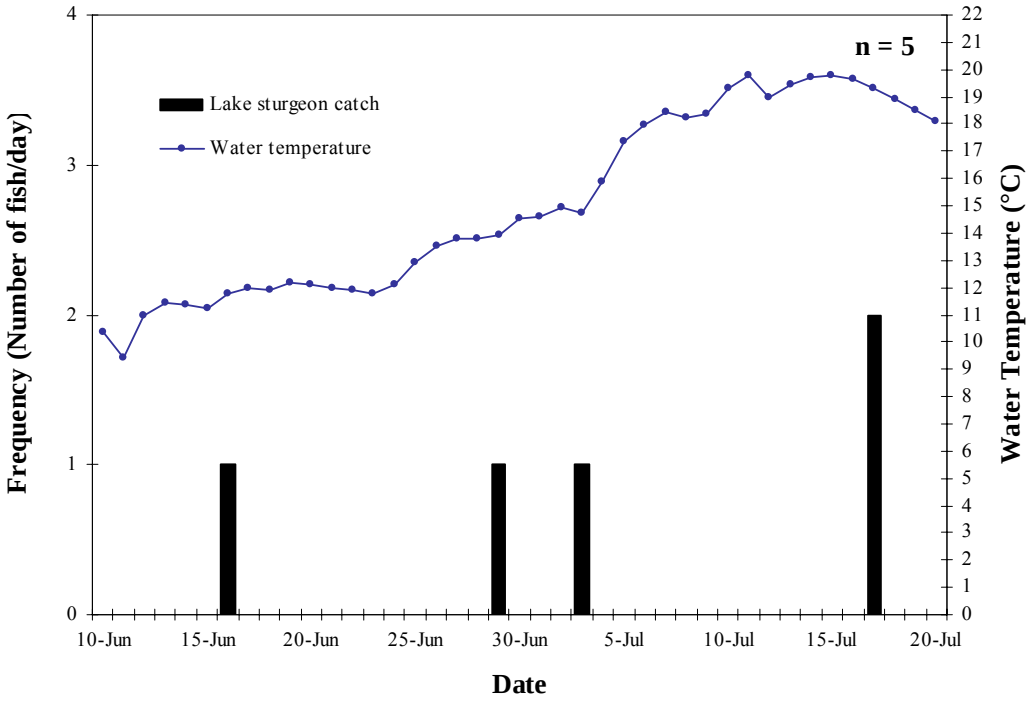

Figure 21. Daily frequency of lake sturgeon captured in Stephens Lake, spring 2004.

APPENDIX 1.

BIOLOGICAL AND FLOY-TAG INFORMATION FOR LAKE STURGEON CAPTURED IN THE KEEYASK STUDY AREA, 2004

Page

Table A1-1. Biological and Floy-tag information for the lake sturgeon captured in the Nelson River between lower Split Lake and Birthday Rapids, 2004. 58

Table A1-2 Biological and Floy-tag information for lake sturgeon captured in the Nelson River between Birthday Rapids and Gull Rapids, 2004. 59

Table A1-3 Biological and Floy-tag information for the lake sturgeon captured in the Nelson River within Gull Rapids, 2004. 62

Table A1-4 Biological and Floy-tag information for the lake sturgeon captured in Stephens Lake, 2004. 62

Table A1-1. Biological and Floy-tag information for the lake sturgeon captured in the Nelson River between lower Split Lake and Birthday Rapids, 2004.

Prefix	Tag Number	Species	Date Captured	Gear Type	Tagging Location (Map Area)	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Recap
NSC	65822	LKST	18-Jun	GN	BR-U	972	1090	6804	M	8	N
NSC	46845	LKST	20-Jun	GN	BR-U	1070	1200	9072	M	8	Y
NSC	50845	LKST	20-Jun	GN	BR-U	940	1060	7711	M	8	Y
NSC	65818	LKST	22-Jun	GN	BR-U	970	1095	5670	M	7	N
NSC	65956	LKST	01-Jul	GN	BR-U	1137	1220	11793	-	-	N

Recap = Fish originally tagged in a previous year
LKST = Lake sturgeon
GN = Gill net
SLRMB = Split Lake Resource Management Board

Table A1-2. Biological and Floy-tag information for lake sturgeon captured in the Nelson River between Birthday Rapids and Gull Rapids, 2004.

Prefix	Tag Number	Species	Date Captured	Gear Type	Tagging Location (Map Area)	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Recap
NSC	64701	LKST	10-Jun	GN	GL-C	1385	1500	25402	-	-	N
NSC	48926	LKST	14-Jun	GN	BR-D	1318	1435	17237	-	-	Y
NSC	64707	LKST	14-Jun	GN	BR-D	1070	1213	9979	-	-	N
NSC	64705	LKST	14-Jun	GN	GL-B	999	1094	6804	-	-	N
NSC	50897	LKST	15-Jun	GN	GL-C	1032	1172	9979	-	-	Y
NSC	64713	LKST	16-Jun	GN	GL-B	1468	1645	29484	-	-	N
NSC	64709	LKST	16-Jun	GN	GL-C	1035	1165	12247	-	-	N
NSC	64710	LKST	16-Jun	GN	GL-C	1046	1194	9979	-	-	N
NSC	64711	LKST	16-Jun	GN	GL-C	902	1001	6350	-	-	N
NSC	64714	LKST	17-Jun	GN	BR-D	1089	1218	9526	M	8	N
NSC	64716	LKST	17-Jun	GN	GL-B	1091	1222	9979	-	-	N
NSC	64717	LKST	17-Jun	GN	GL-C	1084	1213	11794	-	-	N
NSC	64718	LKST	18-Jun	GN	BR-D	1195	1321	16783	-	-	N
NSC	48881	LKST	18-Jun	GN	GL-B	1261	1419	19051	-	-	Y
NSC	48884	LKST	19-Jun	GN	BR-D	1458	1590	31298	-	-	Y
NSC	64719	LKST	19-Jun	GN	BR-D	939	1035	6804	-	-	N
NSC	64720	LKST	20-Jun	GN	GL-A	1041	1149	8845	-	-	N
SLRMB	***	LKST	20-Jun	GN	GL-A	1145	1304	11340	-	-	Y
NSC	64722	LKST	21-Jun	GN	BR-D	1046	1159	10886	M	8	N
NSC	64723	LKST	21-Jun	GN	BR-D	1105	1220	11340	M	7	N
NSC	64721	LKST	21-Jun	GN	GL-A	1420	1540	20185	-	-	N
NSC	64724	LKST	22-Jun	GN	GL-B	1196	1332	16783	-	-	N
NSC	50987	LKST	23-Jun	GN	GL-C	1127	1281	10433	-	-	Y

Table A1-2. Continued.

Prefix	Tag Number	Species	Date Captured	Gear Type	Tagging Location (Map Area)	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Recap
NSC	47166	LKST	24-Jun	GN	BR-D	1178	1304	11794	-	-	Y
NSC	64726	LKST	24-Jun	GN	GL-A	1124	1249	9979	-	-	N
NSC	59519	LKST	25-Jun	GN	BR-D	870	986	5443	-	-	Y
NSC	64728	LKST	25-Jun	GN	BR-D	1040	1172	8165	-	-	N
NSC	47115	LKST	26-Jun	GN	BR-D	1132	1239	12247	M	7	Y
NSC	48947	LKST	26-Jun	GN	BR-D	1255	1392	19051	-	-	Y
NSC	64730	LKST	26-Jun	GN	BR-D	1405	1601	28123	-	-	N
NSC	64731	LKST	27-Jun	GN	GL-B	1128	1270	14062	-	-	N
NSC	48807	LKST	28-Jun	GN	GL-A	1187	1312	11340	M	7	Y
NSC	64733	LKST	28-Jun	GN	GL-A	1384	1530	28123	-	-	N
NSC	64734	LKST	28-Jun	GN	GL-A	1031	1136	10886	-	-	N
NSC	64735	LKST	28-Jun	GN	GL-A	1428	1575	23587	-	-	N
NSC	64732	LKST	28-Jun	GN	GL-C	998	1114	9526	-	-	N
NSC	64736	LKST	29-Jun	GN	BR-D	1002	1113	9072	-	-	N
NSC	47120	LKST	03-Jul	GN	BR-D	1062	1189	9979	-	-	Y
NSC	48866	LKST	04-Jul	GN	BR-D	1145	1259	12247	-	-	Y
NSC	64740	LKST	04-Jul	GN	BR-D	1051	1114	9979	-	-	N
NSC	64741	LKST	06-Jul	GN	BR-D	1115	1228	13608	-	-	N
NSC	64742	LKST	06-Jul	GN	BR-D	1191	1313	18144	-	-	N
NSC	50941	LKST	07-Jul	GN	GL-C	1215	1339	18144	-	-	Y
NSC	64743	LKST	08-Jul	GN	BR-D	1245	1372	19051	-	-	N
NSC	64744	LKST	12-Jul	GN	BR-D	1090	1210	9979	-	-	N
NSC	64747	LKST	13-Jul	GN	GL-B	1354	1470	22226	-	-	N
NSC	64745	LKST	13-Jul	GN	GL-C	1090	1200	11340	-	-	N

Table A1-2. Continued.

Prefix	Tag Number	Species	Date Captured	Gear Type	Tagging Location (Map Area)	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Recap
NSC	64746	LKST	13-Jul	GN	GL-C	1050	1060	7711	-	-	N
NSC	64748	LKST	16-Jul	GN	GL-A	930	1030	6350	-	-	N
NSC	50854	LKST	18-Jul	GN	GL-B	1035	1161	9526	-	-	Y
NSC	64749	LKST	18-Jul	GN	GL-B	1390	1518	27670	-	-	N

*** = Incorrect tag number recorded
GN = Gill net
LKST = Lake sturgeon
Recap = Fish originally tagged in a previous year

Table A1-3. Biological and Floy-tag information for the lake sturgeon captured in the Nelson River within Gull Rapids, 2004.

Prefix	Tag Number	Species	Date Tagged	Gear Type	Tagging Location (Map Area)	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Recap
NSC	47183	LKST	03-Jul	GN	GR-A	1299	1419	20412	-	-	Y

GN = Gill net
LKST = Lake sturgeon
Recap = Fish originally tagged in a previous year

Table A1-4. Biological and Floy-tag information for the lake sturgeon captured in Stephens Lake, 2004.

Prefix	Tag Number	Species	Date Tagged	Gear Type	Tagging Location (Map Area)	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Recap
NSC	57000	LKST	16-Jun	GN	STL-A	1245	1374	-	-	-	N
NSC	56987	LKST	29-Jun	GN	STL-A	1155	1272	20412	-	-	N
NSC	49040	LKST	03-Jul	GN	STL-A	1324	1455	16783	-	-	Y
NSC	46826	LKST	17-Jul	GN	STL-A	1025	1125	9450	-	-	Y
NSC	56324	LKST	17-Jul	GN	STL-A	1150	1285	14742	-	-	N

GN = Gill net
LKST = Lake sturgeon
Recap = Fish originally tagged in a previous year

APPENDIX 2.

WEIGHT-LENGTH REGRESSION ANALYSIS FOR LAKE STURGEON CAPTURED IN THE KEEYASK STUDY AREA, 2004

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Table A2-1. Weight-length regression equation, by location, for lake sturgeon captured in the Keeyask Study Area during 2004. 64

Table A2-1. Weight-length regression equation, by location, for lake sturgeon captured in the Keeyask Study Area during 2004.

Location	n	Regression Line	R^2
Nelson River (SPL-BR)	5	y = 25.458x - 17701	0.80
Nelson River (BR-GR)	51	y = 42.032x - 34161	0.89
Gull Rapids	1	-	-
Stephens Lake	4	y = 22.399x - 10714	0.36

SPL-BR = Split Lake to Birthday Rapids
BR - GR = Birthday Rapids to Gull Rapids
R^2 value measures how successful the fit is in explaining the variation in the data (i.e., a value closer to 1.00 indicates a better fit).

APPENDIX 3.

SUMMARY OF LAKE STURGEON FLOY-TAG RECAPTURES IN THE KEEYASK STUDY AREA, 2004

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Table A3-1. Floy-tag application and recapture information for lake sturgeon recaptured during lake sturgeon investigations, 2004. 66

Table A3-1. Floy-tag application and recapture information for lake sturgeon recaptured during lake sturgeon investigations, 2004.

Prefix	Tag #	Tagging Information					Recapture Information					Distance (km)	Days to Recapture
		Date	Zone	FL[1] (mm)	W (g)	S/M	Date	Zone	FL (mm)	W (g)	S/M		
NSC	46826	28-May-01	STL-A	1000	7750	M7	17-Jul-04	STL-A	1025	9450	-	1.0	1145
NSC	46845	28-May-01	STL-A	1042	8000	-	20-Jun-04	BR-U	1070	9072	M8	45.0	1118
NSC	47115	06-Jun-01	BR-D	1082	13000	M8	20-Jun-03	BR-D	-	-	-	1.0	744
							26-Jun-04	BR-D	1132	12247	M7	1.5	1105
NSC	47120	06-Jun-01	BR-D	990	7750	M8	03-Jul-04	BR-D	1062	9979	-	1.0	1122
NSC	47166	30-Jun-01	BR-D	1103	12250	-	27-Jun-02	BR-D	-	-	-	18.5	362
							24-Jun-04	BR-D	1178	11794	-	24.0	1089
NSC	47183	09-Jul-01	GL-B	1327	23500	-	30-May-03	STL-A	-	-	-	13.0	690
							16-Jun-03	GR-A	-	-	-	12.0	707
							03-Jul-04	GR-A	-	-	-	12.0	1089
NSC	48807	28-Jun-02	BR-D	1161	11794	M7	28-Jun-04	GL-A	1187	11340	M7	14.0	730
NSC	48866	30-Jun-02	BR-D	1140	14515	M9	04-Jul-04	BR-D	1145	12247	-	3.0	734
NSC	48881	02-Jul-02	BR-D	1254	20412	-	06-Jun-03	GL-A	-	-	-	11.0	339
							18-Jun-04	GL-B	1261	19051	-	17.0	716
NSC	48884	05-Jul-02	BR-D	1415	34020	-	19-Jun-04	BR-D	1458	31298	-	0.5	744
NSC	48926	11-Jun-02	BR-D	1299	21092	M7	14-Jun-04	BR-D	1318	17237	-	0.0	733
NSC	48947	10-Jun-02	BR-D	1265	19505	-	26-Jun-04	BR-D	1268	19051	-	3.5	746
NSC	49040	26-Sep-01	STL-A	1360	-	F-	10-Jun-03	STL-A	-	-	-	1.0	622
							03-Jul-04	STL-A	1361	16783	-	0.0	1010
NSC	50845	08-Jun-03	GL-A	916	7500	-	20-Jun-04	BR-U	940	7711	M8	25.0	377
NSC	50854	09-Jun-03	BR-D	1025	8500	-	18-Jul-04	GL-B	1035	9526	-	24.0	404
NSC	50897	13-Jun-03	GL-C	991	9500	-	15-Jun-04	GL-C	1032	9979	-	0.0	367
NSC	50941	01-Jun-03	GL-C	1195	18500	-	07-Jul-04	GL-C	1215	18144	-	0.0	402
NSC	50987	24-Jun-03	GL-A	1089	10433	-	23-Jun-04	GL-C	1127	10433	-	10.0	364
NSC	56324	16-Jul-03	STL-B	1163	13250		17-Jul-04	STL-A	1165	14742	-	10.0	366
NSC	59519	03-Oct-03	BR-D	841	-	-	25-Jun-04	BR-D	870	5443	-	1.0	265

1 – FL = fork length; W = weight; S/M = sex and maturity

APPENDIX 4.

BIOLOGICAL DATA FOR LAKE STURGEON IMPLANTED WITH RADIO OR ACOUSTIC TAGS IN THE KEEYASK STUDY AREA

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Table A4-1. Biological data for lake sturgeon tagged with acoustic transmitters in the Keeyask Study Area, 2001 68

Table A4-2. Biological data for lake sturgeon tagged with radio transmitters in the Keeyask Study Area, 2001 69

Table A4-1. Biological data for lake sturgeon tagged with acoustic transmitters in the Keeyask Study Area, 2001.

Code number	Date tagged	Map Area tagged	Appendix figure	Fork length (mm)	Total length (mm)	Weight (g)	Floy-tag number	Sex	Status
31a	30-May	GL-C	-	1211	1355	14500	47059	-	R 2001
31b	29-Sep	STL-A	A5-1	972	1080	7250	46894	-	MR 2004
32	26-Sep	STL-A	A5-2	1002	1106	10000	49041	F	MR 2004
33	26-Sep	STL-A	-	1360	1440	32500	49040	F	LL 2003
34	14-Jun	STL-A	-	950	1050	8000	46887	-	R 2003
35	20-Jun	STL-A	-	1050	1152	9250	46889	-	LL 2002
36	24-Jun	GL-C	A5-3	1020	1135	9000	47157	-	R 2004
37	20-Jun	GL-C	-	964	1050	9000	47152	-	R 2003
38	20-Jun	GL-C	A5-4	1010	1097	9750	47153	-	MR 2004
39	01-Jun	BR-D	A5-5	1241	1371	24000	47096	F	SA 2002, 2003, 2004
40	20-Jun	GL-C	A5-6	1210	1300	15500	47529	-	MR 2004
41	05-Jun	BR-D	-	1329	1429	17750	47107	-	R 2003
42	01-Jun	GL-A	A5-7	1240	1360	16250	47094	M	MR 2004
43	06-Jun	BR-D	A5-8	1082	1190	10500	47115	M	MR 2004
44	07-Jun	BR-D	A5-9	1130	1275	13000	47117	M	MR 2004
45	06-Jun	BR-D	A5-10	1316	1401	28000	47024	F	MR 2004
46	30-May	GL-C	-	1105	1230	12500	47109	-	R 2002
47	04-Jun	GL-B	A5-11	1180	1242	10500	47016	-	MR 2004
48	06-Jun	BR-D	A5-12	940	1110	7750	47120	M	MR 2004
49	06-Jun	BR-D	A5-13	945	1032	6750	47116	-	MR 2004
50	01-Jun	GL-C	A5-14	1282	1380	23500	47099	M	MR 2004

R = Recaptured and tag returned to North/South Consultants
LL = Last located
SA = Same area
MR = Movement recorded

Table A4-2. Biological data for lake sturgeon tagged with radio transmitters in the Keeyask Study Area, 2001.

Species	Date tagged	Map area tagged	Appendix number	Tag frequency	Code number	Fork length (mm)	Total length (mm)	Weight (g)	Floy-tag number	Sex	Status
LKST	28-May	STL-A	A5-15	149.500	1	1175	1290	15000	46848	-	MR 2003
LKST	31-May	STL-A	A5-16	149.560	1	1320	1448	20500	46701	F	MR 2004
LKST	19-Jun	STL-A	A5-17	149.560	2	1235	1388	20000	46888	-	MR 2004
LKST	13-Jun	STL-A	-	149.580	1	1247	1430	16500	46886	F	LL 2001
LKST	24-Jun	STL-A	-	149.580	2	1230	1315	18000	46891	-	LL 2001
LKST	29-May	STL-A	-	149.620	1	1210	1310	15250	46849	M	LL 2003
LKST	29-May	BR-D	-	149.720	1	1355	1461	23500	47076	F	R 2001
LKST	05-Jun	GL-B	-	149.720	2	1275	1380	17500	47112	-	LL 2003
LKST	07-Jun	BR-D	A5-20	149.720	3	1147	1262	13250	47118	M	MR 2004
LKST	07-Jun	BR-D	A5-21	149.720	4	1260	1346	16500	47125	M	MR 2004
LKST	20-Jun	BR-D	A5-18	149.580	3	1145	1237	14500	47530	-	MR 2004
LKST	20-Jun	GL-C	A5-19	149.580	4	1184	1301	16800	47158	-	MR 2004

R = Recaptured and tag returned to North/South Consultants
LL = Last located
SA = Same area
MR = Movement recorded

APPENDIX 5.

TAGGING AND RELOCATION DATES AND SITES FOR LAKE STURGEON IMPLANTED WITH RADIO OR ACOUSTIC TRANSMITTERS

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