Keeyask Generation Project

Environmental Impact Statement

Supporting Volume

Aquatic Environment

Hydropower Limited Partnership

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APPENDICES

APPENDIX 6A
REVIEW OF LAKE STURGEON ECOLOGY

6A.1 GENERAL ECOLOGY

6A.1.1 DESCRIPTION

The lake sturgeon is a member of the sturgeon family or Acipenseridae and is the only "strictly" freshwater species of the genus. This species retains many primitive characteristics that have been lost or modified in other modern-day fishes. Lake sturgeon are characterized by a torpedo-shaped body, a tough skin, and five prominent rows of bony scutes distributed dorsally, laterally, and ventrolaterally. The dorsal surface is typically olive-brown to grey in color, while the abdomen is white. The dorsal and lateral bony scutes are the same color as the body, and the fins are dark brown or grey with the single, dorsal fin far back near the caudal fin. The caudal fin, or heterocercal tail, which is similar in shape to sharks, is a noteworthy feature of the lake sturgeon derived from its primitive ancestry. Furthermore, lake sturgeon possess a large, ventral and protrusible mouth with four anterior barbels making it well adapted for benthic feeding. Lake sturgeon also have a primitive physostomous swim bladder (no longer found in modern teleost fish), meaning that a connection remains between the swim bladder and the gut. Similarly, the notochord persists in lake sturgeon, a feature found in lampreys but not in modern teleost fish (Harkness and Dymond 1961; Scott and Crossman 1998; Peterson *et al.* 2007).

6A.1.2 DISTRIBUTION

In Canada, the lake sturgeon is distributed from Hudson and James bays as far north as the Fort George River on the east and the Churchill River on the west. Although a single record exists for the mouth of the Seal River (Keleher and Kooyman 1958), no lake sturgeon have ever been recorded from the upper Seal River and associated lakes. The lake sturgeon inhabits the North and South Saskatchewan Rivers in Alberta, the Saskatchewan and upper Churchill Rivers in Saskatchewan, and the Churchill, Nelson, Hayes, Winnipeg, and Pigeon Rivers in Manitoba. Lake sturgeon are also present in the Assiniboine and Red Rivers, but these represent stocked populations from several sources. In Ontario and Quebec, the lake sturgeon inhabits the southern Hudson and James bays in the Moose, Mattagami, Kenogami, Rupert, and Eastmain systems, as well as the Great Lakes drainages, including the freshwater portion of the St. Lawrence River. In the United States, the lake sturgeon occurs in the Great Lakes and Mississippi drainage basins, being found as far south as Arkansas in the Mississippi River (Scott and Crossman 1998; Wisconsin Department of Natural Resources 2006).

6A.1.3 SPECIAL STATUS

Lake sturgeon is a long-lived species, reaching ages of up to 150 years. The species' slow growth, late sexual maturity, and spawning periodicity have made it particularly vulnerable to exploitation (Harkness and Dymond 1961; Brousseau 1987). The commercial fishery for lake sturgeon in Manitoba experienced multiple collapses throughout the early to late 20th century and finally was closed permanently in 1992 (Macdonald 1998). In November 2006, the lake sturgeon was recommended to be considered an endangered species by COSEWIC (2006) under SARA, a process that currently is under review. This

process is at the stage where the Federal Government is assessing the recovery potential for each spawning population within each of the eight designatable units. The final stages of this process are a decision by the Governor in Council on the COSEWIC recommendation under SARA, followed by the implementation of recovery strategies in the various designatable units, if listed.

6A.2 HABITAT REQUIREMENTS

6A.2.1 SPAWNING HABITAT

Lake sturgeon move to spawning sites after the ice melts, typically moving from lakes and low velocity, deeper areas of rivers to suitable, higher velocity habitat when water temperatures are between 8°C and 10°C. Although lake sturgeon have been observed spawning on shorelines of lakes (Harkness and Dymond 1961; Scott and Crossman 1998), this behaviour, first noted in Lake Champlain (Stone 1901), has not been well documented. In larger rivers, lake sturgeon migrate from deeper riverine overwintering habitats to the base of mainstem rapids or falls or up major tributaries to similar habitats. Spawning migrations as far as 100 kilometres (km) have been observed in the Lake Winnebago system, Wisconsin (Bruch and Binkowski 2002).

Many of the detailed field descriptions of lake sturgeon spawning locations describe areas at the foot of rapids or falls that prevent further upstream migration (Richardson 1836; Stone 1900; Stone 1901). However, lake sturgeon have been known to spawn in areas lacking white water in the Detroit River, Michigan (Manny and Kennedy 2002), in the tailrace of Pointe du Bois Generating Station (GS) on the Winnipeg River (McDougall *et al.* 2008a, b), and along shorelines of the Fox and Wolf rivers, Wisconsin (Bruch and Binkowski 2002). Some locations where increased water depth has resulted in the loss of white water but maintained appropriate velocity and substrate conditions have continued to support spawning lake sturgeon. For example, lake sturgeon appear to have continued to spawn in the Nelson River above the Kelsey GS following impoundment (Macdonald *pers. comm.* 2009). Lake sturgeon spawn at depths of 0.6-22 m in areas of swift water or rapids over gravel, cobble, and boulder-sized substrates that provide sufficient interstitial spaces for oxygenation during egg incubation (Harkness and Dymond 1961; Bruch and Binkowski 2002; Manny and Kennedy 2002; McDougall *et al.* 2008b). Flow characteristics in the vicinity of spawning sites have both calm water for staging and swift water for spawning. Actual substrates can vary from igneous bedrock (Aadland *et al.* 2005) and flat limestone (Ambrose *et al.* 2007) to glacial till-derived gravel, cobble, and boulder, and even areas of coal cinders (Manny and Kennedy 2002).

Female lake sturgeon are highly fecund, and may carry between 10,000 and 16,000 eggs per kg (Harkness and Dymond 1961; Bruch *et al.* 2006). During the spawning act, a single female lake sturgeon is surrounded by several males. As the female rises off the ground/ swims upwards, the males vibrate by beating their tails and undulating their bodies to entice the female to release her eggs. Upon the release of eggs, they are fertilized by several males. The adhesive eggs are scattered and adhere to rocks and logs and hatch in 5–8 days (d) (Kempinger 1988). Female lake sturgeon spawn every 4–7 years (Harkness and Dymond 1961) while males generally spawn every other year (Kempinger 1988).

6A.2.2 LARVAL DRIFT

Lake sturgeon eggs typically hatch after 8–14 d depending on water temperature (Kempinger 1988). Newly hatched larvae are pelagic, avoid light, and actively search for cover within the interstitial spaces of the substrates where they were spawned (Harkness and Dymond 1961; Kempinger 1988). Larvae are nourished by a ventral yolk sac for 9–18 d. After about 14 d, the young have developed physical features of the adult; after about 16 d they begin to feed exogenously (Scott and Crossman 1998). Within two to three weeks of hatching, the larvae leave the substrate at night and drift downstream to nursery areas. Lake sturgeon larvae may drift up to 60 km downstream of the spawning site (Auer and Baker 2002). The larval drift phase of lake sturgeon life history is a passive phase ensuring transport to nursery areas, and is a major determinant of reproductive success (D'Amours *et al.* 2001).

6A.2.3 YOUNG-OF-THE-YEAR FORAGING (REARING) HABITAT

Information on the ecology and habitat requirements of YOY lake sturgeon is limited compared to that available for older fish, likely due to the difficulty of capturing young lake sturgeon. In the Kaministiquia River, Ontario, YOY (51–135 mm) were captured along the river margins in depths of 0.20–0.55 m over a primarily sand substrate from 4 July-11 August 2006 (Friday 2006). The growth rate of these fish from the larval drift stage (~20 mm total length [TL]) to 11 August was approximately 1.7 mm/d (Friday 2006).

In the Lower Peshtigo River, Wisconsin, YOY lake sturgeon (40–316 mm TL) were captured from June through October in 2002 and 2003 (Benson *et al.* 2005). YOY appeared to select for areas with sand substrate, low current velocities (median 0.29–0.33 m/s), and depths less than 2 m.

In the Wolf River, Wisconsin, YOY lake sturgeon (29–281 mm; 27–186 d old) were captured over seven summers (1981–1987) in areas with detectable current, flat substrate composed of pea-sized gravel and coarse sand, which lacked rooted vegetation (Kempinger 1996). During visual surveys of nursery habitat in the Sturgeon River, Michigan, five YOY lake sturgeon were observed in riffles and runs comprised of pea-sized gravel and sand substrate, but never over sand alone (Holtgren and Auer 2004). YOY were usually oriented into the current behind woody debris in water 0.3–0.5 m deep and velocities of 0.39–0.48 m/s.

In the Winnipeg River between Slave Falls and Pointe du Bois GS, YOY lake sturgeon were captured during fall over a sand or sand/gravel substrate in water depths between 16 and 40 m and water velocities between 0.15 and 0.23 m/s (North/South Consultants Inc. *unpubl. data* collected for the Pointe du Bois Modernization Project). In the Winnipeg River between Slave Falls GS and Seven Sisters Falls GS, YOY lake sturgeon were captured in water depths between 6.1–24.4 m and over a variety of substrate types ranging from clay/silt to gravel/cobble (Henderson *pers. comm.*).

6A.2.4 SUB-ADULT AND ADULT FORAGING HABITAT

Sub-adult lake sturgeon are those that are older than one year but not yet sexually mature (Hay-Chmielewski and Whelan 1997). After their first year, young lake sturgeon tend to occupy the same habitats as adults (Priegel and Wirth 1971; Hughes 2002). However, in areas of the St. Lawrence River where there is dense mussel coverage (an invertebrate which smaller lake sturgeon are unable to consume as a major food source), the abundance and distribution of juvenile lake sturgeon may differ from that of adults, with juveniles occupying substrates (primarily silt) that support the highest densities of soft-bodied invertebrates (namely, chironomids, amphipods, and caddisfly larvae) and adults occupying substrates (mix of boulder/cobble and silt) where mussels and gastropods are relatively more abundant (Werner and Hayes 2005). In the Winnipeg River, regardless of season, sub-adult lake sturgeon measuring less than 610 mm TL were found to be more abundant in deep water habitat (greater than 13.7 m), whereas larger conspecifics (*i.e.*, greater than 610 mm TL) were more evenly distributed between deep and shallow water habitat types (Barth *unpubl. data*).

Most studies have documented sub-adult lake sturgeon in depths greater than 5 m (Hughes 2002; Environnment Illimité 2003; Holtgren and Auer 2004; Smith and King 2005; Werner and Hayes 2005; Lord 2007). Barth *et al.* (2009) observed large congregations of sub-adult lake sturgeon at depths greater than 13.7 m in the Winnipeg River, whereas sub-adult abundance was several orders of magnitude lower at depths less than 13.7 m. Adult lake sturgeon are also reported in a wide range of depths but tend to inhabit deeper water (greater than 6 m) outside the spawning season (Hay-Chmielewski 1987; MacDonell 1992; Rusak and Mosindy 1997; Block 2001) and may avoid depths less than 3 m (Hay-Chmielewski 1987). Where velocity values were reported, sub-adults were found in areas with detectable current (0.2–0.7 m/s; Hughes 2002; Environnment Illimité 2003; Barth *et al.* 2009). Adults in both riverine and lake environments are also often found in areas of increased water movement (Rusak and Mosindy 1997; Block 2001). Some authors have found a preference by adult lake sturgeon for sloped areas of a lake (Hay-Chmielewski 1987; Block 2001).

Both sub-adults and adults are found over a wide range of substrates from mud, clay, or silt to cobble and boulder (Barth *et al.* 2009); however, some studies have indicated preferences of sub-adult lake sturgeon for particular substrates, including silt, clay, organic, sand, and gravel (Chiasson *et al.* 1997; Hughes 2002; Werner and Hayes 2005; Lord 2007). Habitat selection by lake sturgeon is likely dictated more by prey availability and density rather than physical factors; prey distribution is positively correlated with the latter (Hay-Chmielewski 1987; Werner and Hayes 2005). Other biotic factors (*e.g.*, competition, predator-prey interactions) are also likely important, and in some cases sub-adults may occupy different habitat from the adults in order to avoid competition (Smith and King 2005). Habitat utilized by sub-adult lake sturgeon in the Winnipeg River minimized inter-specific interactions with other species of fish (Barth *unpubl. data*).

6A.2.5 OVERWINTERING

During winter, lake sturgeon generally appear to occupy deep water habitat if it is available (Harkness and Dymond 1961; Scott and Crossman 1998). Deep run and pool habitats are particularly important overwintering areas for lake sturgeon confined to riverine environments (Hay-Chmielewski and Whelan 1997). However, in Black Lake, Michigan, lake sturgeon used significantly shallower areas during winter (7.1 ± 0.8 m) than in summer (10.3 ± 2.1 m; Hay-Chmielewski 1987).

6A.3 SPECIES INTERACTIONS

6A.3.1 DIET

Diet composition of lake sturgeon is linked strongly to the substrates over which they are feeding. It is not uncommon to find thousands of individuals of a single taxon from a stomach, with little to no sediment. Lake sturgeon feed almost exclusively on benthic invertebrates as supported by the presence of host-specific parasites that are transmitted by benthic invertebrates (Choudhury *et al.* 1996; Choudhury and Dick 1998). Although diet composition varies by study, molluscs (Sphaeriidae, Gastropoda), crustaceans, Ephemeroptera, Trichoptera, and Chironomidae are important forage items throughout the range of the lake sturgeon (Harkness and Dymond 1961; Houston 1987; Choudhury *et al.* 1996; Chiasson *et al.* 1997; Beamish *et al.* 1998; Werner and Hayes 2005; Lord 2007). Sub-adult lake sturgeon (220-700 mm TL) in the Winnipeg River were found to feed on three invertebrate taxa (orders Trichoptera, Diptera, and Ephemeroptera in the class Insecta), over a variety of substrate types ranging from clay to boulder, during May, June, and July (Barth *unpubl. data*).

Lake sturgeon feed by taking a mouthful of the substrate and sifting out the invertebrates. This type of feeding would dictate that smaller lake sturgeon would prefer smaller substrate particle sizes compared to larger lake sturgeon, which would be capable of engulfing larger substrates. However, other information suggests that smaller lake sturgeon, feeding in the same habitats as larger lake sturgeon, have fewer of the same diet items, indicating smaller individuals may be selecting for individual food items (Choudhury *pers. comm.* 2008). In the Lower Peshtigo River, Wisconsin, age-0 lake sturgeon appeared to select for areas with macroinvertebrate assemblages dominated by dipterans (primarily Chironomidae and Ceratopogonidae larvae). Baetidae nymphs and Diptera larvae composed the majority of the diet of YOY captured in the Wolf River, Wisconsin over seven summers (1981–1987; 62.2% and 36.5%, respectively; Kempinger 1996). Between 25 July and 10 September, Diptera larvae were the main prey item of YOY lake sturgeon (126–175 mm TL). Larvae from eight Chironomidae genera were consumed by four fairly small YOY (42–500 mm). Although the lake sturgeon primarily is a benthic specialist species, they will feed in the water column when the opportunity to feed on concentrated food sources arise (Block 2001).

6A.3.2 PREDATION AND COMPETITION

Due to the large size of adults and the protection offered by bony scutes of juveniles, lake sturgeon are not believed to be vulnerable to predation by other fish species except at their earliest stages of growth

(Harkness and Dymond 1961). However, there is some evidence that both lake sturgeon and other species will consume lake sturgeon eggs (Barth *pers. comm.* 2010; Bruch and Binkowski 2002). Silver redhorse (*Moxostoma anisurum*) and logperch (*Percina caprodes*) have been either observed feeding on lake sturgeon eggs at spawning sites or eggs have been found in their stomach contents (Johnson *et al.* 2006). Other predators of lake sturgeon eggs include crayfish (*Orconectes* spp.), mudpuppies (*Necturus maculosus*), carp (*Cyprinus carpio*), and post-spawning adult lake sturgeon (Kempinger 1988).

In laboratory trials, white sturgeon (*Acipenser transmontanus*) of up to 134 mm TL have been consumed by predatory fish, including channel catfish (*Ictalurus punctatus*; mean TL = 464 mm), northern pikeminnow (*Ptychocheilus oregonensis*; mean TL = 472 mm), juvenile walleye (*Sander vitreus;* mean TL = 184 mm) and prickly sculpin (*Cottus asper)*, despite the fact that white sturgeon develop scutes at about 25 mm TL (Gadomski and Parsley 2005a). Young white sturgeon that have begun actively seeking food may be more vulnerable to predation than larvae that have not yet begun exogenous feeding (Gadomski and Parsley 2005b, c). Predation is likely contributing to mortality of YOY white sturgeon in the wild and is thought to contribute to year-class failures observed despite evidence of annual spawning (Gadomski and Parsley 2005a).

Diet analyses of juvenile lake sturgeon (250–800 mm; 2–17 years) in unproductive habitat in tributaries of the Moose River, Ontario, have showed them to be generalists (Beamish *et al.* 1998). Diets of the lake sturgeon sampled were similar across the length classes examined. Being benthic feeders, juvenile lake sturgeon consumed similar prey as suckers, lake whitefish and, to a lesser extent, burbot (Beamish *et al.* 1998). Low invertebrate densities (95 individuals/m^2) and the presence of the same invertebrate groups in juvenile lake sturgeon and other dominant fish species suggests that competition for food may be an important determinant of growth in resource-poor habitats. Suckers are often found in association with lake sturgeon and may be considered the most serious competitors of lake sturgeon for food (Harkness and Dymond 1961).

6A.4 MOVEMENTS

6A.4.1 GENERAL MOVEMENTS

Results of several mark-recapture and biotelemetry studies have indicated that lake sturgeon exhibit relatively restricted movements, remaining mostly within the vicinity of their tagging location (Threader and Brousseau 1986; Dumont *et al.* 1987; Sandilands 1987; Fortin *et al.* 1993; Haxton 2003; Haxton and Findlay 2008). Other studies have reported the use of "core areas" or "activity centers," locations heavily used and frequently returned to by lake sturgeon (Borkholder *et al.* 2002; Knights *et al.* 2002; Haxton 2003). In some cases, use of a core area is accompanied by much wider ranging movements by a small percentage of fish (Knights *et al.* 2002). In general, lake sturgeon appear to move more frequently and over longer distances during the open water season, while during winter, fish are more sedentary (Hay-Chmielewski 1987; Mosindy and Rusak 1991; Rusak and Mosindy 1997; Knights *et al.* 2002).

A radio-telemetry study of four lake sturgeon in a 70 km unimpounded reach of the Ottawa River reported a mean home range of 1,528 ha and a maximum movement distance of 10 km over a 2.5 y

period (Haxton 2003). Tagged fish showed high fidelity to a particular basin, with fish sometimes moving to the periphery or outside the basin but later returning (Haxton 2003).

Lake sturgeon in a 52 km reach of the Moose River, Ontario, also appeared to have a relatively small home range. Of 2,346 fish tagged over two years, 169 fish were recaptured. Over 80% of recaptures occurred in the location where the fish had been tagged the year before, and remaining fish had moved less than 5 km from their tagging site (Threader and Brousseau 1986).

In the Kettle River, Minnesota, five radio-tagged lake sturgeon tracked for 1.5 y were found to remain within a 32 km reach despite the absence of barriers at either end of the reach (Bolkholder *et al.* 2002). There was a high correlation between movement and river discharge, with upstream movements corresponding to increasing discharge and downstream movements corresponding to decreasing discharge. Each fish used one to three "activity centers," areas in which they were located at least 80% of the time (Bolkholder *et al.* 2002).

Studies of juvenile lake sturgeon indicate that they too exhibit site fidelity and a relatively limited range of movement. Below Slave Falls GS on the Winnipeg River, Manitoba, a mark-recapture study of 5,671 juvenile lake sturgeon (213–879 mm FL) was conducted concurrently with acoustic telemetry tracking of 23 juvenile lake sturgeon (364–505 mm FL) from May 2006 to October 2008 (Barth *et al.* 2011). Juvenile lake sturgeon were highly sedentary and showed strong site fidelity despite availability of more than 41 km of potential habitat. Approximately 91% of marked fish that were recaptured were caught less than 2.0 river kilometres (rkm) from their original capture location. Similarly, 60% of acoustically tagged lake sturgeon moved 1.8 rkm or less from their release location. Due to the high site fidelity of most tagged fish in this study, a seasonal movement pattern could not be established (Barth *et al.* 2011). However, studies of YOY lake sturgeon in other systems have documented a pattern of downstream movement during fall (Thuemler 1988; Kempinger 1996; Holtgren and Auer 2004; Benson *et al.* 2005), potentially to locate more suitable (lower) water velocities for overwintering (Benson *et al.* 2005). Acoustic telemetry data for juvenile lake sturgeon monitored during winter in the Winnipeg River suggested that juveniles were even more sedentary during this period (Barth *et al.* 2011). In contrast, during spring, several acoustically tagged juvenile lake sturgeon moved upstream to the Slave Falls GS prior to or during the period of lake sturgeon spawning in the area. It is thought that juveniles may have undertaken these movements in order to forage on eggs deposited by spawning adults or to accompany adults to the spawning ground, as both behaviours had been observed in the Winnipeg River or other lake sturgeon populations (Barth *et al,* 2011).

Studies of juvenile lake sturgeon in the Great Lakes watershed have also shown them to have a high degree of site fidelity and relatively small home ranges. In the Sturgeon River/Portage Lake system, Michigan, four juvenile lake sturgeon (220–830 mm FL) tracked with radio telemetry moved an average of 15.5 km (total linear movement) over an 83 d period and had a mean home range area of 11.0 square kilometres (km^2) (Holtgren and Auer 2004). In Black Lake, Michigan, five juvenile lake sturgeon (785–1135 mm TL) implanted with acoustic transmitters exhibited home range areas between 4.79 km^2 and 7.27 km^2 during July to October (Smith and King 2005). Finally, in the St. Clair River, Michigan, nine juvenile lake sturgeon (582–793 mm TL) tracked via acoustic telemetry exhibited home range areas between 0.8 km^2 and 10.8 km^2 over a two year period (Lord 2007).

6A.4.2 SWIMMING PERFORMANCE

Lake sturgeon swimming endurance (*i.e.*, the length of time for which a given speed can be maintained) generally increases with fish length. In addition, large lake sturgeon can attain higher speeds than smaller fish (Peake *et al.* 1997). The maximum sustained swimming speed (the highest speed a fish can maintain indefinitely) for a 130 cm (*i.e.*, sexually mature) lake sturgeon was 96.8 centimeters per second at 14°C, within the temperature range at which lake sturgeon normally spawn (Peake *et al.* 1997). For the two swimming modes that use energy derived exclusively or partially from aerobic processes (*i.e.*, sustained and prolonged swimming), performance increases with water temperature. Only at burst speeds, in which energy is derived from anaerobic processes, does temperature cease to affect performance (Peake *et al.* 1997).

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APPENDIX 6B
LAKE STURGEON METHODS

6B.1 FIELD DATA COLLECTION AND ANALYSIS

A summary of lake sturgeon (*Acipenser fulvescens*) studies conducted between 2001 and 2010 is presented in Table 6B-1. The field program was grouped into four primary components (though activities among the components often overlapped), as follows:

- Spring spawning;
- Open water foraging;
- Overwintering; and
- Fish movements.

Gillnetting studies focused on three different size categories of fish:

- YOY — ~150–200 mm FL or TL (whichever available; ~ three months old based on capture in late summer/early fall);
- Sub-adults — ~200–833 mm FL (~1–15 years old based on data presented in Kooyman 1955 and Sopuck 1987); and
- Adults — greater than or equal to 834 mm FL.

Sub-adults were defined as fish older than one year but not yet sexually mature and adults were defined as sexually mature fish. The size distinction between sub-adult and adult fish was adopted from lake sturgeon spawning at the Weir River (Holm *et al,*. 2006) where a large number of fish can be captured in a smaller area over a short time period compared with the Keeyask area. This allows a greater number of lake sturgeon to be sexed by gamete extrusion providing a more representative dataset on fish size at maturity. This benchmark also corresponded well to the size of the smallest sexually mature fish (826 mm FL) captured in the study area during environmental studies.

6B.1.1 Habitat-Based and Seasonal Assessments of Abundance

Large mesh gill nets were used to investigate lake sturgeon populations in the following study area waterbodies from 2001–2008: the Burntwood, Grass, and Odei rivers; the Nelson River downstream of Kelsey GS; Split Lake; Clark Lake; the Nelson River between Clark and Gull Lakes; Gull Lake; Gull Rapids; the Nelson River between Gull Rapids and Stephens Lake; and Stephens Lake. Large mesh nets consisted of two to four panels (22.9 × 2.7 m) with mesh sizes ranging from 203–304 mm. They were considered effective in catching larger sub-adult fish and adult fish.

Medium mesh gill nets were used to locate YOY and sub-adult lake sturgeon during summer 2006 and fall of 2008 to 2010. The summer study was conducted throughout the study area whereas fall studies focused on the Nelson River between Birthday and Gull rapids, the downstream vicinity of Gull Rapids, and upper Stephens Lake. Medium mesh nets consisted of 2–6 panels (22.9 × 1.8 m) with mesh sizes

ranging from 38–203 mm. In addition to providing a measure of abundance (CPUE), catches provided information on fish size, condition, sex, and state of maturity (Photo 6B-1). Annual mean CPUE (# fish/45.7 m net/24 h) was calculated by season for each life stage by averaging site-specific CPUEs where appropriate mesh sizes for that life stage had been used.

Lake sturgeon habitat at gillnet sites was classified based on water depth, water velocity, and substrate compaction (Table 6B-2). Since most lake sturgeon gillnetting was conducted in areas or during seasons (*e.g.*, spring) where macrophyte growth was negligible, vegetation presence/absence was not used to classify lake sturgeon habitat as was done for other fish species. Substrate composition (organic vs. mineral) was also excluded from lake sturgeon habitat classification as very few gillnet sites were set in areas with organic substrate. Descriptions of general habitats sampled during lake sturgeon studies are summarized by waterbody in Table 6B-3. Seasonal habitat-based mean CPUE was calculated for each life stage by averaging site-specific CPUE (years pooled).

Dietary and age data were obtained from a sub-sample of YOY and sub-adult fish captured during fall 2008 gillnetting studies. Age data were obtained from sub-adult fish captured in upper Stephens Lake during fall 2010.

6B.1.2 Spring Spawning Habitat

This study was conducted to provide information on spawning locations for lake sturgeon.

Large mesh gill nets were employed from mid-May to early July from 2001–2008 throughout the study area to capture adult lake sturgeon, with nets typically set overnight (~ 24 h). Fish captured were assessed for sexual maturity to help assess the location of spawning habitat.

Larval drift traps (after Burton and Flannagan 1976) were also employed during this time period to identify potential spawning habitat in the Grass River below Witchai Lake falls, the Burntwood River below First Rapids, and the mainstem Nelson River (above and below Birthday rapids, below Gull Rapids, and in Gull Lake). Traps consisted of a 43 × 85 centimetres (cm) opening with a 950 micrometres (µm) collecting net (Photo 6B-2).

Potential spawning sites were also assessed through tracking of radio-tagged and acoustic-tagged fish as described in Section 6B.1.4.

6B.1.3 Overwintering Habitat

This study was conducted to provide information on potential overwintering habitat in areas where it was felt that the Project could potentially adversely affect some characteristic of overwintering habitat (*e.g.*, water velocity, dissolved oxygen). Lake sturgeon implanted with radio-tags were tracked periodically during the winter months from 2001–2004 to identify overwintering habitat for VEC species as described in Section 6B.1.4.

Source: North/South Consultants Inc., 2010

Photo 6B-1: Aquatic environmental studies team member processing lake sturgeon captured during lake sturgeon studies in the Keeyask study area, 2010

Source: North/South Consultants Inc.

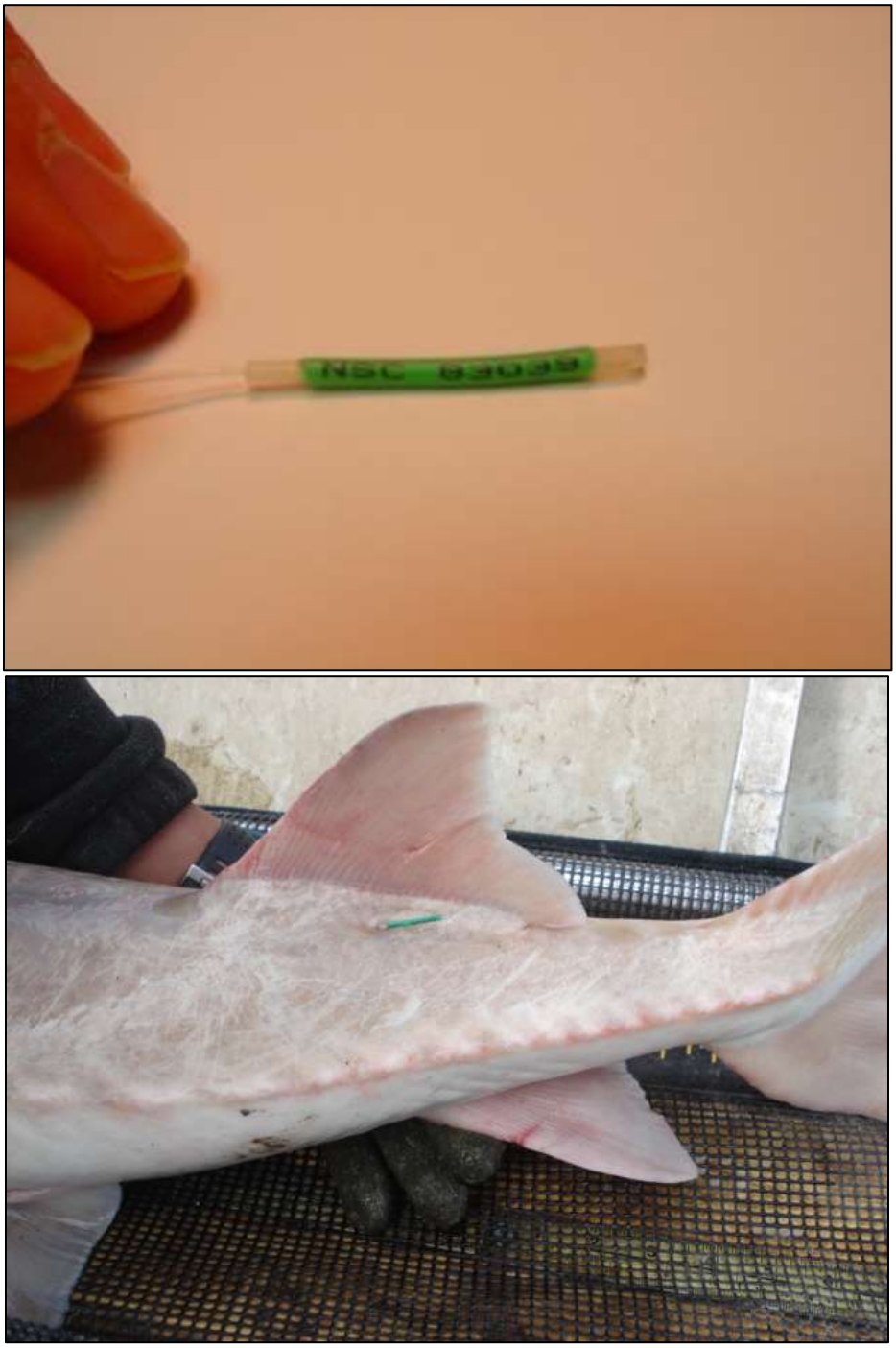
Photo 6B-2: Floating drift trap used to capture newly-hatched larval lake sturgeon as they drift downstream in the Keeyask study area

6B.1.4 Fish Movements

This study was conducted to: a) gain a general understanding of lake sturgeon movements within the study area; b) assess whether fish move upstream and/or downstream through Birthday Rapids and Gull Rapids; and c) document concentrated movements of fish that can be used to identify important habitat, such as spawning locations. Information on fish movements was obtained from recaptures of large numbers of Floy®-tagged fish and through repeated tracking of a relatively small number of radio-tagged and acoustic-tagged fish.

Lake sturgeon were marked with individually numbered plastic Floy® FD-94 T-bar anchor tags throughout the study area between 1999 and 2008. These tags were applied between the basal pterygiophores of the dorsal fin using a Dennison Mark II tagging gun (Photo 6B-3). A total of 871 lake sturgeon were tagged during the environmental studies. The majority of lake sturgeon were tagged between Clark Lake and Gull Rapids (n = 515 fish), followed by the Split Lake Area (n = 280), within Gull Rapids downstream to Stephens Lake (n = 66), and in Stephens Lake (n = 10). The return of Floy®-tags (or tag numbers) from fish captured by local resource users and the associated catch information (*i.e.*, where and when fish were captured) was promoted by posters offering rewards in Split Lake, Gillam, and Thompson. In addition to the fish tagged as part of the environmental studies, tag return information

was collected for an additional 62 lake sturgeon that had been tagged in the Gull Lake reach by Manitoba Conservation in 1995.



Source: North/South Consultants Inc.

Photo 6B-3: Floy®-tag (top) and its location of insertion (bottom) on a lake sturgeon captured during Keeyask environmental studies

Six lake sturgeon captured between Birthday and Gull rapids and six captured downstream of Gull Rapids were implanted with radio transmitters (model MCFT-3A, Lotek Engineering Inc., Newmarket, Ontario) during spring 2001. One of the radio-tagged lake sturgeon from upstream of Gull Rapids was captured by a local resource user during summer 2001, removing one fish from the sample of radio-tagged lake sturgeon. Radio-tagged fish were relocated from the air periodically between June 2001 and February 2004 using a helicopter equipped with a Lotek model SRX-400 receiver and a single 'yagi' antenna.

Sixteen lake sturgeon captured between Birthday and Gull rapids and two lake sturgeon captured downstream of Gull Rapids were implanted with acoustic transmitters (model V16-4H-01-SHK1-R256, Vemco Ltd., Shad Bay, NS) during spring 2001 (Photo 6B-4). One of the acoustic-tagged lake sturgeon from upstream of Gull Rapids was recaptured by a local resource user during summer 2001 and its tag was reapplied to a lake sturgeon captured downstream of Gull Rapids during fall 2001. Two additional lake sturgeon captured downstream of Gull Rapids during fall 2001were implanted with acoustic transmitters. Therefore, as of fall 2001 there were 20 lake sturgeon implanted with acoustic transmitters and 11 fish implanted with radio transmitters in the study area. Acoustic-tagged fish were tracked from June to October of 2001–2004 using 10 Vemco VR1 and VR2 submersible stationary receivers (positioned near the upstream and downstream sides of both Birthday Rapids and Gull Rapids) and by manual tracking by boat using a Vemco VR-60 ultrasonic receiver.

Source: North/South Consultants Inc.

Photo 6B-4: Surgical implantation of an acoustic transmitter in a lake sturgeon

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Table 6B-1: Summary of approach and methods used for lake sturgeon studies in the study area, 2001–2010

Study*	Objective	Method	Equipment	Life Stages Targeted	Location[1]	Date of Sampling	Number of Sites[2]
Spring spawning habitat	To identify habitat used for spawning by lake sturgeon (gill nets also indicate spring foraging habitat for sub-adult fish)	a) sturgeon gill nets	i) 2–4 panels (22.9 x 2.5 m) of 203, 229, 254, and 305 mm stretched twisted nylon mesh; or ii) 1 panel (91.4 × 2.5 m) of 305 mm stretched twisted nylon mesh	i) sub-adult & adult	SPL	May-Jul 2001,-02,-04,-06,-07	i) 408 ii) 0
					NR	May-Jul 2001,-02,-03,-04,-06,-08	i) 233 ii) 0
				ii) sub-adult & adult	GR	May-Jul 2001-06	i) 127 ii) 8
					STL	Jun-Jul 2003,-05,-06	i) 79 ii) 25
		b) drift traps	i) 43 × 85 cm opening with 950 µm Nitex collecting net (large);or ii) 15 × 15 cm opening with 500 µm Nitex collecting net (small)	i) eggs & larvae	SPL	May-Jul 2001–02; Jun 2007	i) 7 ii) 2
					NR	May-Jul 2001–04	i) 39 ii) 10
				ii) eggs & larvae	GR	Jun-Jul 2001–04	i) 33 ii) 4
					STL	May-Jun 2003	i) 0 ii) 7
		c) egg mats	39 x 19 x 9 cm cinder blocks wrapped with air filter material (*i.e.*, latex-coated horse hair or fiberglass) of dimensions 90 x 30 cm	eggs	SPL	Jun 2007	5
Foraging habitat	To identify habitat used for foraging by young-of-the-year [YOY], sub-adult, and adult lake sturgeon during the open-water season	a) sturgeon gill nets	i) 2–4 panels (22.9 x 2.5 m) of 203, 229, 254, and 305 mm stretched twisted nylon mesh; ii) 2–6 panels (22.9 × 1.8 m) of 25, 38, 51, 76, 95, 108, 127, or 203 mm stretched twisted nylon/monofilament mesh; or iii) 1 panel (91.4 × 2.5 m) of 305 mm stretched twisted nylon mesh	i) sub-adult & adult	SPL	Aug-Sep 2006	i) 89 ii) 14 iii) 0
				ii) YOY & sub-adult	NR	Aug-Sep 2006; Sep 2008	i) 31 ii) 19 iii) 0
					GR	Aug-Sep 2006; Sep 2008-09	i) 17 ii) 38 iii) 12
					STL	Sep 2010	i) 0 ii) 10 iii) 0
				iii) sub-adult & adult	STL	Aug-Sep 2006, Sep 2009	i) 6 ii) 11 iii) 25
		b) radio telemetry	individually coded Lotek radio transmitters (model MCFT-3A) and helicopter tracking with SRX-400 receiver	adult	NR, GR, STL	Jun 2001-Feb 2004	11
		c) acoustic telemetry	individually coded Vemco acoustic transmitters (model V16-4H-01-SHK1-R256) and tracking with VR1 and VR2 stationary receivers and VR-60 receivers and boat	adult	NR, GR, STL	Jun-Oct 2001–03	20
Overwintering habitat	To identify habitat used for overwintering by lake sturgeon	a) radio telemetry	as described above	adult	NR, GR, STL	Jan-Mar 2002, Nov-Apr 2002-03, Feb 2004	11
Fish movement	To assess general movement patterns	a) radio telemetry	as described above	adult	NR, GR, STL	Jun 2001-Feb 2004	11
		b) acoustic telemetry	as described above	adult	NR, GR, STL	Jun-Oct 2001–03	20
		c) mark and recapture[3]	individually numbered Floy®-tag attached between fin membranes of dorsal fin	sub-adult & adult	SPL	2001–07	280
					NR	1999, 2001–04,-06,-08	577
					GR	2001–06,-08	66
					STL	2001–06	10

*In addition to the programs described in this table, lake sturgeon were captured incidentally in gill nets set to target other fish species from 1999–2009.

1. SPL = Split Lake area.
   NR = Keeyask area: Nelson River between Clark Lake and Gull Rapids.
   GR = Keeyask area: Gull Rapids and downstream, riverine portion of Stephens Lake.
   STL = Stephens Lake area.
2. For radio/acoustic telemetry and mark/recapture methods, the number represents the number of fish marked rather than the number of sites sampled.
3. Includes 62 lake sturgeon tagged by the Manitoba Fisheries Branch in Gull Lake in 1995.

Table 6B-2: Classification system for fish habitat in the study area

Water Depth[1,2]	Water Velocity[3]	Compaction[4]	Composition	Vegetation
shallow	standing	hard	mineral	no plants
shallow	standing	soft	mineral	no plants
shallow	standing	soft	mineral	plants
shallow	standing	soft	organic	no plants
shallow	standing	soft	organic	plants
shallow	low	hard	mineral	no plants
shallow	low	soft	mineral	no plants
shallow	low	soft	mineral	plants
shallow	low	soft	organic	no plants
shallow	medium	hard	mineral	no plants
shallow	medium	soft	mineral	no plants
shallow	medium	soft	organic	no plants
shallow	high	hard	mineral	no plants
deep	standing	hard	mineral	no plants
deep	standing	soft	mineral	no plants
deep	standing	soft	organic	no plants
deep	low	hard	mineral	no plants
deep	low	soft	mineral	no plants
deep	medium	hard	mineral	no plants
deep	medium	soft	mineral	no plants
deep	high	hard	mineral	no plants

1. Refer to Section 3 for a more detailed discussion of aquatic habitat classification.
2. Shallow: ≤ 3 m; deep = > 3 m.
3. Standing: ≤ 0.2 m/s; low = 0.2–0.5 m/s; medium = 0.5–1.5 m/s; high >1.5 m/s.
4. Soft = silt, soft-packed clay, sand; hard = bedrock, boulder, cobble, gravel, hard-packed clay.

Table 6B-3: Description of general habitat types used to describe foraging and rearing habitat used by lake sturgeon in the study area

Waterbodies	General Habitat Type	Description[3]
Split/Clark lakes	Lacustrine	• Shallow or deep areas with low velocity, a combination of soft (silt, clay, sand) and hard mineral-based substrates (cobble, boulder). Macrophyte beds abundant in some shallow areas but scarce in deep areas.
Split/Clark Lakes; Nelson River from Kelsey GS to Split Lake; lower Grass, Burntwood, and Odei rivers	Riverine	• Shallow or deep areas with primarily low to medium[4] velocity, a combination of soft (silt, clay, sand) and hard mineral-based substrates (gravel, cobble, boulder), and a scarcity of macrophyte beds.
	Rapids	• Shallow or deep areas of primarily medium velocity with low velocity refuge areas (*i.e.*, behind reefs or islands; back eddies), a combination of soft (silt, clay, sand) and hard mineral-based substrates (cobble, boulder, bedrock), and a scarcity of macrophyte beds.
Nelson River[1]	Lacustrine	• Areas of Gull Lake with shallow water or deep water, low velocity, a combination of soft (silt, clay, sand) and hard (gravel, cobble, boulder) mineral-based substrates. Macrophyte beds few in shallow areas and scarce in deep water.
	Riverine	• Areas of the Nelson River with a combination of shallow and deep water, low to medium velocity, hard (gravel, cobble, boulder) mineral-based substrates, and a scarcity of macrophyte beds.
	Rapids	• Shallow or deep areas of primarily medium velocity with low velocity refuge areas (*i.e.*, behind reefs or islands; back eddies), a combination of soft (silt, clay, sand) and hard mineral-based substrates (cobble, boulder, bedrock), and a scarcity of macrophyte beds.
Gull Rapids[2]	Rapids	• Shallow or deep areas of primarily medium velocity with low velocity refuge areas (*i.e.*, behind reefs or islands; back eddies), primarily hard mineral-based substrates (cobble, boulder, bedrock), and a scarcity of macrophyte beds.
	Riverine	• Shallow or deep areas of the Nelson River with low to moderate velocity, a combination of soft (silt, clay, sand) and hard (gravel, cobble, boulder) mineral-based substrates, and a scarcity of macrophyte beds.
Stephens Lake	Lacustrine	• Areas of shallow or deep water, standing to low velocity, primarily soft (silt, clay, sand) mineral-based substrates, with some macrophyte beds in shallow areas and a scarcity of macrophytes in deep water.

1. Nelson River from Clark Lake to Gull Rapids, including Gull Lake.
2. Gull Rapids and the 4 kilometre reach of the Nelson River between these rapids and Stephens Lake.
3. Based on habitat classification system described in Table 6B-2 and Section 3.
4. Areas with high water velocity (> 1.5 m/s) were excluded as suitable foraging/rearing habitat because at water velocities > 1.5 m/s fish of all lengths would employ burst swimming and endurance would be limited to 10 seconds or less.

APPENDIX 6C
DESCRIPTION OF POTENTIAL LAKE STURGEON SPAWNING AREAS MAP

The following text describes the known spawning locations, the suspected spawning locations and the general areas where spawning is known to occur within the Aquatic Environment Study Area. These areas are highlighted on Map 6-4.

Red and green polygons indicate known lake sturgeon spawning locations as evidenced by the consistent capture of spawning male and/or female lake sturgeon and/or the presence of larvae. The red polygons represent specific locations and the broader, green polygons indicate general areas where sturgeon are known to spawn. Orange polygons represent general areas where data suggest that lake sturgeon may spawn (*i.e.*, a small number of captures of sexually mature lake sturgeon and the presence of suitable spawning habitat).

Two areas have been identified as suspected lake sturgeon spawning habitat and four have been identified as known spawning habitat.

1. Grass River at Witchai Lake Falls (suspected):

   One spent male and two large fish thought to be pre-spawning females (based on their large size and distended urogenital openings) were captured in the Grass River in spring 2007. The male was captured immediately below Witchai Lake Falls and the suspected females were captured within approximately 3 km of the falls. Witchai Lake Falls contain the velocities and hard substrata required for lake sturgeon spawning. Witchai Lake Falls was an historic spawning site for lake sturgeon (MacDonell 1997).

2. Nelson River below Kelsey GS (suspected):

   One pre-spawning female and two ripe males were captured in the Nelson River within 2 km downstream of Kelsey GS between 2006 and 2007. A second fish captured in this area in 2007 was tentatively identified as a female maturing to spawn that year based on its large size and distended urogenital opening. Kelsey Rapids was a spawning site for lake sturgeon prior to construction of the Kelsey GS (MacDonell 1997).

3. Burntwood River at First Rapids (known):

   Several pre-spawning or ripe males were captured immediately below First Rapids in the Burntwood River from 2001 to 2007. One sturgeon captured in this area in 2007 was thought to be a female preparing to spawn that year based on its large size and distended urogenital opening. Twenty-two larval lake sturgeon were captured immediately downstream of the rapids in spring 2001.

4. Nelson River between Clark Lake and Birthday Rapids (known):

   Ripe male lake sturgeon were captured 2 km downstream of Clark Lake in spring 2004 and two larval lake sturgeon were captured approximately 1 km upstream of Birthday Rapids the same spring. Habitat in this area is suitable for lake sturgeon egg deposition, with moderate to high water velocities and a cobble/boulder substratum.

5. Nelson River at Birthday Rapids (known):

   Several pre-spawning and ripe males were captured at the base of Birthday Rapids during spring spawning studies conducted in 2001 and 2006. Four pre-spawning males and a pre-spawning female were captured further downstream of the rapids in spring 2003. Water levels and flows at Birthday Rapids were lower in 2003 than in any other year of Keeyask Environmental Studies. No mature fish were captured at the base of the rapids in 2003 and it is believed that this may have been due to the lower flows and that suitable spawning habitat was located further downstream.

6. Nelson River at Gull Rapids (known):

   Five pre-spawning females and several pre-spawning or ripe males were captured immediately below Gull Rapids between 2001 and 2006. One pre-spawning and three spent male lake sturgeon were captured within Gull Rapids during Keeyask spawning studies in 2003. Evidence suggests that lake sturgeon from Stephens Lake congregate below the rapids until water temperatures are favourable for spawning, at which time the fish move into the rapids to spawn.

APPENDIX 6D
LAKE STURGEON HABITAT SUITABILITY INDEX MODELLING RESULTS

6D.1 INTRODUCTION

The Project's potential impacts to Keeyask lake sturgeon were assessed in part using HSI models to predict changes in the suitability and availability of lake sturgeon spawning and foraging (YOY, sub-adult, and adult) habitat between the pre- and post-Project environments. Separate HSI models were developed for each of these four life stages for the Nelson River from Clark Lake to Gull Rapids and the proposed Keeyask GS using data collected during the Keeyask environmental studies, data collected from other locations in Manitoba, and the scientific literature. This appendix describes the data and approaches used to develop suitability criteria for the four HSI models and summarizes pre- and post-Project modelling results.

6D.2 METHODS

6D.2.1 DEVELOPMENT OF HABITAT SUITABILITY INDEX MODELS

An HSI is a dimensionless number bounded by 0 and 1 that represents the suitability of a combination of environmental characteristics to support biotic requirements. An HSI value of 0 indicates unsuitable habitat and 1 indicates optimum habitat. Approaches to HSI are broad-ranging and have been used widely in fisheries for decades (Bovee 1978; Bovee 1982). HSI approaches began to adopt Geographic Information Systems (GIS) approaches in the 1990s.

An HSI is based on a conceptual model of the relationship of a species to its habitat; it is important to understand that this model represents a simplified version of the habitat in that only a few key variables are selected. In addition, these relationships are typically based on correlations of occurrence in a given habitat rather than cause and effect relationships and can be improved as more data are obtained. As a result, the development of HSI models often is incremental as knowledge about the species or life stage of interest grows.

The model hypotheses usually are developed in three stages. First, variables are chosen that represent key aspects of the habitat features known to affect the habitat use of interest for a species (*e.g.*, sturgeon spawning). Second, the relationship between each habitat variable and habitat suitability for the species is depicted graphically as a Habitat Suitability Criteria (HSC) curve. HSC can be developed through a variety of approaches, including expert opinion and/or occurrence data in specific habitats (Crance 1984; Stalnaker *et al.* 1995). Third, the model components are aggregated into a species HSI equation that yields a single numerical description of habitat suitability (ranging from 0–1). The means by which the HSI is calculated varies. Many applications use the mathematical product of the variables' suitability criteria, and/or weight the variables differently in order to govern their relative importance in the model. In a GIS, each location (or pixel) in a map contains an HSI value. These HSIs can be summed to compare,

for example, existing environment and post-Project HSI distributions, or used to calculate pre- and post-Project WUAs[1] (see Diagram 1 below).

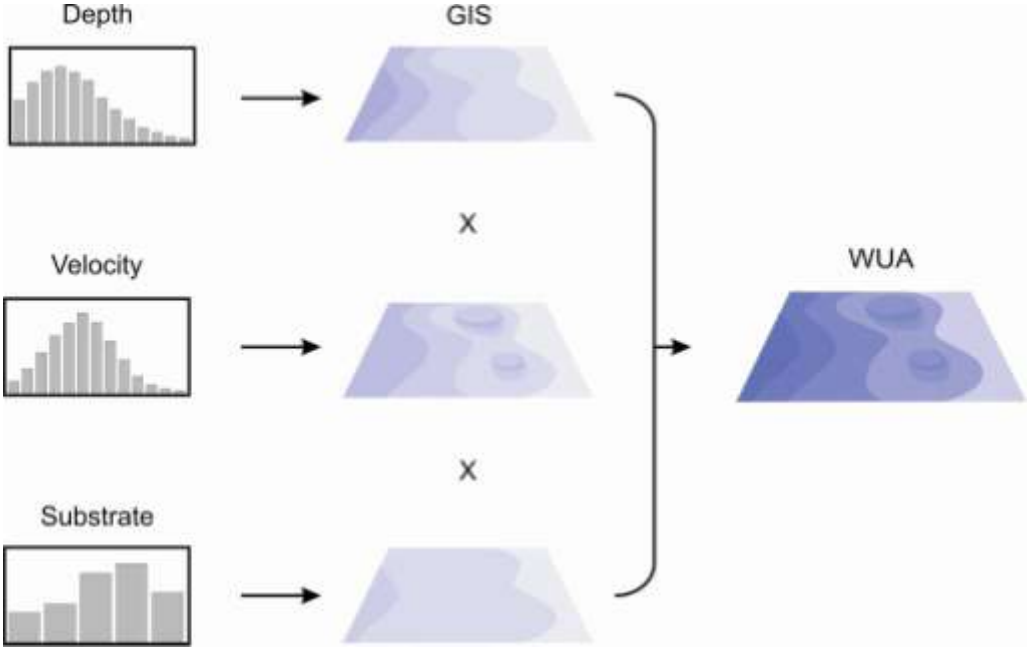

Diagram 1: Schematic of the process by which a Geographic Information System (GIS) calculates weighted usable area (WUA) from Habitat Suitability Criteria (HSC) curves for three input variables in a Habitat Suitability Index model

The development of an HSI model must consider the number of variables and their relative importance. Including more variables in a model does not necessarily result in a model with greater predictive power and may cause the model to be less reliable than a simpler model. Generally, uncertainty in selecting the right environmental requirements of a species is minimized by keeping the number of variables low.

All models contain uncertainty and have assumptions. Many biological communities or habitats are not at their carrying capacity (*i.e.*, the suitable area is not completely occupied) potentially due to an inherent characteristic of the population, or from disturbances such as harvest and/or habitat alteration from human developments. If a suitable habitat is not fully occupied, it may be due to microhabitat selection, site fidelity, or past exploitation that has markedly reduced the population. Fish populations with relatively low numbers are challenging to sample and field data may indicate use of only a subset of potentially suitable habitat. Like all empirical models, the HSI approach assumes that that scale of data collection used to define the HSC matches the scale of the habitat mapping, and both are appropriate for the intended use. It sometimes is difficult to capture fish and habitat data at all scales of habitat use. In

[1] For Keeyask HSI models, WUAs were calculated by summing the habitat suitable indices of each 25 m^2 section of river. For example, if a 25 m^2 section had an HSI of 0.5, then the weighted usable area of that section of river was 25 m^2 ha × 0.5 (= 12.5 m^2).

particular, microhabitats are challenging to sample and may not be well represented by the model if the underlying data do not effectively capture the microhabitat.

6D.2.2 FORAGING HABITAT SUITABILITY MODELS

6D.2.2.1 Modelling Overview

The first step in modelling habitat suitability for lake sturgeon foraging in the Keeyask area (Clark Lake to Gull Rapids) was to determine the range of habitats (as defined by substrate, water velocity, and water depth) in which sturgeon are generally found and the relative frequency of sturgeon within these habitats. This information was compiled from three sources: 1) gillnet capture data collected during Keeyask environmental studies; 2) gillnet capture data collected from the Winnipeg River, Manitoba, during gillnetting studies conducted for the Pointe du Bois GS Modernization Project; and 3) the scientific literature (Table 6D-1). These three data sets were examined separately for three life history stages and suitability criteria were assigned to the range of substrate, water velocity, and depth values for each life stage.

Lake sturgeon life stages were assigned based on fish size as follows[1]:

- YOY — ~150–200 mm long and approximately 3 months old based on capture in late summer/early fall. Data from the literature for younger fish were generally very limited, but were used if available.
- Sub-adults — ~200–833 mm FL or ~1–15 y old (upper limit of age range estimated from data presented in Kooyman 1955 and Sopuck 1987).
- Non-spawning adults — ≥ 834 mm FL. Only summer and fall captures of adult fish were considered because sexual maturity was not always evident for adult fish captured during spring.

Suitability criteria ranged from 0–1, with a value of 1 assigned to the habitat in which sturgeon were most frequently captured or reported.

The second step in habitat modelling was to use the suitability criteria in a GIS containing substrate, water velocity, and water depth information for the Keeyask area. The GIS divided the Keeyask area into pixels (each representing an area of 25 m^2), assigned three suitability criteria to each pixel (one for depth, velocity, and substrate), and calculated the HSI of each pixel by multiplying together its three suitability criteria.

[1] The size distinction between sub-adult (less than< 834 mm) and adult fish (greater than or equal to 834 mm) was adopted from lake sturgeon spawning at the Weir River (Holm *et al.* 2006) where a large number of fish can be captured in a smaller area over a short time period compared with the Keeyask area. This allows a greater number of lake sturgeon to be sexed by gamete extrusion providing a more representative dataset on fish size at maturity. It also corresponds well to the size of the smallest sexually mature fish (826 mm) captured in the study area during environmental studies.

Habitat in the Keeyask area was grouped into four HSI quartile intervals representing the varying degrees of habitat suitability. All HSI values were used to calculate the WUA for sub-adult and adult foraging habitat in the existing and post-Project environments. Because YOY have specific habitat requirements compared to older life stages, WUAs for YOY foraging habitat were calculated from the highest HSI quartile (0.75–1.0) to obtain a proxy for the actual area used within the suitable area. All HSI values from 0–1 were used to calculate WUAs of sub-adult and adult foraging habitat. Changes in WUAs between the existing and post-Project environments were used to help assess the degree to which lake sturgeon foraging habitat would be altered by the Project.

Areas of each HSI quartile were tabulated for 10 reaches within the Keeyask area (Map 6D-1) and mapped for the existing and post-Project environments for each life stage.

6D.2.2.2 Data Compilation

Data used to assign suitability criteria for foraging habitat are summarized in Table 6D-1. The majority of habitat data for Keeyask sturgeon capture sites was based on 5th, 50th, and 95th percentile shorelines. Habitat at each capture location was taken from the appropriate percentile based on a comparison of discharge at Kettle GS at the time of the capture to 5th, 25th, 50th, 75th, and 95th percentile flows in the Keeyask area. *In situ* measurements of depth, velocity, and substrate were used for Keeyask YOY where available (habitat data were collected at some of the gillnetting sites where YOY were captured during the fall 2008 gillnetting study). Multiple captures at the same site were each assigned a randomly generated Universal Transverse Mercator (UTM) coordinate within a 25 m radius of the gillnet set coordinates to better represent habitat in the vicinity of the gill net. Habitat information for Pointe du Bois sturgeon captures was obtained from a GIS that plotted the gillnet capture sites on maps of depth, modelled velocities, and substrate for a 95th percentile shoreline in the Pointe du Bois study area.

Capture frequencies were plotted against depth, velocity, and substrate values for each life stage (*i.e.*, YOY, sub-adult, and adult) and data set (*i.e.*, Keeyask, Pointe du Bois, and literature values) to generate habitat frequency histograms. These histograms were then used to derive HSCs and their associated regression equations for modelling in the GIS.

6D.2.2.3 Habitat frequency histograms and regression curves

Habitat-frequency histograms were plotted for each habitat parameter and life stage to examine the range of substrates, depths, and velocities in which sturgeon are found, both within the Keeyask area and other water bodies. Each habitat parameter was divided into intervals along the x-axis of the histogram, with substrate having categorical intervals (*e.g.*, silt, sand, gravel) and depth and velocity having continuous intervals (*e.g.*, 0–0.049 m/s, 0.05–0.099 m/s). Capture frequencies at gillnet sites that corresponded to a particular depth, velocity, and substrate were converted to suitability criteria between 0 and 1 based on the highest catch frequency assuming a value of 1 and the rest of the capture frequencies calculated in proportion to the highest frequency (*e.g.*, habitats with half the absolute catch of the site with the highest absolute catch would be assigned a value of 0.5). Information from the literature usually only consisted of the range of conditions in which sturgeon were found in the study (*i.e.*, numbers of fish captured in

specific habitats were not available). Therefore, each interval within the range of depths, velocities, or substrates reported by the author was assigned a capture frequency of 1. Capture frequencies for each interval were then summed for all the scientific reports that documented the occurrence of sturgeon in that interval and scaled to values between 0 and 1. A few literature sources provided a description of velocities in which fish were captured rather than an actual value (*e.g.*, 'detectable current' or 'strong current') and professional judgment was used to assign a value to this description (see comments in Table 6D-1).

Curves were plotted based on the depth and velocity histograms to generate equations used to assign suitability criteria to pixels in the GIS. However, greater weight was usually given to local data when plotting the curves. For substrate-frequency histograms, substrates with the highest suitability criteria were assigned a value of 1 and remaining substrates were rated accordingly. Habitat-frequency histograms for depth, velocity, and substrate and corresponding polynomial regression curves are presented for each life stage in Figure 6D-1 to Figure 6D-9. Suitability criteria assigned to each substrate type in the histograms are summarized in Table 6D-2. *Note that substrate was not included in development of the adult foraging habitat model due to the wide range of substrates over which adults are typically found.*

6D.2.4 SPAWNING HABITAT SUITABILITY MODEL

Due to the small sturgeon population in the study area and the consequently low number of spawners in any given year, as well as practical and safety considerations in sampling sturgeon at the spawning locations, the HSI analysis for the Project is based on the HSI spawning model developed for the Winnipeg River as part of the Pointe du Bois Modernization Project. The HSI model was developed from spawning observations, studies of egg deposition, and from the available scientific literature (Table 6D-1).

Habitat Suitability Criteria were identified for velocity, depth and substratum (Figure 6D-10 to Figure 6D-12). Two additional variables were added to the HSI model to account for observations made during the egg deposition studies: 1) the direction of river flow; and 2) distance from the origin of white water and/or a hydraulic feature (OSc; Figure 6D-13). The direction of flow classified as unsuitable those areas with water movement in an upstream direction (*i.e.*, back eddies) where sturgeon would need to face downstream to spawn. The distance to hydraulic feature was added to the model after eggs were only observed in a fraction of the habitat classified as suitable by a model employing velocity, substratum, depth and direction of flow. Available sturgeon egg data showed that 95% of the egg deposition occurred within 92 m downstream of the generating station or spillway rapids over a range of depths and several hard and clean substratum types (Figure 6D-13). The red line in Figure 6D-13 defines the equation used to model this variable. This pattern of egg deposition suggested that sturgeon may prefer to ascend to near the origin of the attractant flow and appear to use a relatively small fraction of suitable habitat.

Spawning HSI values were divided into the same quartile intervals used to categorize foraging habitat (see Section 6D.2.2.1) and areas of each quartile interval were tabulated for 10 reaches in the Keeyask area from downstream of Clark Lake to Gull Rapids/Keeyask GS (Map 6D-1). HSI maps were produced for existing and Year 30 post-Project spawning habitat present scenarios at the 95th percentile inflow, and

95th percentile inflow at full supply level (159 m ASL), respectively. The HSI spawning habitat maps were not shown using quartile categories, as done for the life stages in the preceding sections, but instead are shown using a color gradient. This gradient of HSI values result from the 5th variable, *i.e.* OSc, which weights the model as a continuous variable in the direction of downstream flow. The WUA derived from the spawning model used HSI values between 0.25 and 1.0 for the existing and Year 30 post-Project environments. This range is different than that used for YOY foraging habitat (0.75–1.0) because the spawning model is mathematically different (*e.g.*, an HSI of 0.5 in the spawning model is not the same "value" as the same number in a model for a different life stage), and is considered stronger given it benefits from empirical data that weights the suitable area based on empirical data on egg distribution, which is not possible with the three-variable foraging models. Changes in WUAs between the existing and post-Project environments were used to help assess the degree to which lake sturgeon spawning habitat would be altered by the Project.

6D.3 RESULTS

HSI maps for the existing and post-Project environments are presented and discussed within the main document (Section 6). However, the actual values discussed (HSI quartile areas/weighted usable areas) are presented by reach in Table 6D-3 to Table 6D-26. The boundaries of each reach are shown in Map 6D-1.

Depth and velocity data used in the HSI models were derived from hydraulic models developed by Manitoba Hydro; the use of slightly different input flows for the existing and post-Project environments resulted in small (less than 1 ha) differences in existing and post-Project conditions even where there were no Project effects (*i.e.*, Reach 2A and to a lesser extent, Reach 2B; Map 6D-1). However, such small variations fall within the uncertainty of the models, and do not obscure their overall intent, which is to identify the general areas of habitat pre- and post-Project.

Drafting note: HSI analysis for the downstream reaches (*i.e.*, below Gull Rapids/Keeyask GS) is pending consultation with project engineers regarding extension of the post-Project water regime into Stephens Lake. This analysis will consider the following:

- Placement of a constructed spawning structure for lake sturgeon in the tailrace of the Keeyask GS;
- Various Keeyask GS operating regimes.

6D.4 REFERENCES

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Table 6D-1: Data used to develop suitability criteria for lake sturgeon spawning and foraging (young-of-the-year, sub-adult, and adult) habitat

Habitat (Life Stage)	Data Source	Location	Depth (m)	Velocity (m/s)	Substrate	Comments
Spawning (Adult)	Luther Aadland (*pers. comm.* 2006)	Little Fork River, MN and Rapid River, MN	0.61–1.83	0–1.22	Cobble/Rubble, Boulder, Bedrock	Bedrock substrate at Dead Man Falls, on the Rapid River, MN
	Hay-Chmielewski and Whelan (1997)	Michigan and Wisconsin (various locations)	0.31–3.05	0.91+ (average)	Cobble, Boulder, Fractured Bedrock	Other researchers in Michigan and Wisconsin have characterized spawning habitat as having mean column velocities over 3 feet/s, depths from 1–10 feet, and clean substrates composed of cobble, boulder and fractured bedrock (Auer 1990; T. Thuemler *pers. comm*; both cited in Hay-Chmielewski and Whelan 1997)
	Manny and Kennedy (2002)	St. Clair River, MI	6.0– 0.0	0.35–0.98	Gravel, Cobble, Coal Cinders	-
	LaHaye *et al.* (1992)	Des Prairies River, QC	0.10–1.58	0.02–1.09	Gravel, Cobble, Boulder	-
	LaHaye *et al.* (1992)	L'Assomption River, QC	0.25–0.85	0.40–1.39	Gravel, Cobble, Boulder	-
	LaHaye *et al.* (2003)	St. Lawrence River (Lachine Rapids), QC	1.4–3.0	1.07–2.01	Gravel, Cobble, Boulder	-
	Hayes (2000)	St. Lawrence River and Grasse River, NY	5.5–8.0	0.41–1.50	N/A	-
	Verdon and Gendron (1991)	Des Prairies River, QC	<2	0.40–1.25	Gravel, Cobble, Boulder	-
	Dumont *et al.* (2006)	St. Lawrence River, QC	0.10–6.0	0.10–1.90	Gravel, Cobble, Boulder	-
	Verdon Presentation - Hydro Quebec	St. Maurice River, QC	N/A	0.60–1.36	Gravel, Cobble, Boulder	Values represent the full range at 0 and 294 cms spill flows
	Environnment Illimité Inc. (2004)	Eastmain and Opinaca rivers, QC	0.40–1.25	0.2–1.1	Gravel, Cobble, Boulder, Bedrock	Document consulted was summary of information presented in Environnment Illimité Inc. (2004)
	McKinley *et al.* (1998)	Mattagami River (Cypress Falls), ON	<2.5	0.51–1.50	Cobble, Boulder, Bedrock	Bedrock substrate represents the parent material at hydraulic control points such as constrictions, rapids, or falls.
	Sandilands (1987)	Kenogami River, ON	0.5–2.0	0.11–0.70	Gravel, Cobble, Boulder, Bedrock	Bedrock substrate represents the parent material at hydraulic control points such as constrictions, rapids, or falls.
	Various	Michigan	<5	0.51–1.30	Gravel, Cobble, Boulder	-
	Pointe du Bois GS environmental studies (2007–10)	Winnipeg River, Manitoba	1.0–8.5	0.3–1.2	Gravel, Cobble, Boulder, Bedrock	-
Foraging (young-of-the-year)	Benson *et al.* (2005)	Lower Peshtigo River, Wisconsin	0.56–1.3 (median)	0.29–0.33 (median)	Sand	-
	Friday (2006)	Kaministiquia River, Ontario	0.2–0.55	-	Fine to coarse sand substrates	-
	Holtgren and Auer (2004)	Sturgeon River, Michigan	0.3–0.5	0.39–0.48	Pea gravel or pea gravel/sand	-
	Kempinger (1996)	Wolf River/Lake Winnebago, Wisconsin	< 0.75	Detectable current	Coarse Sand/Pea Gravel	We assigned the Keeyask existing environment 'low velocity' classification scheme (0.2–0.5 m/s) to represent 'detectable current'.
	Smith and King (2005)	Upper Black River, Michigan	-	-	Sand	-

Table 6D-1: Data used to develop suitability criteria for lake sturgeon spawning and foraging (young-of-the-year, sub-adult, and adult) habitat

Habitat (Life Stage)	Data Source	Location	Depth (m)	Velocity (m/s)	Substrate	Comments
Foraging (young-of-the-year)	C. Barth (*pers. comm.*2009)	Winnipeg River between Seven Sisters and Slave Falls GS, Manitoba	-	-	Silt/clay, sand, sand/gravel	-
	Pointe du Bois GS environmental studies (2006–08)	Winnipeg River between Pointe du Bois GS and Slave Falls GS, Manitoba	16.7–39.0	0.15–0.23	Sand or sand/gravel	Ranges shown are for 95th percentile depths and modelled velocities at gillnet capture sites (17 captures)
	Keeyask GS environmental studies (fall 2008 and fall 2009)	Nelson River in Gull Lake and between Gull Rapids and Stephens Lake, Manitoba	7.2–18.3	0.40–0.68	Sand, cobble/boulder	Based on 17 captures. We used *in situ* measurements where available and for remaining fish, GIS randomly assigned a UTM coordinate within a 25 m radius of the site in an attempt to give each fish a unique depth, velocity, and substrate value. 5th, 25th, 50th, 75th, or 95th modelled depths and velocities were assigned based on the Split Lake outflow at the time of capture and the closest modelled Keeyask inflow.
Foraging (Sub-adult)	Lord (2007)	St. Clair River (Canada/U.S. border)	Exceeded 9 m (95% of time); 12–18 m (44% of time)	-	Gravel	-
	Smith and King (2005)	Black River/Black Lake, Michigan	1.5 and 12.2–13.7 m depth contours for yearlings; 5.4–13.4 m for juveniles	-	yearlings -organic and sand substrates; juveniles - organic, sand, and sand/organic	-
	Holtgren and Auer (2004)	Portage Lake, Michigan	4–17	-	-	-
	Chiasson *et al.* (1997)	Mattagami and Groundhog rivers, Ontario	-	-	Substrate dominated by sand and clay	-
	Werner and Hayes (2005)	St. Lawrence River (Canada/U.S. border)	-	-	Silt, random boulders, and cobble	-
	Environment Illimité Inc. (2003)	Rupert River, Quebec	6–8	0.38–0.45	Sand	-
	Haynes *et al.* (In Review)/Hughes (2002)	Niagara River, New York	12	0.24	Sand	-
	Threader *et al.* (1998)	Author developed HSI model using data from several locations	1–14	0–0.74	Silt, sand, gravel, cobble, boulder, clay, bedrock	Author assigned suitability indices to ranges shown to develop model for juvenile and adult lake sturgeon foraging habitat.
	Pointe du Bois GS environmental studies (2006–08)	Winnipeg River below Slave Falls GS; Winnipeg River between Pointe du Bois GS and Slave Falls GS, Manitoba	0.21–42.2	0 – ≥ 1.5	Sand/gravel, sand, silt/clay, bedrock, organic/ deposition, boulder, bedrock/cobble, gravel	Ranges shown are for 95th percentile depths and modelled velocities at gillnet capture sites (973 captures)
	Keeyask GS envrironmental studies (2001–08)	Nelson River between Clark Lake and Kettle GS, Manitoba	0.2–19.0	0 – ≥ 1.5	Gravel/cobble/boulder, sand, cobble/boulder, silt/clay, gravel, cobble/boulder/bedrock, cobble/gravel, clay, silt	Based on 236 captures. For each fish, GIS randomly assigned a UTM coordinate within a 25 m radius of the site in an attempt to give each fish a unique depth, velocity, and substrate value. 5th, 25th, 50th, 75th, or 95th modelled depths and velocities were assigned based on the Split Lake outflow at the time of capture and the closest modelled Keeyask inflow.

Table 6D-1: Data used to develop suitability criteria for lake sturgeon spawning and foraging (young-of-the-year, sub-adult, and adult) habitat

Habitat (Life Stage)	Data Source	Location	Depth (m)	Velocity (m/s)	Substrate	Comments
Foraging (Adult)	Seyler (1997)	Groundhog River, Ontario	1–7	0–0.64	Sand/organic, rubble, sand/gravel, gravel, organic, sand, clay, bedrock	Author assigned suitability indices from 0.1–1.0 to ranges shown to develop model for adult lake sturgeon foraging habitat.
	Haugen (1969)	Saskatachewan River, Alberta	2–8	< 0.8	Sand/silt	82% of sturgeon captured where substrate had high percentage of sand/silt
	Block (2001)	Round Lake & Winnipeg River, Manitoba	7–10	Areas of stronger current	Sand	Author reported fish as being situated near inlet and outlet of lake where flows were greater. We assigned values (0.5-1 m/s) from lower end of the Keeyask existing environment 'moderate velocity' classification scheme (0.5-1.5 m/s).
	Hay-Chmielewski (1987)	Black Lake, Michigan	6–8 m and 10–11 m	-	Mud, sand, or sandy mud	-
	Threader *et al.* (1998)	Habitat Suitability Index (data from several locations)	-	-	Silt, sand, gravel, cobble, boulder	Author assigned suitability indices from 0.2–1.0 to ranges shown to develop model for juvenile and adult lake sturgeon foraging habitat.
	Haynes *et al.* (In Review)/Hughes (2002)	Lower Niagara River/Lake Ontario	10	0.36	Sand	-
	Pointe du Bois GS environmental studies (2006–08)	Winnipeg River below Slave Falls GS; Winnipeg River between Pointe du Bois GS and Slave Falls GS, Manitoba	0.34–34.0	0 – ≥ 1.5	Bedrock, sand, sand/gravel, silt/clay, boulder, bedrock/cobble, bedrock/boulder	Based on 80 captures. Ranges shown are for 95th percentile modelled conditions at gillnet capture sites.
	Keeyask GS environmental studies (2001–08)	Nelson River between Clark Lake and Kettle GS, Manitoba	0.2–14.0	0 – ≥ 1.5	Cobble/boulder, gravel/cobble/boulder, cobble/boulder/bedrock, silt/clay, clay, sand, bedrock, silt	Based on 92 captures. Each fish was randomly assigned a UTM coordinate within a 25 m radius of its capture site in an attempt to give each fish a unique depth, velocity, and substrate value. 5th, 25th, 50th, 75th, or 95th modelled depths and velocities were assigned based on the Split Lake outflow at the time of capture and the closest modelled Keeyask inflow.

Table 6D-2: Substrate suitability criteria for young-of-the-year (YOY) and sub-adult lake sturgeon foraging habitat models

Substrate	Life Stage	
	YOY	Sub-Adult
Fines (silt, clay)	0.3	0.3
Deposition Over Silt/Clay	0.3	0.3
Sand	1.0	1.0
Deposition Over Sand	0.3	0.3
Sand/Gravel	1.0	1.0
Gravel	0.3	1.0
Cobble	0.0	0.6
Deposition/Gravel/Cobble	0.3	0.3
Gravel/Cobble/Boulder	0.1	0.6
Cobble/Boulder	0.0	0.6
Cobble/Boulder/Bedrock	0.0	0.2
Boulder	0.0	0.6
Bedrock	0.0	0.2
Bedrock/Boulder/Cobble	0.0	0.2

1 Due to the wide range of substrates over which adults are generally found this variable was not included in the adult foraging habitat model.

Table 6D-3: Lake sturgeon 5th percentile spawning habitat areas in hectares, by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake				Gull Rapids		Downstream of Gull Rapids			
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Upstream Total	Reach 9A	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	144.0	166.6	246.4	210.9	625.3	1518.3	613.6	332.2	**3857.3**	233.2	105.4	562.1	791.0	**1691.6**	**5548.9**
0.001 – <0.25	Low	37.2	16.1	0.0	54.7	0.0	0.0	0.0	0.0	**108.0**	50.7	72.6	0.0	0.0	**123.3**	**231.3**
0.25 – <0.5	Moderate	3.4	1.0	0.0	4.1	0.0	0.0	0.0	0.0	**8.5**	2.5	12.4	0.0	0.0	**14.9**	**23.5**
0.5 – <0.75	High	1.4	0.3	0.0	1.2	0.0	0.0	0.0	0.0	**2.9**	1.4	4.5	0.0	0.0	**5.9**	**8.8**
0.75 – 1	Very High	0.5	0.2	0.0	0.3	0.0	0.0	0.0	0.0	**1.0**	0.1	0.3	0.0	0.0	**0.4**	**1.3**
Total Wetted Area		**186.6**	**184.2**	**246.4**	**271.2**	**625.3**	**1518.3**	**613.6**	**332.2**	**3977.7**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**5813.8**
Total Suitable Area (0.001–1)		**42.5**	**17.6**	**0.0**	**60.3**	**0.0**	**0.0**	**0.0**	**0.0**	**120.4**	**54.7**	**89.8**	**0.0**	**0.0**	**144.5**	**264.9**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir					Downstream of Keeyask GS				
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A	Upstream Total	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	144.4	169.5	259.9	320.3	945.1	4134.6	1381.6	1214.1	752.8	**9322.4**	61.5	562.9	792.4	**1416.8**	**10739.2**
0.001 – <0.25	Low	37.2	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**54.1**	21.8	0.0	0.0	**21.8**	**76.0**
0.25 – <0.5	Moderate	3.7	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**5.6**	1.5	0.0	0.0	**1.5**	**7.1**
0.5 – <0.75	High	1.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2.0**	0.1	0.0	0.0	**0.1**	**2.1**
0.75 – 1	Very High	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.9**	0.0	0.0	0.0	**0.0**	**0.9**
Total Wetted Area		**187.2**	**189.4**	**259.9**	**320.3**	**945.1**	**4134.6**	**1381.6**	**1214.1**	**752.8**	**9385.0**	**84.9**	**562.9**	**792.4**	**1440.2**	**10825.2**
Total Suitable Area (0.001–1)		**42.7**	**19.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**62.6**	**23.4**	**0.0**	**0.0**	**23.4**	**86.0**

1. Location of reaches outlined in Map 6D-1.

Table 6D-4: Lake sturgeon 5th percentile spawning weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	2.5	1.1	0.0	2.5	0.0	0.0	0.0	0.0	**6.1**	3.0	5.9	0.0	0.0	**8.9**	**15.0**
WUA 0.25 – <0.5	Moderate	1.2	0.4	0.0	1.2	0.0	0.0	0.0	0.0	**2.8**	0.9	4.4	0.0	0.0	**5.3**	**8.0**
WUA 0.5 – <0.75	High	0.9	0.2	0.0	0.9	0.0	0.0	0.0	0.0	**1.9**	0.9	2.7	0.0	0.0	**3.5**	**5.4**
WUA 0.75 – 1	Very High	0.4	0.1	0.0	0.4	0.0	0.0	0.0	0.0	**1.0**	0.1	0.2	0.0	0.0	**0.3**	**1.3**
Total WUA (0.001–1)		**5.0**	**1.7**	**0.0**	**5.0**	**0.0**	**0.0**	**0.0**	**0.0**	**11.8**	**4.8**	**13.2**	**0.0**	**0.0**	**18.0**	**29.8**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	2.5	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**3.7**	2.0	0.0	0.0	**2.0**	**5.7**
WUA 0.25 – <0.5	Moderate	1.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2.0**	0.4	0.0	0.0	**0.4**	**2.4**
WUA 0.5 – <0.75	High	0.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.2**	0.1	0.0	0.0	**0.1**	**1.3**
WUA 0.75 – 1	Very High	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	**0.7**
Total WUA (0.001–1)		**5.1**	**2.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**7.6**	**2.5**	**0.0**	**0.0**	**2.5**	**10.1**

1. Location of reaches outlined in Map 6D-1.

Table 6D-5: Lake sturgeon 50th percentile spawning habitat areas in hectares, by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids	Downstream of Gull Rapids			Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
0	Not Suitable	154.0	173.7	257.0	230.8	676.2	1687.1	676.9	401.7	**4257.4**	230.2	107.2	562.1	791.0	**1690.4**	**5947.9**
0.001 – <0.25	Low	33.3	15.4	0.0	58.8	0.0	0.0	0.0	0.0	**107.6**	53.6	77.3	0.0	0.0	**130.9**	**238.5**
0.25 – <0.5	Moderate	2.5	1.3	0.0	2.9	0.0	0.0	0.0	0.0	**6.7**	3.0	8.8	0.0	0.0	**11.8**	**18.4**
0.5 – <0.75	High	1.0	0.4	0.0	0.5	0.0	0.0	0.0	0.0	**2.0**	1.0	1.9	0.0	0.0	**2.9**	**4.9**
0.75 – 1	Very High	0.5	0.1	0.0	0.1	0.0	0.0	0.0	0.0	**0.8**	0.1	0.1	0.0	0.0	**0.1**	**0.9**
Total Wetted Area		**191.3**	**190.9**	**257.0**	**293.3**	**676.2**	**1687.1**	**676.9**	**401.7**	**4374.4**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**6210.5**
Total Suitable Area (0.001–1)		**37.3**	**17.3**	**0.0**	**62.4**	**0.0**	**0.0**	**0.0**	**0.0**	**117.0**	**57.6**	**88.0**	**0.0**	**0.0**	**145.7**	**262.6**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
0	Not Suitable	154.0	175.7	265.7	322.9	953.6	4134.3	1382.2	1213.9	752.8	**9355.1**	64.3	562.9	792.4	**1419.6**	**10774.7**
0.001 – <0.25	Low	34.3	16.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**50.4**	19.7	0.0	0.0	**19.7**	**70.1**
0.25 – <0.5	Moderate	2.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**4.5**	0.7	0.0	0.0	**0.7**	**5.2**
0.5 – <0.75	High	1.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.7**	0.1	0.0	0.0	**0.1**	**1.8**
0.75 – 1	Very High	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.8**	0.0	0.0	0.0	**0.0**	**0.8**
Total Wetted Area		**192.4**	**194.6**	**265.7**	**322.9**	**953.6**	**4134.3**	**1382.2**	**1213.9**	**752.8**	**9412.4**	**84.9**	**562.9**	**792.4**	**1440.2**	**10852.6**
Total Suitable Area (0.001–1)		**38.4**	**18.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**57.3**	**20.6**	**0.0**	**0.0**	**20.6**	**77.9**

1. Location of reaches outlined in Map 6D-1.

Table 6D-6: Lake sturgeon 50th percentile spawning weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	2.0	1.0	0.0	3.4	0.0	0.0	0.0	0.0	**6.3**	3.0	5.9	0.0	0.0	**8.9**	**15.1**
WUA 0.25 – <0.5	Moderate	0.9	0.4	0.0	1.0	0.0	0.0	0.0	0.0	**2.3**	1.0	3.0	0.0	0.0	**4.0**	**6.3**
WUA 0.5 – <0.75	High	0.6	0.3	0.0	0.3	0.0	0.0	0.0	0.0	**1.2**	0.6	1.1	0.0	0.0	**1.7**	**2.9**
WUA 0.75 – 1	Very High	0.4	0.1	0.0	0.1	0.0	0.0	0.0	0.0	**0.6**	0.0	0.0	0.0	0.0	**0.1**	**0.7**
Total WUA (0.001–1)		**3.8**	**1.8**	**0.0**	**4.8**	**0.0**	**0.0**	**0.0**	**0.0**	**10.4**	**4.7**	**10.0**	**0.0**	**0.0**	**14.7**	**25.1**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reac 2A	Reac 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	1.9	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**3.0**	1.2	0.0	0.0	**1.2**	**4.3**
WUA 0.25 – <0.5	Moderate	0.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.6**	0.2	0.0	0.0	**0.2**	**1.8**
WUA 0.5 – <0.75	High	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.0**	0.1	0.0	0.0	**0.1**	**1.1**
WUA 0.75 – 1	Very High	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	**0.7**
Total WUA (0.001–1)		**3.9**	**2.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**6.3**	**1.5**	**0.0**	**0.0**	**1.5**	**7.8**

1. Location of reaches outlined in Map 6D-1.

Table 6D-7: Lake sturgeon 95th percentile spawning habitat areas in hectares, by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake				Gull Rapids		Downstream of Gull Rapids			
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Upstream Total	Reach 9A	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	166.3	182.6	267.8	253.4	747.9	1806.5	704.6	427.1	**4556.1**	229.7	118.2	562.1	791.0	**1700.9**	**6257.1**
0.001 – <0.25	Low	30.4	12.5	0.0	48.8	0.0	0.0	0.0	0.0	**91.7**	54.2	67.1	0.0	0.0	**121.3**	**213.0**
0.25 – <0.5	Moderate	2.0	1.7	0.0	3.1	0.0	0.0	0.0	0.0	**6.8**	3.3	8.6	0.0	0.0	**11.9**	**18.7**
0.5 – <0.75	High	0.8	0.6	0.0	0.6	0.0	0.0	0.0	0.0	**2.0**	0.7	1.2	0.0	0.0	**2.0**	**3.9**
0.75 – 1	Very High	0.3	0.2	0.0	0.1	0.0	0.0	0.0	0.0	**0.5**	0.0	0.0	0.0	0.0	**0.0**	**0.6**
Total Wetted Area		**199.7**	**197.6**	**267.8**	**306.0**	**747.9**	**1806.5**	**704.6**	**427.1**	**4657.1**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**6493.2**
Total Suitable Area (0.001–1)		**33.4**	**15.0**	**0.0**	**52.6**	**0.0**	**0.0**	**0.0**	**0.0**	**101.0**	**58.2**	**77.0**	**0.0**	**0.0**	**135.2**	**236.2**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir					Downstream of Keeyask GS				
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A	Upstream Total	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	166.4	182.0	273.4	327.0	968.2	4133.0	1382.1	1213.6	752.8	**9398.5**	48.4	562.9	792.4	**1403.7**	**10802.2**
0.001 – <0.25	Low	30.0	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**43.2**	29.1	0.0	0.0	**29.1**	**72.3**
0.25 – <0.5	Moderate	2.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**4.2**	5.6	0.0	0.0	**5.6**	**9.8**
0.5 – <0.75	High	0.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.7**	1.7	0.0	0.0	**1.7**	**3.4**
0.75 – 1	Very High	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.8**	0.1	0.0	0.0	**0.1**	**0.9**
Total Wetted Area		**199.5**	**198.8**	**273.4**	**327.0**	**968.2**	**4133.0**	**1382.1**	**1213.6**	**752.8**	**9448.3**	**84.9**	**562.9**	**792.4**	**1440.2**	**10888.5**
Total Suitable Area (0.001–1)		**33.1**	**16.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**49.9**	**36.5**	**0.0**	**0.0**	**36.5**	**86.3**

1. Location of reaches outlined in Map 6D-1.

Table 6D-8: Lake sturgeon 95th percentile spawning weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to downstream of Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids	Downstream of Gull Rapids			Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	1.3	0.8	0.0	3.2	0.0	0.0	0.0	0.0	**5.3**	3.6	4.6	0.0	0.0	**8.2**	**13.4**
WUA 0.25 – <0.5	Moderate	0.7	0.6	0.0	1.0	0.0	0.0	0.0	0.0	**2.3**	1.1	3.0	0.0	0.0	**4.1**	**6.4**
WUA 0.5 – <0.75	High	0.5	0.3	0.0	0.4	0.0	0.0	0.0	0.0	**1.2**	0.4	0.7	0.0	0.0	**1.1**	**2.3**
WUA 0.75 – 1	Very High	0.2	0.1	0.0	0.1	0.0	0.0	0.0	0.0	**0.4**	0.0	0.0	0.0	0.0	**0.0**	**0.5**
Total WUA (0.001–1)		**2.7**	**1.8**	**0.0**	**4.7**	**0.0**	**0.0**	**0.0**	**0.0**	**9.2**	**5.1**	**8.3**	**0.0**	**0.0**	**13.4**	**22.6**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	1.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2.1**	2.6	0.0	0.0	**2.6**	**4.7**
WUA 0.25 – <0.5	Moderate	0.7	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.5**	2.0	0.0	0.0	**2.0**	**3.4**
WUA 0.5 – <0.75	High	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.1**	1.0	0.0	0.0	**1.0**	**2.1**
WUA 0.75 – 1	Very High	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.7**	0.1	0.0	0.0	**0.1**	**0.7**
Total WUA (0.001–1)		**2.8**	**2.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**5.3**	**5.6**	**0.0**	**0.0**	**5.6**	**11.0**

1. Location of reaches outlined in Map 6D-1.

Table 6D-9: Young-of-the-year lake sturgeon 5th percentile foraging (rearing) habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
0	Not Suitable	79.2	30.1	4.5	27.9	8.2	83.2	13.8	25.3	**272.1**	284.9	154.1	80.4	200.9	**720.3**	**992.4**
0.001 – <0.25	Low	107.3	154.1	238.6	243.3	617.2	1421.6	597.9	209.8	**3589.7**	3.0	41.1	463.0	553.8	**1060.9**	**4650.7**
0.25 – <0.5	Moderate	0.1	0.0	1.5	0.0	0.0	13.2	1.6	23.6	**40.0**	0.0	0.0	18.7	14.0	**32.7**	**72.7**
0.5 – <0.75	High	0.0	0.0	0.5	0.0	0.0	0.2	0.3	38.8	**39.8**	0.0	0.0	0.0	20.7	**20.7**	**60.5**
0.75 – 1	Very High	0.0	0.0	1.2	0.0	0.0	0.0	0.0	34.7	**36.0**	0.0	0.0	0.0	1.5	**1.5**	**37.5**
Total Wetted Area		**186.6**	**184.2**	**246.4**	**271.2**	**625.3**	**1518.3**	**613.6**	**332.2**	**3977.7**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**5813.8**
Total Suitable Area (0.001–1)		**107.4**	**154.1**	**241.9**	**243.3**	**617.2**	**1435.1**	**599.8**	**306.9**	**3705.6**	**3.0**	**41.1**	**481.7**	**590.0**	**1115.9**	**4821.4**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
0	Not Suitable	81.6	20.1	0.9	1.7	132.3	758.5	49.2	337.0	303.4	**1684.6**	43.3	12.7	201.1	**257.1**	**1941.7**
0.001 – <0.25	Low	105.5	169.2	259.1	318.6	812.0	3368.4	1298.9	862.9	454.6	**7649.2**	41.6	524.4	541.3	**1107.3**	**8756.5**
0.25 – <0.5	Moderate	0.0	0.0	0.0	0.0	0.8	8.8	32.1	0.7	2.8	**45.3**	0.0	25.8	25.6	**51.4**	**96.6**
0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.0	0.0	3.7	2.9	0.1	**6.7**	0.0	0.0	17.5	**17.5**	**24.2**
0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	1.8	10.5	0.5	**12.9**	0.0	0.0	6.9	**6.9**	**19.8**
Total Wetted Area		**187.2**	**189.4**	**259.9**	**320.3**	**945.1**	**4134.6**	**1381.6**	**1214.1**	**752.8**	**9385.0**	**84.9**	**562.9**	**792.4**	**1440.2**	**10825.2**
Total Suitable Area (0.001–1)		**105.6**	**169.2**	**259.1**	**318.6**	**812.8**	**3377.2**	**1336.5**	**877.1**	**458.0**	**7714.1**	**41.6**	**550.2**	**591.3**	**1183.1**	**8897.2**

1. Location of reaches outlined in Map 6D-1.

Table 6D-10: Young-of-the-year lake sturgeon 5th percentile foraging (rearing) weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids	Downstream of Gull Rapids			Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	0.5	0.4	5.0	1.3	6.8	90.7	26.9	5.4	**137.0**	0.0	1.5	30.4	28.4	**60.3**	**197.4**
WUA 0.25 – <0.5	Moderate	0.0	0.0	0.6	0.0	0.0	3.4	0.5	9.1	**13.6**	0.0	0.0	4.7	5.3	**9.9**	**23.5**
WUA 0.5 – <0.75	High	0.0	0.0	0.3	0.0	0.0	0.1	0.2	24.3	**24.9**	0.0	0.0	0.0	12.8	**12.8**	**37.7**
WUA 0.75 – 1	Very High	0.0	0.0	1.1	0.0	0.0	0.0	0.0	30.8	**31.9**	0.0	0.0	0.0	1.2	**1.2**	**33.2**
Total WUA (0.001–1)		**0.5**	**0.4**	**7.0**	**1.3**	**6.8**	**94.3**	**27.7**	**69.6**	**207.5**	**0.0**	**1.5**	**35.0**	**47.7**	**84.3**	**291.8**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	0.5	0.7	9.2	12.6	62.0	182.8	86.0	31.1	32.3	**417.3**	1.5	31.2	30.7	**63.4**	**480.8**
WUA 0.25 – <0.5	Moderate	0.0	0.0	0.0	0.0	0.2	2.2	8.3	0.3	0.7	**11.8**	0.0	6.5	8.4	**14.8**	**26.6**
WUA 0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.0	0.0	2.3	1.9	0.1	**4.3**	0.0	0.0	10.7	**10.7**	**15.0**
WUA 0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	1.6	9.6	0.5	**11.7**	0.0	0.0	5.7	**5.7**	**17.3**
Total WUA (0.001–1)		**0.5**	**0.7**	**9.2**	**12.6**	**62.3**	**185.0**	**98.2**	**42.9**	**33.6**	**445.0**	**1.5**	**37.6**	**55.5**	**94.7**	**539.7**

1. Location of reaches outlined in Map 6D-1.

Table 6D-11: Young-of-the-year lake sturgeon 50th percentile foraging (rearing) habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
0	Not Suitable	101.7	45.3	6.7	32.8	41.4	88.4	43.4	24.6	**384.2**	283.9	152.9	92.9	200.7	**730.4**	**1114.7**
0.001 – <0.25	Low	89.4	145.6	247.3	260.5	634.9	1583.6	631.4	275.8	**3868.4**	3.9	42.3	434.1	487.7	**968.1**	**4836.5**
0.25 – <0.5	Moderate	0.2	0.0	1.7	0.0	0.0	14.7	1.6	21.8	**39.9**	0.0	0.0	35.1	55.7	**90.8**	**130.7**
0.5 – <0.75	High	0.0	0.0	0.8	0.0	0.0	0.4	0.4	35.0	**36.6**	0.0	0.0	0.0	8.2	**8.2**	**44.8**
0.75 – 1	Very High	0.0	0.0	0.5	0.0	0.0	0.1	0.1	44.6	**45.3**	0.0	0.0	0.0	38.6	**38.6**	**83.9**
Total Wetted Area		**191.3**	**190.9**	**257.0**	**293.3**	**676.2**	**1687.1**	**676.9**	**401.7**	**4374.4**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**6210.5**
Total Suitable Area (0.001–1)		**89.5**	**145.6**	**250.3**	**260.5**	**634.9**	**1598.7**	**633.5**	**377.1**	**3990.2**	**3.9**	**42.3**	**469.2**	**590.2**	**1105.7**	**5095.8**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
0	Not Suitable	101.4	33.6	3.3	5.2	136.4	746.4	42.8	323.0	302.0	**1694.2**	43.3	25.6	200.6	**269.5**	**1963.7**
0.001 – <0.25	Low	90.9	160.9	262.4	317.7	816.0	3025.5	1186.3	861.6	369.9	**7091.3**	41.6	501.4	483.8	**1026.8**	**8118.1**
0.25 – <0.5	Moderate	0.1	0.0	0.0	0.0	1.2	363.4	150.7	15.3	88.9	**619.6**	0.0	35.8	62.2	**98.0**	**717.7**
0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.5	0.0	**4.2**	0.0	0.0	8.0	**8.0**	**12.2**
0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	2.8	13.5	0.6	**16.9**	0.0	0.0	37.8	**37.8**	**54.7**
Total Wetted Area		**192.4**	**194.6**	**265.7**	**322.9**	**953.6**	**4134.3**	**1382.2**	**1213.9**	**752.8**	**9412.4**	**84.9**	**562.9**	**792.4**	**1440.2**	**10852.6**
Total Suitable Area (0.001–1)		**91.0**	**160.9**	**262.4**	**317.7**	**817.3**	**3388.9**	**1343.5**	**890.9**	**459.4**	**7732.0**	**41.6**	**537.2**	**591.8**	**1170.7**	**8902.7**

1. Location of reaches outlined in Map 6D-1.

Table 6D-12: Young-of-the-year lake sturgeon 50th percentile foraging (rearing) weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	0.5	0.5	4.4	2.0	7.0	93.9	25.2	9.5	**142.8**	0.1	1.3	29.6	33.5	**64.5**	**207.3**
WUA 0.25 – <0.5	Moderate	0.0	0.0	0.7	0.0	0.0	3.8	0.5	8.4	**13.4**	0.0	0.0	8.8	14.5	**23.2**	**36.6**
WUA 0.5 – <0.75	High	0.0	0.0	0.5	0.0	0.0	0.2	0.3	22.2	**23.1**	0.0	0.0	0.0	5.2	**5.2**	**28.4**
WUA 0.75 – 1	Very High	0.0	0.0	0.5	0.0	0.0	0.1	0.1	40.3	**40.9**	0.0	0.0	0.0	37.5	**37.5**	**78.4**
Total WUA (0.001–1)		**0.6**	**0.5**	**5.9**	**2.0**	**7.0**	**97.9**	**26.1**	**80.3**	**220.3**	**0.1**	**1.3**	**38.4**	**90.7**	**130.4**	**350.7**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	0.5	0.6	5.9	8.5	41.4	163.0	84.7	45.1	24.6	**374.3**	1.3	28.9	35.8	**66.0**	**440.3**
WUA 0.25 – <0.5	Moderate	0.0	0.0	0.0	0.0	0.4	90.8	37.9	3.9	22.2	**155.2**	0.0	9.0	16.3	**25.2**	**180.5**
WUA 0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.3	0.0	**2.8**	0.0	0.0	5.1	**5.1**	**7.8**
WUA 0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	2.4	12.9	0.6	**15.9**	0.0	0.0	36.7	**36.7**	**52.6**
Total WUA (0.001–1)		**0.5**	**0.6**	**5.9**	**8.5**	**41.8**	**253.9**	**127.4**	**62.2**	**47.4**	**548.2**	**1.3**	**37.8**	**93.8**	**133.0**	**681.2**

1. Location of reaches outlined in Map 6D-1.

Table 6D-13: Young-of-the-year lake sturgeon 95th percentile foraging (rearing) habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake				Gull Rapids		Downstream of Gull Rapids			
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Upstream Total	Reach 9A	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	129.8	59.5	10.2	43.6	106.1	129.6	39.3	15.1	**533.1**	281.8	150.4	90.5	200.3	**723.1**	**1256.2**
0.001 – <0.25	Low	69.6	138.1	251.1	262.4	641.8	1667.3	663.6	323.7	**4017.6**	6.0	44.8	444.5	381.6	**876.8**	**4894.4**
0.25 – <0.5	Moderate	0.3	0.0	5.2	0.0	0.0	8.6	1.7	25.7	**41.5**	0.0	0.0	27.0	158.8	**185.9**	**227.4**
0.5 – <0.75	High	0.0	0.0	1.3	0.0	0.0	0.8	0.0	18.9	**21.0**	0.0	0.0	0.0	0.0	**0.0**	**21.0**
0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.2	0.0	43.7	**43.9**	0.0	0.0	0.0	50.3	**50.3**	**94.2**
Total Wetted Area		**199.7**	**197.6**	**267.8**	**306.0**	**747.9**	**1806.5**	**704.6**	**427.1**	**4657.1**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**6493.2**
Total Suitable Area (0.001–1)		**69.9**	**138.1**	**257.6**	**262.4**	**641.8**	**1676.9**	**665.3**	**412.0**	**4124.0**	**6.0**	**44.8**	**471.6**	**590.7**	**1113.0**	**5237.0**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir					Downstream of Keeyask GS				
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A	Upstream Total	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	128.2	46.0	5.3	8.8	124.3	623.8	40.0	285.5	301.0	**1562.8**	53.7	93.9	215.3	**363.0**	**1925.8**
0.001 – <0.25	Low	71.0	152.8	268.1	318.2	841.7	2820.3	1114.6	816.0	317.9	**6720.5**	31.1	426.8	361.0	**819.0**	**7539.4**
0.25 – <0.5	Moderate	0.4	0.0	0.0	0.0	2.3	689.9	225.1	98.1	142.0	**1157.7**	0.0	42.1	165.8	**207.9**	**1365.6**
0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.4	0.0	**4.0**	0.0	0.0	0.8	**0.8**	**4.8**
0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	3.0	13.6	0.6	**17.2**	0.0	0.0	49.5	**49.5**	**66.7**
Total Wetted Area		**199.5**	**198.8**	**273.4**	**327.0**	**968.2**	**4133.0**	**1382.1**	**1213.6**	**752.8**	**9448.3**	**84.9**	**562.9**	**792.4**	**1440.2**	**10888.5**
Total Suitable Area (0.001–1)		**71.3**	**152.8**	**268.1**	**318.2**	**844.0**	**3510.2**	**1346.2**	**928.1**	**460.5**	**7899.3**	**31.1**	**468.9**	**577.1**	**1077.2**	**8976.5**

1. Location of reaches outlined in Map 6D-1.

Table 6D-14: Young-of-the-year lake sturgeon 95th percentile foraging (rearing) weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	0.5	0.5	3.1	2.5	8.1	77.0	21.5	17.6	**130.9**	0.2	1.2	26.8	32.3	**60.5**	**191.4**
WUA 0.25 – <0.5	Moderate	0.1	0.0	1.9	0.0	0.0	2.2	0.5	9.2	**13.8**	0.0	0.0	6.8	39.7	**46.5**	**60.3**
WUA 0.5 – <0.75	High	0.0	0.0	0.7	0.0	0.0	0.5	0.0	11.9	**13.1**	0.0	0.0	0.0	0.0	**0.0**	**13.2**
WUA 0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.1	0.0	40.8	**40.9**	0.0	0.0	0.0	50.1	**50.1**	**91.0**
Total WUA (0.001–1)		**0.6**	**0.5**	**5.7**	**2.5**	**8.1**	**79.8**	**22.0**	**79.5**	**198.8**	**0.2**	**1.2**	**33.6**	**122.1**	**157.1**	**355.9**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	0.5	0.6	4.5	6.6	25.3	132.8	87.2	48.3	22.7	**328.3**	1.2	27.9	39.3	**68.4**	**396.6**
WUA 0.25 – <0.5	Moderate	0.1	0.0	0.0	0.0	0.7	172.5	56.4	24.6	35.5	**289.8**	0.0	8.8	34.1	**42.9**	**332.7**
WUA 0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.3	0.0	**2.7**	0.0	0.0	0.3	**0.3**	**2.9**
WUA 0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	2.5	13.1	0.6	**16.2**	0.0	0.0	49.6	**49.6**	**65.8**
Total WUA (0.001–1)		**0.6**	**0.6**	**4.5**	**6.6**	**26.0**	**305.3**	**148.5**	**86.2**	**58.8**	**636.9**	**1.2**	**36.7**	**123.3**	**161.2**	**798.1**

1. Location of reaches outlined in Map 6D-1.

Table 6D-15: Sub-adult lake sturgeon 5th percentile foraging habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
0	Not Suitable	56.5	25.7	6.8	24.5	12.1	75.8	20.5	42.2	**264.0**	105.2	46.0	111.6	209.5	**472.3**	**736.2**
0.001 – <0.25	Low	130.1	156.4	169.4	243.3	553.9	624.9	398.7	200.2	**2477.0**	181.1	143.7	206.5	59.3	**590.5**	**3067.5**
0.25 – <0.5	Moderate	0.0	2.1	68.0	3.4	58.9	212.0	191.6	24.7	**560.9**	0.0	2.4	122.0	392.3	**516.7**	**1077.6**
0.5 – <0.75	High	0.0	0.0	0.3	0.0	0.2	75.8	2.8	17.6	**96.6**	0.0	0.0	81.8	49.6	**131.4**	**228.0**
0.75 – 1	Very High	0.0	0.0	1.8	0.0	0.1	529.7	0.1	47.5	**579.3**	0.0	0.0	38.9	78.6	**117.4**	**696.7**
Total Wetted Area		**186.6**	**184.2**	**246.4**	**271.2**	**625.3**	**1518.3**	**613.6**	**332.2**	**3977.7**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**5813.8**
Total Suitable Area (0.001–1)		**130.1**	**158.5**	**239.6**	**246.7**	**613.2**	**1442.5**	**593.1**	**290.0**	**3713.8**	**181.1**	**146.0**	**449.1**	**579.8**	**1356.0**	**5069.7**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
0	Not Suitable	60.1	17.0	3.4	5.9	60.4	304.6	33.7	129.0	142.0	**756.0**	1.5	1.0	199.7	**202.2**	**958.2**
0.001 – <0.25	Low	127.1	164.5	156.3	163.1	332.1	2134.7	645.4	665.4	362.0	**4750.6**	65.5	220.1	57.7	**343.4**	**5093.9**
0.25 – <0.5	Moderate	0.0	7.9	100.2	151.3	552.7	1696.4	698.5	405.9	256.7	**3869.5**	17.8	232.1	418.4	**668.3**	**4537.8**
0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.2	0.1	**3.6**	0.0	71.6	33.8	**105.5**	**109.1**
0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	4.8	13.7	0.6	**19.1**	0.0	38.0	82.8	**120.8**	**139.9**
Total Wetted Area		**187.2**	**189.4**	**259.9**	**320.3**	**945.1**	**4134.6**	**1381.6**	**1214.1**	**752.8**	**9385.0**	**84.9**	**562.9**	**792.4**	**1440.2**	**10825.2**
Total Suitable Area (0.001–1)		**127.1**	**172.4**	**256.5**	**314.4**	**884.7**	**3831.1**	**1352.0**	**1085.1**	**619.4**	**8642.7**	**83.4**	**561.9**	**592.7**	**1238.0**	**9880.7**

1. Location of reaches outlined in Map 6D-1.

Table 6D-16: Sub-adult lake sturgeon 5th percentile foraging weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids	Downstream of Gull Rapids			Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	3.2	6.6	13.6	15.2	45.5	58.8	29.1	10.0	**181.9**	5.9	8.5	24.9	4.8	**44.2**	**226.1**
WUA 0.25 – <0.5	Moderate	0.0	0.6	20.1	0.9	16.9	77.4	57.2	9.0	**182.2**	0.0	5.9	46.2	127.7	**179.8**	**362.0**
WUA 0.5 – <0.75	High	0.0	0.0	0.2	0.0	0.1	46.6	1.4	10.9	**59.3**	0.0	0.0	53.5	34.9	**88.4**	**147.6**
WUA 0.75 – 1	Very High	0.0	0.0	1.8	0.0	0.1	517.7	0.1	46.2	**565.9**	0.0	0.0	32.9	61.0	**93.9**	**659.8**
Total WUA (0.001–1)		**3.2**	**7.2**	**35.7**	**16.1**	**62.7**	**700.6**	**87.7**	**76.1**	**989.3**	**5.9**	**14.5**	**157.5**	**228.4**	**406.3**	**1395.6**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	3.1	9.4	14.2	19.6	32.0	125.7	54.0	38.7	94.7	**391.5**	6.4	18.3	4.8	**29.5**	**421.0**
WUA 0.25 – <0.5	Moderate	0.0	2.3	29.6	44.5	165.0	587.2	240.7	139.6	94.7	**1303.6**	5.2	69.5	134.2	**208.9**	**1512.5**
WUA 0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.1	0.1	**2.0**	0.0	47.4	23.1	**70.5**	**72.6**
WUA 0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	4.3	12.3	0.6	**17.2**	0.0	35.8	70.9	**106.7**	**123.9**
Total WUA (0.001–1)		**3.1**	**11.7**	**43.8**	**64.1**	**197.0**	**712.9**	**300.8**	**190.8**	**190.1**	**1714.4**	**11.6**	**171.0**	**233.0**	**415.6**	**2130.0**

1. Location of reaches outlined in Map 6D-1.

Table 6D-17: Sub-adult lake sturgeon 50th percentile foraging habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids	Downstream of Gull Rapids			Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
0	Not Suitable	78.5	32.3	6.1	23.7	25.5	24.8	13.4	9.3	**213.6**	97.2	50.6	75.8	199.4	**423.1**	**636.7**
0.001 – <0.25	Low	112.7	156.1	167.0	266.9	588.4	719.1	437.0	293.7	**2740.9**	190.6	131.8	212.8	57.1	**592.4**	**3333.3**
0.25 – <0.5	Moderate	0.0	2.5	81.6	2.7	62.0	229.6	222.9	22.2	**623.6**	0.0	12.7	145.2	406.4	**564.4**	**1188.0**
0.5 – <0.75	High	0.0	0.0	0.1	0.0	0.3	116.3	3.4	16.0	**136.1**	0.0	0.0	87.6	16.9	**104.4**	**240.5**
0.75 – 1	Very High	0.0	0.0	2.1	0.0	0.1	597.3	0.2	60.6	**660.3**	0.0	0.0	40.7	111.1	**151.8**	**812.1**
Total Wetted Area		**191.3**	**190.9**	**257.0**	**293.3**	**676.2**	**1687.1**	**676.9**	**401.7**	**4374.4**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**6210.5**
Total Suitable Area (0.001–1)		**112.7**	**158.6**	**250.9**	**269.6**	**650.8**	**1662.3**	**663.4**	**392.4**	**4160.8**	**190.6**	**144.6**	**486.3**	**591.5**	**1413.0**	**5573.8**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
0	Not Suitable	80.0	28.6	5.6	7.7	61.2	294.3	33.1	126.9	142.0	**779.4**	1.5	1.0	199.7	**202.2**	**981.6**
0.001 – <0.25	Low	112.4	159.2	159.6	174.8	316.5	2128.0	629.5	660.9	359.2	**4700.1**	71.1	210.5	56.5	**338.1**	**5038.1**
0.25 – <0.5	Moderate	0.0	6.8	100.5	140.5	575.8	1590.4	633.4	411.8	217.0	**3676.2**	12.3	235.8	419.3	**667.4**	**4343.6**
0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.1	122.7	84.9	0.5	42.6	**250.9**	0.0	74.2	5.9	**80.1**	**331.0**
0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	5.3	13.7	0.6	**19.7**	0.0	41.5	110.9	**152.4**	**172.1**
Total Wetted Area		**192.4**	**194.6**	**265.7**	**322.9**	**953.6**	**4134.3**	**1382.2**	**1213.9**	**752.8**	**9412.4**	**84.9**	**562.9**	**792.4**	**1440.2**	**10852.6**
Total Suitable Area (0.001–1)		**112.4**	**166.0**	**260.1**	**315.2**	**892.4**	**3841.0**	**1353.2**	**1087.0**	**619.5**	**8646.9**	**83.4**	**561.9**	**592.7**	**1238.0**	**9884.8**

1. Location of reaches outlined in Map 6D-1.

Table 6D-18: Sub-adult lake sturgeon 50th percentile foraging weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids	Downstream of Gull Rapids			Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	3.0	8.2	15.0	19.4	53.2	55.2	31.2	14.7	**199.9**	7.2	8.9	23.7	4.8	**44.7**	**244.6**
WUA 0.25 – <0.5	Moderate	0.0	0.7	23.9	0.7	17.8	81.7	65.7	7.9	**198.5**	0.0	3.7	46.6	139.7	**189.9**	**388.4**
WUA 0.5 – <0.75	High	0.0	0.0	0.1	0.0	0.1	73.5	1.7	9.7	**85.1**	0.0	0.0	58.6	10.8	**69.4**	**154.6**
WUA 0.75 – 1	Very High	0.0	0.0	2.1	0.0	0.1	590.0	0.2	59.2	**651.5**	0.0	0.0	39.7	105.0	**144.7**	**796.2**
Total WUA (0.001–1)		**3.0**	**8.9**	**41.1**	**20.2**	**71.2**	**800.5**	**98.8**	**91.4**	**1135.0**	**7.2**	**12.6**	**168.6**	**260.3**	**448.7**	**1583.8**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	2.7	12.5	20.4	38.4	45.5	132.0	55.8	38.5	46.3	**392.0**	6.7	16.9	4.8	**28.4**	**420.4**
WUA 0.25 – <0.5	Moderate	0.0	0.3	25.8	19.5	148.3	370.8	167.2	132.6	47.1	**911.6**	3.6	71.6	146.8	**222.0**	**1133.5**
WUA 0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.4	329.8	121.9	43.8	68.0	**563.9**	0.0	50.2	4.2	**54.4**	**618.3**
WUA 0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	5.4	13.7	0.6	**19.8**	0.0	40.5	105.3	**145.8**	**165.6**
Total WUA (0.001–1)		**2.7**	**12.8**	**46.1**	**57.9**	**194.2**	**832.6**	**350.2**	**228.7**	**162.0**	**1887.2**	**10.3**	**179.3**	**261.0**	**450.6**	**2337.8**

1. Location of reaches outlined in Map 6D-1.

Table 6D-19: Sub-adult lake sturgeon 95th percentile foraging habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids	Downstream of Gull Rapids			Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
0	Not Suitable	115.2	48.8	10.2	32.6	70.7	26.4	9.4	8.5	**321.7**	87.8	68.3	75.8	199.4	**431.3**	**752.9**
0.001 – <0.25	Low	84.5	148.5	182.7	267.8	617.0	719.4	472.8	307.2	**2799.8**	200.1	118.1	211.5	56.2	**585.9**	**3385.7**
0.25 – <0.5	Moderate	0.1	0.3	71.4	5.7	59.7	220.9	218.7	24.0	**600.8**	0.0	8.8	133.3	375.4	**517.4**	**1118.3**
0.5 – <0.75	High	0.0	0.0	1.4	0.0	0.3	130.0	3.3	13.8	**148.9**	0.0	0.0	94.0	40.1	**134.1**	**283.0**
0.75 – 1	Very High	0.0	0.0	2.1	0.0	0.1	709.8	0.3	73.6	**786.0**	0.0	0.0	47.5	119.9	**167.4**	**953.4**
Total Wetted Area		**199.7**	**197.6**	**267.8**	**306.0**	**747.9**	**1806.5**	**704.6**	**427.1**	**4657.1**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**6493.2**
Total Suitable Area (0.001–1)		**84.5**	**148.8**	**257.6**	**273.4**	**677.1**	**1780.1**	**695.2**	**418.6**	**4335.5**	**200.1**	**126.9**	**486.3**	**591.5**	**1404.8**	**5740.3**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
0	Not Suitable	112.8	44.5	7.6	12.2	32.6	274.4	32.3	122.8	141.8	**780.9**	1.7	0.9	199.7	**202.4**	**983.3**
0.001 – <0.25	Low	86.6	153.0	175.4	246.4	431.2	2123.7	607.3	655.7	354.6	**4834.0**	71.9	209.0	55.5	**336.4**	**5170.4**
0.25 – <0.5	Moderate	0.1	1.3	90.5	68.4	503.6	1076.3	497.6	333.7	128.6	**2699.9**	11.3	231.7	393.4	**636.4**	**3336.3**
0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.8	659.6	243.4	87.6	135.9	**1127.3**	0.0	78.8	27.3	**106.1**	**1233.4**
0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	5.6	13.8	0.6	**20.0**	0.0	42.5	116.5	**158.9**	**178.9**
Total Wetted Area		**199.5**	**198.8**	**273.4**	**327.0**	**968.2**	**4133.0**	**1382.1**	**1213.6**	**752.8**	**9448.3**	**84.9**	**562.9**	**792.4**	**1440.2**	**10888.5**
Total Suitable Area (0.001–1)		**86.7**	**154.3**	**265.8**	**314.8**	**935.6**	**3859.6**	**1353.9**	**1090.8**	**619.7**	**8681.3**	**83.2**	**561.9**	**592.7**	**1237.8**	**9919.0**

1. Location of reaches outlined in Map 6D-1.

Table 6D-20: Sub-adult lake sturgeon 95th percentile foraging weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	2.6	9.8	20.4	21.0	57.1	53.1	42.9	19.5	**226.5**	8.3	6.9	23.9	4.9	**44.0**	**270.5**
WUA 0.25 – <0.5	Moderate	0.0	0.1	20.0	1.6	17.1	78.6	64.1	8.3	**189.8**	0.0	2.6	41.2	141.9	**185.6**	**375.4**
WUA 0.5 – <0.75	High	0.0	0.0	0.8	0.0	0.2	81.4	1.7	8.2	**92.2**	0.0	0.0	63.1	21.2	**84.3**	**176.5**
WUA 0.75 – 1	Very High	0.0	0.0	2.0	0.0	0.1	699.8	0.3	72.4	**774.7**	0.0	0.0	46.1	118.4	**164.5**	**939.2**
Total WUA (0.001–1)		**2.6**	**9.9**	**43.2**	**22.6**	**74.4**	**912.9**	**109.0**	**108.5**	**1283.1**	**8.3**	**9.5**	**174.3**	**286.4**	**478.4**	**1761.5**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	2.7	12.5	20.4	38.4	45.5	132.0	55.8	38.5	47.1	**392.8**	6.3	17.1	4.8	**28.3**	**421.1**
WUA 0.25 – <0.5	Moderate	0.0	0.3	25.8	19.5	148.3	370.8	167.2	132.6	47.1	**911.6**	3.3	72.6	150.2	**226.1**	**1137.7**
WUA 0.5 – <0.75	High	0.0	0.0	0.0	0.0	0.4	329.8	121.9	43.8	68.0	**563.9**	0.0	54.0	13.7	**67.7**	**631.5**
WUA 0.75 – 1	Very High	0.0	0.0	0.0	0.0	0.0	0.0	5.4	13.7	0.6	**19.8**	0.0	42.1	115.2	**157.3**	**177.1**
Total WUA (0.001–1)		**2.7**	**12.8**	**46.1**	**57.9**	**194.2**	**832.6**	**350.2**	**228.7**	**162.8**	**1888.0**	**9.7**	**185.9**	**283.9**	**479.4**	**2367.4**

1. Location of reaches outlined in Map 6D-1.

Table 6D-21: Adult lake sturgeon 5th percentile foraging habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake				Gull Rapids		Downstream of Gull Rapids			
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Upstream Total	Reach 9A	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	56.4	25.8	6.8	24.5	12.1	75.8	20.5	42.2	**263.9**	102.6	41.1	1.3	0.4	**145.4**	**409.3**
0.001 – <0.25	Low	41.3	22.5	6.7	27.7	25.7	65.1	20.3	42.3	**251.5**	39.1	16.1	2.8	1.5	**59.5**	**311.0**
0.25 – <0.5	Moderate	41.2	42.2	21.0	43.7	70.0	166.1	83.1	74.0	**541.4**	44.6	20.7	63.4	17.0	**145.7**	**687.1**
0.5 – <0.75	High	29.9	54.3	40.7	90.8	171.1	135.5	45.5	39.2	**607.0**	39.4	30.0	286.0	682.7	**1038.1**	**1645.1**
0.75 – 1	Very High	17.8	39.5	171.5	84.4	346.3	1076.0	444.2	134.2	**2313.8**	64.5	88.2	210.0	91.3	**454.0**	**2767.7**
Total Wetted Area		**186.6**	**184.2**	**246.4**	**271.2**	**625.3**	**1518.3**	**613.6**	**332.2**	**3977.7**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**5813.8**
Total Suitable Area (0.001–1)		**130.3**	**158.5**	**239.8**	**246.6**	**613.0**	**1442.6**	**593.1**	**289.7**	**3713.7**	**187.6**	**155.0**	**562.2**	**792.4**	**1697.2**	**5410.9**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir					Downstream of Keeyask GS				
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A	Upstream Total	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	60.0	17.0	3.4	5.9	58.0	229.2	14.6	103.7	4.7	**496.6**	1.5	1.0	1.1	**3.6**	**500.2**
0.001 – <0.25	Low	38.9	16.8	4.4	3.9	24.6	185.2	19.0	62.6	6.6	**362.0**	0.7	3.3	1.5	**5.6**	**367.6**
0.25 – <0.5	Moderate	41.2	26.8	10.7	7.0	66.5	851.8	156.3	347.0	64.5	**1571.7**	4.7	61.5	16.8	**83.0**	**1654.7**
0.5 – <0.75	High	28.7	43.7	26.5	29.6	165.6	1829.0	606.7	566.1	249.1	**3545.1**	25.6	278.0	670.7	**974.2**	**4519.3**
0.75 – 1	Very High	18.3	85.1	214.9	274.0	630.5	1041.3	589.4	135.6	436.6	**3425.5**	52.6	219.8	102.7	**375.1**	**3800.6**
Total Wetted Area		**187.2**	**189.4**	**259.9**	**320.3**	**945.1**	**4134.6**	**1381.6**	**1214.1**	**752.8**	**9385.0**	**84.9**	**562.9**	**792.4**	**1440.2**	**10825.2**
Total Suitable Area (0.001–1)		**127.1**	**172.3**	**256.5**	**314.4**	**887.3**	**3907.3**	**1371.4**	**1111.2**	**756.7**	**8904.3**	**83.5**	**562.6**	**791.8**	**1437.9**	**10342.2**

1. Location of reaches outlined in Map 6D-1.

Table 6D-22: Adult lake sturgeon 5th percentile foraging weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake				Gull Rapids		Downstream of Gull Rapids			
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Upstream Total	Reach 9A	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
WUA 0.001 – <0.25	Low	5.5	3.5	1.1	3.7	4.1	10.7	3.5	6.8	**38.9**	5.6	2.2	0.5	0.3	**8.6**	**47.6**
WUA 0.25 – <0.5	Moderate	15.2	15.9	8.3	17.1	27.5	60.2	29.6	27.2	**201.0**	16.5	7.9	26.2	7.1	**57.6**	**258.6**
WUA 0.5 – <0.75	High	18.2	34.1	26.0	57.6	109.3	84.0	28.6	23.2	**381.1**	24.8	18.9	164.8	409.4	**617.9**	**999.0**
WUA 0.75 – 1	Very High	15.7	35.1	165.1	74.8	317.9	1049.2	432.1	131.0	**2220.8**	59.4	83.3	199.9	75.2	**417.9**	**2638.7**
Total WUA (0.001–1)		**54.6**	**88.6**	**200.5**	**153.2**	**458.8**	**1204.1**	**493.8**	**188.2**	**2841.9**	**106.3**	**112.3**	**391.4**	**492.0**	**1102.0**	**3943.8**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	5.1	2.5	0.7	0.6	4.1	31.0	3.2	10.4	24.0	**81.6**	0.1	0.7	0.3	**1.1**	**82.7**
WUA 0.25 – <0.5	Moderate	15.1	9.9	4.2	2.7	24.0	323.1	61.9	123.1	24.0	**588.0**	1.9	25.2	6.9	**34.1**	**622.1**
WUA 0.5 – <0.75	High	17.6	27.9	16.7	19.1	95.6	1057.7	376.7	341.8	155.0	**2108.1**	15.4	158.0	415.2	**588.6**	**2696.7**
WUA 0.75 – 1	Very High	16.1	76.9	208.5	267.4	617.0	901.1	520.8	108.7	390.6	**3107.2**	49.0	212.1	86.3	**347.4**	**3454.5**
Total WUA (0.001–1)		**53.9**	**117.2**	**230.2**	**289.8**	**740.7**	**2312.9**	**962.6**	**584.0**	**593.6**	**5884.9**	**66.4**	**395.9**	**508.8**	**971.1**	**6856.0**

1. Location of reaches outlined in Map 6D-1.

Table 6D-23: Adult lake sturgeon 50th percentile foraging habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake				Gull Rapids		Downstream of Gull Rapids			
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Upstream Total	Reach 9A	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	78.5	32.4	6.1	23.7	25.5	24.8	13.5	9.3	**213.8**	99.0	51.2	1.3	0.4	**152.0**	**365.7**
0.001 – <0.25	Low	38.8	27.7	6.2	26.4	44.2	99.2	48.8	50.7	**342.0**	27.8	19.2	2.6	1.3	**50.9**	**392.9**
0.25 – <0.5	Moderate	34.5	36.3	20.1	56.2	115.9	230.0	52.5	79.9	**625.3**	40.3	22.8	56.1	15.0	**134.2**	**759.5**
0.5 – <0.75	High	22.9	48.6	40.6	94.1	182.8	144.9	81.8	95.5	**711.2**	44.7	35.9	254.4	531.3	**866.4**	**1577.5**
0.75 – 1	Very High	16.8	45.9	184.2	92.9	307.8	1188.2	480.3	166.1	**2482.2**	78.4	66.9	249.1	244.8	**639.2**	**3121.4**
Total Wetted Area		**191.3**	**190.9**	**257.0**	**293.3**	**676.2**	**1687.1**	**676.9**	**401.7**	**4374.4**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**6210.5**
Total Suitable Area (0.001–1)		**113.0**	**158.6**	**251.1**	**269.5**	**650.6**	**1662.4**	**663.4**	**392.2**	**4160.7**	**191.2**	**144.9**	**562.2**	**792.4**	**1690.6**	**5851.3**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir					Downstream of Keeyask GS				
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A	Upstream Total	Reach 9B	Reach 11	Reach 12	Downstream Total	Overall Total
0	Not Suitable	80.0	28.6	5.6	7.9	58.9	221.5	14.2	102.5	5.0	**524.2**	1.7	4.9	3.0	**9.6**	**533.8**
0.001 – <0.25	Low	37.5	19.8	4.2	4.6	26.4	181.2	17.8	61.5	6.3	**359.4**	6.3	8.1	3.3	**17.7**	**377.1**
0.25 – <0.5	Moderate	33.8	25.3	10.8	11.1	68.7	813.6	126.6	342.7	59.9	**1492.6**	17.7	48.5	12.6	**78.7**	**1571.3**
0.5 – <0.75	High	23.5	54.4	37.8	36.3	145.1	1613.4	499.8	442.4	185.5	**3038.3**	27.5	248.4	463.8	**739.8**	**3778.1**
0.75 – 1	Very High	17.6	66.5	207.4	263.2	655.0	1310.6	728.6	266.7	505.0	**4020.6**	31.8	253.7	310.2	**595.7**	**4616.3**
Total Wetted Area		**187.2**	**189.4**	**259.9**	**320.3**	**945.1**	**4134.6**	**1381.6**	**1214.1**	**752.8**	**9385.0**	**84.9**	**562.9**	**792.4**	**1440.2**	**10825.2**
Total Suitable Area (0.001–1)		**112.3**	**166.0**	**260.1**	**315.2**	**895.2**	**3918.8**	**1372.8**	**1113.4**	**756.8**	**8910.8**	**83.4**	**558.6**	**789.9**	**1431.9**	**10342.7**

1. Location of reaches outlined in Map 6D-1.

Table 6D-24: Adult lake sturgeon 50th percentile foraging weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	4.8	3.8	1.0	3.7	6.8	20.9	7.5	8.0	**56.6**	4.0	2.7	0.5	0.2	**7.5**	**64.0**
WUA 0.25 – <0.5	Moderate	12.7	14.0	8.1	22.6	45.1	84.8	21.0	30.1	**238.4**	15.1	8.4	23.2	6.2	**52.9**	**291.3**
WUA 0.5 – <0.75	High	14.1	30.4	25.6	58.4	115.3	90.4	50.9	60.2	**445.2**	27.9	23.0	151.2	332.3	**534.4**	**979.6**
WUA 0.75 – 1	Very High	14.9	39.8	175.8	82.7	283.9	1164.6	465.0	160.4	**2387.0**	72.5	61.2	240.2	213.4	**587.4**	**2974.4**
Total WUA (0.001–1)		**46.6**	**88.1**	**210.5**	**167.4**	**451.0**	**1360.7**	**544.3**	**258.7**	**3127.2**	**119.5**	**95.4**	**415.1**	**552.2**	**1182.1**	**4309.3**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	4.9	2.3	0.7	0.7	4.3	30.3	3.0	10.3	22.2	**78.6**	0.1	0.6	0.2	**1.0**	**79.6**
WUA 0.25 – <0.5	Moderate	12.5	10.0	4.3	4.2	25.2	309.6	49.9	122.4	22.2	**560.4**	5.2	23.5	5.8	**34.5**	**594.9**
WUA 0.5 – <0.75	High	14.4	35.0	24.8	23.6	82.0	925.5	312.2	260.7	114.8	**1793.1**	20.0	152.1	335.0	**507.1**	**2300.2**
WUA 0.75 – 1	Very High	15.6	59.6	200.1	253.2	640.3	1206.8	675.2	225.7	479.4	**3755.7**	33.5	236.2	219.0	**488.6**	**4244.3**
Total WUA (0.001–1)		**47.3**	**106.9**	**229.9**	**281.8**	**751.8**	**2472.2**	**1040.3**	**619.1**	**638.6**	**6187.8**	**58.8**	**412.3**	**560.0**	**1031.1**	**7219.0**

1. Location of reaches outlined in Map 6D-1.

Table 6D-25: Adult lake sturgeon 95th percentile foraging habitat areas (in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids		Downstream of Gull Rapids		Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
0	Not Suitable	115.0	49.2	10.3	33.3	71.7	26.7	9.4	8.9	**324.4**	88.8	68.8	1.3	0.4	**159.3**	**483.7**
0.001 – <0.25	Low	30.8	27.0	8.8	36.5	98.5	61.6	11.7	11.8	**286.6**	27.3	28.0	3.7	1.1	**60.1**	**346.7**
0.25 – <0.5	Moderate	22.9	43.1	29.2	80.4	164.5	237.6	71.7	62.8	**712.1**	40.9	23.5	54.4	12.8	**131.6**	**843.7**
0.5 – <0.75	High	15.7	44.1	39.3	59.2	149.8	202.8	96.2	80.1	**687.1**	52.9	22.4	224.2	360.0	**659.6**	**1346.7**
0.75 – 1	Very High	15.4	34.2	180.2	96.6	263.1	1277.4	515.5	263.6	**2646.0**	80.3	53.3	279.9	418.4	**832.0**	**3478.0**
Total Wetted Area		**199.7**	**197.6**	**267.8**	**306.0**	**747.9**	**1806.5**	**704.6**	**427.1**	**4657.1**	**287.9**	**195.2**	**562.1**	**791.0**	**1836.1**	**6493.2**
Total Suitable Area (0.001–1)		**84.7**	**148.3**	**257.6**	**272.7**	**675.8**	**1779.4**	**695.1**	**418.2**	**4331.8**	**201.4**	**127.3**	**562.2**	**792.4**	**1683.3**	**6015.1**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
0	Not Suitable	114.4	45.2	8.0	13.1	30.1	198.3	12.7	97.3	4.7	**523.8**	1.7	1.0	1.1	**3.8**	**527.5**
0.001 – <0.25	Low	30.3	17.0	7.9	11.2	61.4	173.3	16.1	59.8	6.1	**383.0**	10.9	2.9	1.2	**15.0**	**398.0**
0.25 – <0.5	Moderate	24.4	40.9	22.9	26.8	83.6	763.3	102.1	333.9	54.9	**1452.6**	14.8	53.5	12.3	**80.6**	**1533.3**
0.5 – <0.75	High	16.1	50.3	41.1	75.0	176.2	1472.4	382.9	362.2	128.3	**2704.5**	14.1	227.9	370.1	**612.2**	**3316.7**
0.75 – 1	Very High	16.0	46.1	193.9	201.8	618.3	1530.8	872.7	362.2	567.7	**4409.5**	43.5	278.2	408.2	**729.9**	**5139.4**
Total Wetted Area		**199.5**	**198.8**	**273.4**	**327.0**	**968.2**	**4133.0**	**1382.1**	**1213.6**	**752.8**	**9448.3**	**84.9**	**562.9**	**792.4**	**1440.2**	**10888.5**
Total Suitable Area (0.001–1)		**86.8**	**154.1**	**265.8**	**314.7**	**939.4**	**3939.9**	**1373.9**	**1118.0**	**757.0**	**8949.7**	**83.3**	**562.6**	**791.8**	**1437.7**	**10387.4**

1. Location of reaches outlined in Map 6D-1.

Table 6D-26: Adult lake sturgeon 95th percentile foraging habitat areas and weighted usable areas (WUAs; in hectares), by habitat suitability index (HSI) and reach in the existing and Year 30 post-Project environments from Clark Lake to Gull Rapids and the proposed Keeyask Generating Station (GS)

Existing Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Gull Lake			Upstream Total	Gull Rapids	Downstream of Gull Rapids			Downstream Total	Overall Total
		Reach[1] 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8		Reach 9A	Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	3.8	3.6	1.3	5.5	15.1	10.9	2.0	2.1	**44.3**	3.8	3.6	0.6	0.2	**8.2**	**52.5**
WUA 0.25 – <0.5	Moderate	8.4	16.4	11.0	30.1	61.7	96.2	26.4	23.9	**274.1**	15.5	8.7	22.3	5.3	**51.8**	**325.9**
WUA 0.5 – <0.75	High	9.7	27.9	25.1	36.9	93.0	124.1	62.2	51.3	**430.3**	33.4	14.1	137.4	230.5	**415.4**	**845.7**
WUA 0.75 – 1	Very High	13.9	30.5	168.1	89.8	245.2	1258.6	489.5	247.5	**2543.1**	72.2	50.0	267.3	381.1	**770.6**	**3313.7**
Total WUA (0.001–1)		**35.8**	**78.4**	**205.5**	**162.3**	**415.0**	**1489.8**	**580.0**	**324.8**	**3291.7**	**124.9**	**76.4**	**427.6**	**617.1**	**1246.0**	**4537.7**

Year 30 Post-Project Environment

HSI	Suitability Classification	Upstream Birthday Rapids			Downstream Birthday Rapids		Keeyask GS Reservoir				Upstream Total	Downstream of Keeyask GS			Downstream Total	Overall Total
		Reach 2A	Reach 2B	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9A		Reach 9B	Reach 11	Reach 12		
WUA 0.001 – <0.25	Low	3.7	2.4	1.2	1.7	8.4	29.0	2.7	9.9	20.2	**79.3**	1.8	0.6	0.2	**2.6**	**81.9**
WUA 0.25 – <0.5	Moderate	8.9	16.1	9.2	10.6	31.5	292.6	40.6	120.8	20.2	**550.6**	5.5	21.9	5.0	**32.3**	**582.9**
WUA 0.5 – <0.75	High	10.0	31.0	26.2	48.4	102.5	851.4	243.7	209.6	79.3	**1602.1**	8.9	136.4	242.0	**387.2**	**1989.4**
WUA 0.75 – 1	Very High	14.6	40.7	183.2	186.3	586.1	1469.0	832.0	333.4	551.3	**4196.5**	42.1	266.8	368.8	**677.7**	**4874.2**
Total WUA (0.001–1)		**37.1**	**90.2**	**219.7**	**247.1**	**728.6**	**2642.0**	**1119.0**	**673.8**	**671.0**	**6428.6**	**58.3**	**425.6**	**616.0**	**1099.9**	**7528.5**

1. Location of reaches outlined in Map 6D-1.

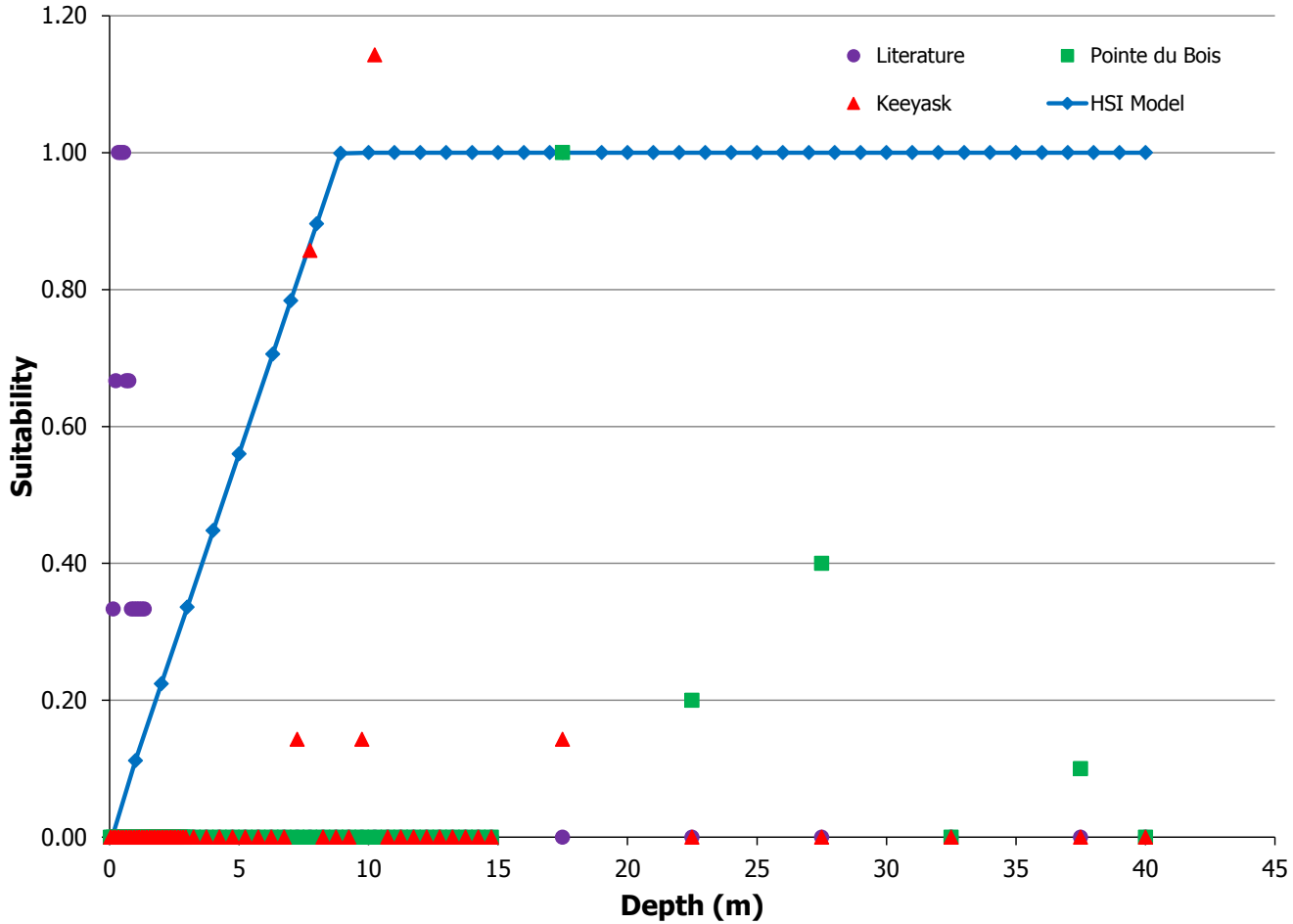


Figure 6D-1: Relative depth frequencies and estimated suitability of water depths for young-of-the-year lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature. Suitability index of 1 represents optimal conditions

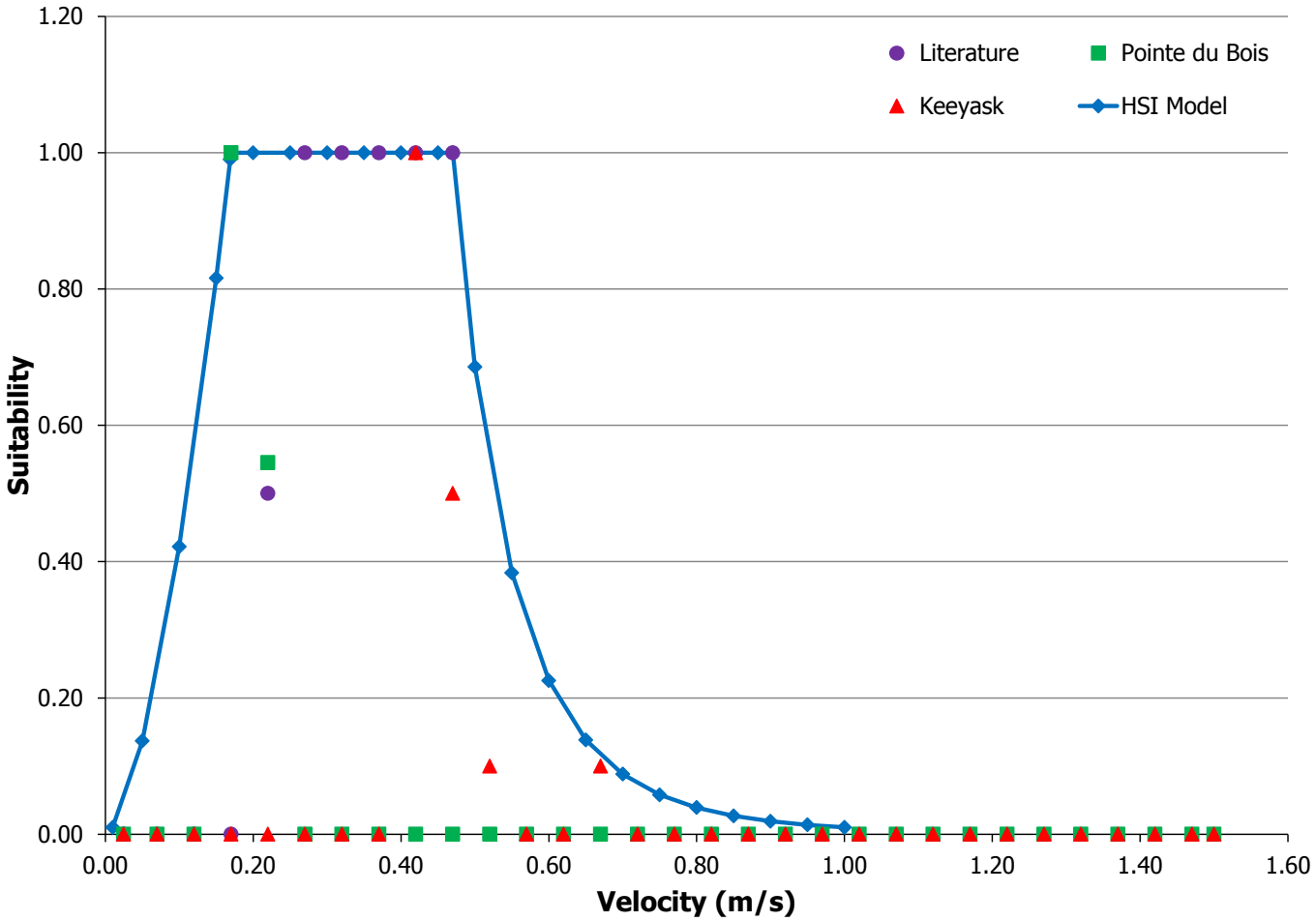


Figure 6D-2: Relative velocity frequencies and estimated suitability of water velocities for young-of-the-year lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature. Suitability index of 1 represents optimal conditions

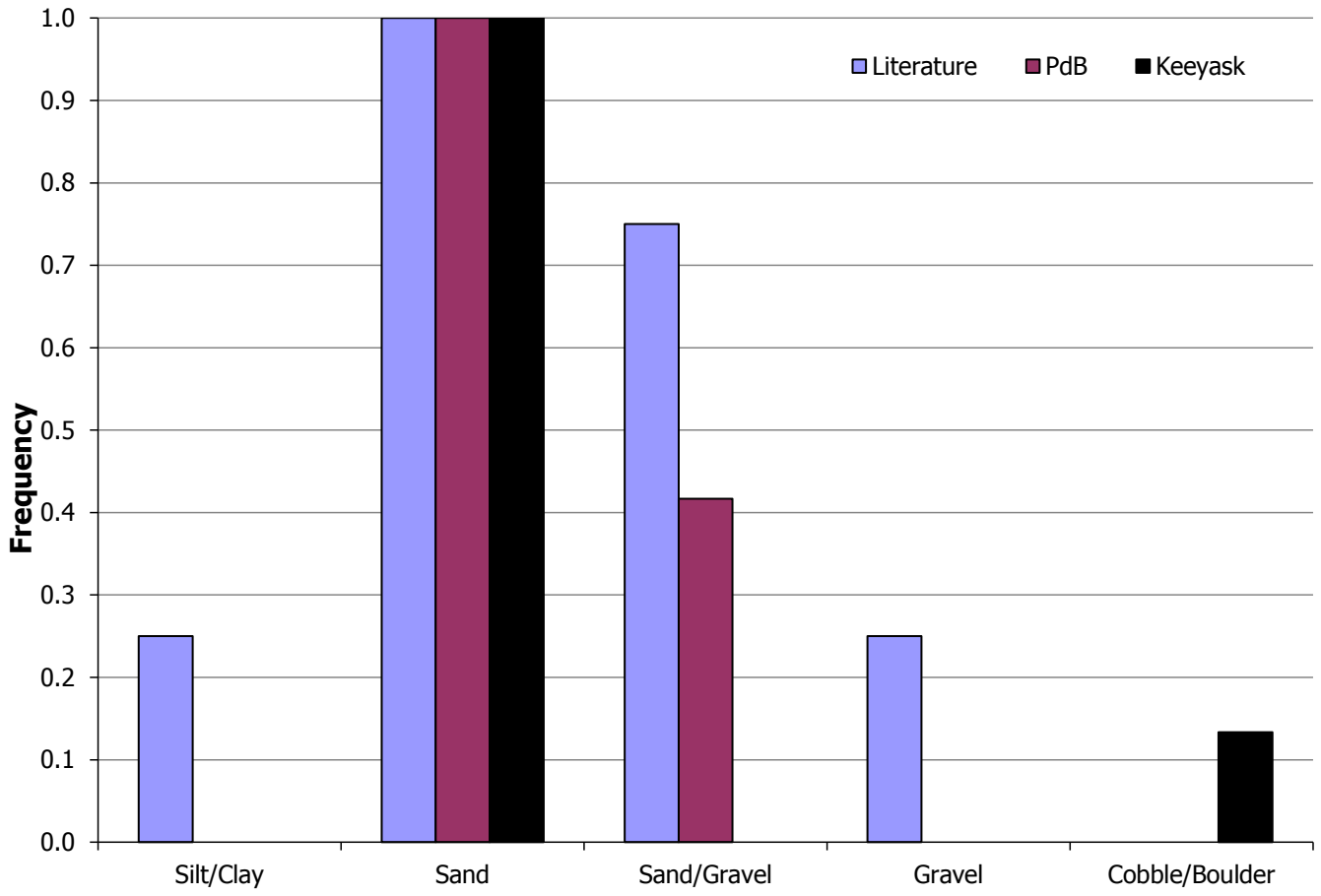


Figure 6D-3: Relative substrate type frequencies for young-of-the-year lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature

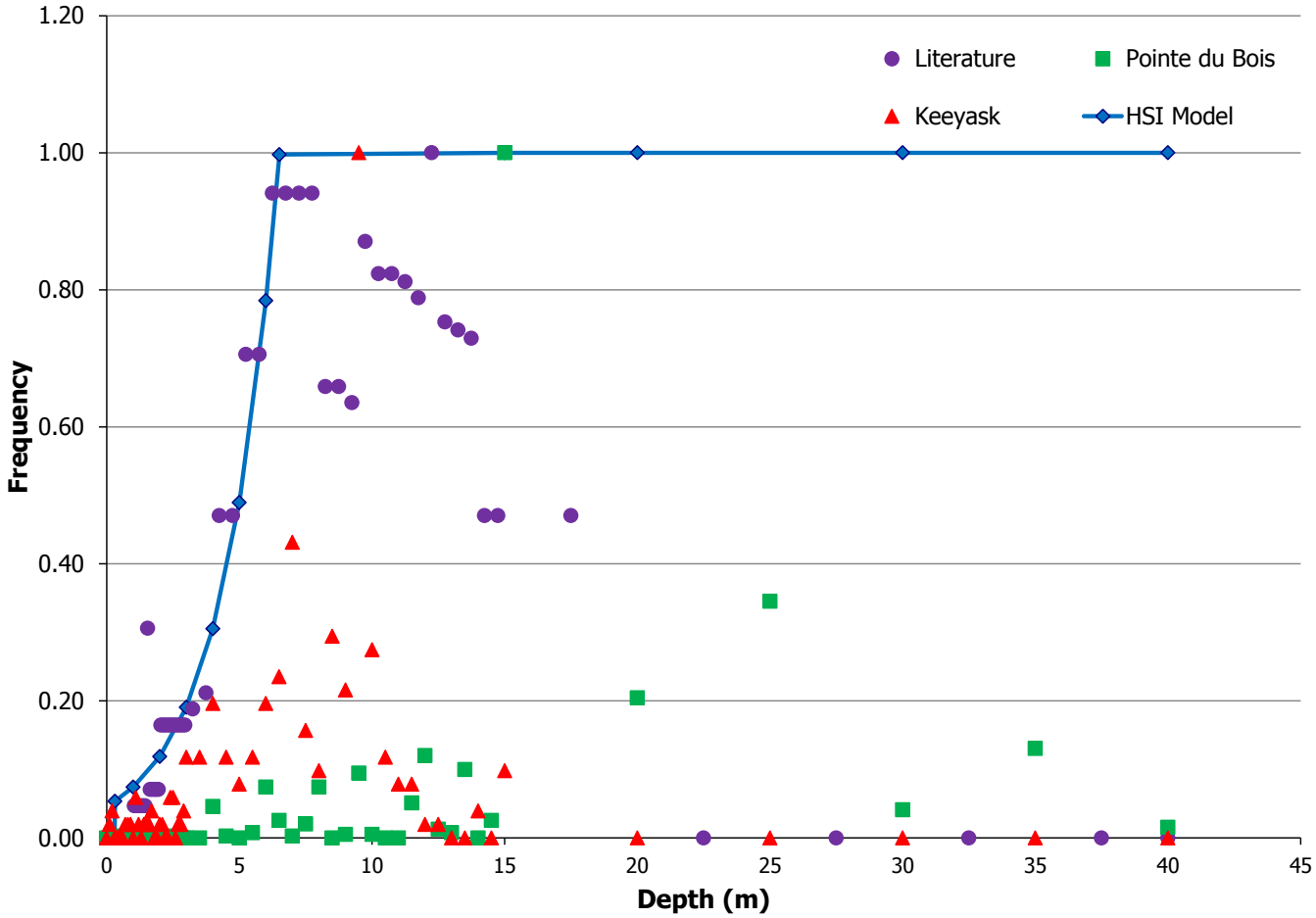


Figure 6D-4: Relative depth frequencies and estimated suitability of water depths for sub-adult lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature. Suitability index of 1 represents optimal conditions

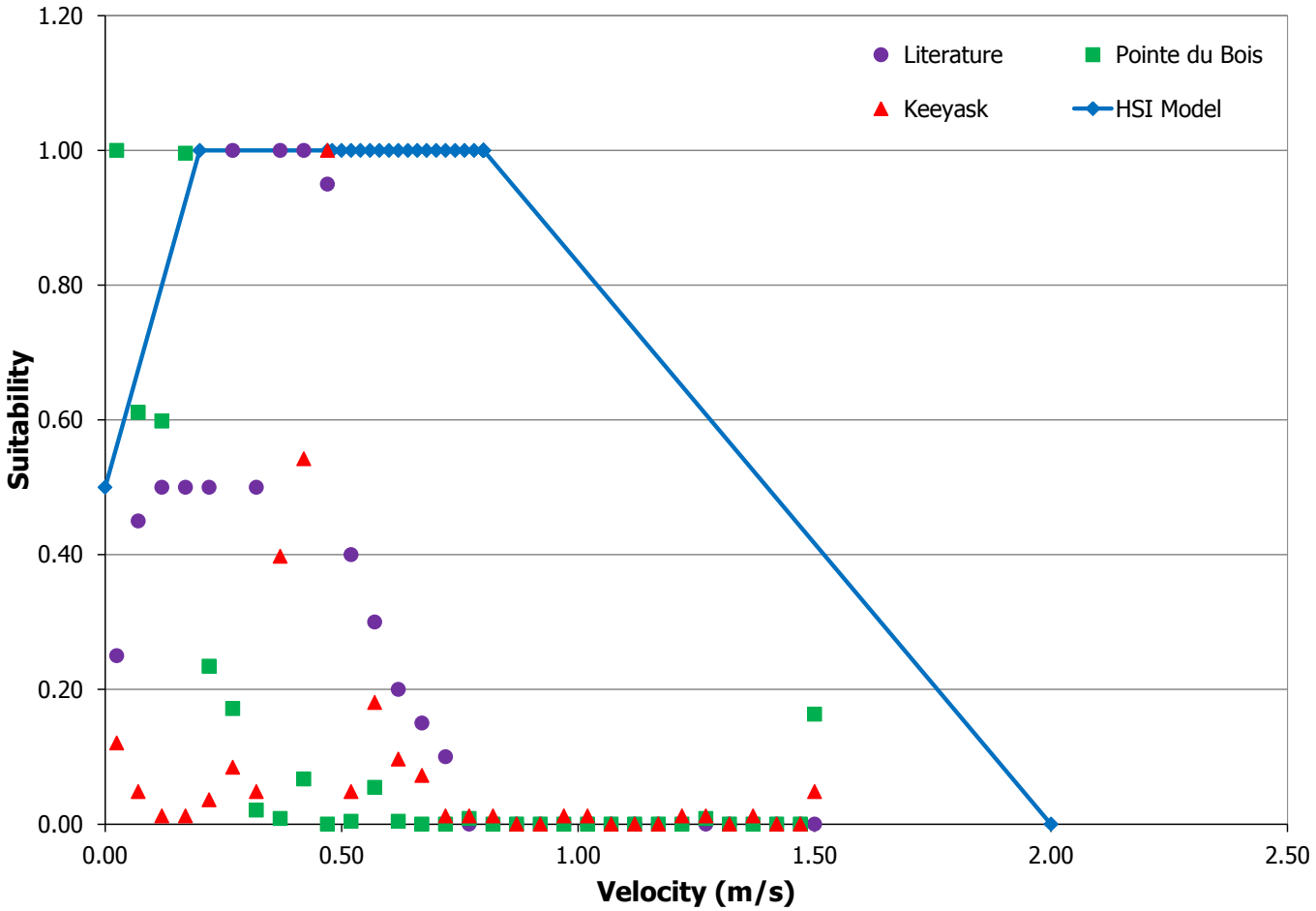


Figure 6D-5: Relative velocity frequencies and estimated suitability of water velocities for sub-adult lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature. Suitability index of 1 represents optimal conditions

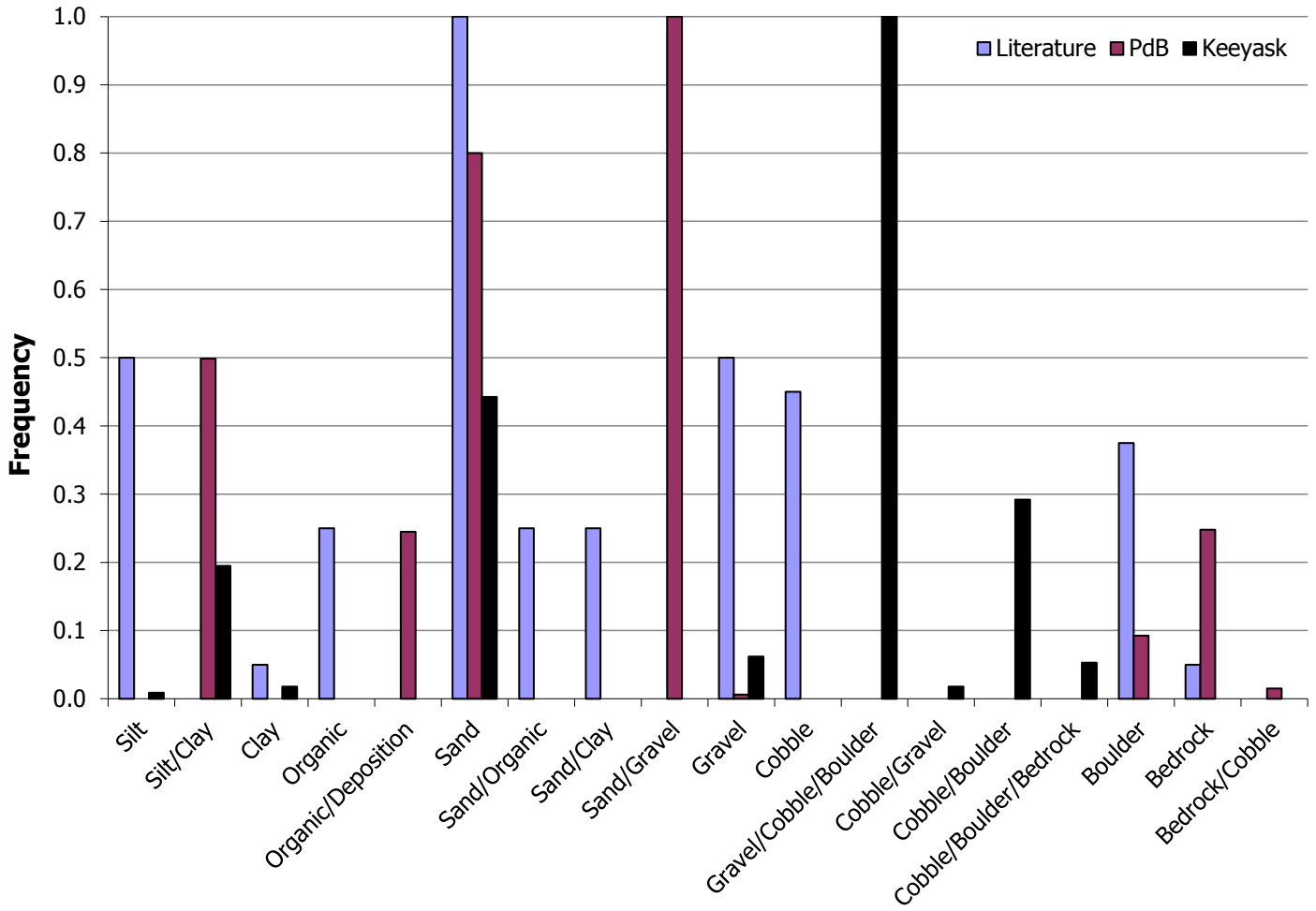


Figure 6D-6: Relative substrate type frequencies for sub-adult lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature

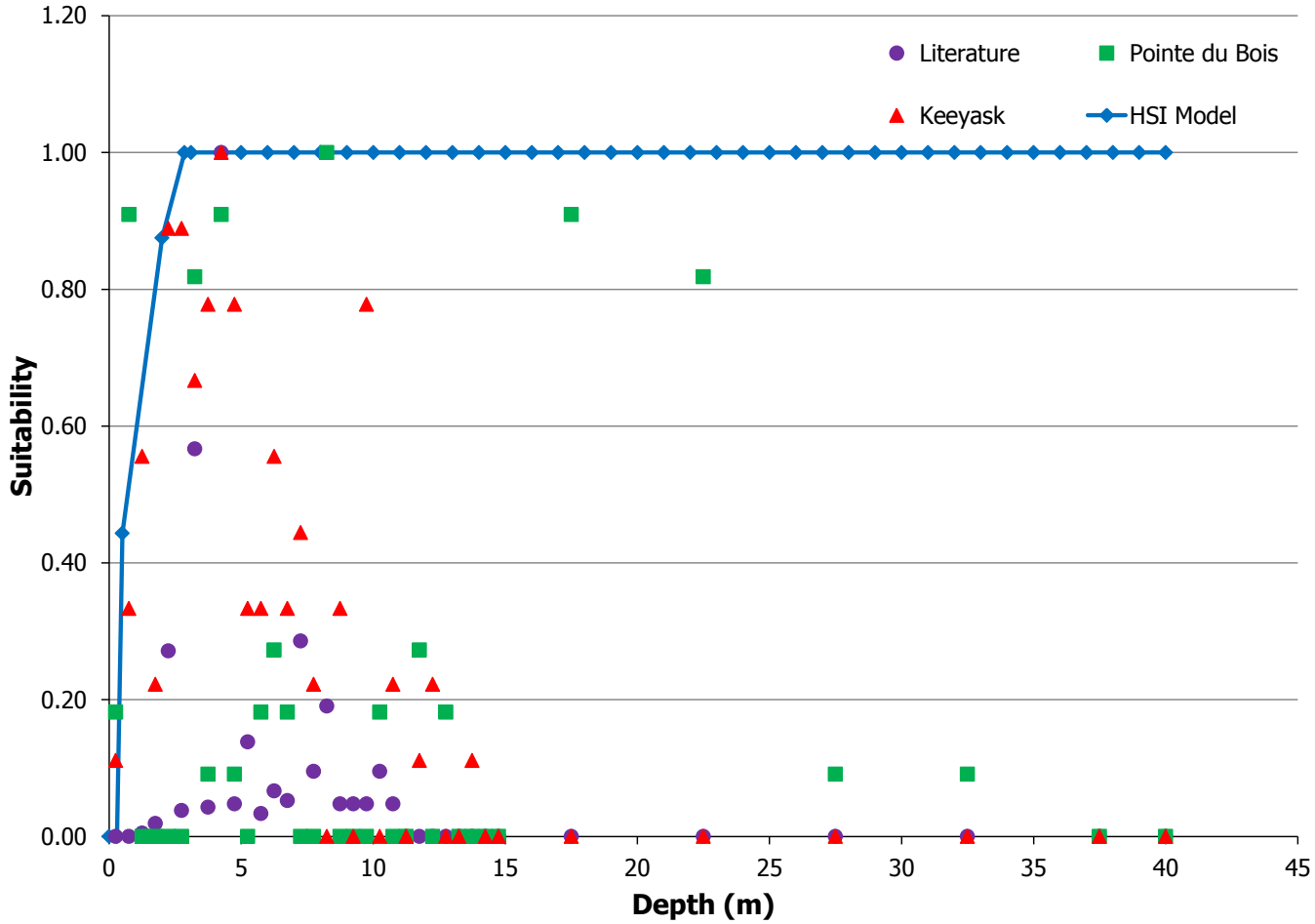


Figure 6D-7: Relative depth frequencies and estimated suitability of water depths for foraging adult lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature. Suitability index of 1 represents optimal conditions

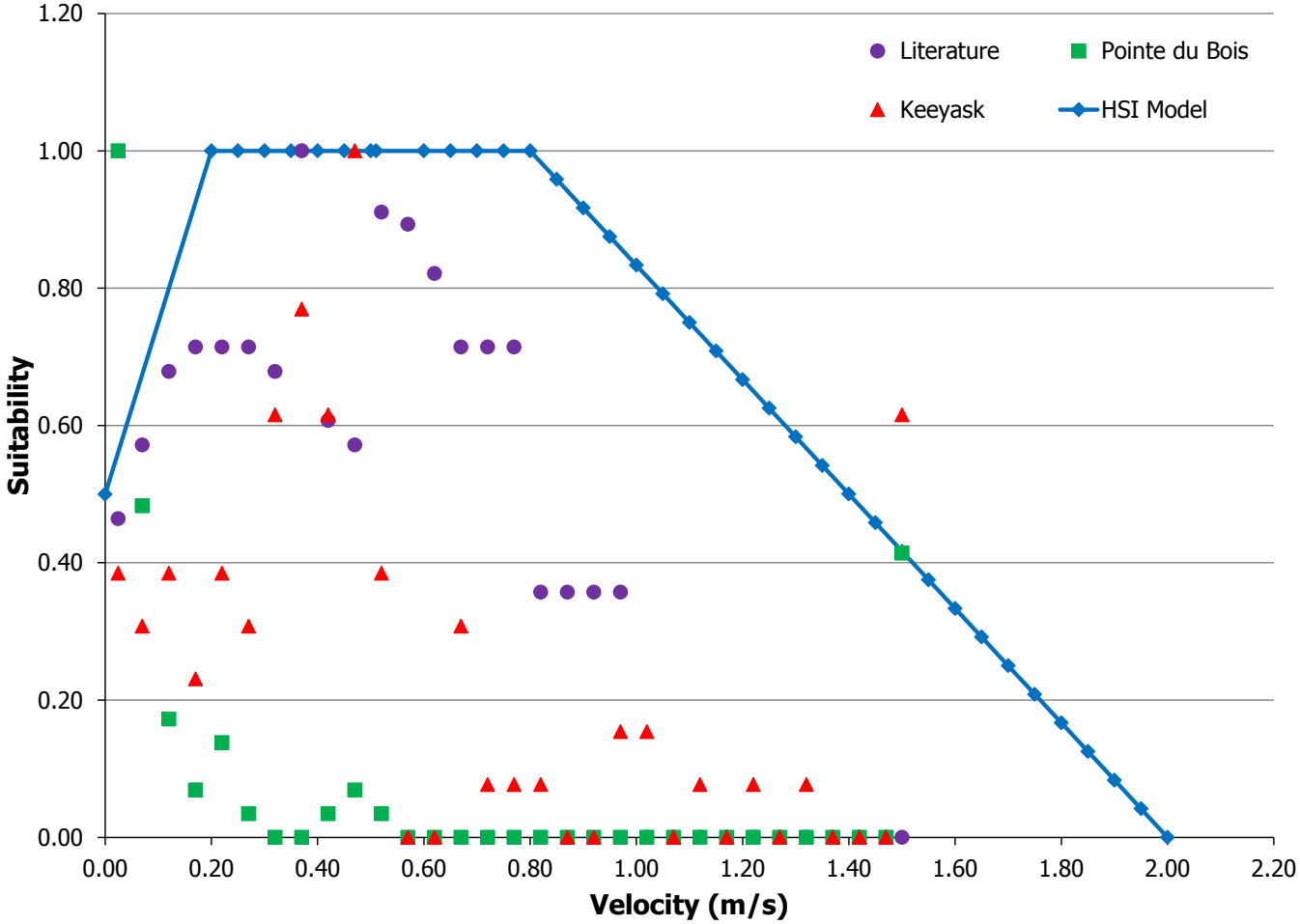


Figure 6D-8: Relative velocity frequencies and estimated suitability of water velocities for foraging adult lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature. Suitability index of 1 represents optimal conditions

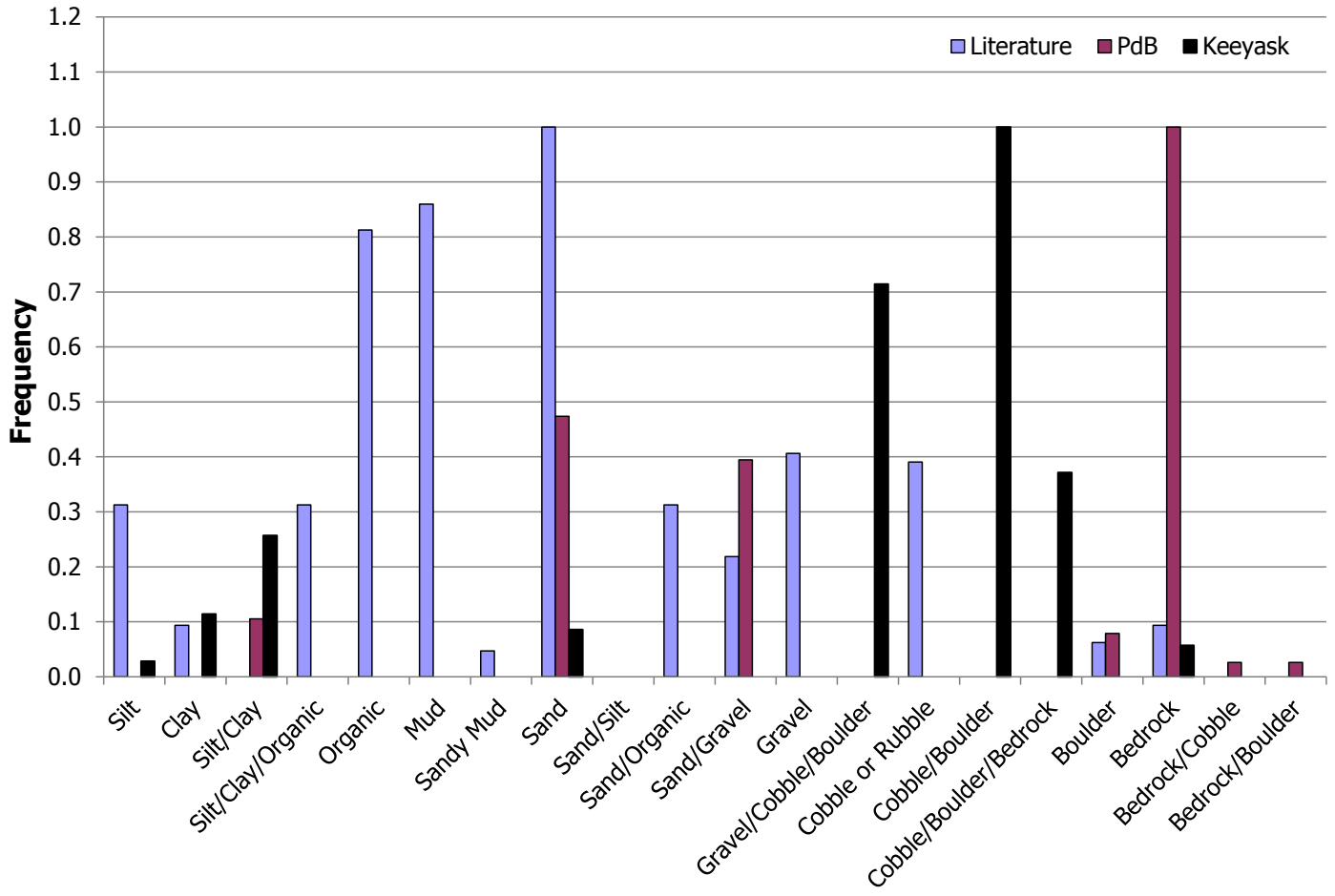


Figure 6D-9: Relative substrate type frequencies for foraging adult lake sturgeon as determined from gillnetting studies conducted in the Nelson River for the Keeyask GS Project, the Winnipeg River for the Pointe du Bois GS (PdB) Modernization Project, and the scientific literature

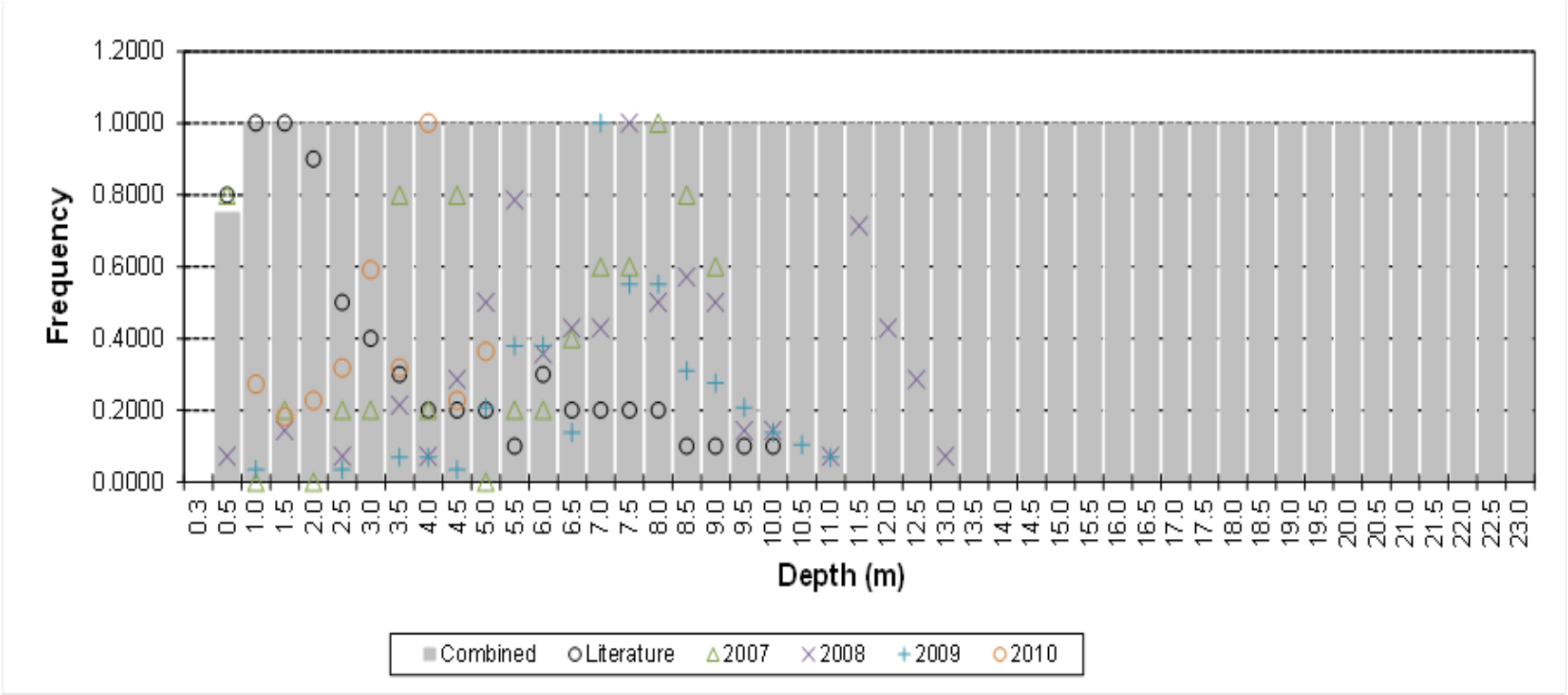


Figure 6D-10: Relative depth frequencies (data points) and estimated spawning depth suitability (vertical bars) for lake sturgeon egg deposition below the Pointe du Bois Generating Station (2007–2010) on the Winnipeg River, Manitoba, and in other water bodies documented in the scientific literature

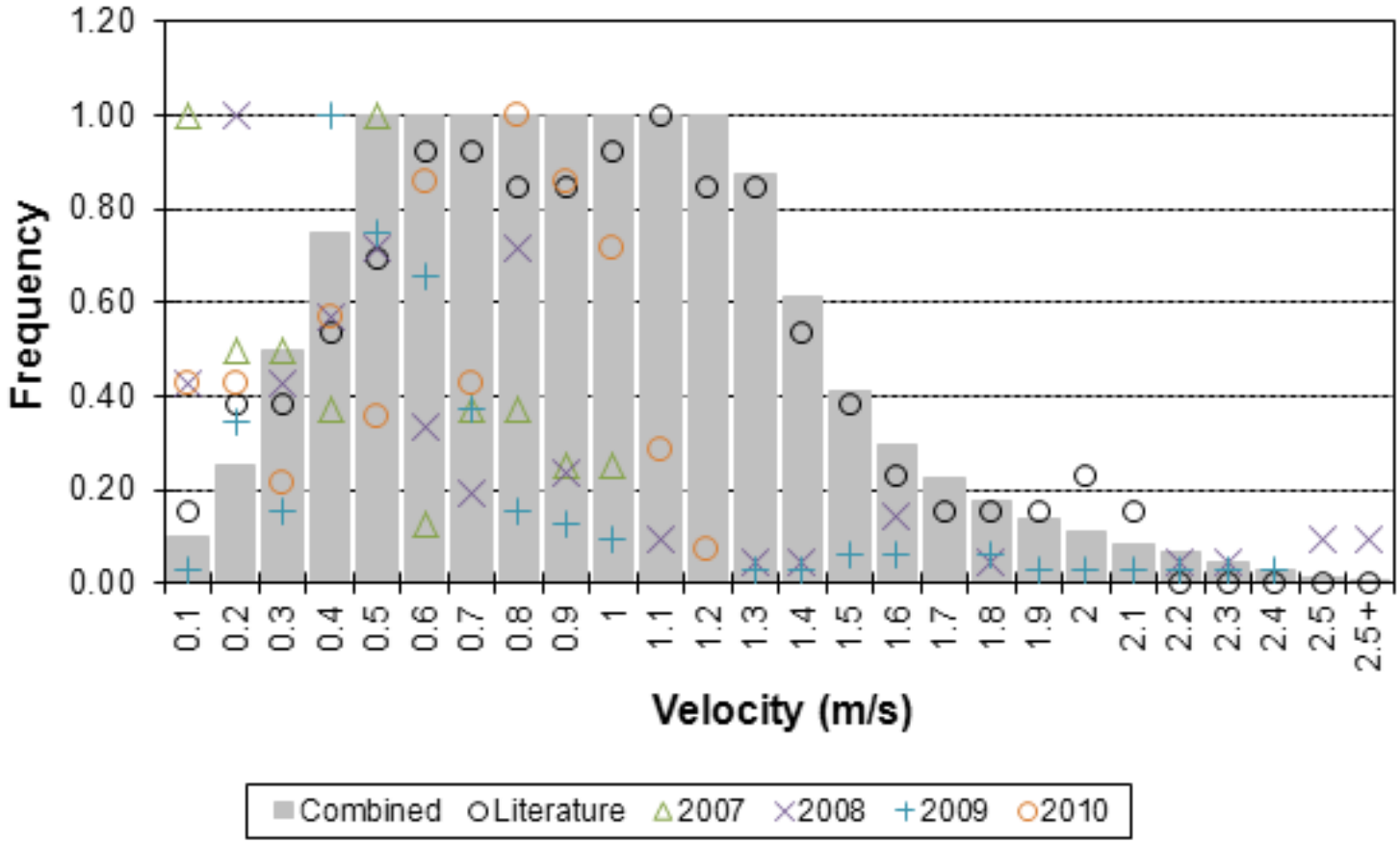


Figure 6D-11: Relative water velocity frequencies (data points) and estimated spawning velocity suitability (vertical bars) for lake sturgeon egg deposition below the Pointe du Bois Generating Station (2007–2010) on the Winnipeg River, Manitoba, and in other water bodies documented in the scientific literature

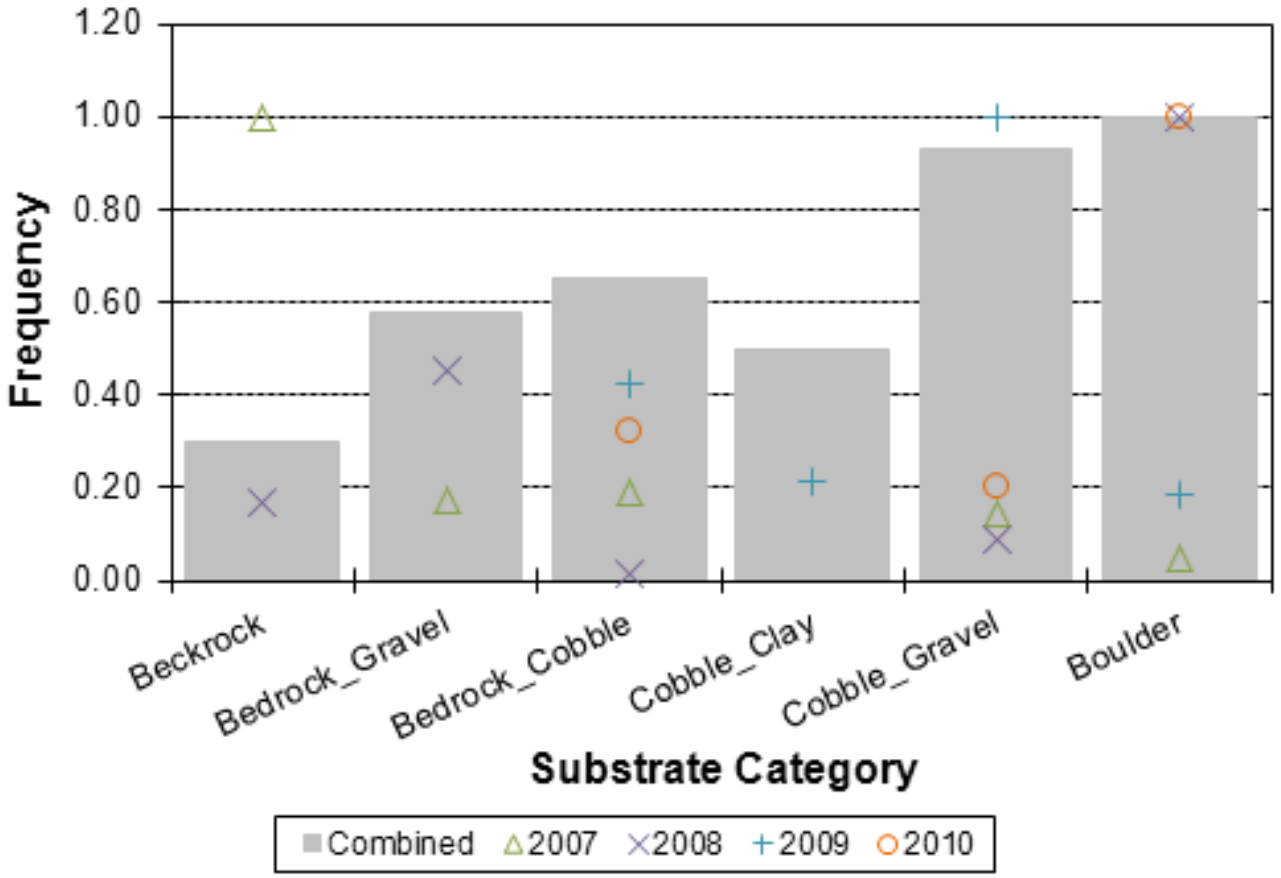


Figure 6D-12: Relative substrate type frequencies (data points) and estimated spawning substrate suitability (vertical bars) for lake sturgeon egg deposition below the Pointe du Bois Generating Station (2007–2010) on the Winnipeg River, Manitoba, and in other water bodies documented in the scientific literature

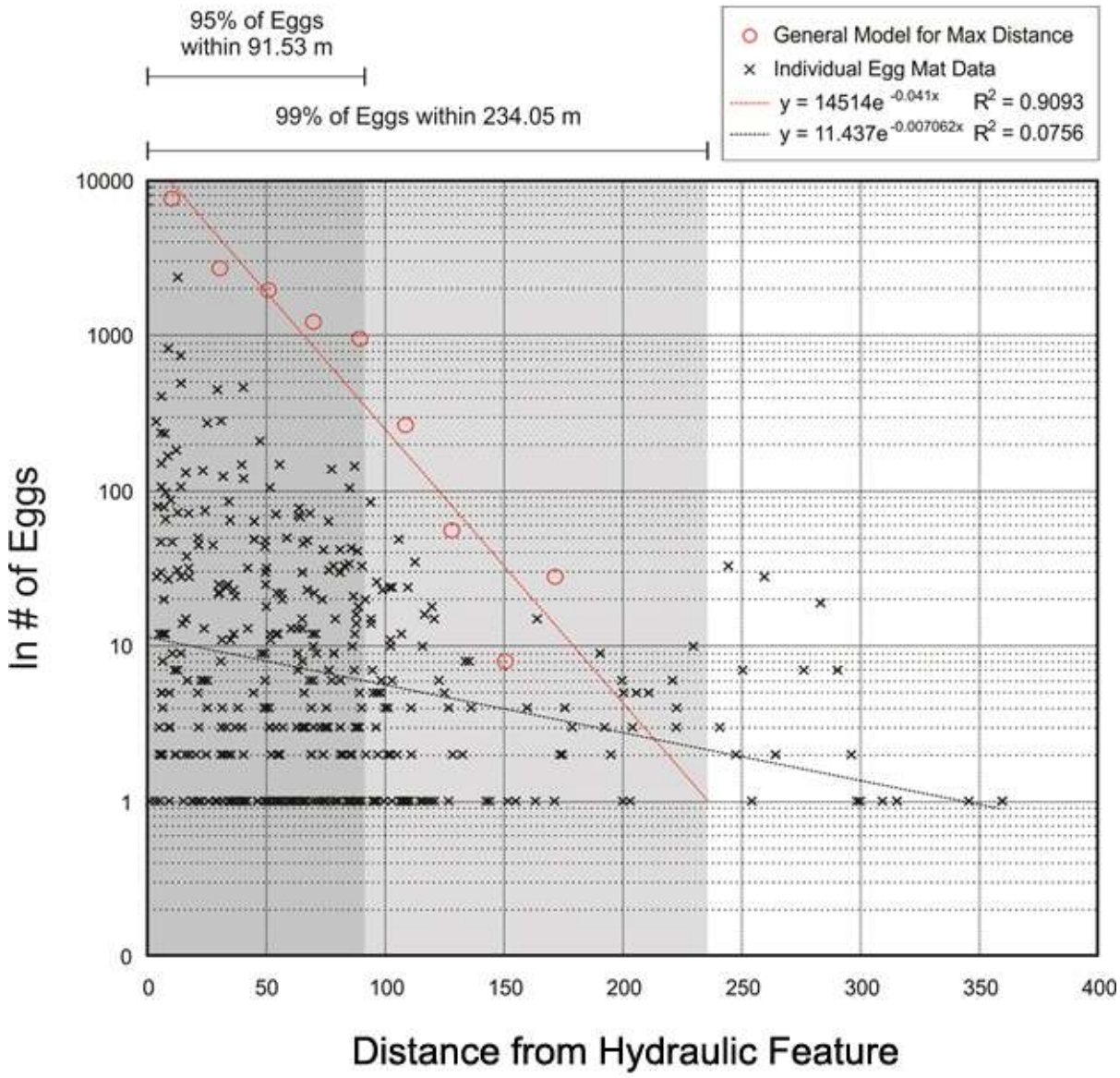
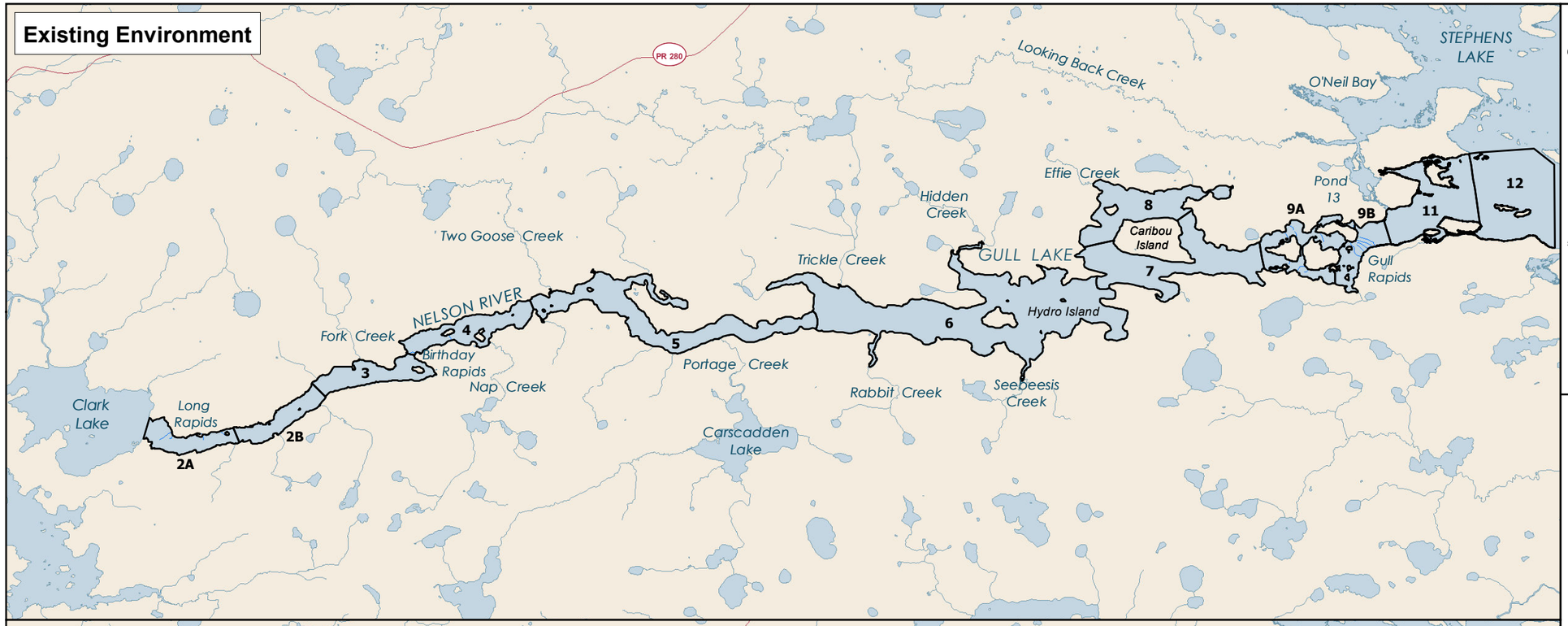
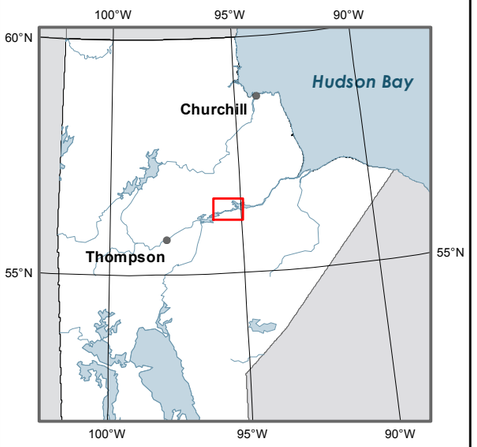


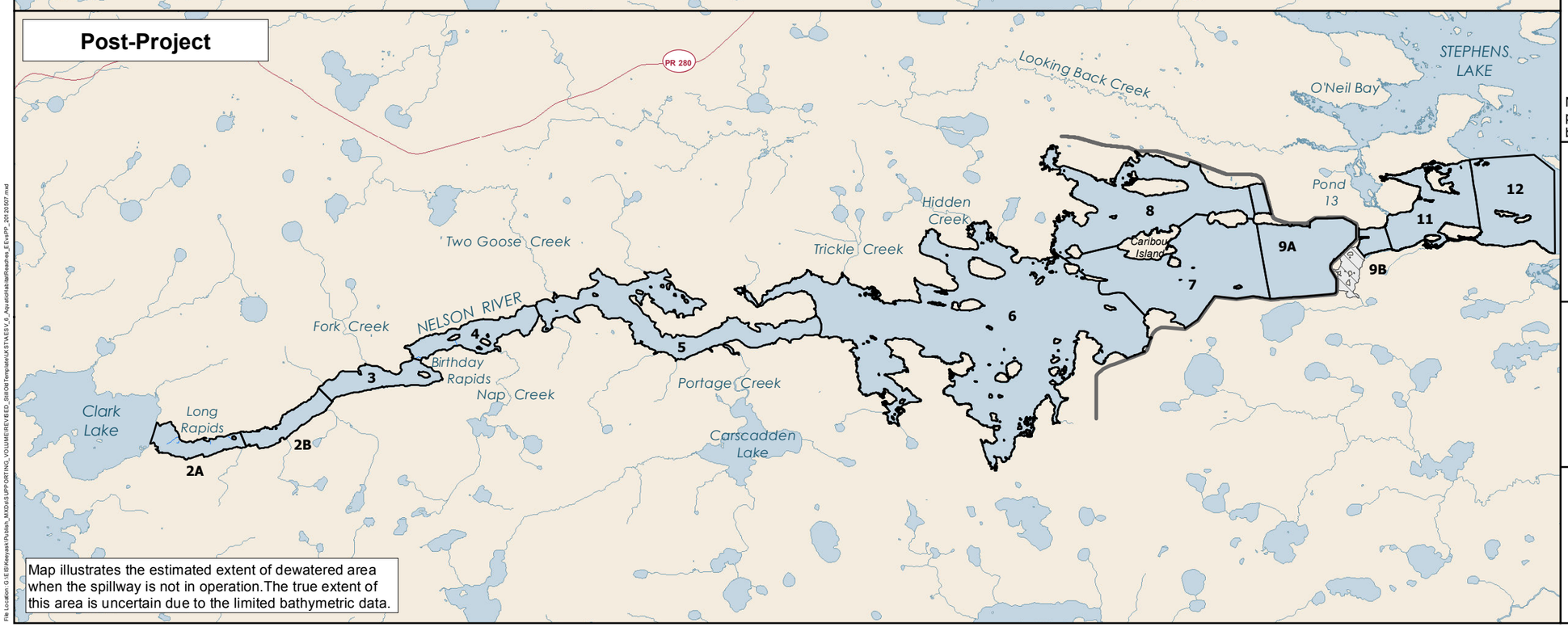
Figure 6D-13: Lake sturgeon egg counts (ln transformed) (x) versus distance (m) from a hydraulic feature (origin of flow or impassable rapids) showing the average relationship used in the model (black line). For comparison, the cumulative count of eggs (O) at an average distance within each 20 m distance bin is also shown (red line).

Existing Environment





Post-Project



Map illustrates the estimated extent of dewatered area when the spillway is not in operation.The true extent of this area is uncertain due to the limited bathymetric data.

Legend

- Reach Boundaries
- Potential Dewatered Area
- Keeyask Principal Structures

Note: Existing Environment and Post-Project frames show 95th percentile inflow. Extents of dewatered area are estimated based on the existing environment 95th percentile flow.

Projection: UTM Zone 15, NAD 83
Data Source: NTS base 1:50 000
Stephens Lake Shoreline - Quickbird@Digitalglobe, 2006
Nelson River Shoreline modelled by Manitoba Hydro

0 2 4 6 8 Kilometres
0 2 4 Miles

Aquatic Habitat Reaches

KEEYASK
Hydropower Limited Partnership

Map 6D-1

File Location: G:\EIS\Keeyask\Publish_MXD\EIS\UPPORTING_VOLUME\REVISED_SHP\06Template\KASTAESV_6_AquaticHabitatReaches_EEvsPP_20120307.mxd

APPENDIX 6E
MEAN SIZE AND CONDITION OF LAKE STURGEON CAPTURED IN THE STUDY AREA

Table 6E-1: Mean size and condition of adult lake sturgeon captured in large mesh gill nets set in the study area during spring, 2001–2008

		Fork Length (mm)					Total Length (mm)					Weight (g)					Condition Factor				
Location	**Year**	**n[1]**	**Mean**	**Std[2]**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**
Burntwood River	2001	16	1019	161	842	1439	16	1078	141	952	1446	14	7271	2205	5100	12300	14	0.80	0.17	0.50	1.13
	2002	13	1022	144	845	1315	14	1153	141	948	1445	14	10066	5606	4725	22000	13	0.81	0.06	0.71	0.92
	2005	14	1002	146	838	1310	14	1109	169	935	1470	14	9555	5639	5000	22226	14	0.86	0.12	0.70	1.01
	2006	32	1018	128	851	1325	33	1139	141	954	1476	34	10166	4927	4990	23133	32	0.86	0.09	0.66	1.02
	2007	53	1005	117	855	1354	50	1114	138	900	1470	53	9567	4228	5227	25000	52	0.88	0.10	0.71	1.12
	All	**128**	**1011**	**130**	**838**	**1439**	**127**	**1120**	**143**	**900**	**1476**	**129**	**9529**	**4597**	**4725**	**25000**	**125**	**0.86**	**0.11**	**0.50**	**1.13**
Grass River	2002	2	915	23	899	931	2	1153	238	985	1321	2	6875	884	6250	7500	2	0.90	0.18	0.77	1.03
	2006	1	983	-	983	983	1	1100	-	1100	1100	1	7257	-	7257	7257	1	0.76	-	0.76	0.76
	2007	10	1158	256	840	1640	10	1293	273	948	1765	10	20185	14007	6123	49895	10	1.12	0.16	0.89	1.36
	All	**13**	**1107**	**242**	**840**	**1640**	**13**	**1257**	**256**	**948**	**1765**	**13**	**17143**	**13440**	**6123**	**49895**	**13**	**1.06**	**0.19**	**0.76**	**1.36**
Kelsey GS area	2001	6	1014	210	836	1423	5	1025	80	920	1143	6	10275	7772	6300	26000	6	0.89	0.10	0.81	1.09
	2002	1	1130	-	1130	1130	1	1270	-	1270	1270	1	18500	-	18500	18500	1	1.28	-	1.28	1.28
	2005	3	917	39	885	960	3	1017	16	1005	1035	3	6890	1057	5670	7500	3	0.89	0.10	0.82	1.01
	2006	12	1034	141	881	1346	12	1160	177	969	1498	12	12058	6919	6804	27216	12	1.01	0.18	0.76	1.48
	2007	30	1015	182	835	1475	28	1127	203	920	1600	29	10417	7088	4082	33112	29	0.87	0.12	0.54	1.09
	All	**52**	**1016**	**169**	**835**	**1475**	**49**	**1121**	**183**	**920**	**1600**	**51**	**10737**	**6881**	**4082**	**33112**	**51**	**0.92**	**0.15**	**0.54**	**1.48**
Odei River	**2007**	**18**	**998**	**107**	**850**	**1298**	**17**	**1094**	**113**	**964**	**1414**	**18**	**9609**	**3570**	**5455**	**20909**	**18**	**0.94**	**0.11**	**0.72**	**1.24**
Split Lake	2001	4	994	165	851	1168	3	1092	221	952	1346	3	9087	6309	5100	16360	3	0.93	0.10	0.83	1.03
	2002	1	1083	-	1083	1083	1	1193	-	1193	1193	1	10300	-	10300	10300	1	0.81	-	0.81	0.81
	2005	8	1101	206	849	1492	8	1206	196	958	1558	8	14602	9652	6136	35909	8	0.99	0.09	0.84	1.08
	2006	4	1099	111	995	1235	4	1225	131	1100	1380	4	12304	6313	6804	20865	4	0.87	0.18	0.69	1.11
	2007	6	967	60	880	1050	6	1061	55	990	1115	5	6849	1383	5670	9072	5	0.79	0.07	0.72	0.89
	All	**23**	**1046**	**154**	**849**	**1492**	**22**	**1154**	**160**	**952**	**1558**	**21**	**11326**	**7297**	**5100**	**35909**	**21**	**0.90**	**0.13**	**0.69**	**1.11**
Nelson River (CL-GR)[3]	2001	73	1048	140	835	1355	72	1152	145	920	1461	71	10542	4955	4250	25000	71	0.88	0.13	0.64	1.26
	2002	60	1065	136	842	1415	60	1175	148	944	1543	58	12521	6128	5443	34020	58	0.97	0.15	0.73	1.39
	2003	84	1085	133	838	1540	83	1204	139	945	1740	78	13432	6791	6350	54431	78	1.02	0.19	0.67	1.49
	2004	54	1132	152	870	1468	54	1260	178	986	1800	54	13385	6722	5443	31298	54	0.86	0.12	0.62	1.10
	2006	107	1102	140	837	1550	105	1208	149	915	1655	107	12334	6498	4800	43091	107	0.86	0.13	0.64	1.44
	2008	40	1126	155	845	1403	37	1220	166	925	1535	39	13526	6552	4763	28576	39	0.87	0.11	0.66	1.08
	All	**418**	**1090**	**143**	**835**	**1550**	**411**	**1200**	**154**	**915**	**1800**	**407**	**12512**	**6344**	**4250**	**54431**	**407**	**0.91**	**0.16**	**0.62**	**1.49**
Gull Rapids	2001	22	1101	170	872	1447	22	1199	182	940	1539	22	13598	9157	5500	38000	22	0.90	0.14	0.71	1.29
	2002	4	1045	51	1001	1100	3	1195	120	1100	1330	4	10888	2995	8050	15000	4	0.94	0.14	0.80	1.13
	2003	24	1105	144	912	1340	24	1219	151	1006	1472	22	13024	6118	6123	25000	22	0.92	0.14	0.72	1.20
	2004	5	1175	105	1025	1299	5	1295	113	1125	1419	4	16254	5265	9450	20412	4	1.03	0.20	0.88	1.32
	2005	4	1009	82	900	1100	1	1205		1205	1205	3	11037	4091	6804	14969	3	1.05	0.10	0.93	1.12
	2006	14	1151	162	902	1421	12	1296	169	1050	1570	13	13817	6352	5897	24948	13	0.88	0.11	0.73	1.05
	All	**73**	**1109**	**149**	**872**	**1447**	**67**	**1231**	**161**	**940**	**1570**	**68**	**13338**	**6970**	**5500**	**38000**	**68**	**0.92**	**0.14**	**0.71**	**1.32**
Stephens Lake	2003-2006	8	1047	118	850	1245	8	1155	122	950	1365	8	10511	3502	5443	17237	8	0.89	0.04	0.84	0.95

1. n = number of fish measured.
2. Std = standard deviation.
3. CL-GR = Clark Lake to Gull Rapids.

Table 6E-2: Mean size and condition of adult lake sturgeon captured in large mesh gill nets set in the study area during summer 2006

	Fork Length (mm)					Total Length (mm)					Weight (g)					Condition Factor				
Location	**n[1]**	**Mean**	**Std[2]**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**
Kelsey GS area	8	935	86	840	1044	8	1049	100	930	1180	8	7286	2706	4082	10886	8	0.86	0.15	0.62	1.08
Split Lake	3	967	107	845	1045	3	1047	100	950	1150	3	8165	3175	4990	11340	3	0.87	0.11	0.79	0.99
Nelson River (CL-GR)[3]	14	1041	163	840	1300	14	1157	177	942	1461	8	10512	5888	5443	19731	8	0.84	0.09	0.64	0.96
Stephens Lake	2	1205	120	1120	1290	2	1335	106	1260	1410	2	17859	6818	13038	22680	2	0.99	0.09	0.93	1.06

1. n = number of fish measured.
2. Std = standard deviation.
3. CL-GR = Clark Lake to Gull Rapids.

Table 6E-3: Mean size and condition of sub-adult lake sturgeon captured in large mesh gill nets set in the study area during spring, 2001–2008

		Fork Length (mm)					Total Length (mm)					Weight (g)					Condition Factor				
Location	**Year**	**n[1]**	**Mean**	**Std[2]**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**
Burntwood River	2001–2007	16	710	131	354	833	16	795	147	405	970	15	3577	1325	1364	5455	15	0.83	0.14	0.57	0.97
Kelsey GS area	2001–2007	31	762	88	605	829	31	859	121	693	990	30	4094	1407	1588	6577	30	0.90	0.16	0.46	1.18
Split Lake	2001–2007	15	756	60	626	820	14	846	65	711	925	14	4127	1190	1818	5897	14	0.92	0.13	0.71	1.15
Odei River	2005–2007	6	707	95	542	810	6	793	89	641	900	6	3030	1234	1364	4318	6	0.81	0.09	0.68	0.92
Nelson River (CL-GR)[3]	2001	6	784	35	739	820	6	887	26	855	925	6	4000	447	3500	4500	6	0.83	0.13	0.63	0.99
	2002	3	745	57	680	785	3	851	66	775	892	3	3931	1048	2722	4536	3	0.93	0.06	0.87	0.99
	2003	5	755	58	700	821	5	857	70	786	935	5	4183	1161	3000	5897	5	0.95	0.08	0.86	1.07
	2006	40	720	110	300	830	40	801	123	324	915	36	3604	995	1134	5216	36	0.84	0.09	0.61	1.00
	2008	11	739	58	648	832	11	834	67	724	951	10	3391	991	2268	5216	10	0.82	0.11	0.70	1.04
	All	**65**	**733**	**94**	**300**	**832**	**65**	**821**	**106**	**324**	**951**	**60**	**3673**	**967**	**1134**	**5897**	**60**	**0.85**	**0.10**	**0.61**	**1.07**
Gull Rapids	2001-2006	6	780	17	759	800	4	897	54	861	978	5	4117	340	3629	4475	5	0.88	0.08	0.82	1.02
Stephens Lake	2003-2006	3	684	140	555	833	3	772	147	641	931	3	2733	929	1700	3500	3	0.87	0.23	0.61	1.02

1. n = number of fish measured.
2. Std = standard deviation.
3. CL-GR = Clark Lake to Gull Rapids.

Table 6E-4. Mean size and condition of sub-adult lake sturgeon captured in medium and large mesh gill nets set in the study area during summer and fall, 2002–2008

		Fork Length (mm)					Total Length (mm)					Weight (g)					Condition Factor				
Location	**Year**	**n[1]**	**Mean**	**Std[2]**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**
Kelsey GS area	2006	5	782	22	750	810	5	868	46	811	920	5	4699	680	3629	5443	5	0.98	0.09	0.86	1.10
Split Lake	2006	6	573	138	353	785	6	655	154	401	882	5	2041	907	1361	3629	5	0.84	0.08	0.75	0.94
Nelson River (CL-GR)[3]	2002-2008	142	604	143	244	832	141	687	159	283	950	85	1868	1141	110	5216	85	0.74	0.09	0.54	1.08
Gull Rapids	2006-2008	8	592	107	428	738	8	665	118	483	832	7	1957	848	575	3100	7	0.78	0.09	0.63	0.90

1. n = number of fish measured.
2. Std = standard deviation.
3. CL-GR = Clark Lake to Gull Rapids.

Table 6E-5. Mean age, size, and condition of young-of-the-year (YOY) and sub-adult lake sturgeon captured in medium mesh gill nets set in Gull Lake during fall 2008

		Fork Length (mm)					Total Length (mm)					Weight (g)					Condition Factor				
Life Stage	**Age (y)**	**n***	**Mean**	**Std****	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**	**n**	**Mean**	**Std**	**Min**	**Max**
YOY	0+	-	-	-	-	-	14	157	11	128	168	-	-	-	-	-	-	-	-	-	-
Sub-adult	1	2	246	2	244	247	2	283	0	283	283	1	-	-	110	110	1	-	-	0.76	0.76
	2	12	357	21	325	389	11	409	20	385	442	4	355	62	300	440	4	0.74	0.12	0.63	0.87

*n = number of fish measured.
**Std = standard deviation.