



ASSESSMENT OF WHETHER UPSTREAM PASSAGE FOR LAKE STURGEON IS NEEDED AT THE POINTE DU BOIS GENERATING STATION (WINNIPEG RIVER)



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Figure 1. Area outlined on map shows the portion of Winnipeg River system (DU5) where Pointe du Bois Generating Station (GS) is located.

Context:

Manitoba Hydro must modernize the Pointe du Bois Generating Station on the Winnipeg River (Figure 1), which will involve replacing the spillway and associated dam segments and either replacing the powerhouse or maintaining, repairing or rehabilitating it. In November 2006, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed the Winnipeg River - English River Lake Sturgeon (*Acipenser fulvescens*) populations, Designatable Unit 5, as Endangered. The reach of Winnipeg River between the Pointe du Bois GS and Slave Falls GS, known as Management Unit 5, contains abundant numbers of Lake Sturgeon which spawn at the base of Pointe du Bois falls and at the outlet of the existing powerhouse. There are concerns that changes to the Pointe du Bois GS will change this spawning habitat and could negatively impact Lake Sturgeon spawning success.

When Manitoba Hydro decides on how it will modernize the Pointe du Bois GS, DFO will likely be required to make regulatory decisions regarding the proposed changes to the GS, including whether Manitoba Hydro will be required to construct upstream fish passage facilities. DFO Habitat Management requested advice from Science on whether upstream passage at the Pointe du Bois GS would be beneficial or detrimental to Lake Sturgeon in the Winnipeg River given the potential negative impacts of the proposed changes to the GS on Lake Sturgeon spawning habitat below Pointe du Bois, the overall status of Lake Sturgeon in the Winnipeg River and the uncertainty surrounding the quality of habitat

upstream of Pointe du Bois.

A science review of the advisory request was conducted on 22 October, 2009. Participants were given a brief overview of the proposal to modernize the GS and reviewed current knowledge of Lake Sturgeon in the area, particularly in MU5. This Science Advisory Report summarizes the potential impacts of the GS modernization on Lake Sturgeon spawning habitat in MU5. It also outlines potential advantages and disadvantages of providing upstream fish passage for Lake Sturgeon at the Pointe du Bois GS and current gaps in knowledge that prevent a full assessment and conclusions. DFO Science and Habitat Management, provincial governments, aboriginal peoples, industry and academia participated in the meeting.

SUMMARY

- Manitoba Hydro must modernize the Pointe du Bois Generating Station (GS) on the Winnipeg River.
- The status of Lake Sturgeon in Designatable Unit (DU) 5, which includes the Winnipeg River, has been assessed as Endangered by the Committee on the Status of Endangered Wildlife in Canada.
- Experts at a recent DFO Recovery Potential Assessment (RPA) meeting identified Management Unit (MU) 5, located immediately downstream of the Pointe du Bois GS, as healthy.
- MU5 contains a relatively high density of Lake Sturgeon, suggesting the population could be near the carrying capacity of the habitat.
- The only spawning area in MU5, immediately below the Pointe du Bois GS, may be significantly altered due to changes in water flow, depending on the design chosen for modernization. Most meeting participants believe the potential changes could negatively affect spawning success, but consensus was not reached on this conclusion.
- A potential benefit of providing upstream fish passage for Lake Sturgeon at the Pointe du Bois GS would be to increase genetic diversity within the Winnipeg River.
- Another potential benefit would be to allow Lake Sturgeon, from the relatively dense population below the GS, to move upstream into MU4 where unfilled habitat may be available and Lake Sturgeon abundance is lower.
- A potential disadvantage of providing fish passage at the GS would be the loss of individual Lake Sturgeon from the healthy population in MU5 with no accompanying benefit to MU4, as the availability of suitable habitat and potential risk of harm there is unknown.
- There would be no net gain to MUs 4 or 5 if migrating Lake Sturgeon returned to MU5 rather than proceeding upstream.
- Several gaps in knowledge need to be filled before the benefits, detrimental impacts and relative risks associated with providing upstream fish passage at Pointe du Bois GS can be fully assessed.

INTRODUCTION

Historically, the Winnipeg River flowed from the Manitoba-Ontario border to Lake Winnipeg along a series of low gradient areas interspersed by short stretches of high gradient. A hydroelectric GS was built at the Pointe du Bois falls beginning in 1909 which became fully operational in 1926. It was the first such station on the Winnipeg River. Today there are eight dams along the Winnipeg River: six in Manitoba and two in Ontario.

It is unknown whether there was any Lake Sturgeon passage at the Pointe du Bois falls before the current station was built and there is no way to address this knowledge gap. The falls are about 14 m high and consist of a series of rock shelves and pools, so it may have been historically possible for fish to move upstream during high flows. Some First Nations elders believe that upstream passage was possible (DFO 2010). No upstream fish passage currently exists at the Pointe du Bois GS. Downstream fish passage at the site was, and is, possible although it is more dangerous now for fish that pass through the turbines. The passage of Lake Sturgeon through the turbines is thought to be unlikely as trashracks preclude entry of adult-size fish.

In November 2006, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed the Winnipeg River–English River Lake Sturgeon (*Acipenser fulvescens*) populations as Endangered (DFO 2010). The river reach from Pointe du Bois downstream to Slave Falls (MU5) is known to contain abundant numbers of Lake Sturgeon. This may be due in part to the availability of good spawning habitat below the Pointe du Bois GS. Modernization of the GS will change the configuration of the station, thereby altering current flow patterns and habitat availability. Depending on the configuration design chosen, these changes could negatively impact spawning habitat.

ASSESSMENT

Pointe du Bois GS

Pointe du Bois is a run-of-the-river GS with a spillway set perpendicular to the Winnipeg River at a natural set of falls (Figure 2). The powerhouse is located on the opposite (west) side of the river at the end of an excavated channel adjacent to the falls. Manitoba Hydro must modernize the century-old Pointe du Bois GS to bring it up to modern dam safety guidelines. This would consist of building a new spillway and associated dam segments and either (1) building a new powerhouse and decommissioning the existing facilities, (2) rehabilitating the existing powerhouse and installing new generators/systems or (3) repairing/maintaining the existing plant and systems. No design has been chosen yet but the new GS is expected have the following features compared with the existing station:

- facility will continue to operate as a run-of-the-river plant,
- maximum forebay will be no higher and minimum forebay no lower than at present,
- velocity will change (contingent on design selected),
- no additional flow will be produced although there will be a small permanent increase in wetted area upstream of the new spillway,
- fluctuations in water levels will not exceed current levels (< 0.3 m),
- number of spillway bays will be reduced from the existing 97 to less than 10,
- if the existing powerhouse is not replaced the frequency of spill will remain at 70%, however if the powerhouse is replaced frequency of spill will be reduced to 30%, and
- capacity will increase from 78 MW to 120 MW if the powerhouse is rebuilt.

Lake Sturgeon biology and ecology near Pointe du Bois GS

Historical information

Lake Sturgeon were commercially fished in the Winnipeg River from 1910 to the 1960s. Some landings were reported (79,000 kg in 1910; 145,437 kg between 1939 and 1947; and 28,800 kg between 1957 and 1959), but catch locations were not recorded. Recreational and First Nations subsistence harvest continued until a species conservation closure was implemented in the Manitoba portion of the Winnipeg River in 1993. No recreational harvest is allowed in Manitoba or Ontario, although a popular catch-and-release recreational fishery for Lake Sturgeon continues near the Pointe du Bois GS. First Nations subsistence harvest is still allowed in Ontario although the fishery is not currently active.

The Manitoba Fisheries Branch conducted an annual Lake Sturgeon tagging program between 1983 and 1998. Population estimates were produced for Lake Sturgeon in MU5 for each year between 1994 and 1997. They ranged between 360 and 1,100 Lake Sturgeon with lower- and upper-most 95% confidence intervals of 186 and 8,393, respectively (DFO 2010).

Current status of Lake Sturgeon

During a recent RPA workshop, experts examined the most recent information available for Lake Sturgeon populations in the Winnipeg River and decided that the current conservation status of Lake Sturgeon in MU4, from Caribou Falls GS and Whitedog GS to Pointe du Bois GS (Figure 3), is cautious and its population trajectory is stable¹. The current conservation status of Lake Sturgeon in MU5 is healthy and its population trajectory stable² (DFO 2010). Both MUs were identified as being important to the recovery of Lake Sturgeon in DU5. The recommended recovery target for DU5, to achieve a 99% probability of Lake Sturgeon persistence over 250 years assuming a balanced sex ratio and five-year spawning periodicity, is for each MU to have at least 413 annual female spawners and 1,886 ha of suitable riverine habitat. MU5 does not contain enough total area to meet the recommended habitat target and, thus, the recommended abundance target. The density of Lake Sturgeon in MU5 suggests that the population could be near the carrying capacity of the available habitat.

Results of recent research

Since 2006, Manitoba Hydro has been conducting research on the aquatic ecosystem from just upstream of Lamprey Rapids, about 13 river km above the Pointe du Bois GS in the lower end of MU4, downstream to Scots Rapids, about 7 river km below the Slave Falls GS in the upper end of MU6 (Figure 1). The study was designed to understand the aquatic ecosystem around Pointe du Bois to aid in the mitigation of impacts of the proposed modernization of the GS, particularly on Lake Sturgeon. The research was not specifically directed at investigating fish passage at the Pointe du Bois GS. The Lake Sturgeon portion of the study examined the biology and ecology of Lake Sturgeon within the study area, including current size and condition, habitat use, important habitat and its physical attributes, and the extent of and frequency of movements within the study area. During the study period, flow conditions varied significantly from a year of low flow (2007) to an exceptionally high-flow year (2009).

¹ Later discussions about MU4, which included additional expert opinion, resulted in a change in status to critical and trajectory to unknown/possibly decreasing although there is evidence of some recruitment.

² Later discussions about MU5 resulted in a change in trajectory to stable or increasing.

Between Lamprey Falls and Pointe du Bois GS (MU4)

Although sampling was more limited upstream of the Pointe du Bois GS than elsewhere in the study area, Lake Sturgeon comprised a smaller percentage of the fish community above the GS than below it. This is not surprising as fewer Lake Sturgeon typically are found in the lower portion of an MU in the Winnipeg River, where the backwater effect from the GS results in increased depths and decreased water velocities. Only fourteen juveniles (300-800 mm fork length) were captured during summer and fall and four adults during spring in this portion of MU4 using standard index gangs (SIG), large mesh gill nets and fine mesh gill nets. Spring gillnetting conducted at 18 sites located above and below Lamprey Rapids in 2007 caught only two Lake Sturgeon (0.1 CPUE) compared with hundreds of fish (7.8-18.7 CPUE) caught during the same period in reaches downstream of the Pointe du Bois GS. One of 18 Lake Sturgeon tagged in this area was recaptured downstream of the GS. No evidence of spawning was found around Lamprey Falls in 2007 or 2009 in spite of significantly different flow conditions between the two years. It is not known whether Lake Sturgeon spawned there historically.

The Ontario Ministry of Natural Resources has conducted Lake Sturgeon research in the Ontario portion of MU4 during the past two years. No population estimate is available yet but hundreds of Lake Sturgeon, including juveniles, have been tagged. There are known spawning locations in the Ontario portion of MU4, below the Caribou Falls GS and Whitedog GS.

Between Pointe du Bois GS and Slave Falls GS (MU5)

From 2006 to 2009, Lake Sturgeon spawned below the Pointe du Bois GS as early as May 10 and as late as June 2 once the river reached a suitable temperature. Hatching success appeared to be higher in high flow (spill) years. Spawning occurred below the powerhouse and spillway with locations varying among years in relation to the flow regime. Lake Sturgeon spawned below the powerhouse throughout the study, but in years of high flow (spill) they tended to use the concentrated flow below the spillway more than below the station. Spawning adults appeared to select suitable spawning sites at the micro-habitat level. In high-flow years they avoided areas of highest flow, instead spawning in the lower-flow 'edge' areas. In a year of lower flow (no spill) they spawned over a broader area below the powerhouse and in specific locations of leakage below the spillway. A Habitat Suitability Index model is being developed to assess the potential impacts of possible changes to the Pointe du Bois GS and to aid in the development of mitigation.

After spawning, most adult Lake Sturgeon were found upstream of Eight Foot Falls or downstream of the Falls near the island between Mayos Bay and Moose Creek in areas of low-velocity flow and 4 -19 m depths over hard substrate. No adult Lake Sturgeon were captured at near-shore sites (<3.5 m depths). By fall 2009, of the 1,762 Lake Sturgeon tagged in MU5 between 2006 and 2009, only 2 of the 214 recaptured fish were located downstream of the Slave Falls GS (MU6). None of the twenty-two adult Lake Sturgeon implanted with an acoustic transmitter moved to the lower reach of MU5 or into MU6.

Juvenile Lake Sturgeon were found aggregated in low-velocity areas ranging primarily from 15 to 27 m in depth, between Eight Foot Falls and just upstream of Moose Creek. Those with a fork length of less than 400 mm were found only at depths greater than 15 m. Juveniles were located over a variety of substrates but favoured a mix of sand and gravel. All 10 of the juvenile Lake Sturgeon implanted with an acoustic transmitter in October 2006 remained in the reach between Eight Foot Falls and upstream of Moose Creek. Few age-0 fish were captured during the study. Most were located over sand-gravel substrates, while some were located over silt-

clay substrates. The deep sandy environment downstream of Eight Foot Falls appears to be ideal for Lake Sturgeon, especially juvenile fish.

In 2007, MU5 was estimated to contain between 2,205 Lake Sturgeon (95% CI: 921-4,095) based on spring gillnetting data for fish greater than 800 mm in length. The current population contains numerous juveniles and adults suggesting that the population of Lake Sturgeon in MU5 is healthy. The length of the river between the Pointe du Bois GS and Slave Falls GS is 10.5 river km. The density of Lake Sturgeon in this reach suggests that the population could be near the carrying capacity of available habitat.

Impact of Pointe du Bois GS Modernization on Spawning Habitat

The only confirmed Lake Sturgeon spawning area in MU5, despite efforts at sampling for both adults and larvae in other potential spawning areas, is located immediately downstream of the Pointe du Bois GS. Lake Sturgeon currently spawn below the spillway and/or powerhouse, depending on the flow conditions. As modernization of the GS has the potential to negatively impact that spawning habitat, Manitoba Hydro aims to recreate the same hydrological regime with the new facility in order to retain as much spawning habitat as possible. No design option has been chosen yet so it was not possible to critically evaluate the impact of the proposed design on Lake Sturgeon spawning. However, a more general assessment of the current design features being considered indicates the potential for the new GS to degrade or destroy spawning habitat.

The updated GS will have many fewer spillway bays than the current design and, if the powerhouse is replaced, the frequency of spill will be reduced from 70% to 30% of the time. Manitoba Hydro is also considering changing the location of the powerhouse, possibly to the middle of the spillway, and stopping the flow of water where the powerhouse currently exists. Under this design option the entire GS footprint would be relocated to the current spillway shelf. Notwithstanding engineering efforts to recreate the same hydrological regime for the new facility, it is highly probable that the current flow regime would change. The proposed changes would likely expose the power station to more of the full flow of the river and might produce flow velocities too high for successful Lake Sturgeon spawning. The new GS design would concentrate river flow into a smaller area, and potentially diminish the availability of lower-flow 'edge' areas, thereby reducing the amount of suitable spawning habitat.

Passage of Lake Sturgeon at Pointe du Bois GS

Prior to the construction of dams along the Winnipeg River, Lake Sturgeon would have been able to pass downstream, but it is not known whether upstream passage was possible at some of the natural waterfalls. Historical and existing water flow information is needed to determine the frequency of high flows events, but even with this data we will never know for certain whether Lake Sturgeon could pass freely upstream. Some First Nations elders support the contention that Lake Sturgeon could pass at Pointe du Bois falls (DFO 2010). One recent Lake Sturgeon study in the Namakan River, Ontario, used radio telemetry and genetics data to examine whether natural barriers block Lake Sturgeon movements. The study results indicated that Lake Sturgeon are able to freely move upstream and downstream of many natural barriers previously thought to be impassable (DFO 2010).

The construction of dams removed any possibility of upstream movement in the Winnipeg River. Fragmentation, natural or artificial, limits the movement of Lake Sturgeon within a river system, thereby affecting genetic diversity. Most Lake Sturgeon in MU5 appear relatively sedentary but some in the river have been known to undertake more extensive movements. One such Lake

Sturgeon, an older juvenile tagged in Ontario, was recaptured downstream in the Winnipeg River after navigating through five dams over a three-month period (DFO 2010). Movement of occasional migrants downstream will ensure the maintenance of genetic diversity in the lower MUs within the Winnipeg River, but result in the loss of genetic diversity in the upper MUs unless upstream passage is made available. It is likely that to maintain a good level of genetic variability, at least one migrant that would contribute new genetic variance (i.e., a new allele) per generation (i.e., about 36 years) would have to move upstream. Thus, one possible advantage of providing upstream passage for Lake Sturgeon at the Pointe du Bois GS would be to increase genetic diversity within the Winnipeg River.

Another potential benefit of providing upstream passage would be to allow the Lake Sturgeon population in MU5, which may be at or near carrying capacity due to habitat limitations, to expand into MU4 where Lake Sturgeon abundance is lower, the population has not yet recovered and unfilled habitat may be available. However, there are a number of issues and current gaps in knowledge which may affect this benefit of providing upstream passage, such as whether Lake Sturgeon will use a fish ladder and whether there is available Lake Sturgeon habitat for all life history stages in MU4.

Lake Sturgeon have been found to use some types of fishways. The Vianney-Legendre fishway was built on the Richelieu River, a tributary of Lake Champlain, in 1997 to provide upstream fish passage for several species at risk including Lake Sturgeon. It did not prove to be particularly effective for Lake Sturgeon until 2007 when the configuration of the entry gate changed. In 2007 and 2009, about 40-55 Lake Sturgeon used the fishway in late spring. Recent research on upstream passage of Lake Sturgeon at the Conte Fish Research Centre has also shown that it is possible to move Lake Sturgeon using a spiral fish ladder (DFO 2010). While adult Lake Sturgeon may use particular fishways, a few participants believed that Lake Sturgeon would not traverse a fishway at Pointe du Bois given the height of the dam. Telemetry and tagging data from MU5 also suggests that it is unlikely juveniles would move upstream because they are usually sedentary. Regardless, juveniles in MU5 may benefit from upstream passage of larger fish because it would reduce overall densities of Lake Sturgeon in MU5.

Some participants expressed concern that some Lake Sturgeon might not remain in MU4 but would immediately return to MU5, given the deeper and slower-moving waters that typically exist immediately above a GS. Attempts to translocate Lake Sturgeon at other locations have met with limited success, although few fish and habitat conditions have been tried to date. In the Winnipeg River system, Dr. Steve Peake captured a small number of Lake Sturgeon below Seven Sisters GS (MU7) in spring 2009 and translocated them above the GS (MU6). The tagged fish quickly moved upstream to Sturgeon Falls where they remained for a few days and may have spawned, then moved back downstream and remained in Dorothy Lake (MU6) (DFO 2010).

There are potential risks to Lake Sturgeon if passed upstream at Pointe du Bois. Lake Sturgeon that continue upstream into Ontario could potentially be harvested in a subsistence fishery. While such a fishery is not currently active, the possibility for First Nations harvest exists in Ontario waters. It is quite possible that individual fish that move upstream to MU4 will not return to MU5. Some participants expressed concern that if a significant number of Lake Sturgeon were lost from MU5 over a period of years it could put at risk one of the two healthy populations in DU5. However other participants noted that fish populations compensate for declines in abundance by increasing individual and population growth rates, survivorship and recruitment. Modelling also indicates that the 2007 Lake Sturgeon population estimate for MU5 (i.e., 2,205) gives about a 95% probability of persistence over 250 years (DFO 2010). Thus, if a small

number of Lake Sturgeon were lost from MU5 as a result of upstream passage to MU4, it would not significantly threaten the overall survival of this species in MU5.

It is currently not possible to fully assess the positive and negative impacts and relative risks associated with the provision of upstream passage for Lake Sturgeon at the Pointe du Bois GS. Several gaps in knowledge need to be filled. These include the final configuration for the modernized GS and its potential effects on Lake Sturgeon spawning habitat and success in MU5. Knowledge is also needed of the distribution and abundance of Lake Sturgeon and availability of habitat in MU4. It would also help to have a better understanding of the historical movement of Lake Sturgeon up- and down-stream at Pointe du Bois, how much movement is needed to maintain genetic variation and current genetic profiles in MUs 4 and 5.

CONCLUSIONS

Manitoba Hydro must modernize the Pointe du Bois Generating Station on the Winnipeg River, which will involve replacing the spillway and associated dam segments. The new spillway may be located slightly downstream of the existing one, but still on the spillway shelf. The powerhouse may also be replaced by building a new one east of and at the same axis as the existing one, or it may be maintained, repaired or rehabilitated with no change in footprint. No decision regarding the powerhouse options has been made.

The status of Lake Sturgeon in Designatable Unit (DU) 5, which includes the Winnipeg River, has been assessed as Endangered by the Committee on the Status of Endangered Wildlife in Canada. Experts at a recent DFO Recovery Potential Assessment (RPA) workshop identified only two of nine Management Units (MUs) in DU5 as healthy. One of which, MU5, is located immediately downstream of the Pointe du Bois GS. Their expert opinion suggests that Lake Sturgeon in MU5 are healthy and their population trajectory is stable or increasing, and that the current densities suggest that the population could be near carrying capacity of the available habitat.

The only spawning area in MU5, located below the Pointe du Bois GS, may be significantly altered due to changes in water flow, depending on the design chosen for modernization. Most meeting participants believe the potential changes could negatively affect spawning success, but consensus was not reached on this conclusion. The extent of impact, and its effect on spawning success, would depend on the GS design option chosen.

Much less is known about the Lake Sturgeon population in MU4, above the Pointe du Bois GS. The RPA workshop experts identified the status and population trajectory of Lake Sturgeon in MU4 as cautious and stable, respectively, and later revised to critical and unknown/possibly decreasing. Netting surveys have found far fewer Lake Sturgeon in MU4 than in MU5, although population estimates are not yet available. There are a number of juvenile year-classes present and Lake Sturgeon are known to spawn in the Ontario portion of the MU.

A potential benefit from providing upstream passage for Lake Sturgeon if the GS is modernized would be to increase genetic diversity within the Winnipeg River as only occasional downstream movement occurs at present. Another would be to allow Lake Sturgeon in a relatively dense population below the GS, to move upstream into areas where unfilled habitat may be available and Lake Sturgeon abundance is lower.

A potential disadvantage of providing upstream fish passage at the GS would be the loss of individual Lake Sturgeon from the healthy population in MU5 with no accompanying benefit to

the Lake Sturgeon population in MU4, as the availability of suitable habitat and potential risk of harm there is unknown. There would be no net gain to MUs 4 or 5 if migrating Lake Sturgeon returned to MU5 rather than proceeding upstream.

Several gaps in knowledge need to be filled before the benefits, detrimental impacts and relative risks associated with providing upstream fish passage at Pointe du Bois GS can be fully assessed. Current knowledge gaps include the final configuration of the new Pointe du Bois GS and its effects on Lake Sturgeon spawning habitat and success, historical movement data and current genetic profiles in DU5, Lake Sturgeon abundance and availability of habitat in MU4. Analysis of historical and existing hydrological data to understand water levels, the frequency of floods in the Winnipeg River and whether upstream passage occurred historically, would also be helpful. It may not be possible to fill some of these gaps.

SOURCES OF INFORMATION

DFO. 2010. Proceedings of the Central and Arctic Regional Science Advisory Process to assess whether upstream passage is needed for Lake Sturgeon at the Pointe du Bois Generating Station (Winnipeg River). DFO Can. Sci. Advis. Sec. Proceed. Ser. 2009/059.



Figure 2. Current configuration of the Pointe du Bois GS (photograph courtesy of Manitoba Hydro).

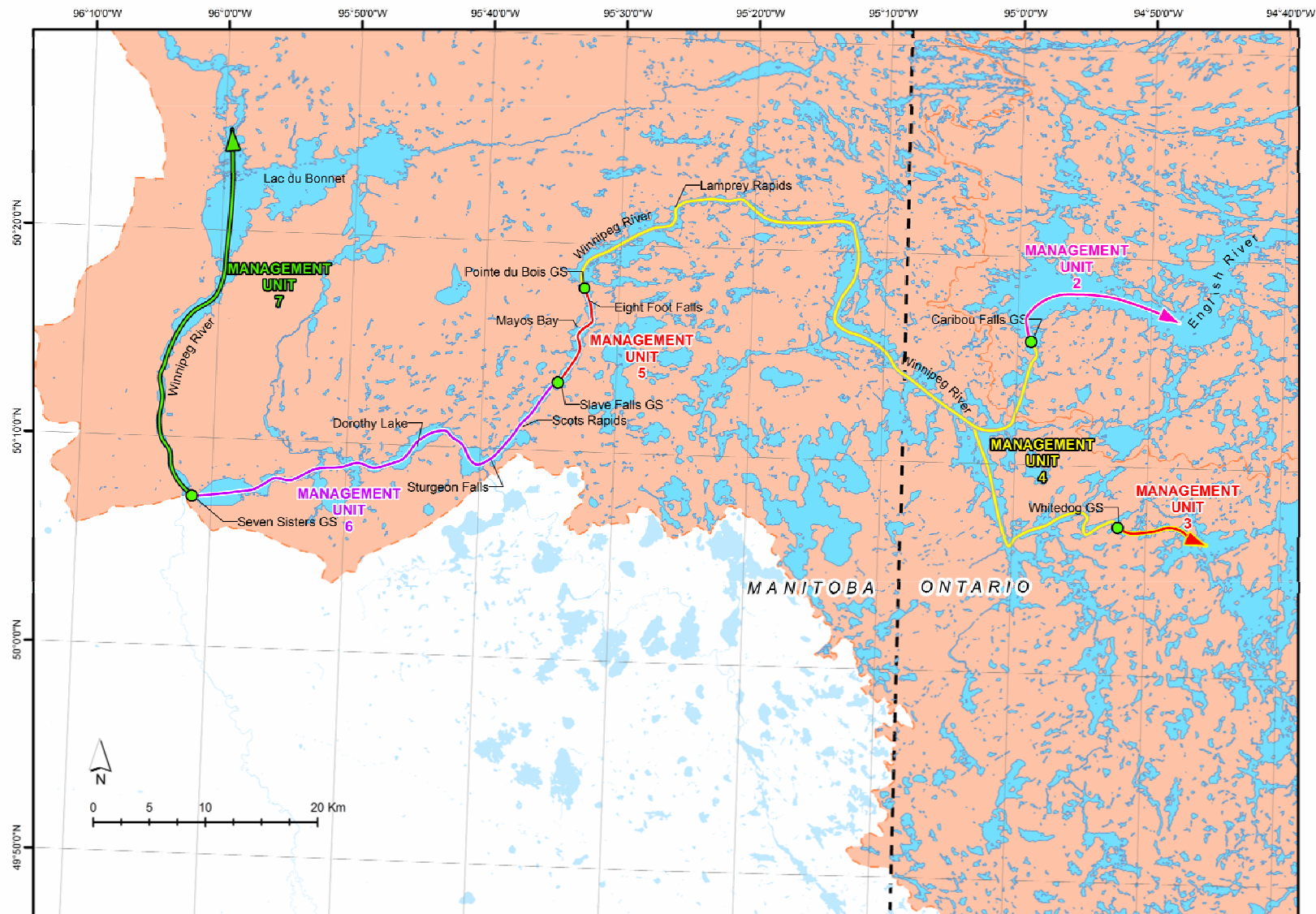


Figure 3. Portion of Winnipeg River system (DU5) that contains the Pointe du Bois Generating Station (GS) and adjoining Management Units (MUs).

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