ONTARIO POWER GENERATION

Public Information Report
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Kaministiquia River Water Management Plan

Implementation Report Submission

July 1, 2005 to Dec 31, 2020

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Acronyms

***	Add others as required
CMP	Compliance Monitoring Plan
cms	Cubic meters per second
DICP	Data and Information Collection Program
EMP	Effectiveness Monitoring Program
IR	Implementation Report
MNRF	Ministry of Natural Resources and Forestry (previously known as)
NDMNRF	Ministry of Northern Development, Mining, Natural Resources and Forestry
OMNR	Ontario Ministry of Natural Resources (previously known as)
OPG	Ontario Power Generation
SAC	Standing Advisory Committee
WMP	Water Management Plan
WSC	Water Survey of Canada
NWO	North West Operations

Table of Contents

1. Background

The original Kaministiquia River System Water Management Plan (KRSWMP) was prepared according to the Ontario Ministry of Natural Resources' 2002 *Water Management Planning Guidelines for Hydropower*, and approved for an initial period of July 1, 2005 to March 31, 2015.

The process of renewing the KRSWMP began in 2010 resulting in an extension of the KRSWMP for a two year period of April 1, 2015 to March 31, 2017. The KRSWMP was extended with minor amendments rather than renewed as it was known there was an upcoming change being the Ontario Ministry of Natural Resources and Forestry's (MNRF) 2016 *Maintaining Water Management Plans* Technical Bulletin.

In August 2017, the KRSWMP was amended to align with the newly issued Ontario Ministry of Natural Resources and Forestry's (MNRF) 2016 *Maintaining Water Management Plans* Technical Bulletin. This administrative amendment resulted in several administrative changes, the largest of which was to include a requirement to prepare an Implementation Report (IR) submission to NDMNRF every five years.

IRs are required to provide status updates, transparency of dam operations, and inform adaptive management considerations, including the following minimum content:

- a summary of all amendment requests received, including the rationale for completed amendments and how proposed amendments that did not proceed were addressed
- the status of the applicable Standing Advisory Committee (SAC),
- the results of the applicable Effectiveness Monitoring Program (EMP), including a summary of monitoring conducted and findings, a determination of whether operations are having a negative or unintended impact, and an assessment of whether revisions to the facility operations, or to the EMP are required; and
- the status and results of any data or information collection outlined in the WMP's Data and Information Collection Program (DICP) and a determination of whether revisions to the program are required.

This document represents the first IR for the KRSWMP and covers the period from July 1, 2005 to December 31, 2020. Subsequent implementation reports will cover five year periods. Text in blue as submitted by the NDMNRF. Text in black is provided by OPG. This document is structured to show the reporting of results from the NDMNRF, followed by reporting from OPG. There are some subjects that cross over and will have reporting shown by both the NDMNRF and OPG. There is a conclusions and recommendations section at the end of the document that provides a summary for future consideration for the next round of implementation reports.

2. Summary of Amendment Requests

2.1. Description

This section of the report provides a summary of all amendment requests pertinent to OPG facilities on the Kaministiquia River, or the KRSWMP document, including the rationale for completed amendments and how proposed amendments that did not proceed were addressed, if applicable.

2.2. Amendment Requests Received by OPG

None.

2.3. Amendment Requests Proposed by OPG

Greenwater Dam operations change - January 18, 2011 (completed May 6, 2014).

A change was made to not operate Greenwater Lake as a reservoir, but to change the dam to operate consistently in a natural flow regime. See 4.3.3. in Effectiveness Monitoring below for further description.

Kashabowie Lake elevation gauge location change - January 18, 2011 (completed May 6, 2014).

A request was made for OPG to remove the gauge from the Resort owner's dock and OPG complied with that request and therefore had to change the WMP to describe the new measuring location on Kashabowie Lake.

Kakabeka Dam, installation of 1" slot to provide minimum flow - February 24, 2012 (completed May 5, 2014).

Addition of the description of the shim installed in the Kakabeka Dam to provide a minimum flow below the dam for riparian purposes.

Extension of original WMP end date from 2015 to 2017 - March 12, 2015

Known changes to the LIRA were expected and the WMP was amended to extend the end date of the WMP to coincide with the timing of the upcoming LIRA changes.

2.4. Amendments Ordered by NDMNRF

'Maintaining Water Management Plans' Technical Bulletin (MNRF, 2016). See below section 2.5 for description of this amendment.

2.5. Amendments Completed by NDMNRF

NDMNRF completed an administrative amendment to the KRSWMP July 25, 2017 to align the plan with the approved 2016 *Maintaining Water Management Plans* Technical Bulletin.

The full text of the Technical Bulletin and additional information on the new requirements for the long-term maintenance of Water Management Plans (WMPs) are available on the NDMNRF website at:

https://www.ontario.ca/page/maintaining-water-management-plans?nocache=1.

This administrative amendment resulted in changes to the following sections of the KRSWMP:

Expiry Date	has been removed
Compliance Monitoring	Section 13.1 was revised
Compliance Reporting	Section 13.2 was revised
Implementation Reports	Section 13.2, added IR
Amendments	Section 14 was revised

3. Standing Advisory Committee (SAC)

3.1. Description

The KRSWMP SAC, was originally created from interested members of the Public Advisory Committee that was formed during the creation of the Water Management Plan. The SAC was created in 2004 and has been active since the implementation of the Water Management Plan.

3.2. SAC Status Update

The SAC is still active. There are annual meetings, typically in May each year, where a variety of information is provided from OPG and the NDMNRF to the SAC. The last meeting was held May 4th, 2021 and was done online. OPG is the administrator of the SAC and keeps records of the meeting minutes. Contact David Pacholczak, OPG Water Manager, for further information regarding the Kaministiquia SAC.

The following tables highlights the current members of the Kaministiquia SAC and the Advisors to the Kaministiquia SAC.

The SAC has an approved terms of reference.

Watershed Interest and Use	Representative / Alternate	Title
First Nation Communities		
Fort William First Nation	Peter Collins/ William Solomon	Chief, FWFN / Alternate
Industry		
Resolute Forest Products	Ashleigh Marchl	Environmental Superintendent
Local Communities & Landowners		
Municipality of Oliver Paipoonge	Lucy Kloosterhuis/ Chris Bowles	Mayor of Oliver Paipoonge / Director of Operations
Established Water User Groups/Association		
Shebandowan Lake Campers Association (including Kashabowie Lake)	Jim Moshonsky	Summer Resident on Shebandowan Lake
Dog Lake Campers Association	Dave Butler	Summer Resident on Dog Lake
Upper Kaministiquia River	Rebecca Dickson	Upper Kaministiquia Resident
Kaministiquia River Recreationalists	Henry Syposz	Lower Kaministiquia Resident
Local Conservation Authorities		
Lakehead Region Conservation Authority	Tammy Cook / Gail Willis	Chief Administrative Officer / Watershed Manager
Government Agencies		
Ministry of the Environment, Conservation and Parks – Water Resources Unit	Todd Kondrat / Jacinth Gilliam-Price	Supervisor (acting) / Surface Water Specialist
Fort William Historical Park	Jason Boesch	Manager of Historical Operations
Kakabeka Falls Provincial Park	Shannon Lawr / Mike Holm	Park Superintendent

Table 1 Current Standing Advisory Committee Members

Advisors to the Standing Advisory Committee		
Ontario Power Generation	David Pacholczak Tana-Leigh Harty	Water Management Officer Corporate Relations Officer
Ministry of Natural Resources	Emily Hawkins / Marek Klich	Resource Management Supervisor / Alternate NDMNRF

Table 2 Advisory to the Kaministiquia Standing Advisory Committee.

4. Effectiveness Monitoring Program

4.1. Description

This section of the report provides a summary of the EMP components applicable to OPG facilities as outlined in the Chapter 12 of the KRSWMP, including details on:

- Definition and goals of effectiveness monitoring,
- Monitoring the effectiveness of operational changes,
- Monitoring the effectiveness of operations in achieving the objectives (e.g., ecological, flooding, power generation, recreation and tourism).o (e.g. ecological, flooding, power generation, recreation and tourism.)
- Determination of whether revisions to the facility operations, or to the EMP, are required, e.g. proposed changes/amendments going forward.

4.2. Effectiveness Monitoring Program Components

The EMP components as found in Chapter 12 of the WMP are as follows:

Assimilative Capacity

Flooding

Power Generation

Aquatic Ecosystem

Recreation and Tourism

4.3. Effectiveness Monitoring Program Results

The following describes the status and results of the effectiveness monitoring program and data gaps for the Kaministiquia River Water Management Plan (WMP) for which NDMNRF is wholly or partially accountable. In some cases, NDMNRF has not fulfilled commitments identified in the approved WMP. Some commitments are being met through other initiatives that were implemented after the approval of the WMP or may be met based on future work

planning. Over time and since the approval of the WMP, ministry priorities, structure and approaches have shifted including those for WMPs. Work undertaken by NDMNRF must always be considered relative to current established priorities, resourcing and workloads.

Where ministry priorities and approaches have changed, and data collection commitments were not being met and/or are now being met through other programs, NDMNRF should consider amending the WMP to reflect these updates.

Effectiveness Monitoring Commitments - NDMNRF

Aquatic Ecosystem: Greenwater Lake – Lake Trout Population Estimate

(WMP Chapter 12, Table 74, Monitoring Question 1)

Greenwater Lake: Perform Lake Trout netting in fall to determine population, and any population changes.

Greenwater Lake: Perform creel survey during winter lake trout open season

Greenwater Lake: Conduct creel survey with specific recreation based WMP questions.

In the autumn of 2004, a program was initiated with the objective of estimating lake trout population abundance in Greenwater Lake. Assessment work included a fall spawning survey followed by a winter creel survey.

Lake trout were captured and marked during their spawning period to maximize the number of fish marked. Fish were recaptured during the 2005 recreational winter fishery. During the tagging event 780 lake trout were marked. These fish ranged from 42 to 91 cm in fork length and from 5 to 30 years of age. A total of 207 fish were observed during the 2005 winter creel survey. These fish ranged from 27 to 75 cm in fork length and from 4 to 31 years of age.

The estimated population size of lake trout, greater than 419 mm, in Greenwater Lake in the autumn of 2004 was 15,717 (8,165-33,090) (values in brackets indicate 95% confidence limits). The wide range in confidence limits is the result of relatively low numbers of recaptures.

At that time (2004), the lake trout population in Greenwater Lake was classified as healthy. The population had a high density when compared with other large bodied lake trout lakes in the province and was made up of a wide range of both size and age classes. Recruitment had been stable based on age frequency distributions of the catch. This indicated that the water level regime over the past 12 years had not negatively affected the lake trout population.

A creel survey with specific recreation based WMP questions was not conducted. The 2005 standard creel addressed the fisheries question. It is not anticipated that such a creel survey will be required or conducted.

Aquatic Ecosystem: Impacts to fish spawning at Greenwater Creek as a result of managed flows

(WMP Chapter 12, Table 74, Monitoring Question 2)

Greenwater Lake & Creek: Confirm spawning sites in Greenwater Creek that were determined in spring 2004, and net again for a spawning population count.

The Greenwater Creek trap netting and spawning / habitat assessment was conducted in 2004. The four components of this project included: trap netting of walleye at the mouth of Greenwater Creek and upstream above the rapids, night monitoring of spawning walleye, habitat assessment through the two sets of rapids, and a bass nesting survey during the summer. Walleye were netted, spotted at night spawning and eggs were documented. It was concluded that walleye do use Greenwater Creek for spawning and that flows between 3 and 4cms are suitable for this purpose. Smallmouth bass also were observed nesting in Greenwater Creek. Their spawning period is later than walleye falling in mid to late June. It was observed that an increase in flows would not hamper spawning activity but a decrease in flows during this time period could have an impact on the availability of adequate bass nesting locations.

Greenwater Creek was assessed for spawning walleye in 2006. The tail end of the spawning run for walleye was observed in the creek on May 2 which was close to two weeks earlier than normal. The peak of the run was likely between April 24 and May 1. Flows out of Greenwater Creek during this time period were reported between 3.0 and 3.1cms. This is a suitable flow for walleye spawning.

NDMNRF staff visited Greenwater Creek on May 3, 2007 to search for spawning walleye. There was very little flow due to continuing drought conditions. The water in the creek was approximately 10cm deep. No walleye were seen but it is not clear if they were absent because they had finished spawning or because the flows were too low and did not allow access further upstream. Common white suckers were observed. Suckers generally spawn immediately following the walleye. The water temperature was 15^0C and was likely warmer than normal due to the lack of cooler inflows from Greenwater Lake.

NDMNRF staff identified 24 smallmouth bass nests and confirmed smallmouth bass spawning in Greenwater Creek on June 22nd and June 29th, 2004

After some effectiveness monitoring studies were completed, a decision was made in 2008 to operate the control dam with 5 logs out of the dam, allowing both the lake and the creek to rise and fall naturally. The WMP was amended in January 2011 to reflect this change. No further manipulation of the dam for power generation purposes are planned. An operating lake elevation of 354.29m based on running the control dam with 5 logs out of the dam has been established as a result of previous work and is adequate for the aquatic ecosystem of the lake. OPG and NDMNRF agree that there is no benefit to operate this dam for the purposes of power generation given the remoteness of the site and the low storage volume. The Greenwater Lake and Greenwater Creek study are considered complete. Baseline has been established as a result of previous work and is adequate for current strategy that does not manipulate the flows. Further work at Greenwater Lake and Greenwater Creek is not required.

Aquatic Ecosystem: Minimum flow assessment

(WMP Chapter 12, Table 74, Monitoring Question 4)

Minimum Flows: Perform studies for data such as wetted perimeter, usable habitat to determine if minimum flows were suitable, or if they should be increased or decreased & Examine parameters regarding minimum flow below structures.

Studies were not performed to evaluate minimum flows below structures with the exception of Kashabowie Creek and Greenwater Creek. Flows in the Matawin River below McGraw Falls are not manipulated, and rise and fall with natural inflows therefore requiring no additional data collection. Flows below the Dog Lake Dam, Shebandowan Lake Dam Mabella Dam and the Kakabeka Falls Dam have not been investigated. Additional work between Kakabeka Falls and the Kakabeka Generating Station outside of the sturgeon flow studies, have not been investigated.

Minimum flows for Shebandowan River- Assess flows below Shebandowan dam to determine wetted perimeter and usable habitat. Map and quantify natural inflows.

Studies were not preformed regarding minimum flows on the Shebandowan River.

Minimum flows for Kashabowie Creek-Determine if walleye are gaining access to Kashabowie Creek at 1.5cms and document.

Flows in Kashabowie Creek were observed in 2004 and 2005. A flow of 1.5 cubic meters/second (cms) has been prescribed by the plan as a minimum flow from April 15 to June 1st. It is concluded that this flow or greater allows walleye the ability to travel over the rock ridge at the mouth of Kashabowie Creek and gain access to spawning areas upstream.

In 2006 walleye spawning occurred the last week of April at this location as well. Numbers of fish and eggs were observed. Adequate flows were also available at this location. The flows were reported between 7.3 and 8.1cms.

NDMNRF observed spawning walleye in Kashabowie Creek on April 24, 2007. The prescribed flows of 1.5cms appear to allow walleye the opportunity to move above the rock ledge to high quality spawning locations. Water temperatures were 8-9^{0}C.

In 2008 NDMNRF staff did not observe spawning walleye at Kashabowie Creek this spring but flows were such that conditions would have been favourable.

On May 8, 2009 the Kashabowie River was investigated at two locations for presence of spawning walleye. The water temperature on this day was +8 Celsius and flows were ~ 16cms (OPG). The first location visited was within 100 m of Upper Shebandowan Lake where numerous walleye (>100 males and females) were observed below a bedrock lip on the Kashabowie River. No walleye were observed upstream (within 100 m) of the bedrock lip at this location. The second location visited was below the Highway 11 Bridge for 100 m. No walleye were observed within this river stretch although habitat looked amenable for spawning.

The normal minimum spring flow of 1.5cms on the Kashabowie River was reduced on April 23, 2010 to approximately 0.8cms in response to low water levels on Kashabowie Lake. On the night of April 24, a large number of walleye were observed below the lower falls at the mouth of the river. Ten walleye were observed above the lower falls, two walleye were below the second falls and one walleye was above the second falls. Additionally, two walleye were seen on the gravel bed below the Highway 11 Bridge. On May 14 another site visit was done in order to determine if flows could be reduced further in order to slow the rate of decline in the level of Kashabowie Lake. At that time eyed eggs were found in the spawning gravel below the Highway 11 Bridge and it was decided to maintain the flow of 0.8cms in order to prevent dewatering of the spawning beds.

Prescribed minimum flows of 1.5cms appear to adequately allow walleye to access the Kashabowie River to spawn.

Aquatic Ecosystem: Fish population as an indicator of ecosystem health lakes

(WMP Chapter 12, Table 74, Monitoring Question 6)

Kashabowie, Shebandowan, Dog Lake: Conduct a fall walleye index netting survey (FWIN).

In 2004, a new Ecological Framework for Fisheries Management (EFFM) was announced in Ontario by the Minister of Natural Resources. The EFFM provides the building blocks for improving the way recreational fisheries are managed by moving away from individual lake management to a landscape approach, where active management of lakes will occur on a zone basis. As a result of this direction, FWINs were not conducted as scheduled. In their place the Broad-scale Fish Community Monitoring (BSM) was implemented. Kashabowie, Shebandowan and Dog Lakes will continue to be monitored via this provincial program.

Kashabowie Lake was sampled in 2008, 2013 and 2018 as part of the provincial BSM program for Fisheries Management Zone (FMZ) 6. Walleye composed 16% of the large mesh catch in 2008, 21% in 2013 and 29% in 2018. Lake trout were captured in all years. There was a wide range of year classes of walleye indicating consistent recruitment.

Shebandowan Lake was sampled in 2008, 2013 and 2018 as part of the BSM Program for FMZ 6. In 2008 walleye was the most common species captured in the large mesh netting at 49% of the catch. In 2013 walleye composed 28% of the large mesh catch and 27% in 2018. Lake trout were not caught during the survey in 2008 but were captured in 2013 and 2018. Walleye catch rates were below average compared to other lakes sampled within the zone. There was a relatively wide range of year classes of walleye indicating consistent recruitment. Estimated angling pressure was in the upper quartile for lakes monitored in FMZ6.

Dog Lake was sampled in 2008, 2013 and 2018 as part of the provincial BSM program for Fisheries Management Zone (FMZ) 6. Walleye composed 48% of the large mesh catch in 2008, 45% in 2013 and 42% in 2018. There was a wide range of year classes of walleye indicating consistent recruitment.

The BSM program was designed to monitor and evaluate lakes at a landscape scale. The program does not meet the intention of monitoring the impacts of changes in flow & levels on individual lakes.

Aquatic Ecosystem: Oxygen profiles on Shebandowan Lake

(WMP Chapter 12, Table 74, Monitoring Question 3)

Shebandowan: Collect late summer oxygen profile data and spring phosphorus from various sections of the lake (2004, 2005, 2006)

Late summer dissolve oxygen levels in Upper and Middle Shebandowan have remained stable over the course of the WMP.

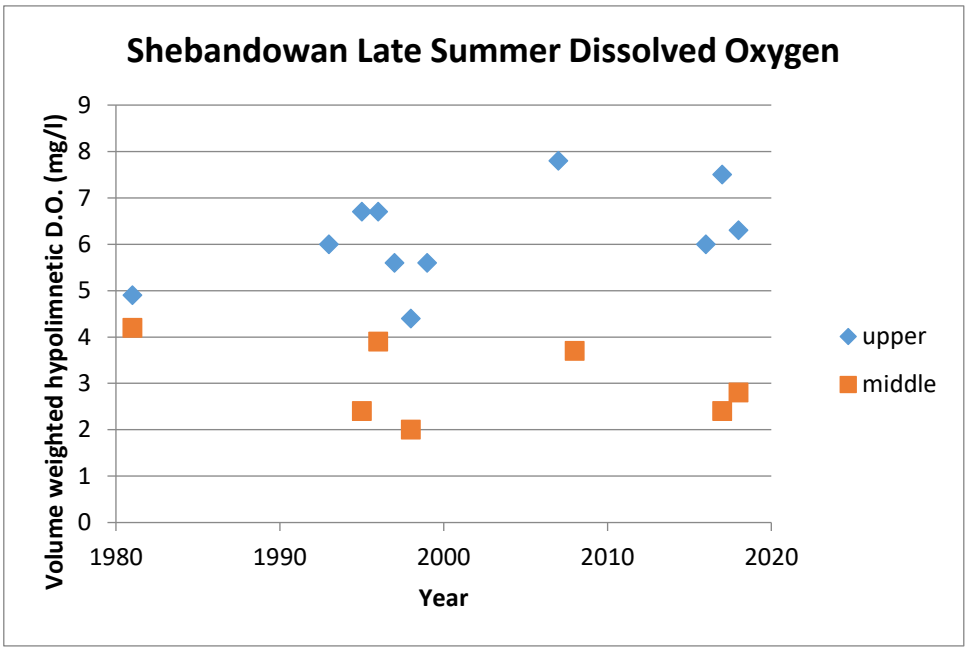

Figure 1. Late summer Mean Volume-Weighted Hypolimnion Dissolved Oxygen

Spring phosphorus data was collected by volunteers through the lake partner program. It is difficult to determine if there is a trend in phosphorous levels due to the annual variation in spring phosphorous levels and the low sampling precision associated with the lake partner program data.

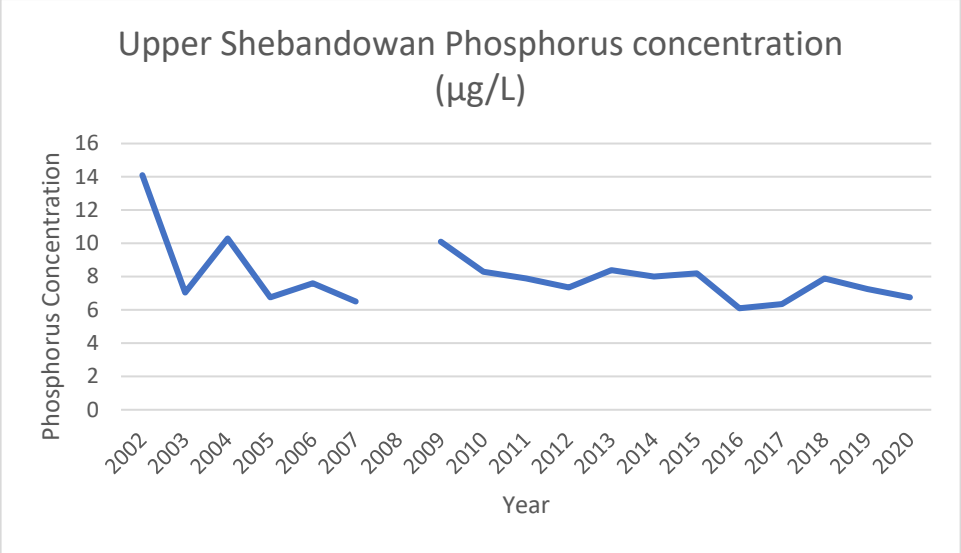

Figure 2. Lake Partner Program sampling results for spring phosphorus in the upper Shebandowan basin.

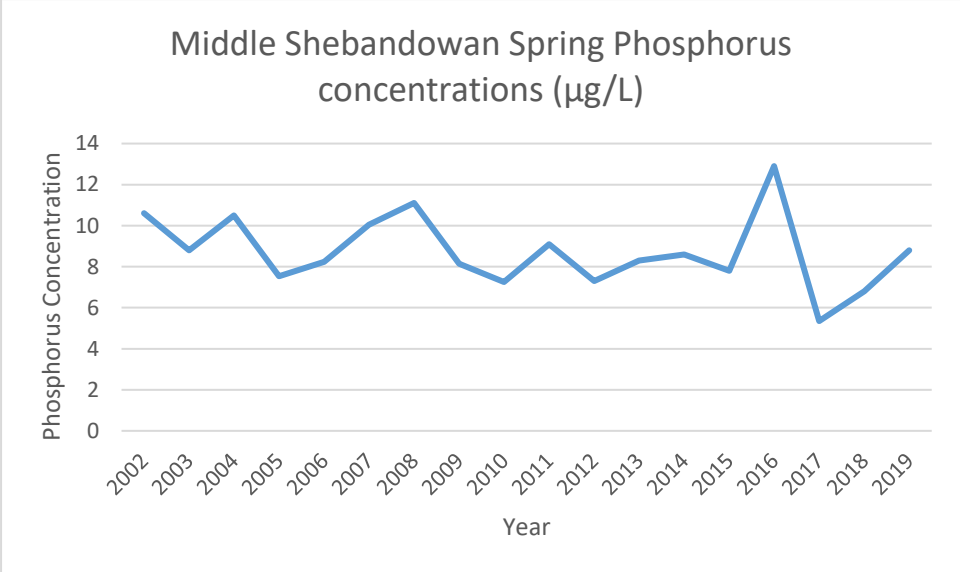

Figure 3. Lake Partner Program sampling results for spring phosphorus in the Middle Shebandowan basin.

Dissolved oxygen and water chemistry were collected on Shebandowan Lake as part of the Broadscale Fisheries Monitoring program for Fisheries Management Zone 6 (FMZ6) in early September of 2008. The upper basin oxygen levels declined below 5 ppm below 22 metres. The middle basin oxygen levels declined below 5 ppm below a depth of 16 metres. Oxygen levels remained above 6ppm at 11 metres in the lower basin.

Although dissolved oxygen data on Shebandowan Lake have been collected since before the WMP, these measurements do not contribute to the effectiveness monitoring of flows and levels in this WMP and will not be continued for this purpose.

Recreation and Tourism: Satisfaction of Shebandowan Lake elevation by recreational users. (WMP Chapter 12, Table 75, single Monitoring Question)

Perform Lake Elevation user survey for recreational use of Shebandowan Lake

Surveys were mailed to Shebandowan Lake cottagers. The majority were satisfied with water levels during the 2006 season. Some concerns were noted with respect to high water in the spring and low water in the fall. These concerns were also noted on unmanaged systems throughout the region. There was no significant difference in satisfaction level based on location on the lake or by month.

A subsequent Shebandowan Lake elevation survey was carried out in 2008 but very few returns (11 total) resulted in limited data on which to make conclusions.

Survey returns expressing dissatisfaction resulted from high water levels in mid-June. Additional surveys were not planned. It is not anticipated that surveys will be conducted in the future.

4.3.3. Effectiveness Monitoring Commitments-OPG

Power Generation: Greenwater Lake Operations

Greenwater Lake/Creek: Assess impacts storage/flow from operating Greenwater Lake. CH12 Table 73

Summary of Greenwater Lake Dam Operations 2005 to 2009

The following is a summary of operations for the initial years of the plan (2005 to 2009). Figure 3 outlines the elevation, inflow, outflow and number of logs out of the dam.

In 2005, the dam operated through January with 4 logs out then went to 5 logs out from January to October. This resulted in flows from 0.5cms to 4cms and the lake level ranged ~40cm.

In 2006, the dam operated through January and February with 4 logs out then increased to 5 logs out March to May, then 6 logs out for June and then returning to 4 logs out for the remainder of the year. This resulted in flows from 0cms to 5.5cms and the lake level ranged ~45cm.

In 2007, the dam operated from January to November with 4 logs out, then increasing to 5 logs out in December. This resulted in flows from 0cms to 4cms and the lake level ranged ~50cm. It should be noted that in 2007 the winter, spring and early summer were very dry on the Kaministiquia system.

In 2008 and 2009, the dam operated with 5 logs out of the dam. This resulted in flows from 1cms to 7cms and lake levels ranged ~70cm. It should be noted that June 2008 was extremely wet which pushed the lake level up to, but not above, the absolute maximum.

OPG amended the WMP with respect to the operation of Greenwater Lake. The normal Greenwater Lake Dam log arrangement will be set at 5 of 13 logs out of the dam. During the

Study period by operating with 5 of 13 logs out of the dam it was determined that the water level can be maintained below the upper limit of 454.29m.

No future assessment is required as the dam is essentially not operated any longer for the purposes of power production.

Aquatic Ecosystem: Comparison of flows to natural patterns on the whole system

Compare annual and median lake elevations and river flows to representative natural flow patterns. Whole system CH12 Table 74, Monitoring Question 5.

Three lakes in Northwestern Ontario, Lac La Croix, Long Lake and Little Turtle Lake, which have long term water level data are used as examples of expected water level fluctuations of lakes under natural (unregulated) flow regimes. Their elevations are used graphically as reference only as a comparator to the elevations of Dog, Kashabowie and Shebandowan Lakes elevations throughout a yearly period. The following figures compare the average elevations of Dog, Shebandowan and Kashabowie Lakes for the periods of 1991-2002 (pre-plan) and 2005-2020 (post-plan) to these reference lakes.

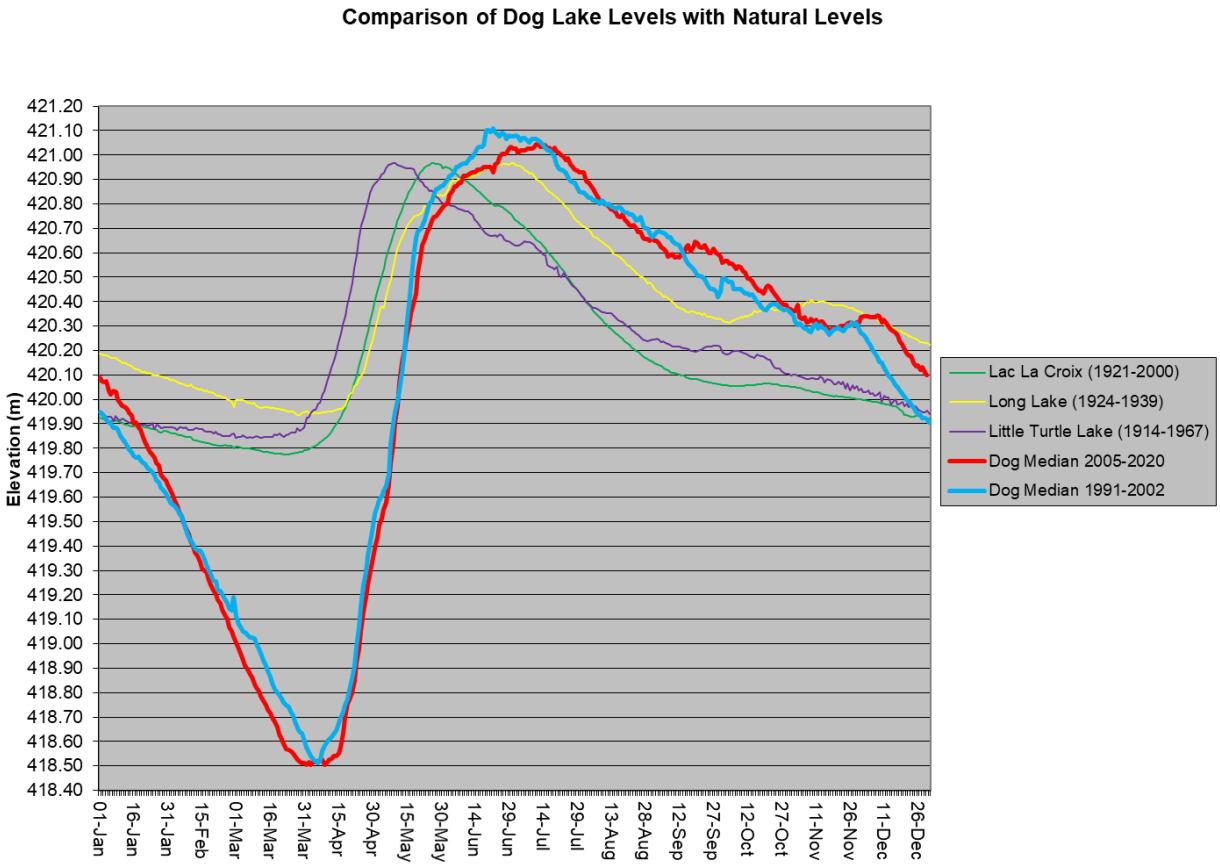

Figure 4. Comparison of median Dog Lake water levels, pre and post WMP, with median water levels from three naturally flowing lakes (Lac La Croix, Long Lake and Little Turtle Lake). All water levels are expressed as the median value for the respective timeframe.

Comparison suggests the Dog Lake winter drawdown and spring refill as more pronounced with a larger variation in elevations than natural, however, that should be expected of a lake with such a large capacity factor, and of a lake that is used as a reservoir. The refill of Dog Lake tends to be later in the year than the natural regime lakes. The summer drawdown is similar to the natural regime lakes. There is not a significant change when comparing the pre-WMP data to the post-WMP data.

Winter draw down and spring refill levels have remained consistent for Dog Lake pre and post plan. The preferred option for Dog Lake Levels in the WMP was the base case which represented the 1991-2002 water levels. One departure from the 1991-2002 operations is that a previous requirement to lower the lake level to 420.30m in the fall as recommended in the 1990 LRCA Kaministiquia River Watershed Management Study was removed as it was determined that the requirement was not meeting its intended purpose for fall spawning fish.

Possible future comparison of natural outflow instead of elevation in order to show the frequency of flooding downstream if the natural regime were adopted.

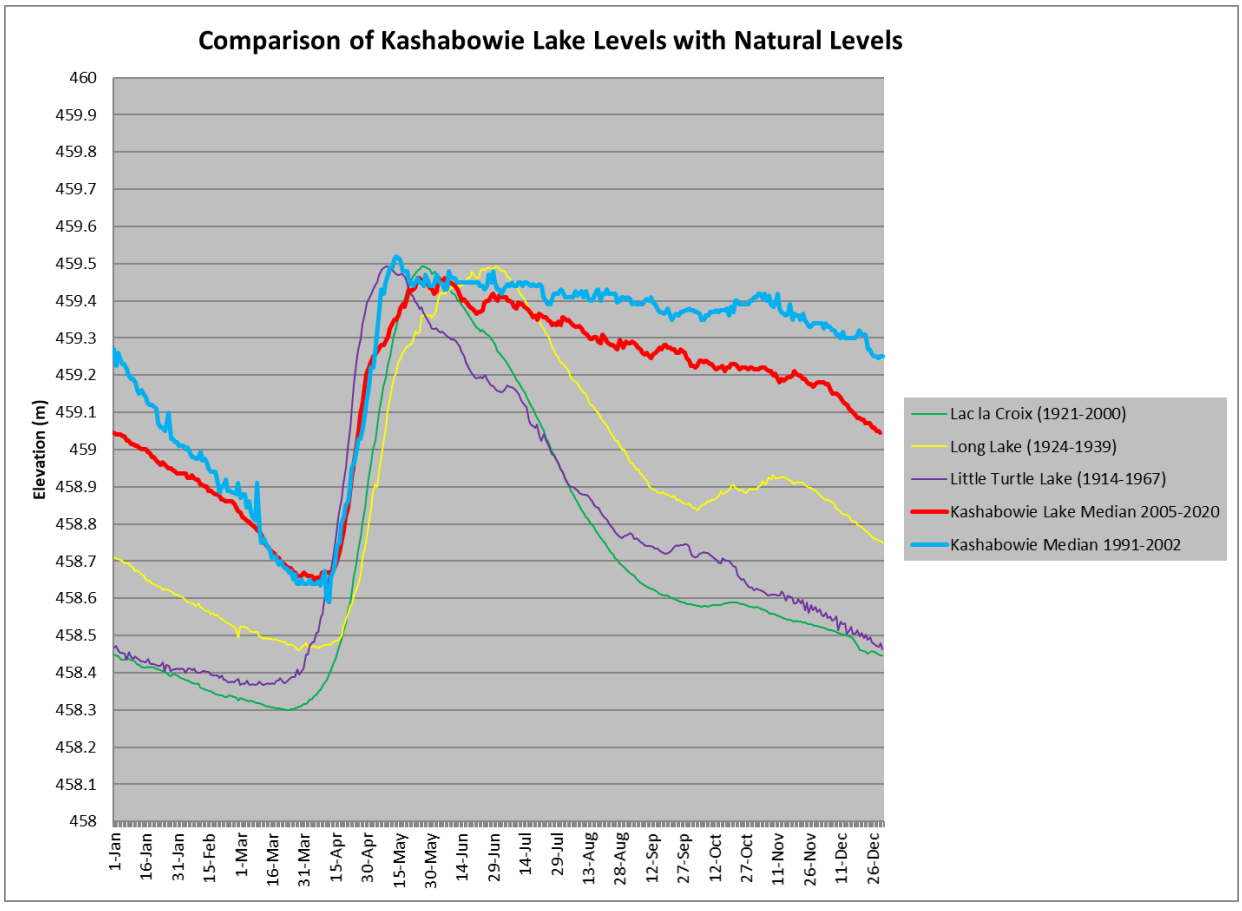

Figure 5. Comparison of median Kashabowie Lake water levels, pre and post WMP, with median water levels from three naturally flowing lakes (Lac La Croix, Long Lake and Little Turtle Lake). All water levels are expressed as the median value for the respective timeframe.

Comparison suggests the drawdown on Kashabowie Lake is less than what would occur naturally in overall amount of elevation change. Kashabowie has a much smaller capacity than Dog Lake which shows in the overall amount of drawdown. The new WMP Preferred Option

Elevation appears to have the elevation move in a direction somewhat closer to a natural flow regime in the summer to fall period.

The WMP preferred option for Kashabowie Lake level was to maintain spring refill and winter drawdown levels but to introduce a 0.2m summer drawdown for the benefit of fall spawning fish species. Median levels from 2005-2020 have been consistent with the WMP preferred option and represent a movement towards a more natural water level regime.

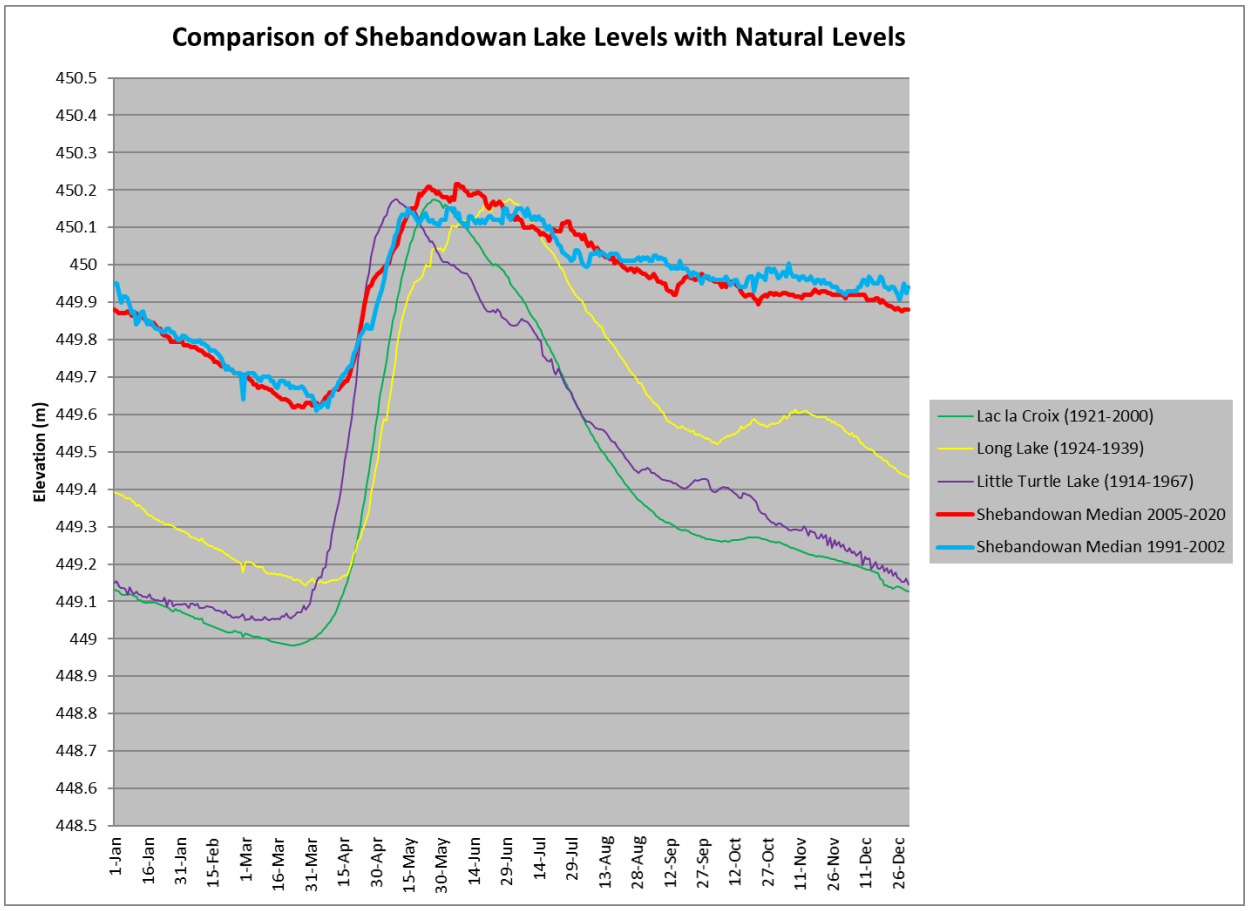

Figure 6. Comparison of median Shebandowan Lake water levels, pre and post WMP, with median water levels from three naturally flowing lakes (Lac La Croix, Long Lake and Little Turtle Lake). All water levels are expressed as the median value for the respective timeframe.

Comparison suggests that the Shebandowan drawdown is less than what would occur naturally in amount of elevation change. The capacity of the lake is much smaller than that of Dog Lake. The new WMP has not changed the overall elevation significantly from pre-WMP data.

The preferred option for Shebandowan Lake water level in the WMP was a refill level 0.1m higher than 1991-2002 operations with a summer drawdown of 0.3m. Median lake levels from 2005-2020 have been consistent with the WMP preferred option, and represent movement towards a more natural water level regime.

Power Generation: Log Operations

Determine number of log operations required to maintain levels in accordance with the WMP operating plans. Whole system CH12 Table 73

The table below shows each year OPG has records for the sites where manual log operations are performed on the Kaministiquia River System. With the exception of Greenwater, the number of log operations at the sites has increased on average compared to before the Water Management Plan was put into place. High water years definitely increase the number of log operations. Greenwater stands out as the flow regime was changed and it was also the subject of tests which drove the requirement to perform log operations at that site. Project work also drove additional log operations as they are done more often through the project to attempt to maintain a desired water level to assist with the work (barges, cofferdams, etc.) The largest amount occurred at Kakabeka Falls GS dam during 2008, which was a high water year. In 2008 there were 66 log operations performed at Kakabeka Falls.

Due to the difficulty in drawing conclusions from this data, it is expected to continue to monitor the log operations per year. Further work will continue to remove data that may be influenced by other factors such as project work or other abnormal events to get a clearer picture and if data shows an increase then associated costs will be calculated then as well.

Work to continue.

	KASHABOWIE	SHEBANDOWAN	GREENWATER	DOG LAKE	KAKABEKA
YEAR	# of Log Ops	# of Log Ops	# of Log Ops	# of Log Ops	# of Log Ops
2021	7	9	0	7	12
2020	14	23	0	22	6
2019	22	22	0	6	34
2018	13	24	0	15	27
2017	17	30	2	16	34
2016	14	25	1	4	27
2015	22	26	0	4	21
2014	7	27	0	9	38
2013	14	26	0	4	46
2012	17	31	2	15	39
2011	9	15	0	5	7
2010	9	14	2	0	1
2009	15	16	0	2	17
2008	12	19	0	15	66
2007	8	16	1	10	23
2006	8	12	3	0	11
2005	14	20	3	4	26
2004	13	14	4	6	18
2003	10	22	0	1	4
2002	12	15	0	0	8
2001	12	16	0	2	19
2000	17	18	0	6	21
1999	11	14	0	1	7
1998	7	13	0	0	7
1997	12	16	0	6	23
1996	19	20	0		12
1995	5	2	0		
1994			0		
1993			2		
1992			0		
1991			0		
1990			4		
1989			0		
1988			3		
1987			6		
	KASHABOWIE	SHEBANDOWAN	GREENWATER	DOG LAKE	KAKABEKA
	average before	average before	average before	average before	average before
	11.8	15	1.1	2.8	13.2
	average after	average after	average after	average after	average after
	13.1	20.9	0.8	8.1	25.6

Table 3: Quantity of Log Operations at OPG Facilities on the Kaministiquia River System year by year.

Flooding

Document flooding and near-flooding events, such as: location, flows, impacts, time of year, and pre-event conditions. Whole system, CH12 Table 72

Flooding events occurred at the Fort William Historical Park due to frazil ice in 2005/06 and in 2007/08 as well. The FWHP had a study performed by KGS Group Consulting Engineers which resulted in a better understanding of the formation and effects of frazil ice. A suggested operational change was implemented to limit the lower Kaministiquia River flow to less than 55cms during the time the river freezes over each winter. Once the ice cap is formed on the river, flows can then be slowly increased to the desired flow. A flooding event at the FWHP also occurred in January of 2019 as the ice cap over the river was delayed in its formation that year due to a warmer than normal December. OPG will continue to research studies by others to determine the conditions (flow and temperature combinations) that may create or accelerate the formation of frazil ice. It should be noted that the FWHP is located within the flood plain mapping as defined by the LRCA, and as such is prone to flooding.

In 2008 and 2012 flooding was avoided at Kakabeka GS, but flooding did occur on the upper Kam River. Both events were due to significant rain which occurred after preceding periods of wet weather. Reports were generated and actions created for the purpose of learning from these events, to be better prepared for any such similar event in the future.

Power Generation: Shebandowan Lake Operations

Assess change in storage/flow from Shebandowan Lake. CH12 Table 73

The following are samples of the assessments from annual reports in 2005 and 2006.

2005 Amount of increased storage /flow from Shebandowan Lake

As compared to previous operation, the new WMP operation did not provide increased storage / flow, based on,

- The winter drawdown and use of storage was similar,
- The spring refill was to .01 m above the previous normal maximum
- The summer water level was to .01 m below the previous summer minimum desirable level
- The fall water levels were within the 1 in 4 year high and low levels

There was a decreased storage /flow from Shebandowan as compared to previous operation, based on

- Previous summer desirable water level is now a minimum compliance level. In the past, in a dry summer the summer minimum desirable level may not have been maintained.
- The Shebandowan water level was approaching the fall maximum compliance limit which necessitated a flow increase and therefore additional spill past Kakabeka Falls GS

2006 Amount of increased storage /flow from Shebandowan Lake

As compared to past operation,

- The winter drawdown was similar, reaching 449.60m prior to spring freshet. In the past a drawdown to 449.70m by April 1 was targeted, then a further 10 cm reduction to 449.60 by April 15. In 2006, due to the early spring, the last 10 cm reduction would not have occurred as spring freshet was already occurring by April 1.
- The summer water level was maintained within the limits of the pre-WMP preferred of 450.0+/-0.15m.
- In the past after Labour Day, it could be expected that the water level would have been drawn lower as the past operation was to draw the lake to 449.75 by Oct 15 then a slow decrease throughout the fall. Where as the current WMP lower compliance limit holds the elevation above 449.85 m until the day prior to Thanksgiving and then preferred option line shows a slight increase throughout the fall
- The year ending water levels were similar to past operations

In summary, there was a similar amount of storage/flow from Shebandowan in 2006 as compared to the pre WMP quantities.

- Realizing the full drawdown potential to 449.6 m, which added 67.6cms-d of water
- By not drawing the fall level as was done in the past which left approximately 10cm of water in the lake by year end which removed 67.6cms-d of water

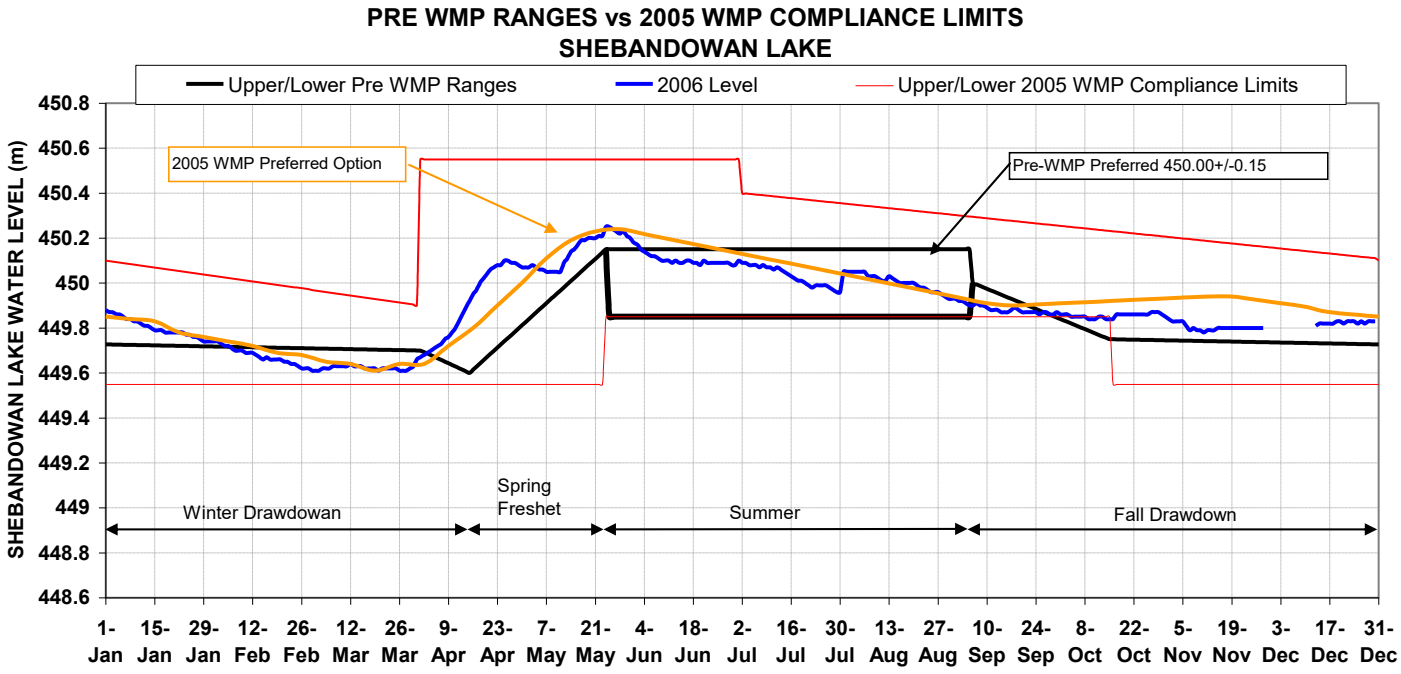

Figure 7: Comparison of Shebandowan Lake elevation compliance limits, pre and post 2005 WMP, with 2006 elevation data as an example year.
Similar reporting can be found for years 2007 through 2013. To summarize, each year has its own water related issues, but in general the increased storage comes from years where the spring freshet refill of the lake can be maximized during wet weather years. The preferred refill is higher than the previous plan, and the upper compliance level was also increased for the refill which allows *for a possibility of* 40 centimeters more refill. It should be noted that under normal operations the upper compliance line would only be utilized in extreme situations and that actions would be taken to leave a buffer between the actual elevation and the upper compliance limit. That amount of storage would be 272cms days of water which is equivalent to 4.73 days of 100% run time at Kakabeka which is 2792MWh of production. This amount could also be equated to 17.1cm of water saved in Dog Lake during extremely dry years. The major problem though is that if Dog Lake is having a dry year, then typically so is Shebandowan and therefore the storage is minimized.

The fall drawdown period also can provide extra storage as the preferred elevation is roughly 20cm higher than the pre-WMP value. This can allow for storage during wet fall conditions to be used over the entire winter period for heating load. There is a slight decrease in the upper compliance limit during the fall drawdown as compared to pre-WMP limits but it is rare to reach those elevations during the fall and hence that reduction does not come into play very often.

Power Generation: Spill

Identify and summarize instances of spill at Dog Lake Dam and Kakabeka Falls Dam throughout the year. Kakabeka and Silver CH12 Table 73

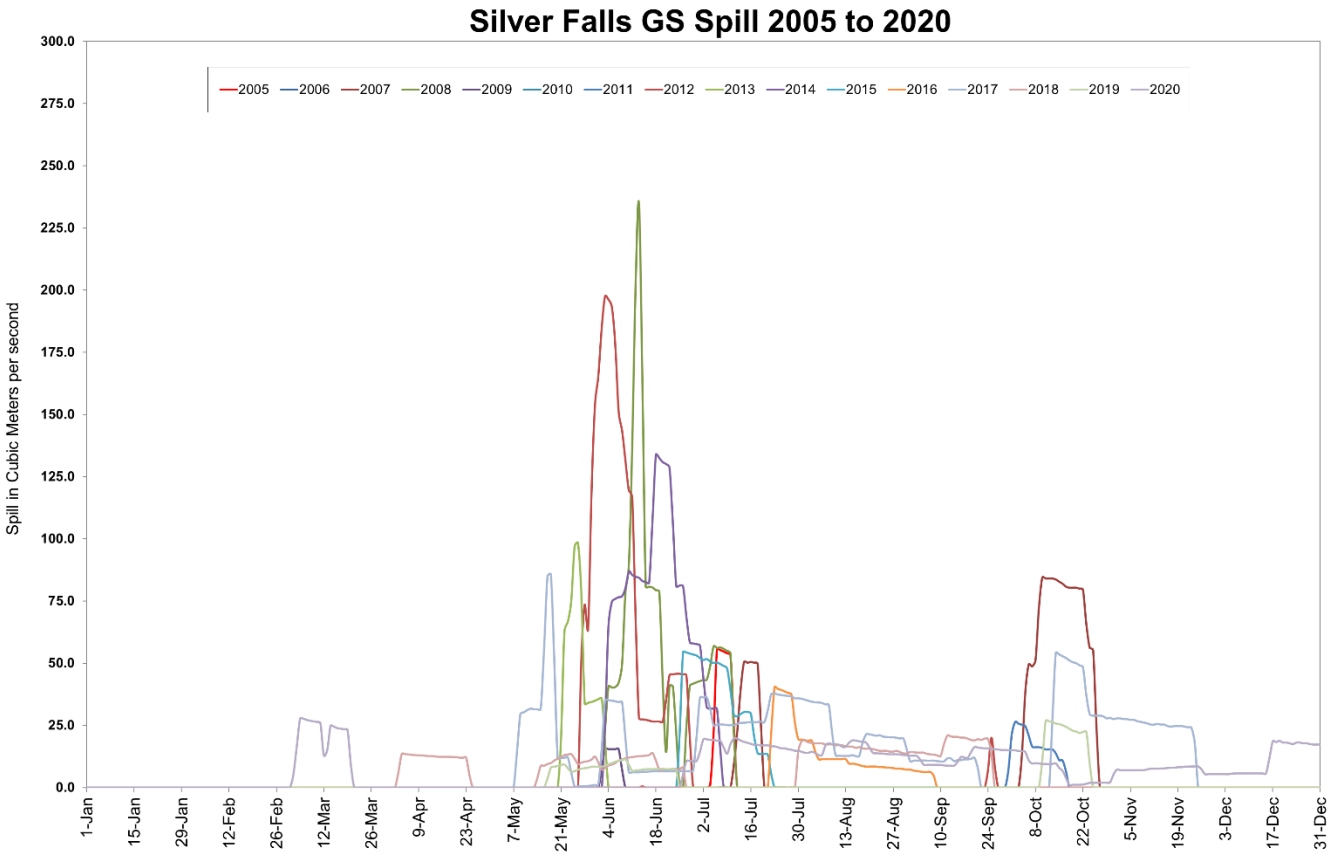

Figure 8: Graphical representation of the amount of water spilled past the Silver Falls GS since inception of WMP

Silver Falls GS Spill Summary

Spill past Silver Falls generally happens in the spring during wetter years when the inflows to Dog Lake cause the elevation on the lake to approach upper levels, and then spill is utilized to prevent excessively high elevations. It can also be noted that this can happen during wet fall weather as well. The amount of spill incurred early in the year has the possibility to be extended due to spawning flow. If spill is initiated at any time during the spawning timeframe it is then required to be maintained throughout the entire spawning period. Spill is also needed during maintenance when the station is not operational and not available to pass flow, yet some flow may be required to provide minimum river flow in the lower Kaministiquia River. Spill, each year, over the life of the WMP has been in the range of 0 to 21% of the full production flow capable of Silver Falls GS.

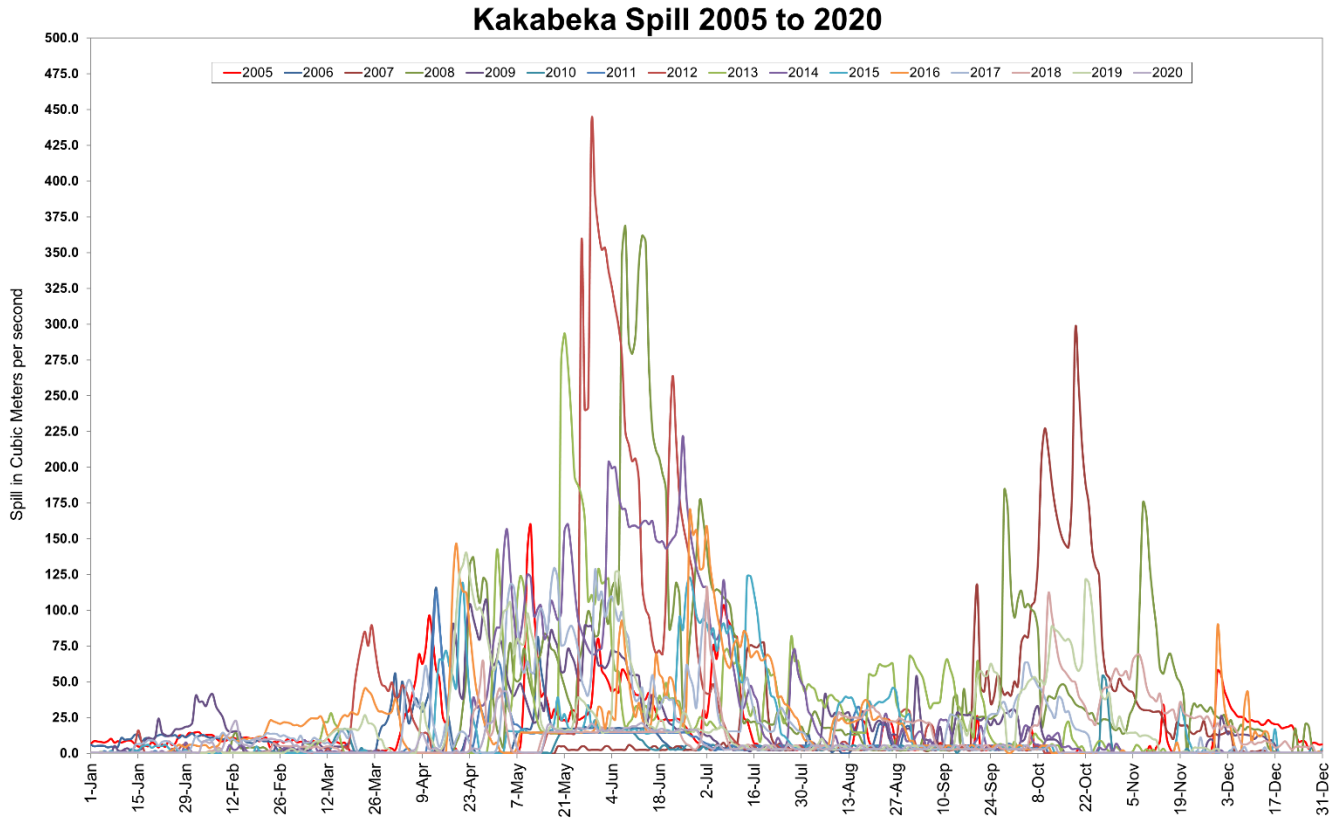

Figure 9: Graphical representation of the amount of water spilled past the Kakabeka GS since inception of WMP

Kakabeka GS Spill Summary.

Kakabeka has no head pond capacity and therefore incoming water must be moved either past the station or through the station. Wet weather years typically provide inflows that are well above the plant capacity and therefore spill generally occurs in the spring and the fall to deal with the excess inflow.

Kakabeka Falls Provincial Park is provided with scenic water during the park season, Victoria Day Weekend to Thanksgiving Day Weekend. A minimum of 4.25cms is released during daylight hours on weekdays and 8.5cms is released during daylight hours on weekends.

Sturgeon, which are an endangered species, are provided various flows, via spill, to assist with their spawning activities from May 5th to June 29th each year.

Electrical system issues can cause spill as the generating station may be tripped offline, which shuts the generators down and the flows would then back up and flow through the overflow pipe above the station for a period of time until operations staff can adjust sluices and head gates to have that excess flow redirected to the sluice at the dam.

There was also an amendment to the WMP to ensure 0.5cms of flow through the dam at all times to keep the downstream side of the dam and the river section above the GS to the falls with enough flow to keep the area wetted for riparian purposes.

Given a comparator of 100% production flow through Kakabeka Falls GS, the table below summarizes each spill as a percent of Kakabeka GSs full production.

Minimum flow of 0.5cms	1%
Sturgeon flow requirement	4%
Scenic flow requirement	3%

The spill caused by weather/high inflows and maintenance varies year by year and can range from almost nil to as high as 63%, as in 2008, which was a very high water year.

Aquatic Ecosystem: Minimum flow assessment

River regions of Kaministiquia River Minimum Flows: Perform studies for data such as wetted perimeter, usable habitat to determine if minimum flows were suitable or should they be increased or decreased. Examine parameters regarding minimum flow below structures. WMP CH12 Table 74, Monitoring Question 4.

Studies performed for sturgeon in the Kaministiquia River below the Kakabeka Falls are described below, on page 34 in section titled **Kaministiquia River Water Management Plan Lake Sturgeon Study**. Future work is required for the Upper Kaministiquia River.

Kashabowie minimum flows were evaluated by NDMNRF and deemed adequate. See same topic in NDMNRF results above on page 11.

A gauge was installed on the Kaministiquia River above the confluence with the Shebandowan River in preparation for minimum flow studies as well as for high water information in wet years. It is installed near the point where the power lines cross the river and so this gauge is referred to as the Hydroline gauge. It is an OPG owned gauge and has been in place since November 2016. Further data collection to create a history, and further work is required to verify the flow vs. elevation data provided by this gauge. Work ongoing.

No studies have been performed at Shebandowan Dam, however it should be noted that the dam has been rebuilt and has facilities (special shim logs) to provide the minimum flow as required by the WMP.

No studies have been performed below the Dog Lake Dam.

There was an amendment to change the WMP minimum flow through the Kakabeka Falls dam in 2011. Previously the minimum flow was described as ‘leakage’ and in 2010 a project replaced wooden logs with new steel logs. Flows were measured before and after the project and after evaluation and consultation with the NDMNRF it was decided that approximately 0.5cms of flow would now be maintained through the dam at all times. This is accomplished

with a 1" shim in a single sluice, and is meant to keep the downstream side of the dam, and the river section above the GS to the falls, with enough flow to keep the area wetted for riparian purposes.

The Mabella and McGraw dams (NDMNRF facilities) are no longer operational and are left in full flow through state, as such, they no longer impact water control on the Kaministiquia River and any actions required for these sites should be removed from the EMP in the future.

Assimilative Capacity

Measure the impact on the power generation objective of the 2-month reduction when 17cms is required for assimilative capacity. Lower KAM WMP CH12 Table 73

The following table (Table 4) provides a summary of the impact on the power generation objective, for the two month reduction of the 17cms required for the assimilative capacity (minimum flow requirement) in the lower Kaministiquia River. The two months each year include April 15 to May 15 and Oct 15 to Nov 15, and are termed the "shoulder months", where the assimilative capacity pre-WMP was 17cms, and has changed to 11cms.

The impact to power generation is a slight benefit of shifting water use from the shoulder seasons into times where power is more often required. The water is not typically wasted, it tends to be stored and used at another time and so the overall impact is minimal. The amount of flow that is altered is 6cms which correlates to approximately 2.5MW of power being shifted rather than lost. Another benefit to the reduction in flow in the shoulder months is that flows can be reduced earlier in drought years and therefore it assists with attempting to maintain the elevations within compliance in the upstream reservoirs.

There were a few years in the 15 years since the WMP was put into place where there were times that the minimum limit in the shoulder months (April 15th to May 15th and October 15th to November 15th) were approached. In the 30 months (two months each year times 15 years) there were 8 months when the flow went below the old limit of 17cms. Of the 8 months where the flows were low only 2 of those required discussions to be held with the SAC/MOEE/NDMNRF towards coming to agreement that the flows were of concern and that other preventative measures be put into place (such as temperature monitoring of the river water, and/or, temporarily lowering the limit early as occurred at the end of summer 2020)

It should be noted that in the years where maintaining the minimum flow is difficult, it is usually compounded by the fact that the minimum flow is required to be sourced from upstream reservoirs (Dog Lake, Shebandowan Lake, Kashabowie Lake, Greenwater Lake) and that those reservoirs are typically also lacking in inflows and therefore suffering in elevation. The reservoirs, especially Dog Lake being the largest, end up going out of compliance, or going further out of compliance, in order to support the minimum flow downstream. The fact that Sturgeon exist in the Kaministiquia River and that they are an Endangered Species tends to be the main driver of maintaining the minimum flow in these low water years and overrides the elevation compliance issues upstream.

OPG has recorded no third party issues or concerns being raised in the 15 year period since the WMP was put into place for the minimum flows for assimilative capacity as found in the WMP. The question concerning if flows were sufficient for water quality purposes lies with the MECP as they are the regulator for issues concerning water quality.

There were minimal changes to power generation as the shoulder season water is normally able to be time shifted rather than spilled. OPG suggests no further requirement to measure the impact on the power generation for the shoulder month reductions when 17cms is required for assimilative capacity. OPG will commit to monitoring any comments or concerns about water quality issues, forward them to the appropriate regulatory agency and report them in the annual report.

Summary of Assimilative Capacity Issues 2005 to 2020

YEAR	RIVER HEALTH	NOTES
2005	No concerns raised	Minimum of 17cms late Aug to early Sep
2006	No concerns raised	14-17cms for 18d between Oct 15 and Nov 15 (dry fall conditions)
2007	No concerns raised	Spring discussions about lowering the flow, but precipitation event prevented this from being required.15-22cms in the preceding weeks (Apr 1 to 14), 11-53cms between Apr 15 to May 15
2008	No concerns raised	Flows greater than 17cms in shoulder months
2009	No concerns raised	Flows greater than 17cms in shoulder months
2010	No concerns raised Discussions held with SAC/MOE/MNR	12-16cms April 15 to May 15 River temperature monitoring also used in Spring 13-16cms for 5d between Oct 15 and Nov 15
2011	No concerns raised	Flows greater than 17cms in Spring 14-17cms for 6d between Oct 15 and Nov 15
2012	No concerns raised	Flows greater than 17cms in Spring Below 17cms for 2d between Oct 15 and Nov 15
2013	No concerns raised	11-17cms for 7d April 15 to May 15, and 17-20cms for 5d April 15 to May 15 Flows greater than 17cms in Fall
2014	No concerns raised	Flows greater than 17cms in shoulder months (from data, not explicitly stated in Annual Report)
2015	No concerns raised	Flows greater than 17cms in shoulder months (from data, not explicitly stated in Annual Report)
2016	No concerns raised	Flows just above 17cms in Spring 14-17cms for 11d between Oct 15 and Nov 15 (from data, not explicitly stated in Annual Report)
2017	No concerns raised	Flows greater than 17cms in shoulder months (from data, not explicitly stated in Annual Report)
2018	No concerns raised	Flows greater than 17cms in shoulder months (from data, not explicitly stated in Annual Report)
2019	No concerns raised	Flows greater than 17cms in shoulder months (from data, not explicitly stated in Annual Report)
2020	No concerns raised Discussions held with SAC/MOE/MNR	Flows slightly greater than 17cms in Spring Flows 12-17cms Oct 7 to 15 (EARLY) with temperature monitoring/agreement from NDMNRF/Resolute 11-17cms for 19d between Oct 15 and Nov 15 (from data, not explicitly stated in Annual Report)

Table 4: River Health Concerns and yearly Water Manager Notes and associated flows for Assimilative Capacity shoulder seasons 2005 to 2020.

Data and Information Collection Program

4.4. Description

This section of the report provides a summary of the applicable DICP components outlined in Chapter 11 of the KRSWMP, including details on:

- background and intent of program component,
- timing and duration of data or information collection conducted,
- findings and conclusions, e.g. assessment of information,
- determination of whether revisions to the facility operations or to the DICP are required, e.g. proposed changes/amendments going forward.

4.5. Data and Information Collection Program Components

Chapter 11 of the KRSWMP lists a number of information gaps identified by the initial Steering Committee during the stakeholders' consultation process as points of interest or questions for future consideration. Filling these gaps was recommended to follow a cooperative approach between NDMNRF and plan proponents, as well as First Nations and other interest groups as applicable.

4.6. Data and Information Collection Program Results

4.6.1. Results as provided by NDMNRF.

Results were set to be provided by either NDMNRF or OPG or SHARED, therefore see "Results provided by OPG" below as it may relate to SHARED results, so as to also avoid duplication.

Dog Lake

Pike access to spawning areas in the spring. WMP 11.3.6

Studies were not preformed regarding this data gap.

Determine spawning locations and weed beds used by fall spawners e.g. whitefish and cisco, and evaluate what drawdown level would support whitefish and cisco spawning. WMP 11.3.6

Studies were not performed regarding this data gap.

Locate weed beds that provide fish habitat and support spring fish spawning e.g. northern pike. WMP 11.3.6

Studies were not performed regarding this data gap.

Identify walleye spawning locations and if spawning is occurring in the lake or rivers. Evaluate if spring water level rise is negatively impacting lake (shoal) walleye spawning success. WMP 11.3.6

Studies were not preformed regarding this data gap.

Dog Lake Dam to Little Dog Lake

Fish community upper Kam and between Little Dog and Dog Lake. WMP 11.3.7

Fish community index netting was conducted on Little Dog Lake in August 2009 in order to establish baseline estimates of fish population density. The study followed the netting protocol established for the NDMNRF's Broadscale Fisheries Monitoring Program. Walleye, Common White Sucker, Lake Whitefish, Yellow Perch, Northern Pike, Long Nose Sucker, Trout Perch Cisco (lake herring) were caught in in 12 net sets. Although not captured smallmouth bass and rainbow smelt are known to inhabit Little Dog Lake.

Greenwater Lake & Greenwater Creek

Flow required in Greenwater Creek migration and spawning. WMP 11.3.3

After effectiveness monitoring studies were completed, a decision was made in 2008 to operate the control dam with 5 logs out of the dam, allowing both the lake and the creek to rise and fall naturally. The WMP was amended in January 2011 to reflect this change. No further manipulation of the dam for power generation purposes are planned. An operating lake elevation of 354.29m based on running the control dam with 5 logs out of the dam has been established as a result of previous work and is adequate for the aquatic ecosystem of the lake. OPG and NDMNRF agree that there is no benefit to operate this dam for the purposes of power generation given the remoteness of the site and the low storage volume. The Greenwater Lake and Greenwater Creek study are considered complete. Baseline has been established as a result of previous work and is adequate for current strategy that does not manipulate the flows. Further work at Greenwater Lake and Greenwater Creek is not required.

Data gaps identified in WMP Section 11.3.3

The 2014 amendment to operate the Greenwater Lake control dam at a consistent level (5 of 13 logs) resulted in the Greenwater Lake levels fluctuating naturally. As a result, the following data gaps were not addressed and are no longer considered a priority for the WMP. These data gaps can be removed from the Water Management Plan.

- **Critical lake trout spawning habitat**
- **Elevations required for successful lake trout spawning**
- **Critical pike spawning habitat in Greenwater Lake**
- **Effect of storage on pike spawning**
- **Effect of regulation change on fish habitat outside of the spawning period-lake and creek**
- **Location of Greenwater Creek critical fish spawning habitat**

Kashabowie Lake/Creek

Minimum spring flow required for walleye spawning

Please refer to the Effectiveness Monitoring program results. See Section titled *Aquatic Ecosystem: Minimum flow assessment* for additional information.

Lake trout spawning shoal locations

Studies were not preformed regarding this data gap.

Effect of winter draw down on lake trout

Studies were not preformed regarding this data gap.

Shebandowan Lake and Shebandowan River

Determine the effect of winter drawdown on lake trout

Studies were not preformed regarding this data gap.

Late summer oxygen profiles for upper, middle and lower

Please refer to the Effectiveness Monitoring program results. See Section titled *Aquatic Ecosystem: Oxygen profiles on Shebandowan Lake* for additional information.

Presence of Coldwater Species in the river

Studies were not preformed regarding this data gap.

Location of critical fish spawning habitat in the river

Studies were not performed regarding this data gap.

Matawin River

Given the low storage volume there is no benefit to operate this dam for the purposes of power generation. The crest of the McGraw Falls Dam is located at an elevation of 394.72 metres. There are 5 logs set at an elevation equal to the crest of the dam, allowing the system to rise and fall naturally. No further manipulation of the dam for power generation purposes is planned. Further work on the Matawin River is not required at this time. As a result, the following data gaps were not addressed and are no longer considered a priority for the WMP.

- **Baseline information and possible effects of regulation. WMP 11.3.2**
- **Hydrological information WMP 11.3.2**
- **Recreational use and how would it be affected by dam operation. WMP 11.3.2.**

Upper Kaministiquia River

Where do walleye spawn in the upper Kam and are local inflows sufficient for walleye spawning when Dog Lake is refilling. WMP 11.3.8

Studies were not preformed regarding these data gaps.

Lower Kaministiquia River

Kakabeka GS

Aquatic ecosystem survey between Kakabeka Falls head works and GS

Studies were not preformed regarding this data gap.

Kakabeka Falls

Evaluate salmon egg mortality (fall spawn) in relation to zero flow requirement over the falls after Thanksgiving weekend.

Studies were not preformed regarding this data gap. The Water Management Plan was amended in 2014 to retain a 0.5cms minimum flow through the dam at all times to keep the downstream side of the dam with enough flow to keep the area wetted for riparian purposes. As a result, this data gap is no longer a priority.

System Wide Data Gaps

Data or Criteria needed to establish minimum flows. WMP Section 11.3.1

See results provided by OPG below

Determine if fish entrapment is occurring, where and how often. WMP Section 11.3.1

See results provided by OPG below

Identify location of major unregulated inflows below each structure and the effects on downstream flows. WMP Section 11.3.1

Studies were not performed regarding this data gap.

Relationship between downstream flooding and drawdown. WMP Section 11.3.1

Studies were not preformed regarding this data gap.

Relationship between flows and riparian perimeters. WMP Section 11.3.1

Studies were not preformed regarding this data gap.

Cultural Heritage Modelling. WMP Section 11.3.1

Modelling was not preformed regarding this data gap.

Digitized Bathymetry data for all lakes. WMP Section 11.3.1

The provincial BSM program digitized bathymetry maps for Kashabowie, Shebandowan and Dog lakes. Data can currently be found at the following link: https://geohub.lio.gov.on.ca/datasets/mnrf::bathymetry-line?geometry=-160.235%2C38.917%2C-9.239%2C58.786

Waterfowl and Loon nesting inventory. WMP Section 11.3.1

Studies were not preformed regarding this data gap.

Habitat mapping for riparian wildlife. WMP Section 11.3.1

Studies were not preformed regarding this data gap

Identify the downstream effects of flow changes at structures. WMP Section 11.3.1

Studies were not preformed regarding this data gap

Socio-Economic Analysis of Planning Area WMP Section 11.3.1

Studies were not preformed regarding this data gap

Determine if fish impingement is occurring at the water intakes. WMP Section 11.3.1

Studies were not preformed regarding this data gap

Locate and determine effects of water management on wetlands, including important habitat for various species, such as waterfowl, shorebirds, beaver, muskrat, amphibians, etc. Appendix E, Table 1

Studies were not preformed regarding this data gap.

Determine minimum flows that would not impact fish habitat downstream of flow control structures. Appendix E, Table 1

Studies were not preformed regarding this data gap.

Kaministiquia River Water Management Plan Lake Sturgeon Study

During the Kaministiquia River Water Management Planning process, the Ontario Ministry of Natural Resources and Forestry (MNRF) identified their concerns regarding the health of the sturgeon population in the Kaministiquia River. The access of adult sturgeon to their historical spawning site and reproductive success was identified as an issue during the planning process. In 2003, the Water Management Plan Steering Committee established a Research and Data Gathering Agreement that set out the principles under which all parties would cooperate to carry out studies and trials related to the Kaministiquia River sturgeon population over the period of the Water Management Plan. This agreement is found at Appendix H of the Final WMP.

Executive Summary:

From 2004 to 2012 the movements of radio tagged sturgeon were tracked as they migrated into and out of the spawning area below Kakabeka Falls throughout different flow conditions. These studies confirmed that Sturgeon can gain access to the spawning area with flows as low as 14cms (with three individuals able to access the site with flows as low as 4.25cms), but for the entirety of the spawning aggregation to reach spawning substrates at the foot of Kakabeka Falls, 17cms is necessary. Most radio tagged sturgeon accessed the spawning site at flows greater than or equal to 17cms. Larval drift net surveys occurred from 2004 to 2013, after the spawning period, during controlled flows, to document the variability in the dispersal period which was used to determine the duration of flow required. The number of larvae caught and dispersal period varied from year to year. In general, reproduction was determined to be successful by OPG.

In 2014 OPG implemented a rule based operating procedure (Mitigation plan) to minimize adverse effects for lake sturgeon under the *Endangered Species Act.* The operating requirements for normal watershed conditions include: ensuring at least 25cms minimum flow from May 5th (to the 15th) in the river at Kakabeka Falls GS to allow adult lake sturgeon migration upriver; and providing a minimum spill over the falls (14cms) though the spawning and larval drift period.

Water conditions change annually and regular communications between NDMNRF and OPG occur to consider the system's ability to meet minimum flows and the required gradual reduction of flow to provide sturgeon with adequate time to move downstream.

As part of its commitment to assess the implementation of the ESA Mitigation plan operating procedure, OPG will undertake a monitoring program that includes:

1. A juvenile netting program Year 4 (2017) or 5 (2018) of the plan with the objective of monitoring sturgeon year class strength at the juvenile stage.

- This commitment was completed in 2019 and 2020.

2. A minimum of one larval drift survey will be completed within the first 5 year implementation period of the mitigation plan.
    - This commitment was completed in June 2021
3. OPG will collect daily and hourly water temperatures and flows throughout the upstream spawning migration, incubation, and drift periods each year for inclusion in an annual monitoring report.

BACKGROUND

The spawning migration and reproductive success of adult lake sturgeon was examined during controlled "spill" flows over Kakabeka Falls on the Kaministiquia River. An attempt was made by OPG to control the spill at 23cms over the falls from May 15 to June 25 and then reduce flows by 3cms every 24 h until scenic flow was attained on June 30.

A shoreline-based data logger was used to track the movements of radio tagged sturgeon as they migrated into and out of the spawning area below Kakabeka Falls. A larval drift netting assessment was carried out to determine if reproduction was successful.

The 2004 study has shown that (i) sturgeon gained access to and from the spawning area during controlled spill flows of 23cms (ii) sturgeon remained in the spawning area from two days to 6.5 months (iii) sturgeon spawned successfully on two occasions approximately 37 d apart; and (iv) there were two larval drift events approximately one month apart.

In 2004, due to significant rainfall events, planned spill flows of 23cms could not be maintained through the entire study period (the study flow was maintained for 18 days).

The 2005 study has shown that (i) sturgeon gained access to and from the spawning area during uncontrolled flow conditions that ranged from 24cms to 160.9cms (ii) sturgeon remained in the spawning area from 1 to 41d (iii) sturgeon spawned successfully on two occasions approximately 10 to 12 d apart (iv) there were two overlapping larval drift events; and (v) both drift events occurred in June during the timeframe of controlled flows and lasted approximately 12 and 7 d respectively.

In 2005, due to rainfall events, planned spill flows of 23cms could not be maintained through the entire study period (the study flow was maintained for 1 day).

In 2006 the NDMNRF planned to examine a lower flow condition (17cms) to determine if migration and successful spawning would occur within the prescribed study timeframe. Study flows, however, were initiated nine days earlier than scheduled due to early upstream migration of radio tagged sturgeon that congregated in the tailrace of the generating station (GS). The study period was, therefore adjusted to run from May 6 to June 16 with a 3cms flow reduction every 24 h until scenic flows were attained on June 22.

Since some radio tagged sturgeon were known to be congregated in the tailrace of the GS; we took the opportunity to spill 14cms to see if they could migrate to the base of Kakabeka Falls. Water flowing over Kakabeka Falls was increased from dam leakage (1cms) to14cms on May

6th and was maintained for 46 hrs. Flow was then increased to 17cms and was maintained until heavy spring rainfall increased flow over the falls to a maximum of 89.3cms on May 13. Flow was not controlled at 17cms until May 18 and was maintained until June 16 for a total of 33 days.

RESULTS

- One sturgeon moved to the base of Kakabeka Falls during spill flows of approximately 14cms.
- Two sturgeon moved a short distance upstream of the GS during spill flows of approximately 14cms.
- Twelve sturgeon moved to the base of Kakabeka Falls during spill flows of approximately 17cms.
- Sturgeon spawned successfully in the study area.
- Larval sturgeon drifted from the spawning site over a 16 d period, during flow conditions that ranged from 15 to 17.7cms.

OTHER STUDIES

In 2006 OPG undertook a feasibility study to investigate the monitoring sturgeon hatching and drifting success downstream of the Kakabeka Falls Generating station. The objectives of the study were to determine:

1. If it is feasible to set larval drift nets in the higher flows (Kakabeka Falls spill flow plus power flow from Kakabeka Falls GS) within 1 km downstream of the GS along the east and west banks of the river;
2. If larval sturgeon hatched upstream can be captured immediately downstream of the GS; and
3. If sturgeon larvae can be captured farther downstream where mixing of the generating station discharge and water from over the falls occurs.

The Consultant hired by OPG to do this investigation was trained by NDMNRF and used similar methodology in handling the D frame drift nets. Several sites and flow conditions were investigated on both sides of the river downstream of the generating station, during the period of June 6th to June 14th, 2006. This period coincided with the greatest numbers of drifting larval sturgeon being reported by the NDMNRF at the upstream driftnets.

The study showed that:

1. Larval drift nets can be successfully used downstream of the GS at discharge rates of at least 55cms.
2. Larval sturgeon hatched upstream of the generating station were not captured in the generating station tailrace. This indicates that (a) sturgeon did not likely spawn in the tailrace in 2006 and (b) the discharge from the generating station and the discharge for the falls do not likely become completely mixed for some distance downstream.
3. Sturgeon larvae were captured 1400 m downstream from the generating station. This location could be used as a baseline to monitor hatching success rates in low and high water level years.

The investigation provided confirmation of and logistical considerations for implementing larval sturgeon driftnet sampling during study years when flows may not be sufficient to allow sturgeon to access Kakabeka Falls

In 2007. The Lakehead Region Conservation Authority area of jurisdiction was in a level II Low Water Condition from November 26, 2006 to July 3, 2007. To take advantage of these conditions, NDMNRF and OPG agreed to study base case flows (scenic flow) over the falls which would allow OPG to investigate if spawning occurred downstream of the generating station (GS).

Scenic flow would be provided during daylight hours of the tourist season (i.e., Victoria Day weekend in May to Thanksgiving Day weekend in October) at flow rates of 4.25cms on weekdays and 8.5cms on weekends and statutory holidays.

A shoreline based data logger was used to track the movements of lake sturgeon radio tagged in the spring of 2007 and those from previous years. The data logger is capable of detecting sturgeon anywhere from downstream of the GS to the base of the falls. Larval drift netting assessments were carried below the GS by OPG (Northern Bioscience) to determine if reproduction was successful and by NDMNRF above the GS (in case of reproduction upstream).

- Scenic flows were maintained for the duration of the study period.
- From May 15 to June 25 the total river flow ranged from 17 to 60.5cms.
- In late April 2007, lake sturgeons (19) were tagged with radio transmitters.
- Nine sturgeon migrated upstream to Kakabeka (7 from 2007, 2 from 2006).

A. Below the GS

- First fish arrived at GS on May 8 (total River flow 14.2cms, water temp 12°C)
- Six fish remained below the GS and migrated back downstream by May 27.
- Spawning likely occurred between May 24 and 25 (mean water temp 14.7°C)
- Drift nets were deployed at three locations from June 6 to June 24, 2006 for a total of 114 net-sets
- Northern Bioscience collected 60 larval sturgeon caught in drift nets below the GS on the east bank with catches ranging from 0 to 6 individuals per net in the period from June 7 to 15 (flows ranged from 17.8 to 60.5cms). No larval sturgeon were captured in the drift nets set on the west bank.

B. Above the GS

- Three radio tagged sturgeon moved to the base of the falls on May 30th (16.7°C)
- Scenic flows during movement ranged from 0.1 to 4.1cms
- Spawning likely occurred between May 30 and June 2 (mean water temp 18.4°C)
- Six drift nets were set at each of two locations upstream of the GS (12 total).
- NDMNRF collected 28 larval sturgeon (17 at the downstream site and 11 at the upstream site) from June 14 to 18 (flows ranged from 0.1 to 11.0cms)

In 2008 the NDMNRF planned to examine spill flows of approximately 14cms within the prescribed study period. Due to flood conditions throughout the Kaministiquia River watershed this target flow could not be provided (study flow maintained for 0 days). Spill flows were provided beyond the study period due to the presence of adult sturgeon and drifting larvae in the study area and to accommodate for the possibility of a late second spawning event. These additional flows ranged from 13 to 29cms and were provided until August 14.

During the study period (May 15 to June 30) mean daily total river flow ranged from 80 to 426cms. Mean daily spill flow ranged from 23 to 369cms.

Due to difficult netting conditions during river flows that were in excess of 100cms only four sturgeon were radio tagged. The remaining 17 radio tags were applied to fish in October 2008 with the hope that some will migrate in the spring of 2009.

The data logger that is used to monitor sturgeon movement at Kakabeka was flooded out on June 6th and was replaced on June 10th. Only 4 radio tagged sturgeon migrated to Kakabeka and arrived from May 6 to June 27 during temperatures that ranged from 7.9 to 17.9 °C and spill flows that ranged from 40.6 to 292.4cms.

Drift netting commenced on June 23 and ended on August 15. Larvae were captured (n=78) from June 26 to July 13 during spill flows that ranged from 21.2 to 177cms and water temperatures that ranged from 15.7 to 18.3°C.

In 2009 OPG and the NDMNRF planned to examine spill flows of approximately 14cms within the prescribed study period from May 15 - June 30th. As a result of high river flows prior to the study start date (spring freshet) and significant rainfall throughout the Kaministiquia River watershed, flow over the falls could not be controlled at 14cms within the study period.

To meet the overall study objectives, OPG agreed to continue to provide a minimum continuous flow over Kakabeka Falls until July 3. From June 30th to July 3, the spill flows ranged from 12.2 to 14.1cms.

During the study period (May 15 to June 30) mean daily total river flow ranged from 58 to 147cms. Mean daily spill flow ranged from 14 to 89cms. External radio transmitters were attached to 15 lake sturgeon in the spring of 2009. These fish ranged from 109 to 161 cm in total length and weighed 9.5 to 22.5 kg. The shoreline based data logger that is used to monitor sturgeon movement at Kakabeka operated from April 23 to September 1.

Seventeen radio tagged sturgeon migrated to the base of Kakabeka Falls in 2009. Seven were radio tagged in the present study, nine were tagged during in the fall of 2008 and one was internally tagged in the fall of 2000. Of the radio tagged fish that moved to the base of the falls in 2009, one fish (frequency 095) also migrated to the base of the falls in 2004 and 2008. Radio tagged sturgeon arrived at Kakabeka between May 9 (9.4°C) and June 4 (11.5°C) during spill flows that ranged from 41.8 to 73.1cms

During 18 overnight sampling events from June 15 to July 3 (3770 sample hours) 1533 larval lake sturgeon were captured. There was one period (drift event) when larvae were captured as

they drifted downstream from the spawning site (June 15 to July 3). During this period, the mean daily spill flows ranged from 12.2 to 40.9cms.

To determine the distribution of larval drift across the width of the river, we set 13 nets overnight from June 25 (set) to June 26 (lift) along an 88 m transect from the standard drift netting site to the west side of the river. A total of 1078 larvae were caught. The highest catches came from nets in proximity to the west bank where water velocity and depths were the greatest.

In 2010 the NDMNRF and OPG originally planned to study the base flow condition (scenic spill only) and to investigate lake sturgeon spawning at the area below the generating station. This plan was altered due to low water conditions throughout the watershed and by late April it was agreed to change the study plan to examine lake sturgeon access to the base of Kakabeka Falls and reproduction during spill flows of approximately 14cms (from May 15 to June 25 with a 5 day taper to scenic flows). The start of the spill flow was adjusted due to the absence of radio tagged sturgeon at the Kakabeka Falls generating station (GS) prior to May 15. The adjusted study period ran from May 18 to June 11 (end of drift) with a 4 day taper to scenic flow.

The Level 1 Low Water condition was upgraded to a Level 2 Low Water condition by the Lakehead Region Conservation Authority in early May

Spill flows were initiated when radio tagged sturgeon were tracked downstream of the GS on May 18th. In order to see if migration would occur at flows less than the target spill (14cms), flow was diverted from the GS to over Kakabeka Falls as follows: Spill increased from 0.5cms to 9.5cms on May 18 and maintained for 23 hours. Spill increased to 11.4cms on May 19 and maintained for 12 hrs. Spill flows increased to 14cms on May 19 and maintained for 1.7 days. Spill flows were then increased to 17cms on May 21 and maintained for 1.5 days after which spill was decreased to 14cms and maintained until June 11.

A shoreline-based data logger was used to track the movements of lake sturgeon radio tagged in the spring of 2010. The data logger is capable of detecting sturgeon downstream of the GS to the base of the falls. Four additional loggers were installed from river kilometer 19 to 42 to track the upstream and downstream migration of radio tagged sturgeon.

Larval drift netting assessments were carried out downstream of the GS by OPG (Northern Bioscience Ltd.) and upstream of the GS by NDMNRF in case reproduction occurred at either site.

During the study period (May 18 to June 11) mean daily total river flow ranged from 18 to 27cms. Mean daily spill flow ranged from 9.2 to 17cms.

External radio transmitters were attached to 25 lake sturgeon in the spring of 2010. These fish ranged from 116 to 172 cm in total length and weighed 8 to 27.5 kg.

The shoreline based data logger that is used to monitor sturgeon movement at Kakabeka operated from May 5 to September 30. The four additional loggers installed from river kilometer 19 to 42 were operational from May 5 to December 31.

Radio tagged sturgeon began to migrate upstream from the lower river during a natural flow increase on May 15. Ten radio tagged sturgeon migrated to Kakabeka in 2010 and arrived between May 16 (11.4°C) and May 19 (15.7°C) during total river flows that ranged from 20 to 28cms. Seven remained downstream of the generating station and three migrated upstream to the base of Kakabeka Falls during spill flows that ranged from 11.4 to 16.6cms.

NDMNRF collected 98 larval sturgeon above the GS from May 31 to June 9 during spill flows of approximately 15cms and water temperature that ranged from 17 to 19 °C.

OPG drift-netting took place from May 31 to June 10, 2010 downstream of the GS. Six nets were set May 31 to June 10 at Site 1 on the east bank of the Kaministiquia River 300 m below the generating station at the same location used in previous studies. An additional three nets were set 200 m upstream at Site 2 and used overnight on June 1 to more closely tie sampling to the station discharge. These three nets were moved 50 m downstream to Site 3 (on June 2 due to high mortality of larval sturgeon (from high water velocities at the nets). They were used there for the duration of the study.

In 2011 the NDMNRF and OPG planned to examine lake sturgeon access to the base of Kakabeka Falls and reproduction during spill flows of approximately 14cms (from May 15 to June 26 with a 4 d taper to scenic flows).

Total river flow was in excess of plant capacity (57cms) prior to the study start date (May 15). Surplus water was therefore spilled over Kakabeka Falls but was controlled at approximately 14cms for the duration of the study period. There were no significant rain events that caused spill over Kakabeka Falls in excess of study flows

A shoreline based data logger (model R4500) was installed upstream of the GS in early May to track the movements of radio tagged sturgeon as they migrated to the study area. A two antenna system was used to interpret the direction of fish movement as one antenna was facing upstream (toward the Falls) and the other was facing downstream (toward the GS). The logger operated from May 4 to October 19.

Larval drift netting assessments were carried out downstream of the GS by OPG (Northern Bioscience Ltd.) and upstream of the GS by NDMNRF in case reproduction occurred at either site. NDMNRF drift netting took place at the standard index site (12 nets) established in 2004, approximately 400 m downstream of Kakabeka Falls on the east shore of the river. We also set 4 nets (400 m downstream of Kakabeka Falls) on the west side of the river to examine drift within the main river channel where the majority of the flow was concentrated during these study flow conditions. All 16 nets were set from June 3 to 30.

OPG drift netting (Northern Bioscience) took place downstream of the GS from June 7 to June 24. Six nets were set in the same location as in 2007 and 2009 (Site 1) on the east bank of the river approximately 300 m downstream the GS.

External radio transmitters were attached to 25 lake sturgeon that ranged in total length from 115.5 to 162.0 cm and weighed 8 to 24.5 kg.

Only two of 25 radio tagged sturgeon migrated to Kakabeka in 2011.

Radio tagged sturgeon arrived at Kakabeka on May 15 (14.7°C) and May 18 (14.8°C) during total river flows that ranged from 32 to 58cms. Frequency 150.822 (130 cm, 16.5 kg) was initially detected by the data logger on May 15 and took approximately 15 hours to access the plunge pool at the base of the falls during controlled spill of 14.7cms. It migrated back downstream on May 17 during controlled spill flow of 16.3cms. Frequency 151.123 (129 cm, 11.5 kg) was initially detected by the data logger on May 18 and took approximately 4 hours to reach the plunge pool at the base of the falls during controlled spill of 14.8cms. It migrated back downstream on June 7 during controlled spill flow of 14.5cms.

NDMNRF Sampling Upstream of GS

During 30 overnight sampling events (June 1 to June 30 with 12 nets) at the standard site upstream of the GS, 1155 larval lake sturgeon were captured. During 29 overnight sampling events (June 1 to June 30 with 4 nets) at the west bank site where flows and depth are greatest, 1862 larval lake sturgeon were captured.

Sampling Downstream of GS (OPG/ Northern Bioscience)

Northern Bioscience set a total of 54 nets sets in the Kaministiquia River downstream of the Kakabeka Falls GS. Drift nets were set from June 6 to June 13 and again from June 19 to June 24 during the period that larval drift of lake sturgeon from the river upstream of the GS was occurring. A total of 12 larval sturgeon were caught in drift nets below the GS, all of which were caught on June 7 to 10 in the three outermost nets. Based on the very low abundance and distribution of larval sturgeon in the net array, it is most likely that the drift originated from above the GS. Due to relatively low station flows during the time of sampling, there was incomplete separation of the bypass and GS flows which would allow sturgeon larvae from above the GS to be caught in nets set on the east bank below the GS. It was therefore concluded that it was unlikely that lake sturgeon spawned in the area immediately downstream of Kakabeka Falls GS in 2011. The 2011 study did provide a useful period to predict the onset and completion of larval sturgeon drift using a temperature model.

In 2012 the NDMNRF and OPG planned to examine lake sturgeon access to the base of Kakabeka Falls and reproduction during planned spill flows of approximately 14cms (from May 15 to June 25 with a 4 day taper to scenic flows). The OPG study plan was actually to initiate controlled spill on May 17, unless water temperature reached 11°C or spill was commenced before that date for any other reason. Spill was initiated on May 14 based on OPG river temperature gauge having reached 11°C. As a result, the study flows were initiated on May 14 at approximately 13:30.

Note: verification of the OPG temperature gauge subsequently showed that it was providing erroneous data at the time and the actual river temperature, based on comparison to NDMNRF logger located upstream, was slightly higher).

Study flow was initiated on May 14 at approximately 13:30 and was maintained in a controlled manner until the evening of May 24 (10 days).

A shoreline based data logger was used to track the movements of lake sturgeon radio tagged in the spring of 2011. The data logger is capable of detecting sturgeon downstream of the GS to the base of the falls.

Drift netting took place at the standard index site (with 6 nets) established in 2004, approximately 400 m downstream of Kakabeka Falls on the east shore of the river.

On May 24 heavy rainfall caused river flows to increase beyond plant capacity (57cms) and our study flow target (14cms) reaching a maximum spill of 439.4cms on May 28. During the planned study period (May 14 to June 29) mean daily total river flow ranged from 28 to 494.8cms. Mean daily spill flow ranged from 6.8 to 439.4cms. Due to water conditions uncontrolled spill was maintained above 14cms until the evening of July 8th when the planned ramp-down to normal scenic flow was initiated: spill flows were reduced starting the evening of July 8, with a return to normal scenic conditions by evening of July 12.

External radio transmitters were attached to 25 lake sturgeon in the spring of 2011. These fish ranged from 116 to 162 cm in total length and weighed 8 to 24.5 kg.

The shoreline based data logger that is used to monitor sturgeon movement at Kakabeka operated from April 24 to November 28.

Of the 25 sturgeon radio tagged in the spring of 2011, nine migrated to Kakabeka in 2012 and arrived between April 28 (13.7°C) and June 16 (15.5°C) during mean daily total river flows that ranged from 43.1 to 126.8cms. Four fish (Freq. 781, 882, 982, 1022) migrated part way into the study area when 14cms was being spilled but did not migrate to the base of the falls. Two fish (742 (13kg), 762 (14kg) migrated to the base of the falls on May 14 (16:45 and 23:29) when 14cms was being spilled. Frequency 723 (18kg) migrated into the study area on June 14 during 95.4cms spill but was not logged at the base of the falls. The other two radio tagged sturgeon (922 (10.5kg), 1085 (17kg)) migrated to the base of the falls on June 16 when 70.3cms was being spilled.

Four radio tagged sturgeon (Freq. 781, 882, 982, 1022) migrated downstream from the study area when 14cms was being spilled. Frequency 762 migrated downstream from the study area when 4.7cms was being spilled. Frequency 742 and 723 migrated downstream from the study area when 216 and 70.3cms was being spilled respectively. Two fish (1085 and 922) were not recorded as moving downstream from their last recorded position at the base of the falls. The tags may have reached the end of their life (batteries died) or the fish may have been removed from the river.

Drift netting was conducted when spill flow was less than 80cms. On June 15 and 16 (15.5°C) we collected two yolk sac larvae (one on each day) when spill was approximately 75cms. Two larval sturgeon were collected on July 6 (21 and 24 mm) and July 7 (22 and 30 mm) respectively during mean daily water temperature of 22°C and spill flow of approximately 18.5cms.

Prior to the start of the planned spill, six radio tagged lake sturgeon were logged downstream of the GS (April 28 to May 14) when spill over Kakabeka Falls was at dam leakage (0.5cms). On

May 14, prior to the initiation of spill at 14:00, lake sturgeon were observed spawning (12°C) on the west side of the river across from the GS from 13:15 to 14:20. On May 15, (when spill over the falls was 14cms) some lake sturgeon partially accessed the study area and were observed spawning on the west shore of the river upstream of the GS. On May 17 NDMNRF verified spawning at this location by observing sturgeon eggs adhered to the underside of rocks. The delay in spill over the falls resulted in some fish spawning at locations other than the base of Kakabeka Falls.

In 2013 OPG implemented a rule based operating strategy for planned or controlled spill over Kakabeka Falls of 14cms from May 10th. Due to high natural inflows, controlled spill was restricted to approximately four days (May 15-19) and remained above the target throughout the rest of the study period.

As a result of the spill flows, it was assumed that Lake Sturgeon had unrestricted access to the base of Kakabeka Falls for spawning and that there was unlikely a spawning event in the vicinity of the station / tailrace. For these reasons, and due to limitations with drift netting, in the high flows, OPG did not conduct drift below the station. Flow over Kakabeka Falls remained well above scenic values throughout the summer and with a nominal decline to scenic flows in late September.

Drift netting was conducted by NDMNRF above the generating station from June 10th to July 6th. Based on river temperature and larval drift results NDMNRF predicted a spawn date of May 31st. Larval drift comments when 150 Cumulative Thermal Units (CTU) had occurred and completion of all larval drift when 400 CTU from date of spawn had occurred. NDMNRF used the data collected in 2013 to test the CTU model for larval drift. Based on the CTU data NDMNRF concluded that the timing of spawning and period of larval drift were similar to other study years

OPG believes that the joint lake sturgeon study agreement should be terminated. Under the Endangered Species Act 2007, OPG has developed a mitigation and monitoring plan to address the flow requirements for lake sturgeon. The Plan includes information collected from 2004 to 2013 as part of the Lake Sturgeon Study Agreement. The information collected has been considered, together with information on the operations, and has been taken into account to develop the reasonable steps that OPG will implement to mitigate adverse effects associated with station operation.

OPG (Northwest Operations-Hydro) has implemented a Local Control Operating procedure (NWCC-LCO-GEN-022) that describes its planned operations to minimize adverse effects on lake sturgeon and to protect habitat used by the species at Kakabeka Falls GS.

In normal years, the basic operational components of this LCO include

- To ensure sufficient flow (25cms) in the lower river prior to May 5th for upstream migration of adult lake sturgeon
- Provide spill flow of at least 14cms over the falls to support lake sturgeon access to the spawning area upstream of the GS, incubation of eggs, and protection of the main larval drift period.

- Providing a three day period of ramp down of spill flow at the end of the above spill period, to allow migration of adults from the upstream area before the return to normal scenic flow regime occurs.
- Once the sturgeon spill has been initiated, the minimum spill will be maintained until the ramp down of flows begins. The ramp down flow will normally begin on June 27th. On a case by case basis, OPG may revisit the start date for commencing the 3 day spill flow ramp down pattern (as per NWCC-LCO-GEN-022) in an effort to maximize reasonable opportunities for adult and larval fish to migrate downstream from the spillway
- During out of normal conditions (as described in the WMP) an alternate flow regime may be implemented. The LCO describes the mechanism for determining when this out of normal condition applies and the operating regime that may be implemented in consideration of the watershed conditions and the needs of all stakeholders on the system.

As required by the legislation OPG has also implemented a variety of controls around staff training and contractor management to ensure there is no inadvertent damage or harm to individual sturgeon as part of our work at the site, and that actual encounters with lake sturgeon are reported appropriately.

As part of its commitment to assess the implementation of this mitigation plan OPG will undertake a monitoring program that includes:

- A juvenile netting program Year 4 (2017) or 5 (2018) of the plan with the objective of monitoring sturgeon year class strength at the juvenile stage.
- A minimum of one larval drift survey will be completed within the first 5 year implementation period of the mitigation plan. Larval drift survey(s) will target a year(s) when the spring spawning condition is considered to be at base case (i.e. ideally, when only 14cms is maintained and no uncontrolled events occur during the spawning migration) in order to ensure that 14cms provides adequate flow for fish accessing the spawning grounds and provides opportunity for successful spawning, emergence and drift.
- OPG will collect daily and hourly water temperatures and flows throughout the upstream spawning migration, incubation, and drift periods each year for inclusion in an annual monitoring report.

In 2014 OPG implemented a rule based operating strategy for operating requirements for lake sturgeon under the Endangered Species Act. The operating requirements for normal watershed conditions include: Ensuring at least 25cms minimum flow on May 5th (to the 15th) in the river at Kakabeka Falls GS to allow adult lake sturgeon migration upriver and providing a minimum spill over the falls though the spawning and larval drift period.

Once the sturgeon spill has been initiated, the minimum spill will be maintained until the ramp down of flows begins. The ramp down flow will normally begin on June 27. On a case by case basis, OPG may revisit the start date for commencing the 3 day spill flow ramp down pattern in an effort to maximize reasonable opportunities for adult and larval fish to migrate downstream from the spillway.

During out of normal conditions (as described in the WMP) an alternate flow regime may be implemented. The LCO describes the mechanism for determining when this out of normal condition applies and the operating regime that may be implemented in consideration of the watershed conditions and the needs of all stakeholders on the system. As part of its commitment to assess the implementation of this mitigation plan OPG will undertake a monitoring program that includes:

- A juvenile netting program Year 4 (2017) or 5 (2018) of the plan with the objective of monitoring sturgeon year class strength at the juvenile stage.
- A minimum of one larval drift survey will be completed within the first 5 year implementation period of the mitigation plan. Larval drift survey(s) will target a year(s) when the spring spawning condition is considered to be at base case (i.e. Ideally, when only 14cms is maintained and no uncontrolled events occur during the spawning migration) in order to ensure that 14cms provides adequate flow for fish accessing the spawning grounds and provides opportunity for successful spawning, emergence and drift.
- Collection of daily and hourly water temperatures and flows throughout the upstream spawning migration, incubation, and drift periods each year for inclusion in an annual monitoring report.

As a result of very high spill flows in 2014, it was assumed that Lake Sturgeon had unrestricted access to the base of Kakabeka Falls for spawning No drift netting was carried out to confirm this due to safety and access reasons.

Starting in early April 2015, approximately weekly (internal) discussions were held to review watershed conditions and determine if the system was considered out of normal. The discussion focused on the watershed conditions and OPG's ability to continue flow mitigation including the ability to meet the 25cms minimum flow starting on May 5. Water and air temperature trends were also discussed. At no time were watershed conditions deemed to be out of normal as defined by the Kaministiquia River System Water Management Plan. OPG was able to provide the total 25cms minimum flow in the river below the station prior to and after May 5. A river temperature trigger (i.e. 24 hour running average tail water temperature) of 11C was first reached on May 3. As a result, OPG initiated the 14cms minimum spill over the falls between 11:00pm and midnight on May 3.

Minimum spill flow requirements were met during the remainder of the Lake Sturgeon spawning and drift period reaching a high of 39.3cms on May 18. This peak spill flow was largely due to the return to service of the Silver Falls Generating Station upstream. Significant rain events in late June prevented the return or a controlled state and scenic flow conditions until late July. The operating requirements of the plan call for a three day ramp down period for spill reduction at the end of the larval drift period. In 2015 the ramp down process began on July 25 at 07:00 and was completed by July 29, 2015 at 21:00. Biological monitoring was undertaken by Northern Bioscience on behalf of OPG in 2015. This work consisted of using driftnets to detect evidence of Lake Sturgeon spawning. Nets were deployed between May 30

and June 22, 2016, with a total of 216 net-sets. A total of 144 larval Lake Sturgeon were caught, all above the Kakabeka Falls GS. Based on the actual flows provided in the Kaministiquia River and over the Kakabeka Falls as well as historic understandings of spawning behavior on the river, OPG does not believe that Lake Sturgeon access to the spawning areas upstream of the station was appreciably impeded or restricted in 2015. This was confirmed through the presence of drifting larval Lake Sturgeon upstream of the station. No larval Lake Sturgeon were captured in drift nets set directly downstream of the station. Based on historic understandings of spawning and larval drift on the Kaministiquia River OPG does not believe facility operations posed a risk to spawning, incubation and/or drift of Lake Sturgeon in 2015.

Starting in early April 2016, approximately weekly (internal) discussions were held to review watershed conditions and determine if the system was considered out of normal. The discussion focused on the watershed conditions and OPG's ability to continue flow mitigation including the ability to meet the 25cms minimum flow starting on May 5. Water and air temperature trends were also discussed. In early May due to abnormally dry conditions the watershed was deemed to be out of normal as defined by the Kaministiquia River System Water Management Plan. NDMNRF agreed that the watershed was out of normal with respect to the WMP but did not provide agreement for a deviation from the ESA plan requirements. Therefore, OPG continued to provide the total 25cms minimum flow in the river below the station prior to and after May 5. A river temperature trigger (i.e. 24 hour running average tail water temperature) of 11C was first reached on May 6. As a result, OPG initiated the 14cms minimum spill over the falls at 17:00 on May 6.

Minimum spill flow requirements were met during the Lake Sturgeon spawning and drift period. Significant rain events in late June prevented the return or a controlled state and scenic flow conditions until late July.

The operating requirements of the plan call for a three day ramp down period for spill reduction at the end of the larval drift period. In 2016 the ramp down process was completed by August 3.

Biological monitoring was undertaken by Northern Bioscience on behalf of OPG in 2016. This work consisted of using driftnets to detect evidence of Lake Sturgeon spawning. Nets were deployed between May 29 and June 16, 2016, with a total of 121 net-sets. A total of 181 larval Lake Sturgeon were caught, all above the Kakabeka Falls GS.

Based on the actual flows provided in the Kaministiquia River and over the Kakabeka Falls as well as historic understandings of spawning behavior on the river, OPG does not believe that Lake Sturgeon access to the spawning areas upstream of the station was appreciably impeded or restricted in 2016. This was confirmed through the presence of drifting larval Lake Sturgeon upstream of the station. No larval Lake Sturgeon were captured in drift nets set directly downstream of the station. Based on historic understandings of spawning and larval drift on the Kaministiquia River, and with appropriate mitigation in place, OPG does not believe facility operations posed a risk to spawning, incubation and/or drift of Lake Sturgeon in 2016.

Starting in early April 2017, approximately weekly (internal) discussions were held to review watershed conditions and determine if the system was considered out of normal. The discussion focused on the watershed conditions and OPG's ability to continue flow mitigation including the ability to meet the 25cms minimum total flow starting on May 5. Water and air temperature trends were also discussed as needed. The month of April was a little cooler than normal with slightly higher than normal amount of precipitation. Rainfall events in April, May, June and July were not significant; however, the rain came as smaller events over a few days keeping flows slightly higher than normal. Flow was above station capacity for all May, June and July. As a result, the target 14cms minimum continuous spill flow over the falls was achieved for the planned 6-week period without exception. Throughout this period, despite the high water conditions, the Kaministiquia Water Management Plan was never deemed out of normal.

The operating requirements of the plan call for a three-day ramp down period for spill reduction at the end of the larval drift period. In 2017, the ramp down process was finally completed on August 4.

No biological monitoring was undertaken by OPG in 2017. Biological monitoring was carried out by NDMNRF. NDMNRF caught 2258 larvae from 13 June to 5 July. Spill was in excess of 14cms during the previously defined study period May 15-June 30.

Based on the actual flows provided in the Kaministiquia River and over the Kakabeka Falls as well as historic understandings of spawning behavior on the river, OPG does not believe that Lake Sturgeon access to the spawning areas upstream of the station was appreciably impeded or restricted in 2017. This was confirmed through the presence of drifting larval Lake Sturgeon upstream of the station (as per communication with NDMNRF). Based on historic understandings of spawning and larval drift on the Kaministiquia River, and with appropriate mitigation in place, OPG does not believe facility operations posed a risk to spawning, incubation and/or drift of Lake Sturgeon in 2017.

Starting in early April 2018, weekly (internal) discussions were held to review watershed conditions and determine if the system was considered out of normal. The discussion focused on the watershed conditions and OPG's ability to continue flow mitigation including the ability to meet the 25cms minimum total flow starting on May 5th. Water and air temperature trends were also discussed as needed. Freshet started on April 24th, approximately two weeks later than normal. Freshet consisted mostly of snowmelt; minimal rain fell during the freshet flow period at Kakabeka. Once the snowmelt flushed through the system, the dry conditions continued. Rainfall was very low in March and April. A few minor rainfall events in May 25 and June caused flows on the Kaministiquia to increase slightly. Flows on the Kaministiquia River were managed to maintain the minimum flow requirement for Kakabeka. As a result, the target 14cms minimum continuous spill flow over the falls was achieved for the planned six week period without exception. Throughout this period, despite the low water conditions, the Kaministiquia Water Management Plan was never deemed out of normal. The operating requirements of the plan call for a three-day ramp down period for spill reduction at the end of the larval drift period. In 2018, the ramp down process started on June 24th and was complete on June 28th.

No biological monitoring was undertaken by OPG in 2018. Based on historic understanding, OPG is confident that the actual flows provided in the Kaministiquia River and over the Kakabeka Falls, provided adequate access for Lake Sturgeon to the spawning areas upstream of the station in 2018. Further, based on historic understanding of spawning and larval drift on the River (OPG, 2013), OPG does not believe facility operations posed a risk to spawning, incubation and/or drift of lake sturgeon in 2018.

Starting in early April 2019, weekly (internal) discussions were held to review watershed conditions and determine if the system was considered out of normal. The discussion focused on the watershed conditions and OPG's ability to continue flow mitigation, including the ability to meet the 25cms minimum total flow starting on May 5th. Water and air temperature trends were also discussed, as needed. Freshet started slowly on April 8th, when the lower part of the Kaministiquia watershed received 25 mm of rainfall and the daily average temperature trended slightly above freezing. Night-time temperatures returned to below freezing over the following week which slowed the snowmelt. Freshet restarted again on April 17th when the daytime temperatures trended into the mid-teens. Freshet flows on the Kaministiquia watershed peaked just below 200cms at Kakabeka on April 22nd which is marginally higher than the upper decile level. Rainfall between May and June was slightly below normal at 77% and 74% respectively, but still sufficient to keep the Kakabeka total flow between median and upper decile for this time of year.

Spill over Kakabeka Falls began in mid-April and lead into the sturgeon spawning time of May 15th, higher than the required 25cms. The start to the sturgeon spawn in 2019 was date driven as the 11C running 24 hr water temperature was not met by May 15th. A continuous flow over Kakabeka Falls was achieved for the planned 6-week spawning period without exception. The operating requirements of the plan calls for a three-day ramp down spill reduction at the end of the larval drift period. In 2019, the ramp down process started on July 8th and was complete on July 12th. No biological monitoring was undertaken by OPG in 2019. Based on historic understanding, OPG is confident that the actual flows provided in the Kaministiquia River and over Kakabeka Falls, provided adequate access for Lake Sturgeon to the spawning areas upstream of the station in 2019. Further, based on historic understanding of spawning and larval drift on the River (OPG, 2013), OPG does not believe facility operations posed a risk to spawning, incubation and/or drift of lake sturgeon in 2019.

To evaluate recruitment of juvenile Lake Sturgeon in relation to flow augmentation at Kakabeka Falls, a structured, randomized gill netting project was conducted by NDMNRF from 23 to 27 September, 2019 and 21 to 25 September, 2020 in the lower Kaministiquia River. A total of 60 overnight gill net sets were carried out. Eight large mesh nets, comprised of four gangs of monofilament gillnets strapped together (total length 99.2 m), were set daily and fished for approximately 20 h (minimum 18 h, maximum 21 h). Collectively, 228 individual lake sturgeon were sampled in the lower Kaministiquia River, at a mean total length of 46.2 cm (14.4 cm SD), mean round weight of 554.2 g (55.0 g SD), mean age of 3.5 years (n = 225, 2.6 years SD) and age range from 0 to 12 years. Mean CPUE of lake sturgeon, for random net sets (n = 32) was 0.86 (0.14 SE) fish·gang-1. Overall, recruitment was sporadic. Strong year-classes were 2008 and 2011 and weak year-classes were 2009, 2010 and 2012 (Friday and Haxton 2021, in prep).

4.6.2. DCIP Results as provided by OPG.

System Wide Data Gaps

Determine minimum flows that would not impact fish habitat downstream of control structures. SHARED APPENDIX E Table 1

Current minimum flows are as follows:

Shebandowan	1cms year round
Kashabowie	0.5cms year round, 1.5cms during spawning (Apr 15-Jun 1)
Dog Lake	No minimum flow
Kakabeka GS	estimated 0.5cms flow through 1" slot in one sluice year round
	14cms through dam for sturgeon May 15 to June 29

These minimum flows have been provided downstream of these facilities. Kashabowie has been studied for effectiveness as mentioned in the above reporting by the NDMNRF. Flow below Kakabeka Falls GS was studied as per the Sturgeon study above as well as previous to the WMP amendment to provide 0.5cms flow when the logs were replaced at the dam.

Greenwater Lake & Greenwater Creek Data Gaps

Execute a number of studies on the Greenwater Lake to determine how it can best be managed, to help determine how much the dam can be utilized without impacting the fisheries. APPENDIX E Table 3

See Effectiveness Monitoring Programming Results. This study was considered completed in 2009. No further manipulation of the dam for power generation purposes is planned. The control dam is being operated with 5 logs out of the dam allowing both the lake and the creek to rise and fall naturally.

Data gaps identified in WMP Section 11.3.3

The 2014 amendment to operate the Greenwater Lake control dam at a consistent level (5 of 13 logs) resulted in the Greenwater Lake levels fluctuating naturally. As a result, the following data gap was not addressed and is no longer considered a priority for the WMP.

- Increase in outflow and storage from new operation of Greenwater Lake.

Shebandowan Lake & River Data Gaps

Shebandowan: Determine the effect of winter drawdown on lake trout. SHARED Appendix E Table 4 / Section 11.3.5

No studies were performed for this data gap.

Mabella Dam – Site visit, documentation of capabilities

No studies were performed for this data gap, the dam has been decommissioned and is not able to be operated. Suggest removing this requirement from the EMP.

Below Dog Lake Dam identify if fish entrapment is occurring as a result of dam operations reducing flows. Where, and how often. SHARED WMP APPENDIX E Table 6 / Section 11.3.7 / APPENDIX E Table 1

There is an OPG procedure entitled 'Fish Checks at Kaministiquia River System Facilities' that was updated in April of 2017 to include a check directly downstream of the Dog Lake Dam#2 if operations were such that the flow was to be decreased to zero. It describes the restrictions for reducing flow during spawning, a minimum flow requirement during the spawning window, a description on how and when to perform a flushing flow to encourage fish to leave the channel, check of the channel, as well as a follow up check the next day, and reporting requirements of on site staff to the control room to report the findings of their inspections.

Since 2017 there have only been a few instances where some flow was occurring at Dog Lake Dam #2 which was then decreased to zero flow. In those instances the procedure above was followed and crews reported no fish found during both the day of the actual reduction and during the follow up on the subsequent day.

The procedure remains, and OPG will continue to inspect below Dog Lake Dam for fish entrapment during times of flow reductions and report the findings as per the procedure.

Lower Kaministiquia River Data Gaps

Identify temperature and flow conditions that cause risk of Kakabeka GS penstocks freezing, WMP 11.3.9

The penstocks at Kakabeka GS are unique in this region as they are the only ones exposed to air temperatures. Other stations in the Northwest are mostly run of river type stations where the penstocks are built into the concrete dam structure itself. Aguasabon and Silver Falls' penstocks are bored directly into the earth and are not exposed to air temperatures. Kakabeka GS penstocks are metal, and are essentially pipes that run along the surface, down the hill from the surge chamber down to the station itself and any temperature below zero will start to cause ice to form. Flow through the penstocks will prevent ice build up inside them, however, if a unit is shut down (no flow condition) for an extended period of time while the ambient temperature goes below zero, ice will slowly start to form inside the penstock.

Standard operation procedure states that from zero to minus five degrees Celsius some flow needs to pass through the penstocks every three days to prevent ice from building up. Temperatures at or below minus five degrees Celsius requires flow through the penstocks at all times to prevent ice from building up in the penstocks.

Determine the degree of fish impingement at the Kakabeka GS intake trash racks. SHARED Appendix E Table 8.

No studies were performed for this data gap.

Studies previously performed to identify flow requirements for Sturgeon below the falls. Kakabeka Falls. SHARED APPENDIX E Table 8 / APPENDIX H

See the section Kaministiquia River Water Management Plan Lake Sturgeon Study within the detailed results as provided by NDMNRF.

Perform studies to assess the impact of scenic day/night flow changes on aquatic habitat and the possibility or degree of fish entrapment downstream. SHARED Appendix E Table 8

The flow through the Kakabeka Dam no longer goes to zero as there was a change to the WMP to the minimum flow through the dam in 2011. Previously the minimum flow was described as 'leakage' and in 2010 a project replaced wooden logs with new steel logs. Flows were measured before and after the project and after evaluation and consultation with the NDMNRF it was decided that approximately 0.5cms of flow would now be maintained through the dam at all times. This is accomplished with a 1" shim in a single sluice, and is meant to keep the downstream side of the dam with enough flow to keep the area wetted for riparian purposes.

Evaluate the required/desired time period and amount of water for scenic viewing. SHARED with MNR/Park Appendix E table 8 / WMP 11.3.9

The current agreement provides scenic flows of 4.25cms on weekdays and 8.5cms on weekends and statutory holidays during daylight hours of the tourist season (May 24 to Thanksgiving weekend inclusive). Daylight hours are 7am to 9pm. The arrangement has been in place for the duration of the WMP.

What is the Minimum/Maximum flow allowed to keep the beach safe for swimmers? What warning mechanisms and their implementation are needed to keep hikers safe at Kakabeka Falls and Silver Falls provincial Parks? WMP 11.3.9

A procedure exists in which OPG operations staff notify the Kakabeka Falls Provincial Park to advise them of any increase in flow at the Kakabeka Dam that is beyond 50cms. There was a new OPG wide public safety initiative that was conducted and therefore this flow amount will be re-evaluated with newer technology to assess the dangers due to various flow increases from the Kakabeka Dam. Current public safety measures at this site also include warning sirens and signage. Before any flow increase, a warning siren will sound and the dam will 'step open' in smaller flow increments every 5 minutes, with a warning sounding in between steps to encourage the public to leave the site and provide ample time to do so. There are also cameras on the Kakabeka Dam that allows control room staff to look at the area below the dam to assess if any people are there before opening.

Signage exists throughout the park and along the river banks within the Kakabeka Falls Provincial Park warning of changing flow conditions on the river. Sirens will also sound near the overflow pipe if the station has experienced a plant trip, which would therefore cause an overflow.

Silver Falls Provincial Park is governed by the same staff at Kakabeka Provincial Park, and is run as a remote site, meaning Park staff visit the Silver Falls PP, but there is not a crew stationed there during the operating season. Safety measures from OPG include signage, with special signs at the two trail heads near the Silver Falls GS 24 hours in advance of flow increases that warns if flows will be increasing and when. Staff also perform visual checks before increasing flow at the dam.

Lastly, water flow and level information can always be found at www.opg.com, under the menu item River System Data. Stay Clear, Stay Safe.

5. Conclusions and Recommendations

In conclusion, OPG continues to operate the Kaministiquia River System as per the Water Management Plan. At times due to drought or high water beyond OPGs control deviations from the WMP have occurred and OPG has responded to these events in conjunction with the NDMNRF to effectively balance the interests of all stakeholders. At this time, there are no known negative or unintended impacts as a result of current operations of the WMP.

OPG believes that it has met and will continue to meet the five *specific* plan objectives;

- Minimize the risk of flooding to protect life and property
- Provide adequate flows for wastewater assimilation capacity in the lower Kaministiquia River
- Maintain or improve the ecological processes and functions of the aquatic ecosystem and provide suitable flows for lake sturgeon reproduction
- Optimize the value of hydroelectric power generation
- Maintain or improve opportunities for tourism and recreation.

The KAM SAC is active and is kept informed yearly, and more often during years with outstanding issues. This report will be provided to them and their input will be considered for ideas and studies for the next implementation report due in five years.

The table (#5) below provides a summary of the objectives, products and results that are detailed in the EMP section in this report, and highlights items expected to continue, or not, and some possible future considerations for the next 5 year Implementation Reporting period.

Table 5 Summary of WMP Objectives, Results and Future Considerations of the Implementation Report

Objective	Details	Product	Frequency	Results	Future Consideration
Assimilative Capacity - Chapter 12, Table 71	Identify incidents where flow requirements were difficult to meet, or where concerns for river health were identified.	Collect and compile information related to assimilative capacity issues below Kakabeka Falls GS.	As required. Between Apr 15 – May 15 and Oct 15 – Nov 15.	Shoulder months not shown to be an issue.	No further study required. Document any reports to OPG pertaining to assimilative capacity and forward appropriately. Record any specific instances where flow deviations are requested or required.
Flooding – Chapter 12, Table 72	Document flooding and near-flooding events	Collect and compile data from existing gauges when flooding or near-flooding occurs. Include location, flows, impacts, time of year, and pre-event conditions.	When / if situations arise, throughout the life of the plan.	Reports generated for the 2008 and 2012 occurrences with actions for improvements. 2009 study/report for frazil ice at FWHP. Reports for flooding at FWHP.	Continue to document flooding events. Further study of frazil ice formation and flow/temperature combinations that may cause it to accelerate.
Power Generation Greenwater Lake Chapter 12, Table 73	Calculate the amount of increased storage/flow from operating Greenwater Lake.	Document the flow on Greenwater Creek or increased storage availability in the Lake.	Annually, for the life of the plan.	Trials performed, decision to operate Greenwater dam at 5 logs out, to provide natural flow regime. Dam not operated for power generation purposes.	Remove this requirement from the WMP as annual assessment is no longer required.
Power Generation Shebandowan Lake Chapter 12, Table 73	Calculate the amount of increased storage/flow from operating Shebandowan Lake.	Document the flow on Shebandowan River or increased storage availability in the Lake.	Annually for the life of the plan.	Storage based primarily on the extra amount of refill in spring. Varies year by year.	Compare quartiles and deciles pre-WMP to post-WMP as an indicator if elevations and therefore storage has changed.

Objective	Details	Product	Frequency	Results	Future Consideration
Power Generation – Spill Chapter 12, Table 73	Determine the number of instances of spill at Dog Lake Dam and Kakabeka Falls Dam throughout the year.	Monitor and document the volume of water spilled past generating facilities and rationale.	Year round. Annually for the life of the plan.	See report above. Spill varies with weather, work catalog, as well as for scenic, sturgeon and minimum flow requirements.	Spill summary to continue to be provided in future Implementation Reports.
Power Generation – Log Operations Chapter 12, Table 73	Determine the number of log operations required to maintain levels in accordance with this operating plan.	Compile data on number of log operations performed at each control structure. Compare to past data.	Annually for life of the plan.	More log operations are required after the WMP than before.	Log operation summary to be provided in future Implementation Reports. Include detail on other factors or abnormal events that cause additional log operations. In the future, log operations as a result of project work (as opposed to normal maintenance of water levels) will be removed from the dataset to properly compare costs associated with maintaining the water elevations as per the WMP.
Power Generation – Flow reduction in shoulder months Chapter 12, Table 73	Measure impact on power generation of the 2 month reduction when 11cms is required for assimilative capacity.	Document when river flows go below 17cms in the shoulder months.	Apr 15- May 15 and Oct 15 – Nov 15, As required throughout the life of the plan	Minimal impact to power generation.	No further requirement to measure the impact of this change to power generation for the WMP. Suggest removal of this requirement from the WMP.

Objective	Details	Product	Frequency	Results	Future Consideration
Aquatic Ecosystem – Chapter 12, Table 74, Question 1	Lake trout were tagged on Greenwater Lake in 2004. A recapture event is needed in 2005 to determine population size.	Produce a report documenting lake trout population size and biological indicators of health.	Two 2 year studies, completed during the life of the plan.	Completed and report published. **Amtstaetter, F. 2006**. Status of Lake Trout in Greenwater Lake	No further action is required as Greenwater Lake is now operating as a natural flow regime. Baseline information has been established and is adequate for the current strategy that does not manipulate the flows. This commitment is deemed complete and can be removed from the WMP when appropriate to do so.
Aquatic Ecosystem – Chapter 12, Table 74, Question 2	Monitor flows in Greenwater Creek to ensure spawning fish are not impacted.	Produce a report documenting spring walleye netting and summer bass surveying.	Completed during the first 2 years of the plan. Continue to monitor for life of plan.	Completed, see results in EMP section above.	Baseline information has been established and is adequate for the current strategy that does not manipulate the flows. This commitment is deemed complete and can be removed from the WMP when appropriate to do so.
Aquatic Ecosystem – Chapter 12, Table 74, Question 6	Assess the health of the aquatic ecosystem on all lakes in the system.	Conduct Fall Walleye Index Netting and report on the results.	One FWIN on a different lake every 2 years for the life of the plan.	FWIN methodology originally performed no longer used by NDMNRF, BSM Program now in effect.	Consider removing from future monitoring as these fisheries assessments do not inform effectiveness monitoring of the WMP.

Objective	Details	Product	Frequency	Results	Future Consideration
Aquatic Ecosystem – Chapter 12, Table 74, Question 3	Assess the health of the aquatic ecosystem on Shebandowan Lake.	Collect late summer oxygen profile data from various sections of the lake and produce a report.	Once per year during late summer. Target years with low water and warm temperatures.	See report above.	Although phosphorus late summer dissolved oxygen levels on Shebandowan Lake have been collected since before the WMP, these measurements do not contribute to the effectiveness monitoring of flows and levels in this WMP and will not be evaluated for this purpose. Lake partner program to continue, however, oxygen levels deemed not to be required for WMP purposes.
Aquatic Ecosystem – Chapter 12, Table 74, Question 4a	Determine if minimum flows identified in this WMP are suitable for the aquatic ecosystem.	Determine if walleye are gaining access to Kashabowie Creek at 1.5cms and document.	Between April 15 and June 1, annually.	Walleye observed spawning by the NDMNRF during the springs of 2006-2010. Walleye were able to gain access to spawning areas at a flow of 0.8cms (below the prescribed limit in the WMP). As a result, the prescribed minimum flows of 1.5cms appear to adequately allow walleye to access the Kashabowie Creek to spawn.	Minimum flow studies on Kashabowie Creek are complete. Consider removing commitment from WMP.

Objective	Details	Product	Frequency	Results	Future Consideration
Aquatic Ecosystem – Chapter 12, Table 74, Question 4b	Determine if minimum flows identified in this WMP are suitable for the aquatic ecosystem.	Assess flows below Shebandowan dam to determine wetted perimeter and usable habitat. Map and quantify natural inflows.	A one-time study	Studies were not performed to evaluate minimum flows below structures on Shebandowan River.	Consideration for a minimum flow study below the Shebandowan Lake Dam.
Aquatic Ecosystem – Chapter 12, Table 74, Question 4c	Determine the natural inflows below Dog Lake.	Document flows on the Kaministiquia River, at a point above the confluence with the Shebandowan River, during the spring period. Map and quantify natural inflows.	One time study, likely over a period of 2 to 4 years.	Studies were not performed to evaluate minimum flows below structures on Kaministiquia River. Hydroline gauge has been installed on the Kaministiquia River above the confluence with the Shebandowan River in anticipation for minimum flow studies and for flood monitoring purposes.	Requires further time to obtain a history and create flow/elevation relationships as it currently shows less flow than the output at Silver Falls GS/Dog Lake Dam.
Aquatic Ecosystem – Chapter 12, Table 74, Question 5	Determine the degree of movement towards a natural flow regime.	Compare annual and median lake elevations and river flows to expected natural flow patterns.	Annually. Movement towards natural flow patterns will be summed up at plan end.	The median lake elevations for Dog, Shebandowan and Kashabowie Lakes for the periods of 1991-2002 (pre-plan) and 2005-2020 (post-plan) were compared to unmanaged reference lakes in the area.	Consider modifying the timing such that a comparison of the annual and median lake elevations and river flows to expected natural flow patterns will occur every IR period (5 years).

Objective	Details	Product	Frequency	Results	Future Consideration
Recreation and Tourism – Chapter 12, Table 75	Lake elevation survey for recreational use on Shebandowan Lake.	Record results from phone interviews conducted at various points throughout the life of the plan.	Focus on unusual level events.	Survey conducted in 2006 and 2008.	Solicited surveys not found to be beneficial as no conclusive results are found, therefore, not to continue. Low participation rate. Unsolicited comments and concerns that are received will continue to be summarized each year in the annual report.

Table 5. Summary of WMP Objectives, Results and Future Considerations of the Implementation Report

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