

**District Municipality of Muskoka
 Operational Adjustments and Scoping Study for the Muskoka River
 Water Management Plan
 Phase 2 Report**



					
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Executive Summary

The Muskoka River Watershed has many lakes and interconnecting river stretches, with numerous and often conflicting interests in the use of the watershed. Severe flooding in recent years has driven a review of the Muskoka River Water Management Plan to determine if there may be opportunities to amend the plan to improve flood mitigation through changes in operation. Two potential options for amendments were identified in Phase 1 of the *Operational Adjustments and Scoping Study for the Muskoka River Water Management Plan*. The work required to move them through the amendment process was addressed in Phase 2 and is presented in this report. An analysis was also performed to determine missing data necessary to inform other potential amendment request options. In addition, the communication processes for sharing freshet information were also reviewed.

The amendment process is well documented in both the Ministry of Natural Resources and Forestry's *Technical Bulletin - Maintaining Water Management Plans* (Ministry of Natural Resources, October 2016) and in the Muskoka River Water Management Plan itself (*Section 17 – Provision for Plan Amendments*). To implement any of the potential amendments suggested in Phase 1 of this project, amendment requests would need to be directed to the Ministry of Natural Resources and Forestry. The Muskoka River Watershed Communications Committee would likely have a significant role in reviewing and assessing any amendment requests.

The first potential amendment request – to review the current snow and rainfall triggers used to initiate extended drawdown of the lakes in the Muskoka River Water Management Plan – might be classified as a minor amendment because it does not involve any operational changes. While analysis of data to assess changing trends and patterns would be required, community consultation would be limited as directed by the Technical Bulletin with respect to minor amendments.

The second potential amendment request – more fully utilize the lower part of the Normal Operation Zone (e.g., lower the Target Operating Level for Lake Muskoka to a point between the current line and the bottom levels of the Normal Operating Zone during the pre-freshet/freshet period) – would likely be classified as a major amendment and would require more extensive community engagement and consultation. Several studies would also be required to understand the potential impacts on other interests in the watershed such as on riparians, boaters and the environment. Consideration should also be given to the potential impacts of this change in years where high flow conditions are not experienced.

It should be noted that the proposed change to lower the Target Operating Level does not imply a change to the Normal Operating Zone in which the Ministry of Natural

Resources and Forestry is allowed to operate Lake Muskoka. It would simply change the guidelines for the target lake level during the pre-freshet and freshet periods. Without commitment from the Ministry to make best efforts to closely follow a revised line, benefits from the change may be further limited.

Impacts due to the effects of climate change on precipitation, temperature and flow in the Muskoka River Watershed will likely continue to create challenges with respect to potential flooding. There are limited operational adjustments to be considered under current conditions, so it is unlikely that adaptation for climate change can be achieved through operational adjustments. However, where necessary, the Muskoka River Water Management Plan should be updated if new information supports new operational changes to support climate change adaptation.

1. Introduction

1.1 Project Background

The Muskoka River Watershed (MRW) has experienced periods of significant springtime flooding throughout history. Most recently, during the spring of 2019, the District Municipality of Muskoka (the District) encountered some of the most severe flooding on record across the MRW which, in turn, resulted in damage to both personal property and municipal infrastructure. This event had been preceded by other significant flooding events in 2008, 2013 and 2016. Concern regarding the impacts of flooding in the watershed has resulted in several studies over the years.

Most recently, in August 2018, the Ministry of the Environment, Conservation and Parks (MECP) established the Muskoka Watershed Conservation and Management Initiative (MWI). This initiative was intended to identify the risks and issues impacting the Muskoka Region so that the community and the Province of Ontario (Province) could work together to establish a path forward to better protect local water resources, infrastructure and the environment.

As a first step, the MECP established the Muskoka Watershed Advisory Group (MWAG) to provide advice and recommendations regarding the MWI. This group was formed following the most recent flooding in 2019. The primary focus of its work was to provide a strategic assessment of the priority issues in the watershed, and the types of projects that could be undertaken to resolve these issues. Following significant outreach and consultation with representatives of local governments, cottage and tourism organizations, waterpower producers, agriculture, the public, etc, the MWAG issued their report entitled "*Interim Advice and Recommendations to Address Priority Environmental Issues in the Muskoka River Watershed*" in June 2020. It contained several recommendations covering a wide range of topics.

On April 20, 2021, the Province announced an initial investment of \$4.25 million to fund projects aimed at helping to reduce the impacts of flooding, and to address the overall health of the MRW based on the recommendations from the MWAG. Based on this funding, and at the direction of the Province, the District undertook advancement of a number of technical projects focused on the MRW to address some of the areas identified in the MWAG's report.

The *Operational Adjustments and Scoping Study for the Muskoka River Water Management Plan* project was established under a Request for Proposal (RFP) issued by the District in September 2021. To provide additional review and support for the projects under this RFP, the District established a Technical Working Group (TWG), consisting of individuals with extensive knowledge of the watershed.

1.2 Project Objective

The District commissioned Hatch to execute the *Operational Adjustments and Scoping Study for the Muskoka River Water Management Plan* project. Phase 1 of this project served to complete a review of the Muskoka River Water Management Plan (MRWMP) and identify potential operational adjustments that may reduce flood risk. Two potential MRWMP amendment requests were identified and subsequently summarized in a report issued to the District on August 22, 2022. Phase 2 of this project (summarized herein) focused on providing a comprehensive scope of work required to address these requests for potential amendments to the MRWMP. In addition, this phase included a gap analysis to identify where insufficient information currently exists and to, in turn, inform future potential amendment requests. Communication and information sharing processes during freshet were also identified for further review in Phase 2. This report addresses Phase 2 of this project.

2. Water Management Planning in Ontario

2.1 Background

Formal water management planning was introduced in Ontario in 2002, shortly after the opening of the electricity market in 2001. While most hydroelectric generating stations already had operating plans in place to address multiple interests, and to reflect the elevation limits within which they operated, the Province wanted to ensure that operations did not become driven by market forces only. To ensure that all interests would be considered, a formal water management planning process was introduced. This process was governed by a technical bulletin entitled Water Management Planning Guidelines for Waterpower, approved by the Minister of Natural Resources on May 14, 2002. To further support the process, public consultation took place during the development of the plan to both include input from the public, and to ensure transparency of the process.

While water management planning was directed towards the power producers, it should be noted that almost all of the dams (one is privately owned) controlling lake outflow in the MRW are owned by the Ministry of Natural Resources and Forestry (MNR). A guiding principle of water management planning is to provide a net benefit to society. This objective can be achieved by striving to “*maximize the net environmental, social and economic benefits derived from the management of water levels and flows by waterpower facilities and other water control structures on a river.*”¹ Water management planning also supports the concept of adaptive management such that the plan can be changed as interests/values change over time.

2.2 Amending a Water Management Plan

2.2.1 Background

All of the initial Water Management Plans (WMPs) included a term over which each plan applied. As the end dates of the terms approached, it was recognized that further direction was required for continuing or amending these plans. In October 2016, the MNR issued a Technical Bulletin entitled Maintaining Water Management Plans. It replaced the previous technical bulletin regarding WMPs (Water Management Planning Guidelines for Waterpower), except for specific applications in circumstances described within the document. Its purpose was to provide new policy direction for the long-term maintenance of all existing WMPs (both simple and complex) and new requirements to be included in all WMPs.

Under the terms of the new Bulletin, all WMPs remained in effect, and dam operators were expected to continue to operate under existing Plan requirements. The current WMPs became permanent documents, with no term, expiration date, or mandatory review. It was recognized that the principle of “adaptive management” would continue to

¹ Muskoka River Water Management Plan, MNR/OPG/OP/BG/AP, January 2006, p.2-4

apply, and changes could be incorporated to accommodate changing conditions or requirements. Adaptive management would continue to be supported by on-going community engagement and consultation, in addition to monitoring and implementation reporting, and consideration of amendments, where appropriate.

2.2.2 Water Management Plan Amendments

The objective of the amendment process is to allow stakeholders in a watershed covered by a WMP to present an issue to any of the proponents of the Plan (power entities or MNR) or the Standing Advisory Committee (SAC), where applicable for consideration. SACs were established in the original complex WMPs to provide plan proponents with an external group for engaging the public and Indigenous communities.

A WMP amendment is one of the potential options to be considered for resolving an issue. Over the course of the WMP amendment process, due diligence is to be applied in screening the issue and developing any potential amendments to address it. Other potentially impacted stakeholders are also given the opportunity to participate in consultation. While plan proponents may work together when a potential amendment request/proposal impacts multiple facilities or the Plan in general, when it is specific to only one plan proponent, that proponent is solely responsible for assessing the request and preparing the amendment proposal, if required. The MNR has the final decision authority regarding proposed amendments.

Two types of amendments can be considered – minor amendments or major amendments. Minor amendments are used to address changes that do not impact the operating regime or plan objectives. In addition, the change would not be expected to be of great public interest or adversely affect Aboriginal and treaty rights. Subsequently, neither public nor First Nations and Metis engagement or consultation would be required (beyond discussion with the SAC, where applicable). Changes that have more significant impacts (e.g., operational changes) are considered to be major amendments. Public, First Nations, and Metis community engagement/consultation are required for a major amendment.

Prior to submitting an amendment request, discussion with the proponent(s)/MNR should be undertaken. This preliminary conversation provides an opportunity to explore if other options are available and provides preliminary assessment of the request with respect to the criteria listed below. If it is decided that the amendment request should proceed, it must contain at least the following information²:

- Description of the change(s) being requested
- Rationale for the change(s) being requested

² Technical Bulletin – Maintaining Water Management Plans, Ministry of Natural Resources and Forestry, October 2016, p.8.

- Results of any pre-consultation completed with potentially affected parties
- Where changes in operations are proposed, a description of how the proposed operation changes may impact other dams subject to the WMP

In assessing any third-party amendment requests, a plan proponent(s)/MNRF must consider the following criteria³:

- Is the proposed amendment consistent with the Technical Bulletin?
- Is the amendment consistent with WMP objectives, or does the amendment propose a change to WMP objectives?
- Is there an alternative method to deal with the request rather than amending the WMP?
- Is the request within the scope of the WMP (e.g., plan objectives, the dam's degree of influence on flows and levels)?
- Is the request related to any ongoing data or effectiveness monitoring commitments?
- Is the request supported by other potentially affected parties?
- Is the amendment required to comply with other regulatory requirements?
- Has the amendment request been considered previously?
- Does the amendment have the potential to negatively affect dam safety/public safety?
- Does the amendment have potential impacts on socio-economic or environmental considerations?

Additional information may be requested if the reviewing proponent(s)/MNRF determine that they do not have enough details to complete the assessment or make a recommendation. Where one exists, a SAC may also provide advice to the reviewers with respect to assessing an amendment request/proposal.

If the review has been completed by plan proponents, excluding the MNRF, it is then forwarded to the MNRF with a notification summarizing the request and supporting rationale, the results of the proponent's assessment, and their recommendation for going forward. Following their review, the Ministry will agree or disagree with the recommendation, or request additional information. Where the MNRF has been directly involved in the initial screening and assessment, the approval or disapproval decision should come directly from the assessment. If the request has been approved, the final amendment proposal would then be developed, and any further planning, consultation or

³ Technical Bulletin – Maintaining Water Management Plans, Ministry of Natural Resources and Forestry, October 2016, p.9.

investigations undertaken. For a request that has been submitted by a party other than the plan proponents, this third party may be expected to support engagement activities.

To move forward through the amendment process, the MNRF may issue an Order to prepare an amendment or approve it under Section 23.1(6) of the Lakes and Rivers Improvement Act (LRIA), to formalize the decision. When any additional consultations or investigations have been completed, a final amendment proposal is prepared. It includes the following information⁴:

- Amendment request and supporting rationale
- Proposed changes (replacement text) as they would appear within the approved plan
- Map of the area affected by the amendment (if applicable)
- Record of consultation (including engagement of the SAC) identifying the type and form of the feedback sought, issues identified, and steps taken by the proponent to modify the proposed amendment in response to comments (if applicable), and
- Any other supporting information deemed applicable to the proposed amendment.

Where the proposal has been prepared by the power entities for a minor amendment, MNRF will complete their review within 30 days. If the proposal is for a major amendment, a period of 60 days is allowed for the review. Additional information can be requested during, or after, the review period. Upon reaching a decision regarding the amendment proposal, the MNRF may

- approve it outright
- approve it with additional changes, or
- refuse the amendment.

Written confirmation of the decision (including rationale) will also be provided. When the amendment is accepted, changes to the WMP are made.

A flow chart summarizing the WMP amendment process is included in Appendix B. Because the 2016 Technical Bulletin was written from the perspective that plan proponents other than the MNRF (i.e., the power entities) would likely be the ones making or addressing amendment requests, it is unclear if all of the steps would still apply if the request involved MNRF facilities.

More specific details of how the process would apply for potential amendments to the MRWMP will be covered in Section 2.3.

⁴ Technical Bulletin – Maintaining Water Management Plans, Ministry of Natural Resources and Forestry, October 2016, p. 12.

2.3 Muskoka River Water Management Plan (MRWMP)

The Hackner-Holden Agreement and the Ministry of Natural Resources (MNR) Dam Operations Manual, plus existing operating plans at the generating stations tied to legal tenure, structural limitations, and water retention limitations, were the starting points for the MRWMP. Minor changes were made to reflect the changing interests and values within the watershed. Important timelines for the MRWMP are shown in Table 2-1.

Table 2-1: Muskoka River Water Management Plan Timeline

Event	Date	Reason
Issue Water Management Plan	Jan 2006	Issue Plan
Amendment 1	Feb 2016	Administrative – Extension of Term
Amendment 2	Feb 2018	Administrative – To align plan with the approved Maintaining Water Management Plans Technical Bulletin
Amendment 3	Dec 2019	Minor – Inclusion of Swift River Energy Limited (SREL) Bala GS

2.3.1 Potential MRWMP Amendments

The amendment process, as it applies specifically to the MRWMP, is also outlined in Section 17 (Provision for Plan Amendments) of the MRWMP.

As mentioned previously, the general amendment process is largely directed towards amendment requests made to, or by, the power entities. However, MNR recognizes that they are a proponent of the MRWMP because they operate the dams that control the lakes and reservoirs in the watershed. Subsequently, they would be responsible for receiving, screening, and administering the amendment process, with support from the third-party requestor, where the amendment request involves the operation of one of their facilities.

From the work carried out under Phase 1 of *the Operational Adjustments and Scoping Study for the Muskoka River Water Management Plan* project, two areas in the Plan were identified as potential candidates for amendment.

2.3.1.1 Amendment Area 1

Review MRWMP criteria (e.g., different thresholds for snow accumulation and temperature trends) for lake drawdown decisions based on experience in 2008, 2013, 2016 and 2019. These flood years may serve as a basis for adjusting or adding new thresholds (e.g., for snow accumulation and temperature trends) to be adopted into the MRWMP.

The MRWMP includes provision to drawdown lakes below their Target Operating Level (TOL), to either the bottom of the Normal Operating Zone (NOZ) or the bottom of the Lower Operating Zone (LOZ), when snow conditions suggest that they may contribute to a higher-than-normal risk of spring flooding (e.g., above average snow water equivalent [SWE]).

These provisions, taken from the MRWMP⁵, are as follows:

- If snowpack water content is >25% above normal on March 15 on the North Branch of the Muskoka River, lakes controlled by MNR will be lowered to the bottom of the NOZ.
- If snowpack water content is >50% above normal on March 15 on the South Branch of the Muskoka River, lakes controlled by MNR will be lowered to the bottom of the NOZ.
- If snowpack water content is >100% above normal on April 1 on both branches of the Muskoka River, lakes controlled by MNR will be lowered to the bottom of the LOZ.

While snow surveys in early winter are generally done on a bi-weekly basis (on approximately the 1st and 15th of the month), the Ministry is expected to start taking snow course measurements on a weekly basis after March 15, if the above conditions exist. The additional data is for monitoring and evaluation purposes and will also help inform additional operating decisions if there is increased potential for the development of more extreme runoff conditions.

Frequent precipitation, rising temperatures, and frozen ground are also recognized as potential contributors to higher-than-normal runoff events. They are addressed as part of additional provisions within the MRWMP.⁶

- On unfrozen ground, with 25 mm of rain in 1 day or 50 mm rainfall over several days and/or >10°C during the day for more than 2 days or above 0°C overnight for more than 2 days lakes controlled by MNR will be lowered to the bottom of the NOZ.
- On frozen ground, with 25 mm of rain in 1 day or 25 mm rainfall over several days and/or >10°C during the day for more than 2 days or above 0°C overnight for more than 2 days, lakes controlled by MNR will be lowered to the bottom of the NOZ.

These conditions for extended drawdown were established many years ago. Since that time, changes in weather patterns/climate may have necessitated alternate timing or alternate SWE/rain values/combinations be considered for initiating greater drawdown on various lakes. For example, early snow conditions in 2013 and 2019 did not suggest that greater than normal drawdown was required on Lake Muskoka. However, heavy rainfall around the start of April, coupled with a ripe snowpack (i.e., high water content; can yield meltwater), quickly resulted in very high runoff conditions.

⁵ Muskoka River Water Management Plan, MNR/OPG/OP/BG/AP, January 2006, p.12-2

⁶ Muskoka River Water Management Plan, MNR/OPG/OP/BG/AP, January 2006, p.12-3

Changing the drawdown trigger values may qualify as a minor amendment as it does not involve a specific operational change. It would be based on data evaluation/evolving science and would represent an updating of the conditions currently referenced in the MRWMP. It is unlikely that external consultation would be required for changes to the trigger values. Similarly, while the power entities would likely be interested in understanding any background for changes, they would not be directly involved in the development of new triggers. Ontario Power Generation (OPG) is the only one of the power entities in the MRW that operates snow survey stations (albeit in other watersheds). While they may be able to offer insight on SWE values versus contribution to run-off based on experience, they generally do not use specific percentages of SWE or rainfall amounts to increase drawdown operations. However, one example (outside the Muskoka watershed) was found where low SWE values were referenced as a guide to limit drawdown on a specific lake.

To determine if defined trigger values should be revised, a number of studies should be considered.

- Historical data from snow surveys should be evaluated to determine if there are any trends suggesting that new snowfall accumulation patterns (e.g., later accumulation, higher SWE in late March/early April, etc) are developing.
- Similarly, timing/trends in temperature and rainfall should also be assessed to better understand if changes in this area are contributing to the development of more frequent high runoff conditions. Findings from these studies may help to inform a revision of the drawdown trigger values so that greater drawdown could be started earlier or done more frequently.
- In addition, consideration should be given to assessing events where there has been a combination of rain-on-snow to determine if there may be additional triggers that could be established to ensure that these events are included in drawdown decisions.
- A further literature search should be carried out in order to determine if dam operators in other watersheds build specific amounts of SWE or percentages into operating decisions or find if there is any academic research related to the topic.

2.3.1.2 *Amendment Area 2*

Consider more fully utilizing the lower range of the NOZ, even when snow conditions are not extremely high, for Lake Muskoka. It should be noted that the TOL serves as an operating guideline for any particular lake but there is no requirement to try to follow it. The MNRF already has the ability to drawdown below the TOL when they feel that it is appropriate. Therefore, instead of lowering the TOL to try to drive lower operation on the NOZ, it may be more effective to obtain agreement from the MNRF to specifically operate lower in the NOZ during freshet. However, this action would require further review of the impacts of increased drawdown on fisheries, or lower fall drawdown start levels. It may also require reduced flow downstream in the spring to ensure that lakes are filled if high flow events do not occur.

While changes to the drawdown triggers may provide for greater or earlier drawdown in some cases, the second recommendation from the Phase 1 report suggests that lowering the TOL, or more fully utilizing the full lower portion of the NOZ on a regular basis during the lead-up to peak freshet flow may provide additional storage that could be used when high run-off conditions are experienced.

A number of studies would be required to determine the impact of this change.

- As reported in the Phase 1 report, analysis of lowering the level of Lake Muskoka to a point halfway between the current TOL and the lower limit of the NOZ, using the Acres Reservoir Simulation Program (ARSP), showed that only a nominal reduction in the maximum water surface elevation of 0.05 m and 0.01 m would have been experienced on Lake Muskoka for the 2013 and 2019 events, respectively. Further analysis could be completed to determine any additional benefit of operating at the bottom of the NOZ during the pre-freshet period, or if any changes in the timing of the drawdown to this lower level might provide additional benefits.
- It is unclear exactly how the TOL was established. However, suggestions have been offered that it was borne from the numerical modelling that supported the development of the WMP. It may be useful to reassess the TOL based on actual levels from the entire period of record as well as for the periods before and after the adoption of the MRWMP to better understand how the presence of the TOL has impacted operations.
- From an operational perspective, it would also be necessary to further assess the changes under average conditions and dry conditions, in addition to wet conditions. While this change may provide limited benefit under high flow conditions, it may be detrimental by leading to lower summer levels when high flows are not experienced, thus making it difficult to refill the lake.
- Pursuit of such an amendment would require a study to determine the optimal start and duration times for operating Lake Muskoka lower in the NOZ. If, for example, the lake was to be drawn down more in the fall, late season boating, and boat haul-outs may be impacted, or it may result in the exposure of some water lines through the winter.

Examination of impacts due to operating lower in the NOZ would not be limited to operational studies. Alterations to the flow regime through Lake Muskoka may alter fish and wildlife habitats supported by the lake. Below is a list of potential impacts and recommended studies based upon sensitivities previously assessed in the MRWMP. While the proposed changes to the operating level may not impact these areas, they should be reviewed to confirm that the conclusions and recommendations of the MRWMP still apply following the proposed changes.

- There are several constraints associated with the operations at the North and South Bala Dams related to spawning habitat for Walleye and Lake Trout. One of the fish habitat

compensation measures for dam construction on the lake included the construction of Walleye spawning habitat at the mouth of the Moon River. Constructed Walleye habitat is designed to provide water levels and velocities that are suitable for the survival of eggs and fry during the Walleye spawning period. Lake Muskoka's water level is held up to 0.12 m above the normal summer levels during lower flow periods to provide steady flow for walleye spawning at the mouth of Moon River from late April to May. Hydraulic analysis should be conducted to determine potential changes to flow velocity and water depth within the constructed spawning area at the mouth of the Moon River if a new operating regime is to be considered.

- To avoid impacts to Lake Trout spawning habitat in Lake Muskoka, the operating levels at the Bala Dams include a drawdown of 0.09 m from September 1 to November 1, and a maximum winter drawdown of 0.45 m between October 15 and March 1 to avoid exposing Lake Trout spawning habitat. If there are changes to the water levels during the Lake Trout spawning period, an assessment of water depths during the spawning period should be conducted to confirm if the amount of suitable spawning habitat available in the lake may be reduced. Timing of increased drawdown may be critical. An early drawdown (fall) may have less impact on fish spawn over the winter and allow for more gradual changes in operation in the spring, but it may have other negative impacts as mentioned above. While difficult to compare, consideration should be given to the value of the fisheries versus the potential damages, costs and safety issues associated with flooding, when assessing a lower operating level. A relatively healthy fishery may be able to withstand periodic impacts on its spawning areas.
- Shoreline habitats and seasonally flooded wetland habitat are important to the survival of a variety of species important to the Muskoka River Watershed ecosystem. Specifically, seasonally flooded wetland habitats provide spawning and nursery habitat in the spring for Northern Pike and Muskellunge. Additionally, access to floodplain habitats is necessary for reproduction of certain furbearing species including beaver, muskrat, as well as amphibian and reptile species. Currently, there is no indication that current water level management regimes have an adverse impact on these species. However, these habitats should be considered in the determination of a new operating regime. The change in wetland water level resulting from the change in lake level should be examined to determine impacts to the shoreline wetlands along the perimeter of Lake Muskoka.
- The reproductive success of loons on Muskoka River is largely dependent on the significance of water level fluctuation during the mid-May to late-June period, with gradual changes being preferable over abrupt and large changes (>30 cm) during this sensitive period. Decreased water levels near low gradient shoreline can threaten the movement of adult loons, as they tend to nest near the water's edge. Areas of low gradient should be assessed hydraulically to determine if the proposed TOL would alter water level fluctuation during the loon nesting period.

- The timing of any extended drawdown versus the timing of ice-out on the lake should also be considered to identify potential issues of ice on docks and boathouses if the lake level is lowered while the ice is still in place.

Because the generating facilities within the watershed are mostly run-of-river, the power entities have generally taken the position that they simply pass the flow as it arrives, regardless of its magnitude.

- Burgess GS, Swift River Energy Limited (SREL) and OPG would potentially be impacted by additional outflow from Lake Muskoka. Burgess GS is an outlet for Lake Muskoka, but its limited capacity means that it generally flows at full capacity already and it may not see any impacts from increased drawdown of Lake Muskoka. However, discussion with the company regarding potential head impacts is recommended.
- SREL staff operate the Bala dams at the direction of MNR and would likely see increased operations to be undertaken to increase the outflow from the lake. It appears that they would be obligated to make additional discharge changes if required. As with Burgess GS, Bala GS may also experience a reduction in head due to a lower level in Lake Muskoka and an increased tailwater elevation. Assessment of the impacts of these changed levels would also be required.
- OPG's facilities in the Bala Reach would be most impacted by additional discharge from Lake Muskoka and a possible extended period of lower levels in the Bala Reach to support passing of the increased flow. The impacts of additional flow may be either positive (additional generation) or negative (additional operations for spill) based on the amount and timing of the flow. Lower levels in the Bala Reach would result in a lower head at Ragged Rapids and the potential for reduced generation. All of these potential impacts would also require assessment.

Consultation and community engagement with property owners on Lake Muskoka and local governments would be required to understand the balance of acceptance between some relief of high-water levels versus the potential for lower summer water levels on occasion. It has been noted in other watersheds that while high water levels can do damage, low water levels are more of an inconvenience, and may be tolerated on a periodic basis if the high-water conditions can be reduced at other times. Additional consultation with the Wahta First Nation would also be required. Depending on the timing and amount of additional flow through the Moon River dam, concerns may be raised.

A program could be set up to test operation lower in the NOZ over a specific number of years to assess its impact, both on potential flooding and also on other concerns. Some preliminary modelling work would be required to assess any potential consequences of extended drawdown in years of average to below average runoff conditions and to perhaps establish limits for the extended drawdown based on SWE values and longer-range rain forecasts. The test program could establish a plan to be carried out over a number of years for drawing the

lake water level down to specific levels, by specific dates, with the view of assessing the impact of this action on the maximum water level reached during freshet. However, any test program would have to remain flexible to accommodate changes required due to evidence of negative impacts on other interests, or to react to low spring runoff.

While a change to the TOL or how the lower range of the NOZ is utilized may be considered a major amendment, a test program may be able to be addressed within the terms of the current MRWMP as a study or gap analysis, before a decision on making a formal amendment request is made.

To consider both potential amendment options together, simulations of the drawdown and refill of Lake Muskoka could also be considered in conjunction with a range of changing SWE/rainfall inputs to determine how changed inputs to the system may impact operations.

2.3.2 Additional Options and Required Gap Identification

In addition to the two recommendations for potential amendments to the MRWMP discussed above, additional options to be considered for future amendments were also outlined in the Phase 1 report. However, because there are several outstanding questions or areas where the necessary information to assess an option was not available, they were not included for amendment consideration at this time. The remaining items from the Phase 1 report are listed below, and an outline of the information/studies required to determine if they could be considered for amendments is provided.

- Review the discharge capability of Lake Rosseau to better understand the drawdown limitations, and to determine changes that might allow for greater drawdown of the lake.

Further drawdown of Lake Rosseau has the potential to provide additional limited storage and to reduce the flow into Lake Muskoka during the freshet. However, anecdotal evidence suggests that there are issues with getting water out of Lake Rosseau at lower water surface elevations. To consider this option further, a review of the capacity and hydraulics of the outflow at Port Carling is required.

- Consider implementing a stepped refill process for Kawagama Lake, Lakes of Bays, and its downstream river reach. Additional study would be required to quantify the step values.

To establish the step values for operation of the three areas in sequence, it would be necessary to determine the relative impacts of flooding for different water levels on the three bodies of water. For example, the water level at which each area experiences water on grass could be considered as step one. The second step might be the water level at which water reaches buildings, and a third step could be building inundation. When the downstream river reach water level reaches its step one level, Lake of Bays and Kawagama Lake would be allowed to rise to their respective step one water levels before the downstream reach water level is allowed to increase further. A similar process would

take place for successive steps. Stepped operation could result in minor flooding in areas that either do not currently experience it, or areas could be inundated earlier in the freshet season than is currently experienced. However, the goal is to minimize the overall impact of flooding as opposed to protecting any particular area (i.e., “sharing the pain”).

Two options that could be used to address this need are identified here.

- ◆ For option one, stage-damage curves could be developed using high-quality Light Detection and Ranging (LiDAR) equipment or topography data (previously collected through the floodplain studies) to establish a relationship between water elevations and the flood extent around each water body. The number of structures/buildings impacted at each elevation would be identified based on an overlap with the projected water levels, and approximate costs based on available data (e.g., permits, size of structure, zoning class, etc) would be determined. A relationship between water elevations and the total replacement cost of structures/buildings impacted could then be developed. Consideration of the duration of impacts should also be included. The longer the duration of flooding, the higher the cost of the flood damage is likely to be.
- ◆ The second option follows some of the concepts used by the International Joint Commission’s (IJC) Great Lakes Adaptive Management Committee (GLAM) in its assessment of the impacts of flooding on Lake Ontario in 2017 and 2019. Initial data collection would be relatively simple, but it would rely on accurate input from riparians around each water body. An on-line survey could be initiated to collect information on location, timing, and extent of flooding in recent years. Identification of flooding would include recognition of impacts such as flooding of docks and boathouses, water on lawns, main building inundation, etc. Municipal governments could also be contacted to consolidate information on impacted buildings and infrastructure that they have collected during flooding events. This information would then be plotted, and where possible, geographic information system (GIS) software could be used to further develop a more comprehensive picture of buildings/infrastructure at risk of flooding. As in the first option, the impact data would be coupled with projected water elevation details to establish a relationship between water levels and damages. Additional information on the GLAM’s work can be found in their report Expedited Review of Plan 2014, Phase 1: Informing Plan 2014 Deviation Decisions Under Extreme Conditions, November 19, 2021, which can be found on the IJC’s website ([online version of the Phase 1 report](#)).
- Assess additional drawdown on other lakes to determine if this action could provide additional storage for flood attenuation.

While only additional drawdown on Lake Muskoka has been assessed in this study, additional drawdown on all, or combinations of, other major lakes in the MRW should be reviewed to understand any issues associated with this action, and the potential benefits.

The lakes or lake groups that could be considered further are Kawagama Lake, Lake of Bays, Lake Vernon/Peninsula/Fairy and Lake Rosseau/Joseph.

- Improve understanding of the flows and levels that impact specific locations or infrastructure to better understand how to “share the pain” of flooding.

Stage-damage curves for lakes could be developed to better understand the effects of flooding on each lake, as a means of optimizing mitigations between lakes. This information will support other potential operating change options such as additional drawdown/refill or stepped operation by providing economic information on the impact of water level changes due to the potential operating changes.

While developing inundation mapping for all the major lakes and river stretches would help with understanding the impacts of flooding, it may also be necessary to establish a better understanding of when and to what extent infrastructure is impacted (e.g., develop flood hazard or flood risk maps).

Developing a correlation between flow amounts/elevations and existing infrastructure may help in developing stage-damage relationships for additional areas or simply improve the overall understanding of when problems are developing. Similarly, an inventory of impacted areas and conditions that have led up to issues could be developed.

3. Communications

A further recommendation from the Phase 1 report was to review the current communication/data sharing process to determine if additional information is needed or if development of an early warning system should be considered.

3.1 Communications Committee

A specific Muskoka River Watershed Communications Committee was established in 2020 based on recommendations contained in a report by Ontario’s Special Advisor on Flooding (Douglas McNeil, October 2019) and further addressed in the Ontario Government’s document *Protecting People and Property: Ontario’s Flood Strategy* (March 2020). Formation of the Communications Committee supports Priority 1 – Understand Flood Risks by helping to increase public awareness and increasing the transparency around water management decisions. As stated in the document, the Province will

“Engage with municipalities and other watershed partners in the Muskoka and Magnetawan watersheds regarding the establishment of a communication protocol. Key intentions of the protocol will be to inform municipalities and partners of watershed conditions and improve understanding of the complex suite of factors that are considered in water management. This would contribute to an environment where municipalities are informed and engaged on the critical operational decisions that are made to balance the interests across the watershed. Should the protocol prove useful, opportunities to implement the protocol in other areas of the province that could benefit will be explored”⁷

The committee consists of municipal government representatives from within the Muskoka watershed (e.g., mayors, Chief Administrative Officers [CAOs]), First Nation representatives, and members of the MRWMP Steering Committee, including the power entities (Bracebridge Hydro, Ontario Power Generation, Orillia Power and Swift River Energy Limited). Some Community Emergency Management Coordinators (CEMC) may also attend, at the request of their respective mayors. Meetings are generally held monthly from late in January through to the end of freshet. They are paused for the summer, and then resume in September and December to end the year. Additional meetings are held if unusual watershed conditions are experienced, and further updates are required. A summary of recent precipitation, future weather forecasts, recent water levels and flows and dam operations is presented at each meeting, and local concerns about water management are discussed at each meeting.

- While the MRWMP initially included a SAC, the Steering Committee decided to disband it in July 2021. With the establishment of the Communications Committee, it was felt that a SAC was no longer required. Subsequently, the Communications Committee would likely act in place of a SAC in reviewing any amendment requests/proposals.

⁷ Protecting People and Property: Ontario’s Flood Strategy, March 2020, p.15.

3.2 Messaging

As identified in Phase 1, there are several products that are issued by the MNRF to provide information on watershed conditions.

When conditions require it, MNRF's Surface Water Management Centre (SWMC) issues "provincial" messages about developing high water events. The flood message definitions shown on the SWMC website are as follows:

- **Watershed conditions statement – flood outlook** gives early notice of flooding based on weather forecasts calling for heavy rain, snow melt, high winds or other conditions.
- **Watershed conditions statement – water safety** indicates that high flows, melting ice or other factors could be dangerous for boaters, anglers, and swimmers. However, flooding is not expected.
- **Flood watch** indicates there is the potential for flooding.

For the MRW, the MNRF Parry Sound District office issues "local" messages to municipalities, First Nations and the media. These local messages are generally issued when high water conditions are predicted, or the weather forecast shows significant rainfall. They provide a high-level overview of the existing conditions, along with public safety information and weather forecasts. While they do not provide specific information on flow or water level forecasts, they may contain general statements suggesting that local flow or levels may increase. A sample of a *Watershed Conditions Statement – Water Safety*, issued by the Parry Sound District (June 14, 2022) can be found in Appendix A.1.

Both the SWMC and local District messages can be found through the following link:
<https://www.lioapplications.lrc.gov.on.ca/webapps/swmc/flood-forecasting-and-warning-program/#localFloodMessages>

In addition to the website noted above, the public can also obtain water level and flow information, or report concerns to the MNRF through the following contacts:

By phone: 705-646-5531

By email: Watermanagement.psdistrict@ontario.ca

3.3 Meetings

A pre-freshet meeting is held every year by the MNRF Parry Sound District for all partners in the watershed to share winter observations, to update all participants on recent flows, and to discuss expectations going forward (e.g., developing trends). Updates are provided on a regular basis after this meeting.

A separate *CEMCs Meeting* has also been held annually since 2014. While it was originally held in person, it has been held in an online meeting setting in recent years because of COVID-19 safety measures. The intended audience for these meetings is the CEMCs from

each municipality and their alternates, but the mayors and councilors of each municipality may also attend, if they are interested. It is held at the start of freshet. As in the general meeting, current water level and flow data, as well as snow observations and precipitation information for the period prior to freshet, is presented. Contact information, watershed messaging and communications are also reviewed and updated, as necessary.

MNRF Parry Sound District water management staff continue to engage with municipal CEMCs via email when a flood watch is issued, to provide high-level updates on a weekly basis. If a flood warning is issued, these updates are done daily. These updates provide an overview of observations only, and do not include predictions or flow forecasts.

Starting in the winter of 2022, bi-weekly watershed updates were issued by MNRF Parry Sound District to MRW Mayors, CAOs and Emergency Management representatives. Other staff can be included, at the discretion of the Mayors and CAOs. These updates provide information during the late winter/early spring period, between Communications Committee meetings.

3.4 Early Warning System

Currently, there is no automated early warning system for the MRW. However, as shown in the previous sections and the Phase 1 report, a lot of information regarding current and potential conditions is available, and meetings are held at frequent intervals to share this information and address potential concerns. Regular distribution of written updates is also available to supplement the meeting information, and direct contact by phone or email is also an option to address questions.

If established, an early warning system would be tied into the existing monitoring systems of the MNRF and the power entities and would provide automated messages/warnings when specific flows or elevations were reached at critical points in the watershed. These messages could be sent for both developing flood situations (warning) and imminent flooding (emergency). They would be directed to municipal decision makers who could provide updates/warnings to the public, or activate emergency procedures, if necessary. The electronic infrastructure and programming necessary to set up an early warning system would have to be acquired/developed.

Prior to considering the implementation of an early warning system, it would be necessary to select the specific locations for which information would be monitored, and to establish trigger points for activation of the system. These points would need to be tied to actual elevations and/or flows that represented situations where warnings could be issued or actions taken, with consideration given to the timing needed for response.

At this time, it is unclear if sufficient information regarding trigger flow and water level information for an early warning system is available, or that an automated system would provide any better information on developing flood situations. Therefore, it is not recommended that an early warning system be implemented now. To support further

consideration of this option, a better understanding of the development of flooding (flows, elevation, rate of increase, etc.) and the impacts on existing infrastructure at specific sites of concern within individual municipalities should be established. This additional information is especially critical for river reaches where flooding is experienced.

4. Climate Change

A literature review revealed that while there have been many studies carried out in the area of climate change, they generally address climate change science and the projected climate changes under various scenarios, but not how to deal with the changes. Where mitigation and adaptation are referenced, it is often at a high level (e.g., policy). Mitigation is generally seen as finding ways to reduce the rate and magnitude of climate change (e.g., reduction in greenhouse gases), while adaptation involves addressing unavoidable impacts from climate change by making adjustments in decisions, activities and thinking.⁸

With respect to the MRW, neither the MNRF nor the power entities have engaged in any formal detailed climate change studies for the area. However, several studies have been completed locally by the Muskoka Watershed Council and the District in recent years. Findings from these studies are documented in the following reports:

- Climate Change and Adaptation in Muskoka, Muskoka Watershed Council, April 2010
- Planning for Climate Change in Muskoka, Muskoka Watershed Council, January 2016
- Climate Science Report, District of Muskoka, Sept 2021
- Future Climatic Projections (infographic), District of Muskoka, Sept 2021.

Hydrologic models that have been developed in support of other Integrated Watershed Management (IWM) projects such as the *Hydrologic Model for the Muskoka River Watershed* project and the *Structural and Watershed Flood Mitigation* project, in addition to the recent flood plain mapping study, offer opportunities to further study the impact of climate change on flows and elevations in the watershed.

In addition, the website <https://climatedata.ca/> is an on-line data portal that was developed through the collaboration of Environment and Climate Change Canada (ECCC), the Computer Research Institute of Montreal (CRIM), Ouranos, the Pacific Climate Impacts Consortium (PCIC), the Prairie Climate Centre (PCC) and Habitat Seven. The portal provides historical data and future climate projections to help interested individuals or organizations better understand the potential climate changes in their area and to develop and implement plans to address these changes.

For the MRW, climate change studies suggest that there will be greater precipitation in fall, winter and spring, with the greatest increases expected in spring and winter⁹. There is also an expectation that more extreme events will occur. At this time, it is unclear how these changes

⁸ Natural Resources Canada Website – Climate Change: Adapting to impacts and reducing emissions (climate change adaptation in Canada page)

⁹ Climate Science Report, District of Muskoka, Sept 2021, p. 20.

will translate into runoff and dam outflow. With potentially increasing temperatures, the increased winter precipitation could result in less snow, but more rain, leading to higher flows over a longer period. Spring precipitation is also expected to increase, but, with a reduced snowpack, there could be fewer incidents of significant rain on a snowpack that is ready to melt. Extreme events will remain an operational challenge depending on their timing. While the existing dams have capacity to pass high flows, lakes in the upper portion of their NOZ will not have the capacity to hold additional water, and river stretches will continue to be negatively impacted by high flows.

Options for adaptation are limited and often fall into categories such as structural (e.g., levees), natural (e.g., use of wetlands) or policy (e.g., infrastructure guidelines, floodplain use planning, etc).^{10,11} Several structural options are presented in the report *Structural Flood Mitigation Options* produced for the District in 2022¹². Since there were few options identified in Phase 1 for operational adjustments in the MRWMP to limit flooding under the current climate, it is unlikely that further operational changes could be incorporated to provide adaptation for climate change impacts. However, as climate change projections continue to be developed, current and enhanced hydrologic models should be run to assess the flow routing through the system and any changes that may occur in the floodplain mapping. This information can further support policy decisions and the need for further structural considerations for managing flow. In addition, periodic review of the flow capacities of the discharge structures in the watershed should be undertaken.

The MRWMP is considered to be a “living document” and adaptive management allows for it to be revised as needed. While the MRWMP does not apply under flood conditions, the operating plans within the MRWMP should continue to be reviewed as additional climate change information becomes available in order to ensure that operational resiliency is maintained to offer the greatest net benefit to society. Adaptation in this form will not eliminate all the potential increased flood impacts due to climate change, but it will help to ensure that their severity is minimized.

¹⁰ Clean, Resilient Flood Technology Options in Canada Prepared for Environment and Climate Change Canada by ACT (the Adaptation to Climate Change Team), Faculty of Environment, SFU June 30, 2020, Author: Andrew Marriott, ACT Research Assistant; MPP Candidate, SFU, p.10.

¹¹ Planning for Climate Change in Muskoka, Muskoka Watershed Council, January 2016, p.44.

¹² Structural Flood Mitigation Options. Hatch for District Municipality of Muskoka. Document No. H367619-0000-2B1-066-0001. September 13, 2022.

5. Summary

Phase 2 of the *Operational Adjustments and Scoping Study for the Muskoka River Water Management Plan* project identified the process to be followed to initiate a WMP amendment request and to see it through to a decision by the MNRF. This process is well documented in both the MNRF's *Technical Bulletin – Maintaining Water Management Plans* (Ministry of Natural Resources, October 2016) and in the MRWMP itself (*Section 17 – Provision for Plan Amendments*). While the amendment request progress generally envisions the request being made for a change in operation at one of the power entities' facilities, in this case, both amendment requests noted on Section 2.3.1 would be directed to the MNRF. Subsequently, they would be responsible for assessing the requests, carrying out any required studies, and approving or disapproving the request. It is likely that the Communications Committee would play a significant role in reviewing and assessing the requests in place of a SAC.

The subject of the first amendment request – to review the current snow and rainfall triggers used to initiate extended drawdown of the lakes in the MRWMP – would likely be a classified as a minor amendment. It is not operational in nature, but it would involve assessment of snow and rain data to enhance the science behind the decisions and to determine if new trends/patterns warrant different trigger values, or trigger values based on different parameters (or combinations). Limited consultation may be necessary for this amendment request.

The subject of the second amendment request – more fully utilize the lower part of the NOZ (e.g., lower the TOL for Lake Muskoka to a point halfway between the current TOL and the bottom level of the NOZ during the pre-freshet/freshet period) – would potentially be classified as a major amendment. Preliminary assessment of this option in Phase 1 showed limited operational improvement but, the impacts of operating even lower in the NOZ should be assessed. However, it should be noted that the proposed change does not change the NOZ in which the MNRF is allowed to operate Lake Muskoka. The amendment would simply change the guidelines for the target lake level during the pre-freshet and freshet periods. Without commitment from MNRF to make best efforts to closely follow a revised TOL, benefits from a change may be further limited.

Several studies should be carried out to determine the impacts of operation at lower water levels in the NOZ on other interests/issues. Some of the interests and potential issues to be considered include impacts on riparians and boaters, water lines, ice issues, and fish and wildlife. In addition to consideration of the impacts of operating at lower water levels, the timing of lowering the water level, and the potential for problems in refilling Lake Muskoka to preferred summer levels should also be considered. Community engagement and consultation with local governments and First Nations may also be required.

While it appears that there are several processes in place for sharing of freshet information, distribution of the available information within local organizations should be undertaken to

ensure that the information is getting to those who need it. In addition, further assessment of impacted areas should be considered to better understand potential conditions to impacts. However, development of an early warning system is not recommended at this time.

It is expected that there will be impacts due to climate change on flow in the Muskoka River, and subsequently, on the potential for and extent of flooding. Changing timing and quantity of precipitation will require additional analysis/modelling to understand these impacts. Discharge capacities of the dams in the watershed should continue to be reviewed on a periodic basis to ensure that operational resiliency is maintained. As more information is obtained, and better understanding of climate change impacts is developed, it may be necessary to update the MRWMP to accommodate these changes.

Appendix A

List of Acronyms

List of Acronyms

ARSP	Acres Reservoir Simulation Program
CAO	Chief Administrative Officer
CEMC	Community Emergency Management Coordinator
CRIM	Computer Research Institute of Montreal
District	District of Muskoka
ECCC	Environment and Climate Change Canada
GLAM	Great Lakes Adaptive Management Committee
GIS	Geographic Information System
GS	Generating Station
IWM	Integrated Watershed Management
LiDAR	Light Detection and Ranging
LOZ	Lower Operating Zone
MECP	Ministry of Environment, Conservation and Parks
MNR	Ministry of Natural Resources
MNRF	Ministry of Natural Resources and Forestry
MRW	Muskoka River Watershed
MRWMP	Muskoka River Water Management Plan
MWAG	Muskoka River Advisory Group
MWI	Muskoka Watershed Initiative
NOZ	Normal Operating Zone
OPG	Ontario Power Generation
PCC	Prairie Climate Centre
PCIC	Pacific Climate Impacts Consortium
Province	Province of Ontario
RFP	Request for Proposal
SAC	Standing Advisory Committee
SREL	Swift Rapids Energy Limited
SWE	Snow Water Equivalent
SWMC	Surface Water Monitoring Centre
TOL	Target Operating Level
TWG	Technical Working Group
WMP	Water Management Plan

Appendix B

Water Management Plan Amendment Process¹³

¹³ Technical Bulletin – Maintaining Water Management Plans, Ministry of Natural Resources and Forestry, October 2016, p. 14.

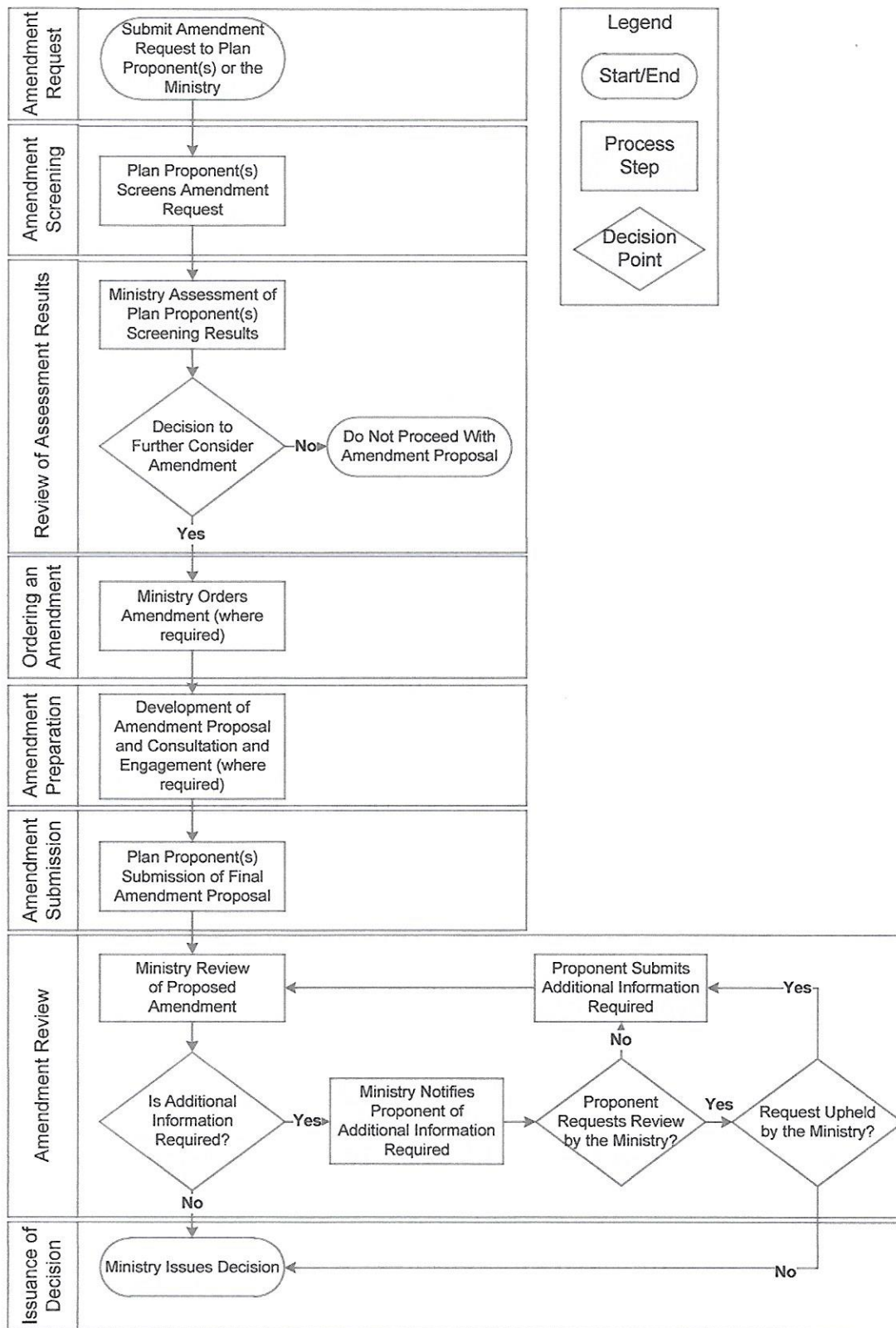


Figure 1: Water Management Plan Amendment Process

Appendix C

Watershed Conditions Statement – Water Safety

Parry Sound District, June 14, 2022

Watershed Conditions Statement - Water Safety

Parry Sound District

Tuesday, June 14, 2022
12:00pm

The Ministry of Natural Resources and Forestry – Parry Sound District is advising area residents that a Watershed Conditions Statement - Water Safety Bulletin is in effect in the District until Tuesday, June 21, 2022

Residents in Parry Sound District, which includes the District Municipality of Muskoka, the Territorial District of Parry Sound and a north-west portion in the County of Haliburton, should exercise caution while around waterbodies and maintain close supervision of children and pets due to high water levels and river flows in the area.

NDMNRF also advises extreme caution when using forest access roads for outdoor activities as they may become seasonally inundated with water, are prone to washouts and may become impassible due to localized flooding.

The ministry is closely monitoring the weather and developing watershed conditions. Further updates will be issued as appropriate.

TECHNICAL INFORMATION

Description of Weather System

The area has received approximately 105mm of rain over the past three weeks causing water levels and flows in local lakes and rivers to rise higher than normal for this time of year.

The 7-day weather forecast issued by Environment Canada is also calling for chance of showers and thunderstorms June 15-17 with daytime high temperatures ranging from 20°C to 27°C.

Description of Current Conditions

Water levels and river flows are generally higher than normal in the Parry Sound and Muskoka area for this time of year. Some areas typically used for recreation and access to

the water are inundated and/or experiencing high river flows making access difficult or possibly dangerous in some locations.

Additional rain as forecasted will cause water levels and river flows to increase further or remain high through the next several days.

DEFINITIONS

- **WATERSHED CONDITIONS STATEMENT – WATER SAFETY:** indicates that high flows, melting ice or other factors could be dangerous for such users as boaters, anglers and swimmers but flooding is not expected.
- **WATERSHED CONDITIONS STATEMENT – FLOOD OUTLOOK:** gives early notice of the potential for flooding based on weather forecasts calling for heavy rain, snow melt, high winds or other conditions
- **SHORELINE CONDITIONS STATEMENT – WATER SAFETY:** indicates that **along the Great Lakes shorelines high water**, melting ice or other factors could be dangerous but flooding is not expected.
- **SHORELINE CONDITIONS STATEMENT – FLOOD OUTLOOK:** gives early notice of the potential for flooding **along the Great Lakes shorelines** based on weather and lake conditions, and water safety information.
- **FLOOD WATCH:** potential for flooding exists within specific watercourses and municipalities
- **FLOOD WARNING:** flooding is imminent or occurring within specific watercourses and municipalities.

LEARN MORE

- Surface Water Monitoring Centre public webpage www.ontario.ca/page/surface-water-monitoring-centre
- Environment Canada bulletins: www.weather.gc.ca
- A close watch on local conditions and weather forecasts from Environment Canada is recommended.