Ideas for the next steps from the Rainy – Lake of the Woods Adaptive Management Committee

This report is based on presentations and brainstorming discussions at a Climate Change Workshop held in Fort Frances, Ontario on August 11, 2022. The workshop was called by the Adaptive Management Committee[1] to formulate ideas for better addressing climate change. The objectives were to highlight basin specific concerns about climate change, to present the IJCs general Climate Change Guidance Framework and then to consider possible next steps including issuing public findings, making changes in the adaptive management program, conducting additional IWI studies, or other actions.

Summary of the brainstorming discussions

The conversation was wide-ranging and explorative; participants discussed issues outside of committee responsibilities in an attempt to place committee business in a larger context. The 2022 flood in the basin drove much of the discussion. When the lakes rose to flood levels, some parts of the affected community argued that management of the lakes was the cause of the flooding. Expert analysis shows this is not true, that in fact, management of releases from the lakes can have little effect on big floods because the space to capture flood inflows is not large enough. Any significant further reduction in future flooding impacts would have to come from floodplain management, something the IJC has no authority to do. Public pressure to reduce flooding could encourage rule curve or operational changes that would have a large negative impact on the environment and recreation. The group wrestled with the tensions inherent in these perspectives, with most concluding that they wanted the Board to do more to address flooding while still staying within the bounds of IJC authorities and missions.

The Adaptive Management Committee is new (created only two years ago) but has some projects underway already that could contribute to flood resiliency and climate change preparedness. The next section briefly summarizes what the Committee has been doing, followed by a short summary of IJC's Climate Change Guidance Framework.

The final section (page 3) considers the conflicting management objectives expressed at the workshop and based on that proposes a few initiatives that could help achieve those objectives.

Background summary of adaptive management efforts under the 2018 Supplemental Order.

After the Supplemental Order (March 1, 2018) was issued, the IJC formed an Adaptive Management Task Team for the Rainy Basin to consider how to implement adaptive management. The current Adaptive Management Committee was formed in 2020 based on the Task Team work. Teika Newton

[1] The Adaptive Management Committee is a committee of the International Rainy-Lake of the Woods Watershed Board, appointed by the International Joint Commission (IJC).

(Canada) and Ryan Maki (U.S.) are co-chairs. The Committee's mission is to monitor outcomes from the application of the 2018 Rule Curves, compare monitored to modeled outcomes, update those models as necessary based on the monitored results, and raise the issue of modifications to the 2018 Rule Curves and associated operations if the new model results suggest worthwhile policy changes. Because changes in climate can affect the performance of the rule curves, the committee also oversees the Board's implementation of the IJC Climate Change Guidance Framework in the basin.

There was no dedicated funding provided for adaptive management from 2018 – 2020. The US Section provided funding in FY21 and is providing it again in FY22. The Canadian Section will provide funds in FY22. The first priority for those funds is to better incorporate Indigenous performance indicators. Then, to the extent possible, the funding would be applied to an Environment and Climate Change Canada (ECCC) effort to update and expand the GIS model of the basin built during the 2000 Namakan-Rainy Rule Curve Study which was known as the Integrated Ecological Resources Model (IERM). As part of the IJCs recent Lake Champlain study, that modeling framework was expanded to include economic and social impacts and was re-named the Integrated Social, Economic and Ecological (ISEE) model.

Summary of the two major presentations (IJC Climate Policy and Regional Climate Research)

1. The IJC Climate Change Guidance Framework and the International Rainy-Lake of the Woods Watershed Board

Bill Werick discussed the IJC Climate Change Guidance Framework at the workshop. A series of reports on the framework is available online; the latest report was published in 2021. The framework was developed at the suggestion of Boards participating in an International Watershed Initiative workshop in 2016, including the Rainy. The Framework has three components:

1. An adaptive management context
2. An iterative four step planning process
3. A commitment to the active sharing of knowledge among IJC Boards.

In the course of applying the Framework, the words "vertical" and "horizontal" have been used to describe either one Board moving through all four steps in one effort (vertical) or focusing attention on one step but across multiple boards (horizontal).

During the 2000 Namakan-Rainy Rule Curve Study (2015), regional climate experts were asked how climate change was expected to manifest itself in the basin with regard to water levels. Net basin supply (NBS) sequences reflecting the expert opinion were created by transforming the historic NBS data. The leading alternative rule curves were tested with ten such climate change net basin supply datasets including some that distributed changes in annual precipitation according to historical seasonal patterns, and some which simulated warmer winters with more smoothly distributed snowpack melt. That analysis showed that the rule curves will have limited ability to reduce flood risk, but rule curve plans that reduce flooding damages more than other plans with the historical NBS will reduce flood damages more than other plans do with climate change NBS. Rule curve operation can make a bigger difference

in preserving recreational opportunities during droughts, and similarly, plans that are better for recreation based on historical NBS are also better when tested with climate change NBS.

2. Regional climate effects on the basin

Dr. Scott Higgins followed the discussion on IJC policy across the border and in the basin with an overview of recent climate research as it applies to the Rainy watershed. Dr. Higgins is a research scientist at the International Institute for Sustainable Development's Experimental Lake Area, northeast of Lake of the Woods. He has published several papers on the effects of climate change on ecosystems and contributed to the 2000 Rule Curve Study climate analysis.

Dr. Higgins showed that regional temperatures are increasing, faster than global averages (Figure 2) with warming in colder months, not during the summer (Figure 3). This is consistent with the reduced duration of ice covers on the lakes (Figure 4). Long term precipitation data indicate a roughly 31-year cycle between wet and dry periods. Based on that periodicity, 2000-2018 would be expected to be in the drought portion of the cycle, but (as can be seen in Figure 5), precipitation in most of those years was high, perhaps indicating that long term trend to greater precipitation overwhelms the wet-dry cycle that has occurred in the past. That raises the question of whether the two trends will be additive, with climate change induced precipitation increases adding to naturally high precipitation in the wet portion of the 31-year cycle, producing even greater flooding.

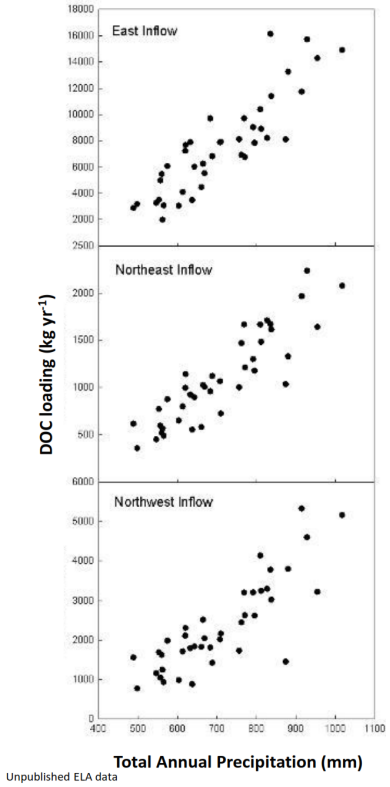


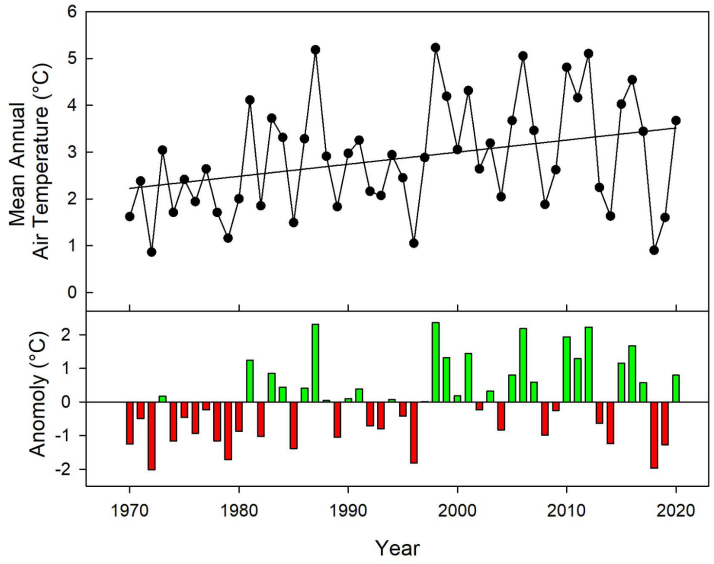
Figure 1. Precipitation and DOC loading

The evidence that precipitation is increasing is strong. In fact, during the 2000 Namakan-Rainy Rule Curve Study, the first question to be addressed was whether the increase in flooding since 2000 occurred because the Rule Curve changed in 2000. That study, and the updated analysis including the 2022 flood, show that while the 2000 Rule Curve can increase smaller floods more than the 1970 Rule Curves because they provide less flood storage in Namakan Lake, the primary factor in larger floods such as 2014 and 2022 is high precipitation. The climate change net basin supply data used in the Rule Curve Study were designed to reflect the trends in precipitation and spring ice melt shown in the data.

Dr. Higgins showed that increased precipitation is likely to lead to increases in algal blooms in headwater lakes. Unpublished data from the Experimental Lakes Area (Figure 1) clearly shows that higher precipitation increases dissolved organic carbon (DOC) loading, including nitrogen and phosphorus.

Dr. Higgins' presentation, the 2000 Rule Curve analysis and the analysis done this year with the Rule Curve SVM show that flooding damages and algal blooms can be expected to a bigger problem in the future unless changes are made to manage the floodplain and basin runoff.

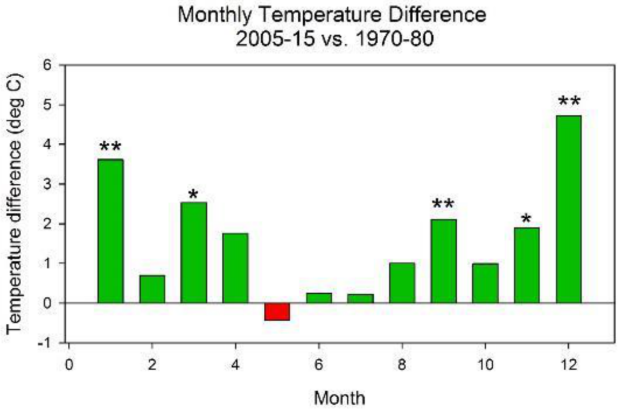
Air Temperature at ELA – The past 50 years



- Mean annual air temperature rising by 0.41 °C /decade (> 2 °C since 1970)
- Global average is ~0.07 to 0.08 °C /decade (since 1880, NOAA)

Figure 2. Temperature trends in the basin

Air Temperature – Seasonality

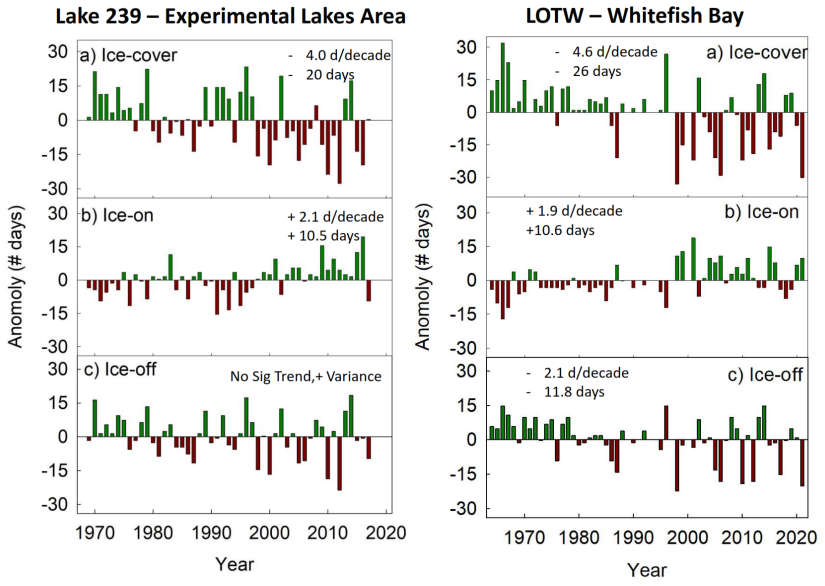


- *p< 0.05, ** p< 0.01 of long-term monthly trends
- Long-term trends in December were 1.3 °C/decade (~ 6 °C since 1970)
- Long-term trends in March were 0.74 °C/decade (>3 °C since 1970)

- Annual mean temperature 'hides' large seasonal dynamics
- Majority of temperature change in region occurs during winter and shoulder seasons. This is consistent with IPCC (2019) review of climate change over global landmasses.
- Fall and winter air temperatures consistently increasing. Spring temperatures highly variable.

Figure 3. Colder parts of the year are warming more

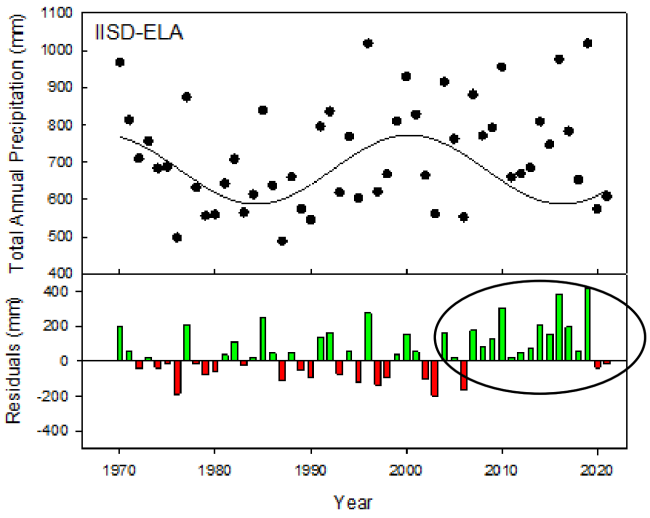
Has the Duration of Ice-Cover Changed?



- Significant declines in duration of ice cover;
  - -1.6 to -4.3 d/decade for 75 Northern Hemisphere lakes (Benson et al. 2004)
- With warmer fall air temperatures, lake ice is forming later and later
- In headwaters, spring melt is becoming more variable (less predictable). For larger lakes, ice melt is consistently occurring earlier and earlier

Figure 4. Ice cover on lakes often comes later and leaves sooner

Regional changes in Annual Precipitation



- Model reasonably predicts 31-year periodicity in Annual precipitation at ELA between 1970-2000
- Model predicts that region heading into a 'drought' period after 2000
- Actual precipitation has consistently been higher than predicted from 2000 - present.
- In other words, the long-term historical model predicted a decline in precipitation that did not occur.
- Model would predict increases in precipitation from 2018 to 2033. (note high residuals at end of dataset)

Figure 5. Complex data patterns suggest precipitation is increasing

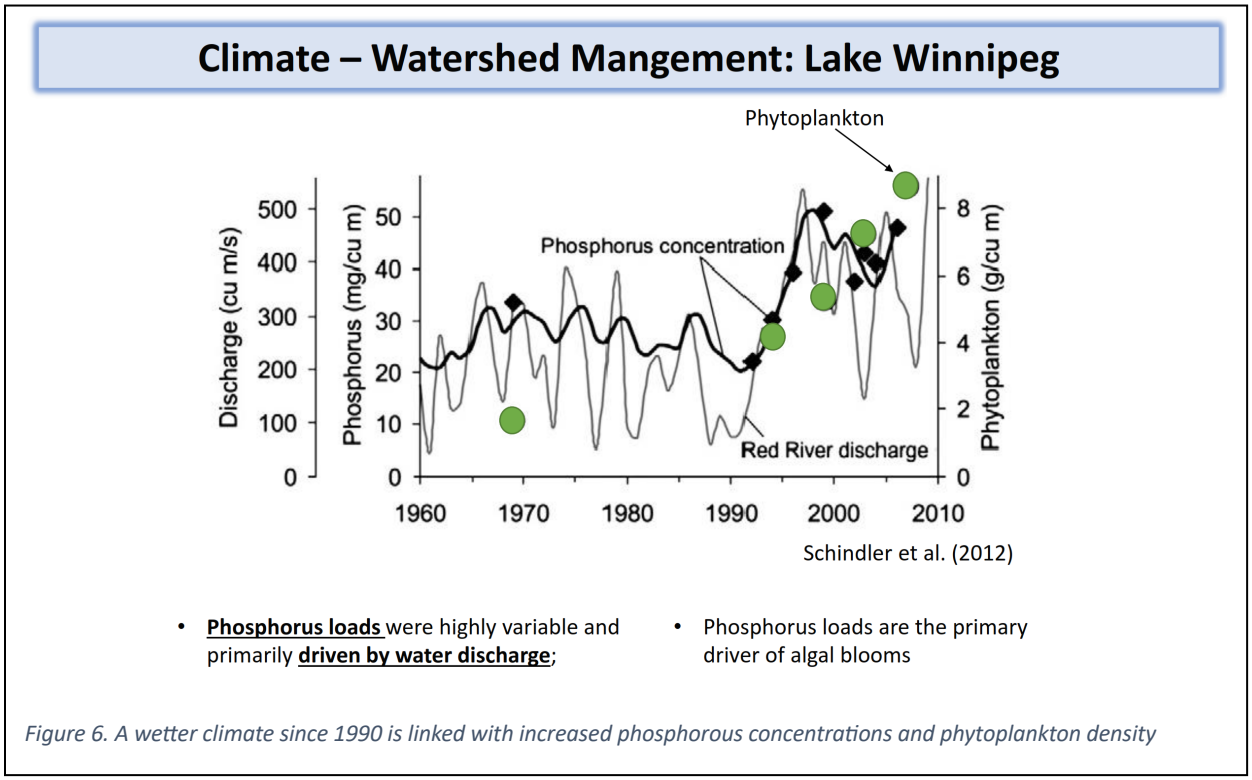


Figure 6. A wetter climate since 1990 is linked with increased phosphorous concentrations and phytoplankton density

Ideas for Addressing Management Objectives

Expert analysis makes it clear that adjustments to Namakan-Rainy rule curve operations can produce only marginal reductions in damages from big floods, but some portions of the public believe otherwise. This conflict offers a story line for media reporting when floods occur and increases pressure on the International Rainy – Lake of the Woods Watershed Board's Water Level Committee to sacrifice other objectives, such as ecosystem health and recreation in pursuit of reduced flood damages. This phenomenon occurs in other basins and affects other IJC Boards. Persistent public involvement, especially when supported by persuasive video arguments can help; absent that, distrust of government increases. What should the Adaptive Management Committee do about that? The following ideas were generated after the workshop based on the workshop discussions.

1. Bring the Boards together again[2] to consider this common concern and formulate a border-wide IWI study to address the issue generally. The IJC's Climate Change Guidance Framework was initiated at a workshop in which Boards met to address a common challenge, and it might make sense to hold such a meeting again to address this common issue, that IJC Boards are often at the center of public debate about flooding related to lakes those Boards regulate, even though regulation of the lakes cannot make a significant difference in flooding. Because climate change is expected to affect flood risks in most places, this could be considered a "horizontal" analysis (step 2) application of the Climate Change Guidance Framework. This multi-Board event could

[2] In 2016, the IJC convened two multi-Board discussions in Washington, D.C. to encourage cross-Board discussions on how to manage water quantity and quality issues under climate change. This led to the IJC's Climate Change Guidance Framework.

precede and bolster any strategy or public statements issued by the Adaptive Management Committee.

2. Expand public involvement in the March 10th decision each year on whether to use the rule curves designed to reduce flooding. Some suggestions to this effect were made during the International Falls, MN public meeting on the evening of the adaptive management workshop.
3. Use the SVM and IERM models more effectively in adaptive management, including refinements of those models to better represent tradeoffs between flood damage reduction and other types of benefits.
4. Expand IERM to an "ISEE" model that could calculate flood damages more accurately and at a greater resolution than the current SVM.
5. Conduct an IWI study in the Rainy basin to consider how the IJC could act as a facilitator of increased flood resiliency, encouraging actions by property owners, industry, natural resources agencies and the Watershed Forum could coordinate what they do individually in a collaborative plan to reduce flood damages.
6. If possible, train Indigenous representatives to develop and use ISEE. This would enmesh the model into the ongoing operation and adaptive management of the 2018 Rule Curves while providing a practical working format for modeling Indigenous performance indicators and including Indigenous knowledge, thus addressing both priorities.
7. Stress test the basin as part of a formal decision scaling analysis. Stress testing involves the simulation of impacts based on inflow datasets representing a range of increased annual precipitation and temperature. Failure points are identified for various management goals, linked to specific changes in temperature and precipitation. The plausibility of such failures is then estimated based on how many current climate models predict those changes in temperature and precipitation.