# Key Findings and Recommendations of the International Souris River Study

## Highlights Report

Prepared by the

**International Joint Commission**

*October, 2021*

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# 1 Introduction

This report presents highlights of the final report of the International Souris River Study, Managing Water Supply and Flood Control in the Souris River Basin.

The Study was launched in 2017 by the International Joint Commission (IJC) to evaluate water management operations under the 1989 International Agreement between the Government of Canada and the Government of the United States of America for Water Supply and Flood Control in the Souris River Basin (the 1989 Agreement). The Study's final report was submitted to the IJC in September 2021.

This highlights report has been prepared by the IJC to:

- inform a wide range of interests across the Souris River basin of the Study's findings and recommendations regarding opportunities to evaluate the 1989 Agreement and strengthen the provision of water supply and flood control benefits; and,
- support engagement and consultation activities by the IJC prior to delivering its advice to the Governments of Canada and the United States in early 2022.

This report presents an overview of the Souris River basin and a summary of the objectives, organization, and approach of the Study. It then highlights the key findings and recommendations of the Study under four broad challenges:

- Evaluating and reviewing the existing 1989 Operating Plan;
- Strengthening water supply and flood control;
- Addressing emerging water management concerns in the Souris River basin; and,
- Strengthening engagement in the Souris River basin.

The final report of the Study, as well as supporting planning, scientific and technical documents, are available on the Study's website: ijc.org/en/srsb.

For more information on the Study and the opportunities to provide comments or participate in the IJC's consultation activities, please contact:

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**The International Joint Commission**
Under the Boundary Waters Treaty of 1909, the Governments of the United States and Canada established the basic principles for managing many water-related issues along their shared international boundary. The Treaty established the IJC as a permanent international organization to advise and assist the governments on a range of water management issues. The IJC has two main responsibilities: regulating shared water uses; and investigating boundary water issues and recommending solutions.

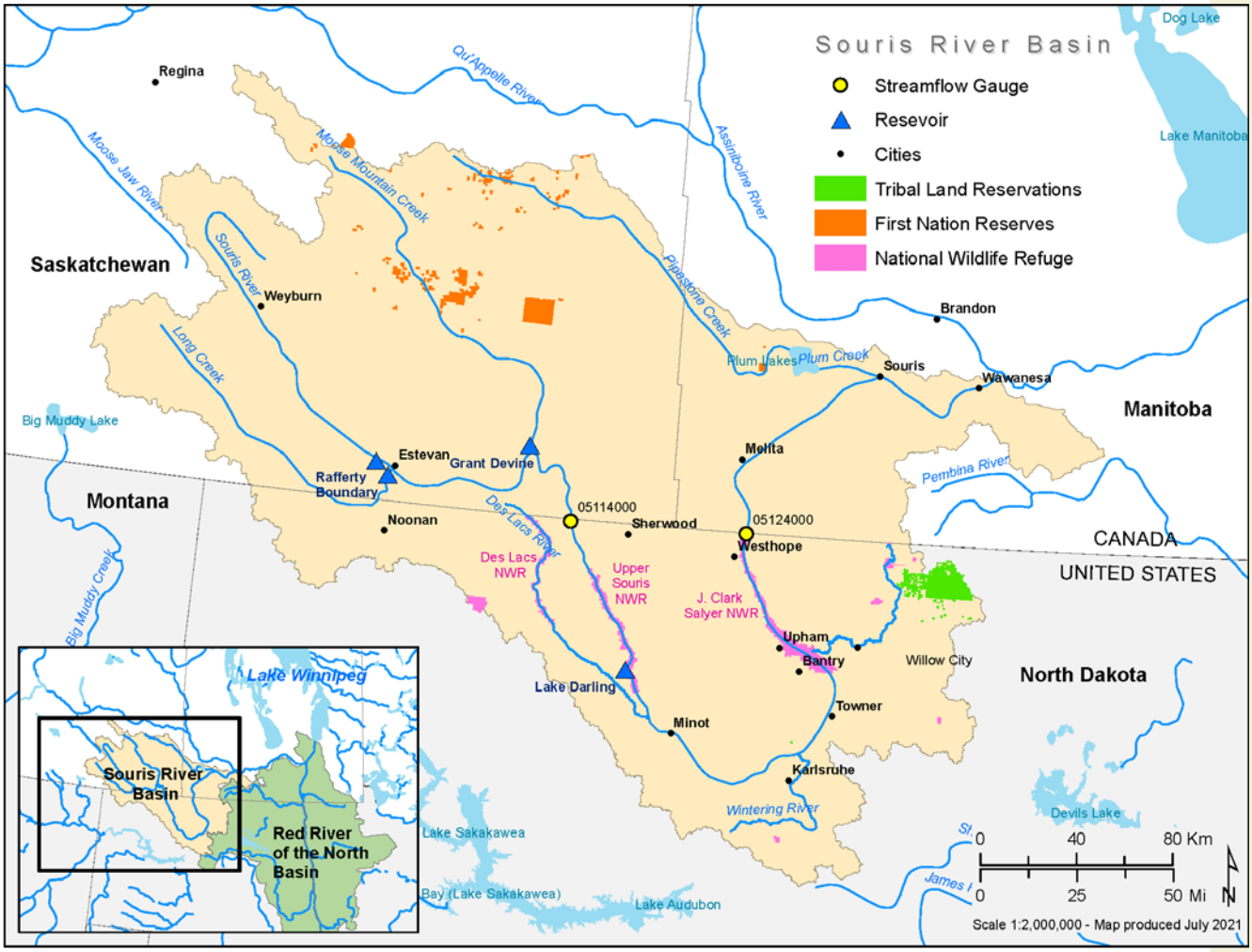
# 2 The Challenges of Water Supply and Flood Control in the Souris River Basin

## The Souris River basin

The Souris River basin covers about 61,900 km$^2$ (23,900 mi$^2$) in the provinces of Saskatchewan and Manitoba in Canada and the state of North Dakota in the United States (Figure 1).

The 700 km (435 mi) river originates in its headwaters in Saskatchewan, just southeast of Regina and continues southward, crossing into North Dakota west of Sherwood. The river continues southward past Minot, North Dakota, before turning northward again and crossing into Manitoba near Westhope, North Dakota. It terminates in eastern Manitoba, where it discharges into the Assiniboine River. For the most part, the Souris River (also known as the Mouse River in North Dakota) is a slow-moving stream with a mild slope and complex meander pattern.

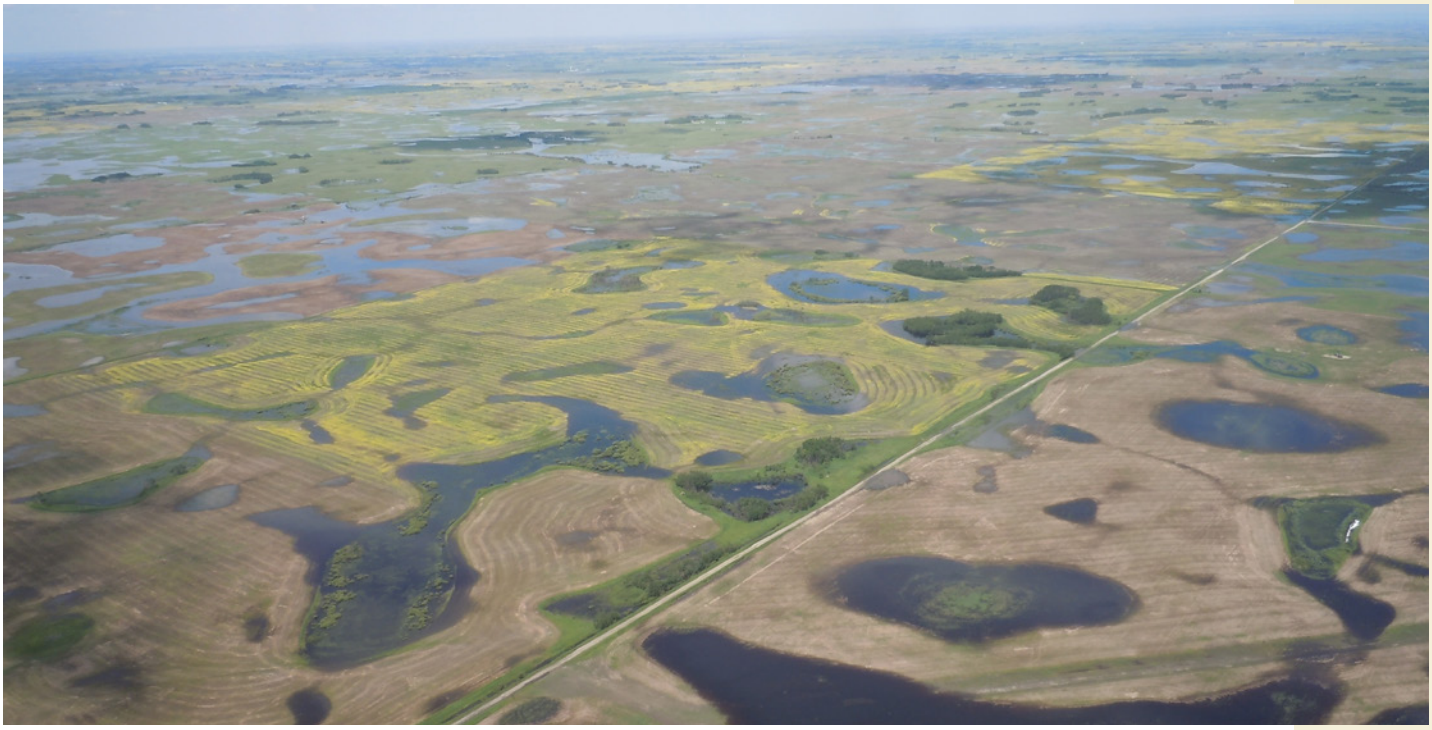
*Figure 1 Souris River basin*




With a total population of about 157,000, the basin's economy is relatively diversified, with a mix of agriculture, coal mining and energy production, service industries and tourism.

Long, cold winters in the basin tend to retain snowfall until the spring melt, which provides most of the annual flow in the region's rivers and streams. Much of the basin is part of the Prairie Pothole Region, characterized by the presence of shallow potholes or kettle lakes that are remnants of the last period of continental glaciation in North America. When the potholes are empty and the basin is generally dry, precipitation does not have a significant effect on river flows. However, when the potholes are full and the basin is already wet, precipitation has a much greater impact. The relative flatness of the basin also affects the duration of runoff periods. Typically, when flood waters rise above riverbanks, large areas can be inundated, and it can take many weeks for flood waters to drain.

The combination of climate and terrain contributes to highly variable flows in the basin, from season to season and year to year. It also makes the basin highly vulnerable to the impacts of extreme weather conditions. As a result, understanding and managing water supplies and floods in the basin have long been critical to meeting the needs of the many interests that depend on that water – including farming and ranching interests, communities, industries, and the natural environment.



## The 1989 Agreement

For more than 80 years, Canada and the United States have worked together through the IJC to manage the transboundary waters of the Souris River. Today, the waters of the Souris River are extensively managed for water supply and flood control by dams and diversion canals.

The current Operating Plan for the Souris River Project reservoirs has been in place for over 30 years as part of the Canada-U.S. 1989 Agreement. Annex A of the Agreement provides the Operating Plan for the operations of the four main reservoirs for flood control and water supply. The main reservoirs covered under the agreement – Rafferty, Grant Devine (formerly Alameda), Boundary and Lake Darling – are collectively known as the Souris River Project. It includes data on physical characteristics of the reservoirs, prescribes rules for flood and non-flood operations, and sets out procedures for communications and the exchange of information among the responsible agencies.

Annex B outlines the water apportionment agreement between Saskatchewan and North Dakota. The annex was amended in 2000 to provide greater clarification of conditions that must prevail for making apportionment determinations.

The Rafferty and Grant Devine Reservoirs are operated by the Saskatchewan Water Security Agency, and Boundary Reservoir is operated by the Saskatchewan Power Corporation. The Lake Darling Dam is operated by the US Fish and Wildlife Service during non-flood periods and by the US Army Corps of Engineers during periods when a flood event is predicted or declared.

Rafferty is the most important reservoir for flood storage. Grant Devine and Lake Darling reservoirs provide some storage capacity, while the Boundary Reservoir is used primarily for water supply and has limited flood storage capacity.

*Clockwise: Rafferty, Grant Devine, Lake Darling, Boundary*

## The 2011 flood

In 2011, the Souris River basin experienced an unprecedented flood, far exceeding the scale of any other flood event in the more than 100 years for which records are available.

The flooding was the result of a combination of a several exceptional weather events. During fall 2010, the basin experienced near-record rainfalls. For example, in the Saskatchewan portion of the Souris basin, the 90-day precipitation for August through October was up to 200 percent above average. As a result, soils in the basin were saturated going into the 2010-2011 winter. Secondly, there was an active winter storm season in North America during the winter of 2011, bringing record snowfalls across parts of the Rockies and northern plains, leading to above average spring runoff in the Souris basin. Finally, the basin received considerable rainfall in the spring and early summer months of 2011, including a series of moderate rainstorms in May and early June, and major rainfall events in mid-June. These rainfall events occurred at a time when all the flood control reservoir impoundments in the basin were at capacity from spring snowmelt runoff.

As a result of these weather events, there were three major runoff periods in the basin: the spring snowmelt in April and early May, in later May following the numerous moderate rainfalls; and, in mid-June following major rainstorms. The flows in the river and its tributaries during June exceeded the one in 100-year design capacity of the basin's flood control system, leading to major flooding along the entire reach of the Souris River:

- In Saskatchewan, several major roads were closed, states of emergency were declared in the cities of Estevan and Weyburn, and more than 4,000 people were forced from their homes;
- In North Dakota, damage to property and infrastructure was estimated at $691 million, with much of the damage concentrated in Minot, where more than 12,000 residents were evacuated and about 200 businesses in the city were damaged;
- In Manitoba, agriculture was particularly impacted, as farmers were unable to plant crops in the wet fields, while in the towns of Melita and Souris, existing municipal dikes needed to be repaired and reinforced.

The 2011 flooding focused renewed attention on the existing operating plan under the 1989 Agreement. The public, as well as several government flood protection and water management agencies, requested that options for additional flood protection measures be evaluated. Across the basin, there were also emerging concerns related to security of water supply, water quality, and environmental protection.


# 3 The International Souris River Study

## Objectives

The International Souris River Study was a direct response of the Governments of Canada and the United States to the extreme flooding events of 2011. Following extensive discussions with interests in the region, in 2013 the IJC submitted a Plan of Study to the two federal governments to address the challenges of flood protection and water supply in the basin.

In July 2017, the Governments of Canada and the United States issued a Reference for the IJC to undertake the Plan of Study. On September 5, 2017, the IJC issued a Directive to establish a Study Board to examine and report to the IJC on matters raised by the Governments of Canada and the United States. Specifically, the Study Board was directed to undertake analysis and make recommendations regarding:

- the Operating Plan contained in Annex A to the 1989 Agreement; and,
- how the provision of water supply and flood control benefits in the basin might be maximized.

## Study organization

The Study Board, comprised of four members each from Canada and the United States, was responsible for providing overall direction and management of the Study, including regular, formal reporting to the IJC. Study Board members included experts from federal, provincial, and state government agencies.

Technical teams were established for each of the technical tasks undertaken as part of the Study. Teams included scientists and engineers from federal, provincial, and state agencies, as well as external expert consultants.

A Public Advisory Group established by the IJC helped plan and implement the Study's engagement and outreach plan. The two co-chairs of the Public Advisory Group were also members of the Study Board.

The Study benefitted from the input of two key advisory groups of experts. A Resource and Agency Advisory Group was established to ensure that any recommendations made by the Study Board with respect to the existing operating plan or alternative measures would be compatible with the mandates, regulations, and resources of agencies in the basin. In addition, a Climate Advisory Group helped identify future climate states used to estimate future hydrological conditions in the basin for future evaluation of alternatives.

The IJC established an independent review group, separate from the Study Board, to provide independent scrutiny and guidance throughout the Study.

Over the course of the Study, the Study Board maintained a close working relationship with the International Souris River Board (ISRB), the permanent board established by the IJC in 2002 and responsible for oversight of transboundary water issues in the basin, including flood operations and apportionment of river flows. Several Study Board members are also current or previous members of the permanent ISRB. The Study Board kept the ISRB informed of progress at all stages and engaged with members to solicit feedback and discuss the transfer of various products and tools following the Study.

## Study approach

The Study Board addressed its objectives by means of a comprehensive, cooperative and scientifically rigorous approach. Using extensive modelling supported by a broad participatory approach to planning and evaluation, the Study Board developed and evaluated numerous alternative Operating Plan measures under a wide range of historical and possible future climate and water supply conditions. It tested, refined, and re-evaluated these alternatives, until it was able to focus in on a small number of alternative measures with potential to improve flood control and water supply benefits in the basin.

In addition, the Study Board addressed important emerging water management issues in the basin, including future climate conditions and the role of adaptive management.

## Engagement and outreach in the Study

With the support of the Public Advisory Group, the Study Board carried out a comprehensive engagement and outreach plan to ensure that all interests in the basin were aware of the Study and opportunities to express their views and concerns. The Study Board convened in-person and virtual public meetings and workshops throughout the basin to present information on the objectives and approach of the Study, respond to questions, receive comments, discuss preliminary findings, explore options through practice decisions and discuss recommendations.

The Study Board also recognized that the Tribes, First Nations and the Métis Nation in the Study area and adjacent regions hold special knowledge of the Souris River basin's waters and ecosystems and that their interests can be affected by changes in water levels and flows in the basin. The Study Board worked to establish lines of communication and build relationships with Indigenous Nations so that their interests could be properly addressed and that all participants could share their knowledge and perspectives.

The full reports of the Study's technical teams and its engagement and outreach initiatives are available on the Study's website: ijc.org/en/srsb.

*Clockwise: Indigenous Nations workshop, PAG workshop, RAAG Workshop and Public meeting.*

# 4. Key Findings and Recommendations of the Study

The findings and recommendations of the International Souris River Study are presented under four key challenges :

- Evaluating and reviewing the 1989 Operating Plan;
- Strengthening the Operating Plan;
- Addressing emerging water management concerns; and,
- Strengthening engagement.

## Challenge 1: Evaluating and Reviewing the 1989 Operating Plan

### 1. REVIEWING THE PERFORMANCE OF THE 1989 OPERATING PLAN

A key first step in considering the potential for improving water supply and flood control benefits in the basin was to evaluate how well the existing Operating Plan has performed. The Study analyzed and compared three model simulations from 1930 to 2017 to understand how the 1989 Agreement affects flood control, water supply and other key areas. The three model simulations were baseline, pre-agreement and unregulated runs.

The Study concluded that:

- Overall, the 1989 Operating Plan has performed well in providing water supply and flood control benefits. There are no major operational changes that will result in significant improvements in both water supply and flood control benefits across the basin.
- The addition of Grant Devine, Rafferty, Boundary and Lake Darling reservoirs has provided modest to significant flood protection from Estevan, Saskatchewan to as far downstream as Westhope, North Dakota, and into Manitoba, for floods similar in magnitude to the major floods experienced in the basin in 1969 and 1976. However, the reservoirs do not provide enough flood storage to provide sufficient flood protection for floods similar to that experienced in 2011.
- In addition to the direct benefits to flood control and water supply, the presence of the Souris River Project reservoirs, results in secondary effects on environmental resources, historic and cultural sites, water quality and recreation.

***Based on these findings, the Study Board recommended that:***

The modelling systems developed by the Study, and used to evaluate flow scenarios (including the effects and performance of the 1989 Agreement), continue to be used and updated to evaluate operational performance.

## 2. CLARIFYING THE 1989 OPERATING PLAN LANGUAGE

The unprecedented flooding in the Souris River basin in 2011 challenged operations as never before. For the operators of the dams, the flooding highlighted long-standing concerns regarding some provisions of the 1989 Agreement. The study built on the cooperative work of the operating agencies and further improved the language of the 1989 Agreement.

The Study:

- Identified specific proposed changes in language and data in the 1989 Agreement that will help improve the clarity and ongoing relevance of the Operating Plan and ensure consistency in its implementation;

- Agreed on an updated 2020 plain language document; and,
- Identified a set of outstanding issues for which no consensus was reached among the operating agencies; resolution of these issues may involve policy considerations and require the attention of the IJC and the Governments of Canada and United States.

***Based on these findings, the Study Board recommended that:***

The International Joint Commission support the plain language revisions and clarifications to the 1989 Annex A recommended by the Study Board (revised language will need legal review and an implementation plan).

The International Joint Commission consider advising the governments on the six issues that need guidance, direction, and legal analysis by the Parties to the Agreement.

## Challenge 2: Strengthening the Operating Plan

Through successive rounds of modelling and evaluation under a wide range of possible water supply conditions, the Study identified a short list of five Operating Plan measures that could be considered as viable alternatives to existing provisions in the 1989 Operating Plan. These measures were largely developed as responses to specific seasonal conditions (Table 1).

*Table 1 Summary of proposed alternative Operating Plan measures*

| Alternative Operating Plan Measure | Objective |
|---|---|
| 1. Winter Drawdown Elevation Targets (two options) | Allows for changes in winter storage in reservoirs, for improved operations that account for antecedent soil moisture and watershed basin conditions |
| 2. Winter Drawdown Extension to March 1 | Extends reservoir drawdown date from February 1 (1989 Agreement) to March 1, providing additional river flow for improved environmental benefits during February |
| 3. Lower Spring Maximum Flow Limits | Reduces the spring flow limits during small/moderate flood years and non-flood years to reduce flood peaks and agricultural flood risk in riverine reaches in North Dakota |
| 4. Summer Operations (two options) | Provides operators guidance for reservoir storage and river flow to maintain lower flow limits during targeted summer flood events to mitigate flood risk |
| 5. Apportionment Year Shift to a Water Year | Changes the apportionment calculations from a Calendar Year (January 1 to December 31) to a Water Year (Nov. 1 to Oct. 31) to ensure flood protection releases in November and December are credited towards apportionment |

Based on the evaluation of the alternatives, the Study concluded that:

- Hydrological research by the Study supports the conclusion that the 1989 Agreement is effective in achieving its intended objectives of flood protection and water supply benefits. Based on modeling, only marginal benefits to water supply and flood protection could be identified. This is due to constraints of the basin's natural characteristics and the river system's existing water infrastructure.
- The Study has documented through extensive analyses, the merits and effectiveness of the 1989 Agreement in providing water supply and flood protection within the constraints of natural and human-built water infrastructure systems of the Souris River. While the 1989 Agreement is functioning well, options for improvements exist, but implementing any of the measures will require balancing trade-offs.
- Selecting the best options will need to consider the full suite of alternative measures, options within the measures, and seasonal sequencing, culminating in choices to replace or remain within established 1989 rules. Careful analysis of trade-offs is required by the Governments of Canada and the United States to find the best and most balanced options for Canada, the United States, Saskatchewan, North Dakota, Manitoba and the citizens in the basin, including Indigenous Nations and diverse stakeholders.

***Based on these findings, the Study Board recommended that:***

The following suite of alternative measures be considered for incremental or marginal improvements to the 1989 Agreement:

1. **Modify the Winter Drawdown Elevation Targets** to build greater flexibility into reservoir operations by varying reservoir elevation targets according to antecedent moisture conditions in the basin.

2. **Extend the Winter Drawdown Date from February 1 to March 1** to provide additional river flow for improved environmental benefits during February.
3. **Lower the Spring Maximum Flow Limits** to reduce flood peaks and agricultural flood risk during small to moderate floods in riverine reaches in North Dakota (i.e., floods under 57-85 m3/s or 2,000 to 3,000 ft3/s).
4. **Establish a Summer Operating Plan** to provide more guidance to reservoir operators to better manage summer reservoir operations under all conditions.
5. **Shift the Apportionment rule calculations to a Water Year (November to October) from the current Calendar Year (January to December)** to ensure flood protection releases in November and December are credited towards apportionment.

## Challenge 3: Addressing emerging water management concerns

In addition to evaluating possible improvements to the Operating Plan under the 1989 Agreement, the Study provided perspectives on several critical emerging water management concerns in the Souris River basin.

### 1. CLIMATE VARIABILITY AND CHANGE IN THE BASIN

There is significant evidence pointing to a high degree of natural variability in the Souris River basin's climate. Both natural climate variability and the potential future impacts of human-driven climate change pose a formidable challenge to formulating an enduring water management plan for the basin.

To better understand and plan for climate variability and change, the Study reviewed recently published, regionally relevant, scientific research characterizing the effects of human-driven climate change on hydrometeorology. The Study also reviewed studies that investigated naturally occurring climate variability, as apparent within paleo-flood records collected in the vicinity of the Souris River basin.

The Study concluded that:

- Although future climate change may fall within the historical natural variability experienced in the basin, it is also possible that climate change may have an effect on the timing, seasonality, variability, intensity, frequency, and duration of streamflow events;
- There is evidence of increasing temperatures in both the historical record and projections of future climate;
- The frequency and intensity of extreme precipitation events and annual precipitation is anticipated to increase; and,
- Addressing the risks of climate variability and change in the basin will need resources dedicated to continued monitoring and improved modelling, and the incorporation of adaptive management in the Operating Plan.

## 2. ARTIFICIAL DRAINAGE IMPACTS

There are concerns that the drainage of marshes, prairie potholes and other wetlands – undertaken to allow increased or more efficient agricultural production – has increased the severity of flooding in the basin and affected water quality and wetlands.

The Study concluded that:

- Artificial drainage is practiced throughout the basin, but there is insufficient data to fully understand its potential impacts on water supply, water quality and apportionment for flow management;
- Regulations and legal requirements are continually being reviewed as scientific understanding of artificial drainage improves; and,
- The IJC and Souris River basin resource agencies need to be aware of current knowledge and legal requirements of artificial drainage and potential impacts on operations management of the Souris River.

***Based on these findings, the Study Board recommended that:***

> The International Souris River Board share scientific understanding of Souris River artificial drainage every two years, to advance evolving expert and public knowledge of the impacts, as well as the associated legal and regulatory requirements.

## 3. ADAPTIVE MANAGEMENT

Adaptive management is a structured, iterative approach for improving decisions through long-term monitoring, modelling, scientific evaluation and policy dialogue. It ensures that outcomes of decisions are reviewed and plans are adjusted, if necessary, as new knowledge becomes available or conditions change. In a complex, binational basin such as the Souris River basin, adaptive management can help resource management agencies assess the effectiveness of water management efforts in light of changing environmental and socioeconomic conditions, including the uncertainty of water supplies associated with climate variability and change.

The Study concluded that:

- Adaptive management approaches have been established in the 1989 Agreement (for example, adjusting flows and reservoir levels to address climate and hydrological variability);
- There are opportunities to strengthen adaptive management approaches for managing water levels and flows in the Souris River basin within the context of the Agreement; and,
- Adaptive management approaches would seek to continually adapt to new knowledge, new science, and changing basin conditions for improved operations and decision making.

***Based on these findings, the Study Board recommended that:***

The International Joint Commission (and, where necessary, the Parties to the Agreement) consider strengthening adaptive management approaches in managing water levels and flows of the Souris River, with the understanding that any changes to the 1989 Agreement will require government to government consensus. Strengthening adaptive management may include, among other things:

- clarifying roles and responsibilities for conducting adaptive management tasks (e.g., determine if the International Souris River Board, a new adaptive management committee, or a different governance structure is best suited to assume adaptive management roles; support roles of operating and designated agencies participating in adaptive management);
- extending but formalizing the period of review of the Operating Plan from five years to potentially up to 15 years (a better period for adapting to new knowledge); and,
- clarifying the roles and responsibilities of the International Joint Commission and the International Souris River Board in adaptive management studies and periodic reviews.

Adaptive management should consider the ongoing role of performance indicators and how they may be a useful tool in guiding new knowledge, studies and decisions. Adaptive management should consider the role of Indigenous Nations and Indigenous Science, and how this knowledge can be incorporated and strengthened under the

leadership of the ISRB. The Board should be responsible for reviewing and updating the performance indicators developed in the Study and collaborating with Indigenous Nations to develop performance indicators that reflect their interests.

Adaptive management will require dedicated resources from many agencies. The International Joint Commission and governments will need to work with the International Souris River Board to consider options for establishing adaptive management governance processes and activities.

Moving forward, if adaptive management is to be formally enhanced for the Souris River basin – with its commitment to continuous monitoring and periodic review of the performance of the operations -- then it will need to have some foundation in an updated Agreement between the two countries.

## 4. IMPROVING DATA COLLECTION AND MANAGEMENT

Over the course of the analysis, the Study identified important gaps in the current system of water data collection and management in the Souris River basin. These gaps limit the ability of dam operators and other government agencies to predict and manage water levels and flows.

The Study concluded that:

- There are serious gaps in the Souris River basin with respect to:
  - precipitation gauging, affecting the meteorological data and risk impairing data analysis and decision-making for flow management;
  - flow gauging, limiting the ability to analyze river flow data and impairing flow management decisions;
  - hydrological data and data collection in the Souris River basin, including gaps in snow survey data, soil moisture data and low-flow and drought monitoring;
- There is a need for improved hydrological models targeted to the Souris River prairie pothole topography, blowing snow, frozen ground conditions and artificial drainage conditions within the basin;
- There is a need for better dissemination of hydrological data to incorporate real-time meteorological and hydrological data for the Souris River basin; and,
- There is a need for more accurate area-capacity curves for Rafferty and Grant Devine reservoirs to support and improve flood forecasting, water supply and operational flow management.

***Based on these findings, the Study Board recommended that:***

The International Joint Commission engage with the appropriate agencies, through the International Souris River Board, to report regularly on any efforts to:

- reduce identified gaps in precipitation gauging stations within the Souris River watershed;

- reduce identified gaps in streamflow gauging stations within the Souris River watershed; and,
- prioritize and report regularly on any efforts to reduce identified gaps in other hydrological data within the Souris River watershed.

The International Joint Commission, through the International Souris River Board, develop better methods to disseminate all hydrological data (including flood forecasting, water flows, and flow operations) in the Souris River watershed, and that these efforts be reported on regularly.

The International Joint Commission work with the Saskatchewan Water Security Agency (through the International Souris River Board) to fill in and report any updates on data gaps in Rafferty and Grant Devine area-capacity curves for developing improved hydraulic models.

## 5. WATER QUALITY

Water quality was identified as an important issue during public engagement. In response, the Study developed a series of water quality performance indicators to help evaluate potential alternative operating measures. An analysis showed that variability in concentration for chloride, sodium, sulfate, and total dissolved solids are largely explained by the variability in flow and can be used to evaluate minimum flow thresholds for each season. The variability in other constituents such as total iron, total suspended solids, and nutrients was explained largely by factors such as seasonality. As a result, the implications of minimum flow thresholds were difficult to evaluate.

A separate trends analysis project being undertaken by the USGS for the ISRB has consolidated water-quality data from various agencies and will provide insight into how processes in the basin affect exceedances of water quality objectives at the two river border crossings. A database was created and will be maintained to ensure a basin-wide picture of water quality. This project may enhance the water quality performance indicators developed under the Study and help assess the effectiveness of the operational changes with respect to water quality conditions.

The Study concluded that:

- Water-quality monitoring should be continued as a basin-wide, long-term activity, to capture a full range of hydrological conditions, changes on the landscape and reservoir operations. The resulting long-term dataset will be critical for evaluating changes in water quality as well as improving knowledge of interconnections between hydrological conditions, landscape changes and reservoir operations on water quality.

### 6. AQUATIC ECOSYSTEM HEALTH

Aquatic ecosystem health was identified as an important issue in the Reference and during the public engagement process.

Dissolved oxygen (DO) is a critical indicator of aquatic ecosystem health. Low DO conditions result in fish kills and have negative effects on aquatic ecosystem health. Low DO conditions also can cause constituents such as phosphate, iron, and manganese (present in sediments) to become soluble and enter the water column.

Although the Study did not directly investigate aquatic ecosystem health, it did develop several PIs that provide a measure of the influence that a proposed operational change may have. A continuous DO monitoring investigation being conducted by the ISRB will contribute greatly to understanding the processes affecting concentrations such as flow, nutrient dynamics, algal growth in the channel, and sediment oxygen demand for different times of the year.

The Study concluded that :

- The findings of the continuous DO monitoring study will be useful in improving PIs. The improved PIs will help assess the effectiveness of the operational changes with respect to aquatic ecosystem health conditions.
- The potential for coupling or interconnecting water quantity and quality modelling should be explored. The additional data and knowledge gained from the efforts related to water quality trend analysis and continuous water quality monitoring will offer new insights into the possible interactions between hydrology, climate-driven flow conditions, aquatic ecosystem health and landscape changes.

## Challenge 4: Strengthening engagement

Over the course of the Study, the Study Board planned and carried out extensive public and resource agency engagement and outreach initiatives. The Study also sought input from Indigenous Nations with current and ancestral interests in the Souris River basin.

Based on this experience, the Study concluded that:

- There are now increased interests and expectations for future engagement beyond the Study, and for an ongoing dialogue between these groups and the IJC into the future; and,

- The increased awareness from Indigenous Nations has led to an interest in continued engagement beyond the Study, through an Indigenous Advisory Group and Indigenous representation on the International Souris River Board.

***Based on these findings, the Study Board recommended that:***

The International Joint Commission and International Souris River Board consider continued engagement with the Study's Public Advisory Group and Resource and Agency Advisory Group.

The International Joint Commission continue to engage with Indigenous Nations. Indigenous Nations expressed interest in forming an Indigenous Advisory Group and participating as Board Members on the International Souris River Board.

# 5. Looking Ahead

The IJC seeks to engage the wide range of interests in the Souris River basin on their views related to findings and recommendations of the International Souris River Study and future management of the waters of the basin.

Following a period of review and comment, the IJC will deliberate on the information gathered before it delivers its advice to the Governments of Canada and the United States. The IJC's advice to governments will present conclusions on the Study's findings and recommendations and the views of the public and other interests. It also will present the IJC's recommendations for actions for the consideration of the governments.

Any decision to amend or replace the 1989 Agreement will be up to the two federal governments.

For more information on opportunities to provide comments on the Study or participate in the IJC's consultation activities, please contact:

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