2017 ANNUAL REPORT

PRAIRIE PROVINCES
WATER BOARD

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WATER BOARD

FOR THE FISCAL YEAR
April 1, 2017 to March 31, 2018

Table of **Contents**

List of **Appendices**

List of **Figures**

Letter of **Transmittal**

May 24th, 2019

Honourable Ministers:

On behalf of the members of the Prairie Provinces Water Board (PPWB), it is my pleasure to submit herewith the Annual Report of the Prairie Provinces Water Board for the fiscal year covering the period from April 1, 2017 to March 31, 2018.

The annual report summarizes the activities of the PPWB, its secretariat and its four technical committees. It confirms that jurisdictional commitments for water apportionment and water quality were met in 2017-2018.

During the period covered by this report the PPWB discussed and made progress on a number of important fronts. The PPWB:

- Continued its work on the development of a groundwater schedule (Schedule F) to the *Master Agreement on Apportionment (MAA)*;
- Continued to be engaged in a review of apportionment methods to ensure apportionment monitoring and calculations are accurate;
- Approved two technical reports:
  - o "Long-Term Trends in Water Quality Parameters at Twelve Transboundary River Reaches (from the beginning of the data record until the end of 2013)". The report provides long-term water quality data that has been collected from the PPWB transboundary sites since the beginning of the monitoring program;
  - o "Basin Review Calculation of Apportionable Flow for the Saskatchewan River at the Saskatchewan/Manitoba Boundary". The report provides options for improvements to apportionment flow calculation procedures for the Saskatchewan River;
- Held a work planning meeting to validate the strategic direction for updating and reviewing the multi-year work plan, the PPWB Strategic Plan and the Communications Strategy to ensure the PPWB's continued success and relevance.

The PPWB administers the *Master Agreement on Apportionment (MAA)*, which serves as a model for dealing with interjurisdictional issues and has enabled the equitable sharing and protection of interprovincial streams while developing a consensus approach through collaboration and information sharing towards preventing interprovincial surface and groundwater conflicts.

Sincerely,
Nadine Stiller
Chair, Prairie Provinces Water Board

Honourable Catherine McKenna
Minister of the Environment
and Climate Change
Ottawa, Ontario

Honourable Marie-Claude Bibeau
Minister of Agriculture
and Agri-Food
Ottawa, Ontario

Honourable Dustin Duncan
Minister Responsible for
the Saskatchewan Water
Security Agency
Regina, Saskatchewan

Honourable Jason Nixon
Minister of Alberta
Environment and Parks
Edmonton, Alberta

Honourable Rochelle Squires
Minister of Sustainable
Development
Winnipeg, Manitoba

Honourable Ron Schuler
Minister of Manitoba Infrastructure
Winnipeg, Manitoba

Message from the **Chair**

The Prairie Provinces Water Board (PPWB) continues to be a vital institution of governance in the prairies that facilitates the sound and collaborative management of shared water resources.

In 2017-2018, the PPWB continued to be guided by its Strategic Plan, approved in 2006 and revised in 2012 and 2016. This Strategic Plan ensures that PPWB delivers on its mandate to monitor whether the commitments made in the *Master Agreement on Apportionment (MAA)* have been met by the Signatory Parties.

Further to its core mandate, the PPWB continued to track and respond to other important water management issues. A number of initiatives took place in 2017 to enhance the ability of the PPWB to deliver on its mandate:

- Reviewing Interprovincial Water Quality Objectives: preparation for the next review by addressing objectives that are still under review and any update to water use objectives.
- Apportionment Monitoring Criteria: establishing formal criteria by which the Board determines which interprovincial basins are subject to apportionment monitoring, as well as the frequency of monitoring.
- The continued discussion on the development of an Agreement on Transboundary Aquifers to be proposed for addition to the *MAA*.

Finally, the PPWB continued to provide a cooperative forum for discussion on transboundary water issues including droughts, floods and the growing risk of invasive species in prairie watersheds.

I wish to thank Steve Topping for his participation on the Board. Steve Topping retired in October 2017. He provided long term contribution and leadership as Manitoba's Board Member on the PPWB over the period of July 1996 to October 31, 2017. In November 2017, Paula Siwik was appointed as the Alternate Board Member for Environment and Climate Change Canada.

The success of the PPWB is dependent on the work of the Secretariat and the four standing committees, including the Committee on Hydrology (COH), the Committee on Water Quality (COWQ), the Committee on Groundwater (COG) and the Committee on Flow Forecasting (COFF). Dedication and engagement by Board Members, jurisdictional representatives on committees, and the Secretariat are essential, and much appreciated.

Nadine Stiller
Chair

PPWB continues to be a vital institution of governance in the prairies.

Message from the **Executive Director**

During 2017-2018, the work of the PPWB Secretariat and four standing committees focused on achieving the goals outlined in the PPWB Strategic Plan and activities listed in the 2015-16 to 2020-21 Work Plan.

During 2017, agreed transboundary apportionment of flows on all eastward flowing streams was achieved for all river reaches.

Adherence to the *MAA*'s water quality objectives was good.

The Committee on Hydrology (COH) continued work on the review of apportionment methods and associated documentation to ensure apportionment monitoring and calculations are accurate. In 2017, the review of the Saskatchewan River basin was completed and the Board approved the report entitled "*Basin Review Calculation of Apportionable Flow for the Saskatchewan River at the Saskatchewan/Manitoba Boundary*" as a PPWB technical report. The Qu'Appelle River basin review has not been completed. This basin review is more complex and requires more time in its review. It is expected to be completed in 2018.

The Committee on Groundwater (COG) prepared a draft Agreement on Transboundary Aquifers to be added as Schedule F to the *MAA*. A comprehensive legal review of the proposed agreement by all jurisdictions is ongoing.

The Committee on Water Quality (COWQ) completed a trend report to identify long-term trends in water quality at the boundaries. The report titled "*Long-Term Trends in Water Quality Parameters at Twelve Transboundary River Reaches (from the beginning of the data record until the end of 2013)*" was approved in March 2018 as a PPWB technical report.

The Committee on Flow Forecasting (COFF) continues to work on harmonizing of spring runoff potentials. This work is ongoing.

The Board continued its role in helping to ensure coordination of water management and planning that may have transboundary implications. The Board continued to provide a forum for sharing information, including progress on actions to address Saskatchewan-Manitoba drainage issues, the impact of sediment transport from the Carrot River on the Saskatchewan River, drought and flood management and invasive species management in the Prairie Provinces.

Mike Renouf
Executive Director

Summary of **Performance Results**

During 2017-2018, apportionment responsibilities of the Board were met through:

- Reviewing and approving the apportionment monitoring network comprised of hydrometric and meteorological stations;
- Confirming apportionment obligations were met on Cold Lake, North Saskatchewan River, South Saskatchewan River below the Red Deer River, Battle Creek, Lodge Creek, Middle Creek, Churchill River, Saskatchewan River, Red Deer River (Saskatchewan), Qu'Appelle River, Assiniboine River, and Pipestone Creek.

The Committee on Hydrology (COH) activities included:

- Continuing work on the process of reviewing apportionment methods in all basins. The Saskatchewan River basin review was completed in 2017. Because of its complexity, the Qu'Appelle River Basin review will continue into 2018;
- Drafting criteria to document the rationale by which the PPWB determines which basins are subject to apportionment monitoring and the frequency of this monitoring; and,
- Continuing with the initiatives to further study evaporation estimation methods. In 2017, the field component of the study was completed. A report documenting the project is expected to be available in 2018.

In 2017, the overall adherence rate to the interprovincial water quality objectives was 96.1%. This adherence rate is based on the comparison of 5,583 water quality results to water quality objectives.

The Committee on Water Quality (COWQ) activities included:

- Contracting a fish biologist to complete a fish tissue report from data that the PPWB had collected from 1992 to 2004. The objective of the report is to better understand the utility of using biological indicators of riverine health;
- Preparing for the next water quality objectives review. The focus of the next review will be on outstanding issues from the last comprehensive review and is expected to be completed by 2020;
- Completing a trend report to identify long-term trends in water quality at the boundaries from the beginning of the data record until the end of 2013; and,
- Reviewing sediment invertebrate monitoring activities to answer questions on what methods are available, and where benthic monitoring is currently being done.

The Committee on Groundwater (COG) developed a draft Agreement on Transboundary Aquifers to be added as Schedule F to the *MAA*.

- A legal review of the proposed draft Agreement began in 2014 and progresses. The proposed agreement will provide a cooperative framework for managing transboundary aquifers using a Risk Informed approach;
- Mock scenarios were developed to illustrate the response to various groundwater situations under the proposed Schedule F; and,
- An inventory of aquifers along the Alberta-Saskatchewan boundary and the Saskatchewan-Manitoba boundary was completed. These aquifers will be targeted for the first review cycle when the proposed Schedule F is ratified.

One of the key activities for the PPWB's Committee on Flow Forecasting (COFF) has been investigation of spring runoff potential forecasting procedures across the three Prairie Provinces.

During the year, the Board discussed the following transboundary issues:

- Water quality in Lake Winnipeg;
- Downstream impacts of drainage in Saskatchewan upon Manitoba; and,
- Management of invasive species across the Prairie Provinces.

1. Introduction

This report summarizes the activities of the Prairie Provinces Water Board (PPWB), its Secretariat, and four standing committees that supported PPWB activities for the period April 1, 2017 to March 31, 2018.

The PPWB administers the *Master Agreement on Apportionment (MAA)*, signed on October 30, 1969 by Canada and the Provinces of Alberta, Saskatchewan, and Manitoba.

The *MAA* provides for an equitable sharing of available waters for all eastward flowing streams that cross interprovincial boundaries, including transboundary lakes. It also serves to protect transboundary aquifers and surface water quality. Schedules to the *MAA* describe the role of the Board, stipulate how the water shall be apportioned, and set water quality objectives for the water passing from Alberta to Saskatchewan and from Saskatchewan to Manitoba.

The Board consists of three provincial members, representing the Provinces of Alberta, Saskatchewan, and Manitoba and two federal members, representing Environment and Climate Change Canada and Agriculture and Agri-Food Canada.

PPWB activities are jointly funded by the provinces and the federal government, with the provinces each contributing one-sixth and the federal government contributing one-half to the annual budget. The *MAA* assigns the responsibility to monitor water quantity and quality in support of the Agreement to the federal government. Environment and Climate Change Canada conducts this monitoring on behalf of the Government of Canada. The Board approves the annual budget and costed work plan.

Section 2 of this Annual Report presents the performance results for each of the Goals in the Strategic Plan and 2017-2018 activities in the Work Plan. Included in this section is Goal 8, which provides a summary of the administration activities and financial expenditures for the year 2017-2018.

Appendices provide detailed information on the PPWB. Appendix I illustrates where monitoring is conducted to assess whether jurisdictions have met their requirements in the *MAA*. Appendix II presents 2017 apportionable flow data. Appendices III and IV present the water quality parameters that were monitored by Environment and Climate Change Canada and the 2017 Report on Excursions to Interprovincial Water Quality Objectives. Appendix V provides the organization chart and Appendix VI lists agency representatives on the Board and committees. Appendix VII provides the Financial Expenditure Statement. Finally, Appendix VIII describes the history of the PPWB.

2. Performance Results

Update

All activities in the 2016/17-2020/21 PPWB work plans target achieving the eight goals in the PPWB's Strategic Plan. Progress made in 2017-2018 is discussed below for each of these goals.

GOAL 1: Agreed Transboundary Apportionment of Water is Achieved

The PPWB's Strategic Goal 1 is to achieve transboundary apportionment of water as agreed to in the 1969 *MAA's* Schedule A and Schedule B.

Apportionment Monitoring of Rivers

The *MAA* states that all eastward flowing streams are subject to apportionment. Currently, the Board conducts apportionment monitoring of Cold Lake, North Saskatchewan River, South Saskatchewan River below the Red Deer River confluence, Battle Creek, Lodge Creek, and Middle Creek on the Alberta-Saskatchewan boundary; and Churchill River, Saskatchewan River, Red Deer River, Qu'Appelle River, Assiniboine River, and Pipestone Creek on the Saskatchewan-Manitoba boundary.

Water Quantity Monitoring

The PPWB is required to assess and report on whether surface water quantity apportionment requirements have been met. Environment and Climate Change Canada conducts the water quantity monitoring in accordance with the terms of the *MAA*. In 2017, the PPWB Secretariat calculated apportionable flows using monitoring data from 90 hydrometric stations, 25 meteorological stations as well as various third party water use measurements. The PPWB utilizes data from four additional hydrometric stations for water management purposes (Appendix 1).

Figures 1 and 2 illustrate the apportionment balance through the history of PPWB apportionment monitoring for each basin. The black bars illustrate the amount of apportionable flows that were required to be delivered by Alberta to Saskatchewan (Figure 1) and by Saskatchewan to Manitoba (Figure 2). The blue and red bars indicate the flow surpluses and deficits.

For rivers with surplus flows, the combined black (provincial share) and blue (surplus) stacked bars show the total recorded flows. The red bars indicate deficits. For rivers showing a deficit, the required provincial share is the combined height of the black and red bars. The analysis shows that large surpluses are fairly common for many of the rivers, and annual flow volumes vary considerably over the years. Because flows vary so much, scientific notation is used on the y-axis to show the magnitude of differences of flows across rivers.

Only Middle and Lodge Creeks have experienced deficits in delivery through the apportionment record. For Middle Creek, minor deficits occurred in 1988, 1989, 1998, 2000 and 2008. Deficits were, however, so small in 1988 and 2000 that they are not obvious in Figure 1. For Lodge Creek, minor deficits occurred in 1988, 1989, 1992, 1998 and 2000. Again, deficits for this creek in 1992 and 2000 were small enough that they are not obvious in Figure 1. Under the terms of the *MAA*, Alberta is required to pass 75% of the apportionable flow of Lodge and Middle Creeks to Saskatchewan. Under the terms of the international water sharing agreement between Canada and the United States, Saskatchewan must in turn pass 50% of the natural flow of Lodge Creek at the international boundary to Montana. Any early season use within Alberta puts Alberta at a risk of deficit if the remainder of the year is dry. Apportionment delivery deficits between Alberta and Saskatchewan can impact the ability of Saskatchewan to meet its international apportionment requirements. Alberta and Saskatchewan continue to work cooperatively and investigate solutions, including improvements to the accuracy of interim water use reporting, to ensure future deficits on Lodge and Middle Creeks do not occur.

In October 2017, the Board reviewed and endorsed the monitoring stations lists for 2018-2019. There were only minor changes to the PPWB Hydrometric Monitoring Stations list from the previous year. These changes reflect procedure changes resulting from the Saskatchewan River Basin review. There were also minor changes to the Meteorological Monitoring Stations list because of changes to data availability.

Figure 1. Historic River Flows on the Alberta-Saskatchewan Boundary

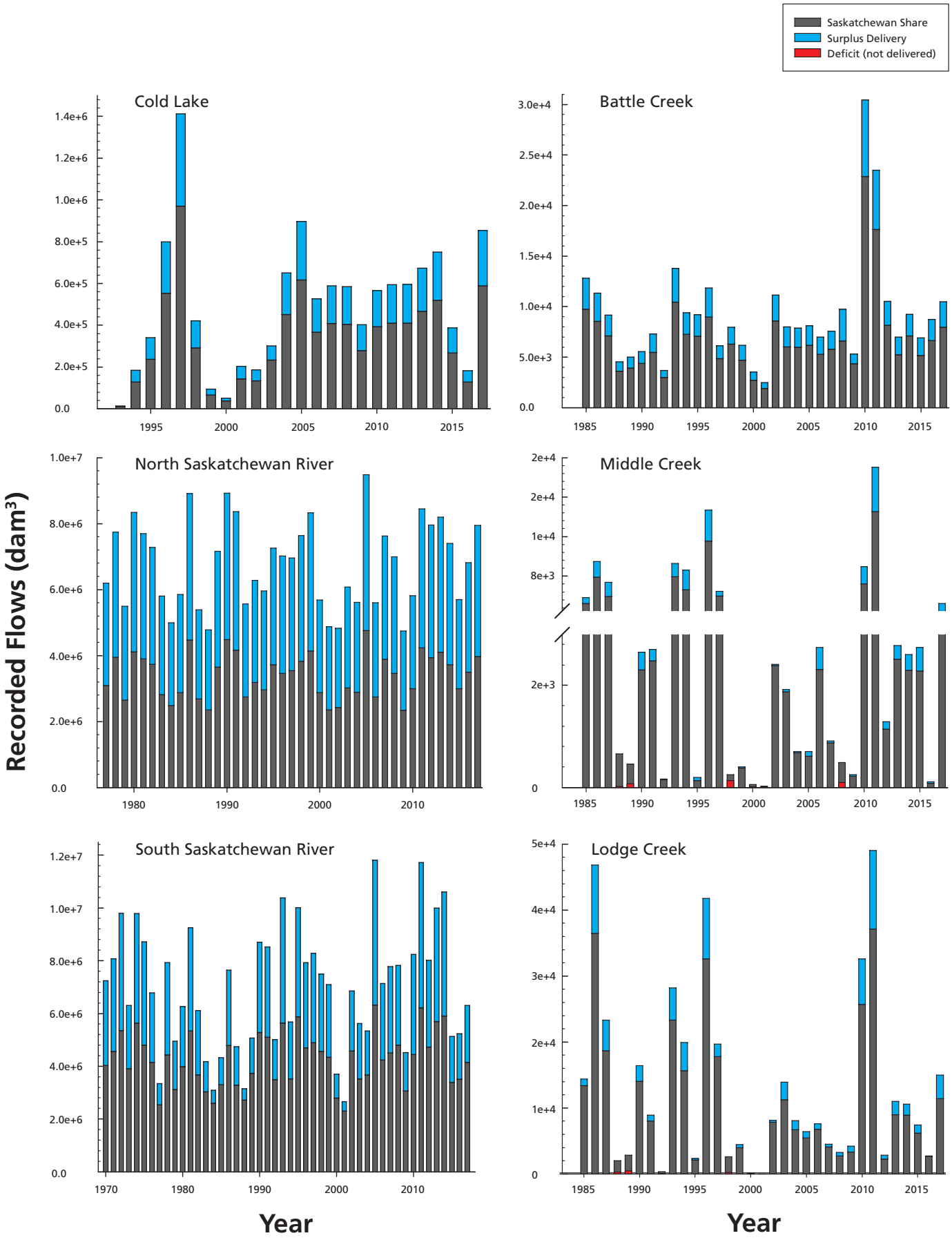
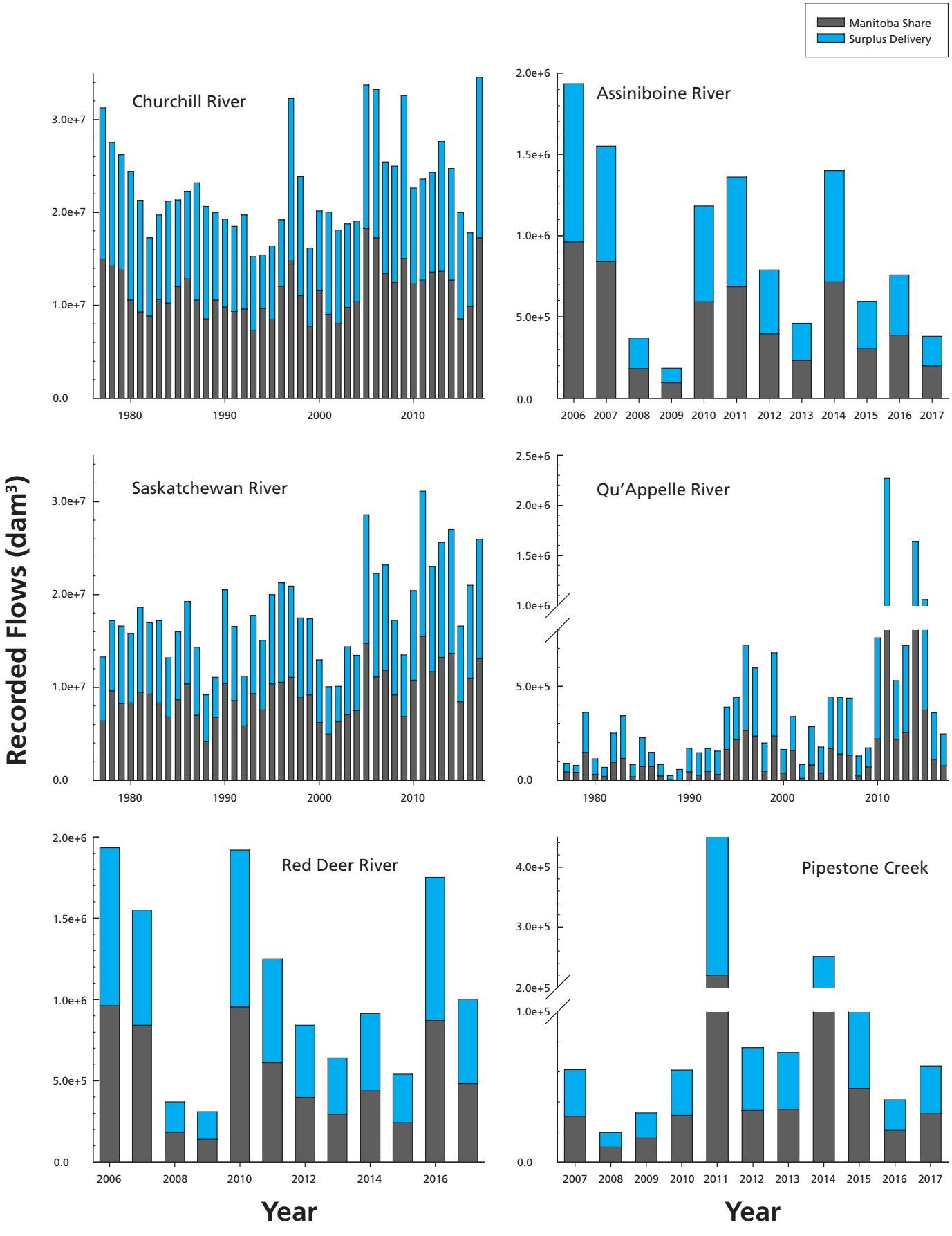


Figure 2. Historic River Flows on the Saskatchewan-Manitoba Boundary



Performance Results *continued*

Flows Reported in 2017

Interim internal apportionable flow reporting was completed for four basins in 2017. Quarterly reports to the Board presented interim recorded and apportionable flows for the South Saskatchewan River, Middle Creek and Lodge Creek, as well as one mid-year report for Cold Lake.

Appendix II presents the final monthly and total apportionment results. For all apportioned rivers and creeks the recorded flow at the interprovincial boundary was higher than the amount that the upstream province was required to deliver. In summary, all apportionment requirements were met in the 2017 calendar year.

The combined daily recorded flows for the South Saskatchewan and Red Deer Rivers at the Alberta-Saskatchewan boundary for January 1 to December 31, 2017 met the condition of Clause 4 of Schedule A to the *MAA* which states that Alberta may not consume or divert greater than 50% of the natural flow, such that it reduces the recorded flow to less than 42.5 m^3/s (1,500 cfs). The Committee on Hydrology (COH) is reviewing the need for protocols should such low flow incidents occur in the future. These protocols could include notification requirements, as well as steps that must be taken during low flow situations to confirm that Clause 4 of Schedule A to the *MAA* is being adhered to.

Improving Apportionment Methods

Apportionment Procedure Review

The COH continued to be engaged in the ongoing review of apportionment methods to ensure apportionment monitoring and calculations have a level of accuracy acceptable to the Committee for the purposes of monitoring compliance with the *MAA*.

In November 2017, the Board approved the report entitled *"Basin Review Calculation of Apportionable Flow for the Saskatchewan River at the Saskatchewan/Manitoba Boundary"* as PPWB technical report #178. Through 2017 the COH continued work on the review of the apportionable flow calculation procedures for the Qu'Appelle River Basin at the Saskatchewan-Manitoba boundary. The Qu'Appelle River calculation is slightly more complex than some of the other apportioned basins due to the complexity of the connection between the river and Last Mountain Lake. The Qu'Appelle River Basin review is expected to be completed by the end of 2018.

The COH is planning to review the South Saskatchewan River apportionable flow calculation procedure in several phases. An apportionment monitoring needs assessment report has been drafted to confirm the goal and purpose of apportionment monitoring by the PPWB for the South Saskatchewan River. The findings of the needs assessment report will determine what model time step is required to monitor adherence with the requirements of the *MAA* to the satisfaction of the Board. The decisions made through the needs assessment phase will set the foundation for the subsequent phases of the South Saskatchewan River basin review.

Apportionment Monitoring Criteria

A sub-committee of the COH was formed to establish formal criteria by which the PPWB determines which interprovincial basins are subject to apportionment monitoring, as well as the frequency of monitoring for those basins. In 2017, the sub-committee drafted an Apportionment Monitoring Assessment Procedure which proposes

Performance Results *continued*

that basins be evaluated using a classification system as part of the apportionment procedure review process. The purpose of the document is to formalize a ranking and classification system that will be applied by the PPWB to evaluate current apportionment monitoring and reporting and support decisions regarding changes in the future. The COH is currently testing the application of the assessment procedure on low, medium and high priority rivers and creeks.

Modernizing Apportionment Software

Historically the PPWB relied solely on a suite of FORTRAN programs for the calculation of apportionable flow. This posed problems in terms of both a risk to business continuity as well as flexibility, as the ability to easily adjust and run these programs on modern computers was rapidly diminishing. As a result, the COH has been undertaking a long-term effort to move to completing these calculations using either spreadsheets or a customized apportionable flow calculation platform developed for the PPWB called the River Basin Assessment Tool (RBAT). The overall modernization process is nearing completion with working calculations for almost all of the routinely apportioned basins having been transferred to either one or both formats. A rigorous review of the functionality and utility of RBAT for continued use remains an ongoing focus of the COH.

Evaporation Investigations

Evaporation is an important component of apportionment calculations used to ensure equitable distribution of water between Alberta, Saskatchewan and Manitoba. As such, the COH has an interest in continually improving lake/reservoir evaporation estimation methods.

The PPWB contracted researchers at the University of Saskatchewan to conduct a two-year evaporation field study at Newton Lake (Saskatchewan) and Shellmouth Reservoir (Manitoba) using eddy covariance techniques. The study will provide direct measurement of lake evaporation and associated hydrometeorological variables that can be used to assess evaporation estimates from various models and potentially used to calibrate model parameters for optimized results. Results from this study will improve understanding of lake evaporation in the Canadian prairie environment and improve PPWB apportionment calculations.

In 2017, the field work component of the study was completed. A report documenting the project is expected to be completed by December 31, 2018. The final deliverable from the study will be measurements of evaporation and associated hydrometeorological variables from both locations at various time increments (hourly, daily, etc.). The next step will be to compare the field measured evaporation with estimated evaporation and make recommendations on which methods provide the best approximation, as well as possible refinements to those methods.

Performance Results *continued*

GOAL 2: Transboundary Groundwater Aquifers Are Protected and Used in a Sustainable Manner

The PPWB's Strategic Goal 2 is to protect groundwater quantity and quality and promote sustainable use of transboundary aquifers.

The *MAA* currently has a general statement to refer any transboundary groundwater issues to the Board for their review and recommendation. No issues or concerns were identified in 2017.

Groundwater Schedule F

Development and Consultation

In October 2007, the Board directed the Committee on Groundwater (COG) to proceed towards the creation of a specific groundwater agreement to be added as Schedule F to the *MAA*. The objectives of the proposed Schedule are to promote:

- Effective and efficient management of transboundary aquifers;
- Sustainable use and equitable sharing of transboundary aquifers; and,
- Protection and preservation of transboundary aquifers and associated aquatic environments.

Work on the proposed Schedule is ongoing. An internal review of the proposed Schedule F by each of the signatories to the *MAA* began in 2014 and is progressing. The Government of Canada is also consulting with other federal departments that have an interest in groundwater.

Roles and Responsibilities

As part of the internal review and consultation process, a document containing several mock scenarios was developed to illustrate the response to various groundwater situations under the proposed Schedule F. The Board determined that the next step would be to develop a roles and responsibilities document as part of the implementation plan for the proposed Schedule F. Under the direction of the Board, the COG developed a "Schedule F Anticipated Roles and Responsibilities" document that outlines some of the expected duties of the jurisdictions, the Board, the COG and the PPWB Secretariat once the proposed groundwater schedule is in force. The document is currently under review.

Aquifer Inventory

The COG completed an inventory of aquifers along the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries that will be targeted for the first review cycle when the proposed Schedule F is ratified. The list includes all the major fresh water aquifers, but is not exhaustive of all transboundary aquifers that are captured under the proposed schedule.

Notification System

COG members are responsible to notify their neighbouring jurisdiction of groundwater development proposals that may have transboundary impacts. In 2017 there was one such notification between Saskatchewan and Alberta.

Transboundary Groundwater Workshop

In 2017 the COG began planning of a one day technical workshop to be held in 2018 on the theme of transboundary groundwater. Attendees at the workshop will be hydrogeologists and other staff from the PPWB member agencies, as well as invited guests from other agencies and academia from both Canada and the United States. The workshop will provide a learning opportunity, and a forum to exchange information, share knowledge and promote dialogue on this important topic.

Performance Results *continued*

GOAL 3: Agreed Transboundary *MAA* Water Quality Objectives Are Achieved

The PPWB's Strategic Goal 3 is to achieve agreed transboundary water quality objectives. Schedule E of the *MAA* includes a list of water quality objectives that were established for a number of key water courses at the Alberta-Saskatchewan and Saskatchewan-Manitoba boundary locations.

Each fall a water quality monitoring program is approved by the PPWB. Monitoring results are compared annually to the objectives to determine if any excursions to the objectives occurred. If there are excursions, the Committee on Water Quality (COWQ) reviews the excursions, and when necessary prepares a work plan to assess the cause and the potential to mitigate. The work plan is then carried out by the member agencies.

Water Quality Monitoring

The *MAA*'s water quality monitoring locations are shown in Appendix I. The *MAA*'s water quality monitoring parameters are shown in Appendix III.

In 2017, in accordance with the terms of the *MAA*, Environment and Climate Change Canada conducted water quality monitoring at 12 sites as requested by the PPWB. The water quality monitoring program for 2017 included:

- On-going monthly sampling of nutrient, physical, major ion, metal and biota (bacteria) parameters for all of the PPWB Rivers, with the exception of the Churchill River which has a sampling frequency of four times a year (February, March, July and October);
- Pesticide parameters such as acid herbicides, neutral herbicides, organo-chlorines and glyphosate sampled:
  - Monthly on the Carrot and Assiniboine Rivers;
  - Eight times (in February, April, May, June, July, August, October and December) on the Red Deer River (Saskatchewan-Manitoba boundary) and the Beaver River as part of the annual rotation for pesticide sampling;
  - Four times (February, May, July and October) on the Churchill River;
  - Sampling for acid herbicides on the North Saskatchewan River, Battle River, Red Deer River (Alberta-Saskatchewan boundary), South Saskatchewan River, Saskatchewan River and the Qu'Appelle River eight times as part of the normal pesticide monitoring in 2017.

The 2017 monitoring program was completed as approved by the Board at their November 9th, 2016 Meeting No. 117, with the following exceptions: one neutral herbicide sample was not collected on the Beaver River due to a sample bottle breakage during transit, extra pesticide samples were collected and analyzed for the Saskatchewan River in February, and major ion analyses were not completed for the Cold River in June. Additionally, chlorophyll *a* samples were collected on six Alberta-Saskatchewan transboundary rivers from July to December 2017.

Environment and Climate Change Canada undertook a total of 136 water sampling events at the 12 PPWB river sites in 2017. The 2017 PPWB Report on Excursions of Interprovincial Water Quality Objectives, January-December 2017, can be found in Appendix IV.

Performance Results *continued*

Adherence or Excursions to Transboundary Water Quality Objectives

In 2015 the PPWB established water quality objectives for individual parameters based on values that protect aquatic life, drinking water treatment use, recreation, agriculture uses and fish consumption.

A total of 5,583 water quality results were compared to transboundary water quality objectives to determine whether any excursions to the objectives occurred in 2017.

Overall, there were no acute water quality concerns apparent from review of the data in 2017. In summary, the transboundary water quality objectives were adhered to, on average, 96.1% for all parameters. Adherence rates from 2017 are similar to those of previous years. Most rivers show an approximately 5% variation in adherence rates amongst the years. In 2017, all rivers on the Alberta-Saskatchewan boundary showed a decrease in overall adherence rates from 2016. On the Saskatchewan-Manitoba boundary, five out of six rivers showed a slight increase in overall adherence rate. The Carrot River was the only river on this boundary to show a reduction in adherence rate from 2016 to 2017. The Battle and the Red Deer rivers on the Alberta-Saskatchewan boundary continue to show the greatest variation in compliance to the water quality objectives.

Excursions for nutrients, biota (bacteria), total suspended solids (TSS) and major ions were the most common among sites. Excursions for metals were more prevalent on the Alberta-Saskatchewan boundary sites, while excursions for major ions were more prevalent at the Saskatchewan-Manitoba sites in 2017.

The PPWB Report on Excursions of Interprovincial Water Quality Objectives, January-December 2017 indicate that there are a number of areas that require further investigation. Nutrients, in particular total nitrogen, have been assessed as a priority. The COWQ is currently completing a pilot study to investigate nutrient levels in two transboundary watersheds: the Red Deer River (Alberta-Saskatchewan boundary) and the Carrot River. Another priority area includes pesticides, in particular acid herbicides and glyphosate, which are the most frequently detected pesticides in the Alberta-Saskatchewan and Saskatchewan-Manitoba boundary rivers. Environment and Climate Change Canada has implemented annual monitoring for acid herbicides to further assess the conditions and review available data on the transboundary rivers.

Fish Tissue Report and Fish Monitoring Program

To better understand the utility of using biological indicators of riverine health, the COWQ compiled and reviewed fish tissue data collected by PPWB from 1992 to 2004. A fish biologist has been contracted to draft a report. Completion of this report will provide data to the jurisdictions, the public and other interest groups and provide information on the utility of this type of biological monitoring program for meeting objectives of the PPWB. The contract is expected to be completed in November 2018.

Water Quality Objectives Review

The PPWB has committed to reviewing the water quality objectives every five years. The revised objectives from the last review were adopted in 2015. The focus of the next water quality review will be on outstanding issues from the last comprehensive review and will include:

- Reviewing current PPWB objectives that are derived from use-specific criteria by comparing them with objectives from other agencies or jurisdictions that may have recently updated their objectives;
- Establishing site specific objectives and/or justification for not having objectives for certain parameters;

Performance Results *continued*

- Assessing options for different approaches to developing site-specific objectives.

The review is expected to be completed by 2020.

Dissolved Oxygen Monitoring

Presently, there are no ice-covered (winter) objectives for dissolved oxygen (DO) in the Battle, Beaver, and Carrot rivers. These three rivers typically have low winter flows and low water volumes between the bottom sediment and ice and consequently DO reaches low levels, typically less than 1 mg/L. A pilot study was initiated to understand how different conditions affect winter oxygen depletion rates. Over the last two winters Environment and Climate Change Canada installed DO loggers in the three rivers. Data were reviewed and showed that the rivers become anoxic very quickly. The COWQ has determined that they will recommend not establishing winter DO objectives for the Beaver, Battle and Carrot rivers for the next water quality objectives review. This is due to the rapid decline of DO on these rivers throughout the winter months and the low flow condition on these rivers.

Long-Term Trends at Transboundary River Reaches

Long-term water quality monitoring has been undertaken on transboundary Prairie Rivers by Environment and Climate Change Canada since the late 1960s. Trend assessments are considered to be an important part of the PPWB water quality program as the identification of change in water quality can be difficult due to the natural variations in water quality and anthropogenic influences.

The COWQ has completed a trend report to identify long-term trends in water quality at the boundaries. At their March 2018 meeting, the Board approved the report titled "Long-Term Trends in Water Quality Parameters at Twelve Transboundary River Reaches (from the beginning of the data record until the end of 2013)" as a PPWB technical report. The purpose of this report is to summarize analyses of the long-term trend assessments conducted for a range of water quality parameters at the 12 transboundary rivers from the inception of the monitoring program until the end of 2013.

The Committee is currently reviewing the trend results and prioritizing future actions based on the magnitude of the trends.

Sediment Invertebrate Monitoring

Sediment invertebrate monitoring activities are being reviewed by the COWQ to answer questions on what methods are available, and where benthic monitoring is currently being done.

The intent is to assess ecosystem health and incorporate a biological program to complement the chemistry program that already exists. The COWQ will be contacting provincial macro-invertebrate specialists to discuss their invertebrate programs and to further discuss how a benthic program would meet the objectives of the PPWB jurisdictions.

The *MAA* provides for an equitable sharing of available waters for all eastward flowing streams that cross interprovincial boundaries, including lakes and serves to protect transboundary aquifers and surface water quality.

Performance Results *continued*

GOAL 4: Governments Are Informed About Emergency and Unusual Water Conditions

The PPWB's Strategic Goal 4 is to inform jurisdictions of emergency and unusual water conditions, facilitating effective and cooperative transboundary water management.

PPWB Contingency Plan

The PPWB Interprovincial Event Contingency Plan is an effective method of informing government agencies of spills or unusual water quality conditions as well as emergency or unusual surface water quantity or groundwater quantity and quality events in transboundary basins.

The PPWB Event Contingency Plan is not meant to replace any jurisdictional emergency spill response mechanism. The Contingency Plan includes information on: area coverage, responsibilities, pattern of response and organizational structure. The Contingency Plan also ensures that proper communication approaches within each jurisdiction are addressed and that the Board will discuss the effectiveness of this communication on a regular basis.

One unusual water quantity event was reported in 2017-2018:

Alberta Environment and Parks (AEP) distributed a notice indicating that flows dipped below the 42.5 m^3/s low flow threshold on the South Saskatchewan River at the Alberta-Saskatchewan boundary for a ten-day period in December 2017 because of a winter freeze up event. The event was considered short term, and final hydrometric data from Environment and Climate Change Canada have confirmed there were no days in 2017 when flows were below 42.5 m^3/s.

Flood Conditions in the Prairies

Most of the southern prairies experienced dry conditions in 2017. However in the northern areas of Saskatchewan and Manitoba, precipitation in summer and fall was above average (over 300 mm of rain). Communities around the Churchill River basin saw a 1 in 100 year rainfall event in July 2017. As a result, the Churchill River saw a significant flow increase, even though the river was holding at peak levels in many places.

Drought Conditions in the Prairies

In Canada, drought most frequently occurs in the prairies. This was evident in 2017 in which Saskatchewan experienced one of the driest July's in over one hundred years.

In 2017, drought also affected areas in southern Manitoba and Alberta. In Manitoba, the Assiniboine River basin received below normal to well below normal precipitation from spring to fall.

Performance Results *continued*

GOAL 5: Transboundary Water Issues Are Addressed Cooperatively to Avoid Disputes

The PPWB's Strategic Goal 5 is to avoid conflicts and disagreement over transboundary water issues. During the year, the PPWB discussed issues related to several existing projects of interest to different jurisdictions.

Committee on Flow Forecasting

The Committee on Flow Forecasting (COFF) was formed in 2015 to improve collaboration, coordination and communication between jurisdictions as well as federal agencies concerning flow forecasting.

During 2017-2018, the COFF began investigating and comparing the current spring runoff forecasting procedures used by each of the Prairie Provinces, including such things as the forecast input data, forecast schedule, categories used, and the presentation graphics. A report summarizing this project is expected to be finalized in 2018.

In 2017-2018 the COFF met twice, once in person and once by videoconference. During these meetings the committee members shared information about the current work objectives and priorities of their respective agencies. Most notably the COFF members from each of the provincial jurisdictions used the committee as a venue for exchange of information on their investigations into various flow forecasting models and modelling platforms, a topic of significant ongoing interest to all. The COFF members also used the committee as a forum to discuss the availability and suitability of various sources of flow forecasting input data, as well as other topics of mutual interest with respect to flow prediction. The COFF table also provided an avenue for discussions between the jurisdictions and federal departments (ECCC, AAFC) regarding federally produced data products germane to flow forecasting (e.g. hydrometric, weather and climate data).

Lake Winnipeg Nutrient Issues

Lake Winnipeg is Canada's sixth-largest freshwater lake, and is fed by a vast international basin covering 960,000 square km, extending over four provinces and four states. Nutrient loading to Lake Winnipeg from agriculture, municipal wastewater, and urban surface runoff from multiple transboundary sources continues to exceed the lake's natural capacity to process them, causing increased magnitude, duration and frequency of algal blooms. The Province of Manitoba, Environment and Climate Change Canada and many other partners are engaged in numerous initiatives to address water quality issues.

The PPWB provides a forum to exchange information on Lake Winnipeg initiatives with the Provinces of Manitoba, Saskatchewan and Alberta. In addition,

Performance Results *continued*

Canada and Manitoba signed a Memorandum of Understanding (MOU) in September 2010 to continue their collaborative partnership in support of Lake Winnipeg into the long-term. In 2015, the MOU was extended to 2020.

The goal of the MOU is to establish a long-term collaborative and coordinated approach between the federal and provincial governments to support the sustainability of Lake Winnipeg and its contribution to economic activities, recreation and watershed functions. Specific goals are to coordinate science, information sharing and any activities that support the MOU. The MOU Steering Committee met in December 2017.

The Board was informed about the renewal of Environment and Climate Change Canada's efforts to reduce excessive nutrient loading to Lake Winnipeg. On July 24, 2017 the Minister of Environment and Climate Change, Catherine McKenna, announced the Government of Canada's investment of $25.7 million (2017-2022) in the Lake Winnipeg Basin Program. New programming will focus on three priorities:

- reducing nutrient loading to Lake Winnipeg;
- enhancing collaborative governance opportunities to protect freshwater quality throughout the Lake Winnipeg Basin; and
- supporting enhanced engagement of Indigenous peoples on freshwater issues.

The Board was also kept informed of Manitoba and Environment and Climate Change Canada's efforts with the relevant boards of the International Joint Commission (IJC) to reduce nutrient loading in the Lake Winnipeg basin. Members of the IJC's International Red River Board are working with their respective jurisdictions to implement a basin-wide nutrient management strategy which includes the development of nutrient objectives for the Red River at the international border at Emerson, MB. The development of the Red River nutrient objectives will be coordinated with developing nutrient objectives for Lake Winnipeg.

Saskatchewan-Manitoba MOU Respecting Water Management

Saskatchewan and Manitoba signed an MOU in October 2015 to facilitate a cooperative and coordinated approach to mitigate flooding and drought and to protect and improve water quality and aquatic ecosystem health. The intent of the MOU is not to duplicate efforts, but to make use of existing mechanisms for coordination and cooperation when dealing with water management.

The MOU acknowledges the important work of the PPWB and agrees to work through the PPWB where it is the appropriate existing mechanism.

Performance Results *continued*

GOAL 6: Ministers, Senior Managers and Appropriate Staff of Governments Are Informed About PPWB Activities

The PPWB's Strategic Goal 6 is to keep jurisdictions informed about PPWB activities. This transparency ensures that cost-shared activities are delivered efficiently and effectively and are consistent with the mandate of the PPWB.

The PPWB member governments were informed about PPWB activities through various means, including the ongoing distribution of Board and Committee Minutes and Quarterly and Annual Reports, as well as through brochures and fact sheets, technical reports, and the PPWB website. The PPWB website (www.ppwb.ca) exists to inform the public and interested parties of PPWB activities, and to provide a means for member governments to exchange information and facilitate the business of the PPWB. The PPWB website provides access to a complete suite of PPWB publications and fact sheets. A member portal also facilitates the exchange of information.

To maintain good communications between the Board and the committees, the Board regularly invites Committee members to participate in Board meetings when the meetings are held in the Committee members' jurisdiction.

Performance Results *continued*

GOAL 7: Information, Knowledge and Research Are Shared Among Governments

The PPWB provides a forum to foster effective and cooperative water management on the Prairies. Goal 7 facilitates cooperation by exchanging information and knowledge amongst jurisdictions and participating in research projects of mutual interest and relevance to the PPWB mandate.

Outreach

The PPWB has been involved in a number of outreach activities to share information, become engaged and increase public awareness of work conducted by the Board. Opportunities in 2017-2018 included collaboration with the Partners For the Saskatchewan River Basin (PFSRB), the Assiniboine River Basin Initiative (ARBI) and providing support to the Global Water Futures.

The PFSRB promotes stewardship and sustainability of the Saskatchewan River Basin across three Prairie Provinces and a portion of Montana. The PFSRB was formed in 1993 to promote watershed sustainability through awareness, linkages, and stewardship. In October 2017, the PFSRB hosted a conference in Leduc, Alberta. The theme of the conference was "Flowing Waters: Water Quality and Transboundary Issues in the Saskatchewan River Basin". Mike Renouf, Executive Director of the PPWB, provided a presentation on the work of the Board. In addition, Dr. Joanne Sketchell, Secretary to the Board's Committee on Water Quality, shared information on the development of water quality objectives and their use together with long-term trend analysis in the assessment of transboundary river water quality. Sharon Reedyk, a member of the Committee on Water Quality, shared information on the water quality excursion process.

The ARBI is an organization of stakeholders comprised of citizens, local governments, provincial and state governments, business and non-governmental groups who live and/or operate in the Assiniboine River Basin. Its vision is to create a resilient Assiniboine River Basin from an environmental, economic and social perspective. In February 2018, the ARBI hosted its fourth annual conference which was held in Regina, Saskatchewan. The theme of the conference was "The Ripple Effect of Watershed Management Decisions in the Assiniboine River Basin". Information was shared on the work of the Board and transboundary water quality issues the PPWB is working on.

The Board is also collaborating with the Global Water Futures on work related to the "*Integrated Modelling Programme for Prediction and Management of Change in Canada's Major River Basins*" (Integrated Modelling Project). This is a multi-faceted project that will provide information on addressing the need for improved modelling tools for use across the Canadian Prairie Provinces.

The PPWB interprets that there are direct linkages of the Integrated Modelling Project elements to its work related to the long term resilience of the *Master Agreement on Apportionment (MAA)*, work on eutrophication and nutrient transport, and on its work on streamflow forecasting in interprovincial basins.

Invasive Species

The PPWB member agencies continue to share information and knowledge on their invasive species programs and legislation.

At their Meeting No. 117, held in November 2016, the Board supported the idea of bringing expertise within each jurisdiction to provide information on the jurisdiction's invasive species program. As meetings rotate from one jurisdiction to another, expertise from that location will be invited to present information on their invasive species program. In November 2017, PPWB Meeting No. 124 was held in Edmonton, Alberta. An Aquatic Invasive Species Technician from Alberta Environment and Parks, Fish and Wildlife Policy, was invited to present information on Alberta's invasive species program. The presentation focused on where aquatic invasive species originate, intentional releases, estimated costs of invasive mussel infestation and the five elements of Alberta's aquatic invasive species program (policy and legislation, education and outreach, monitoring, inspections and response).

Performance Results *continued*

GOAL 8: PPWB Business is Conducted Effectively

The PPWB's Strategic Goal 8 focuses primarily on administration, work planning, and financial management. Goal 8 ensures that work planning and budgeting is consistent amongst jurisdictions, day to day activities are administered effectively, there is effective communications, and succession planning is done to ensure continuity of Board, committee and Secretariat functions.

Administrative and Financial Management

As illustrated by the organization chart in Appendix V, the Board operates through its Executive Director and four technical Standing Committees (Committee on Hydrology, Committee on Groundwater, Committee on Water Quality and Committee on Flow Forecasting). The Board consists of senior officials engaged in the administration of water resources in the Provinces of Alberta, Saskatchewan, and Manitoba and senior officials from Environment and Climate Change Canada and Agriculture and Agri-Food Canada (Appendix VI). Committee members are managers and technical experts within each member agency. The Board is chaired by the Environment and Climate Change Canada member. The Committees are chaired by the Executive Director.

Secretariat support is provided to the PPWB through the Transboundary Waters Unit, Environment and Climate Change Canada at Room 300, 2365 Albert St., Regina, Saskatchewan. The portion of time each Secretariat staff person spends on PPWB activities is charged to the PPWB and cost-shared by the members. In addition, technical support is provided, as required, by other staff of the Government of Canada and the three Prairie Provinces.

Eight Board and eight Committee meetings were held throughout the 2017-2018 fiscal year. The Board invites the various Committee members to participate in Board meetings. This practice is common with all of the Board Committees, thereby improving communication and understanding between the Board and the Committees.

PPWB

- Meeting No. 121A. June 28, 2017 – Teleconference
- Meeting No. 121B. July 5, 2017 – Teleconference
- Meeting No. 122A. October 23, 2017 – Teleconference
- Meeting No. 122B. October 25, 2017 – Teleconference
- Meeting No. 123. October 25, 2017 – Teleconference
- Meeting No. 124. November 9, 2017 – Edmonton
- Meeting No. 125. February 27, 2018 – Teleconference
- Meeting No. 126. March 14-15, 2018 – Saskatoon

COH

- Meeting No. 135. September 7-8, 2017 – Winnipeg
- Meeting No. 136. March 1-2, 2018 – Edmonton

COWQ

- Meeting No. 132. October 16-17, 2017 – Edmonton
- Meeting No. 133. January 30-31, 2018 – Videoconference

COG

- Meeting No. 72. September 11, 2017 – Videoconference
- Meeting No. 73. February 8, 2018 – Videoconference

COFF

- Meeting No. 5. September 13, 2017 – Saskatoon
- Meeting No. 6. February 1, 2018 – Videoconference

The Board approves the annual budget for the PPWB. The budget for 2017-2018 was $1,002,989 and final expenditures were $800,709 as shown in Appendix VII. Final expenditures were below the approved budget due to a number of delays with deliverables for existing contracts related to Goal 1, Agreed Transboundary Apportionment of Water is Achieved, and delays in activities related to the proposed groundwater agreement under Goal 2, Transboundary Groundwater Aquifers are Protected and Used in a Sustainable Manner.

Performance Results *continued*

The Board conducts budget planning early in the year and has a substantial discussion on the budget at the fall meetings. This discussion facilitates early input by the Board into the budget processes of the PPWB member governments.

The PPWB Work Plan is a standing item on regular Board meeting agendas to review items that are derived from the Work Plan. The Board approved the Work Plan for fiscal years 2017-18 to 2021-22.

The purpose of the work plan is to:

- position the Board to anticipate and plan for future work priorities and resource requirements;
- guide the Board in its work over 5 years, ensuring that activities target fulfilling the Goals in the PPWB Strategic Plan;
- feed into multi-year work plans for the four Standing Committees and the Secretariat; and
- provide the foundation for communication with Ministers and senior officials within each government.

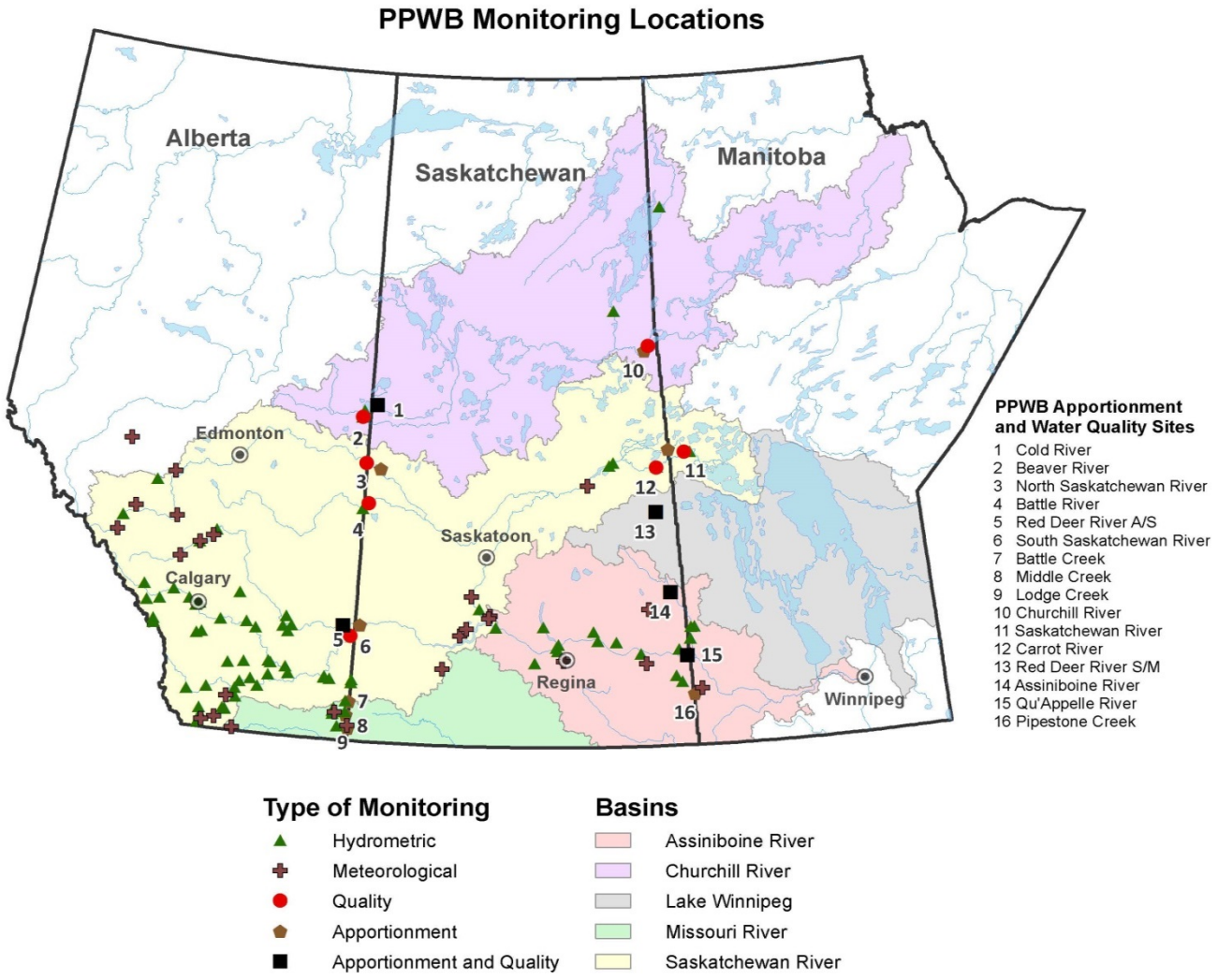
On November 7th and 8th, 2017, in Edmonton, Alberta, the Board hosted a two day work planning meeting to validate strategic direction for updating and reviewing the multi-year work plan, PPWB Charter and Strategic Plan to ensure the PPWB's continued success and relevance for the next five to ten years, and enhance operational efficiencies. Board Members discussed internal and external drivers (factors that influence conditions in regions) related to the *MAA* and the PPWB mandate from a regional / provincial / jurisdictional perspective (e.g. reduced water flows, reduced water quality in regions). Technical committee members and the PPWB Secretariat were also invited to participate in the work planning meeting. The PPWB Work Plan has been refined to reflect the meeting's outcome.

Renewal and Modernizing of PPWB Documents

To modernize, enhance, streamline and avoid duplication, the Board reviews PPWB documents periodically. In 2017, the Board identified that the PPWB Communications Strategy and the PPWB Strategic Plan need to be reviewed, modernized and updated. The communications plan and the strategic plan were both last revised in 2012. The Board will review both documents in 2018.

Further information on the history and administration of the PPWB can be found in Appendix VIII.

APPENDIX I: PPWB Monitoring Stations for 2017-2018



APPENDIX II: 2017 Recorded and Apportionable Flows
APPENDIX IIA: Flows at the Alberta-Saskatchewan Boundary (in Cubic Decametres)

SOUTH SASKATCHEWAN RIVER – ALBERTA-SASKATCHEWAN BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	203000	202000	409000	423000	816000	1264000	296000	153000	131000	158000	175000	160000	4390000
CONSUMPTIVE USE	9	16100	26200	131000	358000	417000	552000	408000	269000	123000	1700	0	2302000
CHANGE IN RESERVOIR STORAGE	-36900	-28400	-27200	-89400	116000	255000	-50800	-227000	-218000	-41200	-10800	53500	-305000
INTERBASIN TRANSFER*	0	0	0	5820	11700	18300	13000	11300	11700	8800	31	0	80700
APPORTIONABLE FLOW	166000	190000	408000	470000	1301000	1953000	811000	345000	193000	250000	165000	214000	6466000

* Irrigation diversions to the Eastern and Western Irrigation Districts which are subsequently returned to the Red Deer River.

RED DEER RIVER – ALBERTA-SASKATCHEWAN BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	49600	57900	184000	450000	300000	432000	149000	66300	60300	62100	46100	45200	1903000
CONSUMPTIVE USE	0	0	0	0	344	4440	5350	6690	4910	1460	48	0	23200
CHANGE IN RESERVOIR STORAGE	-16500	-18800	-9290	-43300	19900	42900	26400	18600	2450	-4160	-13500	-22400	-17700
INTERBASIN TRANSFER**	0	0	0	-5820	-11700	-18300	-13000	-11300	-11700	-8800	-31	0	-80700
APPORTIONABLE FLOW	33200	39000	175000	401000	310000	462000	167000	80400	56200	49700	32600	22800	1829000

** Irrigation return flow from the Eastern and Western Irrigation Districts.

SOUTH SASKATCHEWAN RIVER – BELOW CONFLUENCE WITH RED DEER RIVER

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	253000	260000	594000	873000	1116000	1696000	445000	219000	192000	220000	221000	206000	6295000
APPORTIONABLE FLOW	199000	229000	583000	871000	1611000	2415000	978000	425000	249000	300000	198000	237000	8295000
NET DEPLETION BY ALBERTA	-54000	-31000	-11000	-2000	495000	719000	533000	206000	57000	80000	-23000	31000	2000000
CUMULATIVE PERCENT DELIVERY	127%	120%	109%	105%	89%	81%	76%	75%	75%	75%	76%	76%	76%

Recorded flow was 76% of the apportionable flow. Alberta is required to deliver 50% of the apportionable flow to Saskatchewan unless the total annual flow below the confluence is less than 5,180,000 dam^3, in which case Alberta is allowed a total net depletion of 2,590,000 dam^3 regardless of the percent delivery. However, Alberta cannot consume, divert or store more than 50% of the apportionable flow if the effect reduces the flow below the confluence to less than 42.5 m^3/s at any one time. Alberta satisfied this condition throughout 2017.

Apportionment of the South Saskatchewan River is specified in Article 4, Schedule A of the *MAA*. Apportionable flow calculations are based on the methodology described in the report entitled "*South Saskatchewan River Below Red Deer River – Natural Flow*", April 1985 (PPWB Report No. 45). Volumes may be routed to reflect travel time and rounded to reflect measurement accuracy and therefore the values presented in the table may not exactly balance when summed.

NORTH SASKATCHEWAN RIVER – ALBERTA-SASKATCHEWAN BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
ESTIMATED FLOW	367000	315000	374000	1355000	1065000	1573000	661000	506000	433000	409000	490000	399000	7947000
APPORTIONABLE FLOW	145000	128000	185000	1130000	1206000	1897000	1041000	730000	548000	363000	344000	213000	7930000

Estimated flow at the Alberta-Saskatchewan boundary is calculated by taking the recorded flow at the hydrometric station near Deer Creek, SK and subtracting the estimated net inflow to the river between the boundary and the station. Estimated flow was 100% of the apportionable flow. Alberta is required to deliver 50% of the apportionable flow to Saskatchewan.

BATTLE CREEK – ALBERTA-SASKATCHEWAN BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	N/A	392	2590	1820	1970	1330	723	494	443	737	N/A	N/A	10500
APPORTIONABLE FLOW	N/A	392	2590	1820	1970	1350	726	494	466	743	N/A	N/A	10600

Recorded flow was 99% of the apportionable flow. Alberta is required to deliver 75% of the apportionable flow to Saskatchewan. Hydrometric data is collected only for the open water season.

LODGE CREEK – ALBERTA-SASKATCHEWAN BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	N/A	N/A	12000	1820	988	147	2	0	0	0	N/A	N/A	15000
APPORTIONABLE FLOW	N/A	N/A	12100	1820	1130	158	0	0	0	0	N/A	N/A	15200

Recorded flow was 99% of the apportionable flow. Alberta is required to deliver 75% of the apportionable flow to Saskatchewan. Hydrometric data is collected only for the open water season.

MIDDLE CREEK – ALBERTA-SASKATCHEWAN BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	N/A	N/A	4830	188	112	38	18	13	22	27	N/A	N/A	5250
APPORTIONABLE FLOW	N/A	N/A	5130	188	98	22	8	1	15	23	N/A	N/A	5490

Recorded flow was 96% of the apportionable flow. Alberta is required to deliver 75% of the apportionable flow to Saskatchewan. Hydrometric data is collected only for the open water season.

COLD LAKE – ALBERTA-SASKATCHEWAN BOUNDARY (AT THE OUTLET OF COLD LAKE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	6460	10500	14700	23800	57700	105000	140000	142000	114000	97000	76900	66400	854000
APPORTIONABLE FLOW	6840	11000	15300	24400	58500	106000	141000	143000	114000	97300	77200	66700	861000

Recorded flow was 99% of the apportionable flow. Alberta is required to deliver 68.4% of the apportionable flow to Saskatchewan.

APPENDIX IIB: Flows at the Saskatchewan-Manitoba Boundary (in Cubic Decametres)

CHURCHILL RIVER – SASKATCHEWAN-MANITOBA BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
ESTIMATED FLOW	2081000	1864000	1996000	1948000	3272000	3845000	4325000	4056000	3325000	2735000	2552000	2529000	34528000
APPORTIONABLE FLOW	2193000	1845000	1963000	1940000	3162000	3546000	4031000	3866000	3390000	3059000	2815000	2764000	34574000

Estimated flow includes recorded flow at Sandy Bay, SK and estimated inflow from Sandy Bay to the Saskatchewan-Manitoba Boundary. Estimated flow was near 100% of the apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

SASKATCHEWAN RIVER – SASKATCHEWAN-MANITOBA BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
ESTIMATED FLOW	1402000	1316000	1673000	3212000	3781000	4225000	3466000	1905000	1257000	1267000	1129000	1297000	25930000
APPORTIONABLE FLOW	917000	886000	1454000	3610000	3971000	4942000	3828000	2022000	1295000	1315000	981000	955000	26177000

Estimated flow at the Saskatchewan-Manitoba boundary is calculated using the recorded flow of the Saskatchewan River at The Pas minus 1.34 times (Fall and Winter) and 1.64 times (Spring and Summer) the recorded flow of the Carrot River near Turnberry. Estimated flow was 99% of the apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

QU'APPELLE RIVER – SASKATCHEWAN-MANITOBA BOUNDARY (NEAR WELBY)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	19800	15900	32400	98800	24500	14100	8000	5250	3990	8920	9380	6000	247000
APPORTIONABLE FLOW													153000

Recorded flow was 161% of the apportionable flow. Known issues with the current calculation method cause an underestimate of the apportionable flow, which exaggerates the percent delivery for the Qu'Appelle River. The PPWB is currently undertaking a study to revise the calculation procedures to fix these problems. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

RED DEER RIVER – SASKATCHEWAN-MANITOBA BOUNDARY (NEAR ERWOOD)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	15400	11000	22000	482000	225000	136000	45800	12500	4120	19700	18200	11200	1003000
APPORTIONABLE FLOW	14800	10600	21000	466000	217000	129000	43300	11700	3900	19000	17500	10800	965000

Recorded flow was 104% of the apportionable flow due to the contribution of agricultural drainage to the flow of the Red Deer River. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

ASSINIBOINE RIVER – SASKATCHEWAN-MANITOBA BOUNDARY (AT KAMSACK)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	7630	4160	15700	222000	84600	24800	10700	4120	1000	1900	1900	2730	381000
APPORTIONABLE FLOW	7600	4180	18800	230000	86200	25600	11400	4880	1410	2130	1870	2720	397000

Recorded flow was 96% of the apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

PIPESTONE CREEK – SASKATCHEWAN-MANITOBA BOUNDARY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	1350	1020	7070	42800	5070	4090	1440	77	2	256	382	340	63900
APPORTIONABLE FLOW	1380	1060	7330	42700	5050	4140	1490	128	49	294	417	386	64400

Recorded flow was 99% of apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

APPENDIX III: PPWB Water Quality Monitoring 2017 Parameter List

Water is collected monthly at all sites with the exception of the Churchill River (4x/yr)

ALKALINITY, phenol & total
ALUMINUM, diss. & total
AMMONIA, total θ
ANTIMONY, diss. & total
ARSENIC, diss. θ & total θ
BARIUM, diss. & total θ
BERYLLIUM, diss. & total θ
BICARBONATE, calcd.
BISMUTH, diss. & total
BORON, diss. & total θ
CADMIUM, diss. & total θ
CALCIUM, diss.
CARBON, diss. organic
CARBON, part. organic
CARBON, total organic, calcd.
CARBONATE, calcd.
CHLORIDE, diss. θ
CHROMIUM, diss. & total θ
COBALT, diss. & total θ
COLIFORMS FECAL θ
COLOUR TRUE
COPPER, diss. & total θ
E. COLI θ
FLUORIDE, diss. θ
FREE CO_2, calcd.
GALLIUM, diss. & total
HARDNESS NON-CARB. (CALCD.)
HARDNESS TOTAL (CALCD.) CACO3
IRON, diss. θ & total
LANTHANUM, diss. & total
LEAD, diss. & total θ
LITHIUM, diss. & total θ
MAGNESIUM, diss.
MANGANESE, diss. θ & total
MOLYBDENUM, diss. & total θ
NICKEL diss. θ & total
NITROGEN NO_3 & NO_2, diss. θ
NITROGEN part.
NITROGEN, total calcd.
NITROGEN, diss.
OXYGEN, diss. θ
pH θ
PHOSPHOROUS ortho, diss.
PHOSPHOROUS, part. calcd.
PHOSPHOROUS, total θ
PHOSPHOROUS, diss.
POTASSIUM, diss.
RESIDUE FIXED NONFILTRABLE
RESIDUE NONFILTRABLE
RUBIDIUM, diss. & total
SELENIUM, diss. & total θ
SILVER, diss. & total θ
SILICA
SODIUM ADSORPTION RATIO, calcd. θ
SODIUM, diss. θ
SODIUM PERCENTAGE, calcd.
SPECIFIC CONDUCTANCE
STRONTIUM, diss. & total
SULPHATE, diss. θ
TEMPERATURE WATER
THALLIUM, diss. & total θ
TOTAL DISSOLVED SOLIDS, calcd. θ
TURBIDITY
URANIUM, diss. & total θ
VANADIUM, diss. & total θ
ZINC diss. & total θ

ACID HERBICIDES*θ
NEUTRAL HERBICIDES◆
ORGANOCHLORINE INSECTICIDES◆

θ Parameters with PPWB site-specific objectives

* Collected from all PPWB Transboundary Rivers except for the Cold River in 2017

◆ Collected from the Beaver, Red Deer (S/M), Carrot, Assiniboine and Churchill Rivers in 2017

APPENDIX IV:

PPWB Report on Excursions of
Interprovincial Water Quality Objectives

JANUARY-DECEMBER 2017

Table of **Contents**

List of **Figures**

List of **Tables**

Summary

This 2017 report fulfils requirements of the *Master Agreement on Apportionment (MAA)* to report on the protection of water quality for major interprovincial prairie rivers. During 2017, water quality samples were collected on 12 major interprovincial rivers. The water quality results were compared to water quality objectives for each site. In general, water quality was suitable for the intended water uses for the rivers with few excursions to the established objectives. Based on the evaluation of excursions in 2017 and with consideration of results from previous excursion reports, trends, and on-going work by the Committee on Water Quality (COWQ), the following are recommended:

- Nutrients continue to be a priority area of investigation for the transboundary rivers because increasing levels of nutrients can lead to more eutrophic waters, which can affect ecosystem function. Understanding the processes affecting nutrient concentrations in rivers will improve understanding regarding the causes of excursions and trends. The COWQ's on-going work to understand nutrient sources and trends will continue in 2018.
- Common use pesticides, such as dicamba, MCPA and glyphosate, are frequently detected in transboundary rivers on the prairies. There are frequent pesticide excursions at several transboundary rivers, notably of MCPA and dicamba. The objectives for these two pesticides are based on irrigation guidelines for sensitive crops and are low compared to other pesticides. Glyphosate and its breakdown products are also detectable at low concentrations in the transboundary rivers. The COWQ is working with the jurisdictions to better understand the potential effects to the aquatic environment and users of these waters. Once this work is complete the COWQ will provide a recommendation to the Board. Given low level but frequent occurrence of certain pesticides, understanding the aquatic and use implications continues to be a priority.
- Excursions to total metals, nutrients and bacteria objectives at several sites appear to be related to peaks in suspended solids, and sometimes flow. Trends in metal concentrations and relationships to physical parameters, including flow and suspended solids, continue to be examined for select rivers to gain further understanding on how these factors influence metal concentrations and other parameters in transboundary rivers.

Introduction

In 1969 the governments of Alberta, Saskatchewan, Manitoba and Canada entered into the *Master Agreement on Apportionment*. The agreement provided for equitable sharing of water in eastward flowing streams across interprovincial boundaries. Schedule E, the agreement on water quality, was added to the Agreement in 1992. The Agreement is administered by the Prairie Provinces Water Board (PPWB) which has a mandate to foster and facilitate interprovincial water quality management among the parties to encourage the protection and restoration of the aquatic environment. One of the processes the PPWB uses to meet this mandate is this annual report on adherences to the interprovincial water quality objectives. If, as a result of human activity, chemical, biological or physical variables do not meet acceptable limits then the appropriate jurisdiction has agreed to undertake reasonable and practical measures to ensure the quality of the water in that river reach is within acceptable limits (*MAA* Schedule E, 1992).

Schedule E requires the PPWB to monitor the quality of the aquatic environment and make annual comparisons with established interprovincial water quality objectives. Water quality objectives have been established at 12 major interprovincial eastward flowing river reaches (Appendix 1). The water quality objectives were reviewed and updated in 2015, and are designed to protect water uses including the protection of aquatic life, source water for drinking, recreation, agricultural uses (livestock watering and irrigation) and fish consumption. The Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries each have six river sites (Figure 1).

Water quality monitoring includes a range of physical, chemical and biological parameters at one site in each of the river reaches. Parameters include nutrients, major ions, metals, fecal coliforms, physical characteristics and pesticides. This report presents adherence of 2017 water quality data to the interprovincial water quality objectives.

Field Program – Summary of (2017) Sampling

Environment and Climate Change Canada (ECCC) undertook a total of 136 water sampling outings at the 12 PPWB river sites in 2017. The monitoring program for 2017 was completed, as approved by the PPWB (Appendix 2), with the following exceptions: neutral herbicides were not reported on the Beaver River on the Alberta-Saskatchewan boundary in May 2017 as the sample bottle was broken during transit. There were also extra pesticide samples collected and analyzed for the Saskatchewan River on the Saskatchewan-Manitoba boundary in February 2017. Major ion analyses were not completed for the Cold River in June 2017.

Chlorophyll a sample collection and analyzes were also initiated on the transboundary rivers in 2017. Chlorophyll a was sampled and analyzed on the six Alberta-Saskatchewan boundary rivers, but this was only initiated in July and continued through December 2017. Chlorophyll a was not monitored on the Saskatchewan-Manitoba boundary rivers in 2017.

Figure 1: Map showing location of PPWB water quality monitoring stations

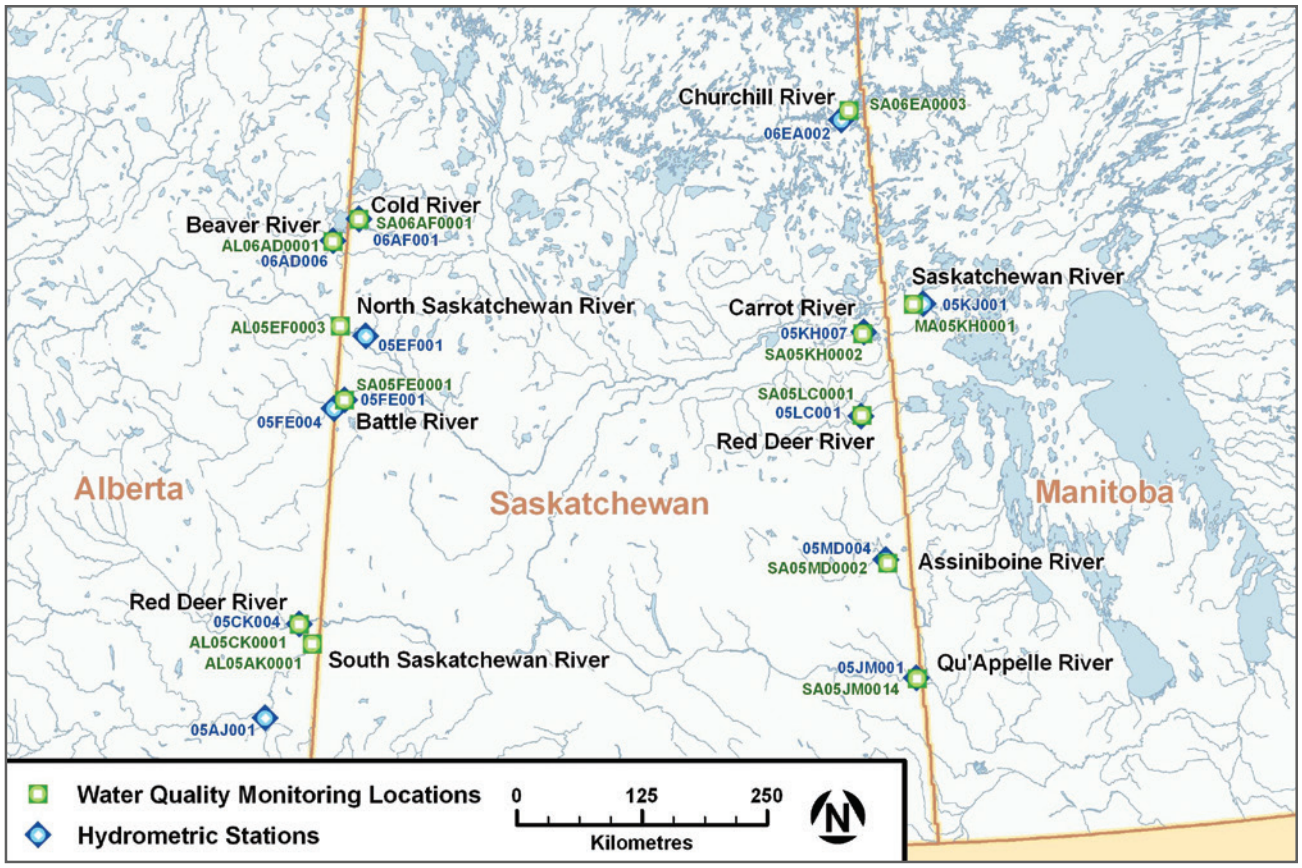


Table 1: PPWB water quality station information

RIVER	STATION NUMBER	LATITUDE	LONGITUDE	HYDROMETRIC SITE(S)
Alberta-Saskatchewan				
Battle	SA05FE0001	52° 56'25.008"	109° 52'23.988"	05FE004
Beaver	AL06AD0001	54° 21'15.012"	110° 12'42.984"	06AD006
Cold	SA06AF0001	54° 34'00.000"	109° 50'10.000"	06AF001
North Saskatchewan	AL05EF0003	53° 36'05.004"	110° 00'29.988"	05EF001
Red Deer (Bindloss)	AL05CK0001	50° 54'10.008"	110° 17'48.984"	05CK004
South Saskatchewan	AL05AK0001	50° 44'15.000"	110° 05'44.016"	05AJ001*
Saskatchewan-Manitoba				
Assiniboine	SA05MD0002	51° 31'59.016"	101° 53'20.004"	05MD004
Carrot	SA05KH0002	53° 36'00.000"	102° 07'00.012"	05KH007
Churchill	SA06EA0003	55° 36'29.016"	102° 11'44.016"	06EA002**
Qu'Appelle	SA05JM0014	50° 29'02.004"	101° 32'35.016"	05JM001
Red Deer (Erwood)	SA05LC0001	52° 52'00.012"	102° 10'59.016"	05LC001
Saskatchewan	MA05KH0001	53° 50'30.012"	101° 20'03.984"	05KJ001***

*Estimated flow for the PPWB South Saskatchewan site is based on recorded flow at Medicine Hat plus the flow from Seven Person Creeks and Ross Creek with a two day lag.
**Estimated flow for PPWB Churchill site includes recorded flow at Sandy Bay and estimated inflow from Sandy Bay to the boundary.
***Estimated flow for PPWB Saskatchewan site includes recorded flow at 05KJ001 minus flow at the Carrot River 05KH007.

Results

Overall Adherence to Interprovincial Water Quality Objectives

The overall adherence rate to the interprovincial water quality objectives was, on average, 96.1% in 2017 (Figure 2). This adherence rate is based on the comparison of 5,583 water quality results to water quality objectives (Table 8 and 9). There are no acute water quality concerns apparent from review of the overall adherence rate values for 2017.

Overall adherence rates from 2017 are similar to those from previous years (Figure 3). While this is the third year that the 2015 water quality objectives have been applied to the PPWB river reaches, adherence rates were calculated retroactively for 2003 through 2014 with the new water quality objectives to understand how rates would have changed over a longer period of time. This analysis allows for comparison of adherence rates for 2017 with previous years using the same 2015 water quality objectives.

Most rivers show little variation in adherence rates among years (approximately 5%). The Battle and Red Deer (Bindloss) rivers have the greatest variability in adherence rate among years. For the Battle River this variability is due to high and low adherence rates in 2006 and 2003, respectively. The lower adherence rate in 2003 was in part due to more excursions of major ions. For the Red Deer River (Bindloss) high and low adherence rates were observed in 2004 and 2005, respectively. The lower adherence rate in 2005 was not specifically attributable to a single variable or one group of variables. Quite often the variability of adherence rates demonstrates the susceptibility of river water quality to various weather/hydrological events (e.g. storm, drought) and environmental factors (e.g. farming, erosion).

From 2016 to 2017, all the Alberta-Saskatchewan boundary rivers showed a decrease, ranging from 0.5% on the Cold River to 4.3% on the Battle River, in the overall adherence rate. The decrease in the adherence rate on the Battle River was due to excursions in nutrients, metals, TDS, TSS and bacteria. The total number of excursions for the Battle River in 2016 was 16 whereas the total number of excursions in 2017 was 35.

On the Saskatchewan-Manitoba boundary the Red Deer River near Erwood has historically shown the greatest fluctuations in overall adherence rate to water quality objectives. In 2016, this river showed the greatest decrease in overall adherence rate (4.4%). However, in 2017, the Red Deer River showed the greatest increase. In 2016 there were 32 total excursions to the water quality objectives, including nutrients, TDS, TSS and bacteria. The number of excursions was reduced to 23 in 2017, but continues to include nutrients, TDS and TSS, and several metals.

The Carrot River was the only river on the Saskatchewan-Manitoba boundary to show a reduction (0.5%) in adherence rate from 2016 to 2017. All the other five transboundary rivers on this boundary showed a slight increase in the overall adherence rate ranging from 0.3% on the Assiniboine River to 3.3% on the Red Deer River near Erwood.

The 2017 adherence rate for each river was similar to the 15 year median adherence rate for the respective river (with nine sites within less than 1%, and all below 1.5% except for the Battle River).

Figure 2: Percent adherences to interprovincial water quality objectives in 2017.

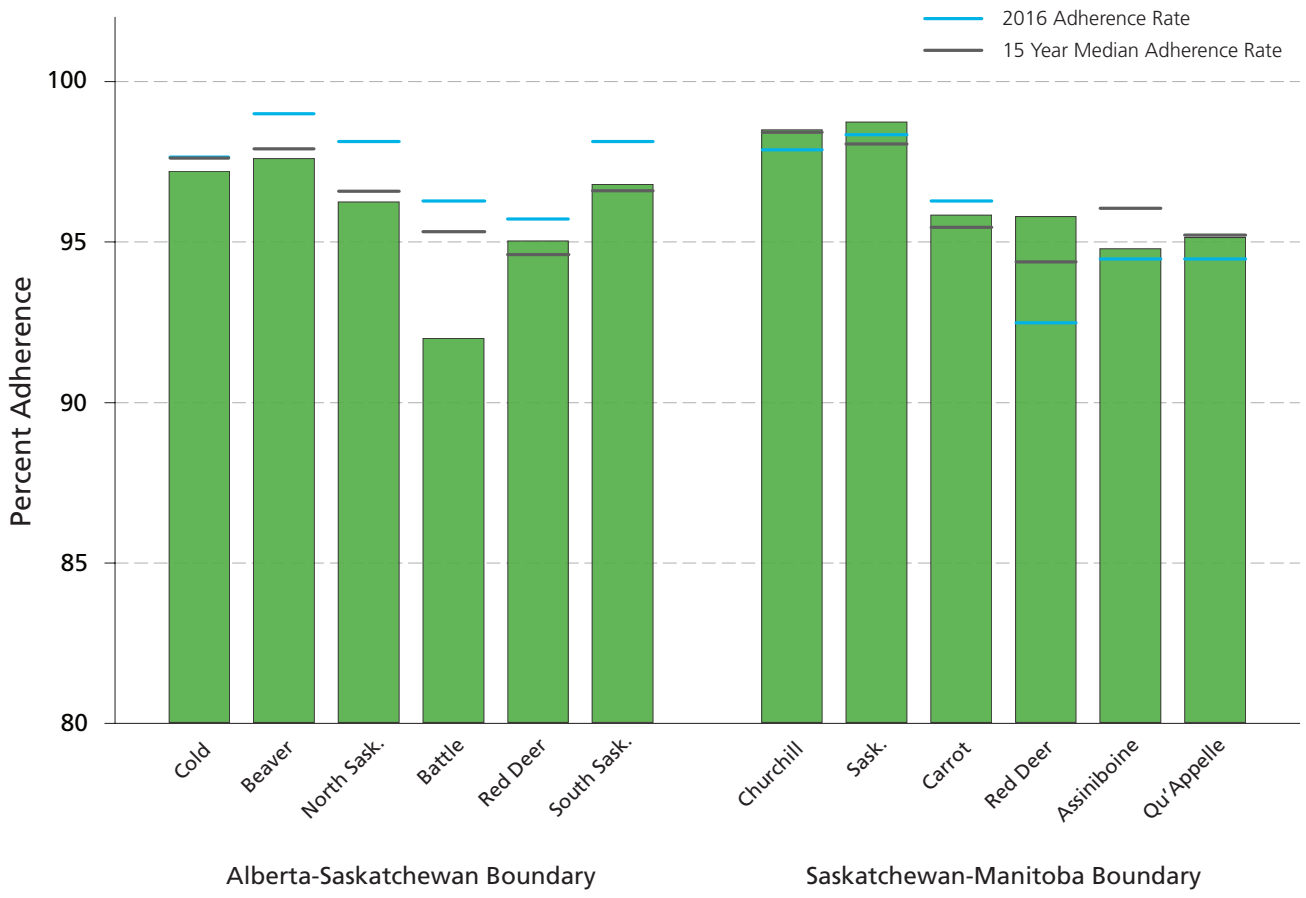
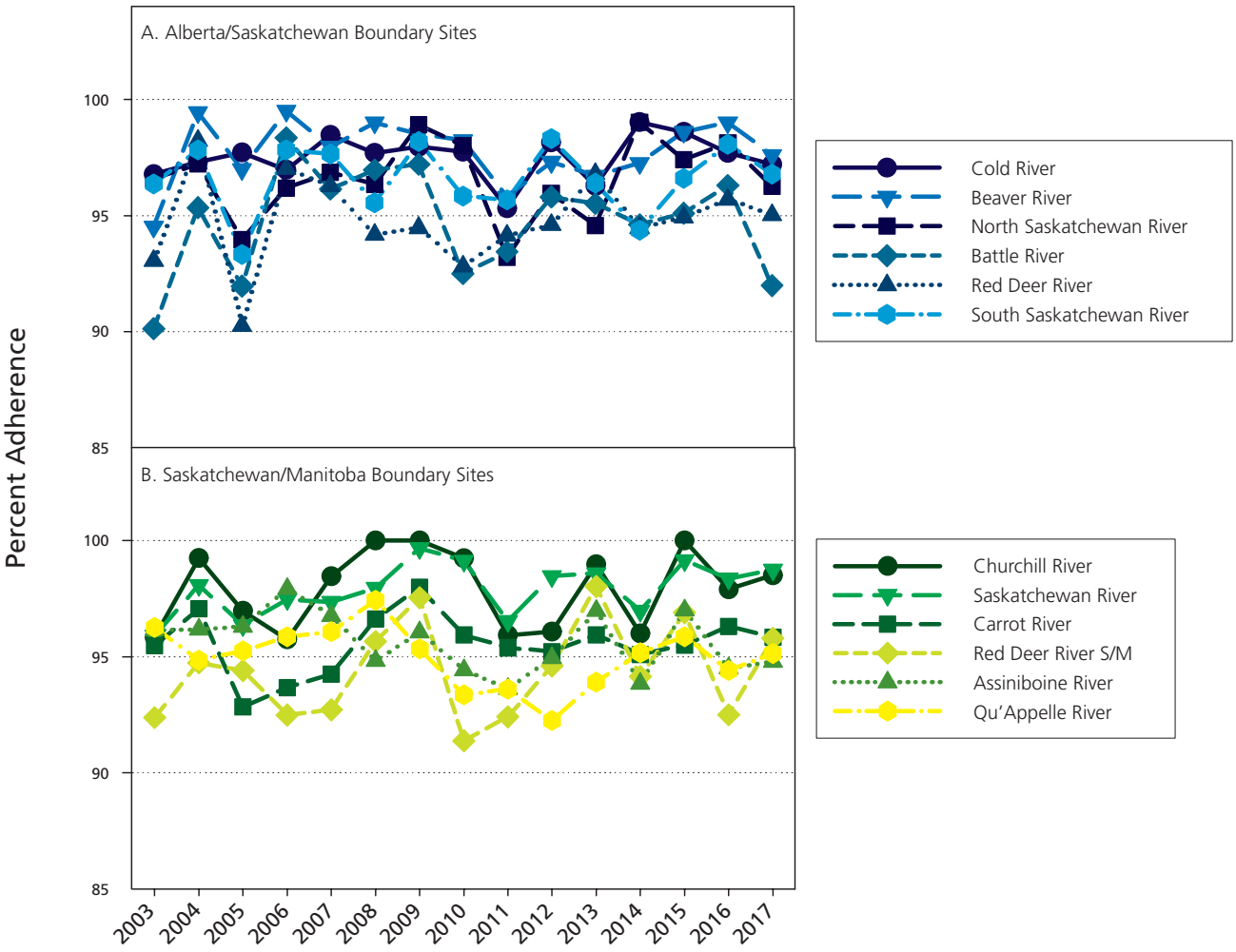


Figure 3: Percent adherences to interprovincial water quality objectives for (A) the Alberta-Saskatchewan and (B) the Saskatchewan-Manitoba boundaries from 2003 to 2017.



Results *continued*

Examination of Specific Parameter Excursions for 2017

Alberta-Saskatchewan Boundary

For the Alberta-Saskatchewan transboundary rivers, there were excursions of nutrients (total phosphorus (TP), total nitrogen (TN), and total dissolved phosphorus (TDP)), total suspended solids (TSS), metals (arsenic, cadmium, copper, iron, lead, silver and zinc), major ions (sodium, and total dissolved solids (TDS)), bacteria (fecal coliforms and *E. coli*), and pesticides (dicamba) (Tables 2, 4, 6 and 8).

Total suspended solids is a measure of sediment and particulate matter in the water column. In the water column, sediment may be due to a variety of causes such as erosion of soil and river banks and re-suspension of bottom sediments. When TSS concentrations are elevated it is not unexpected to see elevated levels of nutrients, total metals and coliform bacteria. Elevated TSS concentrations are typical during spring runoff and other episodic events such as high flows following summer storms. TSS also has a lower objective that was set in recognition of the turbid nature of prairie rivers that some fish species require (e.g. Goldeye). The lower TSS objective was not met (water was low in TSS) at some sites on some dates in 2017. Flow has an influential effect on water quality and is therefore important to consider when understanding inter- and intra-annual changes in water quality.

Since 2015, site-specific nutrient objectives have been established for TP, TDP and TN for each of the transboundary rivers. The objectives were established using a statistical approach that evaluated long-term data from each site. In all cases, a site-specific nutrient objective was set at the 90th percentile of data for each season. Where statistical trends existed, an additional objective was established based on the 90th percentile of the lowest value 10 year period. It is expected that there will be a certain proportion of excursions over the long term. For objectives set using the complete period of record it is expected that the excursion rate will be on average around 10%. Typically these excursions are expected to be more frequent in some years and less frequent in other years based on annual variability which can be impacted by hydrology, precipitation and temperatures.

Nutrient excursions occurred in all six rivers at the Alberta-Saskatchewan boundary in 2017 (Tables 2 and 6). Nutrient objectives for TP, TDP and TN are based on seasonal background concentrations, and in 2017 nutrient excursions occurred in both seasons. The Battle River had the highest number of nutrient excursions on the Alberta-Saskatchewan boundary in 2017. Fourteen nutrient excursions were reported in 2017 which represented 39% of the samples collected. The Red Deer River (near Bindloss) had the second most number of nutrient excursions and represented a quarter (25%) of the samples collected in 2017.

The Battle River had excursions of total nitrogen (TN) throughout the first part of the year (January through May). Phosphorus (TP and TDP) objectives had excursions in March, April, May and June with excursions of TDP also occurring in July. Flow results show that the river discharge from mid-March to end of June was mostly above its upper quartile. Most of the phosphorus reported in the open water was in the particulate form (e.g. with ratios of 0.88, 0.80 and 0.84 observed in April, May and June respectively). Higher TSS values were reported in April and May, during spring freshet. In addition to the nutrient excursions in these months, there were also excursions to the TSS objective and six metals (arsenic total, cadmium total, copper total, iron dissolved, lead total, and zinc total).

For the Red Deer River, all TP, TN and TDP excursions, with the exception of one TDP in April and one TP and TN excursion in June, occurred in the winter months during the closed water period (January, February, March and December). The nutrient excursions in January through March do not appear to be related to spikes in TSS or flow. However, excursions of the TN and TP site-specific objectives that occurred in June did correspond with the peak in TSS. There were smaller spikes in TSS in April and December that also corresponded to nutrient excursions. However, a larger spike in TSS in

Results *continued*

October 2017 did not result in nutrient excursions to the site-specific objectives. Therefore, elevated TSS levels could not account for all the nutrient excursions observed on this river in 2017.

Similar to 2016, the Cold River, on the Alberta-Saskatchewan boundary, had the third most number of excursions to the nutrient objectives in 2017. Total nitrogen exceeded the objectives five times in 2017 (February, April, August, September and October). Similar to 2016, most of the nitrogen (84 to 94%) in the samples with TN excursions was comprised of total dissolved nitrogen, which in turn was largely dissolved organic nitrogen. For TDP, an excursion to the background objective occurred in April and August and while this also coincided with TN excursions it did not coincide with increased TSS. In fact, excursions to the minimum TSS value were reported for these two dates in 2017. Total phosphorus did not exceed the site-specific objectives for the Cold River in 2017.

The South Saskatchewan River, the North Saskatchewan River and the Beaver River, also had excursions to all three site-specific nutrient objectives in 2017. While increases in flow and peaks in TSS cannot explain all of the excursions observed on these rivers in 2017, peaks in nutrients, TSS and flow did co-occur. Excursions to site-specific objectives did occur on the South Saskatchewan River in June, the North Saskatchewan River in April and June, and the Beaver River in April, and these excursions did occur with peaks in flow and TSS. The Committee continues to work towards a better understanding of nutrient dynamics and sources and while peaks in flow and TSS can explain some of the observed excursions to objectives it cannot explain all of the excursions observed in these rivers.

Objectives for TSS were set using historical data and included an upper and lower limit to protect aquatic life, in particular to protect turbid water fish that are present in prairie river systems. Total suspended solids background objectives were based on the open water season only as this is the most critical time for the protection of fish and early life stages. Given the statistical approach used to set the TSS objectives, there is an expectation that a certain number of excursions will occur over the long term (10% lower and 10% upper).

All six rivers on the Alberta-Saskatchewan boundary exceeded the open water site-specific objective for TSS at least twice in 2017. The upper water quality objective was exceeded usually during periods of higher flow in the spring and early summer, while the lower objective was exceeded during the late summer and fall. The rivers that are part of the Saskatchewan River basin system (Battle, North Saskatchewan, Red Deer and South Saskatchewan), all had excursions to both the upper and lower level objectives, while the Beaver River only exceeded the upper objective in the spring.

Of note, for the Cold River all observed TSS excursions (4 of 7 samples) were a result of low TSS concentrations for this river, which resulted in TSS not meeting the lower objective. This was also the case in 2015 and 2016. Low concentrations of TSS are not unexpected given the water quality is monitored at the outflow from Cold Lake. Cold Lake is a substantial deep-water lake and it has a moderating effect on the water quality of the outlet.

Seven metals (arsenic, cadmium, copper, iron, lead, silver and zinc) exceeded water quality objectives on the Alberta-Saskatchewan transboundary rivers in 2017. All six rivers monitored on this boundary had at least one exceedance to a metal objective. The objectives are for the total metal with the exception of iron, nickel and manganese, which are in the dissolved form. Of note was the Battle River, which exceeded water quality objectives for six metals (arsenic, cadmium, copper, iron, lead and zinc) in 2017. Excursions for all six metals occurred during the spring and early summer, and several of the metals (copper, lead and zinc) closely followed the hydrograph. A peak in TSS was reported in April for this river and this coincided with excursions for all six metals. Additional metal excursions occurred in May and June and while TSS did not exceed objectives it did remain elevated during these sampling events.

The South Saskatchewan River had excursions of cadmium, copper, lead and zinc in June 2017. These excursions coincided with a distinctly elevated TSS level and a peak in the river flow on the sample date when compared to the

Results *continued*

river hydrograph. For the North Saskatchewan River, similar to the South Saskatchewan River, cadmium, copper, lead and zinc exceeded water quality objectives at least once in 2017. Excursions occurred in April for all four metals and in June for cadmium and copper. In these cases the excursions also coincided with a peak in TSS. Copper was the only metal in 2017 on this river that also had an excursion in February under ice conditions and was not related to either flow or TSS. However, this value for copper (total) appears to be anomalous, as it was higher than would be expected for this river, at this time of year. There was also no corresponding increase in dissolved copper. Historically, elevated copper values have been observed during the spring and summer months, but they are not typically elevated throughout the winter months. While the copper value was flagged as an exceedance, the COWQ will continue to monitor copper in 2018 to see if there are re-occurrences of the elevated levels warranting further investigation.

The Beaver River exceeded the cadmium objective four times in 2017, including in April, May, July and August. Elevated TSS also occurred in April and May, as well as a rise in the river hydrograph as a result of spring freshet. Spring flow peaked on May 22nd (84 m^3/s) but the highest flow for this river occurred in early August 2017 (100 m^3/s). The Beaver River also had excursions of dissolved iron in August and December. The dissolved iron excursions do not appear to be related to TSS for this river in 2017.

For the Red Deer River, three metals exceeded the water quality objectives in 2017 (lead, silver and zinc). All three metals exceeded the interprovincial water quality objectives in June and October, which did coincide with an elevated TSS level in both months. In a recent publication, elevated metal concentrations on the Red Deer River were explained by erosion of natural soils and high instream sediment mass (Kerr and Cooke, 2017).

As reported in the 2016 annual report, the COWQ has identified the Red Deer River for further investigation and analysis following a number of atypical excursions and water quality conditions in 2015. The COWQ is continuing to follow up on excursions on the Red Deer River and is working with the Province of Alberta as the upstream jurisdiction. A report from the upstream jurisdiction is anticipated for review by the COWQ in 2018.

The Battle River was the only river on the Alberta-Saskatchewan boundary to exceed a major ion or total dissolved solids (TDS) objective in 2017. Sodium and TDS exceeded the water quality objectives in the Battle River during the ice-cover season. These exceedances were likely a result of low flows in the Battle River in late winter under ice conditions.

Sources of fecal coliform are numerous and include wildlife and pet waste, discharge of wastewater, and runoff from agricultural activities including livestock operations and agricultural fields that receive animal-waste products. Occasional exceedances of fecal coliform objectives are not unexpected in surface waters, particularly in response to rainfall events that can transport fecal bacteria through runoff. All rivers on the Alberta-Saskatchewan boundary, except the Beaver and Cold rivers, exceeded the fecal coliform bacteria water quality objective occasionally in 2017.

In the case of the Red Deer River, the detection of fecal coliform bacteria did appear to be related to elevated levels of TSS. For the other three rivers (Battle, North Saskatchewan and South Saskatchewan Rivers) the detection of fecal coliform bacteria did not appear to be related to any significant increase in

Results *continued*

TSS or peak flow, but could have been a small local event. All bacteria detections occurred during the open water season. *Escherichia coli (E. coli)*, is also a measure of fecal contamination in water supplies and is often the preferred indicator rather than fecal coliform bacteria. In 2017, *E. coli* exceeded the water quality objectives once in each of the Battle, Red Deer, South Saskatchewan, and North Saskatchewan rivers. The *E. coli* excursions occurred during August for the Battle and South Saskatchewan rivers, April for the North Saskatchewan River and October for the Red Deer River. The *E. coli* excursion on the North Saskatchewan River did appear to be related to peaks in TSS, but again this was not the case for the other transboundary rivers. Fecal coliform bacteria did exceed the water quality objective more frequently than *E.coli*, but the interprovincial water quality objective is lower for fecal coliforms as compared to *E.coli*. For the Battle, South Saskatchewan and the Red Deer rivers the *E. coli* excursions did coincide with a fecal coliform excursion, although this was not the case for the North Saskatchewan River. As *E. coli* is a sub group of bacteria within the fecal coliform group it is not unexpected that excursions may occur at the same time for the two measures of fecal contamination.

Pesticide monitoring on the transboundary rivers is conducted on a rotational basis with each river being monitored once every four years. As a result of this rotational sampling, the full suite of pesticide monitoring was conducted on the Beaver River on the Alberta-Saskatchewan boundary in 2017. In addition, the acid herbicide group of pesticides were also measured on the Battle, North Saskatchewan, Red Deer and South Saskatchewan rivers on this boundary as part of additional monitoring implemented on select rivers with more frequent excursions to this group of pesticides. MCPA and dicamba are two acid herbicides commonly used throughout the Prairie Provinces. A review of recent PPWB pesticide data for the Alberta-Saskatchewan rivers (2006 to 2013) showed that these herbicides are often detected at low concentrations in water samples and frequently exceed the PPWB water quality objectives. MCPA exceedances of the PPWB objective have ranged from 0 to 30% since 2006 and dicamba exceedances have ranged from 20 to 50% in the years the South Saskatchewan River has been monitored for pesticides. Similarly, for the Battle River, exceedances of MCPA have ranged from 25 to 43% and dicamba from 0 to 14% for the years it has been monitored (PPWB Report #175, 2016).

In 2017, excursions were observed for the acid herbicide dicamba (Table 4). Dicamba exceeded the water quality objective three times in the South Saskatchewan River (June, August and September) and twice in the Red Deer River (October and December). The COWQ will continue to do follow-up work with each of the jurisdictions on the presence of these pesticides in the transboundary river systems.

Glyphosate is a nonselective systemic herbicide that is used extensively throughout the prairies. The PPWB does not currently have a numerical objective for glyphosate, but given its extensive use throughout the prairies, the PPWB has chosen to report detections of this herbicide. In 2017, glyphosate was monitored on the Beaver River. For this river glyphosate was detectable at very low levels in three water samples collected throughout the year. The highest concentration of glyphosate reported for the Beaver River (51 ng/L) occurred in April during spring freshet.

Results *continued*

Saskatchewan-Manitoba Boundary

In 2017, excursions for the Saskatchewan-Manitoba boundary included nutrients (TP, TDP, TN), total suspended solids (TSS), metals (cadmium, copper, and manganese), major ions (sodium, sulphate), TDS, bacteria (*E. coli* and fecal coliforms) and pesticides (MCPA and dicamba) (Tables 3, 5, 7 and 9).

Nutrient objectives for the Saskatchewan-Manitoba boundary, similar to the Alberta-Saskatchewan boundary, were established with a statistical approach that evaluated long-term data from each site. There were multiple nutrient excursions at all sites on the Saskatchewan-Manitoba boundary in 2017 (Tables 3 and 7). The highest number of excursions to the site-specific objectives occurred in the Carrot River, the Red Deer River, and the Assiniboine River. All three rivers, as well as the Qu'Appelle River, had excursions of all three site-specific nutrient objectives (TN, TP and TDP). The Churchill River and the Saskatchewan River exceeded two of the three site-specific objectives. The Churchill River had excursions to TN and TDP, while the Saskatchewan River had excursions to TN and TP.

In 2017, the Carrot River had the highest number of nutrient excursions to the site-specific objectives of any of the transboundary rivers. As the Carrot River has shown statistically significant increasing trends in phosphorus (TP and TDP), and nitrogen (TN) site-specific objectives were established for each representing the 90th percentile of the entire period of record and the 90th percentile of the lowest running 10 years for each of the two seasons. For TP, excursions of the 90th percentile objective occurred in February, March, July, August and September. When this objective is exceeded, the lowest running 10 year 90th percentile objective (lower objective) will also be exceeded (Table 7). In January, May, June and October, while the 90th percentile background objective was not exceeded, the lower objective did exceed its seasonal objective. Similarly, TDP also exceeded both the site-specific objectives in January, February, June, July, August and September. However, the lowest running 10 year objective also exceeded the seasonal objective in March and May.

Total nitrogen for the Carrot River also had excursions to the 90th percentile objective throughout the spring, summer and fall (March, July, August, September and October), as well as the lowest 90th percentile in late winter (February). Overall, for the Carrot River, over half (54%) of the samples collected in 2017 exceeded one of the site-specific nutrient objectives. For this river a peak in flow was reported in April and elevated TSS was reported in July and September. However, not all of the nutrient excursions on this river could be related to either flow or TSS. Results showed that dissolved nitrogen dominated among the various nitrogen constituents in all samples. Ammonia levels appeared to contribute significantly to the exceedances in February and March. Ammonia being the dominant form of inorganic nitrogen is not surprising given the anoxic conditions in the river during these months. Organic nitrogen appeared to contribute significantly to the exceedances from June to October.

The Red Deer River (Erwood) had the second highest number of excursions to the site-specific nutrient objectives on the Saskatchewan-Manitoba boundary. Nutrient excursions, TP and/or TDP, exceeded the background objectives throughout the late winter, spring, and summer months (January through July), while excursions of TN occurred in the spring and summer (March, April and July). While the winter nutrient excursions were not related to TSS or flow, the spring excursions did coincide with elevated TSS levels and spring freshet.

The Assiniboine River also had a number of excursions to TN, TP and TDP objectives. Excursions for this river occurred throughout the late winter months and spring for TN (January, February, March and April). For TP and TDP, excursions occurred in March and April, during peak inflows in the spring. The April excursions for all three site-specific nutrients coincided with a peak in TSS for this river.

The Qu'Appelle River had excursions to all three site-specific nutrient objectives. Excursions to TN and TP occurred in April during spring freshet and a corresponding peak in TSS. Total nitrogen also had an excursion to the site-specific objective in June, which also coincided with a peak in TSS. Total dissolved phosphorus exceeded the lower 90th percentile objective in January 2017 but did not exceed the period of record 90th percentile objective in 2017.

Results *continued*

Nutrients continue to be a priority for prairie river systems for all jurisdictions. The COWQ has for the last several years focused work on the Red Deer River (AB) and the Carrot River watersheds to assess point and non-point sources of nutrients to these transboundary rivers. This work continues and is on-going. Trend analysis work has highlighted TN as the nutrient with the highest priority for understanding temporal changes in many of the prairie rivers.

Total suspended solids (only open water objectives) were exceeded on at least one occasion for all six Saskatchewan-Manitoba boundary river sites in 2017. For three of the rivers, the Assiniboine, Carrot and the Qu'Appelle rivers, only the upper objective was exceeded in 2017. For the Red Deer River, there was an excursion to the TSS objective three times in 2017, including both the upper and lower objective, while for the Saskatchewan and Churchill rivers, only the lower objective was not met.

Similar to previous years, the Assiniboine River exceeded the TSS objectives during higher flows in the spring and summer. The Carrot River exceeded the TSS objective once during the open water season in July. The Qu'Appelle River had TSS excursions during the spring (April and June) in 2017. The Red Deer River had TSS excursions in May, July and October. The Saskatchewan and Churchill rivers each had one excursion to the lower TSS objective in October 2017.

Three metals (cadmium, copper and manganese) exceeded water quality objectives on the Saskatchewan-Manitoba boundary sites in 2017. Five of the six transboundary rivers had at least one excursion, with the Churchill River being the only river not to exceed a metal objective.

Cadmium and copper exceeded water quality objectives in five rivers in 2017. For all five rivers, the elevated cadmium and copper levels coincided with higher TSS. In all cases cadmium and copper exceeded their water quality objectives for the same sampling dates. For the Saskatchewan River, cadmium and copper both exceeded their respective water quality objectives in October. Cadmium and copper objectives, for the Red Deer River (near Erwood), were exceeded in April during spring freshet and these excursions coincided with peak TSS levels. However, cadmium on this river also exceeded the water quality objective in October when the TSS was extremely low and did not meet the lower TSS objective.

The third metal to exceed water quality objectives in 2017 was manganese (dissolved) on the Red Deer River (near Erwood). There were four excursions to the manganese objective in 2017 and these occurred during the winter months (January through April). The elevated manganese levels may be the result of groundwater inflows during low flow periods and the ice-covered season.

In 2016, uranium exceeded the water quality objectives on the Assiniboine River in November. While elevated concentrations of uranium do not regularly occur on the Assiniboine River, they have been observed from time to time. Uranium was also noted to have an increasing trend on the Assiniboine River. The COWQ will continue to evaluate uranium concentrations and have identified it as a priority parameter to review with respect to increasing trends. No other excursions were observed in 2017 for uranium on any of the transboundary rivers.

Three rivers on the Saskatchewan-Manitoba boundary had an excursion to a major ion or TDS in 2017. This included the Assiniboine, Qu'Appelle and the Red Deer rivers. The Carrot, Churchill and Saskatchewan rivers did not have any reported excursions to the objectives in 2017.

Concentrations of sulphate and TDS exceeded objectives on multiple occasions in the Assiniboine River in both the open and closed water seasons. The Qu'Appelle River exceeded interprovincial water quality objectives for sulphate, sodium and TDS during the winter months and TDS excursions were reported on three occasions in the Red Deer River in 2017.

For the Assiniboine River, sulphate and TDS objectives were set with a similar approach to nutrients, whereby statistical analysis using historical data was used to define an expected range

Results *continued*

of concentrations. As with nutrients, there is an expectation that there will be a certain proportion of excursions over the long term. The percent exceedances in 2017 were greater, 50% for sulphate and 42% for TDS, than expected (10%) over the long term.

Sulphate and TDS exceeded the background objectives on the Assiniboine River throughout the winter and into the summer. Sulphate and TDS levels drop during the summer and throughout the fall. The cause of the higher sulphates is not clear but this pattern for this river was similar to the results observed in 2015 and 2016. Recently updated trend analysis work completed by the COWQ, also shows increasing trends for sulphate in a number of the transboundary rivers including the Assiniboine River. Initial review of data suggests that during periods of higher flow in the Assiniboine River, the Whitesand River, which is a tributary to the Assiniboine River and has greater sulphate and TDS, contributes a greater proportion of flow.

For the Qu'Appelle River, similar to the Assiniboine River, site-specific objectives for TDS and sulphate were established based on historical background data. In 2017, the Qu'Appelle River had four excursions to the sulphate objective, three excursions to the TDS objective and one excursion to sodium. Excursions all occurred in the winter months under ice-cover with excursions to all three also being reported in November 2017.

There were three TDS excursions on the Red Deer (Erwood) River, with all three occurring in winter (January, February, and March). The highest TDS concentration on the Red Deer River in 2017 was 671 mg/L. Assessment of long-term data from the Red Deer (Erwood) River found that half of the winter samples (January to March) typically are greater than the objective value of 500 mg/L TDS. The 2017 frequency of TDS excursions is similar to what has been observed in previous years.

On the Saskatchewan-Manitoba boundary, two rivers had excursions to fecal coliform bacteria and/or *E. coli*. The Assiniboine River had excursions to fecal coliforms in August and September, and *E. coli* in September. The counts were notably high in September and did not coincide with a peak in TSS or flow. The Qu'Appelle River also exceeded the fecal coliform interprovincial objective four times in 2017 (June, July, September and October). Only the July sample coincided with an elevated spike in TSS. *E. coli* did not exceed the established objective in 2017.

Results *continued*

Concentrations of the pesticides dicamba and MCPA were found to exceed water quality objectives in 2017 (Table 5). Dicamba was detected above the water quality objective in the Assiniboine River on two occasions (September and November), while concentrations of MCPA also exceeded the water quality objective twice and these occurred earlier in the year (June and August). The Qu'Appelle River had one excursion of MCPA in June, and the Carrot River had one excursion to the dicamba objective, in the spring (April).

MCPA and dicamba belong to a group of pesticides known as acid herbicides. A recent report on PPWB pesticide data by the COWQ highlighted that MCPA and dicamba exhibit regular patterns of excursions to the water quality objectives on the Carrot and Assiniboine rivers. Other rivers are not sampled annually for acid herbicides and consequently the excursion frequency and patterns are more difficult to evaluate for those other rivers. The report highlighted that the pesticide exceedances occur primarily during the spring and summer months. The COWQ is continuing to follow up on pesticides and is working with the jurisdictions on the recommendations and follow-up actions from this report. Additional annual monitoring of the acid herbicides has been implemented for the rivers that most frequently exhibit pesticide excursions.

The PPWB, as noted earlier, has also implemented the monitoring of glyphosate and its metabolites as this is the highest single use pesticide in the prairies. In 2017, glyphosate was monitored on the Churchill, Carrot, Red Deer near Erwood, and the Assiniboine rivers on the Saskatchewan-Manitoba boundary. In addition, one sample was also collected from the Saskatchewan River in February. For all the rivers where samples were collected, glyphosate was detectable in at least one sample for all sites except the Churchill River where no detections were found. Of the five rivers monitored in 2017, the Red Deer River had the highest glyphosate concentration at 747 ng/L. Peak concentrations in glyphosate varied for each of the rivers depending on the river reach. For the Red Deer and Assiniboine rivers, the peak concentrations occurred in April during spring freshet. For the Carrot River, peak concentrations occurred in late winter (January). The COWQ will continue to monitor and report detections of glyphosate in the transboundary rivers given its extensive use throughout the prairies.

Table 2: Excursion frequency summary table for Alberta-Saskatchewan water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).

	ALBERTA-SASKATCHEWAN BOUNDARY					
	BATTLE RIVER	BEAVER RIVER	COLD RIVER	NORTH SASK. RIVER	RED DEER RIVER A/S	SOUTH SASK. RIVER
METALS						
ARSENIC DISSOLVED	—	—	—	—	—	—
ARSENIC TOTAL	1(12)	0(12)	0(12)	0(12)	0(12)	0(12)
BARIUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
BERYLLIUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
BORON TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
CADMIUM TOTAL	3(12)	4(12)	1(12)	2(12)	—	1(12)
CHROMIUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
COBALT TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
COPPER TOTAL	4(12)	0(12)	0(12)	3(12)	—	1(12)
IRON DISSOLVED	1(12)	2(12)	0(12)	0(12)	0(12)	0(12)
LEAD TOTAL	2(12)	0(12)	0(12)	1 (12)	2(12)	1(12)
LITHIUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
MANGANESE DISSOLVED	—	—	0(12)	0(12)	0(12)	0(12)
MOLYBDENUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
NICKEL DISSOLVED	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
SELENIUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
SILVER TOTAL	0(12)	0(12)	0(12)	0(12)	2(12)	0(12)
THALLIUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
URANIUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
VANADIUM TOTAL	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
ZINC TOTAL	1(12)	0(12)	0(12)	1(12)	2(12)	1(12)
NUTRIENTS						
AMMONIA UN-IONIZED	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
PHOSPHORUS TOTAL *	4(12)	1(12)	0(12)	2(12)	2.5(12)	1(12)
PHOSPHORUS TOTAL DISSOLVED *	5(12)	2.5(12)	2(12)	0.5(12)	2.5(12)	0.5(12)
NITROGEN TOTAL *	5(12)	1(12)	5(12)	1(12)	4(12)	2.5(12)
NITROGEN DISSOLVED NO3 & NO2	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
MAJOR IONS						
CHLORIDE DISSOLVED	0(12)	0(12)	0(11)	0(12)	0(12)	0(12)
FLUORIDE DISSOLVED	0(12)	0(12)	0(11)	0(12)	0(12)	0(12)
SODIUM DISSOLVED/FILTERED	1(12)	0(12)	0(11)	0(12)	0(12)	0(12)
SULPHATE DISSOLVED	0(12)	0(12)	0(11)	0(12)	0(12)	0(12)
TOTAL DISSOLVED SOLIDS	2(12)	0(12)	0(10)	0(12)	0(12)	0(12)
BIOTA						
COLIFORMS FECAL	3(12)	0(12)	0(12)	1(12)	2(12)	1(12)
ESCHERICHIA COLI	1(12)	0(12)	0(12)	1(12)	1(12)	1(12)
PHYSICALS and OTHERS						
OXYGEN DISSOLVED	0(6)	0(5)	0(12)	0(12)	0(12)	0(12)
PH	0(12)	0(12)	0(12)	0(12)	0(12)	0(12)
SODIUM ABSORPTION RATIO	—	0(12)	0(11)	0(12)	0(12)	0(12)
TOTAL SUSPENDED SOLIDS	2(7)	2(7)	4(7)	5(7)	2(7)	2(7)
Number of Excursion Comparisons	**397**	**408**	**420**	**427**	**403**	**427**
Total Number of Excursions Observed	**35**	**12.5**	**12**	**17.5**	**20.0**	**12**
Sampling Frequency (no./year)	**12**	**12**	**12**	**12**	**12**	**12**

* Summary information – details in Table 6

Table 3: Excursion frequency summary table for Saskatchewan-Manitoba water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).

	SASKATCHEWAN-MANITOBA BOUNDARY					
	ASSINIBOINE RIVER	CARROT RIVER	CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER S/M	SASK. RIVER
METALS						
ARSENIC DISSOLVED	—	0(12)	—	0(12)	—	—
ARSENIC TOTAL	0(12)	—	0(4)	—	0(12)	0(12)
BARIUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
BERYLLIUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
BORON TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
CADMIUM TOTAL	1(12)	1(12)	0(4)	1(12)	2(12)	1(12)
CHROMIUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
COBALT TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
COPPER TOTAL	1(12)	1(12)	0(4)	2(12)	1(12)	1(12)
IRON DISSOLVED	0(12)	—	0(4)	0(12)	0(12)	0(12)
LEAD TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
LITHIUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
MANGANESE DISSOLVED	—	—	0(4)	—	4(12)	0(12)
MOLYBDENUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
NICKEL DISSOLVED	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
SELENIUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
SILVER TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
THALLIUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
URANIUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
VANADIUM TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
ZINC TOTAL	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
NUTRIENTS						
AMMONIA UN-IONIZED	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
PHOSPHORUS TOTAL *	2(12)	7(12)	0(4)	1(12)	3.5(12)	1(12)
PHOSPHORUS TOTAL DISSOLVED *	2(12)	7(12)	1(4)	0.5(12)	3.5(12)	0(12)
NITROGEN TOTAL *	4(12)	5.5(12)	1(4)	2(12)	3(12)	1(12)
NITROGEN DISSOLVED NO3 & NO2	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
MAJOR IONS						
CHLORIDE DISSOLVED	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
FLUORIDE DISSOLVED	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
SODIUM DISSOLVED/FILTERED	0(12)	0(12)	0(4)	1(12)	0(12)	0(12)
SULPHATE DISSOLVED	6(12)	0(12)	0(4)	4(12)	0(12)	0(12)
TOTAL DISSOLVED SOLIDS	5(12)	0(12)	0(4)	3(12)	3(12)	0(12)
BIOTA						
COLIFORMS FECAL	2(12)	0(12)	0(4)	4(12)	0(12)	0(12)
ESCHERICHIA COLI	1(12)	0(12)	0(4)	0(12)	0(12)	0(12)
PHYSICALS and OTHERS						
OXYGEN DISSOLVED	0(12)	0(5)	0(4)	0(12)	0(12)	0(12)
PH	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
SODIUM ABSORPTION RATIO	0(12)	—	0(4)	—	0(12)	0(12)
TOTAL SUSPENDED SOLIDS	3(7)	1(7)	1(3)	2(7)	3(6)	2(7)
Number of Excursion Comparisons	**415**	**384**	**143**	**403**	**426**	**427**
Total Number of Excursions Observed	**27**	**22.5**	**3**	**20.5**	**23**	**6**
Sampling Frequency (no./year)	**12**	**12**	**4**	**12**	**12**	**12**

* Summary information – details in Table 7

Table 4: Excursion frequency summary table of pesticides for Alberta-Saskatchewan water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).

	ALBERTA-SASKATCHEWAN BOUNDARY					
	BATTLE RIVER	BEAVER RIVER	COLD RIVER	NORTH SASK. RIVER	RED DEER RIVER A/S	SOUTH SASK. RIVER
PESTICIDES						
2,4-D	0(8)	0(8)	Not sampled	0(8)	0(8)	0(8)
ATRAZINE	NA	0(7)		NA	NA	NA
BROMOXYNIL	0(8)	0(8)		0(8)	0(8)	0(8)
DICAMBA	0(8)	0(8)		0(8)	2(8)	3(8)
DICLOFOP-METHYL	NA	0(7)		NA	NA	NA
ENDOSULFAN	NA	0(8)		NA	NA	NA
GAMMA-BENZENEHEXACHLORIDE	NA	0(8)		NA	NA	NA
HEXACHLOROBENZENE	NA	0(8)		NA	NA	NA
MCPA	0(8)	0(8)		0(8)	0(8)	0(8)
METOLACHLOR	NA	0(7)		NA	NA	NA
METRIBUZIN	NA	0(7)		NA	NA	NA
PENTACHLOROPHENOL (PCP)	—	—		—	—	—
PICLORAM	0(8)	0(8)		0(8)	0(8)	0(8)
SIMAZINE	NA	0(7)		NA	NA	NA
TRIALLATE	NA	0(7)		NA	NA	NA
TRIFLURALIN	NA	0(7)		NA	NA	NA
GLYPHOSATE	Not sampled	3(8)[a]		Not sampled	Not sampled	Not sampled
Number of Excursion Comparisons	**40**	**113**		**40**	**40**	**40**
Total Number of Excursions Observed	**0**	**0**		**0**	**2**	**3**
Sampling Frequency (no./year)	**8**	**8**		**8**	**8**	**8**

a= Detected at low levels, not included in the excursion counts

Table 5: Excursion frequency summary table of pesticides for Saskatchewan-Manitoba water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).

	SASKATCHEWAN-MANITOBA BOUNDARY					
	ASSINIBOINE RIVER	CARROT RIVER	CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER S/M	SASK. RIVER
PESTICIDES						
2,4-D	0(12)	0(12)	0(4)	0(8)	0(8)	0(8)
ATRAZINE	0(12)	0(12)	0(4)	NA	0(8)	0(1)
BROMOXYNIL	0(12)	0(12)	0(4)	0(8)	0(8)	0(8)
DICAMBA	2(12)	1(12)	0(4)	0(8)	0(8)	0(8)
DICLOFOP-METHYL	0(12)	0(12)	0(4)	NA	0(8)	0(1)
ENDOSULFAN	0(12)	0(12)	0(4)	NA	0(8)	0(1)
GAMMA-BENZENEHEXACHLORIDE	0(12)	0(12)	0(4)	NA	0(8)	0(1)
HEXACHLOROBENZENE	0(12)	0(12)	0(4)	NA	0(8)	0(1)
MCPA	2(12)	0(12)	0(4)	1(8)	0(8)	0(8)
METOLACHLOR	0(12)	0(12)	0(4)	NA	0(8)	0(1)
METRIBUZIN	0(12)	0(12)	0(4)	NA	0(8)	0(1)
PENTACHLOROPHENOL (PCP)	—	—	—	—	—	—
PICLORAM	0(12)	0(12)	0(4)	0(8)	0(8)	0(8)
SIMAZINE	0(12)	0(12)	0(4)	NA	0(8)	0(1)
TRIALLATE	0(12)	0(12)	0(4)	NA	0(8)	0(1)
TRIFLURALIN	0(12)	0(12)	0(4)	NA	0(8)	0(1)
GLYPHOSATE	10 (12)[a]	11(12)[a]	0(4)	Not Sampled	7 (8)[a]	1(1)[a]
Number of Excursion Comparisons	**180**	**180**	**60**	**40**	**120**	**50**
Total Number of Excursions Observed	**4**	**1**	**0**	**1**	**0**	**0**
Sampling Frequency (no./year)	**12**	**12**	**4**	**8**	**8**	**8**

a= Detected at low levels, not included in the excursion counts

Table 6: Nutrient Excursions for Alberta-Saskatchewan water quality stations

LOCATION		TOTAL PHOSPHORUS		TOTAL DISSOLVED PHOSPHORUS		TOTAL NITROGEN		Number of Excursion Comparisons	Total Number of Excursions Observed
BATTLE RIVER	Open Water Ice-Covered	3(7) 1(5)	3(7) 1(5)	4(7) 1(5)		2(7) 3(5)		36	14
BEAVER RIVER	Open Water Ice-Covered	1(7) 0(5)		4(7) 0(5)	1(7) 0(5)	1(7) 0(5)		36	4.5
COLD RIVER	Open Water Ice-Covered	0(7) 0(5)		2(7) 0(5)		4(7) 1(5)	4(7) 1(5)	36	7
NORTH SASK. RIVER	Open Water Ice-Covered	2(7) 0(5)	2(7) 0(5)	1(7) 0(5)	0(7) 0(5)	1(7) 0(5)	1(7) 0(5)	36	3.5
RED DEER RIVER A/S	Open Water Ice-Covered	1(7) 2(5)	0(7) 2(5)	1(7) 3(5)	0(7) 1(5)	1(7) 3(5)		36	9
SOUTH SASK. RIVER	Open Water Ice-Covered	1(7) 0(5)	1(7) 0(5)	0(7) 1(5)	0(7) 0(5)	2(7) 1(5)	2(7) 0(5)	36	4

Open water season = April or May to October

Downward Trend | Upward Trend | No Trend

Nutrient objectives were established based on analyses of historical data, which indicated that concentrations vary with season (open water versus ice-covered) and in some cases showed trends. In all cases, a site-specific base nutrient objective was set at the 90th percentile of data for each season, which would be exceeded on average 10% of the time (values in yellow and white boxes). Where statistical trends existed, an additional objective was established based on the 90th percentile of the lowest value 10 year period (values in blue boxes = decreasing trend; green boxes = increasing trend). Exceedance of this second objective indicates a nutrient concentration greater than the 90th percentile of the lowest 10 year period for that site.

The total number of excursions is calculated as the sum of the base objective exceedances (yellow boxes) plus the arithmetic average of the trend (blue or green boxes) and corresponding base (white boxes) objective exceedances.

Table 7: Nutrient Excursions for Saskatchewan-Manitoba water quality stations

LOCATION		TOTAL PHOSPHORUS		TOTAL DISSOLVED PHOSPHORUS		TOTAL NITROGEN		Number of Excursion Comparisons	Total Number of Excursions Observed
ASSINIBOINE RIVER	Open Water Ice-Covered	1(7) 1(5)		1(7) 1(5)		1(7) 3(5)		36	8
CARROT RIVER	Open Water Ice-Covered	6(6) 3(6)	3(6) 2(6)	5(6) 3(6)	4(6) 2(6)	4(6) 2(6)	4(6) 1(6)	36	19.5
CHURCHILL RIVER	Open Water Ice-Covered	0(3) 0(1)		1(3) 0(1)		1(3) 0(1)		12	2
QU'APPELLE RIVER	Open Water Ice-Covered	0(6) 1(6)	0(6) 1(6)	0(6) 1(6)	0(6) 0(6)	1(6) 1(6)		36	3.5
RED DEER RIVER S/M	Open Water Ice-Covered	3(6) 1(6)	2(6) 1(6)	2(6) 4(6)	0(6) 1(6)	1(6) 2(6)		36	10
SASK. RIVER	Open Water Ice-Covered	2(7) 0(5)	0(7) 0(5)	0(7) 0(5)	0(7) 0(5)	1(7) 0(5)		36	2

Open water season = April or May to October

Downward Trend | Upward Trend | No Trend

Table 8: Overall excursion summary, by category, for Alberta-Saskatchewan water quality stations.

	ALBERTA-SASKATCHEWAN BOUNDARY					
	BATTLE RIVER	BEAVER RIVER	COLD RIVER	NORTH SASK. RIVER	RED DEER RIVER A/S	SOUTH SASK. RIVER
CATEGORY						
METALS	12(228)	6(228)	1(240)	7(240)	6(216)	4(240)
NUTRIENTS (TN, TP, TDP)	14(36)	4.5(36)	7(36)	3.5(36)	9(36)	4(36)
NUTRIENTS (TOXICITY)	0(24)	0(24)	0(24)	0(24)	0(24)	0(24)
MAJOR IONS	3(60)	0(60)	0(54)	0(60)	0(60)	0(60)
BIOTA	4(24)	0(24)	0(24)	2(24)	3(24)	2(24)
PHYSICAL and OTHER	2(25)	2(36)	4(42)	5(43)	2(43)	2(43)
PESTICIDES	0(40)	0(113)	ND	0(40)	2(40)	3(40)
Number of Excursion Comparisons	**437**	**521**	**420**	**467**	**443**	**467**
Total Number of Excursions Observed	**35**	**12.5**	**12**	**17.5**	**22**	**15**
Sampling Frequency (no./year)	**12**	**12**	**12**	**12**	**12**	**12**
Overall Adherence Rate	**91.99**	**97.60**	**97.14**	**96.25**	**95.03**	**96.79**

Table 9: Overall excursion summary, by category, for Saskatchewan-Manitoba water quality stations.

	SASKATCHEWAN-MANITOBA BOUNDARY					
	ASSINIBOINE RIVER	CARROT RIVER	CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER S/M	SASK. RIVER
CATEGORY						
METALS	2(228)	2(216)	0(80)	3(228)	7(240)	2(240)
NUTRIENTS (TN, TP, TDP)	8(36)	19.5(36)	2(12)	3.5(36)	10(36)	2(36)
NUTRIENTS (TOXICITY)	0(24)	0(24)	0(8)	0(24)	0(24)	0(24)
MAJOR IONS	11(60)	0(60)	0(20)	8(60)	3(60)	0(60)
BIOTA	3(24)	0(24)	0(8)	4(24)	0(24)	0(24)
PHYSICAL and OTHER	3(43)	1(24)	1(15)	2(31)	3(42)	2(43)
PESTICIDES	4(180)	1(180)	0(60)	1(40)	0(120)	0(50)
Number of Excursion Comparisons	**595**	**564**	**203**	**443**	**546**	**477**
Total Number of Excursions Observed	**31**	**23.5**	**3**	**21.5**	**23**	**6**
Sampling Frequency (no./year)	**12**	**12**	**4**	**12**	**12**	**12**
Overall Adherence Rate	**94.79**	**95.83**	**98.52**	**95.15**	**95.79**	**98.74**

Conclusion

Interprovincial water quality objectives set at the 12 transboundary river reaches are designed to protect water uses for aquatic life, agriculture, recreation, treatability of source water for drinking water, and fish consumption. Interprovincial water quality objectives were met on average 96.1% of the time in 2017. There is an expectation that objectives will be exceeded occasionally (particularly for those set with the background method) and that some exceedances will occur naturally (for example, during high flow events). The adherence rate to interprovincial water quality objectives ranged from 98.7 (Saskatchewan River) to 92.0% (Battle River) in 2017. Water quality was generally suitable for the intended water uses for these rivers.

Overall, each of the 12 transboundary river reaches has shown little variation in adherence rate during the past 15 years. However, of the 12 rivers, the Battle and Red Deer rivers on the Alberta-Saskatchewan boundary have shown the greatest variation in compliance to the water quality objectives, indicating the susceptibility of the rivers to various weather/ hydrological and environmental factors.

Excursions from the water quality objectives for nutrients, biota (bacteria), TSS and major ions were the most common among sites. Excursions for metals were more prevalent on the Alberta-Saskatchewan boundary, while excursions for major ions were more prevalent at the Saskatchewan-Manitoba boundary sites in 2017. Excursions of TDS, sulphate and pesticides occurred for specific rivers on both boundaries. The results of this excursion report, in addition to those from previous years, indicates a number of areas that warrant further consideration by the COWQ, Board, and/or provinces.

- Nutrients continue to remain a priority for the PPWB. The COWQ's work to understand sources and trends in nutrients is on-going. The recent completion and update of the trend analysis work to the end of 2013, and a review of priority parameters across both boundaries, has highlighted that TN is increasing in a number of the transboundary rivers and will continue to be a high priority. The COWQ continues to work on the Red Deer River (AB/SK) and Carrot River pilot project, and while this project is still on-going it is anticipated to be completed within the next year. In 2018, the COWQ will continue to discuss and follow up on nutrient issues in the transboundary rivers.
- Suspended solids and flow can play an important role with respect to their influence on certain water quality parameters, in particular total metals and nutrients. While TSS and flow appear to be related to spikes in metals and nutrients observed in the transboundary rivers, this does not explain all the exceedances or variation observed with these parameters. Further investigation of the relationship between flow and TSS to these parameters is warranted to better understand these relationships.
- For pesticides, the frequent exceedance of the acid herbicides, MCPA and dicamba objectives in prairie rivers is suggestive of a generally low-concentration but wide spread presence of these pesticides in the environment. Monitoring of glyphosate and its breakdown products also show that this widely used pesticide is also frequently present at low-concentrations. Given its detection in the larger transboundary river systems it is considered to be present at a broad scale across the Prairie Provinces. The COWQ is continuing to work with the jurisdictions to better understand the presence and the effects of these pesticides to the aquatic environment and users of these waters.
- Overall, in comparison to other sites, the Battle River and the Red Deer River on the Alberta-Saskatchewan boundary, continue to have the lowest adherence rates to the water quality objectives (due to excursions in nutrients, metals, major ions, bacteria, and TSS). On the Saskatchewan-Manitoba boundary, the Assiniboine River had the lowest compliance to the water quality objectives in 2017, due to excursions in nutrients and major ions. The Carrot River had the second highest number of excursions in 2017 in part due to a substantial number of excursions to nutrients.
- A number of the transboundary prairie rivers have higher saline waters and constituent ions that vary based on precipitation, flow, and groundwater inputs. Total dissolved solids and sulphate are the two parameters that appear to exceed water quality objectives the most in select transboundary rivers, particularly on the Saskatchewan-Manitoba transboundary rivers. In addition, increasing trends have been noted in a number of rivers. The COWQ will continue to track these parameters and evaluate as more data become available.

Ongoing

Interprovincial water quality objectives have been reviewed for all transboundary river reaches and revised objectives were approved by Ministers responsible for the PPWB on July 8th, 2015. The revised objectives adopted an approach to protect all water uses for all rivers, and included a number of site-specific water quality objectives for selected parameters. This report represents the third year that the PPWB is reporting against these water quality objectives. However, the COWQ is continuing to work on updating water quality objectives, particularly in those areas where objectives were not established for select parameters and rivers, including several metals (dissolved iron and manganese, total copper and cadmium) and dissolved oxygen. It is anticipated that the objectives will continue to be revised with updated water quality objectives proposed for the transboundary rivers in 2020.

The COWQ also continues to work on the review of excursions to the approved interprovincial water quality objectives and prioritization of any potential issues for further consideration or actions. Several areas have been flagged by the COWQ including nutrients, and in particular TN trends, which have been assessed as a priority. While nutrients have been assigned the highest priority in all transboundary watersheds, there is a focus on investigating nutrient levels in two transboundary watersheds as a pilot program: the Red Deer River (AB/SK) and Carrot River watersheds. Once this work has been completed, the COWQ will assess the next steps to address nutrient issues.

Other areas of interest to the COWQ include pesticides that have also been identified as a priority area for future work. The COWQ has completed a review of all available pesticide data for the PPWB transboundary rivers (PPWB Report #175, 2016) and will continue to follow up on pesticides with the jurisdictions with particular emphasis on the acid herbicides and glyphosate, which are the most frequently detected pesticides in transboundary rivers. One recommendation from the report was to increase acid herbicide monitoring to every year on select rivers which have had a number of observed detections. Environment and Climate Change Canada has implemented annual monitoring for the acid herbicides to address this recommendation.

In the 2015 Excursion report, the COWQ recommended a further review of the Red Deer River (AB/SK) following a number of excursions on that river, and some observed unusual water quality conditions. Alberta Environment and Parks are continuing to review provincial data and assess the potential causes of non-compliance. This work has been initiated, is on-going and is anticipated to be completed in 2018. Once the available information has been reviewed, the COWQ will make recommendations on whether further investigation is warranted.

The assessment of excursions to water quality objectives will continue to assist the COWQ to assess areas of potential concern and to set future priorities. In conjunction with the excursion assessment, the COWQ will continue to look at long term trends in water quality for each of the transboundary rivers. Trend analysis work incorporating additional data was completed in 2017 and the report is anticipated to be available in 2018.

References

Kerr, J.G. and Cooke, C.A. 2017. Erosion of the Alberta badlands produces highly variable and elevated heavy metal concentrations in the Red Deer River, Alberta. Science of the Total Environment 596-597: 427-436.

MAA Schedule E 1992. Agreement on water quality. http://www.ppwb.ca/information/115/index.html

PPWB Report #175. 2016. Response to the 2011 pesticide excursions in transboundary rivers in the prairie provinces of Canada. pp. 103.

PPWB Report #177. 2017. Prairie water quality workshop with a focus on nutrients. Prepared by S. L. McLeod Consulting pp. 32.

Appendix 1: Water Quality Objectives
Table A1: AB-SK

	2015 Interprovincial Water Quality Objectives – AB-SK Boundary					
PARAMETER	**BATTLE RIVER**	**BEAVER RIVER**	**COLD RIVER**	**NORTH SASK. RIVER**	**RED DEER RIVER (BINDLOSS)**	**SOUTH SASK. RIVER**
Nutrients						
Nitrate as N (mg/L)	3	3	3	3	3	3
Ammonia Un-ionized (mg/L)	0.019[a]	0.019[a]	0.019[a]	0.019[a]	0.019[a]	0.019[a]
Major Ions						
Total Dissolved Solids (mg/L)	872	500	500	500	500	500
Sulphate Dissolved (mg/L)	250	250	250	250	250	250
Sodium Dissolved (mg/L)	200	200	200	200	200	200
Fluoride Dissolved (mg/L)	0.31	0.19	0.12	0.18	0.2	0.19
Chloride Dissolved (mg/L)	100	100	100	100	100	100
Physicals and Other						
pH Lab	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
pH Field	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
Oxygen Dissolved (mg/L)						
Open Water Season (>5°C)	5	5	5	5	5	5
Ice-Covered Season (<5°C)	Under Review	Under Review	3	3	3	3
Sodium Adsorption Ratio	Under Review	3	3	3	3	3
Total Suspended Solids (mg/L)	5.0-320.0	3.0-48.8	1.2-4.8	5.0-295.8	30.0-832.6	5.6-339.8
Biota						
E. Coli (No./100 mL)	200	200	200	200	200	200
Coliforms Fecal (No./100 mL)	100	100	100	100	100	100
Metals						
Arsenic Total (µg/L)	5	5	5	5	5	5
Arsenic Dissolved (µg/L)	No Objective	No Objective	No Objective	No Objective	No Objective	No Objective
Barium Total (µg/L)	1000	1000	1000	1000	1000	1000
Beryllium Total (µg/L)	100	100	100	100	100	100
Boron Total (µg/L)	500[b]	500[b]	500[b]	500[b]	500[b]	500[b]
Cadmium Total (µg/L)	Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]	Under Review	Calculated[c]
Chromium Total (µg/L)	50	50	50	50	50	50
Cobalt Total (µg/L)	50	50	50	50	50	50
Copper Total (µg/L)	Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]	Under Review	Calculated[c]
Iron Dissolved (µg/L)	300	300	300	300	300	300
Lead Total (µg/L)	Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]
Lithium Total (µg/L)	2500	2500	2500	2500	2500	2500
Manganese Dissolved (µg/L)	Under Review	Under Review	50	50	50	50
Molybdenum Total (µg/L)	10[d]	10[d]	10[d]	10[d]	10[d]	10[d]
Nickel Dissolved (µg/L)	Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]
Selenium Total (µg/L)	1	1	1	1	1	1
Silver Total (µg/L)	0.1	0.1	0.1	0.1	0.1	0.1
Thallium Total (µg/L)	0.8	0.8	0.8	0.8	0.8	0.8
Uranium Total (µg/L)	10	10	10	10	10	10
Vanadium Total (µg/L)	100	100	100	100	100	100
Zinc Total (µg/L)	30	30	30	30	30	30

Superscripts

a. Ammonia guideline: Expressed as mg unionized ammonia per L. This would be equivalent to 15.6 mg/L ammonia-nitrogen. Guideline for total ammonia is temperature and pH dependent, please consult the Canadian Water Quality Guidelines for the Protection of Aquatic Life Ammonia factsheet for more information.

b. Guideline is crop-specific 500 to 6000 µg/L.

c. Value is a function of hardness (mg/L) in the water column. The objective is a calculated value.
Cadmium Concentration = $10^{0.86[\log10(\text{hardness})]-3.2}$ µg/L
Copper Concentration = $e^{0.8545[\ln(\text{hardness})-1.465}$ *0.2 µg/L
The copper objective is a minimum of 2 µg/L regardless of water hardness. If the water hardness is not known, the objective is 2 µg/L. The Objective maximum is 4 µg/L
Lead Concentration = $e^{1.273[\ln \text{hardness})]-4.705}$ µg/L. The objective is a minimum of 1 µg/L regardless of water hardness. If the water hardness is not known, the objective is 1 µg/L.
Nickel Concentration = $0.998*e^{(0.8460[\ln (\text{hardness})]+2.255)}$µg/L

d. Molybdenum guideline = up to 50 $\mu g/L^{-1}$ for short-term use on acidic soils.

Table A2: AB-SK

	2015 Water Quality Objectives – AB-SK Boundary					
PARAMETER	BATTLE RIVER	BEAVER RIVER	COLD RIVER	NORTH SASK. RIVER	RED DEER RIVER (BINDLOSS)	SOUTH SASK. RIVER
Acid Herbicides						
2,4-D (µg/L)	4	4	4	4	4	4
Bromoxynil (µg/L)	0.33	0.33	0.33	0.33	0.33	0.33
Dicamba (µg/L)	0.006	0.006	0.006	0.006	0.006	0.006
MCPA (µg/L)	0.025	0.025	0.025	0.025	0.025	0.025
Picloram (µg/L)	29	29	29	29	29	29
Organochlorine Pesticides in Water						
Endosulfan (µg/L)	0.003	0.003	0.003	0.003	0.003	0.003
Hexachlorocyclohexane (gamma-HCH) (Lindane) (µg/L)	0.01	0.01	0.01	0.01	0.01	0.01
Hexachlorobenzene (µg/L)	0.52	0.52	0.52	0.52	0.52	0.52
Pentachlorophenol (PCP) (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5
Neutral Herbicides in Water						
Atrazine (µg/L)	1.8	1.8	1.8	1.8	1.8	1.8
Diclofopmethyl (Hoegrass)* (µg/L)	0.18	0.18	0.18	0.18	0.18	0.18
Metolachlor (µg/L)	7.8	7.8	7.8	7.8	7.8	7.8
Metribuzin (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5
Simazine (µg/L)	0.5	0.5	0.5	0.5	0.5	0.5
Triallate (µg/L)	0.24	0.24	0.24	0.24	0.24	0.24
Trifluralin (µg/L)	0.2	0.2	0.2	0.2	0.2	0.2
Other						
Glyphosate (ng/L)	Report Detections	Report Detections	Report Detections	Report Detections	Report Detections	Report Detections

Legend

Protection of Aquatic Life	Ag-Livestock	Ag-Irrigation	Recreation	Treatability	Ag-Irrigation + Treatability	Ag-Irrigation and Livestock	Fish Consumption

Table A3: SK-MB

2015 Interprovincial Water Quality Objectives – SK-MB Boundary							
PARAMETER	ASSINIBOINE RIVER	CARROT RIVER		CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER (ERWOOD)	SASK. RIVER
		open	closed				
Nutrients							
Nitrate as N (mg/L)	3	3		3	3	3	3
Ammonia Un-ionized (mg/L)	0.019[a]	0.019[a]		0.019[a]	0.019[a]	0.019[a]	0.019[a]
Major Ions							
Total Dissolved Solids (mg/L)	834	742	1672	500	1144	500	500
Sulphate Dissolved (mg/L)	299	250		250	486	250	250
Sodium Dissolved (mg/L)	200	164	442	200	200	200	200
Fluoride Dissolved (mg/L)	0.26	0.20	0.29	0.12	0.25	0.18	0.18
Chloride Dissolved (mg/L)	100	267	728	100	100	100	100
Physicals and Other							
pH Lab	6.5-9.0	6.5-9.0		6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
pH Field	6.5-9.0	6.5-9.0		6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
Oxygen Dissolved (mg/L)							
Open Water Season (>5°C)	5	5		5	5	5	5
Ice Covered Season (<5°C)	3	Under Review		3	3	3	3
Sodium Adsorption Ratio	3	Under Review		3	Under Review	3	3
Total Suspended Solids (mg/L)	5.0-69.2	6.08-98.2		2.2-6.2	22.6-122.2	1.0-19.7	27.0-125.0
Biota							
E. Coli (No./100 mL)	200	200		200	200	200	200
Coliforms Fecal (No./100 mL)	100	100		100	100	100	100
Metals							
Arsenic Total (µg/L)	5	No Objective		5	No Objective	5	5
Arsenic Dissolved (µg/L)	No Objective	50		No Objective	50	No Objective	No Objective
Barium Total (µg/L)	1000	1000		1000	1000	1000	1000
Beryllium Total (µg/L)	100	100		100	100	100	100
Boron Total (µg/L)	500[b]	500[b]		500[b]	500[b]	500[b]	500[b]
Cadmium Total (µg/L)	Calculated[c]	Calculated[c]		Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]
Chromium Total (µg/L)	50	50		50	50	50	50
Cobalt Total (µg/L)	50	50		50	50	50	50
Copper Total (µg/L)	Calculated[c]	Calculated[c]		Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]
Iron Dissolved (µg/L)	300	Under Review		300	300	300	300
Lead Total (µg/L)	Calculated[c]	Calculated[c]		Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]
Lithium Total (µg/L)	2500	2500		2500	2500	2500	2500
Manganese Dissolved (µg/L)	Under Review	Under Review		50	Under Review	50	50
Molybdenum Total (µg/L)	10[d]	10[d]		10[d]	10[d]	10[d]	10[d]
Nickel Dissolved (µg/L)	Calculated[c]	Calculated[c]		Calculated[c]	Calculated[c]	Calculated[c]	Calculated[c]
Selenium Total (µg/L)	1	1		1	1	1	1
Silver Total (µg/L)	0.1	0.1		0.1	0.1	0.1	0.1
Thallium Total (µg/L)	0.8	0.8		0.8	0.8	0.8	0.8
Uranium Total (µg/L)	10	10		10	10	10	10
Vanadium Total (µg/L)	100	100		100	100	100	100
Zinc Total (µg/L)	30	30		30	30	30	30

Superscripts

a. Ammonia guideline: Expressed as mg unionized ammonia per L. This would be equivalent to 15.6 mg/L ammonia-nitrogen. Guideline for total ammonia is temperature and pH dependent, please consult the Canadian Water Quality Guidelines for the Protection of Aquatic Life Ammonia factsheet for more information.

b. Guideline is crop-specific 500 to 6000 µg/L.

c. Value is a function of hardness (mg/L) in the water column. The objective is a calculated value.
Cadmium Concentration = $10^{0.86[\log10(\text{hardness})]-3.2}$ µg/L
Copper Concentration = $e^{0.8545[\ln(\text{hardness})-1.465}$ *0.2 µg/L
The copper objective is a minimum of 2 µg/L regardless of water hardness. If the water hardness is not known, the objective is 2 µg/L. The Objective maximum is 4 µg/L
Lead Concentration = $e^{1.273[\ln \text{hardness})]-4.705}$ µg/L. The objective is a minimum of 1 µg/L regardless of water hardness. If the water hardness is not known, the objective is 1 µg/L.
Nickel Concentration = $0.998*e^{\{0.8460[\ln (\text{hardness})]+2.255\}}$µg/L

d. Molybdenum guideline = up to 50 $\mu g/L^{-1}$ for short-term use on acidic soils.

Table A4: SK-MB

	2015 Water Quality Objectives – SK-MB Boundary						
PARAMETER	ASSINIBOINE RIVER	CARROT RIVER		CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER (ERWOOD)	SASK. RIVER
		open	closed				
Acid Herbicides							
2,4-D (µg/L)	4	4		4	4	4	4
Bromoxynil (µg/L)	0.33	0.33		0.33	0.33	0.33	0.33
Dicamba (µg/L)	0.006	0.006		0.006	0.006	0.006	0.006
MCPA (µg/L)	0.025	0.025		0.025	0.025	0.025	0.025
Picloram (µg/L)	29	29		29	29	29	29
Organochlorine Pesticides in Water							
Endosulfan (µg/L)	0.003	0.003		0.003	0.003	0.003	0.003
Hexachlorocyclohexane (gamma-HCH) (Lindane) (µg/L)	0.01	0.01		0.01	0.01	0.01	0.01
Hexachlorobenzene (µg/L)	0.52	0.52		0.52	0.52	0.52	0.52
Pentachlorophenol (PCP) (µg/L)	0.5	0.5		0.5	0.5	0.5	0.5
Neutral Herbicides in Water							
Atrazine (µg/L)	1.8	1.8		1.8	1.8	1.8	1.8
Diclofopmethyl (Hoegrass)* (µg/L)	0.18	0.18		0.18	0.18	0.18	0.18
Metolachlor (µg/L)	7.8	7.8		7.8	7.8	7.8	7.8
Metribuzin (µg/L)	0.5	0.5		0.5	0.5	0.5	0.5
Simazine (µg/L)	0.5	0.5		0.5	0.5	0.5	0.5
Triallate (µg/L)	0.24	0.24		0.24	0.24	0.24	0.24
Trifluralin (µg/L)	0.2	0.2		0.2	0.2	0.2	0.2
Other							
Glyphosate (ng/L)	Report Detections	Report Detections		Report Detections	Report Detections	Report Detections	Report Detections

Legend

Protection of Aquatic Life	Ag-Livestock	Ag-Irrigation	Recreation	Treatability	Ag-Irrigation + Treatability	Ag-Irrigation and Livestock	Fish Consumption

Table A5: AB-SK

PARAMETER	2015 Water Quality Objectives – Alberta-Saskatchewan Boundary					
	BATTLE RIVER	BEAVER RIVER	COLD RIVER	NORTH SASK. RIVER	RED DEER RIVER (BINDLOSS)	SOUTH SASK. RIVER
Physicals and Other						
Reactive Chlorine Species (mg/L)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Cyanide (free) (mg/L)	0.005	0.005	0.005	0.005	0.005	0.005
Metals						
Mercury (total) (µg/L)	0.026	0.026	0.026	0.026	0.026	0.026
Fish Tissue						
Mercury in Fish (muscle) (µg/kg)	200	200	200	200	200	200
Arsenic in fish (muscle) (µg/kg)	3500	3500	3500	3500	3500	3500
Lead In fish (muscle) (µg/kg)	500	500	500	500	500	500
DDT (total) in fish (muscle) (µg/kg)	5000	5000	5000	5000	5000	5000
Aquatic Biota Consumption						
PCB in fish (muscle) mammalian (µg TEQ/kg diet wet weight)	0.00079	0.00079	0.00079	0.00079	0.00079	0.00079
PCB in fish (muscle) avian (µg TEQ/kg diet wet weight)	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
DDT total in fish (muscle) (µg/kg diet wet weight)	14	14	14	14	14	14
Toxaphene in fish (muscle) (µg/kg diet wet weight)	6.3	6.3	6.3	6.3	6.3	6.3
Radioactive						
Cesium-137 (Bq/L)	10	10	10	10	10	10
Iodine-131 (Bq/L)	6	6	6	6	6	6
Lead-210 (Bq/L)	0.2	0.2	0.2	0.2	0.2	0.2
Radium-226 (Bq/L)	0.5	0.5	0.5	0.5	0.5	0.5
Strontium-90 (Bq/L)	5	5	5	5	5	5
Tritium (Bq/L)	7000	7000	7000	7000	7000	7000

Legend

Protection of Aquatic Life	Treatability	Fish Consumption

Table A6: SK-MB

2015 Water Quality Objectives – Saskatchewan-Manitoba Boundary							
PARAMETER	ASSINIBOINE RIVER	CARROT RIVER		CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER (ERWOOD)	SASK. RIVER
		open	closed				
Physicals and Other							
Reactive Chlorine Species (mg/L)	0.0005	0.0005		0.0005	0.0005	0.0005	0.0005
Cyanide (free) (mg/L)	0.005	0.005		0.005	0.005	0.005	0.005
Metals							
Mercury (total) (µg/L)	0.026	0.026		0.026	0.026	0.026	0.026
Fish Tissue							
Mercury in Fish (muscle) (µg/kg)	200	200		200	200	200	200
Arsenic in fish (muscle) (µg/kg)	3500	3500		3500	3500	3500	3500
Lead In fish (muscle) (µg/kg)	500	500		500	500	500	500
DDT (total) in fish (muscle) (µg/kg)	5000	5000		5000	5000	5000	5000
Aquatic Biota Consumption							
PCB in fish (muscle) mammalian (µg TEQ/kg diet wet weight)	0.00079	0.00079		0.00079	0.00079	0.00079	0.00079
PCB in fish (muscle) avian (µg TEQ/kg diet wet weight)	0.0024	0.0024		0.0024	0.0024	0.0024	0.0024
DDT total in fish (muscle) (µg/kg diet wet weight)	14	14		14	14	14	14
Toxaphene in fish (muscle) (µg/kg diet wet weight)	6.3	6.3		6.3	6.3	6.3	6.3
Radioactive							
Cesium-137 (Bq/L)	10	10		10	10	10	10
Iodine-131 (Bq/L)	6	6		6	6	6	6
Lead-210 (Bq/L)	0.2	0.2		0.2	0.2	0.2	0.2
Radium-226 (Bq/L)	0.5	0.5		0.5	0.5	0.5	0.5
Strontium-90 (Bq/L)	5	5		5	5	5	5
Tritium (Bq/L)	7000	7000		7000	7000	7000	7000

Legend

Protection of Aquatic Life	Treatability	Fish Consumption

Table A7: Site-specific nutrient objectives, both boundaries

Nutrient Objectives							
Objectives for Nutrients		Total Phosphorus (mg/L)		Total Dissolved Phosphorus (mg/L)		Total Nitrogen (mg/L)	
Alberta-Saskatchewan Boundary							
Battle River near Unwin	Open Water	0.267	0.335	0.051		2.260	
	Ice-covered	0.075	0.100	0.045		1.550	
Beaver River at Beaver Crossing	Open Water	0.171		0.043	0.060	1.140	
	Ice-covered	0.127		0.042	0.060	1.862	
Cold River at Outlet of Cold Lake	Open Water	0.023		0.010		0.453	0.460
	Ice-covered	0.024		0.017		0.452	0.467
North Saskatchewan River at Highway 17	Open Water	0.253	0.278	0.026	0.046	1.169	1.230
	Ice-covered	0.063	0.115	0.048	0.101	1.175	1.225
Red Deer River near Bindloss	Open Water	0.315	0.563	0.023	0.035	2.320	
	Ice-covered	0.035	0.069	0.008	0.024	0.860	
South Saskatchewan River	Open Water	0.159	0.246	0.014	0.018	1.073	1.114
	Ice-covered	0.054	0.110	0.010	0.067	1.638	1.771

Legend

No Trend – 90th % of Database	90th % of Database	Decreasing Trend – Lowest 90th % of 10yr Running	Increasing Trend – Lowest 90th % of 10yr Running

Table A7: Site-specific nutrient objectives, both boundaries *continued*

Nutrient Objectives								
Objectives for Nutrients		Total Phosphorus (mg/L)		Total Dissolved Phosphorus (mg/L)		Total Nitrogen (mg/L)		
Saskatchewan-Manitoba Boundary								
Assiniboine River at Hwy 8 Bridge	Open Water	0.311		0.186		1.801		
	Ice-covered	0.180		0.115		2.252		
Carrot River near Turnberry	Open Water	0.099	0.140	0.027	0.057	1.087	1.417	
	Ice-covered	0.170	0.266	0.031	0.059	1.814	2.052	
Churchill River below Wasawakasik	Open Water	0.025		0.010		0.484		
	Ice-covered	0.021		0.010		0.411		
Qu'Appelle River	Open Water	0.278	0.304	0.156	0.190	1.822		
	Ice-covered	0.221	0.290	0.129	0.249	1.767		
Red Deer River at Erwood	Open Water	0.052	0.066	0.021	0.029	1.195		
	Ice-covered	0.074	0.161	0.025	0.055	1.998		
Saskatchewan River	Open Water	0.088	0.124	0.014	0.018	0.838		
	Ice-covered	0.028	0.034	0.011	0.017	0.761		

Legend

No Trend – 90th % of Database	90th % of Database	Decreasing Trend – Lowest 90th % of 10yr Running	Increasing Trend – Lowest 90th % of 10yr Running

Appendix 2: Water Quality Monitoring

PPWB Water Quality Monitoring 2017

The water quality monitoring program is provided in the attached table and includes the previous monitoring program (2016) and the recommended 2017 monitoring program. The changes to be implemented for 2017 from 2016 are highlighted.

In 2017, pesticide sampling is recommended on the Beaver, Churchill, and Red Deer (S/M) rivers in accordance with the standard rotation of the pesticide sampling in addition to the annual sampling at the Carrot and Assiniboine rivers. Since 2013, the COWQ has recommended that the acid herbicides be sampled on the Battle River and the South Saskatchewan River due to a number of detections of these pesticides on these two rivers. In 2015, the COWQ had also recommended that the acid herbicide pesticides be monitored on the Saskatchewan River and the Qu'Appelle River again due to frequent detections of this group of pesticides on these rivers.

Following a review of the pesticide data for all 12 transboundary rivers the COWQ is recommending that acid herbicides be added as part of the annual monitoring program to six of the transboundary rivers including: the Battle River, South Saskatchewan River, North Saskatchewan River, Red Deer River (A/S), Saskatchewan River, and the Qu'Appelle River and that the acid herbicides continue to be monitored on the Assiniboine and Carrot rivers on an annual basis. Monitoring for the other pesticide groups (neutral herbicides and organochlorines) is recommended to continue on a rotational sampling basis, with the exception of the Assiniboine and Carrot rivers which are recommended to remain as an annual sampling program.

In addition, continued monitoring of biological oxygen demand (BOD) is recommended for the Battle, Beaver and Carrot Rivers in 2017 due to low dissolved oxygen levels in these rivers during the winter months.

PPWB Monitoring 2017: Alberta-Saskatchewan Sites

SITE	NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*)	PESTICIDES (AH, NH, OC's, Glyphosate)
Site 1 Cold River	2017: 12x / year 2016: 12x / year	2017: none 2016: none
Site 2 Beaver River	2017: 12x / year 2016: 12x / year	2017: 8x / year[1, 2] 2016: none
Site 3 North Saskatchewan River	2017: 12x / year 2016: 12x / year	2017: 8x / year[1, 3] 2016: none
Site 4 Battle River	2017: 12x / year 2016: 12x / year	2017: 8x / year[1, 3] 2016: 8x / year[1, 2]
Site 5 Red Deer River A/S	2017: 12x / year 2016: 12x / year	2017: 8x / year[1, 3] 2016: 8x / year[1, 2]
Site 6 South Saskatchewan River	2017: 12x / year 2016: 12x / year	2017: 8x / year[1, 3] 2016: 8x / year[1, 3]

[1]Months sampled = Feb, Apr, May, June, July, Aug, Oct, Dec
[2]All Pesticides sampled
[3]Acid Herbicide sampled
AH: Acid Herbicide; NH: Neutral Herbicide; OC: Organochlorine;
Highlighting indicates changes from previous year's sampling schedule.

PPWB MONITORING 2017: Saskatchewan-Manitoba Sites

SITE	NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*)	PESTICIDES (AH, NH, OC's, Glyphosate)
Site 7 Churchill River	2017 : 4x / year[0] 2016 : 4x / year[0]	2017: 4x / year 2016: none
Site 8 Saskatchewan River	2017 : 12x / year 2016 : 12x / year	2017 : 8x / year[1,3] 2016 : 8x / year[1,2]
Site 9 Carrot River	2017 : 12x / year 2016 : 12x / year	2017 : 12x / year 2016 : 12x / year
Site 10 Red Deer River S/M	2017 : 12x / year 2016 : 12x / year	2017 : 8x / year[1,2] 2016 : none
Site 11 Assiniboine River	2017 : 12x / year 2016 : 12x / year	2017 : 12x / year[2] 2016 : 12x / year[2]
Site 12 Qu'Appelle River	2017 : 12x / year 2016 : 12x / year	2017 : 8x / year[1,3] 2016 : 8x / year[1,2]

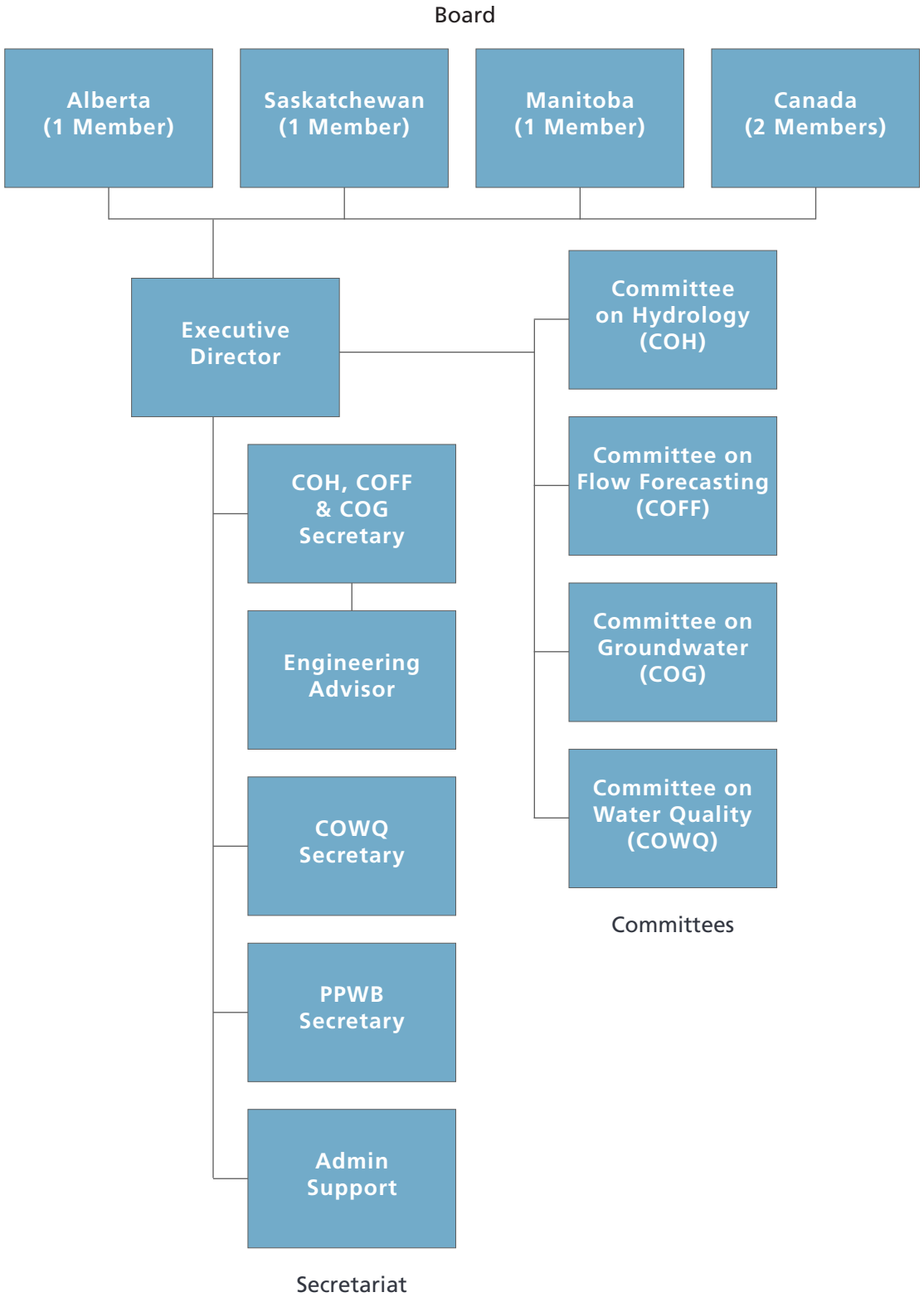
[0] Churchill River Months sampled = Feb, May, July, Oct
[1] Months sampled = Feb, Apr, May, June, July, Aug, Oct, Dec
[2] All Pesticides sampled
[3] Acid Herbicide sampled
AH: Acid Herbicide; NH: Neutral Herbicide; OC: Organochlorine;
Highlighting indicates changes from previous year's sampling schedule.

Other Objectives

Monitoring was not recommended for radionuclides, total residual chlorine, cyanide and mercury in 2017. Water quality objectives are available in Schedule E for radionuclides, total residual chlorine, cyanide and mercury. However, these water quality objectives were included in Schedule E in the event of a future water quality issue or emergency but are not intended to be routinely monitored due to low risk. For example, radionuclides have not been monitored since January 1984.

Monitoring is not recommended for contaminants in fish in 2017. The historical data set of contaminants in fish for the transboundary sites has been compiled and is currently being reviewed by the COWQ. Any future fish monitoring program will reflect the results of the previous program.

Appendix V: PPWB Organizational Chart



Appendix VI: Board / Committee Membership 2017-2018

PRAIRIE PROVINCES WATER BOARD

Manitoba, Saskatchewan, Alberta and Canada agree to establish and there is hereby established a Board to be known as the Prairie Provinces Water Board to consist of five members to be appointed as follows:

(a) two members to be appointed by the Governor General in Council, one of whom shall be Chairman of the Board, on the recommendation of the Minister of Energy, Mines and Resources,

(b) one member to be appointed by the Lieutenant Governor in Council of each of the Provinces of Manitoba, Saskatchewan and Alberta.

Schedule C, Section 1
Master Agreement on Apportionment

PPWB BOARD MEMBERS

CHAIR	Cheryl Baraniecki (Jun/15 to Feb/18)	Associate Regional Director General West & North Environment and Climate Change Canada
CHAIR	Nadine Stiller (Apr/18 to current)	Associate Regional Director General West & North Environment and Climate Change Canada
	Lynden Hillier	Director General Asset Management and Capital Planning Corporate Management Branch Agriculture and Agri-Food Canada
	Brian Yee	Director Transboundary Waters Secretariat Alberta Environment and Parks
	Steve Topping (Jul/96 to Oct/17)	Executive Director Hydrologic Forecasting & Water Management Manitoba Infrastructure
	Vacant (Nov/17 to current)	Manitoba Infrastructure
	Vacant (Sept/15 to current)	Water Security Agency (Saskatchewan)

Appendix VI: Board / Committee Membership 2017-2018 *continued*

SECRETARIAT

EXECUTIVE DIRECTOR	Mike Renouf	Transboundary Waters Unit Prairie Provinces Water Board
SECRETARY	Lynne Quinnett-Abbot	Transboundary Waters Unit Prairie Provinces Water Board

PPWB ALTERNATE BOARD MEMBERS

Paula Siwik (Nov/17 to current)	Manager, Regional Program Integration Environment and Climate Change Canada
Dave Zapshala	Director, Water Infrastructure Division Corporate Management Branch Agriculture and Agri-Food Canada
Carmen de la Chevrotière	Transboundary Water Quantity Specialist Transboundary Waters Secretariat Alberta Environment and Parks
Sam Ferris	Acting/Vice President Regulatory Division Water Security Agency (Saskatchewan)
Nicole Armstrong	Director Water Science and Watershed Management Branch Department of Sustainable Development (Manitoba)

Appendix VI: Board / Committee Membership 2017-2018 *continued*

COMMITTEE ON HYDROLOGY

Terms of Reference: Mandate

At the request of, and under the direction of the PPWB, the Committee on Hydrology (COH) shall investigate, oversee, review, report and recommend on matters pertaining to hydrology of interprovincial or interjurisdictional basins.

The committee may consider such things as natural flow; forecasting; network design; collection, processing and transmission of data; basin studies and other items of interprovincial interest involving hydrology.

The COH will engage the Committee on Groundwater, the Committee on Flow Forecasting and the Committee on Water Quality on items of mutual interest or when the expertise of those committees will assist the COH.

COMMITTEE ON HYDROLOGY MEMBERS

CHAIR	Mike Renouf	Executive Director Prairie Provinces Water Board
MEMBERS	Malcolm Conly	Hydrometric Operations Environment and Climate Change Canada
	Ron Woodvine	Corporate Management Branch Agriculture and Agri-Food Canada
	Carmen de la Chevrotière	Transboundary Waters Secretariat Alberta Environment and Parks
	Mark Lee	Surface Water Management Department of Sustainable Development (Manitoba)
	Bart Oegema	Hydrology Services Water Security Agency (Saskatchewan)
	Anthony Liu	Meteorological Service of Canada Environment and Climate Change Canada
SECRETARY	Megan Garner	Transboundary Waters Unit Prairie Provinces Water Board
	Marie Hyde	Transboundary Waters Unit Prairie Provinces Water Board

Appendix VI: Board / Committee Membership 2017-2018 *continued*

COMMITTEE ON WATER QUALITY

Terms of Reference: Mandate

Under the direction of the Prairie Provinces Water Board (PPWB), the Committee on Water Quality (COWQ) shall investigate, oversee, review, report, recommend and advise the Board on matters pertaining to the water quality and aquatic ecosystem integrity of interprovincial waters.

The responsibilities of the committee shall include directing, planning, and coordinating a water quality monitoring and trend assessment program by identifying monitoring requirements and overseeing transboundary monitoring and synoptic surveys. The committee shall promote an ecosystem approach to water quality management and the protection and enhancement of interprovincial waters by ensuring the compatibility of water quality guidelines, objectives, sampling and analytical protocols, monitoring approaches, quality assurance and data bases. It shall interpret data and identify, investigate and define existing and potential interprovincial water quality problems through the application of PPWB Water Quality Objectives, trend assessment and other approaches. The committee shall inform the Board and member agencies, through the PPWB contingency plan, of any spills or unusual water quality conditions that have the potential to adversely affect interprovincial streams. It shall assess the implications of these problems and may recommend remedial or preventative measures for avoiding and resolving water quality issues and if required, additional synoptic water quality monitoring.

The committee shall foster awareness and understanding of the importance of effective water quality management, encourage the use of "state of the art" procedures for evaluating water quality and identify research needs pertinent to water quality management on the prairies. The committee shall facilitate effective water quality management practices through integration of agency initiatives and the promotion of joint planning on interprovincial streams.

The COWQ will engage the Committee on Hydrology, Committee on Flow Forecasting and the Committee on Groundwater on items of mutual interest or when the expertise of those committees will assist COWQ.

Appendix VI: Board / Committee Membership 2017-2018 *continued*

COMMITTEE ON WATER QUALITY MEMBERS

CHAIR	Mike Renouf	Executive Director Prairie Provinces Water Board
MEMBERS	Paul Klawunn	Science and Technology Branch Environment and Climate Change Canada
	Nicole Armstrong (2009 to Apr/17)	Water Science and Watershed Management Branch Department of Sustainable Development (Manitoba)
	Elaine Page (Apr/17 to current)	Water Science and Watershed Management Branch Department of Sustainable Development (Manitoba)
	John-Mark Davies	Water Quality Services Water Security Agency (Saskatchewan)
	Gongchen Li	Transboundary Waters Secretariat Alberta Environment and Parks
	Sharon Reedyk (Feb/14 to Feb/18)	Science and Technology Branch Agriculture and Agri-Food Canada
	Claudia Sheedy (Feb/18 to current)	Lethbridge Research and Development Centre Agriculture and Agri-Food Canada
SECRETARY	Joanne Sketchell	Transboundary Waters Unit Prairie Provinces Water Board

Appendix VI: Board / Committee Membership 2017-2018 *continued*

COMMITTEE ON GROUNDWATER

Terms of Reference: Mandate

Recognizing the inter-relationship between surface and groundwater, the Committee on Groundwater shall, at the request of, and under the direction of the Prairie Provinces Water Board, investigate, oversee, review, report, and recommend on matters pertaining to quantity and quality of groundwater at or near interprovincial boundaries.

Responsibilities of the committee may include: exchange of information; compilation and interpretation of existing data; recommendations on groundwater information and monitoring requirements; determination of implications of proposed projects which may impact the quantity and/or quality of waters at interprovincial boundaries; and other items of interjurisdictional interest involving groundwater.

The COG will engage the Committee on Hydrology, Committee on Flow Forecasting and the Committee on Water Quality on items of mutual interest or when the expertise of those committees will assist the COG.

COMMITTEE ON GROUNDWATER MEMBERS

CHAIR	Mike Renouf	Executive Director Prairie Provinces Water Board
MEMBERS	Garth van der Kamp	Groundwater Hydrology Water Science and Technology Directorate Environment and Climate Change Canada
	Anthony Cowen	Science and Technology Branch Agriculture and Agri-Food Canada
	Guy Bayegnak	Groundwater Policy Specialist Alberta Environment and Parks
	Kei Lo	Hydrology and Groundwater Services Water Security Agency (Saskatchewan)
	Graham Phipps	Groundwater Section Department of Sustainable Development (Manitoba)
SECRETARY	Megan Garner	Transboundary Waters Unit Prairie Provinces Water Board
	Marie Hyde	Transboundary Waters Unit Prairie Provinces Water Board

Appendix VI: Board / Committee Membership 2017-2018 *continued*

COMMITTEE ON FLOW FORECASTING

Terms of Reference: Mandate

At the request of, and under the direction of the Prairie Provinces Water Board (PPWB), the Committee on Flow Forecasting (COFF) shall investigate, oversee, review, report and improve the accuracy of flow forecasting at the interprovincial boundaries; and, recommend on matters pertaining to streamflow forecasting of interprovincial basins.

The committee may consider such things as flow forecasting methods, hydraulic and hydrologic basin forecast models, tools and techniques, inter-jurisdictional communications, provision and transmission of data, studies, and other items of interprovincial interest involving streamflow forecasting.

The COFF will engage the Committee on Hydrology, Committee on Groundwater and the Committee on Water Quality on items of mutual interest or when the expertise of those committees will assist the COFF.

COMMITTEE ON FLOW FORECASTING MEMBERS

CHAIR	Mike Renouf	Executive Director Prairie Provinces Water Board
MEMBERS	Bruce Davison	National Hydrologic Services Meteorological Service of Canada (Hydrology) Environment and Climate Change Canada
	Anthony Liu	Meteorological Service of Canada (Meteorology) Environment and Climate Change Canada
	Patrick Cherneski	National Agroclimate Information Services Agriculture and Agri-Food Canada
	Fisaha Unduche	Hydrologic Forecasting & Coordination Manitoba Infrastructure
	Curtis Hallborg	Flow Forecasting & Operations Planning Water Security Agency (Saskatchewan)
	Bernard Trevor	Watershed Resilience and Mitigation Alberta Environment and Parks
SECRETARY	Megan Garner	Transboundary Waters Unit Prairie Provinces Water Board

Appendix VII: Statement of Final Expenditures 2017-2018

	2017-2018	
	Budget	**Actual**
Salary Component		
PY's	4.850	4.583
Base Salary	$520,303	$448,807
BPE	$104,061	$89,761
Total Salary	$624,364	$538,569
O&M Component		
Contracts & Students		
Goal 1		
Cont. Improvement	$190,625	$100,265
Goal 2		
Cont. Improvement	$50,000	$0
Goal 3		
Cont. Improvement	$85,000	$115,830
Goal 5		
Cont. Improvement	$13,000	$0
Goal 7		
Core Activities	$20,000	$0
Sub-total contracts	$358,625	$216,095
Operating Expenses	$20,000	$46,045
Total O&M	$378,625	$262,140
Grand Total	$1,002,989	$800,709

Appendix VIII: History of the PPWB

The Prairie Provinces Water Board (PPWB) was formed on July 28, 1948 when Canada and the Provinces of Alberta, Saskatchewan, and Manitoba signed the Prairie Provinces Water Board Agreement. This Agreement established a Board to recommend the best use of interprovincial waters, and to recommend allocations between provinces.

From 1948 to 1969, the Engineering Secretary to the Board was a Prairie Farm Rehabilitation Administration employee. The support staff for studies and office accommodation during these years was provided by the PFRA in Regina at no charge.

After twenty years, changes in regional water management philosophies resulted in a need to modify the role of the Board. Consequently, the four governments entered into the *MAA* on October 30, 1969. This Agreement provided an apportionment formula for eastward flowing interprovincial streams, gave recognition to the problem of water quality, and reconstituted the Prairie Provinces Water Board.

The *MAA* has five schedules which form part of the Agreement. These Schedules are:

1. Schedule A. An apportionment agreement between Alberta and Saskatchewan.
2. Schedule B. An apportionment agreement between Saskatchewan and Manitoba.
3. Schedule C. The Prairie Provinces Water Board Agreement describes the composition, functions and duties of the Board.
4. Schedule D. A list of Orders-in-Council for allocations of interprovincial waters made before 1969.
5. Schedule E. A Water Quality Agreement describes the role of the PPWB in interprovincial water quality management and established Water Quality Objectives for 12 interprovincial river reaches.

This Schedule became part of the Master Agreement in 1992 and was updated in 2015.

Under Schedule C, the PPWB was reconstituted and was given the responsibility of administering the agreement. Schedule C also provided for the necessary Board staff, accommodation, and supplies to be jointly financed by the four participating governments. Following the reconstitution of the PPWB, the members also agreed to the establishment of a semi-autonomous Board Secretariat.

The PPWB's change in administration policy was implemented when an Executive Director was appointed on July 1, 1972. The By-laws, and Rules and Procedures also came into effect on this date.

On April 2, 1992, the *MAA* was amended to include a Water Quality Agreement that became Schedule E to the Master Agreement. The Agreement sets interprovincial water

quality objectives at 12 transboundary river reaches and commits each of the Parties to take reasonable and practical measures to maintain or improve existing water quality.

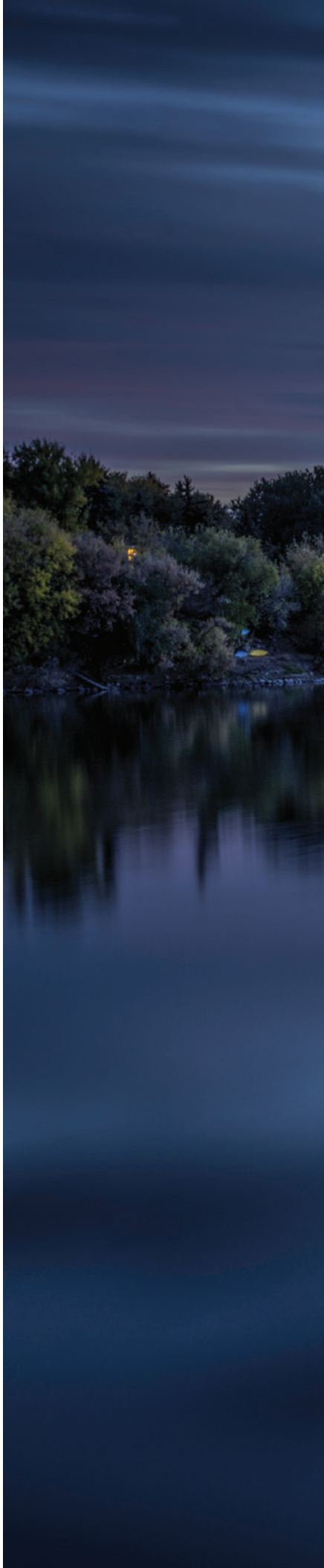
At the March 1995 meeting, the Board agreed that full time Secretariat staff was no longer necessary and that functional support would be provided by staff of Environment and Climate Change Canada. The process of disbanding the PPWB Secretariat and integrating its functions into Environment and Climate Change Canada was completed during 1995-1996. The portion of time each Environment and Climate Change Canada staff person spends on PPWB activities is charged to the PPWB and cost-shared by the members.

The Board currently operates through its Executive Director, supported by four standing committees: the Committee on Hydrology, the Committee on Groundwater, the Committee on Water Quality and the Committee on Flow Forecasting.

The Board approves an annual PPWB budget with one-half the operating budget being provided by Canada and one-sixth by each of the three provinces. The Government of Canada is responsible to conduct and pay for the costs of water quantity and quality monitoring.

In March 2018, a costed multi-year Work Plan was reviewed and approved by the Board to identify activities and projected budgets for 2017-2022.

A work planning meeting took place in November 2017 to validate the strategic direction for updating and reviewing the multi-year work plan, the PPWB Strategic Plan and the Communications Strategy to ensure the PPWB's continued success and relevance.



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