2020-2021 ANNUAL REPORT
PRAIRIE PROVINCES WATER BOARD

Photo credit: Videre Images
North Saskatchewan River Bridge at Lea Park
in the County of Vermilion River, Alberta.

Prairie Province Water Board

FOR THE FISCAL YEAR
April 1, 2020 to March 31, 2021

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Honourable Steven Guilbeault
Minister of Environment and Climate Change
Government of Canada

Honourable Marie-Claude Bibeau
Minister of Agriculture and Agri-Food
Government of Canada

Honourable Sonya Savage
Minister of Environment and Protected Areas
Government of Alberta

Honourable Dana Skoropad
Minister of Environment
Government of Saskatchewan

Honourable Jeremy Cockrill
Minister Responsible for the Water Security Agency
Government of Saskatchewan

Honourable Kevin Klein
Minister of Environment and Climate
Government of Manitoba

December 8, 2023

Honourable Ministers:

On behalf of the members of the Prairie Provinces Water Board (PPWB), it is my pleasure to submit the Annual Report of the Prairie Provinces Water Board for the fiscal year covering the period April 1, 2020 to March 31, 2021.

Sincerely,

Nadine Stiller
Chair, Prairie Provinces Water Board

Message from the Chair

In 2020-2021, the Prairie Provinces Water Board (PPWB) achieved its core commitments under the *Master Agreement on Apportionment (MAA)* related to water apportionment and water quality. Further to its core mandate, the PPWB continued to monitor, assess and report important water management issues. Key highlights this year included:

- The COVID-19 global pandemic impacted everyone, including the PPWB. There were significant disruptions, but we adjusted and adapted to working remotely from home.
- The pandemic resulted in the suspension of the ECCC water quality monitoring program, which included the monitoring of PPWB transboundary sites. Multiple suspensions resulted in significant gaps in the water quality data record.
- Despite this, we continued with our work and focused on achieving core apportionment and water quality activities. We continued to review a new Schedule on groundwater for the Master Agreement on Apportionment.

In January 2021, Board Member Sam Ferris with Saskatchewan's Water Security Agency retired. We thank him for his four years of dedicated service as both a Board and Alternate Member. On a very sad note, we lost two valued Committee Members during the year. Bart Oegema, a long-time hydrologist with the Saskatchewan Water Security Agency and member of the Committee on Hydrology (COH), passed away after a lengthy illness. Bart was a dedicated and knowledgeable member of the COH and contributed significantly to the work of the Committee in his more than 9 years serving as a member for Saskatchewan. And Claudia Sheedy, a research scientist and pesticide expert for Agriculture and Agri-Food Canada, and member of the Committee on Water Quality (COWQ), died in an accident. Claudia made significant contributions to the work of the COWQ on pesticides in the prairie region in her more than 2 years serving as the AAFC committee member. Bart and Claudia will be greatly missed by their PPWB colleagues.

The PPWB continues to be a vital institution of governance for the collaborative management of shared water resources in the Canadian Prairie region. The success of the PPWB depends on the work of the Secretariat and the four standing Technical Committees on hydrology, water quality, groundwater and flow forecasting. The dedication and engagement of all involved are essential, and much appreciated. The *MAA* was a forward-looking document when it was created in 1969. We are confident the Board and the Agreement will continue to serve the Prairie region well in the decades ahead.

Nadine Stiller
Chair

Message from the Executive Director

This was a historic year. In March 2020, in response to the COVID-19 pandemic, ECCC enacted its Business Continuity Plan to prioritize the health and safety of the Department's workforce and to concentrate on the delivery of critical services. All federal staff were required to work remotely from home, and this applied to PPWB Secretariat staff as we are housed within Environment and Climate Change Canada. ECCC field and laboratory work related to non-critical services, including water quality monitoring of PPWB transboundary sites were suspended and were not resumed until October 2020. Further suspensions followed as waves of COVID rose and subsided. Over the course of the year, the PPWB adjusted to the challenges and focused on core activities. All PPWB Board and Committees meetings were held via teleconference or virtually on several apps.

Drought began to appear in the southern Prairies in August, and after October severe drought conditions existed in southern Saskatchewan and Manitoba. By March 2021, pockets of extreme drought had developed in southern Manitoba. In contrast, northern Alberta and northern Saskatchewan experienced above-normal precipitation and runoff. Overall, the agreed transboundary apportionment of flows on all eastward flowing streams was achieved for all river reaches. Despite data gaps in the water quality monitoring record in 2020, due to pandemic related water quality monitoring suspensions, annual reporting for the transboundary rivers with comparisons to water quality objectives was completed for the available data. Adherence to the *MAA's* water quality objectives was 97.6%, with no unexpected water quality issues or concerns specifically highlighted because of the 2020 sampling program. As a reminder, the period of reporting for this annual report is the fiscal year (April 2020 to March 2021), while water flow and water quality data are analyzed for the calendar year (January 2020 to December 2020).

Four Technical Committees (Hydrology, Water Quality, Groundwater, and Flow Forecasting) support the Board. The committees continued with their workplans but some refocusing was done to adjust to COVID and changes in the Secretariat and the Committees. Despite these challenges, several significant pieces of work were completed or advanced including the Water Quality Objectives review and update, and moving towards finalizing a new Schedule on groundwater. A list of achievements for the year is on the Summary of Performance Results page.

There were changes in the Secretariat and the Committees. In August 2020, we welcomed Elaine Page as the PPWB Secretary. She comes to PPWB with more than 13 years as a water quality specialist and manager with the Province of Manitoba and a former member of the Committee on Water Quality. Staffing actions for the two PPWB engineering positions were completed with Marie Hyde appointed to the former at the start of the year and Jim Friesen to the latter near the end of the year. Jim comes to the PPWB with a 24 year work history in engineering consulting in Manitoba.

This was a particularly challenging year with a high degree of uncertainty and change. We focused on our core priorities and continued with our work administering the *Master Agreement on Apportionment (MAA)* to cooperatively share and manage interprovincial waters. The current environment highlights our role and the importance of understanding the risks and vulnerabilities to water security and governance in the Prairie region and the strategies, plans and best practices for coping with risk going forward.

Patrick Cherneski
Executive Director

Summary of Performance Results

Apportionment and water quality monitoring in 2020-2021 indicated that interprovincial apportionment and water quality obligations were met in accordance with schedules to the *Master Agreement on Apportionment (MAA):*

- All rivers met apportionment obligations at the Alberta-Saskatchewan boundary (Schedule A) and the Saskatchewan-Manitoba boundary (Schedule B).
- The overall adherence rate for transboundary water quality objectives was 97.6%, for all parameters (Schedule E).
- There were no acute water quality concerns apparent from review of the adherence rate values for 2020.

During 2020-2021, responsibilities of PPWB were met through the following activities:

- Reviewing and approving the hydrometric, meteorological and water quality monitoring networks.
- Monitoring apportionment requirements and water quality adherence for the six transboundary sites along or near the Alberta-Saskatchewan boundary and the six sites along the Saskatchewan-Manitoba boundary.
- Providing oversight and direction to the activities of PPWB including approving the 2021-2022 budget and work plan of the Board and four standing Committees.
- Reporting on adherence to the MAA obligations and communicating the results with Ministers, government agencies and external collaborators.

The Committee on Hydrology (COH) activities included:

- Reviewing the hydrometric and meteorological monitoring programs and preparing annual revisions;
- Model, review, and provide advice to the Board on apportionment computations and reports on 12 transboundary rivers;
- Continuing the Qu'Appelle River Basin Review;
- Re-planning the Saskatchewan River Basin Review;
- Conducting a joint (with COWQ) water quality/ hydrology study of the Carrot and Red Deer Rivers; and
- Ongoing project management of the Evaporation study.

The Committee on Water Quality (COWQ) activities included:

- Completing the 2020 Excursion report
- Completing the review and update of the water quality objectives and approved the report, with amendments to the MAA currently being prepared by the PPWB for Ministerial approvals;
- Planning for the 2025 WQ Objectives review;
- Prioritizing and conducting studies of basins demonstrating significant upward trends in monitored parameters, including:
    - planning a GIS Study of historic land use change on the Prairies, and conducting the joint water quality/hydrology study with the COH; and
    - Developing recommendations on future actions regarding pesticides.

The Committee on Groundwater (COG) activities included:

- Reviewing and updating transboundary aquifer assessment criteria using the Risk Informed Management (RIM) evaluation; and
- Preparing for Schedule F implementation, including developing a plan for harmonization of groundwater data across jurisdictions.

The Committee on Flow Forecasting (COFF) activities included:

- Continuing work to harmonize spring runoff potential maps across the Manitoba, Saskatchewan, and Alberta borders;
- Sharing river and environmental conditions, flow forecasting knowledge and experience between agencies;
- Supervising a co-op student for six months to advance development of a flow forecasting model for the Saskatchewan River Basin (SRB);
- A flow forecasting 'toolbox' for use by the jurisdictions was refined in 2020. By the end of the year, it contained 45 items.

Introduction

This report summarizes the activities of the PPWB, its Secretariat, and four standing Committees that supported PPWB activities for the period April 1, 2020 to March 31, 2021.

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 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 2020-2021 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 2020-2021.

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 2020 apportionable flow data. Appendices III and IV present the water quality parameters that were monitored by Environment and Climate Change Canada and the 2020 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.

Performance Results

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 Master Agreement on Apportionment (*MAA*) Schedule A and Schedule B.

Apportionment Monitoring of Rivers

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*.

Currently, the Board conducts apportionment monitoring for 12 rivers including Cold Lake, North Saskatchewan River, South Saskatchewan River, 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.

In 2020, the PPWB Secretariat computed apportionable flows with monitoring data from 90 hydrometric stations, 24 meteorological stations, as well as various third-party water use measurements. The PPWB requires data from four additional hydrometric stations to support bilateral water management (Appendix I).

To prepare for next year, the 2021-2022 hydrometric and meteorological monitoring station lists were reviewed and approved by the Board at Meeting No.136 (November 3, 2020). There were no changes to the PPWB Hydrometric Monitoring Stations list from the previous year.

2020 Water Apportionment

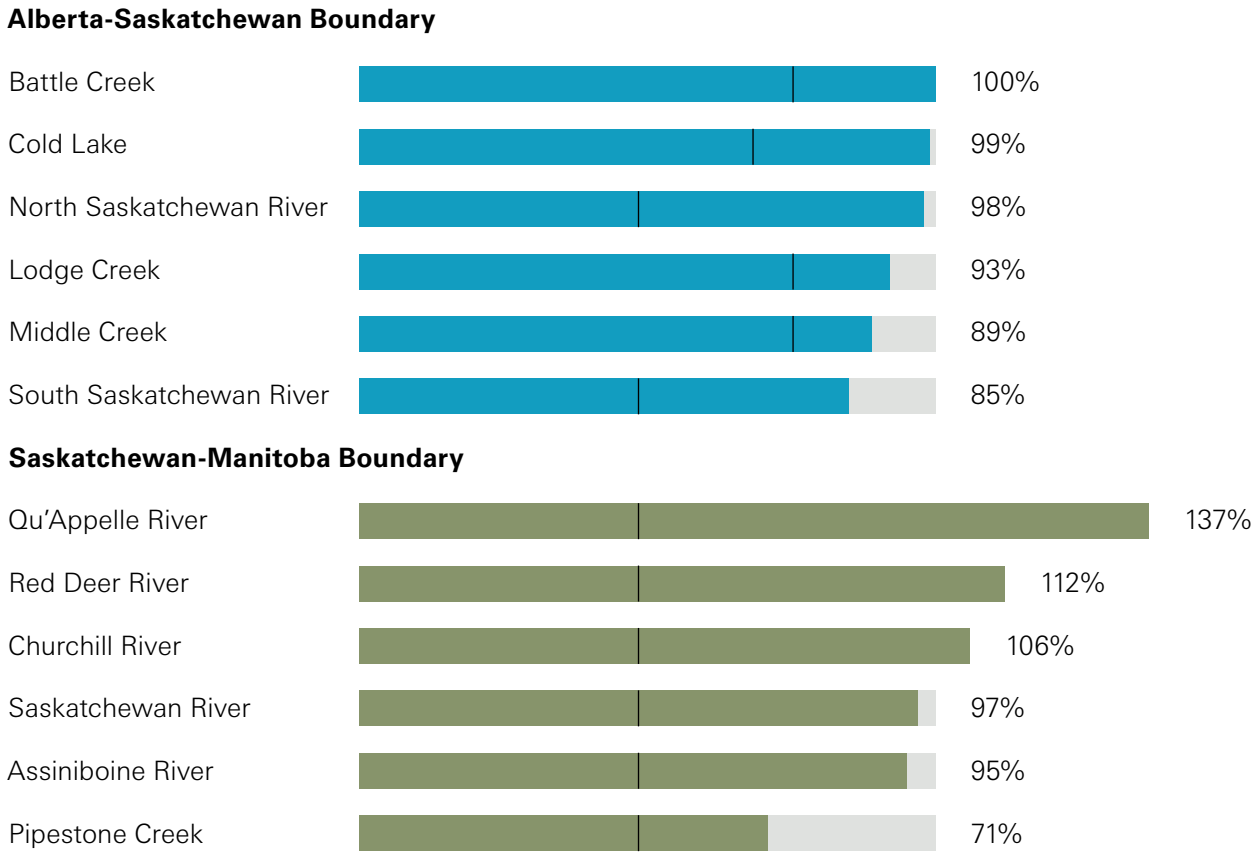
Interim apportionable flow reporting was completed for four basins in 2020 including for the South Saskatchewan River, Middle Creek and Lodge Creek, as well as one mid-year report for Cold Lake.

Appendix II presents the final monthly and total apportionment results in 2020 for all twelve rivers. Figure 1 illustrates the percentage of annual apportionable flow, delivered from Alberta to Saskatchewan and from Saskatchewan to Manitoba in 2020. For all apportioned rivers and creeks, the recorded flow at the interprovincial boundary was higher than the amount the upstream province was required to deliver. In summary, all apportionment requirements were met in the 2020 calendar year.

Historic river flows and apportionment balances for each basin are provided in Appendix II for the historic period of PPWB monitoring. Large surpluses are fairly common for many of the rivers. Only Middle Creek (in 1989, 1998 and 2008) and Lodge Creek (in 1988 and 1989) at the Alberta-Saskatchewan boundary have experienced deficits in delivery through the apportionment record. These deficits were followed up with both board and bilateral discussion. Flow deficits have not occurred on the Saskatchewan-Manitoba boundary.

As there have been past years with deficits on Lodge and Middle Creeks, Alberta and Saskatchewan continue to work cooperatively and investigate solutions, including improvements to timing and accuracy of interim water use reporting, to ensure future deficits do not occur.

Figure 1. Percent of Apportionable Flow Passed from Alberta to Saskatchewan (blue bars; upper panel) and from Saskatchewan to Manitoba (green bars; lower panel) in 2020.



*Black lines in each bar above represent the 2020 apportionment requirements according to the Master Agreement on Apportionment. See Appendix II for detail.

Improving Apportionment Methods

Apportionment Procedure Review

The Committee on Hydrology (COH) continued with the ongoing review of apportionment methods to ensure apportionment computations have a level of accuracy acceptable to the Committee for the purposes of monitoring compliance with the *Master Agreement on Apportionment (MAA)*.

The COH is conducting a review of the Qu'Appelle River Basin and the South Saskatchewan River Basin. The Qu'Appelle River segment is more complex than other apportioned basins due to the intricate connection between the river and Last Mountain Lake. The South Saskatchewan River apportionable flow computation procedure is also large and complex and will take several phases.

Qu'Appelle River Basin Review

Qu'Appelle River Basin Review final report is partially completed. Consumptive uses and evaporation components were reviewed and updated. Water use licences were confirmed by the Water Security Agency and will be added to the PPWB Hydrometric Monitoring Network list. The Last Mountain Lake model work is ongoing. Spreadsheet model clean up continues.

South Saskatchewan River Basin Review

The South Saskatchewan River Basin Review consists of a pre-phase and five phases work plan. This fiscal year, Pre-phase assessment is progressing, with background work and discussion of desired computation and reporting time steps, and application of apportionment monitoring criteria. Phase 1 Evaporation Investigation commenced with a literature review and work scoping.

MAA Resiliency

The potential impacts of climate change on Prairie region water management have been a topic of discussion at the Board for many years. Discussions on resiliency were collated and captured in a *MAA* Resiliency Assessment report, prepared by Committee on Hydrology for Board review in May 2019. The summary report included relevant historical work, current studies and strategies, and proposed next steps for assessing and potentially strengthening the resiliency of the *MAA*. In November 2019, a joint Committee on Hydrology and Committee on Flow Forecasting workshop on resiliency was held in Edmonton.

In March 2020, the Board decided to retain *MAA* Resilience as a standing agenda item with discussion on the need for structured protocols for addressing excursions to the apportionment provision in the *MAA*. The Board further reviewed Committee recommendations and prioritized a drought tournament for PPWB for 2020. The drought tournament concept is a well-established useful tool with which to explore and highlight the complexities of water management decision-making under climate extremes. Unfortunately, the COVID pandemic delayed planning and preparation of a drought tournament. To ensure ongoing discussion, the '*MAA* Resiliency' topic was added to COH meeting agendas as a standing item under Drought Preparedness / Management Actions.

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

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

The *Master Agreement on Apportionment (MAA)* currently has a general statement to refer any transboundary groundwater issues to the Board for their review and recommendation.

Groundwater Schedule F

Development and Consultation

The Committee on Groundwater (COG) developed 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.

Due to Saskatchewan elections and the timing of the writ period, the finalization of Schedule F has been deferred to March 2021. In the meantime, each jurisdiction is preparing to brief respective senior management for signing of Schedule F.

Aquifer Inventory

COG created a sub-committee for developing a methodology to classify transboundary aquifers according to the Risk Informed Management (RIM) document within the proposed Schedule F.

A list of aquifers identified along the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries would be subject to the assessment once Schedule F is ratified. The list includes aquifers that have been agreed upon by the Committee along the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries as test cases for the implementation of the RIM methodology.

In 2020, the finalization of a proof-of-concept document on the proposed method to classify transboundary aquifers is progressing. This includes flagging knowledge gaps for completing a harmonized approach to assessing transboundary aquifers.

Notification System

COG members are notifying their neighbouring jurisdiction of groundwater development proposals that may have transboundary impacts.

In 2020, there were no unusual conditions or events to report by either Alberta, Saskatchewan, or Manitoba.

Saskatchewan gave notification of one deep-well geothermal project into the Deadwood formation near the Saskatchewan-Manitoba boundary and an exploratory well drilled into the Ribstone aquifer and overlying Belly River aquifer near the Alberta-Saskatchewan boundary.

Alberta and Manitoba had nothing to report.

GOAL 3: Agreed Transboundary MAA Water Quality Objectives Are Achieved

The PPWB Strategic Goal 3 is to achieve agreed transboundary water quality objectives. Schedule E of The *Master Agreement on Apportionment (MAA)* includes a list of water quality objectives that were established for a number of key watercourses at the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries.

Each fall a water quality monitoring program is approved by the PPWB and subsequently implemented by ECCC. The PPWB compares monitoring results 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 2020 monitoring program was approved by the Board at Meeting 132 (November 4, 2019). Environment and Climate Change Canada conducted water quality monitoring at 12 major interprovincial rivers in 2020 (Appendix I). A list of the water quality monitoring locations is provided in Appendix IV (Table 1). The list of water quality parameters monitored by the PPWB are in Appendix III.

Water quality monitoring parameters include nutrients, major ions, metals, fecal coliforms, physical characteristics, and pesticides. There were no unexpected water quality issues or concerns specifically highlighted because of the 2020 sampling program. In general, water quality was suitable for the intended water uses for these rivers.

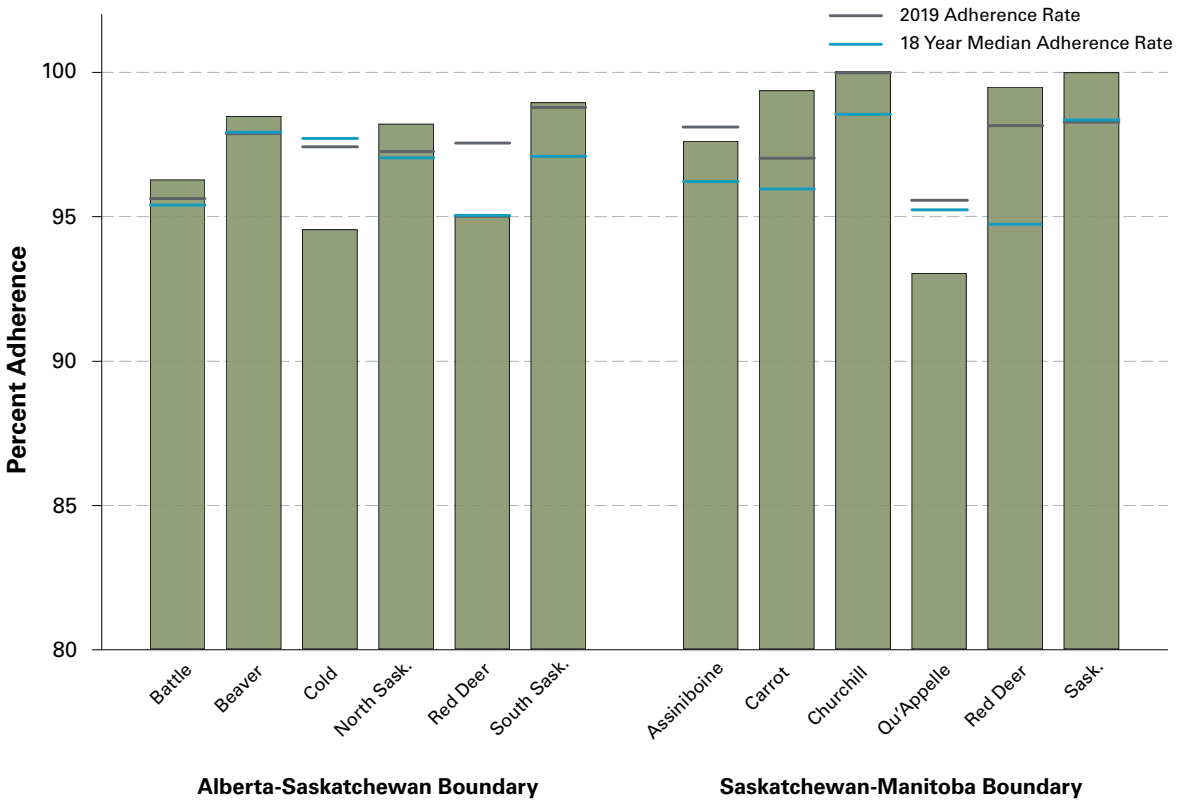
Further details on the 2020 water quality monitoring program and the 2020 PPWB Report on Excursions of Interprovincial Water Quality Objectives, January-December 2020 are presented in Appendix IV.

During 2020, water quality samples were collected from 12 major interprovincial rivers but due to the COVID-19 pandemic, monitoring and analyses were reduced at the transboundary sites. There was considerable disruption to the water quality-monitoring program including both the field and laboratory operations, as monitoring was suspended in March 2020 and was not reinstated until October 2020. There is a seven-month gap in the 2020 dataset, including the freshet period that incorporates the majority of the water inflow, as well as throughout the open water growing season. COWQ continues to address the gaps in the long-term water quality data, excursion report, trend analysis, and pesticide monitoring. As a lesson learned, COWQ looks forward to strengthening and building resilience in the MAA transboundary water quality monitoring network.

Adherence or Excursions to Transboundary Water Quality Objectives

A total of 1,944 water quality parameter values were compared to transboundary water quality objectives that protect aquatic life, source water for drinking, recreation, agriculture uses and fish consumption to determine whether any excursions to the objectives occurred in 2020.

Figure 2. Percent adherences to Interprovincial Water Quality Objectives in 2020. (Note: 2020 adherence rates were calculated using an average of 37% of the comparisons used in previous years. See Appendix IV for further details.)



The transboundary water quality objectives were met, on average, in 97.6 % of samples for all parameters. Adherence rate is the degree to which a river meets the interprovincial water quality objectives. Adherence rates from 2020 are similar to those of previous years ranging from 100% (Churchill River and Saskatchewan River) to 93% (Qu'Appelle River). Most rivers have shown approximately 4 to 8 % variation in adherence rates over the last 18 years (Figure 2).

Overall, there were no acute water quality concerns apparent from review of the adherence rate values for 2020. As such, COWQ will continue to focus its efforts to understanding broader scale questions related to factors affecting water quality on the Prairies.

On the Alberta-Saskatchewan boundary, Red Deer River and Battle River had the greatest variability in adherence rate at 8% over the past 18 years. In 2020, excursions on the Red Deer River were attributed to E.coli and total suspended solids. None of the six rivers on the boundary exceeded the major ions and total dissolve solids interprovincial water quality objectives in 2020.

On the Saskatchewan-Manitoba boundary, Red Deer River near Erwood had the greatest variability in adherence rate at 8% over the past 18 years. Exceedances to objectives on Red Deer River included nutrients, total suspended solids, and several metals. Total dissolved solids and sulphate exceeded water quality objectives most frequently in 2020, particularly on the Qu'Appelle River under-ice conditions.

At both boundaries, excursion from the water quality objectives for nutrients and biota occurred in 2020. The highest number of excursions to the interprovincial water quality objectives was observed for Cold River on the Alberta-Saskatchewan with a 94.5% overall adherence rate and Qu'Appelle River on the Saskatchewan-Manitoba with a 93% overall adherence rate. COWQ continues to work on several integrated studies including assessing land-use changes to understand how this might be influencing nutrients in Prairie watersheds. In 2021, COWQ will continue to discuss and follow up on nutrient issues in the transboundary rivers.

On both the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries, total dissolved solids and sulphate exceeded water quality objectives most frequently in 2020. In addition, increasing trends in total dissolved solids and major ions have been noted in several rivers on both the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries. Given the water quality samples were collected during the closed water season in 2020, the COWQ will continue to track these parameters and evaluate as more data become available.

Water Quality Objectives Review

Work to review and update the water quality objectives continues, particularly in those areas where objectives were not established for select parameters and rivers. On-going objective review is a requirement of the MAA, with the PPWB making recommendations to adopt new and/or revised objectives as appropriate, approximately every five years. The current five-year Water Quality Objective

review has been completed by the COWQ and amendments to the MAA are currently being prepared by the PPWB.

The assessment of excursions to water quality objectives will continue to assist COWQ to assess areas of potential concern and to set future priorities. In conjunction with the excursion assessment, COWQ will continue to look at long-term trends in water quality for each of the transboundary rivers. Trend analysis work incorporating data from the start of the data set for each of the transboundary rivers to the end of 2018 is currently underway.

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

The PPWB 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 jurisdictions of events that may adversely affect water quality in transboundary water bodies or aquifers or cause public concern in transboundary basins. The PPWB Event Contingency Plan is not meant to replace jurisdictional emergency spill response mechanisms. The Contingency Plan includes information on the area of coverage, responsibilities, pattern of response and organizational structure. The Contingency Plan also ensures that cross-jurisdictional communication processes within each jurisdiction are addressed and that the Board will discuss the effectiveness of this communication on a regular basis.

No notifications were received in 2020-2021.

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

The PPWB Strategic Goal 5 is to avoid conflicts and disagreement over transboundary water issues. During the year, the PPWB discussed several issues of interest to the jurisdictions such as enhancing flow forecasting, water resource developments, and unusual conditions.

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 2020-2021, COFF continued to discuss harmonization of provincial spring runoff forecasts between the jurisdictions. The COFF resolved some differences in runoff and precipitation map products and work continued on enhancing flow forecasting communication networks between jurisdictions.

The COFF also continues to share flow forecasting knowledge and experience between jurisdictions related to flow forecasting platforms, collaborative modelling, forecasting data and tools, drought management, research initiatives (e.g., FloodNet, Global Water Futures) and relevant workshops/ events. The COFF also brought on a university student to assist with the development of a real-time forecasting model for the Saskatchewan River Basin.

Committee on Groundwater

The Committee on Groundwater (COG) exchanged information on water resource developments within 30 km of the inter-provincial boundaries.

Discussions continued in advance of implementing transboundary aquifer classification using the Risk Informed Management (RIM) method in the proposed Schedule F.

Committee on Hydrology

The Committee on Hydrology (COH) discussed unusual conditions (droughts and floods) at bi-annual meetings and as required to facilitate transboundary communication.

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.

Environment and Climate Change Canada's commitment to Lake Winnipeg includes $25.7 million over 5 years (2017-2022) for the Lake Winnipeg Basin Program in support of the following priority issues:

- on the ground nutrient reducing actions throughout the Lake Winnipeg Basin using a strategically targeted and outcome focused approach;
- enhancing collaborative efforts and increased capacity building to protect freshwater quality throughout the Lake Winnipeg Basin; and
- enhancing engagement of Indigenous peoples in addressing freshwater issues.

For 2020-2021 under the Lake Winnipeg Basin Program there were nine nutrient reduction projects with Prairie associations and academia, one collaborative governance project, and five Indigenous Engagement projects.

Canada/Manitoba MOU Respecting Lake Winnipeg and Lake Winnipeg Basin

Canada and Manitoba signed a Memorandum of Understanding (MOU) in September 2010 to

continue their partnership by establishing a long-term collaborative and coordinated approach to support the sustainability of Lake Winnipeg. In 2015, the MOU was extended to September 13, 2020. Plans for a renewal are underway.

The MOU provides a forum for information sharing and the involved agencies provide regular reports on activities.

Alberta and Saskatchewan do not participate in this forum. However, any issues that arise can be forwarded for broader discussion through the PPWB Chair, who is also the co-chair of the MOU forum.

Saskatchewan-Manitoba MOU Respecting Water Management

Saskatchewan and Manitoba signed a 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.

Current dialogue between Saskatchewan and Manitoba includes renewal of the existing MOU (which expires in 2020), discussion of upcoming drainage and other water infrastructure projects, watershed planning, and various other aspects of drainage (e.g., regulatory and enforcement approaches, mitigation measures and assessment of impacts).

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

Strategic Goal 6 is about keeping 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.

Member jurisdictions 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 technical reports, the PPWB website, fact sheets and brochures.

The PPWB website (www.ppwb.ca) exists to inform the public and interested parties of PPWB activities and provide a means for member jurisdictions to exchange information and facilitate the business of the PPWB. The PPWB website provides a complete list and access to a suite of PPWB publications. A member-only webpage also facilitates the exchange of information.

To maintain good internal and external communications, guests are invited. 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. Although this year, due to COVID, all meetings were virtual. Senior executives are also invited to Board meetings to share information, to remain informed about Board activities, and discuss important water issues across the Prairies. This year's invited guests included:

- Environment and Climate Change Canada on water quality monitoring program suspensions and implications;
- Environment and Climate Change Canada on the creation of a Canada Water Agency; and
- Western Economic Diversification on its Prairie Prosperity Report, including Lake Diefenbaker Irrigation Project.

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. Strategic Goal 7 facilitates cooperation by exchanging information and knowledge amongst member jurisdictions and participating in research projects of mutual interest and relevance to the PPWB mandate.

Board and Committee Outreach

In 2020, the Board and its Committees continue discussions with Natural Resources Canada, Global Water Futures, Western Economic Diversification, and several prairie universities on the topics of data harmonization, forecast modeling, knowledge mobilization, delivery of solutions, and potential joint workshops.

A planned Committee on Groundwater (COG) workshop was put on hold due to the COVID-19 pandemic. Planning continues with identifying a number of options and ideas for presentations and potential alignment with other forums or networks e.g., Common Hydrology Features Canada Centre for Mapping and Earth Observation, NRCan National Dialogue Call on Groundwater, and Open Geospatial Consortium on Groundwater.

In addition, activities under Goal 5: Transboundary Water Issues Are Addressed Cooperatively to Avoid Disputes often involve Board outreach.

Joint Study

Committee on Hydrology (COH) and Committee on Water Quality (COWQ) conducted an Integrative Study on Carrot River and Red Deer River in response to and tasked with examining factors contributing to the rivers' nutrient levels.

The joint study was composed of four workshops over the July 2020 to January 2021 time period. Workshop #1 presentations were on trend analysis, hydrometric data availability, basic climate information, and Pasqua Pumping. Workshop #2 included discussions on Carrot River downstream, and historical precipitation for Prince Albert and The Pas. Workshop #3 was a Q and A on hydrology and water quality. Workshop #4 consisted of presentations on fertilizer application, review of annual and seasonal flow vs precipitation for Carrot River. Key findings will be presented to the Board in 2021.

Agency Reports

The PPWB member agencies continue to share information and knowledge on their water related legislation, policies, science, and initiatives.

Alberta's Agency November 2020 Report provided information on water-related legislation, policy regulations or planning; science monitoring and information; major initiatives; and watershed stewardship groups. These topics included updates on the province's Water Management Planning, Land Use Framework, Tailings Management Framework, and Alberta Wetland Policy. Additional updates were provided on: Alberta River Forecast Centre, Alberta Flow Estimation Tool for Ungauged Watersheds, State of Groundwater and Subsurface Knowledge in Transboundary Aquifers between Alberta and the Northwest Territories, Alberta's Water Research and Innovation Strategy, and Alberta Innovates' Water Innovation Program.

Saskatchewan's Agency October 2020 Report provided information on Irrigation Development in Saskatchewan, Qu'Appelle Water Quality Study, Quill Lakes Flood Mitigation, Drainage Regulations, Transfer of Federal Dams, and Water Supply Conditions and Outlook.

Manitoba Agency October 2020 Report provided information on Manitoba Drought Management Strategy, Provincial Water Management Strategy, Drainage and Water Control Works, Lake Winnipeg, SK-MB MOU Respecting Water Management, Watershed Districts, Growing Outcomes in Watersheds, and Shellmouth Reservoir and Downstream Flooding.

Environment and Climate Change Canada November 2020 Report provided information on the Support to the PPWB, Lake Winnipeg Basin Program, Risk-based Adaptive Management Framework, Water Quality Monitoring and Surveillance Report, Meteorological Services of Canada Report, Open Data, and Whirling Disease.

GOAL 8: PPWB Business is Conducted Effectively

The PPWB Strategic Goal 8 focuses primarily on administration, work planning, and financial management. Goal 8 ensures that work planning and budgeting are understood and supported by the jurisdictions, day to day activities are administered effectively, communications are effective, 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 jurisdiction. 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. 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.

Five Board meetings and eight Committee meetings were held during 2020-2021.

PPWB

- Meeting No. 134. May 21, 2020 – Teleconference (Special Board Meeting)
- Meeting No. 135. Sept 30, 2020 – Teleconference (Special Board Meeting)
- Meeting No. 136. Nov 3, 2020 – Videoconference
- Meeting No. 137. Nov 17-18, 2020 – Videoconference
- Meeting No. 138. Mar 11-12, 2021– Videoconference

COH

- Meeting No. 141. Oct 27, 2020 – Videoconference
- Meeting No. 142. Feb 23, 2021 – Videoconference

COWQ

- Meeting No. 138. Oct 21-22, 2020 – Videoconference
- Meeting No. 139. Feb 3-4, 2021 – Videoconference

COG

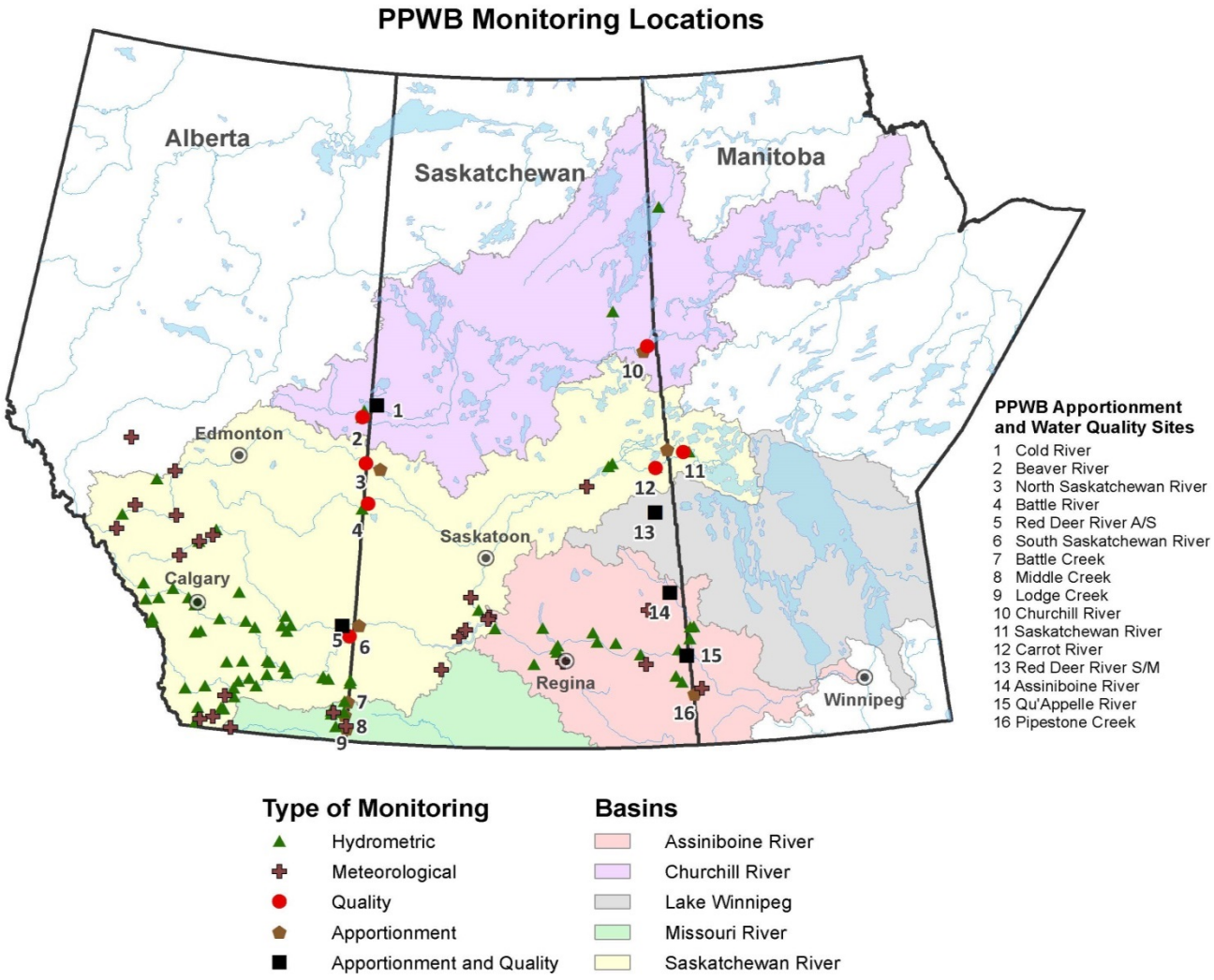
- Meeting No. 78. Sept 23, 2020 – Videoconference
- Meeting No. 79. Jan 27, 2021 – Videoconference

COFF

- Meeting No. 11. Aug 19 and Sept 9, 2020 – Videoconference
- Meeting No. 12. Jan 13, 2021 - Videoconference

The Board approved the annual budget for the PPWB. The budget for 2020-2021 was $773,560 and final expenditures were $588,352 as shown in Appendix VII. Final expenditures were below the approved budget due to a number of delays with deliverables for existing contracts, and delays in some planned activities due to COVID.

Appendix I. PPWB Monitoring Stations for 2020-2021



Appendix II: 2020 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	182000	195000	262000	528000	884000	1716000	1337000	272000	223000	267000	253000	169000	6288000
CONSUMPTIVE USE	7	0	130	14100	281000	265000	232000	389000	238000	46800	0	0	1466000
CHANGE IN RESERVOIR STORAGE	-43400	-27700	-76900	-30700	182000	253000	121000	-117000	-156000	-64000	23100	-18400	54000
INTERBASIN TRANSFER*	0	0	0	31100	19100	26700	25500	13600	13200	9100	0	0	138000
APPORTIONABLE FLOW	139000	167000	185000	543000	1366000	2261000	1716000	558000	318000	259000	285000	151000	7948000

* 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	43700	45400	55800	536000	508000	469000	475000	181000	99900	72400	69400	59600	2615000
CONSUMPTIVE USE	0	0	0	0	0	808	4090	6110	2570	640	88	0	14300
CHANGE IN RESERVOIR STORAGE	-22200	-18000	-23400	36500	-45800	28300	38400	16600	5640	-2580	-2080	-16700	-5300
INTERBASIN TRANSFER**	0	0	0	-31100	-19100	-26700	-25500	-13600	-13200	-9100	0	0	-138000
APPORTIONABLE FLOW	21500	27400	32400	541000	443000	471000	492000	190000	94900	61400	67400	42900	2485000

** 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	226000	240000	318000	1064000	1392000	2185000	1812000	453000	323000	339000	322000	229000	8903000
APPORTIONABLE FLOW	161000	194000	217000	1084000	1809000	2732000	2208000	748000	413000	320000	352000	194000	10432000
NET DEPLETION BY ALBERTA	-65000	-46000	-101000	20000	417000	547000	396000	295000	90000	-19000	30000	-35000	1529000
CUMULATIVE PERCENT DELIVERY	140%	131%	137%	112%	94%	88%	86%	84%	84%	84%	85%	85%	85%

Recorded flow was 85% of the apportionable flow. In 2020, Alberta was required to deliver 50% of the apportionable flow to Saskatchewan. Apportionment of flow in South Saskatchewan River is specified in Schedule A of the Master Agreement on Apportionment.

North Saskatchewan River – Alberta-Saskatchewan Boundary

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
ESTIMATED FLOW	396000	376000	423000	1223000	1732000	1825000	2496000	978000	557000	511000	461000	427000	11405000
APPORTIONABLE FLOW	128000	161200	198000	1087000	1810000	2330000	3046000	1244000	659000	407000	284000	223000	11577000

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 98% of the apportionable flow. Alberta is required to deliver 50% of the apportionable flow to Saskatchewan.

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	48600	43200	44000	41500	61800	115000	148000	125000	91500	71400	51700	45800	888000
APPORTIONABLE FLOW	49000	43600	44400	41900	62300	116000	148000	126000	91900	71700	52000	46100	893000

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

Lodge Creek – Alberta-Saskatchewan Boundary

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	N/A	N/A	1330	19800	3210	115	0	0	0	0	N/A	N/A	24500
APPORTIONABLE FLOW	N/A	N/A	1460	21500	3210	115	0	0	0	0	N/A	N/A	26300

Recorded flow was 93% of the apportionable flow. Alberta is required to deliver 75% of the apportionable flow to Saskatchewan. Hydrometric data is only collected 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	156	6260	2100	45	34	36	43	36	N/A	N/A	8710
APPORTIONABLE FLOW	N/A	N/A	160	7290	2110	45	34	36	43	36	N/A	N/A	9750

Recorded flow was 89% 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.

Battle Creek – Alberta-Saskatchewan Boundary

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	N/A	17	264	2870	2720	1160	973	518	615	544	N/A	N/A	9590
APPORTIONABLE FLOW	N/A	17	264	2780	2720	1180	973	518	615	544	N/A	N/A	9610

Recorded flow was 100% 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.

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	2428000	2170000	2221000	2074000	2759000	3328000	5613000	5972000	4998000	4812000	3877000	3519000	43771000
APPORTIONABLE FLOW	2321000	2024000	2004000	1852000	2721000	3651000	4283000	5319000	4759000	4494000	4099000	3728000	41255000

Estimated flow includes recorded flow at Sandy Bay, SK and estimated inflow from Sandy Bay to the Saskatchewan-Manitoba Boundary. Estimated flow was near 106% 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	1247000	1366000	1662000	1900000	3677000	3801000	4917000	4152000	2145000	1620000	1644000	1526000	29656000
APPORTIONABLE FLOW	791000	882000	1242000	2302000	4129000	4766000	5497000	4345000	2194000	1621000	1467000	1222000	30457000

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 97% of the apportionable flow. 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	6290	6060	7180	112000	166000	48200	89700	15900	8240	4980	5990	5200	476000
APPORTIONABLE FLOW	5620	5410	6310	103000	148000	41800	79400	13900	7300	4440	5330	4630	425000

Recorded flow was 112% of the apportionable flow due to an increase in the natural effective drainage area attributed to agricultural drainage. 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 [dam^3]	1320	1200	1600	44600	46300	7340	8730	3460	1300	645	1100	921	118000
APPORTIONABLE FLOW [dam^3]	1210	1210	1580	47000	47000	8140	9360	4170	1650	856	1090	902	124000

Recorded flow was 95% 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	7310	5240	11000	23800	11200	5500	2290	1850	1710	7040	4350	3370	84800
APPORTIONABLE FLOW													61800

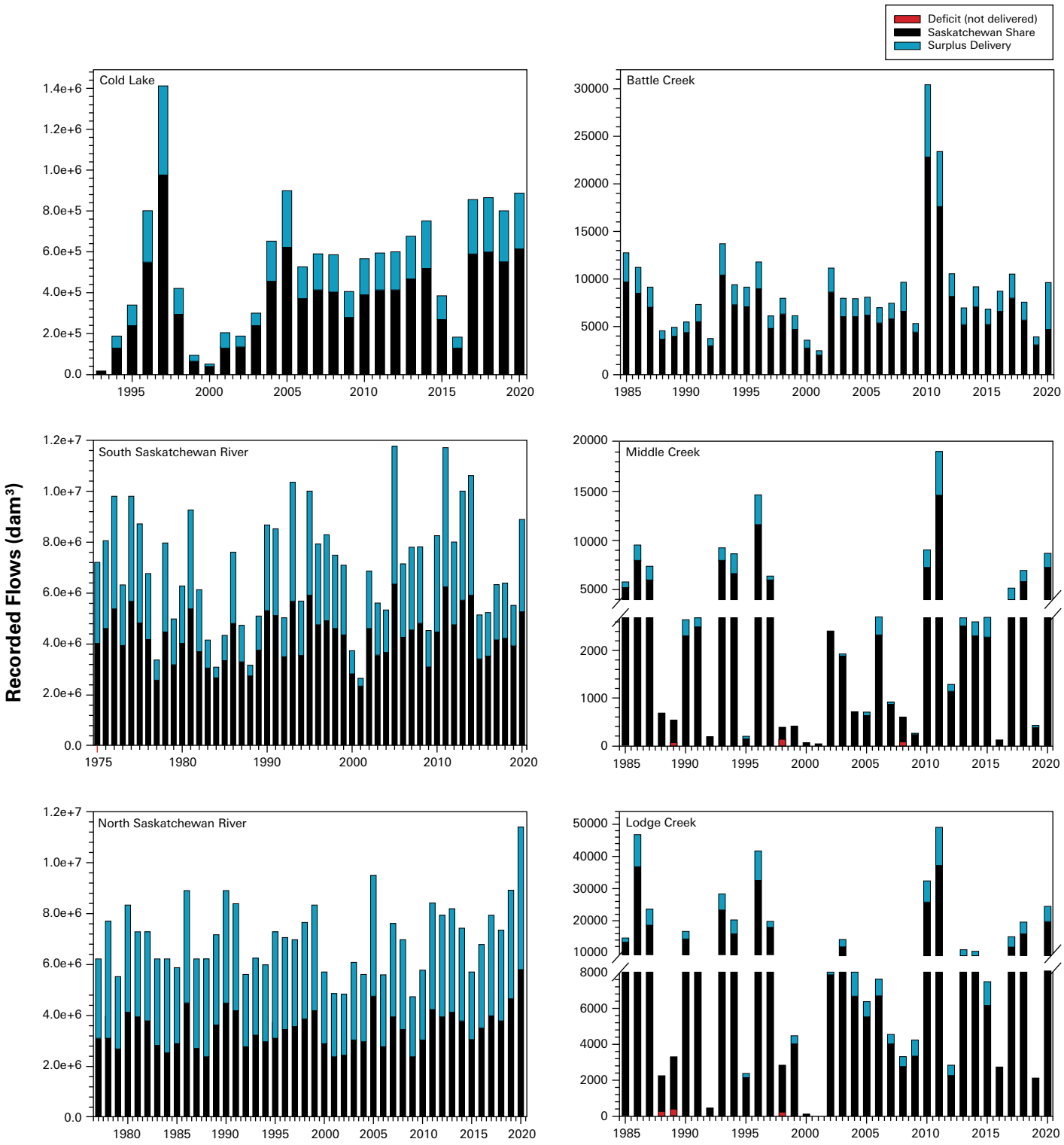
Recorded flow was 137% of the apportionable flow. The current calculation method overestimates the percent delivery. The PPWB is currently undertaking a study to revise the calculation procedures to address these problems. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

Pipestone Creek – Saskatchewan-Manitoba Boundary

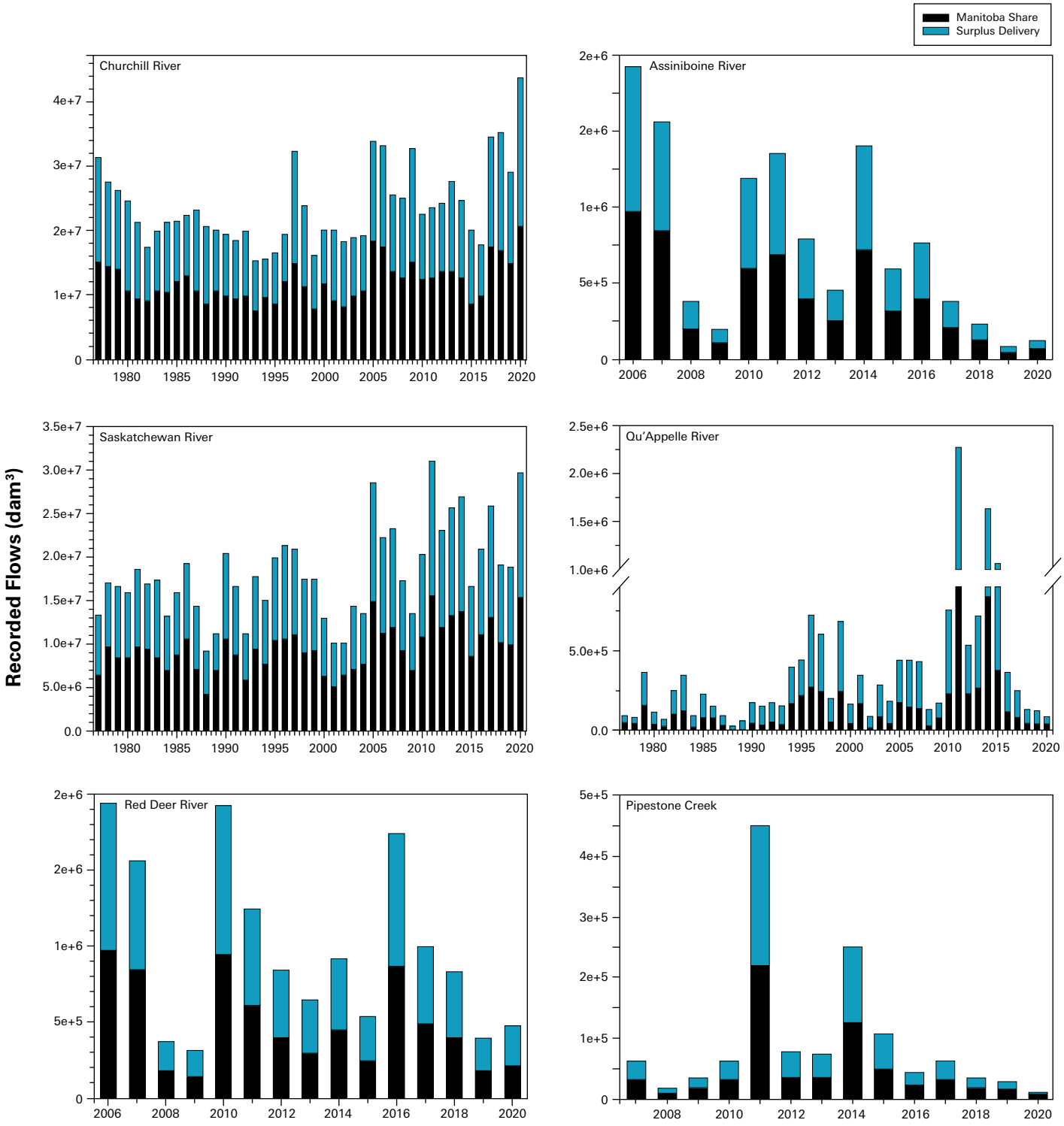
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
RECORDED FLOW	588	494	1170	4290	1920	255	472	124	420	45	7	0	9790
APPORTIONABLE FLOW													13700

Recorded flow was 71% of apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba. Due to unresolved issues with the Fortran program used to calculate monthly apportionable flows, a simplified procedure was developed in 2018 was used again for the 2020 annual apportionable flow for Pipestone Creek.

Appendix IIC: Historic River Flows on the Alberta-Saskatchewan Boundary



Appendix IID: Historic River Flows on the Saskatchewan-Manitoba Boundary



Appendix III: PPWB Water Quality Monitoring 2020 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
CHLOROPHYLL A
CHROMIUM, diss. & total θ
COBALT, diss. & total θ
COLIFORMS FECAL θ
COLOUR TRUE
COPPER, diss. & total θ
E. COLI θ
FLUORIDE, diss. θ
FREE CO2, calcd.
GALLIUM, diss. & total
GLYPHOSATE ◆
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 θ
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 Beaver, Churchill, Cold and Red Deer (S/M) Rivers in 2020

◆ Collected from the Assiniboine, Carrot, Saskatchewan and Qu'Appelle in 2020

Appendix IV: PPWB Report on Excursions of Interprovincial Water Quality Objectives

January - December 2020

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Summary

This 2020 report fulfils requirements of the *Master Agreement on Apportionment (MAA)* to report on the protection of water quality for major interprovincial prairie rivers. During 2020, water quality samples were collected from 12 major interprovincial rivers but due to the COVID-19 pandemic, monitoring and analyses were reduced at the transboundary sites. Where data were available, the water quality results are compared to interprovincial water quality objectives for each site. Although water samples were only collected during the winter and fall season, in general, water quality was suitable for the intended water uses for these rivers. Based on the evaluation of excursions in 2020 and with consideration of results from previous years, trends, and on-going work by the Committee on Water Quality (COWQ), the following are recommended:

- There were no unexpected water quality issues or concerns specifically highlighted as a result of the 2020 sampling program. As such, the Committee will continue to focus its efforts to understand broader scale questions related to factors affecting water quality on the prairies.
- 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 Committee's on-going work to understand nutrient sources and trends is on-going.
- Common use pesticides are frequently detected in transboundary rivers on the prairies. The COWQ is working with the jurisdictions to understand the potential effects of trace-level pesticides to the aquatic environment and users of these waters. Given low level but frequent occurrence of certain pesticides, understanding the aquatic life and use implications continues to be a priority.
- A number of the transboundary prairie rivers have constituent ions that vary based on precipitation, flow and groundwater inputs. Total dissolved solids and sulphate exceeded water quality objectives most frequently in 2020, particularly on the Saskatchewan-Manitoba boundary. In addition, increasing trends in TDS and major ions have been noted in a number of rivers on both the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries. The COWQ will continue to track these parameters and evaluate as more data become available.
- Disruptions in water quality monitoring and laboratory analyses associated with the COVID-19 pandemic have negatively affected the COWQ's ability to monitor the quality of the aquatic environment and make annual comparisons to established interprovincial water quality objectives. The disruption also negatively affects the PPWB's ability to meet their mandate to foster and facilitate interprovincial water quality management among the parties to encourage the protection and restoration of the aquatic environment. Recognizing the challenges associated with the COVID-19 pandemic, the COWQ looks forward to working with ECCC to strengthen the resiliency of this water quality monitoring network.

Introduction

In 1969, the governments of Alberta, Saskatchewan, Manitoba and Canada entered into the Master Agreement on Apportionment (*MAA* or Agreement). This agreement provided for equitable sharing of water in eastward flowing rivers across interprovincial boundaries. Schedule E, the agreement on water quality, was added to the Agreement in 1992. The Prairie Provinces Water Board (PPWB) who has a mandate to foster and facilitate interprovincial water quality management among the parties and to encourage the protection and restoration of the aquatic environment administers the Agreement. 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 to 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; Table 1).

Water quality monitoring includes a range of physical, chemical and biological parameters collected and measured at one site on each of the rivers. Parameters include nutrients, major ions, metals, fecal coliforms, physical characteristics and pesticides. This report presents adherence of the 2020 water quality data to the interprovincial water quality objectives.

Field Program – Summary of (2020) Sampling

In March 2020, in response to the COVID-19 pandemic, ECCC enacted its Business Continuity Plan (BCP) in an effort to prioritize the health and safety of the Department's workforce which focused the efforts of the Department on the delivery of critical services. Consequently, some field and laboratory work related to non-critical services, including water quality monitoring, were temporarily suspended. ECCC developed a Departmental strategy for a phased return to field and laboratory work that included consistent occupational health and safety plans to address COVID-19 considerations and resumed water quality monitoring in October.

Environment and Climate Change Canada (ECCC) conducted water quality monitoring at the 12 PPWB transboundary river sites in 2020, however, the monitoring program was not completed as approved by the PPWB (Appendix 2). On the Alberta-Saskatchewan boundary, water quality samples were collected from the six transboundary rivers on five separate occasions during the months of January, February, October, November and December 2020. On the Saskatchewan-Manitoba boundary, water

samples were collected in January, February, March, October, November and December, with the exception of the Churchill River, which was sampled only in March and October 2020. Water samples were not collected during freshet or the spring/summer months for any of the river reaches in 2020. At the time of writing this report not all water quality analyses had been completed due to COVID-19 related laboratory shut-downs, start-up delays and sample backlogs. Nutrient, and major ion analyses were complete for all samples, but analytical results for metals and pesticides are still pending for a number of samples. Consequently, metal and pesticide results from some samples collected are not included in this report. These data will be available at a later date. Field related parameters including biota and general water chemistry parameters (*i.e.*, pH, DO) were provided for all samples collected in 2020.

Figure 1: Map showing the locations of PPWB water quality monitoring stations.

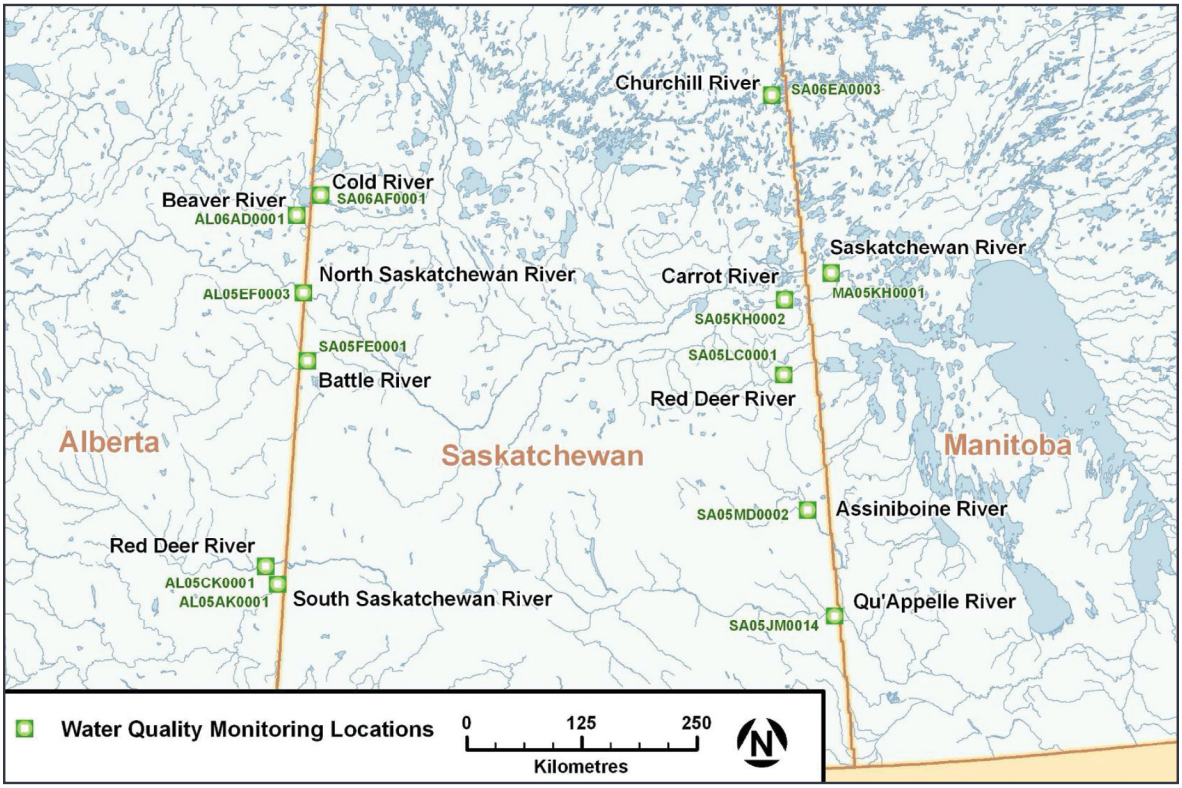


Table 1: PPWB water quality station information.

RIVER	STATION NUMBER	LATITUDE	LONGITUDE	LATITUDE	LONGITUDE	HYDROMETRIC SITE(S)
Alberta-Saskatchewan		Open Season		Closed Season		
Battle	SA05FE0001	52°'56'23.09"	109°52'34.60"	52°56'23.20"	109°52'33.55"	05FE004
Beaver	AL06AD0001	54°21'19.06"	110°12'57.13"	54°21'19.71"	110°13'00.19"	06AD006
Cold	SA06AF0001	54°33'56.51"	109°50'29.23"	54°33'56.65"	109°50'29.81"	06AF001
N. Saskatchewan	AL05EF0003	53°36'13.35"	110°00'38.87"	53°35'50.28"	109°59'31.05"	05EF001
Red Deer	AL05CK0001	50°54'11.91"	110°17'57.69"	50°54'10.00"	110°17'48.98"	05CK004
S. Saskatchewan	AL05AK0001	50°43'51.88"	110°04'10.73"	50°44'01.31"	110°05'00.87"	05AJ001*
Saskatchewan-Manitoba		Open Season		Closed Season		
Assiniboine	SA05MD0002	51°31'57.86"	101°52'38.33"	51°31'57.85"	101°52'37.72"	05MD004
Carrot	SA05KH0002	53°36'52.54"	102°06'14.75"	53°36'52.79"	102°06'15.84"	05KH007
Churchill	SA06EA0003	55°33'40.16"	102°15'41.83"	55°33'47.10"	102°15'48.90"	06EA002**
Qu'Appelle	SA05JM0014	50°29'28.38"	101°33'31.37"	50°29'28.17"	101°33'30.93"	05JM001
Red Deer	SA05LC0001	52°51'34.87"	102°11'44.70"	52°51'33.73"	102°11'44.88"	05LC001
Saskatchewan	MA05KH0001	53°50'36.19"	101°19'59.70"	53°51'08.80"	101°20'33.90"	05KJ001***

*Estimated flow for the PPWB South Saskatchewan site is based on recorded flow at Medicine Hat plus the flow from Seven Persons Creek 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, 97.6% in 2020 (Figure 2). No acute water quality concerns were apparent from review of these data. The adherence rate is based on the comparison of 1,944 available water quality results to water quality objectives (Table 8 and 9). In comparison, on average 5287 water quality results were compared to water quality objectives over the previous five years. The 2020 data set did not include samples from the freshet or summer season.

Adherence rates for each site in 2020 were compared to previous years (Figure 3). The water quality objectives were updated in 2015 and have been applied in annual reporting to the PPWB river reaches since then. However, to understand better how adherence rates change over time the 2015 objectives were used to retroactively calculate adherence rates from 2003 to 2014. This analysis allows for longer-term comparison of adherence rates for 2020.

Most rivers show little variation in adherence rates among years (approximately 4 to 8%). The Red Deer River and Battle River on the Alberta-Saskatchewan boundary have had the greatest variability in adherence rate among years, each with an 8% variation in adherence rate over the past 18 years. For the Red Deer River, high and low adherence rates were observed in 2018 and 2005, respectively. The lower adherence rate in 2005 was not specifically attributable to a single variable or one group of variables, although annual discharge was on the higher end for this river in 2005. The higher adherence rate in 2018 was attributed to no excursions for metals and fewer nutrient excursions. In 2020, excursions on the Red Deer River were attributed to nutrients, E.coli and TSS. For the Battle River, the highest adherence rate was observed in 2006 and the lowest was in 2003. However, since 2007 adherence variation rates on the Battle River have been small. The lower adherence rate in 2003 was attributed to multiple excursions to the nutrients, major ions, metals and an excursion to TSS. In 2020, excursions were a result of nutrient excursions to the site-specific objectives.

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, also with a variation of 8% over the last 18 years. Exceedances to objectives on this river included nutrients, TSS, and several metals. Quite often the variability of adherence rates demonstrates the susceptibility of a watershed to various weather/hydrological events (e.g., storm, drought) and environmental and land use factors (e.g., agriculture and urban activities, erosion) that also vary annually. Direct comparison of the 2020 data to previous years should be made with caution due to the COVID-19 disruptions in sampling and reduced data to evaluate adherence rates.

Figure 2: Percent adherences to interprovincial water quality objectives in 2020. Blue bars summarize 2020 adherence rates for each river, the red lines are adherence rates for the previous year to this report (2019) and blue lines are the 18-year median adherence rates. Note, 2020 adherence rates were calculated using an average of 37% of the comparisons used in previous years.

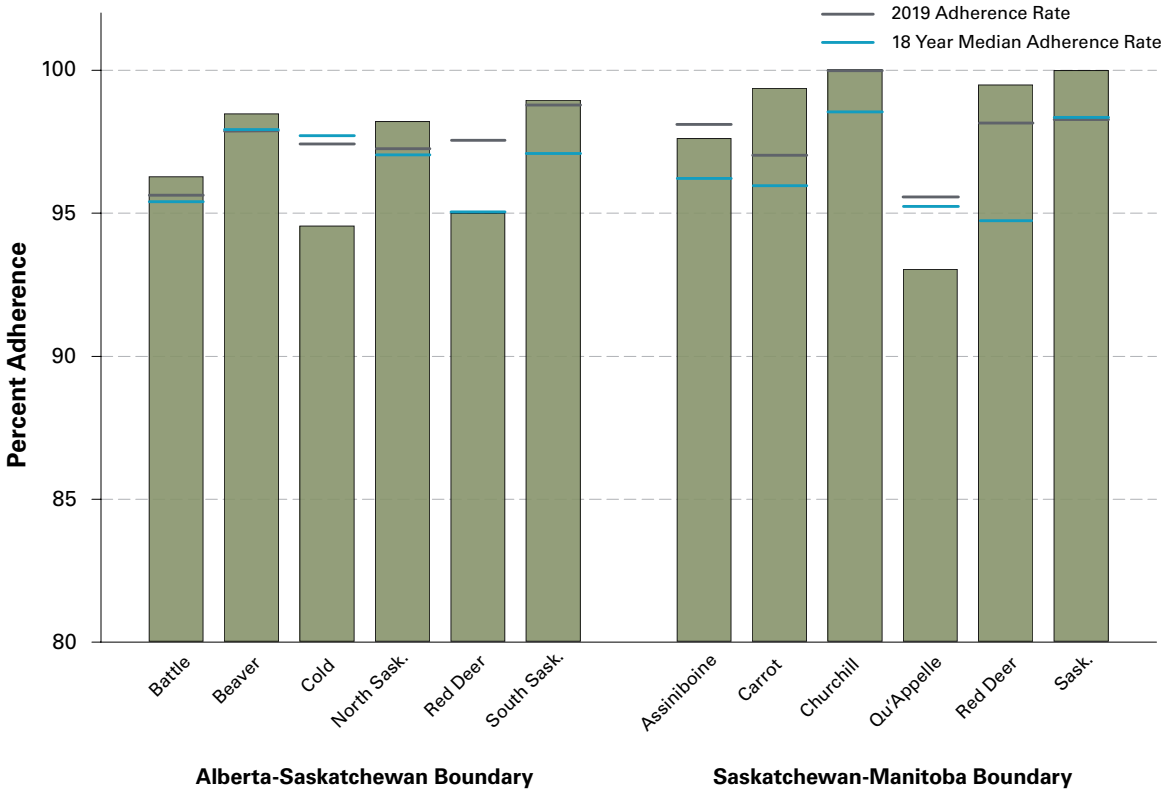
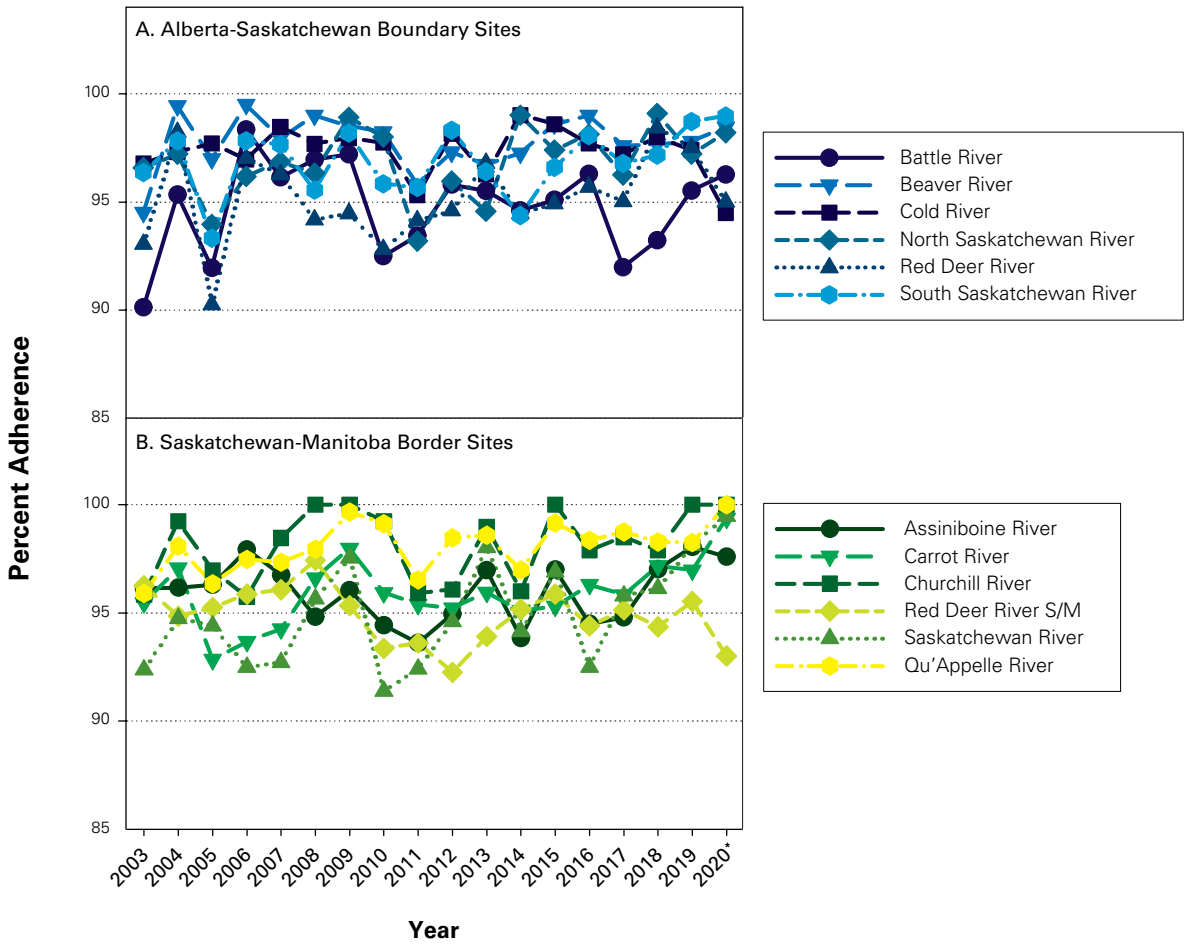


Figure 3: Percent adherences to interprovincial water quality objectives for (A) the Alberta-Saskatchewan and (B) the Saskatchewan-Manitoba boundaries from 2003 to 2020.



Examination of Specific Parameter Excursions for 2020

Alberta-Saskatchewan Boundary

For the Alberta-Saskatchewan transboundary rivers, there were excursions of objectives for nutrients (total phosphorus (TP), total nitrogen (TN), and total dissolved phosphorus (TDP)), total suspended solids (TSS), metals (cadmium, and iron), bacteria (fecal coliforms and *E. coli*), and a pesticide (dicamba) (Tables 2, 4, 6 and 8).

Total suspended solids is a measure of sediment and particulate matter in the water column. Sediment may arise from a variety of different processes including; erosion of soils in the watershed and along riverbanks and re-suspension of river sediments. When TSS concentrations are elevated, elevated levels of nutrients, total metals and coliform bacteria can occur. Elevated TSS concentrations are typical during spring runoff and other episodic flow events such as following summer storms.

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. The lower objective was designated in recognition that some fish species require turbidity, particularly during spring spawning (e.g., Goldeye and mooneye). Total suspended solids site-specific 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 objective plus 10% upper objective). As the TSS water quality objective is only applied to the open water season, in 2020 the only open water samples collected were in October. For the locations on the Saskatchewan River system (Red Deer, South and North Saskatchewan), the TSS objective did not meet its lower objective. Given these excursions occurred in the autumn there are no concerns from a fisheries perspective about the clear water of these rivers.

Site-specific nutrient objectives were established for TP, TDP and TN for each of the transboundary rivers in 2015. 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 all data for each season (open water and closed). Where statistical trends existed, an additional objective was established based on the lowest running 10-year 90th percentile. Given this percentile approach, it is known that there will be a certain proportion of excursions over the long term. The reason for establishing these objectives was to provide a benchmark for evaluating nutrient levels in each river. For objectives set using the complete period of record it is expected that the excursion rate will, on average, be 10%. Typically, these excursions are expected to be more frequent in some years and less frequent in other years based on annual variability affected by hydrology, precipitation and temperature.

Nutrient excursions occurred in four of the six rivers at the Alberta-Saskatchewan boundary in 2020 (Tables 2 and 6). No excursions to the nutrient objectives were observed on the North Saskatchewan and Beaver rivers.

The majority of the samples collected in 2020 occurred during the closed water season, with one sample collected in the open water season (October). Despite the limited number of open water samples, nutrient excursions occurred in the Cold River in both seasons. For the Battle, Red Deer, and South Saskatchewan Rivers, nutrient excursions occurred

during the winter season (excursions were not observed in October). Of the rivers with nutrient excursions in 2020, three (Battle, Cold, and Red Deer Rivers) had excursions to all three site-specific nutrient objectives. The rivers with the highest number of excursions on the Alberta-Saskatchewan boundary were the Battle and the Cold Rivers. The exceedances are generally within the historical ranges of the concentrations, without any staggering increase observed.

The Cold River had 5.5 excursions to the nutrient objectives, exceeding TP twice and TDP three times in 2020. In addition, TN exceeded the lowest 90th percentile once in February. Excursions occurred in late winter, with the exception of one TDP excursion observed in October. For these excursions, with the exception of the open water season sample in October, TDP comprised 79 to 82% of the TP. Total dissolved phosphorus was also a high proportion (71 to 75%) of the TP in the November and December winter samples when the site-specific objectives were not exceeded. This higher proportion of phosphorus as total dissolved phosphorus, under-ice-conditions is similar to previous years. The number of nutrient excursions throughout the closed water season have increased in the Cold River over the last several years with the most nutrient excursions reported in 2020.

The Battle River had total nitrogen (TN) and phosphorus (TP and TDP) excursions to the interprovincial objectives in February. Additional TP excursions also occurred under ice-conditions in November and December 2020. The Red Deer River had the third highest number of excursions to the nutrient objectives in 2020, which was similar to 2019. In total, the Red Deer River had four excursions, with TP, TDP, and TN exceeding the site-specific objectives in February. For the TN exceedance in February, the majority of TN was comprised of total dissolved nitrogen, approximately 80% with the nitrate/nitrite comprising 64% of the total dissolved nitrogen. The high proportion of dissolved nitrogen contributing to the TN concentration was consistent with other winter samples, inferring a non-sudden impact to water quality. For the Red Deer River both TP and TDP exceeded the site-specific water quality objectives in February. In addition to the exceedance in February, the TDP also exceeded the lowest-running 10-year objective in November and December.

The Committee continues to work towards a better understanding of nutrient dynamics and sources. While peaks in flow and TSS can explain some excursions to objectives, observed during freshet and the open water season these factors do not directly explain the closed water nutrient excursions. Nutrients under ice-conditions can increase from organic degradation, sediment suspension and wastewater inflows. The statistical method used to derive the objectives also accounts for some of the observed excursions, because a certain percentage of excursions will occur. The nutrient objectives were established so the Committee has a means of more readily assessing the frequency of high concentrations. In 2020, the frequency and magnitude of nutrient excursions observed did not raise specific, short-term concerns about high concentration levels of nutrients for these rivers.

While some analytical results are still pending for metals, based on the currently available results, two metals (cadmium (total), and iron (dissolved)), exceeded water quality objectives in 2020 along the Alberta-Saskatchewan boundary. The Beaver River exceeded the dissolved iron objective in January and

November in 2020. This is similar to 2019 when the dissolved iron was exceeded throughout the closed water season (January, November, and December). The Beaver River is a low-flow river with little flow and low water levels throughout the winter months. Under these conditions, groundwater inputs or sediment iron release are thought to drive the higher iron levels observed throughout the winter months in this river.

The Cold River had an excursion to cadmium (total) in November 2020. The November exceedance was atypical for this site. While monitoring on this river began in 1993 and monthly monitoring was implemented in 2012 no other winter sample has had elevated cadmium levels. Since 2003, when there was an analytical method change for metals, there have been six excursions to the cadmium (total) objective on the Cold River including the November 2020 sample. Three of the excursions occurred during spring freshet (April and May 2012 and April 2015). The other two exceedances occurred in July and October 2011. Total cadmium concentrations since 2003 have ranged from less than the detection limit to 0.621 µg/L. In November 2020, the cadmium (total) concentration was 0.063 µg/L. The cause of the November exceedance is unknown at this time, but the Committee will continue to pay attention to the winter cadmium levels on the Cold River, including reviewing the December 2020 cadmium concentration once available and in upcoming years.

A general lack of metal exceedances in 2020 can be attributed to the pending analytical results and the lack of samples collected during spring freshet when metals concentrations are occasionally elevated along with elevated TSS concentrations.

In 2020, none of the six rivers on the Alberta-Saskatchewan boundary exceeded the major ions and total dissolved solids (TDS) interprovincial water quality objectives. In recent years (2017, 2018, 2019) the Battle River has exceeded the site-specific TDS objectives during the winter season. These exceedances are considered to be a result of low flows in the Battle River in late winter and under-ice-conditions. However, in 2020 while the TDS values were elevated in January and February (833 and 843 mg/L, respectively), they did not exceed the site-specific objective of 872 mg/L.

Sources of fecal coliform are numerous and include wildlife, discharge of wastewater, and runoff from agricultural activities including livestock operations and agricultural fields that receive manure. Occasional exceedances of fecal coliform objectives are expected in surface waters, particularly in response to rainfall events that can transport fecal bacteria through runoff. Given the majority of the samples collected in 2020 were during the closed water season it was not surprising that few exceedances were *reported to the fecal coliform and Escherichia coli (E. coli) water quality objectives*. The North Saskatchewan River did have one exceedance to the fecal coliform bacteria objective in October, where the fecal coliform density was reported to be equal to the water quality objective of 100 No./100 mL.

Fecal coliform densities for the North Saskatchewan River ranged from less than 3 to 100 No./100 mL.

Peak densities for the Beaver, Red Deer, Battle, South Saskatchewan and Cold rivers in 2020 were 95, 56, 38, 10 and <2 No./100 mL respectively. Peak densities occurred in the October open water sample for the North Saskatchewan, Battle and Beaver rivers, while the peak densities for the South Saskatchewan River and the Red Deer River occurred in February, based on the incomplete dataset of the year.

Escherichia coli (E. coli) is also a measure of fecal contamination in water sources and is generally considered the preferred indicator because it is more specific than fecal coliform bacteria counts. In 2020, *E. coli* exceeded the water quality objectives once in the Red Deer River in February (500 No./100 mL). While a corresponding excursion in fecal coliform was not observed (56 No./100 mL) for the same sample, although a higher coliform density was reported. As *E. coli* is a subgroup of bacteria within the fecal coliform group it is not unexpected that elevated levels may occur at the same time for the two measures of fecal contamination. It is unusual to have E.coli level around a magnitude higher than that of fecal coliform. Information from other parameters show that total aluminum and turbidity are significantly higher in the February sample (both coincidentally 16.6 times of that in January). It is likely the February sample was mixed with higher sediment content, and E.coli numbers are occasionally much higher in the sub-sample taken for the *E.coli* testing. For the six transboundary rivers the *E. coli* concentrations ranged from 2 to 500 No./100 mL.

Pesticide monitoring on the transboundary rivers is conducted on a rotational basis with each river monitored once every four years. As a result of this rotational sampling, the full suite of pesticide monitoring was not scheduled for the rivers on the Alberta-Saskatchewan boundary in 2020. However, the acid herbicide group of pesticides were scheduled to be measured eight times on the North and South Saskatchewan rivers, the Red Deer and Battle rivers in 2020. However, monitoring was limited to February, October and December, with results currently available for February and October. December sample results were still pending at the time of writing this report.

In 2020, one excursion was observed for the acid herbicide dicamba on the Red Deer River (Table 4). The excursion occurred in February with a concentration of 17.3 ng/L, exceeding the irrigation objective of 6 ng/L. Given that open water samples were only collected in October, further analysis of excursions that might have occurred and are more typical during the growing season on the Red Deer River is not feasible for 2020. However, based on the historical data from this river, excursions of the dicamba objective have typically occurred in the open water season (89%), with dicamba exceeding the water quality objective in 18% of all samples collected since 2003. The February excursion observed in 2020 was atypical for this river. Excursions to the dicamba interprovincial water quality objective have not been previously reported in samples collected in the late winter months (January to March).

2020 monitoring results for glyphosate and aminomethylphosphonic acid (AMPA), a breakdown product of glyphosate, are pending.

Saskatchewan-Manitoba Boundary

In 2020, water quality excursions for the Saskatchewan-Manitoba boundary included objectives for nutrients (TP, TDP, TN), major ions (sodium, sulphate and TDS), bacteria (fecal coliforms), and general water chemistry (dissolved oxygen) (Tables 3, 5, 7 and 9).

Nutrient objectives for the Saskatchewan-Manitoba boundary, as for the Alberta-Saskatchewan boundary, were established with a statistical approach that evaluated long-term data from each site. There were nutrient excursions at two sites on the Saskatchewan-Manitoba boundary in 2020 (Tables 3 and 7). The number of excursions, out of 18 comparisons, to
the site-specific objectives were two excursions on the Assiniboine River and one and half on the Carrot River. The Churchill, Qu'Appelle, Red Deer and the Saskatchewan rivers did not exceed any site-specific nutrient objectives in 2020.

In 2020, the Assiniboine River had two excursions to the site-specific nutrient objectives, while the Carrot River had 1.5 excursions. The two excursions on the Assiniboine River occurred in November with excursions to both TP and TDP. For this November sample, the TDP comprised 89% of the total phosphorus. Phosphorus excursions to the site-specific objectives have historically occurred in every month. However, most excursions to the TDP site-specific objective have occurred in the month of October followed by the spring freshet months of March and April. For TP, exceedances occur most often during spring freshet due to high flows and elevated TSS levels. However, similar to TDP, a number of excursions to the site-specific TP objective occurred in October. The number of excursions to the TP and TDP site-specific objectives in November has generally been low (2 and 5% respectively).

As the Carrot River has shown statistically significant increasing trends in concentrations of phosphorus (TP and TDP), and nitrogen (TN), site-specific objectives were established for both 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. In October 2020, while the Carrot River did not exceed the 90th percentile site-specific objective for any of the nutrients, the open water lowest running 10-year 90th percentile objective was exceeded for all three nutrients (TP, TDP and TN). Historically, for the Carrot River, the spring freshet and open water months have had the highest number of exceedances to the site-specific nutrient objectives. Excursions to the objectives in October have occurred previously but typically at a much lower frequency. In the October sample, total phosphorus was comprised of 77% particulate phosphorus, while the particulate nitrogen was 26% of the total nitrogen,

Understanding specific factors affecting nutrient concentrations continues to be a priority for the Committee and all jurisdictions. In 2020, the Committee focused its nutrient work on the Carrot River watershed, and its hydrology to get a better understanding of the hydrology in this watershed and how different flows might be affecting nutrient water quality.

The total suspended solids objectives, which have only been established for the open water season, were not exceeded for any of the six Saskatchewan-Manitoba boundary river sites in 2020. However, the only open water sample in 2020 was collected in

October. Typically, exceedances of the upper objective are observed on the transboundary rivers during spring freshet or summer storm events. Similarly, no metal exceedances were reported for any of the Saskatchewan-Manitoba transboundary rivers in 2020. Total metal excursions to the water quality objectives usually occur when the TSS peaks, with the highest percentage of excursions occurring during spring freshet.

Three rivers, the Qu'Appelle, Assiniboine, and Red Deer rivers, on the Saskatchewan-Manitoba boundary had excursions to TDS in 2020, which was similar to 2019. The Qu'Appelle River also had excursions to sulphate and sodium in 2020. However, the Churchill, Carrot, and Saskatchewan rivers did not have any reported excursions to major ions and/or TDS objectives in 2020.

For the Assiniboine and Qu'Appelle rivers, TDS and sulphate objectives were set with a similar approach to nutrients, whereby statistical analyses using historical data were used to define an expected range of concentrations. As with nutrients, there is an expectation that there will be a certain proportion of excursions over the long term. In 2020, the Qu'Appelle River had five excursions to TDS during the closed water season (January, February, March, November and December) representing 100% of the winter months, with a maximum exceedance of 17% over the objective. For the open water sample in October, while it met the site-specific TDS objective, it was only just below the objective with a TDS concentration of 1130 mg/L compared to the objective of 1144 mg/L. In comparison in 2019, the Qu'Appelle River TDS exceeded its objective in January to March and October to December. The objective was exceeded to a maximum amount of 12% above the objective. This pattern is similar to what has been observed in previous years with the late winter months having the most excursions to the site-specific objectives over the historical record. Sulphate excursions occurred on all the same dates as those for TDS but also included an excursion in the October sample. Hence, excursions for sulphate occurred in 100% of the samples collected in 2020. Sulphate concentrations ranged from 496 to 621 mg/L (Qu'Appelle sulphate objective = 486 mg/L). In addition, to the TDS and sulphate, sodium also exceeded the interprovincial water quality objectives in 2020. The sodium exceedance occurred in November and coincided with the peak in TDS and sulphate. Sodium did not exceed the water quality objective of 200 mg/L, in any of the other winter samples collected in 2020, although the concentration values did remain close to the objective.

In 2020, the Assiniboine River had three excursions to TDS during the closed water season (January, February, and March) representing 50% of the samples with a maximum exceedance of 14% over the objective. The proportion of exceedances in 2020 was the same as 2019, higher than that in 2018 (where there were two exceedances) and lower than the four exceedances found in 2017. All the exceedances in these years were in the months sampled in 2020.

In 2020, the Assiniboine River did not have any exceedances to the sulphate objective, which was similar to 2019. However, the Assiniboine River has previously reported exceedances to this objective including in consecutive years from 2007 to 2018 when comparing the same months as samples in 2020. Trend analysis work completed by the Committee to the end of 2013 (PPWB 2018) has shown increasing trends for TDS and sulphate in

a number of the transboundary rivers including the Assiniboine River. Initial review of these 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 higher concentrations of sulphate and TDS, contributes a greater proportion of flow.

The Red Deer (Erwood) River has a water use TDS objective of 500 mg/L and had one exceedance in March of 502 mg/L under-ice-cover, which is similar to the results in 2019 where there was one exceedance to the TDS objective also in March. Historically, this river has had excursions to the TDS objective during the late winter months (January to March). Long-term assessment has shown that more than half of the winter samples typically are greater than the objective. In 2020, TDS concentrations peaked in March, and while the freshet and summer samples were not collected, the October open sample had a TDS of 265 mg/L. The subsequent samples did not exceed the water use objective but the concentrations gradually increased in November and December.

On the Saskatchewan-Manitoba boundary, the Qu'Appelle River was the one river to have excursions to the fecal coliform bacteria objective in 2020. The exceedance occurred in October (the only open water sample) and densities were slightly elevated (120 No./100 mL) as compared to the objective of 100 No./100 mL. Densities of *E. coli* in the same sample were below the recreation-based objective of 200 No./100 mL. Given the variability of bacterial densities in water, the observed exceedance did not raise specific concerns.

In 2020, the Assiniboine, Carrot, Qu'Appelle and Saskatchewan rivers were monitored for acid herbicides, neutral herbicides and organochlorine pesticides. The Assiniboine and Carrot rivers were sampled for pesticides on all sampling trips (January, February, March, October, November and December) as part of their annual water quality-monitoring program. The Qu'Appelle and the Saskatchewan rivers were sampled three times in 2020 (February, October and December). These rivers are sampled for the three pesticide groups once every four years as part of a rotational pesticide sampling program for the transboundary rivers. The Red Deer and Churchill rivers were not monitored for pesticides in 2020. At the time of writing this report, pesticide results are still pending for a number of the pesticide groups and the outstanding results varies by river. However, based on the available results, none of the pesticides within the three pesticide groups monitored on the Assiniboine, Carrot, Qu'Appelle and Saskatchewan rivers exceeded the interprovincial water quality objectives in 2020.

In 2020, glyphosate and AMPA were monitored on the Carrot, Assiniboine, Qu'Appelle and Saskatchewan rivers on the Saskatchewan-Manitoba boundary. For these four rivers on the Saskatchewan-Manitoba boundary, the results are only available for October. For all four rivers, glyphosate was not detected above the detection limit of 16.6 ng/L. In contrast, AMPA was detected at low levels. AMPA concentrations ranged from 234 ng/L on the Assiniboine River to 23.8 ng/L on the Saskatchewan River. The concentration of AMPA on the Assiniboine River in October 2020 was substantially lower than the peak concentration reported for this river in October 2019 when AMPA had a concentration of 25,400 ng/L. This was the highest concentration of AMPA detected in the transboundary rivers since monitoring for AMPA began in 2013.

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	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
BARIUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
BERYLLIUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
BORON TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
CADMIUM TOTAL	0(3)	0(3)	1(3)	0(2)	—	0(3)
CHROMIUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
COBALT TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
COPPER TOTAL	0(3)	0(3)	0(3)	0(2)	—	0(3)
IRON DISSOLVED	0(3)	2(3)	0(3)	0(2)	0(3)	0(3)
LEAD TOTAL	0(3)	0(3)	0(3)	0 (2)	0(3)	0(3)
LITHIUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
MANGANESE DISSOLVED	—	—	0(3)	0(2)	0(3)	0(3)
MOLYBDENUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
NICKEL DISSOLVED	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
SELENIUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
SILVER TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
THALLIUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
URANIUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
VANADIUM TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
ZINC TOTAL	0(3)	0(3)	0(3)	0(2)	0(3)	0(3)
NUTRIENTS						
AMMONIA UN-IONIZED	0(5)	0(5)	0(5)	0(4)	0(5)	0(5)
PHOSPHORUS TOTAL *	3(5)	0(5)	2(5)	0(4)	1(5)	0(5)
PHOSPHORUS TOTAL DISSOLVED *	1(5)	0(5)	3(5)	0(4)	2(5)	0.5(5)
NITROGEN TOTAL *	1(5)	0(5)	0.5(5)	0(4)	1(5)	0(5)
NITROGEN DISSOLVED NO3 and NO2	0(5)	0(5)	0(5)	0(4)	0(5)	0(5)
MAJOR IONS						
CHLORIDE DISSOLVED	0(5)	0(5)	0(5)	0(4)	0(5)	0(5)
FLUORIDE DISSOLVED	0(5)	0(5)	0(5)	0(4)	0(5)	0(5)
SODIUM DISSOLVED/FILTERED	0(5)	0(5)	0(5)	0(4)	0(5)	0(5)
SULPHATE DISSOLVED	0(5)	0(5)	0(5)	0(4)	0(5)	0(5)
TOTAL DISSOLVED SOLIDS	0(5)	0(5)	0(5)	0(4)	0(5)	0(5)
BIOTA						
COLIFORMS FECAL	0(5)	0(5)	0(5)	1(4)	0(5)	0(5)
ESCHERICHIA COLI	0(5)	0(5)	0(5)	0(4)	1(5)	0(5)
PHYSICALS and OTHERS						
OXYGEN DISSOLVED	0(1)	0(1)	0(5)	0(4)	0(5)	0(5)
PH	0(5)	0(5)	0(5)	0(4)	0(5)	0(5)
SODIUM ADSORPTION RATIO	—	0(5)	0(5)	0(4)	0(5)	0(5)
TOTAL SUSPENDED SOLIDS	0(1)	0(1)	1(1)	1(1)	1(1)	1(1)
Number of Excursion Comparisons	124	129	136	101	130	136
Total Number of Excursions Observed	5	2	7.5	2	6	1.5
Sampling Frequency (no./year)	5	5	5	4	5	5

* 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(5)	—	0(4)	—	—
ARSENIC TOTAL	0(5)	—	0(2)	0(4)	0(5)	0(5)
BARIUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
BERYLLIUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
BORON TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
CADMIUM TOTAL	0(5)	0(5)	0(2)	0(4)	1(5)	0(5)
CHROMIUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
COBALT TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
COPPER TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
IRON DISSOLVED	0(5)	—	0(2)	0(4)	0(5)	0(5)
LEAD TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
LITHIUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
MANGANESE DISSOLVED	—	—	0(2)	—	0(5)	0(5)
MOLYBDENUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
NICKEL DISSOLVED	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
SELENIUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
SILVER TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
THALLIUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
URANIUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
VANADIUM TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
ZINC TOTAL	0(5)	0(5)	0(2)	0(4)	0(5)	0(5)
NUTRIENTS						
AMMONIA UN-IONIZED	0(6)	0(6)	0(2)	0(6)	0(6)	0(6)
PHOSPHORUS TOTAL *	1(6)	0.5(6)	0(2)	0(6)	0(6)	0(6)
PHOSPHORUS TOTAL DISSOLVED *	1(6)	0.5(6)	0(2)	0(6)	0(6)	0(6)
NITROGEN TOTAL *	0(6)	0.5(6)	0(2)	0(6)	0(6)	0(6)
NITROGEN DISSOLVED NO3 and NO2	0(6)	0(6)	0(2)	0(6)	0(6)	0(6)
MAJOR IONS						
CHLORIDE DISSOLVED	0(6)	0(6)	0(2)	0(6)	0(6)	0(6)
FLUORIDE DISSOLVED	0(6)	0(6)	0(2)	0(6)	0(6)	0(6)
SODIUM DISSOLVED/FILTERED	0(6)	0(6)	0(2)	1(6)	0(6)	0(6)
SULPHATE DISSOLVED	0(6)	0(6)	0(2)	6(6)	0(6)	0(6)
TOTAL DISSOLVED SOLIDS	3(6)	0(6)	0(2)	5(6)	1(6)	0(6)
BIOTA						
COLIFORMS FECAL	0(5)	0(6)	0(2)	1(6)	0(6)	0(6)
ESCHERICHIA COLI	0(5)	0(6)	0(2)	0(6)	0(6)	0(6)
PHYSICALS and OTHERS						
OXYGEN DISSOLVED	1(6)	0(1)	0(2)	0(6)	0(6)	0(6)
PH	0(6)	0(6)	0(2)	0(6)	0(6)	0(6)
SODIUM ADSORPTION RATIO	0(6)	—	0(2)	—	0(6)	0(6)
TOTAL SUSPENDED SOLIDS	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)
Number of Excursion Comparisons	184	170	143	403	426	392
Total Number of Excursions Observed	6	1.5	0	13	1	0
Sampling Frequency (no./year)	6	6	2	6	6	6

* Summary information – details in Table 6

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(2)	Not Sampled	Not Sampled	0(2)	0(2)	0(2)
ATRAZINE	NA			NA	NA	NA
BROMOXYNIL	0(2)			0(2)	0(2)	0(2)
DICAMBA	0(2)			0(2)	1(2)	0(2)
DICLOFOP-METHYL	NA			NA	NA	NA
ENDOSULFAN	NA			NA	NA	NA
GAMMA-BENZENEHEXACHLORIDE	NA			NA	NA	NA
HEXACHLOROBENZENE	NA			NA	NA	NA
MCPA	0(2)			0(2)	0(2)	0(2)
METOLACHLOR	NA			NA	NA	NA
METRIBUZIN	NA			NA	NA	NA
PENTACHLOROPHENOL (PCP)	—			—	—	—
PICLORAM	0(2)			0(2)	0(2)	0(2)
SIMAZINE	NA			NA	NA	NA
TRIALLATE	NA			NA	NA	NA
TRIFLURALIN	NA			NA	NA	NA
GLYPHOSATE	0(0)[a]	Not Sampled	Not Sampled	0(0)[a]	0(0)	0(0)[a]
Number of Excursion Comparisons	10			10	10	10
Total Number of Excursions Observed	0			0	1	0
Sampling Frequency (no./year)	2			2	2	2

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(3)	0(3)	Not Sampled	0(1)	Not Sampled	0(1)
ATRAZINE	0(5)	0(5)		0(2)		0(2)
BROMOXYNIL	0(3)	0(3)		0(1)		0(1)
DICAMBA	0(3)	0(3)		0(1)		0(1)
DICLOFOP-METHYL	0(5)	0(5)		0(2)		0(2)
ENDOSULFAN	0(5)	0(5)		0(2)		0(2)
GAMMA-BENZENEHEXACHLORIDE	0(5)	0(5)		0(2)		0(2)
HEXACHLOROBENZENE	0(5)	0(5)		0(2)		0(2)
MCPA	0(3)	0(3)		0(1)		0(1)
METOLACHLOR	0(5)	0(5)		0(2)		0(2)
METRIBUZIN	0(5)	0(5)		0(2)		0(2)
PENTACHLOROPHENOL (PCP)	—	—		—		—
PICLORAM	0(3)	0(3)		0(1)		0(1)
SIMAZINE	0(5)	0(5)		0(2)		0(2)
TRIALLATE	0(5)	0(5)		0(2)		0(2)
TRIFLURALIN	0(5)	0(5)		0(2)		0(2)
GLYPHOSATE	0(1)[a]	0(1)	Not Sampled	0(1)	Not Sampled	0(1)
Number of Excursion Comparisons	65	65		25		25
Total Number of Excursions Observed	0	0		0		0
Sampling Frequency (no./year)	5	5		2		2

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	0(1) 3(4)	0(1) 3(4)	0(1) 1(4)		0(1) 1(4)		15	5
BEAVER RIVER	Open Water Ice-Covered	0(1) 0(4)		0(1) 0(4)	0(1) 0(4)	0(1) 0(4)		15	0
COLD RIVER	Open Water Ice-Covered	0(1) 2(4)		1(1) 2(4)		0(1) 1(4)	0(1) 0(4)	15	5.5
NORTH SASK. RIVER	Open Water Ice-Covered	0(1) 0(3)	0(1) 0(3)	0(1) 0(3)	0(1) 0(3)	0(1) 0(3)	0(1) 0(3)	12	0
RED DEER RIVER A/S	Open Water Ice-Covered	0(1) 1(4)	0(1) 1(4)	0(1) 3(4)	0(1) 1(4)	0(1) 1(4)		15	4
SOUTH SASK. RIVER	Open Water Ice-Covered	0(1) 0(4)	0(1) 0(4)	0(1) 1(4)	0(1) 0(4)	0(1) 0(4)	0(1) 0(4)	15	0.5

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 the 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 grey 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) or the arithmetic average of the trend (grey 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	0(1) 1(5)		0(1) 1(5)		0(1) 0(5)		18	2
CARROT RIVER	Open Water Ice-Covered	1(1) 0(5)	0(1) 0(5)	1(1) 0(5)	0(1) 0(5)	1(1) 0(5)	0(1) 0(5)	18	1.5
CHURCHILL RIVER	Open Water Ice-Covered	0(1) 0(1)		0(1) 0(1)		0(1) 0(1)		6	0
QU'APPELLE RIVER	Open Water Ice-Covered	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)		18	0
RED DEER RIVER S/M	Open Water Ice-Covered	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)		18	0
SASK. RIVER	Open Water Ice-Covered	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)	0(1) 0(5)		18	0

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. (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
CATEGORY						
METALS	0(57)	2(57)	1(60)	0(40)	0(54)	0(60)
NUTRIENTS (TN, TP, TDP)	5(15)	0(15)	5.5(15)	0(12)	4(15)	0.5(15)
NUTRIENTS (TOXICITY)	0(10)	0(10)	0(10)	0(8)	0(10)	0(10)
MAJOR IONS	0(25)	0(25)	0(25)	0(20)	0(25)	0(25)
BIOTA	0(10)	0(10)	0(10)	1(8)	1(10)	0(10)
PHYSICALS and OTHERS	0(7)	0(12)	1(16)	1(13)	1(16)	1(16)
PESTICIDES	0(10)	0(0)	0(0)	0(10)	1(10)	0(10)
Number of Excursion Comparisons	134	129	136	111	140	146
Total Number of Excursions Observed	5	2	7.5	2	7	1.5
Sampling Frequency (no./year)	5	5	5	4	5	5
Overall Adherence Rate	96.3	98.5	94.5	98.2	95.0	99.0

Table 9: Overall excursion summary, by category, 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 to the right.)

	SASKATCHEWAN-MANITOBA BOUNDARY					
	ASSINIBOINE RIVER	CARROT RIVER	CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER S/M	SASK. RIVER
CATEGORY						
METALS	0(95)	0(90)	0(40)	0(76)	0(100)	0(100)
NUTRIENTS (TN, TP, TDP)	2(18)	1.5(18)	0(6)	0(18)	0(18)	0(18)
NUTRIENTS (TOXICITY)	0(12)	0(12)	0(4)	0(12)	0(12)	0(12)
MAJOR IONS	3(30)	0(30)	0(10)	12(30)	1(30)	0(30)
BIOTA	0(10)	0(12)	0(4)	1(12)	0(12)	0(12)
PHYSICALS and OTHERS	1(19)	0(8)	0(7)	0(13)	0(19)	0(19)
PESTICIDES	0(65)	0(65)	0(0)	0(25)	0(0)	0(25)
Number of Excursion Comparisons	249	235	71	186	191	216
Total Number of Excursions Observed	6	1.5	0	13	1	0
Sampling Frequency (no./year)	6	6	2	6	6	6
Overall Adherence Rate	97.6	99.4	100.0	93.0	99.5	100.0

Conclusions

Interprovincial water quality objectives established 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. Due to the COVID-19 pandemic in 2020, there was disruption to the water quality-monitoring program including both the field and laboratory operations. Monitoring was suspended in March 2020 and was not reinitiated until October 2020. This suspension of operations therefore left seven and six month gaps in the 2020 dataset for the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries, respectively. Spring freshet and summer water samples were not collected in 2020, leaving a gap in the data set during a period that incorporates the majority of the water inflow to these rivers and during the growing season. Most water samples that were collected were for the closed water period. At the time of writing this report, there were also some outstanding analytical results pending for a number of the samples, comprising mainly of metals and pesticides. While not all analytical results were available at the time of reporting, these results will be available at a later date and incorporated into the water quality database. Based on the five to six samples available for each of the rivers, the interprovincial water quality objectives were met on average 97.6% of the time in 2020. There is an expectation that objectives will be exceeded occasionally (particularly for those sites with a statistically derived site-specific objective) and that some exceedances will occur naturally. The adherence rate to interprovincial water quality objectives ranged from 100% (Churchill River and Saskatchewan rivers) to 93% (Qu'Appelle River) in 2020. Water quality in these transboundary rivers continues to be generally suitable for their intended uses.

Excursions from the water quality objectives for nutrients and biota occurred at both boundaries in 2020. While excursions of TSS, metals and pesticides occurred for specific rivers on the Alberta-Saskatchewan boundary, excursions of TDS and major ions occurred for specific rivers on the Saskatchewan-Manitoba boundary in 2020. In 2020, the highest number of excursions to the interprovincial water quality objectives was observed for the Cold River (7.5) on the Alberta-Saskatchewan boundary and the Qu'Appelle River (13) on the Saskatchewan-Manitoba Boundary (each with a 94.5% and 93% overall adherence rate respectively).

The 2020 excursion report, in conjunction with those from previous years, provides several key conclusions for the Committee, Board, and/or provinces:

- There were no unexpected water quality issues or concerns specifically highlighted as a result of the 2020 sampling program. As such, the Committee will continue to focus its efforts to understand broader scale questions related to factors affecting water quality on the prairies.
- Excursions to nutrient objectives continue to occur at both the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries, and as such, work to understand sources and trends remains a priority. In 2020, the Committee continued to work on several integrated studies including assessing land-use changes to understand how this might be influencing nutrients in prairie watersheds. In 2021, the Committee will continue to discuss and follow up on nutrient issues in the transboundary rivers.

- In 2020, the majority of the water samples were collected during the ice-covered season. A number of the transboundary prairie rivers have constituent ions that vary based on precipitation, flow and groundwater inputs. Total dissolved solids and sulphate exceeded water quality objectives most frequently on the Saskatchewan-Manitoba boundary and in particularly on the Qu'Appelle River under-ice-conditions. In addition, increasing trends in TDS, sulphate, sodium, and chloride have been noted in a number of rivers on both the Alberta-Saskatchewan and Saskatchewan-Manitoba boundary. The COWQ will continue to track these parameters and evaluate as more data become available.
- Due to the COVID-19 impacted sampling regime in 2020, the number of excursions to pesticides were low. While excursion frequencies vary from year-to-year, the COWQ is currently working with the jurisdictions to complete a review of the prevalence of the acid herbicides MCPA and dicamba. Monitoring of glyphosate and its principal breakdown product in previous years also demonstrates that glyphosate is frequently present at low concentrations. The COWQ is continuing to work with the jurisdictions to understand better the presence and the effects of these pesticides on the aquatic environment and to users of these waters.
- Disruptions in water quality monitoring and laboratory analyses associated with the COVID-19 pandemic have negatively affected the COWQ's ability to monitor the quality of the aquatic environment and make annual comparisons to established interprovincial water quality objectives. The disruption also negatively affects the PPWB's ability to meet their mandate to foster and facilitate interprovincial water quality management among the parties to encourage the protection and restoration of the aquatic environment. Recognizing the challenges associated with the COVID-19 pandemic, the COWQ looks forward to working with ECCC to strengthen the resiliency of this water quality monitoring network.

On-going

Background

Interprovincial water quality objectives for the 12 transboundary rivers were revised and approved by Ministers responsible for the PPWB on July 8th, 2015. The objectives recognize the need to protect all water uses for all rivers and include a number of site-specific water quality objectives for selected parameters. Work to review and update the water quality objectives as needed continues, particularly in those areas where objectives were not established for select parameters and rivers. On-going objective review is part of the mandate within the PPWB, with the PPWB making recommendations to adopt new and/or revised objectives as appropriate, approximately every five years.

The assessment of excursions to water quality objectives will continue to assist the Committee to assess areas of potential concern and to set future priorities. In conjunction with the excursion assessment, the Committee will continue to look at long-term trends in water quality for each of the transboundary rivers. Trend analysis work incorporating data to 2018 is currently underway.

References

MAA Schedule E 1992. Agreement on water quality.
https://www.ppwb.ca/about-us/what-we-do/1969-master-agreement-on-apportionment/schedule-e

PPWB Report #179. 2018. Long-Term Trends in Water Quality Parameters at Twelve Transboundary Rivers Reaches (from the beginning of the data record until the end of 2013). pp 1072.

Appendix 1: Water Quality Objectives

Table A1: AB-SK

PARAMETER	2015 Interprovincial Water Quality Objectives – AB-SK Boundary					
NUTRIENTS	BATTLE RIVER	BEAVER RIVER	COLD RIVER	NORTH SASK. RIVER	RED DEER RIVER (BINDLOSS)	SOUTH SASK. RIVER
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

Table A2: AB-SK

PARAMETER / PESTICIDES	2015 Interprovincial Water Quality Objectives – AB-SK Boundary					
	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

Superscripts

a. Ammonia guideline: Expressed as mg un-ionized ammonia per L. This would be equivalent to 15.6 mg/L ammonia-nitrogen. Guideline for total ammonia is temperature and pH dependent.

b. Guideline is crop-specific 500 to 6000µg/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 = $\exp^{\{0.8460[\ln (\text{hardness})]+0.0584\}*0.997}$ µg/L.

d. Molybdenum guideline = up to 50 µg/L for short-term use on acidic soils.

Table A3: SK-MB

PARAMETER	2015 Interprovincial Water Quality Objectives – SK-MB Boundary						
	ASSINIBOINE RIVER	CARROT RIVER		CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER (ERWOOD)	SASKATCHEWAN RIVER
NUTRIENTS		OPEN	CLOSED				
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

Table A4: SK-MB

PARAMETER / PESTICIDES	2015 Water Quality Objectives – SK-MB Boundary						
	ASSINIBOINE RIVER	CARROT RIVER		CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER (ERWOOD)	SASKATCHEWAN 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

Superscripts

a. Ammonia guideline: Expressed as mg un-ionized ammonia per L. This would be equivalent to 15.6 mg/L ammonia-nitrogen. Guideline for total ammonia is temperature and pH dependent.

b. Guideline is crop-specific 500 to 6000µg/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 = $\exp^{\{0.8460[\ln (\text{hardness})]+0.0584\}*0.997}$ µg/L.

d. Molybdenum guideline = up to 50 µg/L for short-term use on acidic soils.

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

PARAMETER	2015 Water Quality Objectives – SK-MB Boundary						
	ASSINIBOINE RIVER	CARROT RIVER		CHURCHILL RIVER	QU'APPELLE RIVER	RED DEER RIVER (ERWOOD)	SASKATCHEWAN 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 Running 10-year 90th Percentile	Increasing Trend – Lowest Running 10-year 90th Percentile

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)	
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 Running 10-year 90th Percentile	Increasing Trend – Lowest Running 10-year 90th Percentile

Appendix 2: Water Quality Monitoring

PPWB Water Quality Monitoring 2020

In 2020, pesticide sampling (for all pesticide groups) is recommended on the Saskatchewan River and the Qu'Appelle River in accordance with the standard rotation of the pesticide sampling program, in addition to the annual sampling at the Carrot and Assiniboine rivers.

Annual acid herbicides monitoring and glyphosate and AMPA monitoring should include the following transboundary rivers; Battle, South Saskatchewan North Saskatchewan, Red Deer River (AB/SK), Saskatchewan, and Qu'Appelle Assiniboine and Carrot rivers.

Monitoring for the other pesticide groups (neutral herbicides and organochlorines [now a multi-scan]) 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.

Changes at the National Laboratory for Environmental Testing (NLET) to the analytical methodologies for organic (pesticide) analysis has resulted in several class of pesticides being analysed together in a multi-scan. This GC multi scan will include both the neutral herbicides and the organochlorines, as well as, organophosphates, and two carbamates.

The BOD monitoring was discontinued on the Battle, Beaver and Cold rivers following the completion of the dissolved oxygen investigation on these rivers. The 2019 monitoring program is also provided for reference in separate tables.

The recommended water quality monitoring for 2020 is provided in the attached tables. The changes to be implemented for 2020 from 2019 are highlighted in yellow.

Other Objectives

Monitoring was not recommended for radionuclides, total residual chlorine, cyanide, and mercury in 2020. 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. Radionuclides have not been monitored since January 1984.

Monitoring is not recommended for contaminants in fish in 2020. The historical data set of contaminants in fish for the transboundary sites has been compiled and is currently being reviewed by the Committee. Any future fish monitoring program will reflect the results of the previous program.

PPWB MONITORING 2020: Alberta-Saskatchewan Sites

SITE	NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*) CHLOROPHYLL *a*	PESTICIDES		
		Acid Herbicides	Multi-Scan - Neutral Herbicides Organochlorine Organophosphates Carbamates	Glyphosate AMPA
Site 1 Cold River	12x / year	—	—	—
Site 2 Beaver River	12x / year	—	—	—
Site 3 North Saskatchewan River	12x / year	8x/year	—	8x/year
Site 4 Battle River	12x / year	8x/year	—	8x/year
Site 5 Red Deer River A/S	12x / year	8x/year	—	8x/year
Site 6 South Saskatchewan River	12x / year	8x/year	—	8x/year

Pesticides sampled 8x / year in Feb, Apr, May, June, July, Aug, Oct, and Dec.

PPWB MONITORING 2020: Saskatchewan-Manitoba Sites

SITE	NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*) CHLOROPHYLL *a*	PESTICIDES		
		Acid Herbicides	Multi-Scan - Neutral Herbicides Organochlorine Organophosphates Carbamates	Glyphosate AMPA
Site 7 Churchill River[1]	4x / year	—	—	—
Site 8 Saskatchewan River	12x / year	8x/year	8x/year	8x/year
Site 9 Carrot River	12x / year	12x/year	12x/year	12x/year
Site 10 Red Deer River S/M	12x / year	—	—	—
Site 11 Assiniboine River	12x / year	12x/year	12x/year	12x/year
Site 12 Qu'Appelle River	12x / year	8x/year	8x/year	8x/year

[1] Churchill River Months sampled = Feb, May, July, Oct
Pesticides sampled 8x/year in Feb, Apr, May, June, July, Aug, Oct, and Dec

PPWB MONITORING 2019: Alberta-Saskatchewan Sites

SITE	NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*) CHLOROPHYLL *a*	PESTICIDES			
		Acid Herbicides	Neutral Herbicides	Organochlorine	Glyphosate
Site 1 Cold River	12x / year	—	—	—	—
Site 2 Beaver River	12x / year	—	—	—	—
Site 3 North Saskatchewan River	12x / year	8x/year	—	—	8x/year
Site 4 Battle River	12x / year	8x/year	8x/year	8x/year	8x/year
Site 5 Red Deer River A/S	12x / year	8x/year	8x/year	8x/year	8x/year
Site 6 South Saskatchewan River	12x / year	8x/year	—	—	8x/year

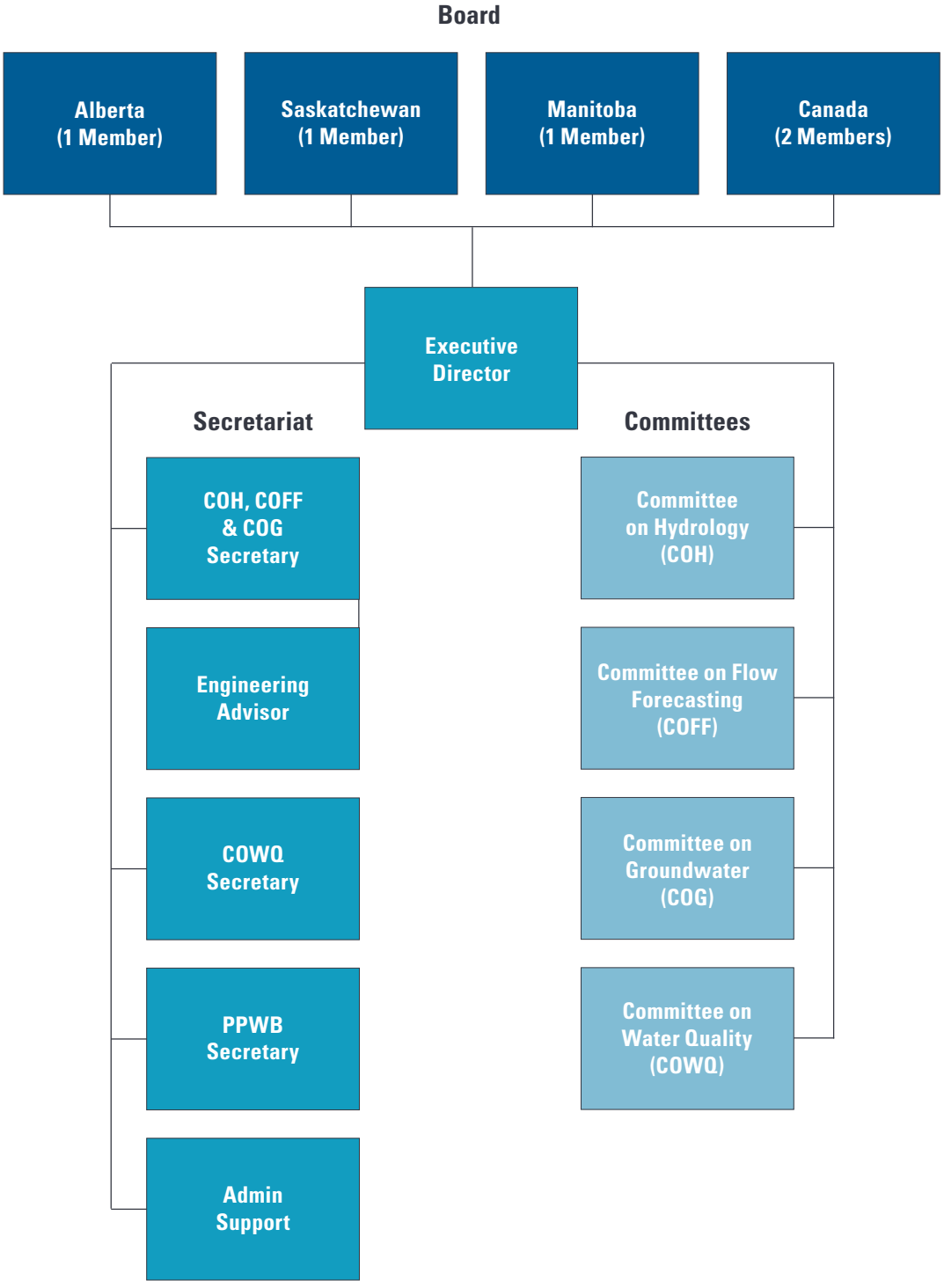
Pesticides sampled 8x / year in Feb, Apr, May, June, July, Aug, Oct, and Dec.

PPWB MONITORING 2019: Saskatchewan-Manitoba Sites

SITE	NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*) CHLOROPHYLL *a*	PESTICIDES			
		Acid Herbicides	Neutral Herbicides	Organochlorine	Glyphosate
Site 7 Churchill River[1]	4x / year	—	—	—	—
Site 8 Saskatchewan River	12x / year	8x/year	—	—	8x/year
Site 9 Carrot River	12x / year	12x/year	12x/year	8x/year	12x/year
Site 10 Red Deer River S/M	12x / year	—	—	—	—
Site 11 Assiniboine River	12x / year	12x/year	12x/year	8x/year	12x/year
Site 12 Qu'Appelle River	12x / year	8x/year	—	—	8x/year

[1] Churchill River Months sampled = Feb, May, July, Oct
Pesticides sampled 8x/year in Feb, Apr, May, June, July, Aug, Oct, and Dec

APPENDIX V: PPWB Organizational Chart



APPENDIX VI: Board / Committee Membership 2020-2021

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	Nadine Stiller (Apr 2018 to current)	Associate Regional Director General West & North Environment and Climate Change Canada
	Vacant (2018 to current)	Agriculture and Agri-Food Canada
	Vacant (Feb 2020 to current)	Alberta Environment and Parks
	Vacant (Oct 2017 to current)	Manitoba Environment, Climate and Parks
	Sam Ferris (Sep 2018 to Jan 2021)	Senior Vice President Regulatory Division Water Security Agency (Saskatchewan)

SECRETARIAT

EXECUTIVE DIRECTOR	Patrick Cherneski (Oct 2019 to current)	ECCC Transboundary Waters Unit Prairie Provinces Water Board
SECRETARY	Elaine Page (Aug 2020 to current)	ECCC Transboundary Waters Unit Prairie Provinces Water Board

PPWB ALTERNATE BOARD MEMBERS

Paula Siwik (Nov 2017 to current)	Executive Director, Mackenzie River Basin Board Environment and Climate Change Canada
Dave Zapshala (Feb 2016 to current)	Director, Water Infrastructure Division Corporate Management Branch Agriculture and Agri-Food Canada
Carmen de la Chevrotière (Aug 2014 to current)	Transboundary Water Quantity Specialist Transboundary Waters Team Alberta Environment and Parks
John Fahlman (Sep 2018 to current)	Senior Vice President Technical Services and Chief Engineer Water Security Agency (Saskatchewan)
Nicole Armstrong (May 2014 to current)	Director Water Science and Watershed Management Branch Agriculture and Resource Development (Manitoba)

COMMITTEE ON HYDROLOGY

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.

PPWB Board Minute 92-65 (Oct. 7, 2009)

COMMITTEE ON HYDROLOGY MEMBERS

CHAIR	Patrick Cherneski (Oct 2019 to current)	Executive Director Prairie Provinces Water Board
MEMBERS	Malcolm Conly (Mar 2015 to current)	Hydrometric Operations Environment and Climate Change Canada
	Ron Woodvine (Jun 2008 to current)	Corporate Management Branch Agriculture and Agri-Food Canada
	Carmen de la Chevrotière (Feb 2014 to current)	Transboundary Waters Team Alberta Environment and Parks
	Mark Lee (Nov 2012 to current)	Water Science and Watershed Management Branch Agriculture and Resource Development (Manitoba)
	Bart Oegema (Oct 2011 to Feb 2021)	Hydrology Services Water Security Agency (Saskatchewan)
	Anthony Liu (Oct 2011 to current)	Meteorological Service of Canada Environment and Climate Change Canada
SECRETARY	Marie Hyde (Apr 2020 to current)	Transboundary Waters Unit Prairie Provinces Water Board

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.

PPWB Board Minute 92-65 (Oct. 7, 2009)

COMMITTEE ON WATER QUALITY MEMBERS

CHAIR	Patrick Cherneski (Oct 2019 to current	Executive Director Prairie Provinces Water Board
MEMBERS	Paul Klawunn (Sept 2013 to current	Science and Technology Branch Environment and Climate Change Canada
	Elaine Page (Apr 2017 to Jul 2020)	Water Science and Watershed Management Branch Agriculture and Resource Development (Manitoba)
	John-Mark Davies (Oct 2008 to current)	Water Quality Services Water Security Agency (Saskatchewan)
	Gongchen Li (Jul 2014 to current)	Transboundary Waters Secretariat Alberta Environment and Parks
	Claudia Sheedy (Feb 2018 to Jul 2020)	Lethbridge Research and Development Centre Agriculture and Agri-Food Canada
SECRETARY	Joanne Sketchell (Aug 2009 to current)	Transboundary Waters Unit Prairie Provinces Water Board

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.

PPWB Board Minute 92-65 (Oct. 7, 2009)

COMMITTEE ON GROUNDWATER MEMBERS

CHAIR	Patrick Cherneski (Oct 2019 to current	Executive Director Prairie Provinces Water Board
MEMBERS	Garth van der Kamp (Oct 2004 to Feb 2020)	Groundwater Hydrology Water Science and Technology Directorate Environment and Climate Change Canada
	Yves Michaud (Feb 2020 to Sep 2020)	Geological Survey of Canada Natural Resources Canada
	Éric Boisvert (Sep 2020 to current)	Geological Survey of Canada Natural Resources Canada
	Tony Cowen (Oct 2005 to current)	Science and Technology Branch Agriculture and Agri-Food Canada
	Guy Bayegnak (Feb 2017 to current)	Groundwater Policy Specialist Alberta Environment and Parks
	Kei Lo (Oct 2013 to current)	Hydrology and Groundwater Services Water Security Agency (Saskatchewan)
	Graham Phipps (Apr 2012 to current)	Water Science and Watershed Management Branch Agriculture and Resource Development (Manitoba)
SECRETARY	Marie Hyde (Apr 2020 to current)	Transboundary Waters Unit Prairie Provinces Water Board

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.

PPWB Board Minute 115-27 (November 2-3, 2015)

COMMITTEE ON FLOW FORECASTING MEMBERS

CHAIR	Patrick Cherneski (Oct 2019 to current)	Executive Director Prairie Provinces Water Board
MEMBERS	Bruce Davison (Dec 2015 to current)	National Hydrologic Services Meteorological Service of Canada (Hydrology) Environment and Climate Change Canada
	Anthony Liu (Jan 2016 to current)	Meteorological Service of Canada (Meteorology) Environment and Climate Change Canada
	Trevor Hadwen (Feb 2020 to current)	National Agroclimate Information Service Agriculture and Agri-Food Canada
	Fisaha Unduche (Dec 2015 to current)	Hydrologic Forecasting & Coordination Manitoba Infrastructure
	Curtis Hallborg (Dec 2015 to current)	Flow Forecasting & Operations Planning Water Security Agency (Saskatchewan)
	Colleen Walford (Mar 2020 to current)	River Engineering and Technical Services Alberta Environment and Parks
SECRETARY	Marie Hyde (Apr 2020 to current)	Transboundary Waters Unit Prairie Provinces Water Board

APPENDIX VII: Statement of Final Expenditures 2020-2021

For the year 2020-21		Budget		Actual
Salary Component				
PY'S (person years)		4.75		3.83
Base Salary	$	474,189	$	449,833
Casual/Term	$	50,000	$	0
BPE (benefits)	$	94,838	$	86,412
Total Salary	**$**	**619,027**	**$**	**536,245**
O&M Component				
Contracts & Students				
Goal 1	$	40,000	$	0
Goal 2	$	20,000	$	0
Goal 3	$	58,368	$	22,888
Goal 5	$	14,165	$	22,112
Goal 7	$	0	$	0
Sub-total	**$**	**132,533**	**$**	**45,000**
Operating Expenses	**$**	**22,000**	**$**	**7,107**
Total O&M	**$**	**154,533**	**$**	**52,107**
Grand Total	**$**	**773,560**	**$**	**588,352**

APPENDIX VIII: History of the PPWB

The 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 (PFRA) 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 Master Agreement on Apportionment (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.

Prairie Provinces Water Board
10th Floor, Alvin Hamilton Building,
1783 Hamilton Street, Regina, SK S4P 2B6
www.ppwb.ca