

**Hydrologic Forecast Centre
Manitoba Infrastructure, Winnipeg, Manitoba**

**FEBRUARY OUTLOOK REPORT FOR MANITOBA
February 23, 2018**

Overview

The February Outlook Report prepared by the Hydrologic Forecast Centre of Manitoba Infrastructure indicates normal to below normal runoff potential across the province. The risk of overland flooding is generally low across the province. This could change depending on weather conditions between now and the spring melt.

Basin Conditions:

- Winter precipitation to date (November 1 to February 18) ranges from near normal in the northern Manitoba watersheds to well below normal in the south and south east Manitoba watersheds
- Snow water content generally ranges between zero inches (0 mm) to 3 inches (76 mm). The snow water content in most southern Manitoba watersheds is less than 2 inches (50 mm). The normal for this time of the year across Manitoba watersheds is between 2 and 3.5 inches (50 mm and 90 mm).
- Soil moisture at the time of freeze up ranges from below normal in central and southern regions to near normal in the north
- Base flows and water levels vary from near normal in most areas to well above normal in a few locations. Base flow/level conditions indicate the extent of ground saturation.
- Ice thicknesses in most rivers in southern Manitoba are greater than normal due to the persistent colder than normal temperatures and the lack of sufficient snow to insulate from the cold. Ice thicknesses in most areas ranges from 24 inch (61 cm) to 34 inch (86 cm).
- Long term weather forecasts indicate near normal precipitation and below normal temperatures for the months of February, March, and April.

Flood risk:

- The risk of flooding is low for most southern Manitoba basins, including the Red, Assiniboine, Souris and Qu'Appelle River basins, as well as the Interlake region.
- The risk of flooding is low to moderate for most northern Manitoba basins, including the Churchill and Saskatchewan River basins.
- The risk of flooding is low for all Manitoba Lakes.

- Ice jam related flooding could be a concern due to above normal ice thicknesses on many southern Manitoba rivers.

Flood Control Structures:

- The Red River Floodway could be operated under unfavourable weather conditions, but operation is unlikely under normal weather conditions.
- The Portage Diversion will likely be operated in order to reduce the risk of ice jamming on the lower Assiniboine River.
- Shellmouth Dam will continue to be operated to achieve the summer target level after the spring runoff period.

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Soil Moisture Conditions

As previously outlined in the 2017 Fall Conditions Report, the soil moisture analysis based on weighted summer and fall precipitation indicates normal to below normal soil moisture for most of Manitoba. The soil moisture is generally near normal in northern Manitoba and Saskatchewan and below normal in southern Manitoba and Saskatchewan (Figure 1).

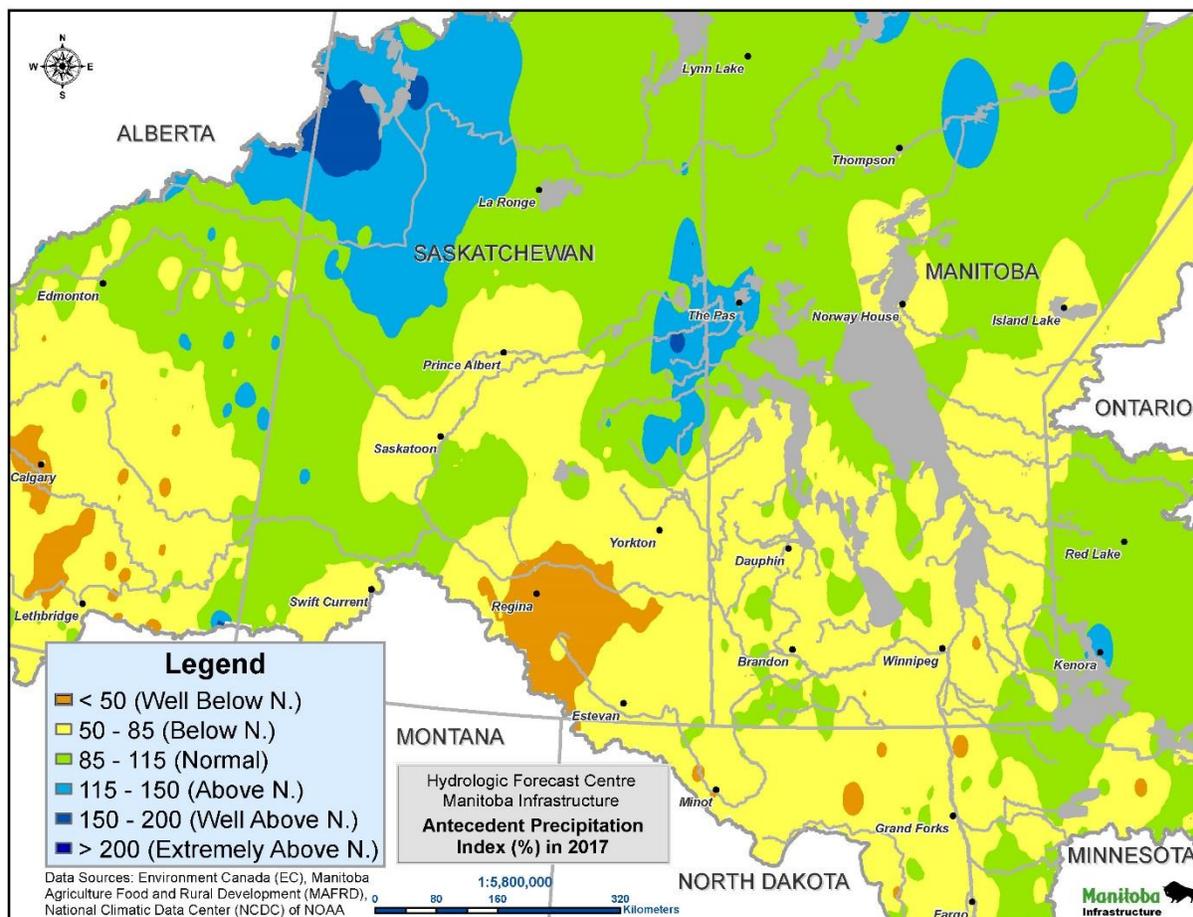


Figure 1 - Antecedent Precipitation Index (API) for the Fall of 2017.

Frost Depth

Frost depth information is sparse and variable across watersheds due to varying winter temperatures and amounts of snow cover insulation. Frost depth is estimated to be above normal throughout most of the province. The areas with above average snowpack will have a lower frost depth than areas that have received normal to below normal winter precipitation.

Winter Precipitation & Snow Water Content

November to February precipitation has been normal to slightly above normal in northern Manitoba and Saskatchewan while most of southern Manitoba, Saskatchewan and the U.S. portion of the Red and Souris River basins have received below normal to well below normal precipitation. A map of percent normal winter precipitation is shown in Figure 2.

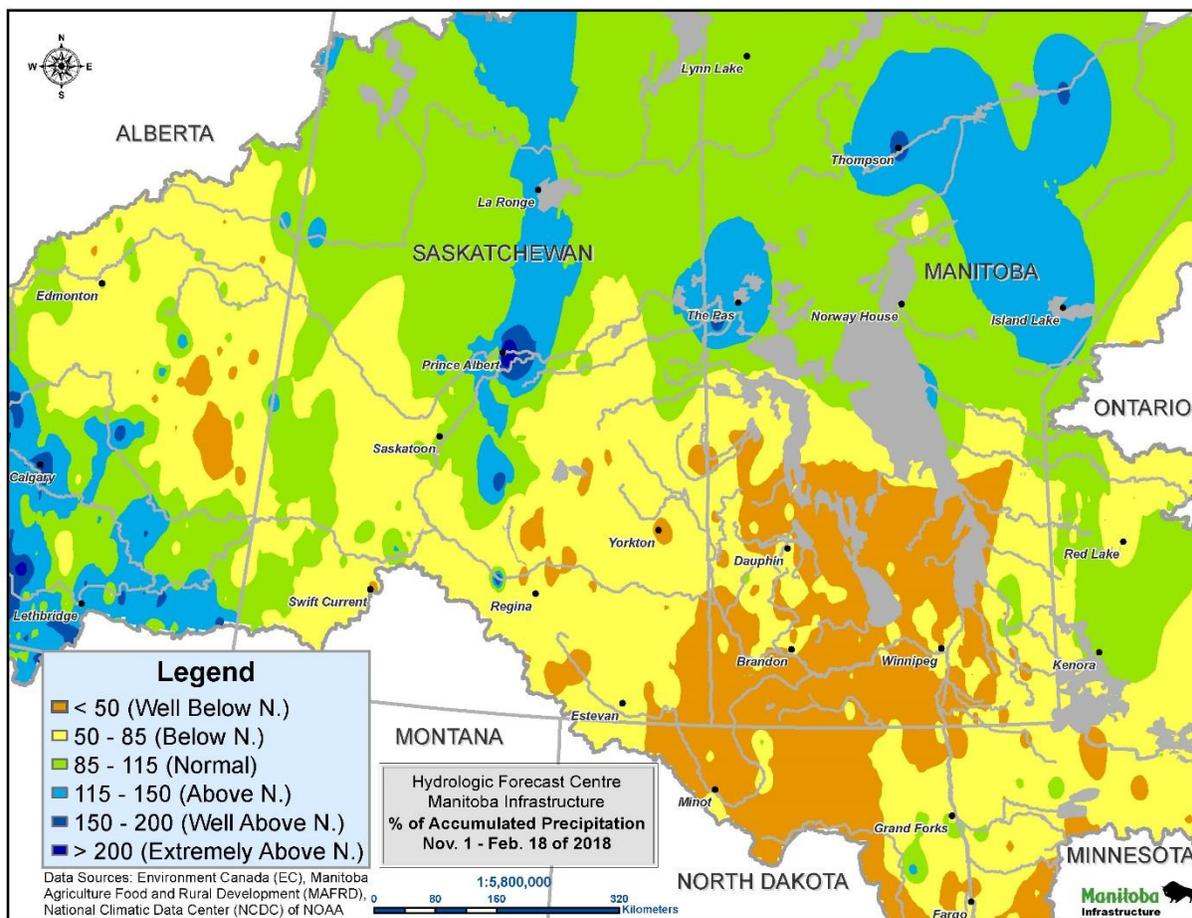


Figure 2 - Percent of Normal Precipitation from November 1, 2017 to February 20, 2018.

Snow water content ranges from 0 to 3 inches (0 mm to 75 mm) for most areas of the province with some higher readings in northern Manitoba and in Riding Mountain National Park. Most southern watersheds currently have less than 2 inches (25 mm) of snow water content. Normal measurements for this time of year are 2 to 3.5 inches (25 to 90 mm). A snow survey map based on manual readings is shown in Figure 3. Figure 4 illustrates the snow water content based on gamma airborne survey.

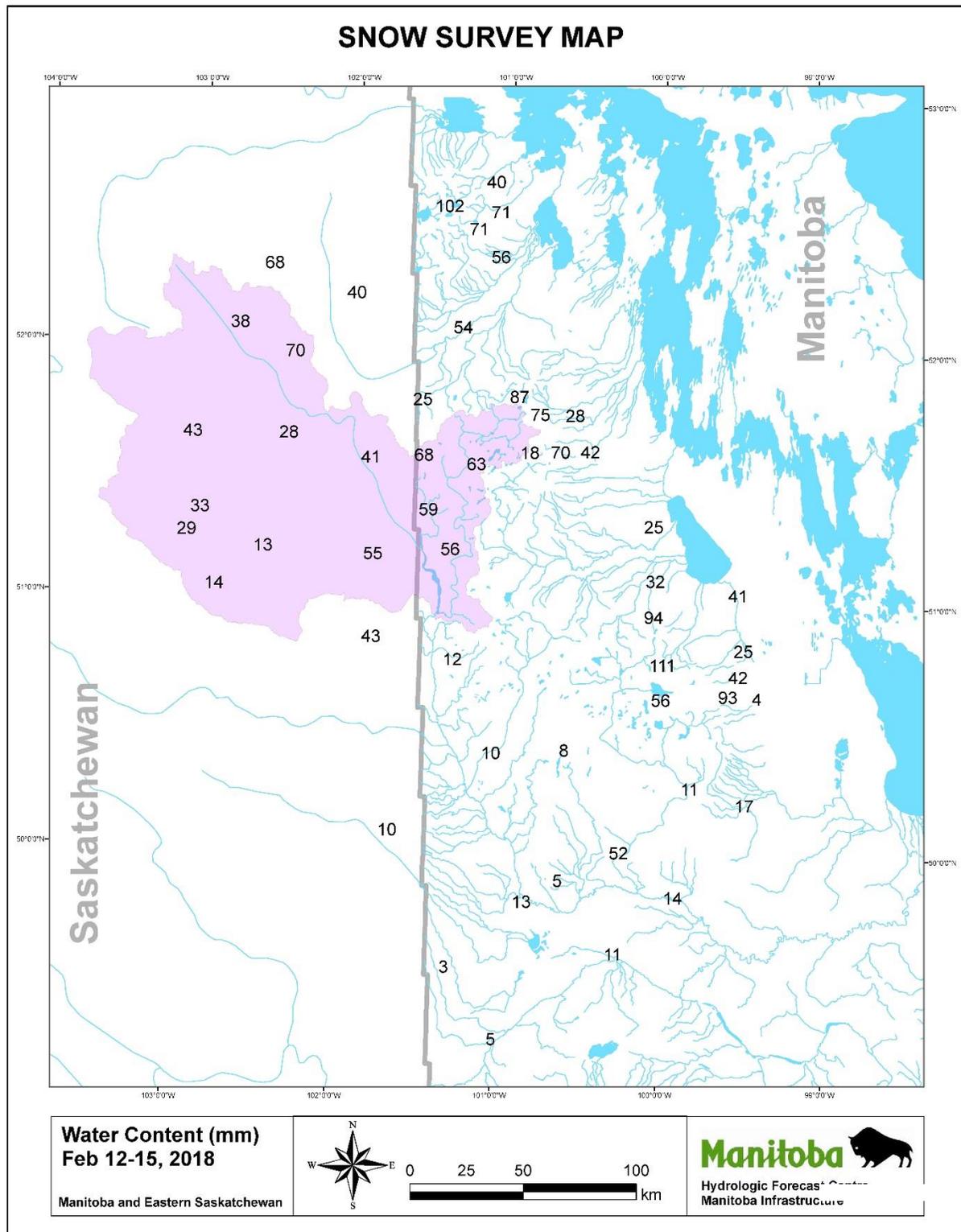


Figure 3 - February 12th – 15th, 2018 snow survey results in millimetres of water content.

Gamma Flight Survey SWE #16 : 2/21/2018

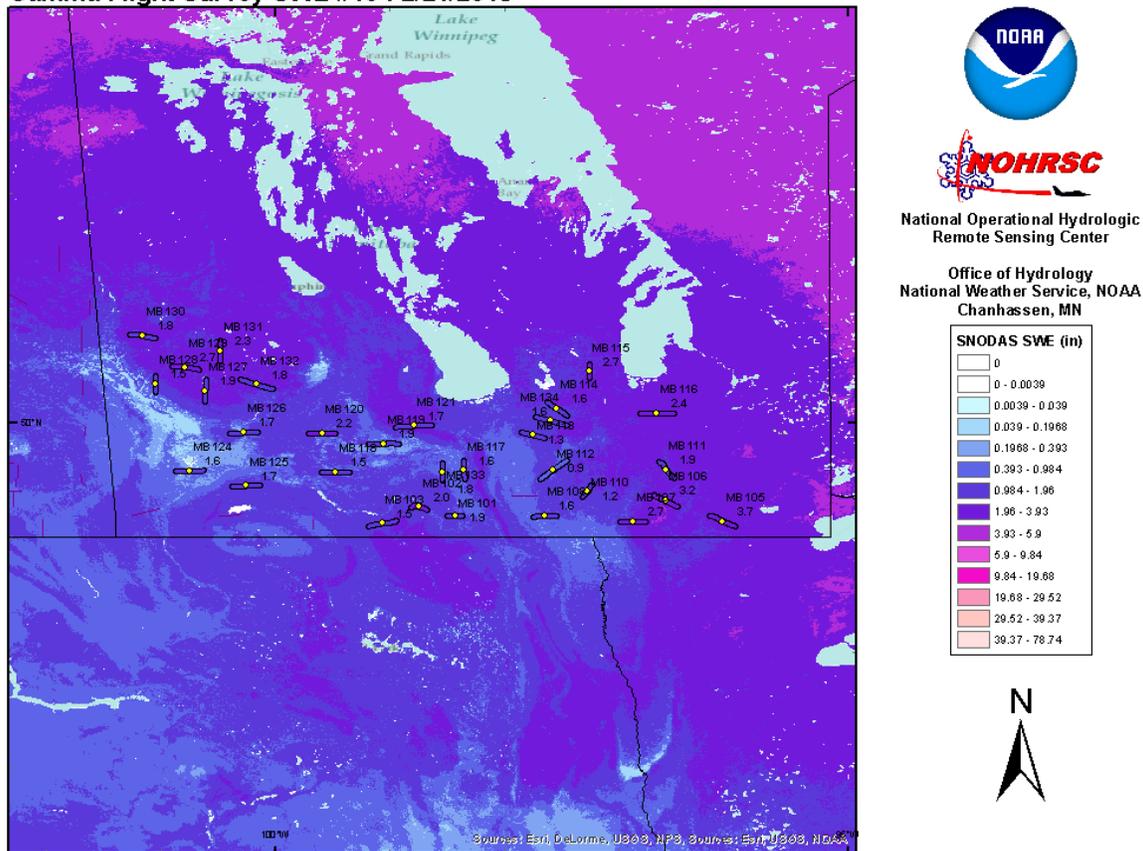


Figure 4 – Snow Water Equivalent in inches of water content based on Gamma Flight Survey.

Base Flow and Level Conditions

Current (also called “base”) flow and level conditions throughout the province range from near normal in most cases to above normal and well above normal at a few locations. Base flow and level conditions indicate the relative extent of ground saturation for this time of the year. Some level readings are affected by ice which may cause spikes in the calculated discharge readings. A map of the gauges with base flow conditions is shown in Figure 5.

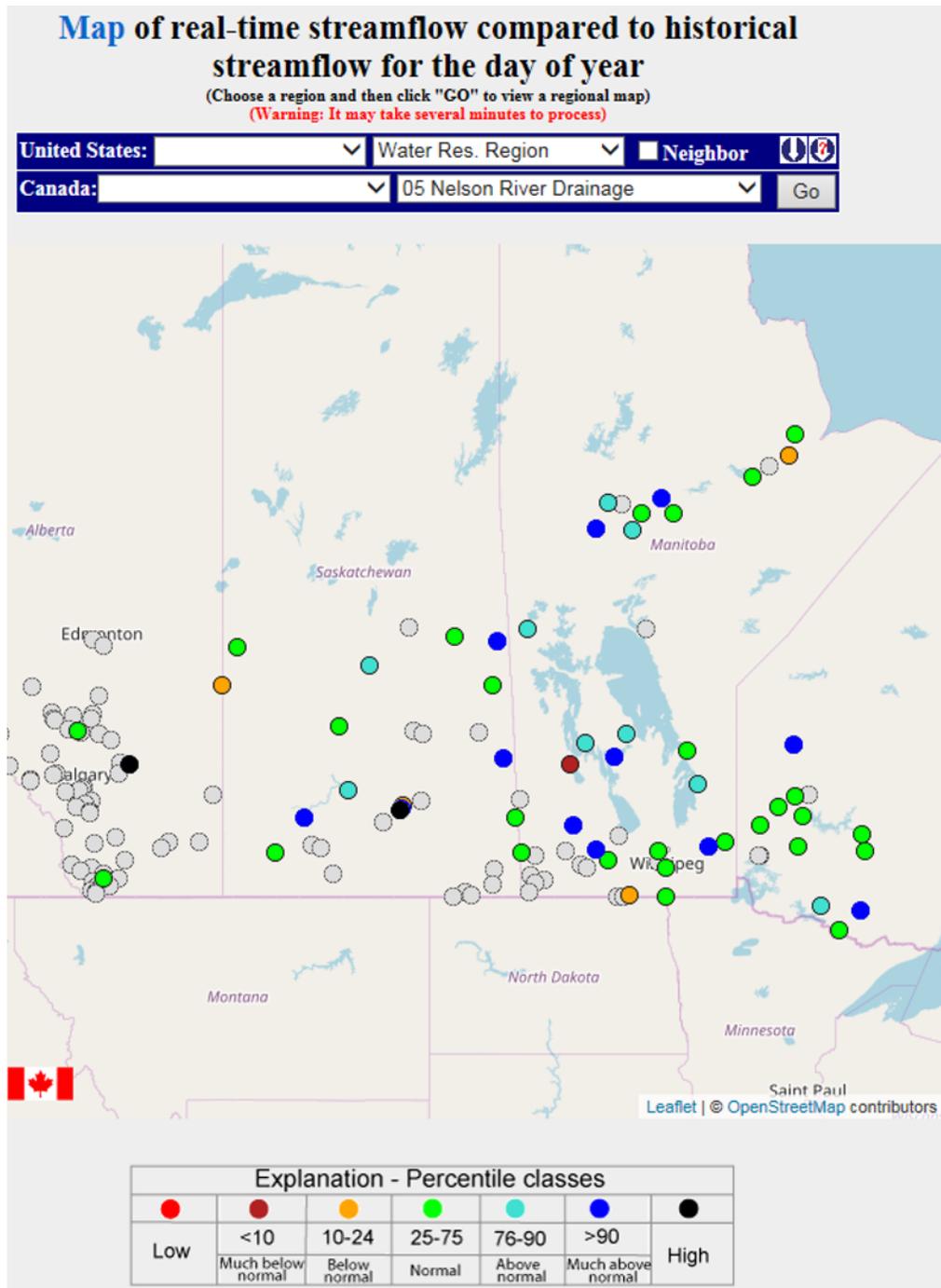


Figure 5 – Current (Base) River Flow Conditions

River Ice Conditions and Ice Jamming¹

The Red River currently has above normal ice thicknesses in most areas. Based on February measurements this year, ice thicknesses range between 24 and 34 inches (0.61 to 0.86 m) and are shown in Figure 6. Normal ice thicknesses for this time of the year vary according to the river flow velocity, and the location of the river; they typically range between 12 and 24 inches (0.3 to 0.6 m).

Spring weather affects the extent and timing of the deterioration of river ice and will be a significant factor in determining ice strength at break-up. It is difficult to predict if ice jamming will occur and, if it does occur, when and to what extent the jamming will occur. However, ice cutting and the Amphibex ice breaking activities currently underway on the lower Red River will reduce the risk of ice jamming and related flooding in that area.

Localized flooding can occur when and where ice jams develop, even with below average river flows. The chances of localized flooding due to snow and ice blockages in drains, ditches and small streams during the early part of the run-off period will depend on the nature of the spring breakup and rate of melt.

¹ See Appendix A for 'Ice Jam' definition

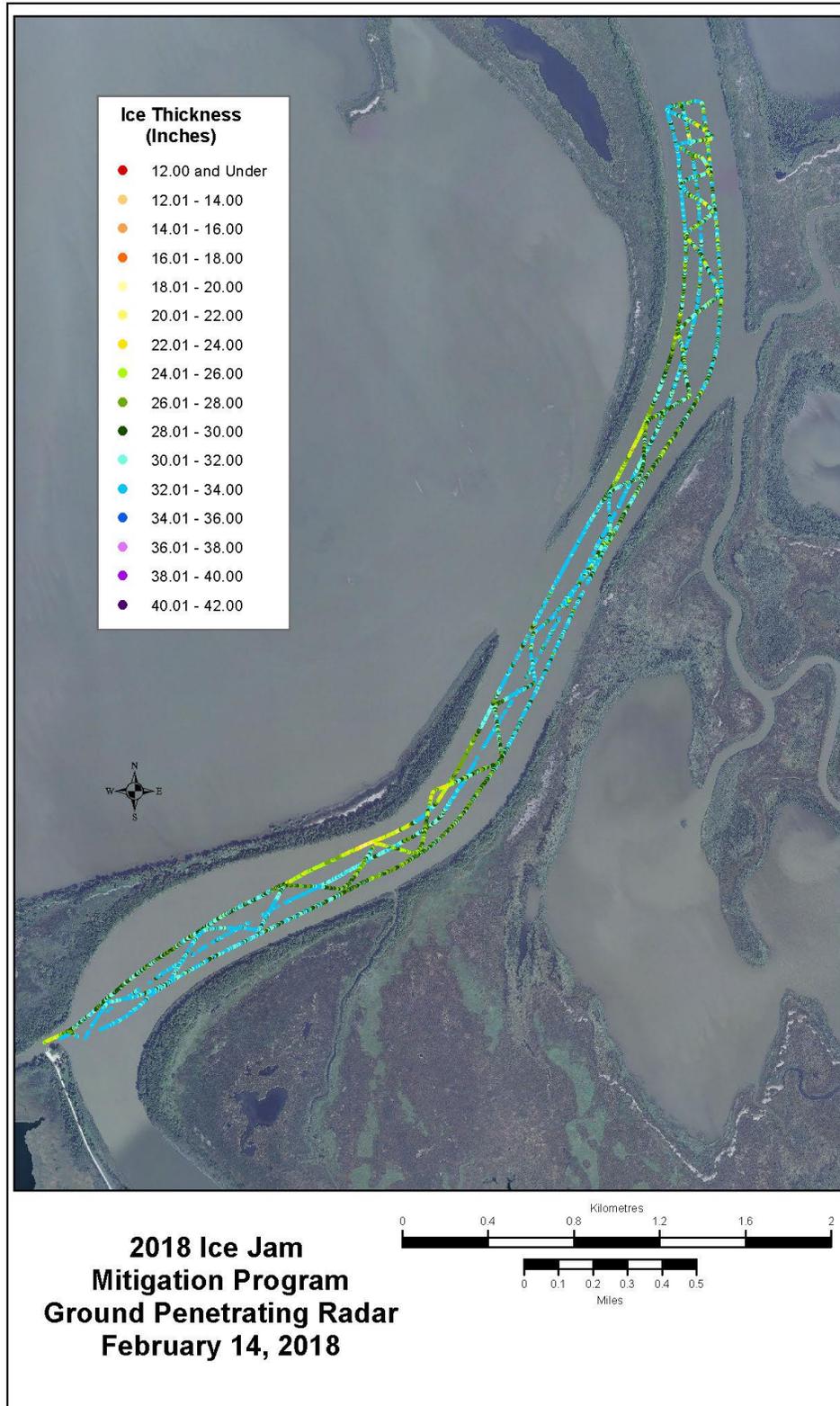


Figure 6 – Ice Thickness Measurements based on Ground Penetrating Radar, Netley North

Future Weather

Long term weather forecasts are available from Environment and Climate Change Canada. These forecasts extend until the end of April. The long term forecast is for an increased chance of below normal temperatures and near normal precipitation through to the end of April (Figures 7 & 8).

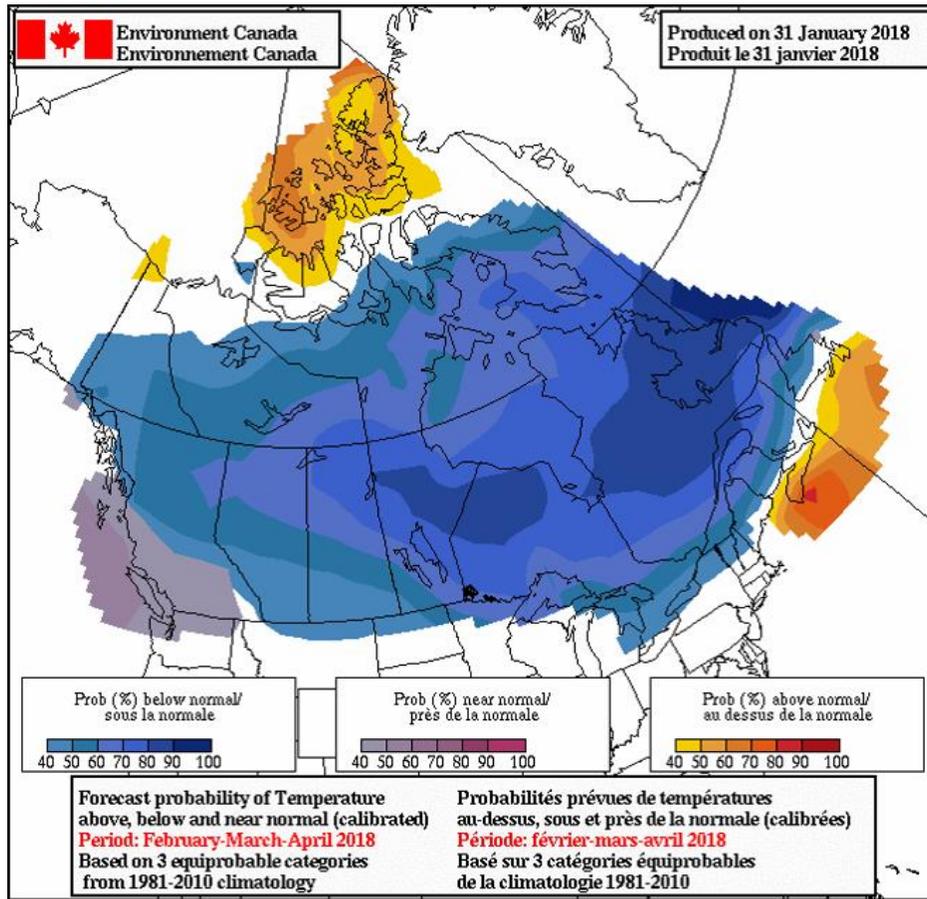


Figure 7 – Long Term Temperature Forecast (Environment and Climate Change Canada)

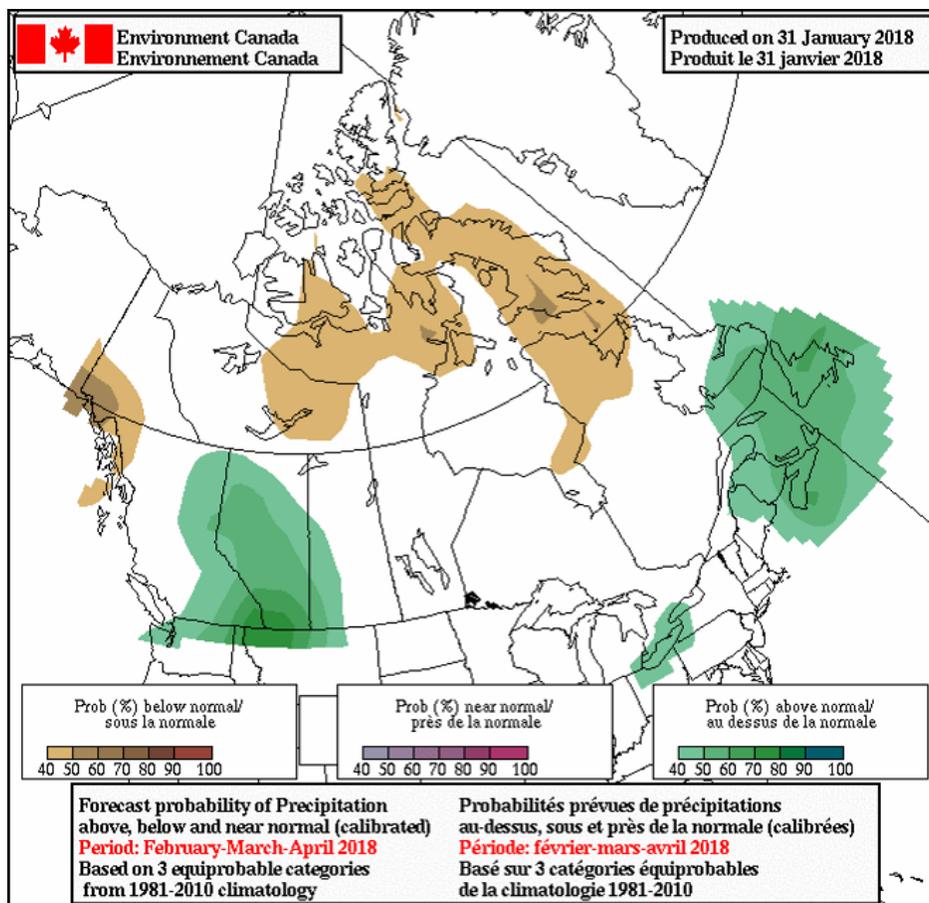


Figure 8 – Long Term Precipitation Forecast (Environment and Climate Change Canada)

Runoff Potential²

The forecasted 2018 spring runoff potential (Figure 9) is based on:

- 2017 measurements of soil moisture at freeze up;
- winter precipitation as of February 20, 2018; and
- future weather condition scenarios based on historic data.

The runoff potential is near normal for northern Manitoba and below normal for southern Manitoba. This trend is similar in northern and southern Saskatchewan. The runoff potential in the Souris and Red River basins in the U.S. is below normal. The runoff potential in the Ontario portion of the Whiteshell and Winnipeg River basins is near normal.

² See Appendix A for 'Runoff Potential' definition

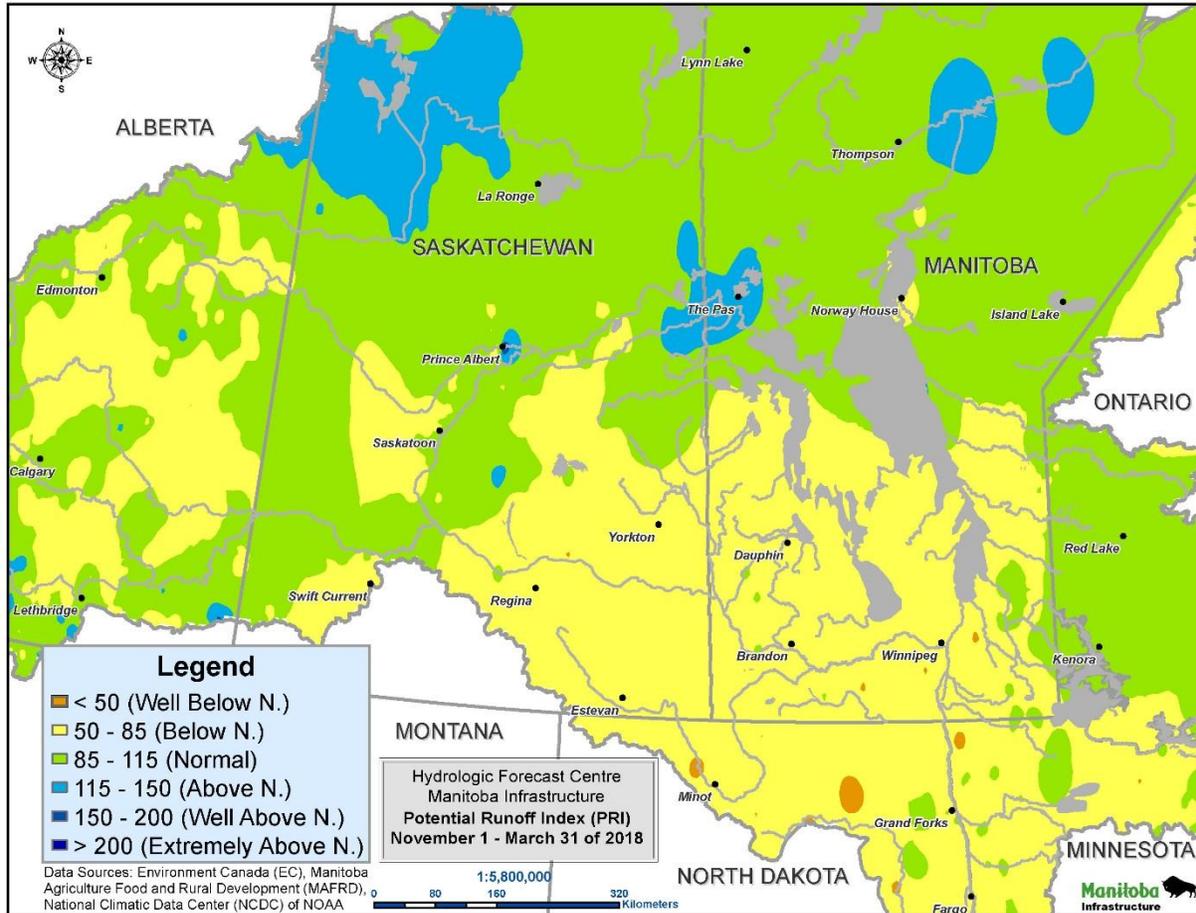


Figure 9 – Forecasted Runoff Potential as of March 31, 2018 (assuming normal weather for the remainder of winter).

Flood Outlook³

This February spring flood outlook provides estimated peak river levels or flows that are based on current basin conditions, and three possible future weather scenarios. These weather scenarios are favourable, normal, and unfavourable, which correspond to three different probabilities of occurrence (lower decile, median, and upper decile). The province's practice is to plan and prepare for the upper decile condition. For further information see Appendix A: Definitions.

Lake level forecasts will be issued in the March flood outlook.

³ See Appendix A for 'Flood Outlook', 'Weather Scenarios', 'Favourable Weather', 'Normal Weather', and 'Unfavourable Weather' definitions

⁷ See Appendix A for 'Minor/Moderate/Major and Severe' Flood risk definitions

The risk of potential flooding is described by four categories: low (minor), moderate, major and severe⁷.

A number of uncertainties exist with respect to the flood peak values contained in this flood outlook. These include, but are not limited to the following:

- future weather uncertainties (snowfall and spring rainfall);
- winter snowpack, onset of melt, and melt rate (i.e. timing and speed of snow melt);
- uncertainty in meteorological and hydrometric data;
- timing of the peak flows;
- frost depth at the time of spring melt; and,
- computer model prediction uncertainty.

The below table summarizes estimated flood peak flows (in cubic feet per second (cfs)) on some rivers at key locations along the rivers. The flood risk potential is also shown in the table.

Red	Lower Decile	Median	Upper Decile	Flood Risk
Emerson	31,000	42,000	66,000	Low
Ste. Agathe	34,000	42,000	64,000	Low

Assiniboine				
Miniota	1,800	3,000	5,000	Low
Brandon	3,000	5,500	8,400	Low
Portage	4,000	6,260	10,100	Low

Souris				
Melita	300	450	1,000	Low
Wawanesa	400	650	1,250	Low

Qu'Appelle				
Welby	400	500	635	Low

Flood Control Structures

- The Red River Floodway is not expected to be operated under favourable and normal weather conditions. The Floodway will likely be operated under unfavorable weather conditions.

- The Portage Diversion will likely be operated in order to reduce the risk of ice jamming on the Assiniboine River east of Portage la Prairie.
- The Shellmouth Dam will continue to be operated to achieve a reservoir water level at the summer target level after the spring runoff.

Flood Preparations

- As a matter of standard practice in the lead-up to the spring flood season, the Manitoba government and municipalities review existing emergency response plans, share information, and prepare flood response resources.
- The ice jam mitigation program has commenced with ice cutters and Amphibex machines working on the lower Red River to weaken the ice.

Future Flood Forecast Information

If the spring melt and runoff has not yet begun, a second flood outlook will be published with updated information towards the end of March when further precipitation and other weather details are available.

Appendix A: Definitions

¹ Ice Jam:

- A blockage of ice on a river/stream which restricts flow, resulting in increased water levels upstream.
- Jams may occur due to changing river channel geometry, bends in the river channel, depth of ice, rate of water level rise, or a solid section of ice downstream.

² Runoff Potential:

- Indication of how much water is expected to flow overland as opposed to being absorbed into the ground.
- Is based on soil moisture measurements at freeze up, most recent snowpack conditions, and normal future weather conditions.
- Is a contributing factor into flood outlook determinations.
- Described in comparison to normal historical conditions (i.e. normal, near normal, slightly above normal, etc.).
- Can change significantly if future precipitation and melt rates differ from the average.

³ Flood Outlook:

- Estimated spring peak water levels and flows provided before spring water flow begins.
- Estimates are based on diverse information, such as soil moisture, winter precipitation, snowpack, topography, current water level, channel capacity, and future weather condition scenarios (precipitation, temperatures, etc.).
- Estimates are provided for three weather scenarios (favourable, normal, and unfavourable) which correspond to three different probabilities of occurrence (lower decile, median and upper decile).

³ Weather Scenarios:

- Used to account for future weather such as additional snow, melt rates and spring rainfall, determined by statistical analysis of the past 30 - 40 years of climate data.
- Three scenarios used:
 - Lower decile
 - There is a 10% chance of the weather being that 'favourable' or better. 90% of the time the weather will be worse than this 'favourable' condition.
 - Median
 - There is a 50% chance of the weather being 'normal' or better.
 - Upper decile
 - There is a 10% chance of the weather being that 'unfavourable' or worse. 90% of the time the weather will be better than this 'unfavourable' condition.
- Province's practice is to plan/prepare to the upper decile condition.

³ Favourable Weather:

- Characterized by little additional precipitation and a gradual snow melt.

³ Normal Weather:

- Characterized by normal rainfall and temperature.
- Typically used to describe historic climate trends.

³ Unfavourable Weather:

- Significant wide spread precipitation with a rapid snowmelt.

⁵Flow/Discharge [expressed in cubic feet per second (cfs) or cubic metres per second (cms)]:

- The volume of water that passes a given location within a given period of time.

⁶ FPL – Flood Protection Level:

- The greater of the flood of record or the 1-in-200-yr flood, plus a freeboard allowance for a particular waterway (typically 2 ft) or water body (site specific).
- It is provided by the Hydrologic Forecasting and Water Management (HFWM) branch of MI on a site specific and structure specific basis.
- This is formally set by the Water Resources Administration Act for the Red River designated flood areas.
- Outside of Designated Flood Areas, the FPL is recommended by the province, but ultimately regulated by the local planning districts and/or municipalities.

⁷Definition for minor/moderate/major and severe flood risk:

- Minor Risk: The probability that stages in rivers and lakes exceed the flood stage is very minor (small or below average).
- Moderate Risk: The probability that stages in rivers and lakes exceed the flood stage is moderate (average).
- Major Risk: The probability that stages in rivers and lakes exceed the flood stage is high (above average).
- Severe Risk: The probability that stages in rivers and lakes exceed the flood stage is very high (well above average).

Additional terminology:

Operational Forecasts:

- Estimated future crest water level, flow and date of occurrence provided once active melt and river flow has begun.
- Estimates are modelled based on observed flow, existing conditions (including channel capacity, topography, and remaining snowpack) and normal future weather.
- Observed conditions are monitored throughout the flood and compared against the historic climate data used to generate the forecast.
- Forecasts are updated when weather conditions are outside the range of historical climate data used to generate the forecast.
- A range of forecasted values is provided further in advance of an upcoming forecasted crest because of unknowns in the basin conditions and river flows, and limitations in the modelling procedures.