Hydrologic Forecast Centre
Manitoba Infrastructure, Winnipeg, Manitoba

MARCH OUTLOOK REPORT FOR MANITOBA
March 23, 2018

Overview

The March Outlook Report prepared by the Hydrologic Forecast Centre of Manitoba Infrastructure indicates near normal to below normal runoff potential across the province. The risk of major flooding remains 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 March 17) ranges from near normal in the northern Manitoba watersheds to well below normal in the southern Manitoba watersheds.
- Snow water content generally ranges from 1.4 inches (35 mm) to 4 inches (102mm). The snow water content in most southern Manitoba watersheds is less than 2.0 inches (50 mm). The normal for this time of the year across Manitoba watersheds is between 2.0 and 4.0 inches (50 mm and 102 mm).
- Soil moisture at the time of freeze up ranges from below normal in central and southern regions to near normal in the north.
- Current flows and water levels vary from near normal in most areas in the province, and above normal at some locations. Base flow/level conditions indicate the extent of ground saturation.
- Ice thickness in most rivers in southern Manitoba is greater than normal due to the persistent colder than normal temperatures and the lack of sufficient snow to insulate from the cold. Ice thickness in most areas ranges from 30 inches (76 cm) to 42 inches (107 cm).
- Long term weather forecasts for March, April and May give no indication that precipitation will be either above or below normal, and indicate above normal temperatures.

Flood risk:

- The risk of major flooding is low for the Souris, Qu'Appelle and Pembina rivers and their tributaries.
    - The levels will be below flood protection levels even under unfavorable weather conditions.

- The risk of major flooding is low for the Red River and the main stem of the Assiniboine River. There is a moderate risk of overland flooding along these rivers:
    - The risk of major flooding will be low as the forecasted levels will be below flood protection levels even under unfavorable weather conditions.
    - The risk of overland flooding is moderate as the flows could go outside of river banks even under normal weather conditions.
- The risk of major flooding is moderate in the northern basins, including for Churchill River, Saskatchewan River at the Pas, and Carrot River.
- The risk of major flooding is low for the Interlake region.
- The risk of major flooding is also low for all Manitoba lakes.
- Ice jam related flooding could be a concern due to above normal ice thicknesses.

Flood Control Structures:

- The Red River Floodway is expected to be operated under normal and unfavourable weather conditions, but operation is unlikely under favorable weather conditions.
- The Portage Diversion will likely be operated in order to reduce the risk of ice jamming on the lower Assiniboine River for all weather conditions. Portage Diversion will likely be operated under unfavorable weather conditions even if the ice is moved out in order to cap the downstream flow as per the operating guidelines.
- Shellmouth Dam will continue to be operated to achieve the summer target level after the spring runoff period.

Contents

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).

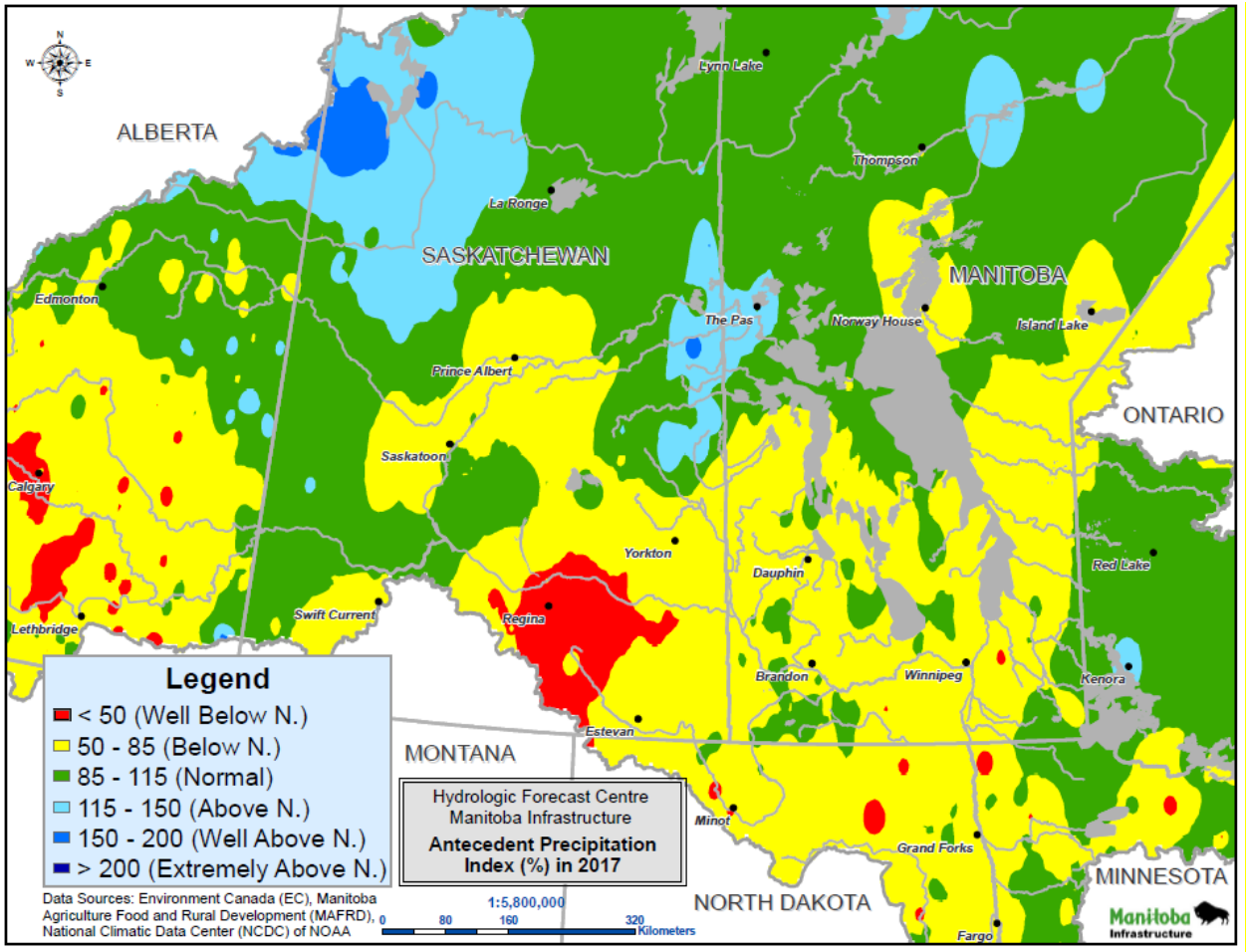

Figure 1 - Antecedent Precipitation Index (API) for the Fall of 2017.

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

Winter (November 1 to March 17) precipitation has been near normal to slightly above normal in northern Manitoba and most of Saskatchewan. All of southern Manitoba, southeast Saskatchewan and the U.S. portion of the Red and Souris River basins have received below normal to well below normal precipitation, with the exception of the central Red River that received near normal precipitation. Figure 2 shows a map of percent of normal winter precipitation.

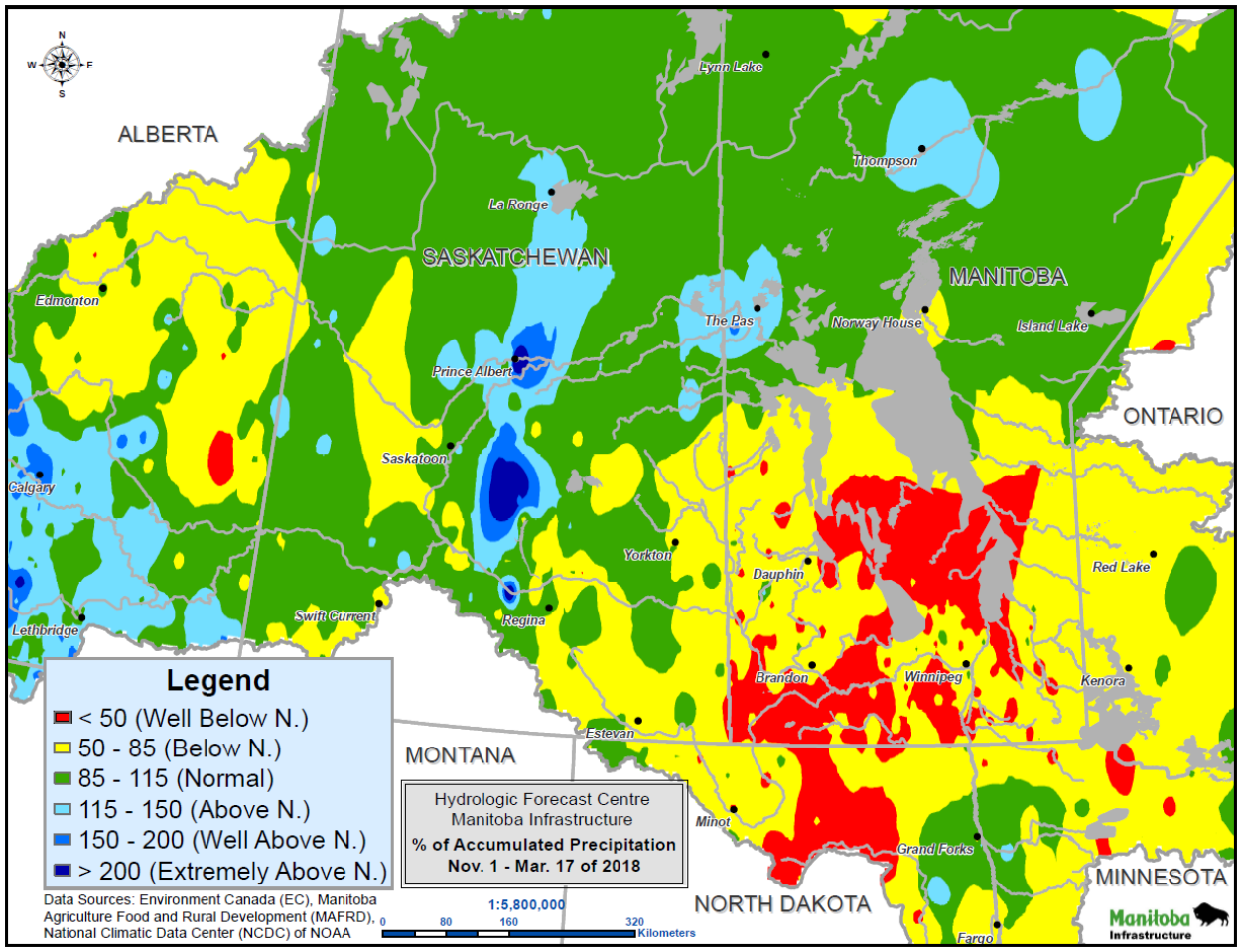

Figure 2 - Percent of Normal Precipitation from November 1, 2017 to March 17, 2018.

Snow water content ranges from 1.4 to 4 inches (35 mm to 102 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 2.0 inches (50 mm) of snow water content. Normal measurements for

this time of year are 2.0 to 4.0 inches (50 to 102 mm). A snow survey map based on manual readings is shown in Figure 3. Figure 4 illustrates the snow water content based on the airborne gamma survey.

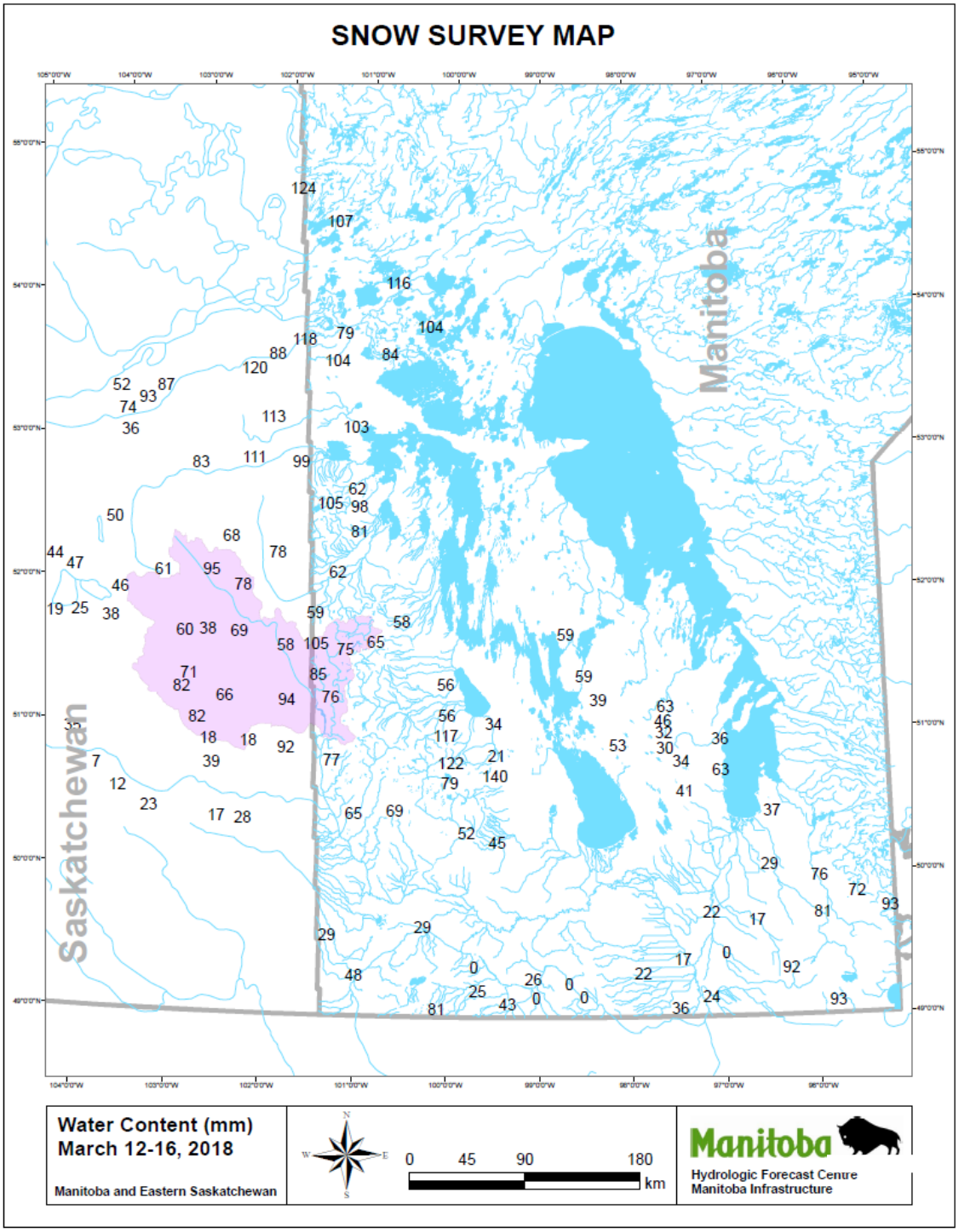

Figure 3 - March 12th – 16th, 2018 snow survey results in millimetres of water content.

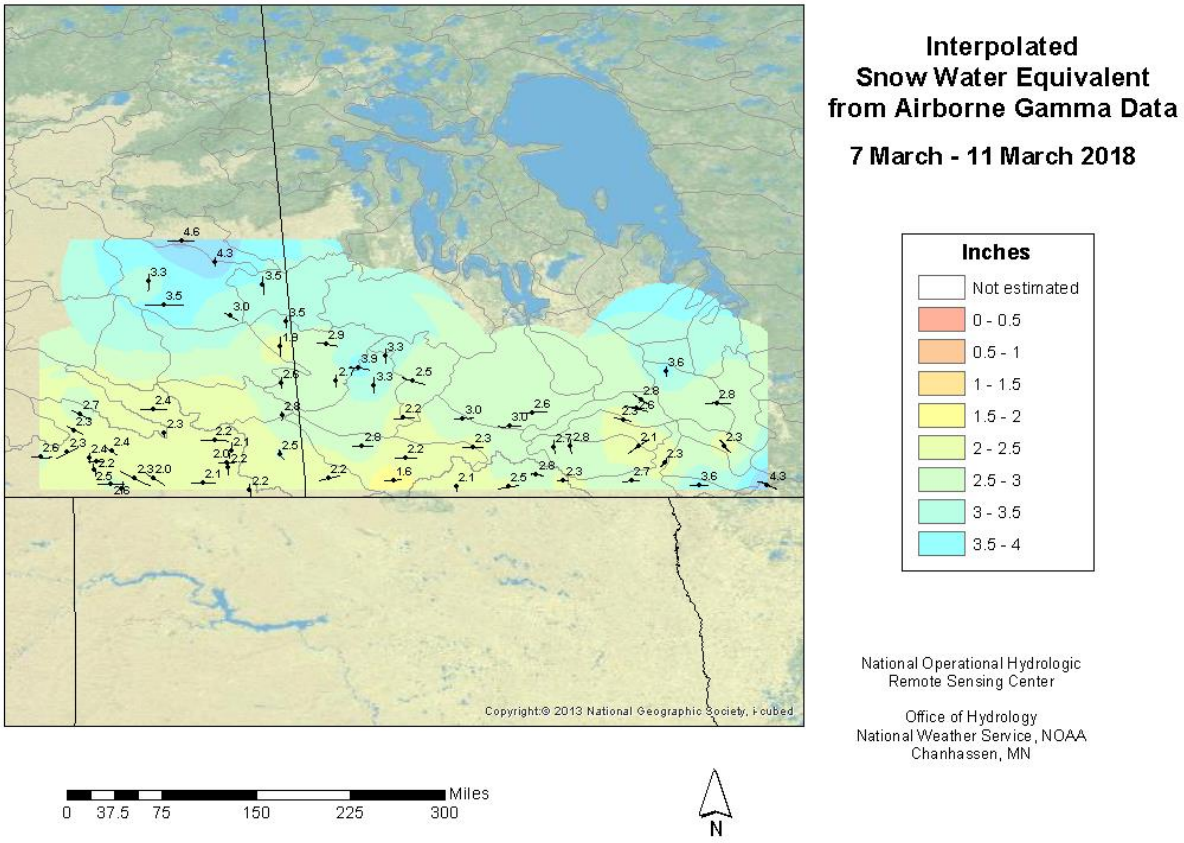

Figure 4 – Snow Water Equivalent in inches of water content based on Gamma Flight Survey.

Base Flow and Level Conditions

Current (also called "base") flow and level conditions throughout the province as of March 21st, 2018 range from below to near normal in most areas to above normal at some locations. Base flow and level conditions indicate the relative extent of ground saturation for this time of the year. Ice may affect some level readings, which may cause spikes in the calculated discharge readings. Figure 5 shows a map of gauges with the base flow conditions.

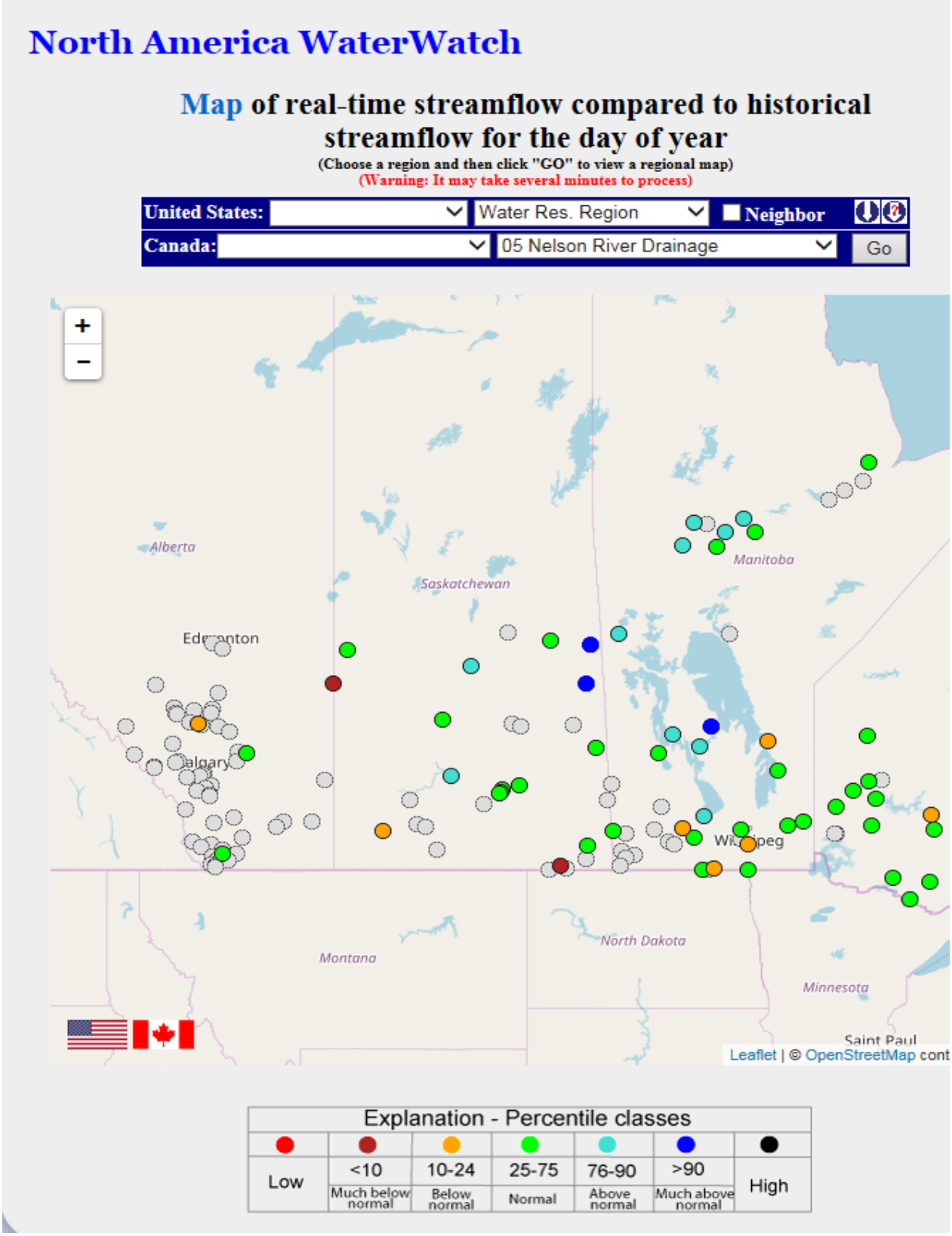

Figure 5 – Current (Base) River Flow Conditions

River Ice Conditions and Ice Jamming[1]

The Red River currently has above normal ice thickness in most areas. Based on March measurements this year, ice thickness ranges between 30 and 42 inches (0.76 to 1.07 m). Ice thickness measurements on the Red River are shown in Figure 6. Normal ice thickness for this time of the year for southern Manitoba rivers 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. Ice cutting and the Amphibex ice breaking activities have been completed for about 28 km on the lower Red River at and north of Selkirk. Ice cutting and the Amphibex ice breaking activities are currently underway on the Fisher River and Brokenhead River and will soon be taking place on the Icelandic River at Riverton. The ice cutting and breaking activities will then move to the Portage Diversion outlet to break up the ice to reduce the risk of ice jamming at the outlet.

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

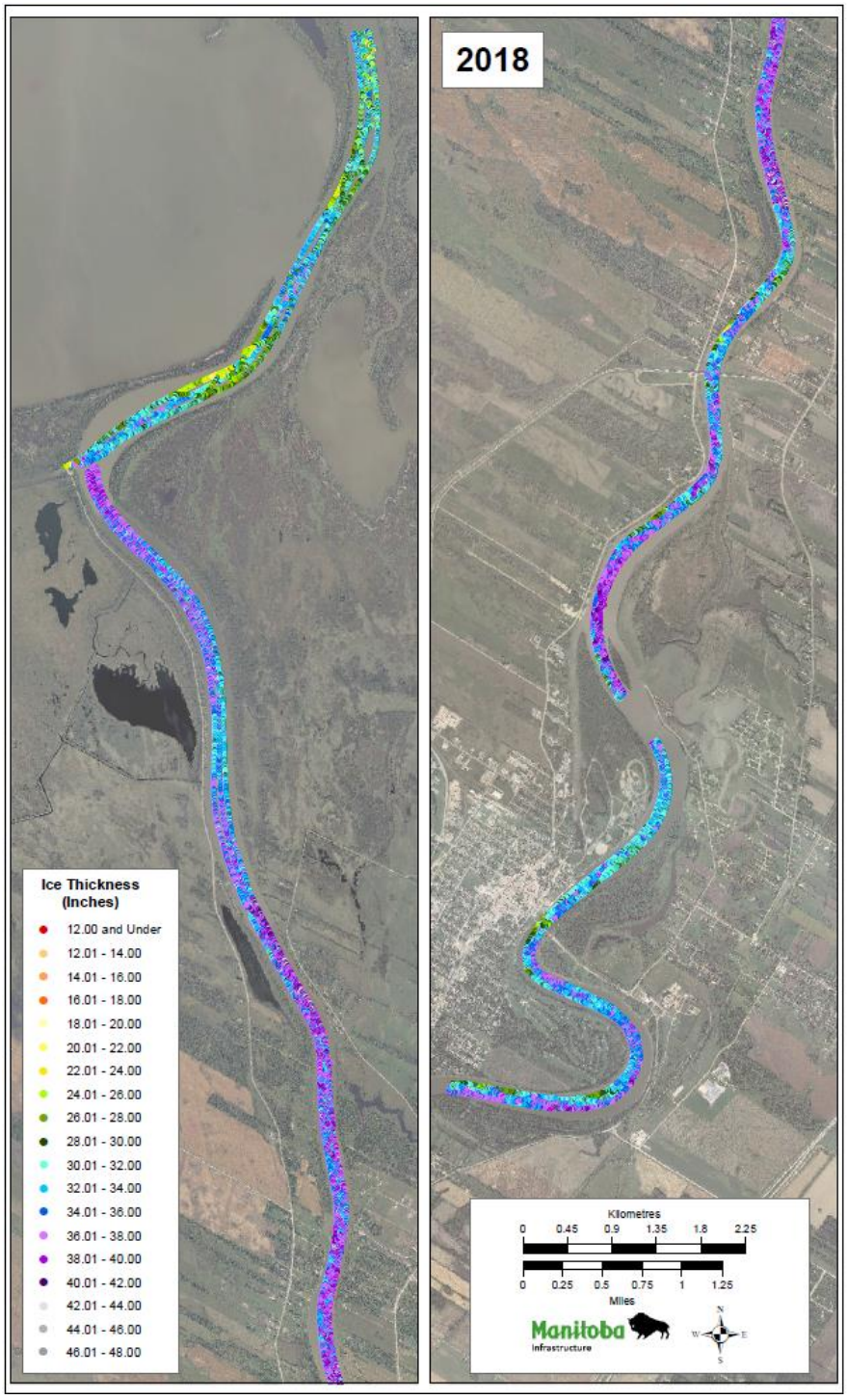

Figure 6 – Ice Thickness Measurements based on Ground Penetrating Radar, Lower Red River

Future Weather

Long-term weather forecasts are available from Environment and Climate Change Canada. These forecasts extend until the end of May. The long-term forecast indicates an increased chance of above normal temperatures, and no trend of precipitation forecast throughout the province to the end of May (Figures 7 & 8).

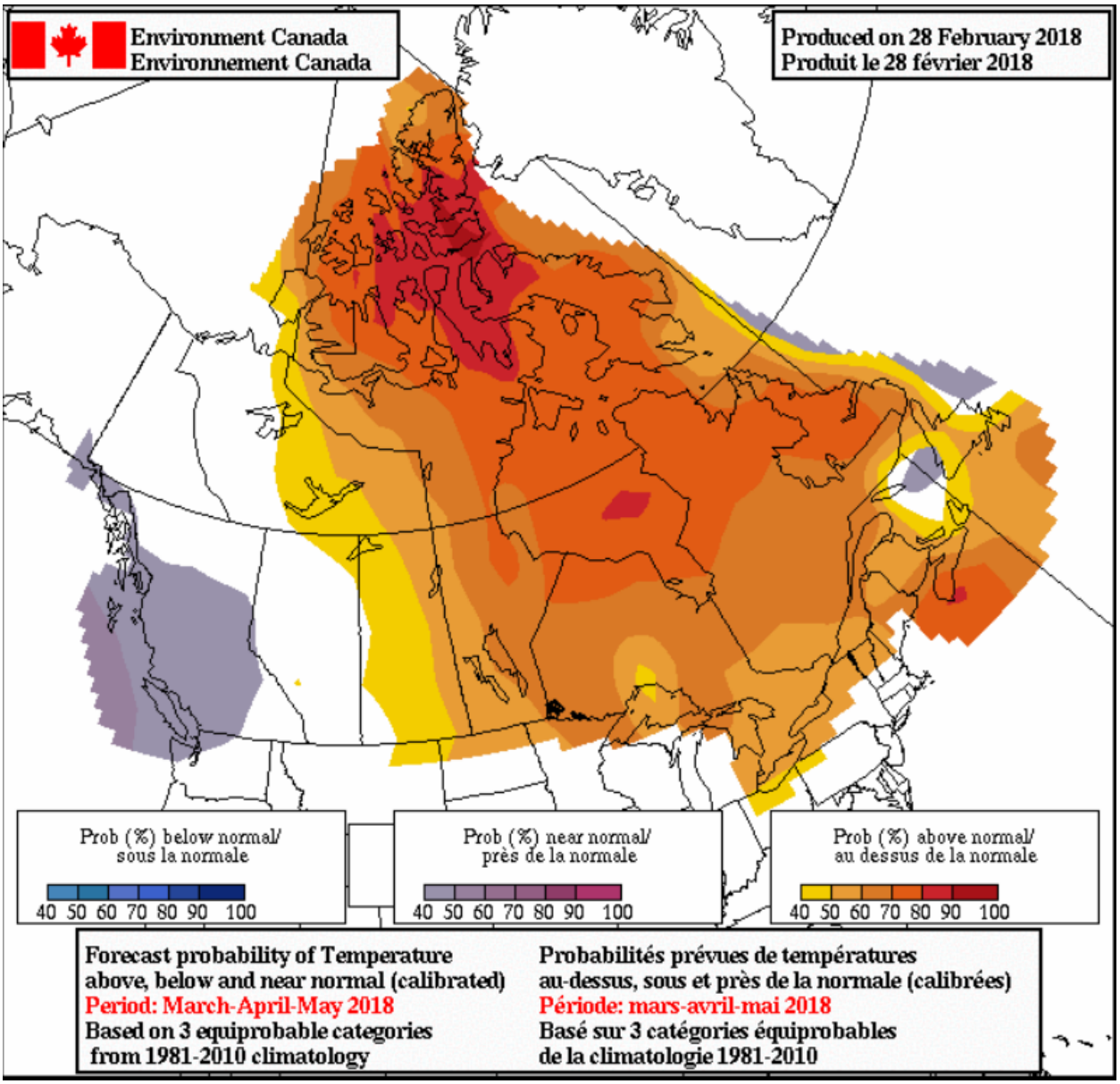

Figure 7 – Long Term Temperature Forecast (Environment and Climate Change Canada)

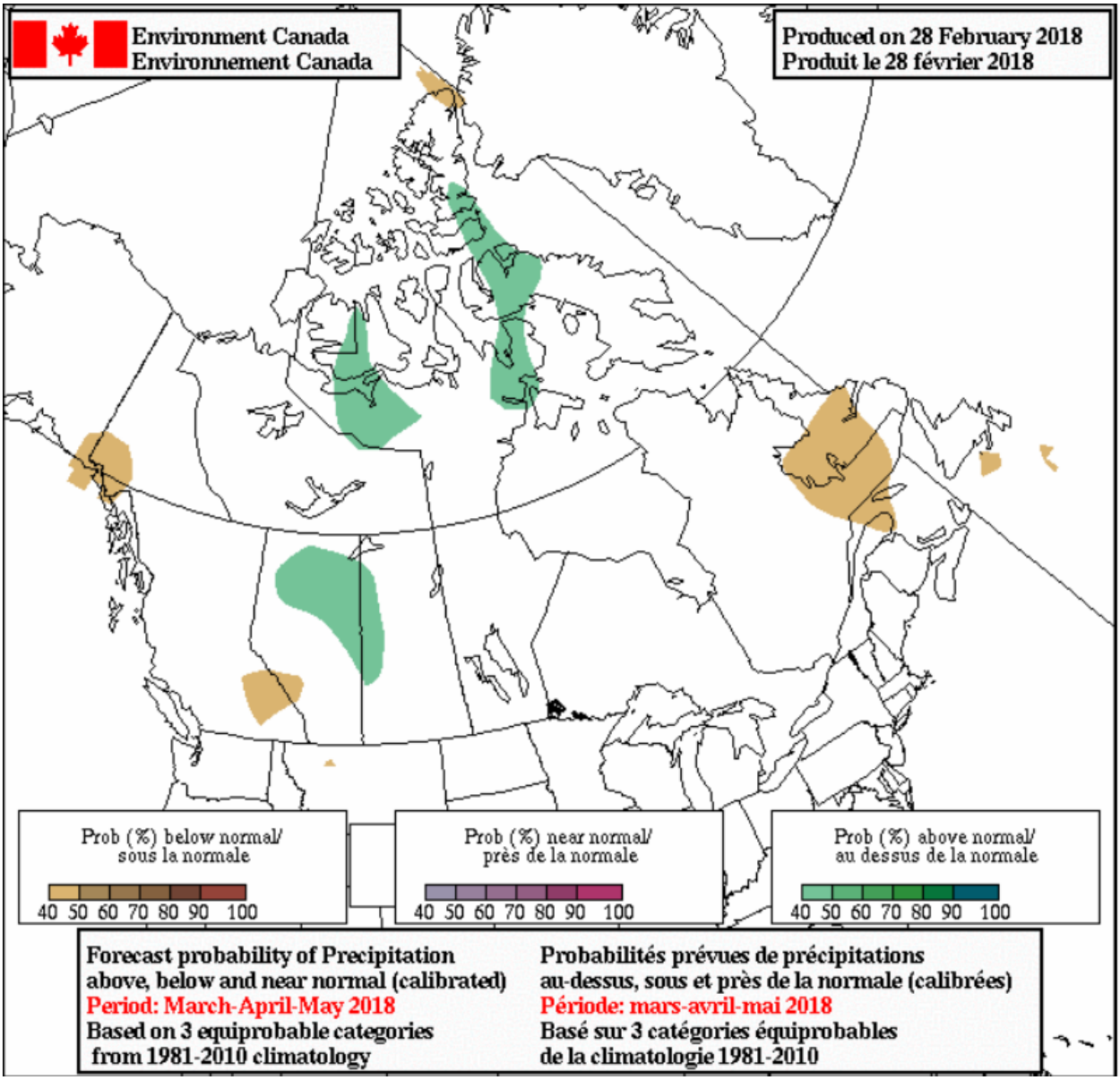

Figure 8 – Long Term Precipitation Forecast (Environment and Climate Change Canada)

Runoff Potential[2]

The forecasted 2018 spring runoff potential (**Error! Reference source not found.**9) is based on:

- 2017 measurements of soil moisture at freeze up;
- winter precipitation as of March 17, 2018; and
- future weather condition scenarios based on historic data.

[2] See Appendix A for 'Runoff Potential' definition

The runoff potential is near normal for northern Manitoba (north of Lake Winnipegosis), northern and central Saskatchewan and in the Ontario portion of the Whiteshell and Winnipeg River basins. The runoff potential is below normal for southern Manitoba (south of Lake Winnipegosis) and south east Saskatchewan. The runoff potential in the Souris and Red River basins in the U.S. is below normal, except in the central Red River area where runoff potential is near normal.

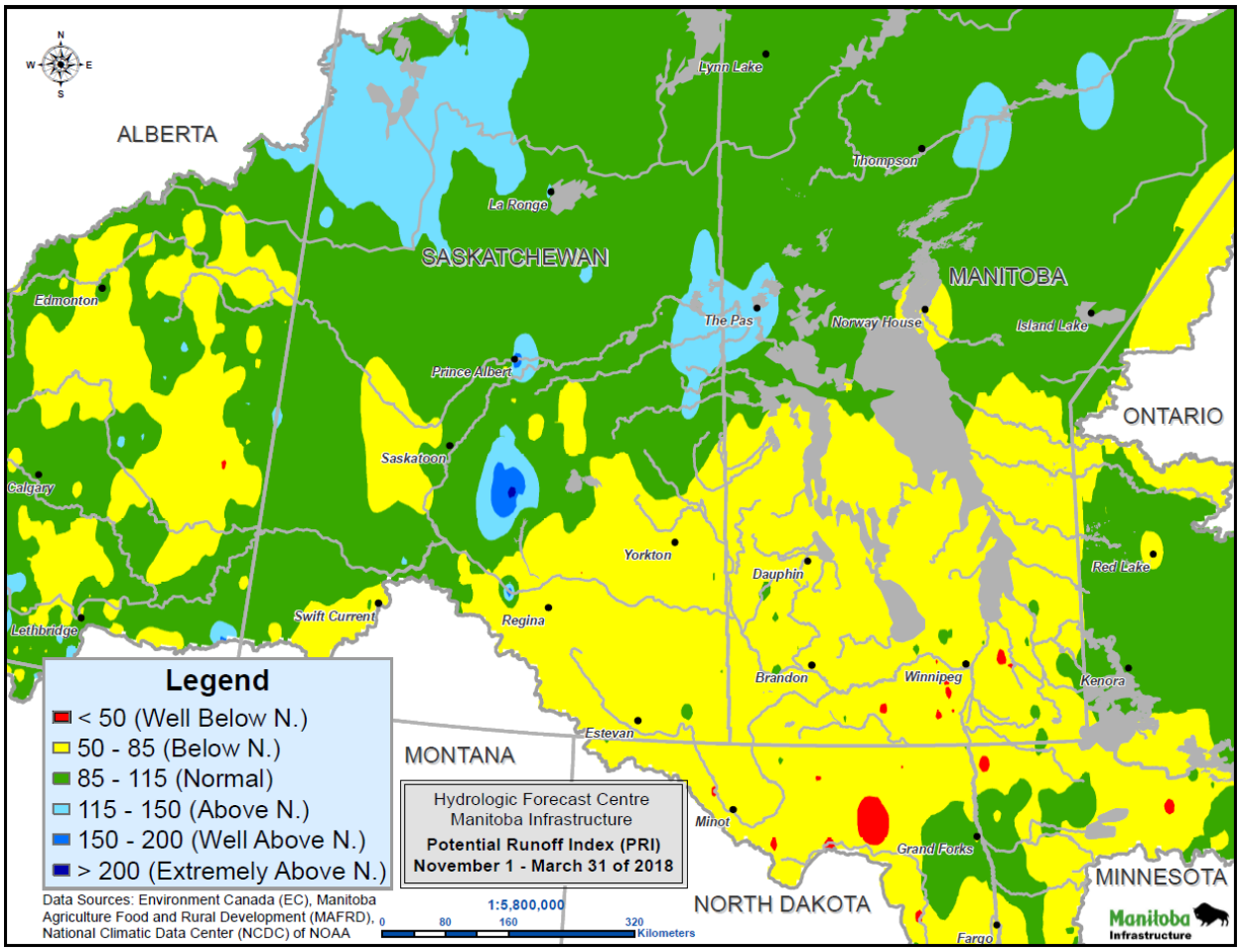

Figure 9 – Forecasted Runoff Potential as of March 31, 2018 (assuming normal weather for the remainder of winter).

Flood Outlook[3]

The March 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,

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

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.

The risk of potential flooding is described by four categories: low (minor), moderate, major and severe[7].

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 risk of major flooding is low for the Souris River, Qu'Appelle River and Pembina River and their tributaries. The levels in these rivers will be below flood protection levels even under the unfavorable weather conditions.

The risk of major flooding is low for the Red River and the main stem of the Assiniboine River. The risk of overland flooding for these rivers is moderate as the flows could go outside of river banks even under normal weather conditions. However, the risk of major flooding is low as the forecasted levels are below flood protection levels even under unfavorable weather conditions.

The risk of major flooding is moderate in the northern basins, including for Churchill River, Saskatchewan River at the Pas, and Carrot River.

The risk of major flooding is low for the Interlake region and all lakes.

The below table summarizes estimated flood peak flows (in cubic feet per second (cfs)) and peak levels (in feet (ft)) on some rivers and lakes at key locations. The table also shows the flood risk potential of the rivers/lakes.

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

The forecasted flows and historic flow comparisons for the Red, Assiniboine and Souris Rivers are shown on Figures 10 to 12.

Red	Lower Decile	Median	Upper Decile	Major Flood Risk
Emerson	40,000	50,000	60,000	**Low**
Ste. Agathe	46,000	52,000	64,000	**Low**
Winnipeg, James		17.5	19.0	**Low**
Assiniboine				
Miniota	4,800	7,200	10,700	**Low**
Brandon	5,700	8,500	13,300	**Low**
Portage	7,000	10,200	17,400	**Low**
Souris				
Melita	600	1,000	2,900	**Low**
Wawanesa	800	1,200	3,100	**Low**
Qu'Appelle				
Welby	600	700	1,000	**Low**
Lake Manitoba				
Westbourne		812.2	812.75	**Low**

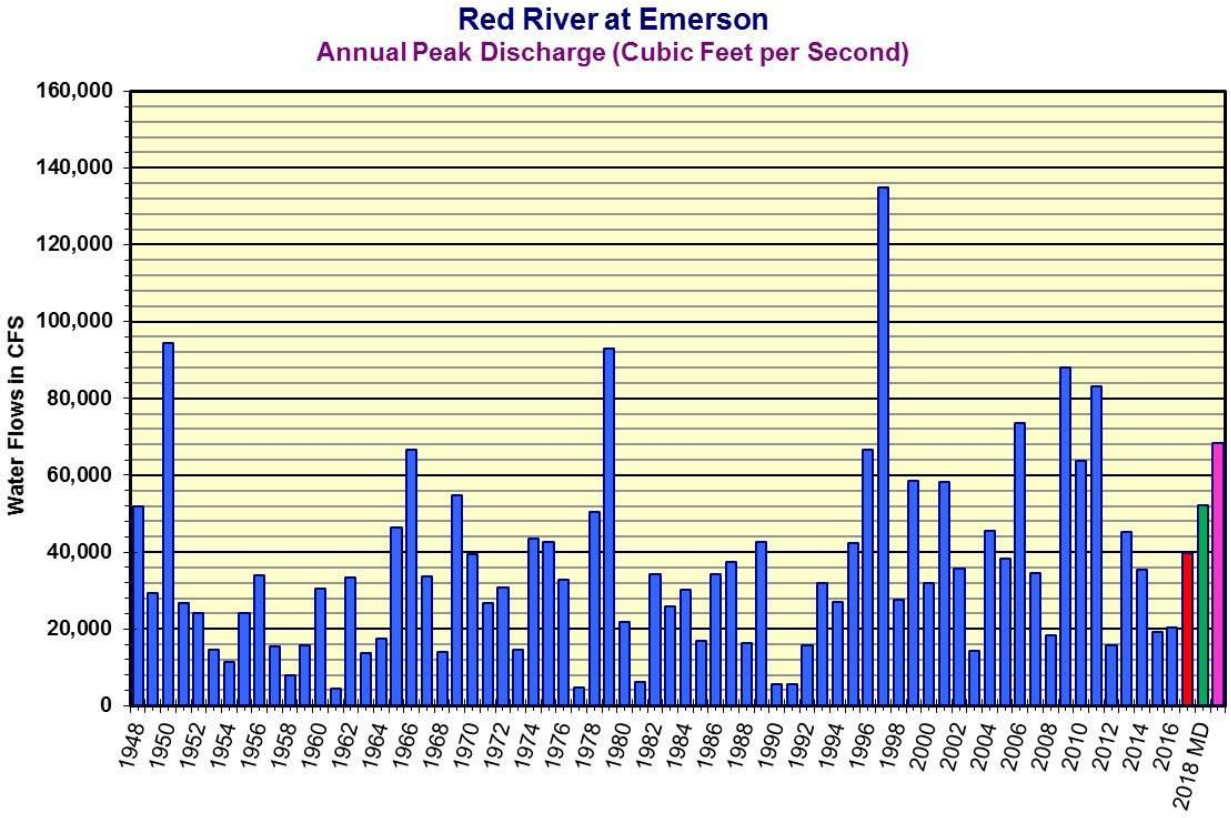

Figure 10 – Historic flows and 2018 forecasted flows for the Red River at Emerson

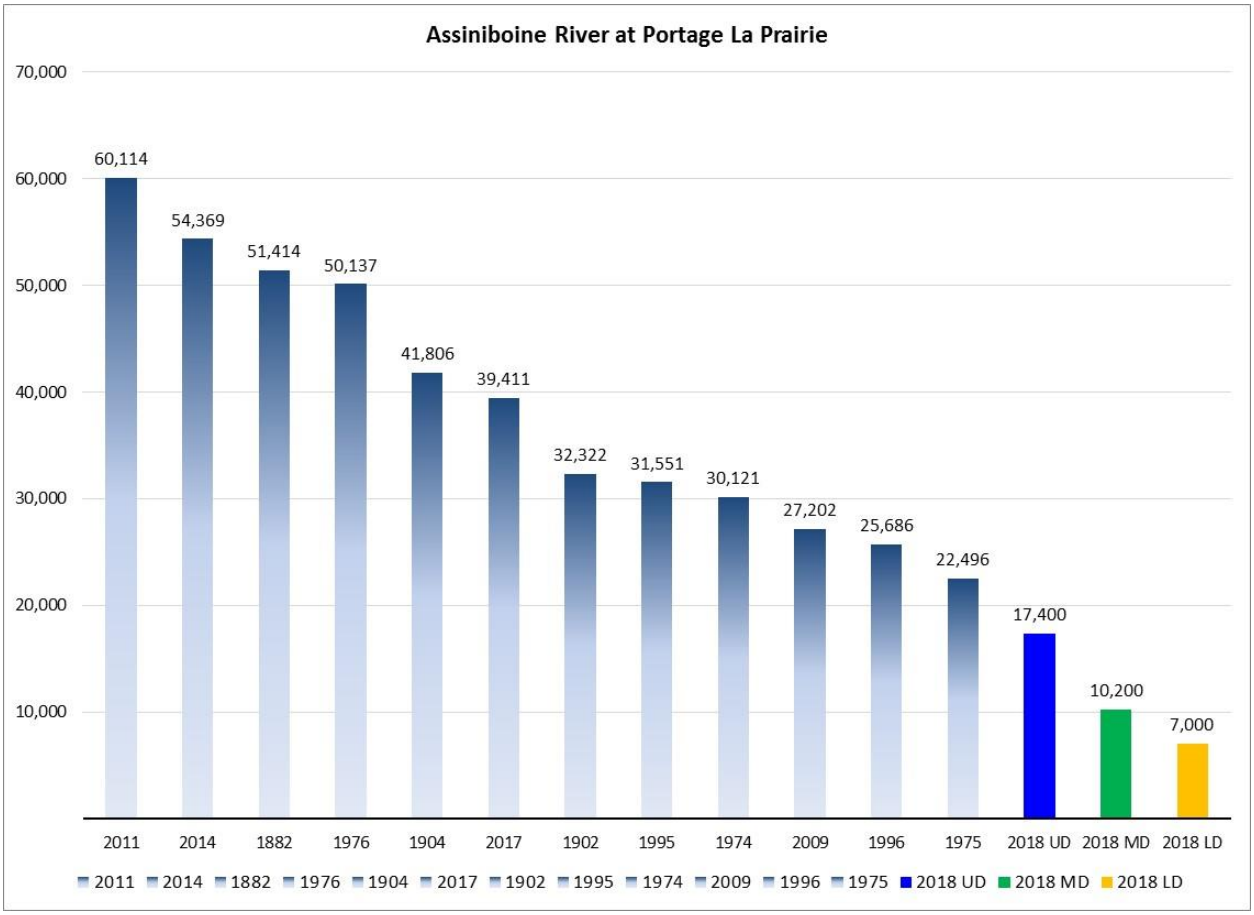

Figure 11 Historic flows and 2018 forecasted flows for the Assiniboine River at Portage

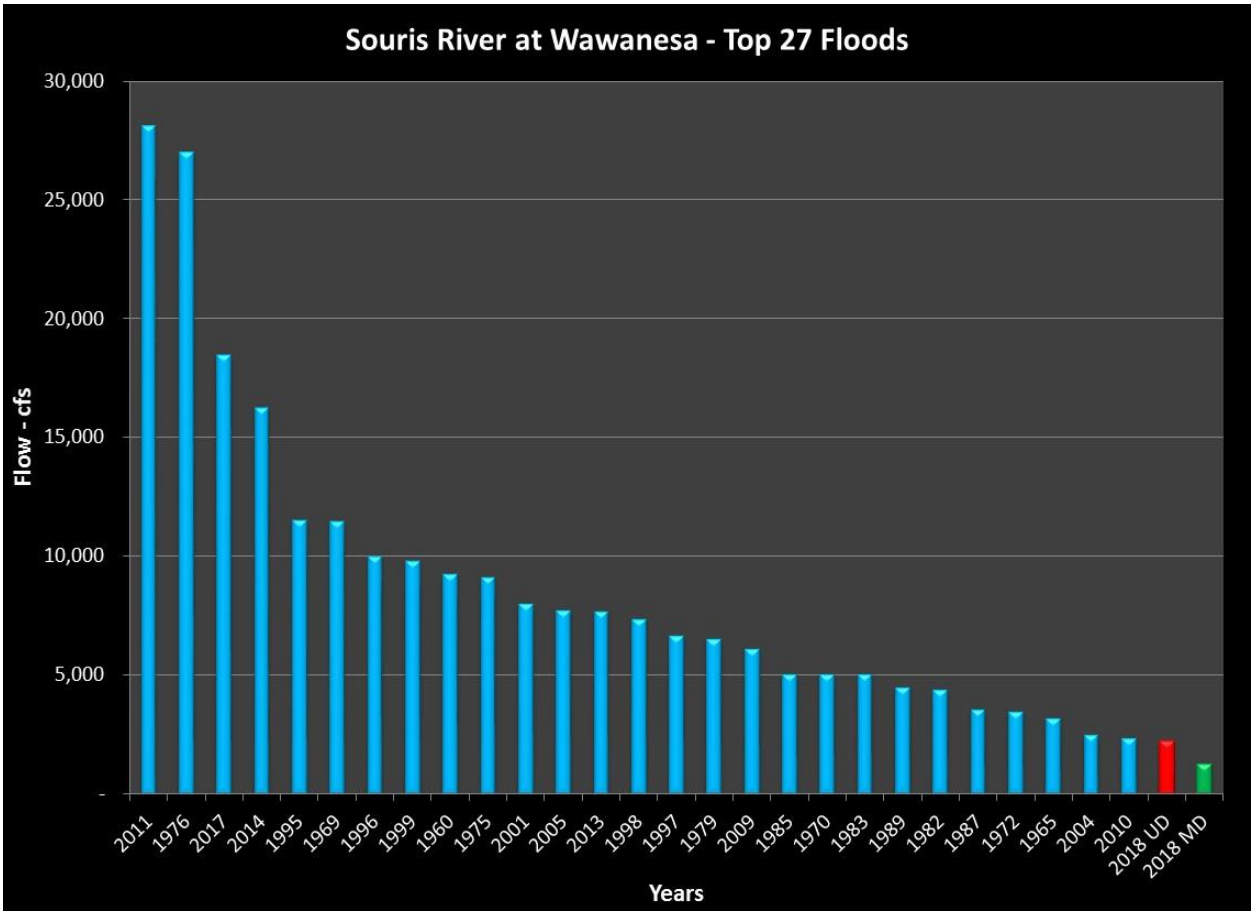

Figure 12 – Historic flows and 2018 forecasted flows for the Souris River at Wawanesa

Flood Control Structures

- The Red River Floodway will likely be operated under normal and unfavorable weather conditions. The Floodway is not expected to be operated under favourable weather conditions.
- The Portage Diversion will likely be operated for all weather conditions in order to reduce the risk of ice jamming on the lower Assiniboine River. The Portage Diversion will likely be operated under the unfavorable weather conditions in order to cap the downstream flow as per the operation guidelines.
- 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 completed with ice cutters and Amphibex machines working on the lower Red River to weaken the ice, and has started working on other rivers.

Future Flood Forecast Information

The spring melt and runoff has not yet begun. Once the spring runoff period is underway, operational forecasting will begin, and daily updates will be provided for required basins as the melt progresses.

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.

[5]Flow/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.

[7]Definition 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.