

2017 January Conditions Report

Manitoba Hydrologic Forecasting and Coordination Branch
Manitoba Infrastructure

1/30/2017

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

**JANUARY CONDITIONS REPORT FOR MANITOBA
January 30, 2017**

Overview

The January Conditions Report prepared by the Hydrologic Forecast Centre of Manitoba Infrastructure reports normal to well above normal runoff potential across the province. The risk of overland flooding is generally moderate to major across the province.

Due to the high soil moisture and high winter precipitation to the end of January, this conditions report estimates the potential for overland flooding as moderate to major in most areas of the province. This could change depending on weather conditions between now and the spring melt. The flood outlook at the end of February will further define the flood potential.

Most of the major lakes are above normal levels for this time of the year, and the risk for lake high water flooding is moderate to major depending on future weather conditions. Flows and levels in most rivers are above normal for this time of the year.

Soil Frost Depth:

Frost depth is near-normal to below normal throughout most of Manitoba. Generally, below normal frost depth means that the soil can absorb more melting surface water and potentially decrease the amount of overland flooding whereas above normal frost depth can contribute to increased runoff.

Soil Moisture Conditions at Freeze up:

Soil moisture is generally normal to well above normal on all Manitoba basins.

- Southern Manitoba including the Red River Valley: normal to above-normal
- Western Manitoba: above-normal to well-above-normal
- Saskatchewan: above-normal to well-above-normal
- Northern Manitoba, including The Pas region: above-normal to well-above-normal
- Interlake: normal to above-normal
- Eastern Manitoba: near-normal

Winter Precipitation:

Winter precipitation is normal to well above normal throughout the southern, southeastern and southwestern portions of Manitoba including the Red River, the Souris River, the Pembina River, the Roseau River, the Winnipeg River, the Interlake, and the Whiteshell area.

The winter precipitation in the Red River basin in United States and in the Winnipeg River basin in Ontario are above normal.

Winter precipitation has been below normal for Western and Northern Manitoba and Saskatchewan. Below normal winter precipitation is recorded in the Qu'Appelle River, the Upper Assiniboine River and the Saskatchewan River watersheds including the Lake Winnipegosis basin.

Future Weather:

Environment Canada and the National Weather Service's latest long term precipitation forecast indicates precipitation will be above normal for the southern Manitoba basins including the Souris River, the Pembina River and the Red River basins. Precipitation will be near normal for the rest of the province. The long term temperature forecast from Environment Canada and the National weather service do not correspond as to temperature trends. The National Weather Service's latest long term temperature forecast indicates below normal temperature for southern Manitoba.

Runoff:

The potential for spring runoff is above normal to well above normal in the Red River, the Souris River, the Pembina River and the Roseau River basins as well as the Lake Winnipegosis region. The potential for spring runoff is near-normal to above normal in the upper Assiniboine River, the Saskatchewan River, the lower Assiniboine River, the Qu'Appelle River, the Winnipeg River basins and the Interlake region. The runoff potential is above normal for the Whiteshell area. The runoff potential is normal to above-normal throughout the rest of the province.

Preliminary Flood Outlook:

The magnitude of spring flood potential is still very dependent on weather until the spring melt. Flood potential is significantly affected by:

- the amount of additional snow and spring rain;
- frost depth at the time of runoff;
- the timing and rate of the spring thaw; and

- the timing of peak flows in Manitoba, the U.S. and other provinces.

Delayed thaw and spring rainstorms could result in rapid snow melt aggravating overland flooding and increasing tributary flows. A single precipitation event similar to the rainstorm that occurred in the summer of 2014 could change the flood outlook significantly.

The province's practice is to plan and prepare for the unfavourable weather condition scenario (the upper decile or a 1 in 10 chance that Manitoba will experience the historical extreme weather scenario resulting in a high flood risk). The preliminary outlook shows the risk of overland flooding for the unfavourable weather scenario in the following watersheds:

- Red River: major risk;
- Pembina River: major risk;
- Roseau River: major risk;
- Assiniboine River: moderate to major risk;
- South West Region: major risk;
- Interlake Region and the Fisher River: moderate risk;
- Eastern Region and the Winnipeg River: moderate to major risk; and
- Northern Manitoba/The Pas Regions and the Saskatchewan, Carrot and Swan Rivers: moderate to major risk.

Preparations:

The Manitoba government, municipalities and First Nations are continuing to prepare for spring flooding. This includes working with municipal emergency management teams to review existing emergency response plans and sharing information through conference calls and flood information seminars in Morris, Brandon and Selkirk.

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Soil Moisture Conditions

As previously outlined in the 2016 Fall Conditions Report, the soil moisture analysis based on weighted summer and fall precipitation indicates normal to well above normal soil moisture for most of Manitoba and above normal to well above normal throughout most of Saskatchewan and the Saskatchewan River basin. The soil moisture is normal to above normal for the US portion of the Red River basin (Figure 1 and Figure 2). The Assiniboine, Qu'Appelle River and Souris River basins have above normal to well above normal soil moisture.

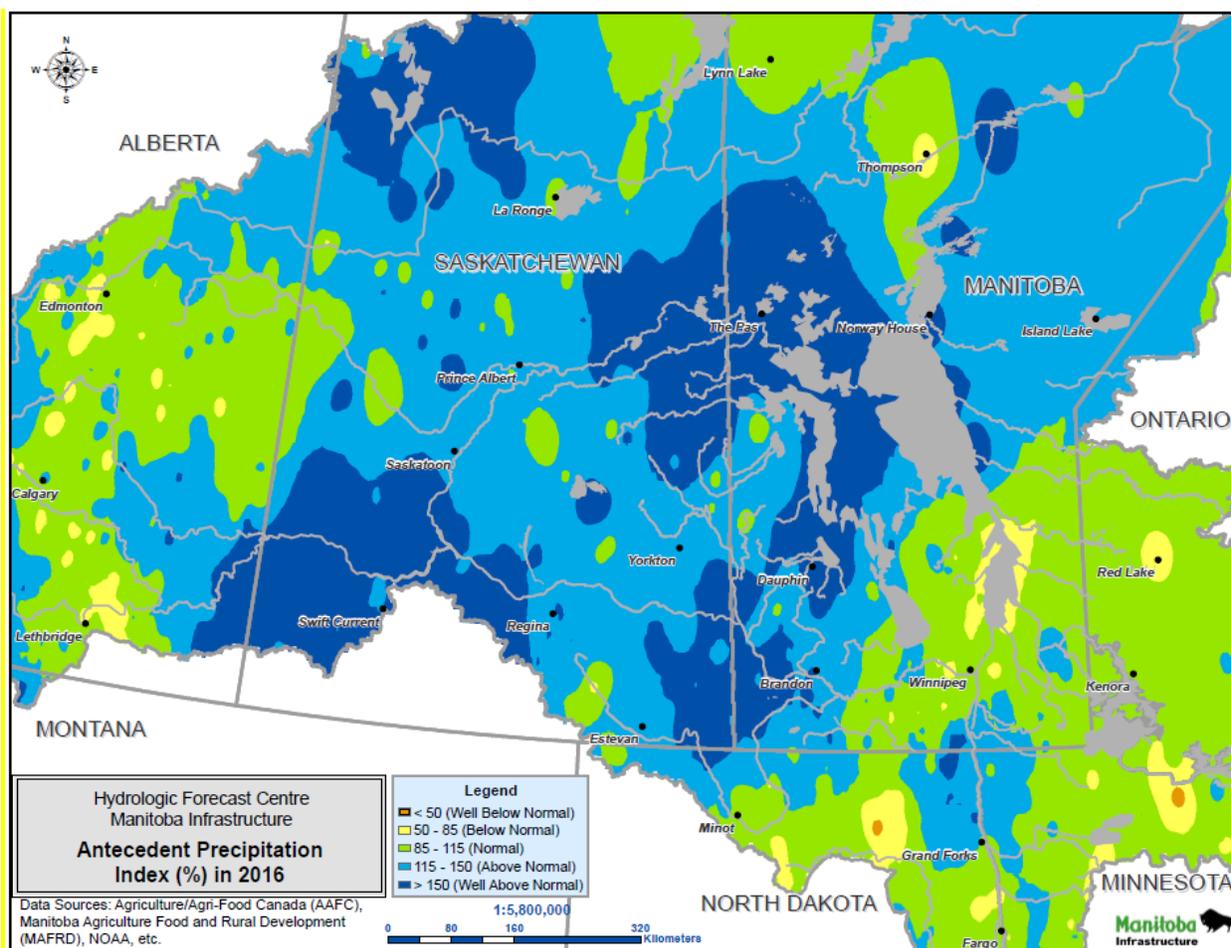


Figure 1 - Antecedent Precipitation Index (API) for the Fall of 2016.

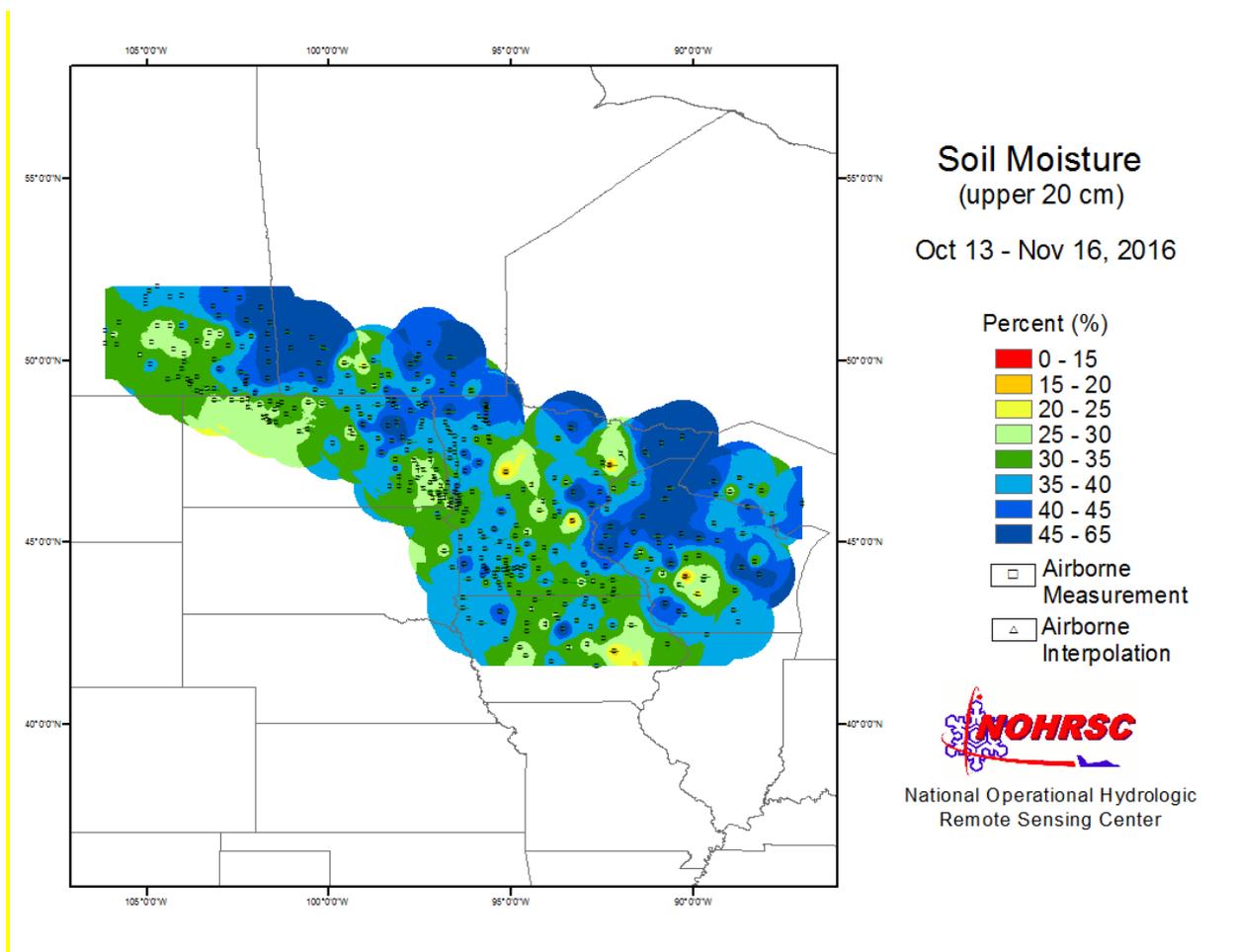


Figure 2 - Gamma Survey derived soil moisture (in the upper 20 cm of soil) from October 13 - November 16, 2016.

Frost Depth

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

Winter Precipitation & Snow Water Content

November to January precipitation has been normal to above normal in most of southern, central and eastern Manitoba and well above normal on the U.S. portion of the Red River and Souris River basins. In western Manitoba, northern Manitoba, Saskatchewan and most of Alberta winter precipitation has been below normal. (**Error! Reference source not found.**)

Over 100 mm (4 inches) of precipitation has been observed in most parts of the Souris River and the Red River basins in the United States and southeastern corner (Whiteshell area) of Manitoba between November 1, 2016 and January 24, 2017 (Figure 4). Generally, southern, central, and southwestern portions of Manitoba received between 45 to 85 mm (2 to 3.5 inches) of precipitation during the same time period (Figure 4).

Based on the available mid-January field observations (Figure), the average water content in the snowpack in the upper Assiniboine basin is 30 mm (1.2 inches) (observations range between 10 mm to 60 mm), 70 mm (2.8 inches) in the Souris River basin (observations range between 40 mm to 90 mm), and 80 mm (3.1 inches) in the Pembina River basin (observations range from 40 mm to 170 mm). The snow survey data for the remaining areas will be available as part of the February outlook.

Snow water content obtained from the Snow Water Equivalent (SWE) analysis conducted through gamma airborne survey on January 13-23 indicates between 1.7 to 5.5 inches of snow water content on the United States and South Eastern corner of Saskatchewan (Figure 6). The same snow water content analysis covering southern portions of the Manitoba basins and updated readings for the United States and Saskatchewan will be available in the February outlook.

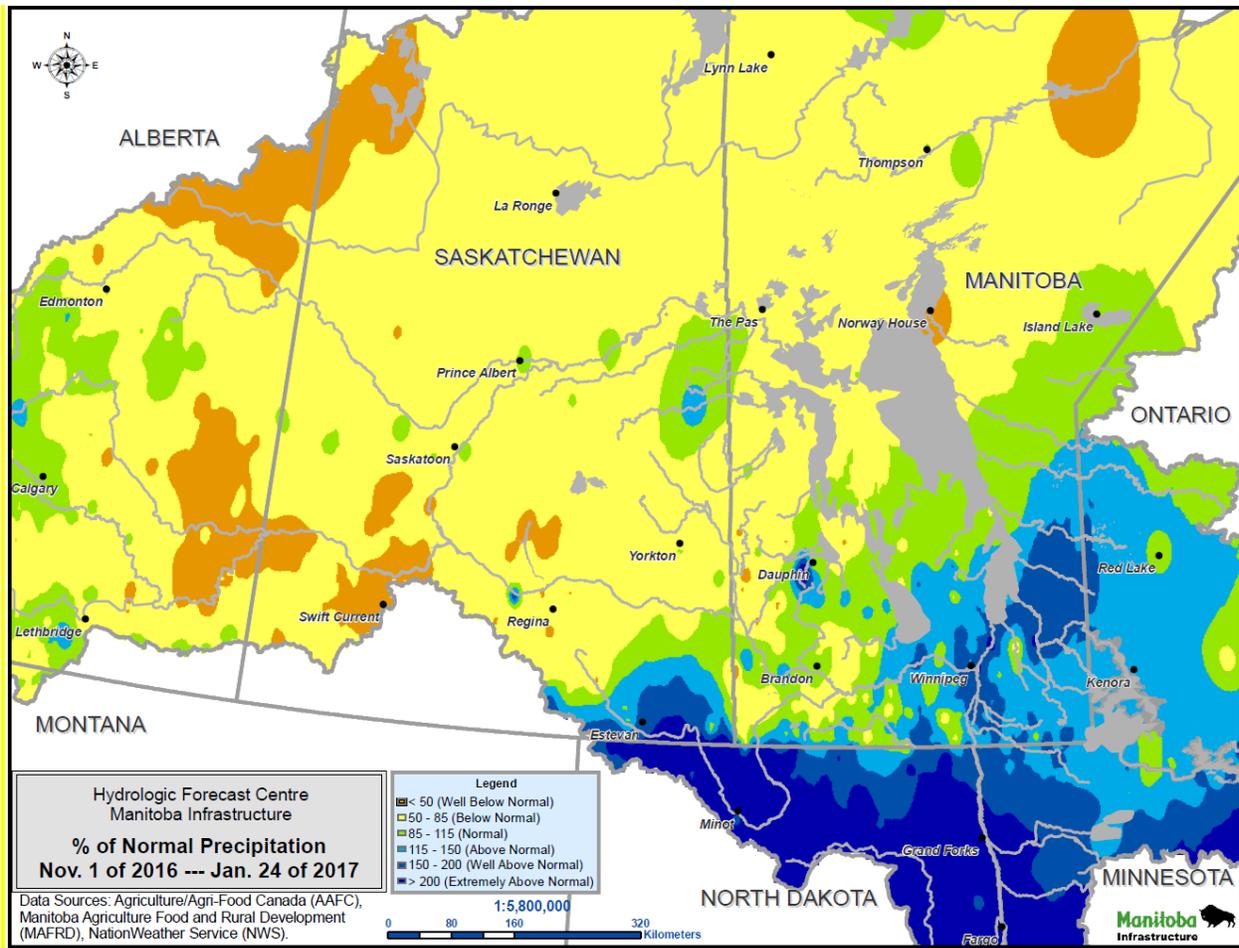


Figure 3 - Percent of Normal Precipitation from November 1, 2016 to January 24, 2017.

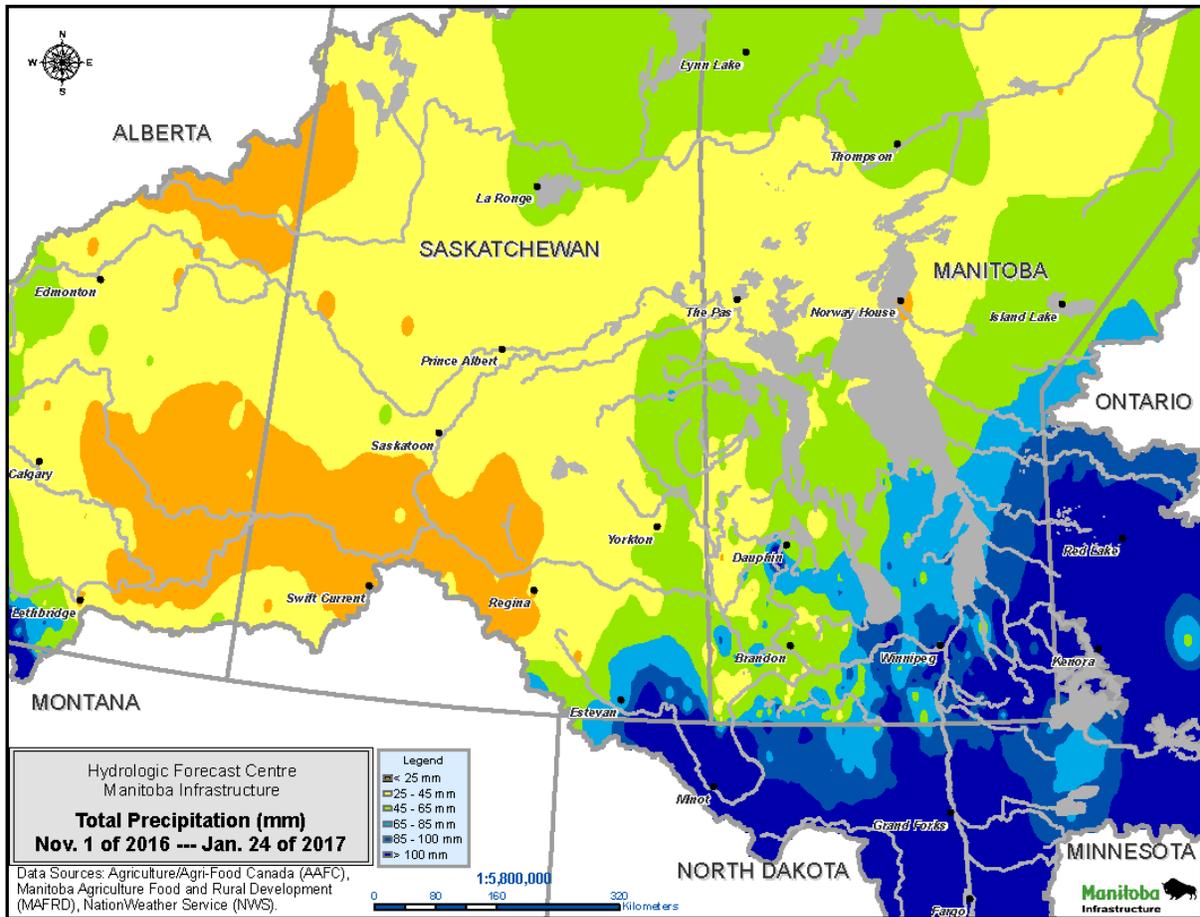


Figure 4 - Accumulated precipitation between November 1, 2016 to January 24, 2017.

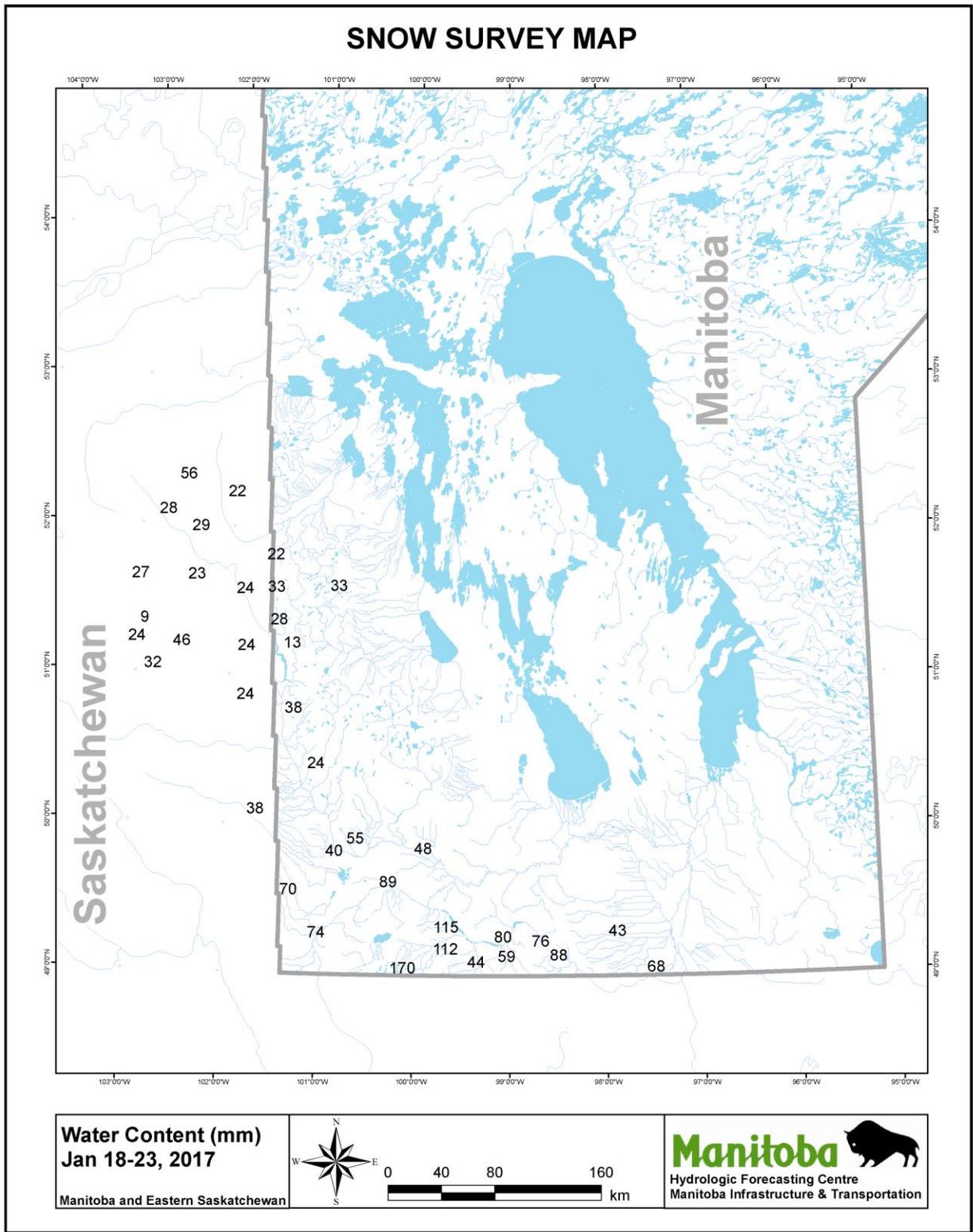


Figure 5 - January 18th – 23rd, 2017 snow survey results in millimetres of water content.

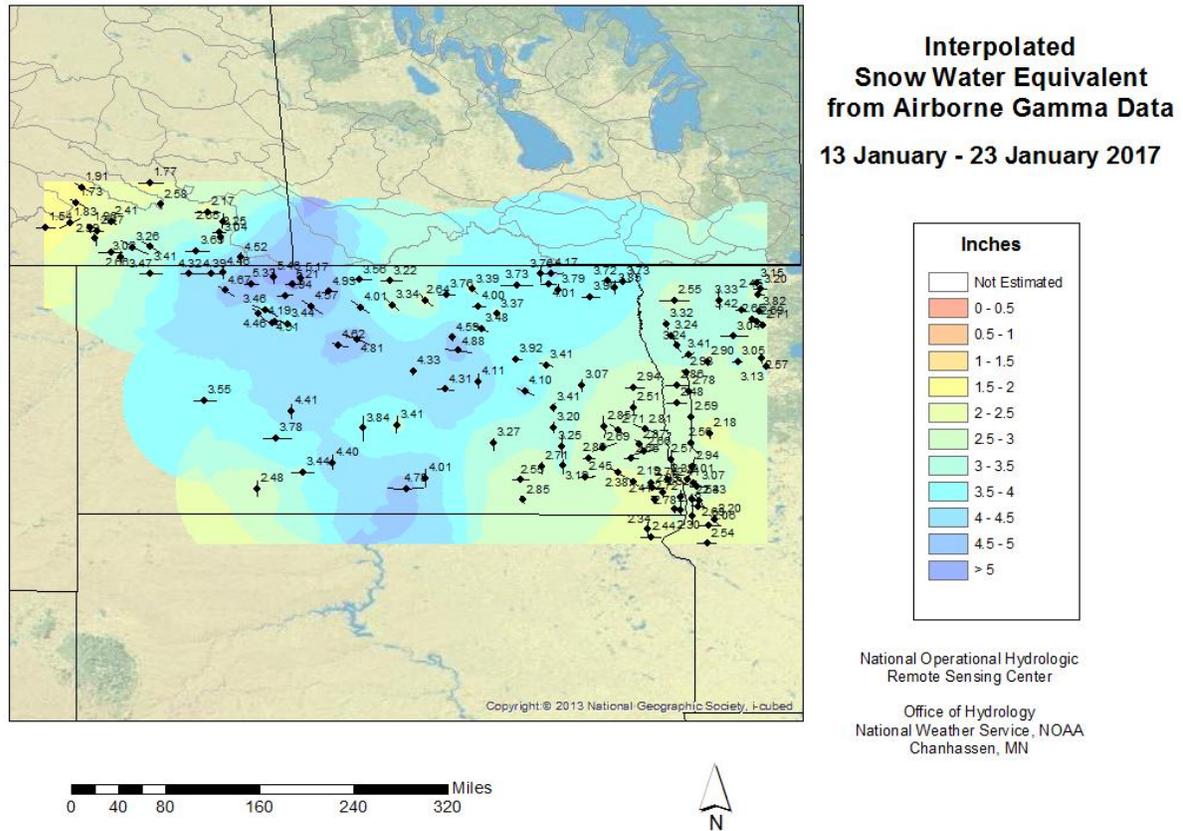


Figure 6 - January 13th – 18th, 2017 Airborne Gamma Survey results in millimetres of water content.

Lake Level and River Flow Conditions

Water levels/flows at freeze-up:

- Saskatchewan, Carrot, Red Deer and Assiniboine Rivers: well above normal;
- Red, Souris and Qu’Appelle Rivers: above normal; and,
- Major lakes, such as Dauphin, St. Martin, Winnipegosis, Manitoba, and Winnipeg: above normal levels.

Current river flow conditions:

- Red River, Roseau River, Pembina River: generally flows are normal to above normal for this time of year;

- Northern Rivers (including Red Deer, Saskatchewan, and Carrot Rivers): flows are well above normal for this time of year;
- Assiniboine River, Souris River, Qu'Appelle River: flows are above normal for this time of year; and,
- Interlake rivers (including the Waterhen, Fisher, and Fairford Rivers): flows are normal to above-normal for this time of year.

River Ice Conditions and Ice Jamming¹

There have not been any ice thickness readings taken as measurements on the Red River typically occur in February. Normal ice thickness for this time of the year varies according to the river flow velocity, and the location of the river, typically ranging between 30 cm (12 inches) and 61 cm (24 inches).

Spring weather affects deterioration of ice and will be a significant factor in determining ice strength at break-up. It is difficult to predict the time of occurrence and extent of ice jamming. However with the ice cutting and the Amphibex ice breaking activities ice jamming and related flooding on the lower Red River will be reduced.

Localized flooding can occur when and where ice jams develop, even with below average river flows.

Ice Jam Mitigation Program with the Ice Cutters and the Amphibex Fleet:

This year's ice jam mitigation program will focus on the north Red, Assiniboine, Icelandic, Brokenhead and Fisher Rivers as well as the Portage Diversion to reduce the potential of ice jams. The Amphibexes will start breaking the ice on February 22, 2017.

The chances of minor localized flooding due to snow 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. Due to the wet fall conditions there is a risk that drainage culverts that could be blocked with ice accumulations.

¹ See Appendix A for 'Ice Jam' definition

Runoff Potential²

The expected 2017 spring runoff potential (Figure 7) is based on:

- 2016 measurements of soil moisture at freeze up;
- Winter precipitation as of January 24, 2017; and,
- The average future weather conditions.

The runoff potential ranges from normal to above normal for most of Manitoba and above normal to well above normal in the U.S. while the runoff potential in Saskatchewan is normal to above normal with portions of the Saskatchewan and Souris River basins well above normal. The runoff potential is described for the following areas:

- Red River Basin: above normal to well above normal;
- Pembina River: above normal;
- Southeastern Manitoba: above normal;
- Upper Assiniboine River basin: normal to above normal conditions upstream of Shellmouth Reservoir;
- Qu'Appelle River basin: normal to above normal;
- Saskatchewan River basin; normal to above-normal;
- Souris River basin: above normal to well above normal;
- Interlake Region: near normal;
- Northern Manitoba: normal to above normal;
- Dauphin Lake/Riding Mountain area: normal to above normal;
- Northwest Manitoba (including the northern areas of Lake Winnipegosis, The Pas): above normal; and,
- Regions to the east of Lake Winnipeg (including Berens River) and Island Lake area: normal to above normal.

² See Appendix A for 'Runoff Potential' definition

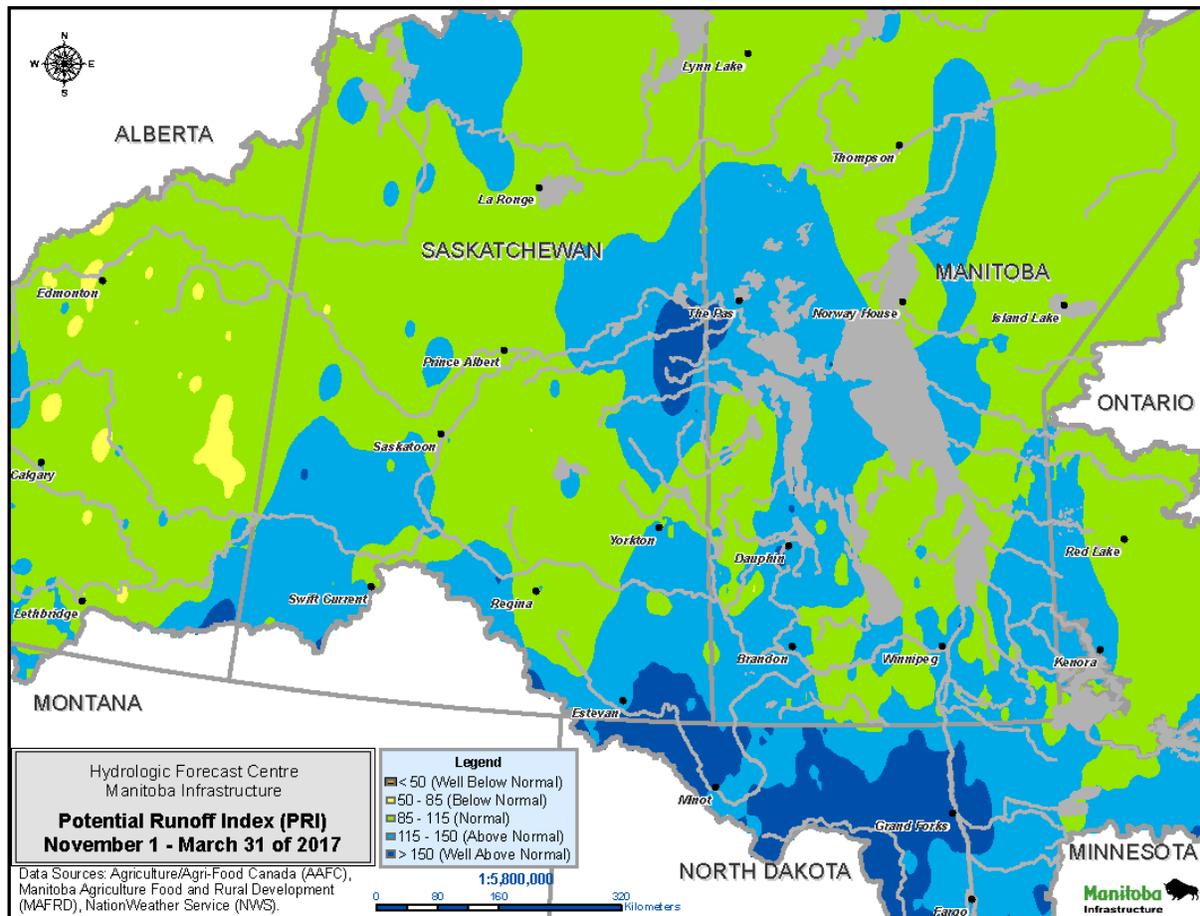


Figure 7 – Runoff Potential as of March 31, 2017. (Assuming normal weather for the remainder of winter)

Preliminary Flood Outlook³

Spring flood outlooks are estimated river and lake peak water levels or flows that are based on current basin conditions. Outlooks are also provided for three weather scenarios (favourable, normal, unfavourable) which correspond to three different probabilities of occurrence (lower decile, median, upper decile). The Province's practice is to plan and prepare for the upper decile condition. For further information see Appendix A: Definitions.

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: minor, moderate, major and severe.

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

- Future weather uncertainties (snowfall and spring rainfall);
- 2017 winter snowpack, onset of melt, and melt rate (i.e. timing and speed of snow melt);
- Water regulation in the USA and Saskatchewan;
- Uncertainty in meteorological and hydrometric data;
- Timing of the peak flows;
- Frost depth at the time of spring melt; and
- Model prediction uncertainty.

Red River

- There is a risk of major spring flooding on the Red River main stem. This outlook is consistent with the outlook issued by the National Weather Service River forecast Center of the United States. The current soil moisture condition varies from above normal on the U.S. portion of the basin to near normal on the Canadian side of the border. Winter precipitation has been above normal to well above normal this year throughout the basin.
- Favourable weather: moderate risk of flooding
 - Levels would be slightly lower than spring melt levels observed in 2007 from Emerson to Ste. Agathe.
- Normal weather: moderate risk of flooding
 - Levels would be slightly higher than spring melt levels observed in 2010 from Emerson to Ste. Agathe.
- Unfavourable weather: major risk of flooding
 - Levels on the Red River main stem would be similar to 2009 from Emerson to Ste. Agathe.
- There is a moderate flood risk for the small tributaries such as the La Salle, Rat and Morris Rivers.
- There is sufficient community protection within the Red River basin as community dike elevations are higher than the predicted levels.

Red River Floodway

- The Red River Floodway has been operated for 31 out of the 48 years since it has been constructed for the purpose of providing flood protection to the City of Winnipeg. Due to above normal conditions throughout the basin, there is a very high chance that the Floodway will be operated during the 2017 spring melt.
- The ice-induced peak at James Avenue is estimated between 5.6 m (18.5 feet) to 6.9 m (22.6 feet).
- Open water estimated levels at James Avenue are:
 - Favourable weather: 5.2 m (17.0 feet)
 - Unfavourable weather: 6.1 m (20.0 feet)

Pembina River and Roseau River

- The potential for spring flooding is major on both the Pembina and Roseau Rivers. Both basins have received above normal snowfall on top of above normal soil moisture.
 - Favourable weather: moderate risk of flooding.
 - Normal to unfavourable weather: major risk of flooding.

Assiniboine River

- Flood risk ranges from moderate to major due to above normal soil moisture in the watershed and near normal snow water equivalent in the snowpack.
 - Favourable weather: minor risk of flooding
 - Levels will be slightly less than 2009 or 2007 from Shellmouth downstream to Brandon.
 - Levels will be similar to 2009 levels from Brandon to Portage.
 - Normal weather: moderate risk of flooding
 - Levels will be higher than 2009 but lower than 2005 from Shellmouth downstream to Brandon.
 - Levels will be similar to 1995 levels from Brandon to Portage.
 - Unfavourable weather: major risk of flooding
 - Levels will be similar to 1995 or 1976 levels from Shellmouth downstream to Brandon. Brandon flood protection levels⁶ are adequate for this scenario.
 - Levels will be slightly less than levels observed in 2011 or 2014 summer rain from Brandon to Portage.

- With high contributions expected from the Souris River, the flood risk on the Assiniboine River increases to major downstream of the confluence with the Souris River.
- The preliminary flood outlook for the Qu'Appelle River at St. Lazare:
 - Favourable to normal weather: minor risk of flooding
 - Unfavourable weather: moderate risk of flooding
 - St Lazare flood protection⁶ levels are adequate.

Portage Diversion

- The Portage Diversion has been operated 34 out of the 47 years since it has been constructed for the purpose of preventing ice jamming on the Assiniboine River east of Portage and to provide flood protection to the City of Winnipeg in accordance with the operating guidelines. Based on the runoff potential in the Assiniboine and Souris basins, the probability of operating the Portage Diversion is high.

Shellmouth Dam

- The forecasted inflow volume into the Shellmouth reservoir for favourable, normal and unfavourable conditions are 300,000 ac-ft, 500,000 ac-ft and 750,000 ac-ft, respectively.
- The Shellmouth Dam is being operated to draw down the reservoir to provide storage capacity for reservoir inflows to reduce flooding downstream. The current reservoir level as of January 30th, 2017 is 424.60 m (1393.0 ft). The Shellmouth Liason Committee is continuing to manage operations to meet the target level of 427.33 m to 427.94 m (1402 ft to 1404 ft) after the spring runoff. The current outflow from the reservoir is 1,450 cfs (cubic feet per second).

Souris River (South West Region)

- Both snow accumulation and soil moisture within the Souris River basin are above normal to well above normal conditions. Estimated flooding for the Souris River and its tributaries is as follows:
 - Favourable weather: moderate risk of flooding downstream of Minot along the main stem.
 - Levels are expected to be similar to the 2013 levels at Wawanesa.
 - Normal weather: major flood risk downstream of Minot along the main stem.
 - Levels are generally expected to be similar to 2014 summer levels at Wawanesa.
 - Unfavourable weather: major to severe flood risk downstream of Minot along the main stem.

- Levels are expected to be between 1976 and 2011 levels at Wawanesa.
- The existing dikes in the towns of Melita, Souris and Wawanesa have sufficient elevation to protect against these levels.

Interlake Region

- Soil moisture is normal to above normal throughout the Interlake region with near normal snow accumulation. Estimated flooding potential is as follows:
 - Favourable to normal weather: minor risk of flooding.
 - Unfavourable weather: moderate risk of flooding.
- As in most years the risk of ice jamming is high for the Icelandic, Fisher and Whitemud Rivers.

Fairford Control Structure

- The Fairford Control Structure is operating at 100% of maximum capacity and will remain this way throughout the spring.

Eastern Region

- The soil moisture is normal to above normal and the accumulated snowpack is above normal for the Eastern Region, including Winnipeg River. Estimated flooding potential:
 - Favourable to normal weather: moderate risk flooding.
 - Unfavourable weather: major risk of flooding.

Manitoba Lakes

- Current lake levels are provided with indication of how levels are trending as compared to long-term average levels. Further forecast information for lake levels will be provided in the February Flood Outlook. Currently, most major lakes are above normal levels.

Lake Manitoba

- Lake Manitoba's current level is 247.65 m (812.49 ft).
- The current level is 0.21 m (0.70 ft) above normal for this time of year, and is above the interim operating range of 247.0 m (810 ft) to 247.7 m (812 ft).

Lake St. Martin

- Lake St. Martin is currently at 244.50 m (802.16 ft).
- The current level is 1.21 m (3.96 ft) above normal for this time of year.

Lake Winnipeg

- Lake Winnipeg's current level is 218.04 m (715.37 ft).

- The current level is 0.70 m (2.30 ft) above normal for this time of year and above the operating range of 216.71 m (711 feet) to 217.93 m (715 feet).

Lake Winnipegosis

- Lake Winnipegosis is currently at 254.17 m (833.89 ft).
- The current level is 1.02 m (3.35 ft) above normal for this time of year.

Dauphin Lake

- Dauphin Lake's current level is 261.00 m (856.32 ft).
- The current level is 0.70 m (2.30 ft) above normal for this time of year and above the upper operating range of 260.5 m (854.8 feet).

Northern Manitoba and The Pas Regions

- Soil moisture is generally above normal throughout the Saskatchewan River Basin in Manitoba and Saskatchewan. Soil moisture in the Saskatchewan River basin in Alberta is near normal. The accumulated snowpack is below normal for most of the basin with higher accumulation near the Manitoba-Saskatchewan border. The peak open water level on the main stem of the Saskatchewan River at The Pas is expected to be below bank full level in the unfavourable weather scenario, although much will depend on future weather and the regulation of Saskatchewan's Tobin Lake outflows.
- Saskatchewan River potential flooding ranges from minor to moderate when considering all potential weather scenarios.
 - Favourable to normal weather: minor risk of flooding.
 - Unfavourable weather: moderate risk of flooding
- The Carrot River near Turnberry and the Red Deer River near Erwood are both tracking above normal streamflow conditions and under unfavourable weather may have a major risk of flooding.
- Swan River estimated flows and flooding:
 - Unfavourable weather: moderate risk of flooding.

Flood Preparations

- As a matter of standard practice in the lead-up to the spring flood season, the Manitoba government and municipalities are continuing to prepare for spring flooding. This includes work with municipal emergency management teams to review existing emergency response plans and sharing information through conference calls and flood-preparedness meetings.

- The ice-jam mitigation program north of Winnipeg will begin in February with ice cutters and Amphibex machines working along the Red River to weaken the ice. No river ice-cutting is complete at this time.

Future Forecast Information

A flood outlook will be published with updated information towards the end of February when further precipitation and other weather details are available. If the timing of the melt permits, an outlook will follow in March.

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, 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-100-yr flood, plus a freeboard allowance for a particular waterway (typically 2 feet) or water body (site specific).
- It is provided by the HFWM branch of MIT 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.
- In non 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 sever 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)
- Sever 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.