

Hydrologic Forecast Centre

Manitoba Infrastructure

Winnipeg, Manitoba

FEBRUARY FLOOD OUTLOOK REPORT FOR MANITOBA

February 28, 2019

Overview

The February Outlook Report prepared by the Hydrologic Forecast Centre of Manitoba Infrastructure reports variable flood risks across the province. Due to the normal to below normal soil moisture at freeze-up and above normal winter precipitation to the end of February, the Red River valley is at a high risk of major flooding. Minor to moderate flooding is expected in other areas of the province. This could change depending on weather conditions between now and the spring melt.

Most of the major lakes are near normal levels for this time of the year, and the risk for lake flooding is minor at this time. Flows and levels in most rivers are near normal for this time of the year.

Soil Frost Depth:

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

Soil Moisture Conditions at Freeze up:

Soil moisture is generally normal to below normal in all Manitoba basins. Southern Manitoba, including the Red River Valley and central and western Manitoba, are all within the normal to below normal range. Northern Manitoba, including the Pas Region, and eastern Manitoba are near normal.

Winter Precipitation:

Winter precipitation has been near normal to above normal throughout the Red River Valley, in the Souris River and Saskatchewan River basins. Winter precipitation has been below normal for most of the Assiniboine River watershed in Manitoba. Winter precipitation has been below normal for all other areas, including the Qu'Appelle River and the upper Assiniboine River basins in Saskatchewan, and the Interlake and northern Manitoba regions.

Future Weather:

Environment Canada's latest long term forecast for southern Manitoba and most of Saskatchewan shows an equal chance of below normal, near normal and above normal precipitation for the next three months. The forecast shows a slightly higher chance of above normal precipitation across northern Manitoba. It also shows there is a slightly higher chance of below normal temperatures throughout most of the Prairies for the next three months.

The United States National Weather Service's long term forecast shows an equal chance of above and below normal temperatures and precipitation across the Red and Souris River basins.

Runoff:

The potential for spring runoff is above normal for most of the southern Manitoba basins including the Red, the Assiniboine, the Souris, the Pembina and the Roseau River basins. The Qu'Appelle and upper Assiniboine River basins in Saskatchewan have below normal to normal runoff potential and the Saskatchewan River basin has normal to above normal runoff potential.

Flood Outlook:

The magnitude of the spring flood flows on Manitoba's rivers is still very dependent on weather conditions from now till the spring melt and during the spring melt period. The flood potential is significantly affected by the amount of additional snow and the spring rains; the frost depth at the time of runoff; the timing and rate of the spring thaw; and the timing of peak flows in Manitoba, the United States, Saskatchewan and Ontario. A late thaw and spring rainstorms could result in a rapid snow melt that increases overland flooding and the flows on tributary streams and the larger rivers . 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, which is a weather scenario that would result in a 1 in 10 chance of occurring. The preliminary outlook shows the risk of major flooding is high for the Red River and the Roseau River. The Assiniboine, Souris and Saskatchewan Rivers are at high risk of moderate flooding. The risk of flooding is low in other regions of the province including the Interlake region and the Whiteshell Lakes area.

Preparations:

The Manitoba government, municipalities and First Nations are continuing to prepare for spring flooding. This includes review of existing emergency response plans, information sharing, and preparation of resources used in flood response.

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Soil Moisture Conditions

The soil moisture analysis is based on summer and fall precipitation. The analysis indicates normal to below normal soil moisture for most of Manitoba and Saskatchewan, with the exception of parts of northwest Manitoba that has above normal soil moisture (Figure 1). The soil moisture is below normal in southern Saskatchewan, including the Qu'Appelle River and the upper Assiniboine River basins.

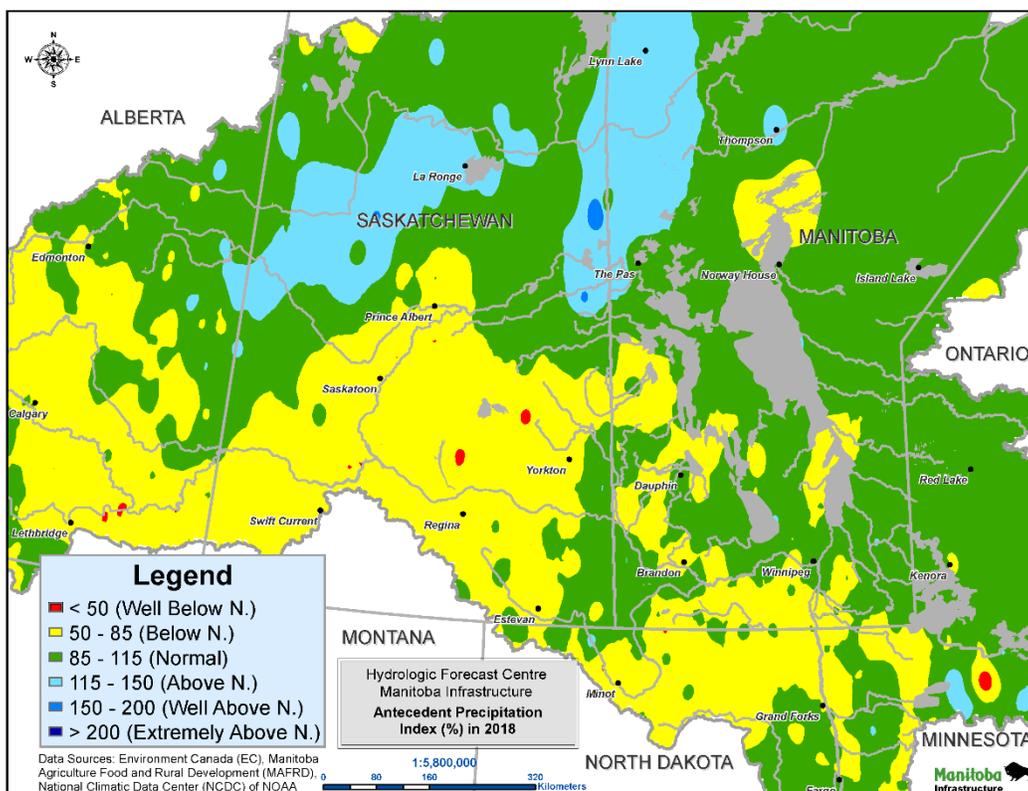


Figure 1 – Soil moisture expressed as Antecedent Precipitation Index (API) for the fall of 2018.

Soil Frost Depth

Soil frost depth is dependent on winter temperatures and the amount of snow cover insulation. The frost depth is variable across the watersheds, but is generally considered to be deeper than normal throughout most of the province.

Winter Precipitation & Snow Water Content

November to February precipitation has been near normal throughout southern Manitoba and below normal for the remainder of the province. The U.S. portion of the Red and Souris River basins have had above normal to well above normal winter precipitation. In Saskatchewan, the Qu'Appelle and Assiniboine River basins have had below normal precipitation and the Saskatchewan River basin has been normal to above normal (Figure 2).

Generally, southern Manitoba received 70 to 90 mm (2.8 to 3.5 inches) of precipitation from November 1, 2018 to February 23, 2019, while some local areas had slightly more (Figure 3). Most of the rest of the province received between 50 to 70 mm (2.0 to 2.8 inches) of precipitation. The Red River and the Souris River basins in the U.S. received 70 to 110 mm (2.8 to 4.3 inches). The Qu'Appelle and Assiniboine River basins in Saskatchewan received up to 70 mm (2.8 inches) and the Saskatchewan River basin generally received 50 to 90 mm (2.0 to 3.5 inches).

Snow water equivalent (SWE) estimates obtained from the gamma airborne survey and from mid-February field measurements (Figure 4) indicate that the average water content in the snowpack is 70 to 90 mm (2 to 2.8 inches) in most of southern Manitoba including most of the Assiniboine River watershed, and in the U.S. portions of the Red and Souris Rivers. The south-central part of Manitoba and the south-eastern portion of the Red River within the U.S. have 90 to 110 mm (3.5 to 4.3 inches) of snow water equivalent. Snow water content is 50 to 70 mm (2.0 to 2.8 inches) in central Manitoba and in the west lakes part of Manitoba.

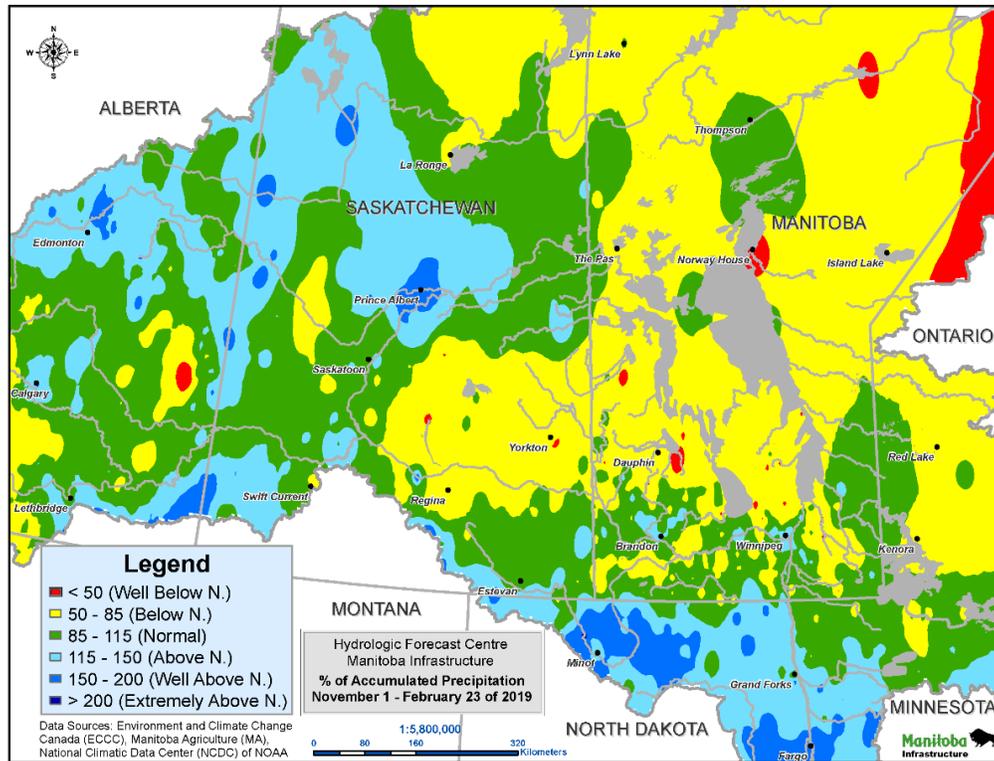


Figure 2 - Percent of Normal Precipitation from November 1, 2018 to February 23, 2019.

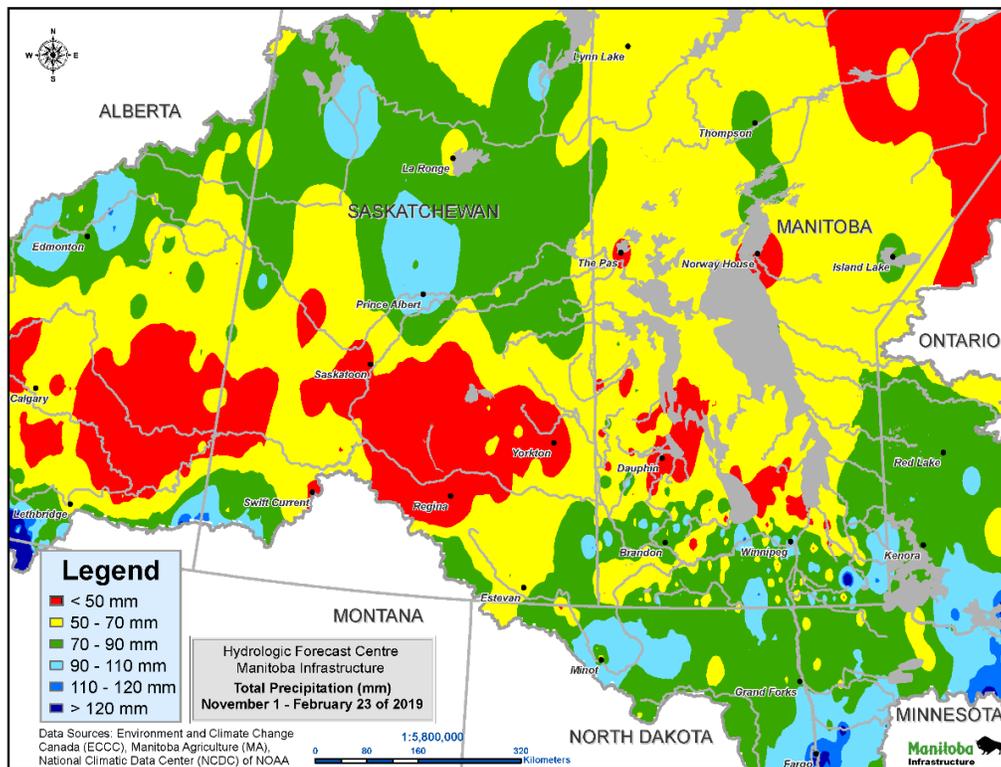


Figure 3 - Cumulative precipitation from November 1, 2018 to February 23, 2019.

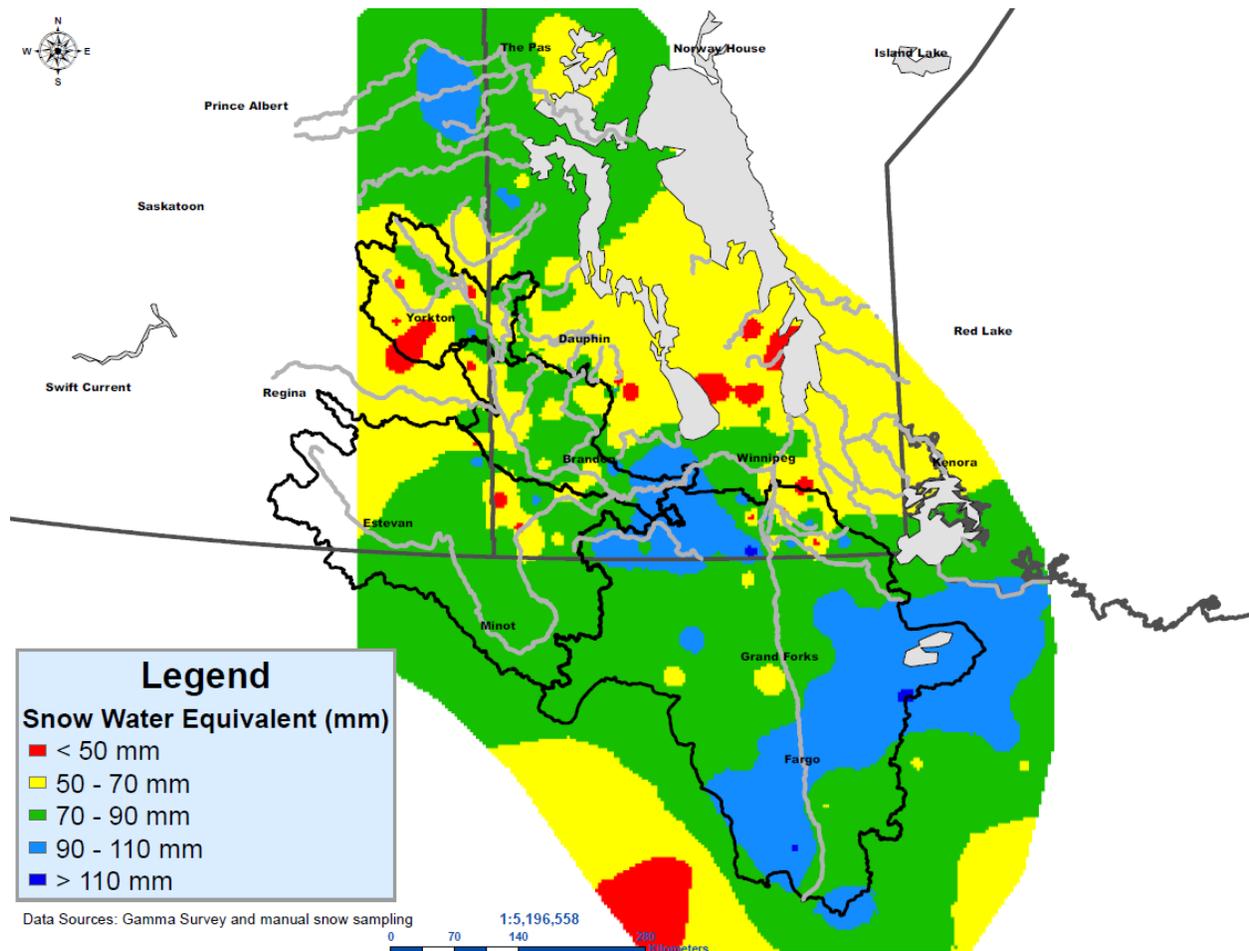


Figure 4 – Snow Water Equivalent (SWE) in mm from Gamma Survey and field measurements.

Lake Level and River Flow Conditions

Water levels and flows at freeze-up:

- Saskatchewan, Carrot, Dauphin and Fairford Rivers: above normal flows;
- Red, Assiniboine, Souris and Qu'Appelle Rivers: near normal flows;
- Lake Manitoba and Lake Winnipeg: below normal levels; and,
- Lake Winnipegosis, Dauphin Lake and Lake St. Martin: above normal levels.

Current river flow conditions:

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

Current lake water levels:

- The water levels on major lakes in Manitoba are near normal to above normal heading into the spring.

River Ice Conditions and Ice Jamming¹

The Red River currently has an above normal ice thickness. Based on February measurements this year, the ice thickness generally ranges between 56 cm (22 inches) and 102 cm (40 inches). However, in the vicinity of the channel connecting Netley Lake to the Red River, the ice was thicker at 81 cm (32 inches) to 102 cm (40 inches) (Figure 5). Normal ice thickness for this time of the year varies according to the river flow velocity and the location of the river; it typically ranges between 30 cm (12 inches) and 61 cm (24 inches).

Spring weather affects the timing and rate of the deterioration of the river 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 breaking activities currently underway on the Red River, the chance of ice jamming and related flooding on the lower Red River should be reduced.

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

¹ See Appendix A for 'Ice Jam' definition

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.

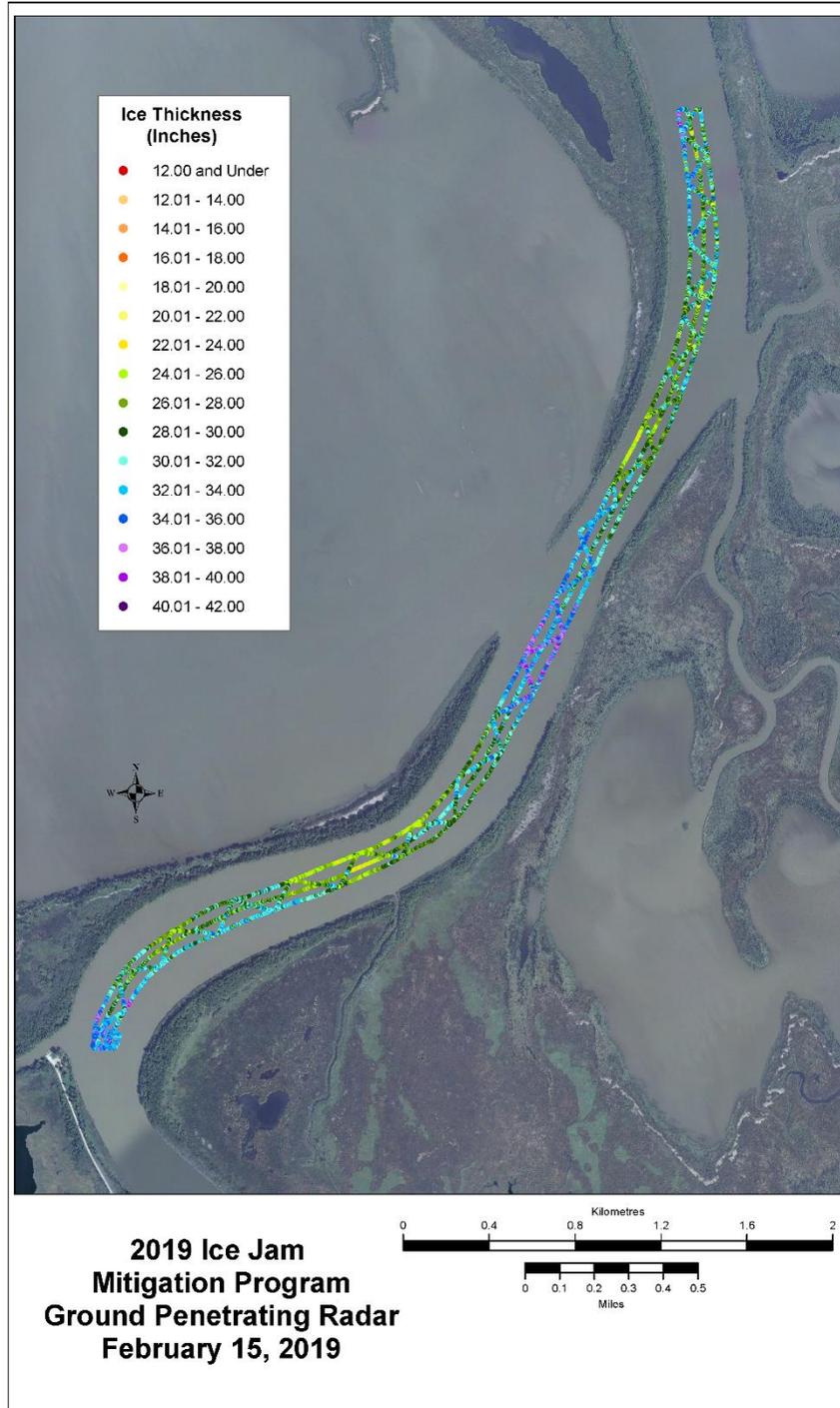


Figure 5 – Ice Thickness Measurements (inches) based on Ground Penetrating Radar: Red River

Flood Outlook²

Spring flood outlooks provide estimates of peak river flows and lake water levels that are based on current basin conditions, and three possible future weather scenarios. These weather scenarios are: favourable, normal, and unfavourable. These scenarios 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 extent of flooding is defined by three categories: major flooding, moderate flooding, and minor (no) flooding. Major flooding is associated with property damages and significant economic impacts. Moderate flooding is associated with flooding of agricultural lands and low-lying areas. In moderate flooding, economic impacts are limited because flood levels are below the tops of most roads and are well below the flood protection levels of community and individual flood protection works. Minor (no) flooding is associated with no or very limited overland flows and peak river water levels generally remain within the river banks.

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

- future weather uncertainties (snowfall and spring rainfall);
- winter snowpack, date of the 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.

² 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

Red River

- There is a high risk of major spring flooding along the Red River main stem. The current soil moisture condition varies from normal to below normal. Winter precipitation has been near normal to well above normal this year throughout the basin.
- In favorable weather conditions, the risk of flooding is low
 - Levels would be similar to spring peak levels observed in 2014 from Emerson to the Red River Floodway Inlet.
- Normal weather: high risk of moderate flooding
 - Levels would be similar to spring peak levels observed in 2011 from Emerson to the Red River Floodway Inlet.
- Unfavourable weather: high risk of major flooding
 - Levels on the Red River main stem would be similar to 2009 from Emerson to Red River Floodway Inlet
- The risk of moderate flooding is high for the Red River's tributaries, such as the La Salle, Rat and Morris Rivers.
- The flood protection level of the community dikes and the individual flood protection works within the Red River basin are higher than the predicted peak levels, even in the unfavourable weather scenario.

Red River Floodway

- The Red River Floodway has been operated in 32 out of the 50 years since it has been constructed for the purpose of providing flood protection to the City of Winnipeg.
- Due to the expected high flows on the Red River, there is a very high chance that the Floodway will be operated during the 2019 spring melt.
- The ice-induced peak at James Avenue is estimated to be between 6.1 m (20.0 feet) to 6.7 m (22.0 feet).
- Open water peak estimated levels at James Avenue are:
 - Favourable weather: 5.6 m (18.5 feet)
 - Unfavourable weather: 6.2 m (20.4 feet).

Pembina River and Roseau River

- There is high risk of moderate flooding on the Pembina River and high risk of major flooding on the Roseau River. Both basins have received near normal to above normal snowfall, but have below normal soil moisture.
 - Favourable weather: low risk of flooding.
 - Normal to unfavourable weather: high risk of moderate to major flooding.

Assiniboine River

- Moderate flooding is expected on the Assiniboine River due to normal to below normal soil moisture in the watershed and normal to below normal snow water equivalent in the snowpack.
 - Favourable weather: high risk of moderate flooding
 - Levels will be similar to 2015 levels from Shellmouth downstream to Brandon.
 - Levels will be less than 2009 levels from Brandon to Portage la Prairie.
 - Normal weather: high risk of moderate flooding
 - Levels will be less than 2014 spring levels from Shellmouth downstream to Brandon.
 - Levels will be similar to 1995 levels from Brandon to Portage la Prairie.
 - Unfavourable weather: high risk of moderate flooding
 - Levels will be slightly higher than 2014 spring levels from Shellmouth downstream to Brandon.
 - Levels will be similar to 2017 levels from Brandon to Portage la Prairie.
- The preliminary flood outlook for the Qu'Appelle River at St. Lazare shows a very low risk of flooding even under unfavorable weather conditions.

Portage Diversion

- The Portage Diversion has been operated 36 out of the 49 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 and the areas along the Assiniboine River downstream of Portage. 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 volumes into the Shellmouth reservoir for favourable, normal and unfavourable conditions are 210,000 acre-feet, 340,000 acre-feet and 490,000 acre-feet, 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 February 27th, 2019 is 425.24 m (1395.13 ft).
- The Shellmouth Liaison Committee provides regular input into the Dam 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 21 cms (cubic metres per second) (741 cfs (cubic feet per second)).

Souris River (South Western Region)

- Soil moisture within the Souris River basin is normal to below normal and snow accumulation is normal to above normal. Estimated flooding for the Souris River and its tributaries is as follows:
 - Favourable weather: high risk of moderate flooding downstream of Minot along the main stem of the Souris River.
 - Levels are expected to be generally similar to the 2013 spring levels.
 - Normal weather: high risk of moderate flooding downstream of Minot along the main stem of the Souris River.
 - Levels are generally expected to be between the 2013 and 2014 spring levels .
 - Unfavourable weather: high risk of moderate flooding downstream of Minot along the main stem of the Souris River.
 - Levels are expected to be generally similar to the 2017 spring levels.
 - The existing dikes in the towns of Melita, Souris, and Wawanesa are at an elevation which are high enough to protect against these flood levels.

Interlake Region

- Soil moisture is near normal throughout the Interlake region with below normal snow accumulation. There is low risk of flooding within the Interlake region.
- As in most years, the risk of ice jamming is high for the Icelandic and Fisher Rivers.

Fairford River Water Control Structure

- The flow through the Fairford River Water Control Structure is currently operating at 85% of maximum capacity. If and when the Lake Manitoba water level reaches 247.65 m (812.5 ft), the structure will be fully opened, in accordance with the operating guidelines.

Eastern Region

- The soil moisture is near normal and the accumulated snowpack is normal to below normal for the Eastern Region, including Winnipeg River. The potential risk of flooding is low in the eastern region.

Manitoba Lakes

- Currently, most major lakes are near normal to above normal levels. Inflow into most Manitoba lakes is normal to below normal. Therefore, most lakes are expected to be within their normal operating range after the spring runoff.

Lake Manitoba

- Lake Manitoba's current level is 247.36 m (811.55 ft).
- The current level is 0.08 m (0.26 ft) below normal for this time of year, and is within the operating range of 247.04 m (810.5 ft) to 247.65 m (812.5 ft).
- After spring runoff, the lake level is expected to be within the operating range under median to upper decile inflows.

Lake St. Martin

- Lake St. Martin is currently at 243.73 m (799.64 ft).
- The current level is 0.44 m (1.44 ft) above normal for this time of year.
- After spring runoff, the lake level is expected to be below flood protection works under median to upper decile inflows.

Lake Winnipeg

- Lake Winnipeg's current level is 217.30 m (712.93 ft).

- The current level is 0.04 m (0.13 ft) below normal for this time of year and within the operating range of 216.71 m (711 ft) to 217.93 m (715 ft).

Lake Winnipegosis

- Lake Winnipegosis is currently at 253.51 m (831.78 ft).
- The current level is 0.36 m (1.18 ft) above normal for this time of year.
- After spring runoff, the lake level is expected to be above the normal levels.

Dauphin Lake

- Dauphin Lake's current level is 260.40 m (854.33 ft).
- The current level is 0.08 m (0.26 ft) above normal for this time of year and within the operating range of 260 m to 260.5 m (853 ft to 854.8 ft).

Northern Manitoba and The Pas Regions

- Soil moisture is generally normal to above normal throughout the Saskatchewan River basin in Manitoba and below normal to above normal in Saskatchewan. Soil moisture in the Saskatchewan River basin in Alberta is normal to below normal. The accumulated snowpack is normal to above normal for most of the basin. . 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 this will depend on future weather and the regulation of Saskatchewan's Tobin Lake outflows.
- There could be moderate flooding along the Saskatchewan River when considering all potential weather scenarios.
- The Carrot River near Turnberry and the Red Deer River near Erwood are both tracking above normal streamflow conditions and under unfavourable weather could experience moderate flooding.
- Similarly, Swan River is also expected to experience moderate flooding under unfavourable weather conditions.

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 north of Winnipeg has commenced with ice cutters and ice breaking equipment working along the Red River to weaken the ice.

Future 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 and thickness 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 estimated future weather conditions.
- Is a contributing factor into flood outlook determinations.
- Described in comparison to normal historical runoffs (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. These are 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 (i.e., unfavourable) 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 conditions.

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:

- Is the water level of 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 (i.e., the freeboard is 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.
- In non Designated Flood Areas, the province uses the determined FPLs. For other works or developments, the FPL is recommended by the province, but ultimately regulated by the local planning districts and/or municipalities.

⁷Definition for minor/moderate/major flooding:

- Minor Flooding:
 - Minimal or no property damage is expected, but there is potential for some public impact, such as inundation of roads below the FPL⁷.
- Moderate Flooding:
 - Potential for flooding of agricultural and low-lying areas.
 - Flood water levels are expected to be below the FPL.
- Major Flooding:
 - Potential for extensive inundation of buildings, structures and roads below the FPL near drains, streams, rivers and lakes.
 - Flood water levels could exceed the FPL.
 - It likely will be required to evacuate some people and move movable property to higher elevations or safer locations.
 - Major highway closures associated with substantial economic impacts

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.