

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

**FIRST SPRING FLOOD OUTLOOK FOR MANITOBA
February 27, 2015**

Overview

The Hydrologic Forecast Centre of Manitoba Infrastructure and Transportation's first 2015 spring flood outlook reports a variable risk of potential flooding across the province.

This first outlook estimates the potential for overland flooding is normal to above normal in the western areas of the province and normal to below normal in the rest of the province. This could change depending on weather conditions between now and the spring melt. The second outlook at the end of March will further define the flood potential.

Most of the major lakes are well above normal levels for this time of the year, and the risk for potential flooding is above normal even under normal weather conditions. Flows and levels in most rivers are well above normal for this time of the year.

Runoff:

The potential for spring runoff is normal to above normal in the Assiniboine River basin, the Qu'Appelle River basin and the upstream watersheds of the Souris River basin. The potential for a spring runoff is below normal in the Red River basin, the Pembina River basin, the Roseau River and the Interlake region. The runoff potential is near normal in the Saskatchewan River basin and is normal to below normal throughout the rest of the province, including the Winnipeg River basin.

The potential for increased runoff in the Assiniboine, upper Souris and Qu'Appelle River basins is a result of above normal soil moisture content at freeze-up and normal to above normal snowpack water content. The Red River valley has experienced normal to below normal soil moisture conditions and well below normal precipitation, resulting in a low risk of flooding.

Frost in Soil:

Due to the extreme cold weather and lack of sufficient snow cover on the ground, frost depth is above normal in the Red River valley. Frost depth is near normal throughout the remainder of the province. Generally, above normal frost depth means that frozen soil cannot absorb melting water and could result in overland flooding.

Soil Moisture Conditions at Freeze up:

- Southern Manitoba including the Red River Valley: below normal
- Western Manitoba and Eastern Saskatchewan: above normal
- Interlake and northern Manitoba regions, including The Pas region: near normal
- Eastern Manitoba: near normal

Winter Precipitation:

Winter precipitation is below normal to well below normal throughout the central and southern portions of the province including the Red River basin, the Winnipeg River basin, Interlake region and the downstream watersheds of the Souris River and the Assiniboine River.

It is near normal to above normal in eastern and southern portions of Saskatchewan including the headwaters of the Souris River, the Assiniboine River and the QuAppelle River. Winter precipitation is above normal to well above normal in central and western Saskatchewan, including the Saskatchewan River watershed.

Ice Jams:

When warmer temperatures arrive and runoff starts, there is a chance of localized flooding due to ice jams or snow blockages in drains, ditches and small streams. Major ice jams are difficult to predict as to location and magnitude and cannot be ruled out. On most major rivers, ice thickness is above normal for this time of the year due to lack of sufficient snow cover to provide insulation and inhibit freezing.

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

The North Red Community Water Maintenance Corporation will be focusing this year's ice jam mitigation program on the north Red, Assiniboine, Icelandic, Brokenhead and Fisher Rivers as well as the Portage Diversion to reduce the potential of ice jams.

The Amphibex icebreakers and ice cutters will be focusing this year's ice-jam-mitigation program on the north Red, Assiniboine, Icelandic, Brokenhead and Fisher rivers, as well as the Portage Diversion. On the Red River, the Amphibex fleet has already broken a seven-kilometre channel down the centre and 15.5 km of ice have been cut, slightly more than this time last year.

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.

Flood Outlook:

The potential for overland flooding is normal to above normal on the Assiniboine River, the Qu'Appelle River, the Saskatchewan River and the headwaters of the Souris River due to normal to above normal water content in snow and above normal soil moisture levels at freeze-up. The potential for overland flooding is below normal in the Red River basin, the Pembina River basin, the Roseau River and the Interlake region. The potential for overland flooding is normal to below normal for the Winnipeg River basin and near normal for the rest of the province.

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 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 unfavourable weather conditions, the worst case scenario. The outlook shows the risk of overland flooding for the unfavourable weather scenario in the following watersheds:

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

Preparations:

The Manitoba government and municipalities 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.

Provincial flood-fighting equipment includes:

- 2.5 million regular sandbags;
- six sandbag-making machines;
- 19,900 super sandbags;
- 32.5 km of Hesco cage barriers, into which sand or other heavy material is placed;
- nearly 67 km of water-filled barriers, of which 35.3 km are in rapid-response trailers;
- a total of 34 pumps;
 - 17 of which are heavy duty pumps used to move large volumes of flood water;
 - the remainder are part of mobile trailers kits used to fill water barriers, and
- 61 heavy-duty steamers.

Manitoba continues to work with stakeholders across the Assiniboine River basin through the newly formed Assiniboine River Basin Initiative. Representatives from the Manitoba government, Keystone Agricultural Producers, the Association of Manitoba Municipalities and Manitoba Conservation Districts Association will join other stakeholders for a meeting next week in Moosomin, Saskatchewan. The goal is to discuss options and solutions to common concerns such as drainage, flooding, water quality and drought.

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Soil Moisture Conditions

As previously outlined in the 2014 Fall Conditions Report, the soil moisture analysis based on weighted May to October precipitation indicates normal to above-normal conditions for south-western Manitoba, and above-normal conditions throughout much of southern Saskatchewan. The soil moisture is below-normal for the Red River basin and near-normal for the rest of the province (Figure 1 and Figure 2). The Assiniboine River, the Qu'Appelle River and the Souris River basins have observed similar soil moisture as that recorded in the Fall of 2010. This may be significant, as this high level of ground saturation was an important attributing factor to the major flooding in the spring of 2011.

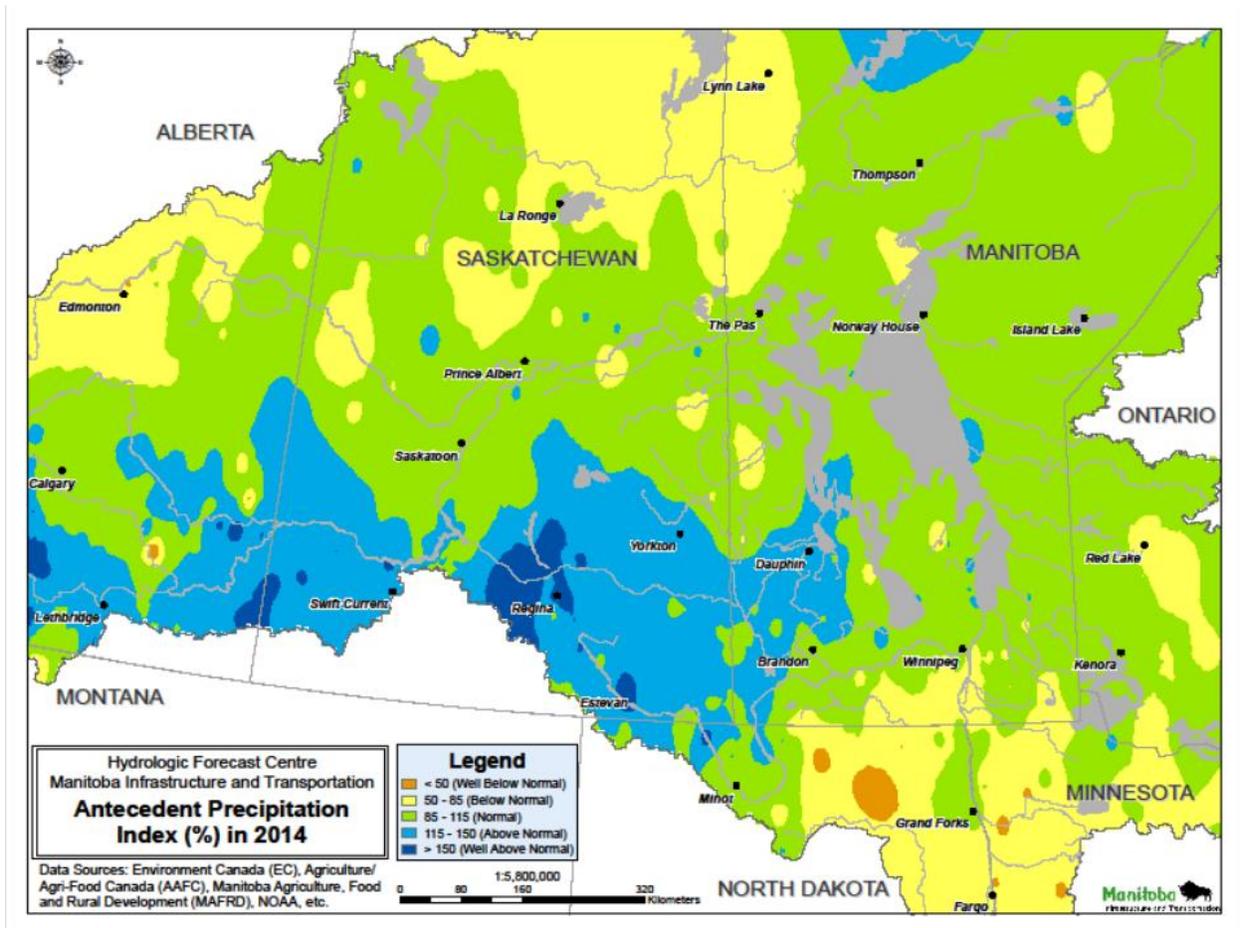


Figure 1 - Antecedent Precipitation Index (API) for the Fall of 2014.

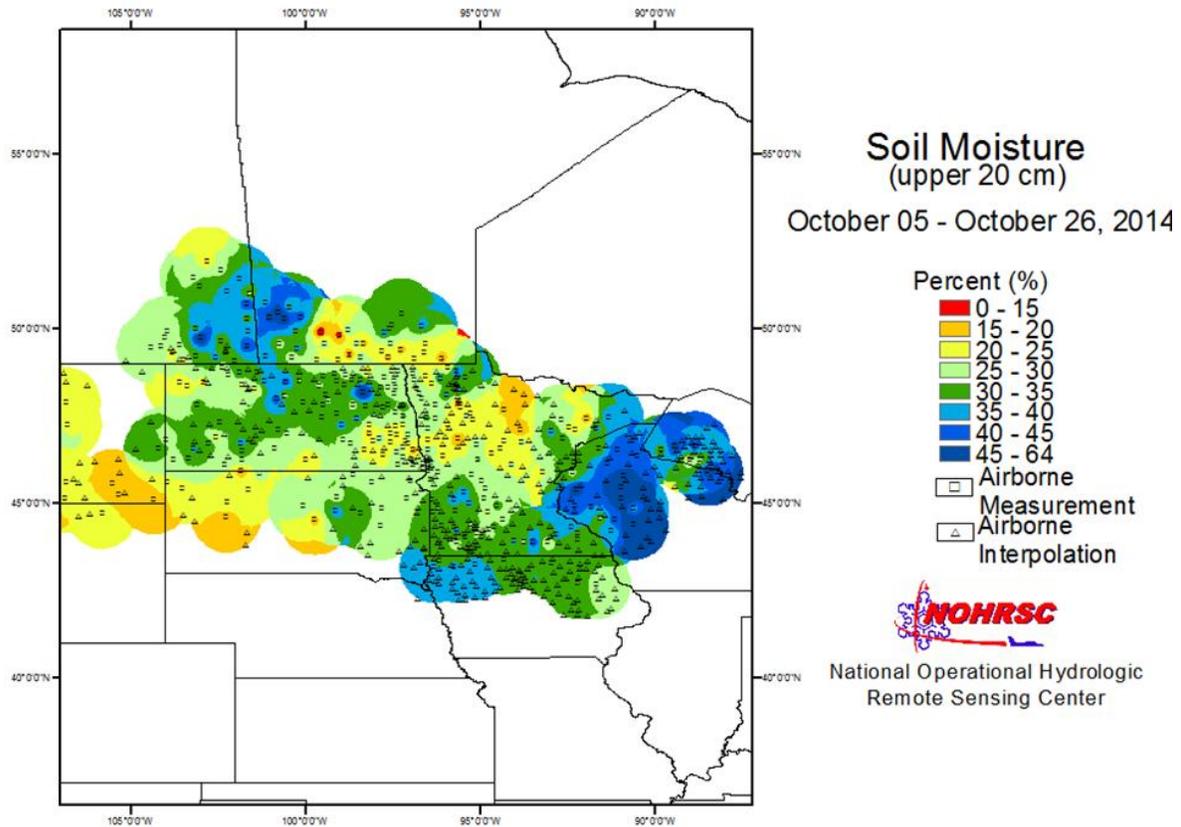


Figure 2 - Gamma Survey derived soil moisture (in the upper 20 cm of soil) from October 5 - October 26, 2014.

Frost Depth

Frost depth information is sparse and highly variable across the watersheds. Frost depth is deeper than normal in the Red River, the Pembina River and Roseau River watersheds mainly due to periods of well below freezing temperatures. Frost depth is generally normal for the rest of the province. Modeled frost depths range from ~1.7 m (5.6 feet) to ~2.16 m (7.1 feet).

Snowpack Conditions & Snow Water Content

November to February snowfall has been below normal to near normal in most areas of Manitoba, with the exception of the U.S. and Manitoba portions of the Red River basin, which show well below normal snow accumulation. Conversely, southern Saskatchewan and The Pas region have experienced normal to above normal snowfall, increasing to well above normal conditions throughout portions of central and western Saskatchewan. Alberta displays highly variable accumulated snowfall, ranging from below

normal to well above normal throughout the center and southern portions of the province (Figure 3 and Figure 4).

Based on mid-February field observations (Figure 5), the average water content in the snowpack in the upper Assiniboine is 55 mm (2.2 inches) (observations range between from 20 mm to 100 mm), 60 mm (2.4 inches) in northwestern parts of Manitoba (including The Pas region) and into northeast Saskatchewan (observations range between 35 mm to 80 mm), 40 mm in the Interlake region (observations range from 20 mm to 65 mm), and 25 mm (1.0 inch) in the Red River basin (observations range from 0 mm to 75 mm). Environment Canada’s SSM/I satellite-derived SWE (snow water equivalent) mapping for the Canadian Prairies is in general agreement with the aforementioned field observations (Figure 6a).

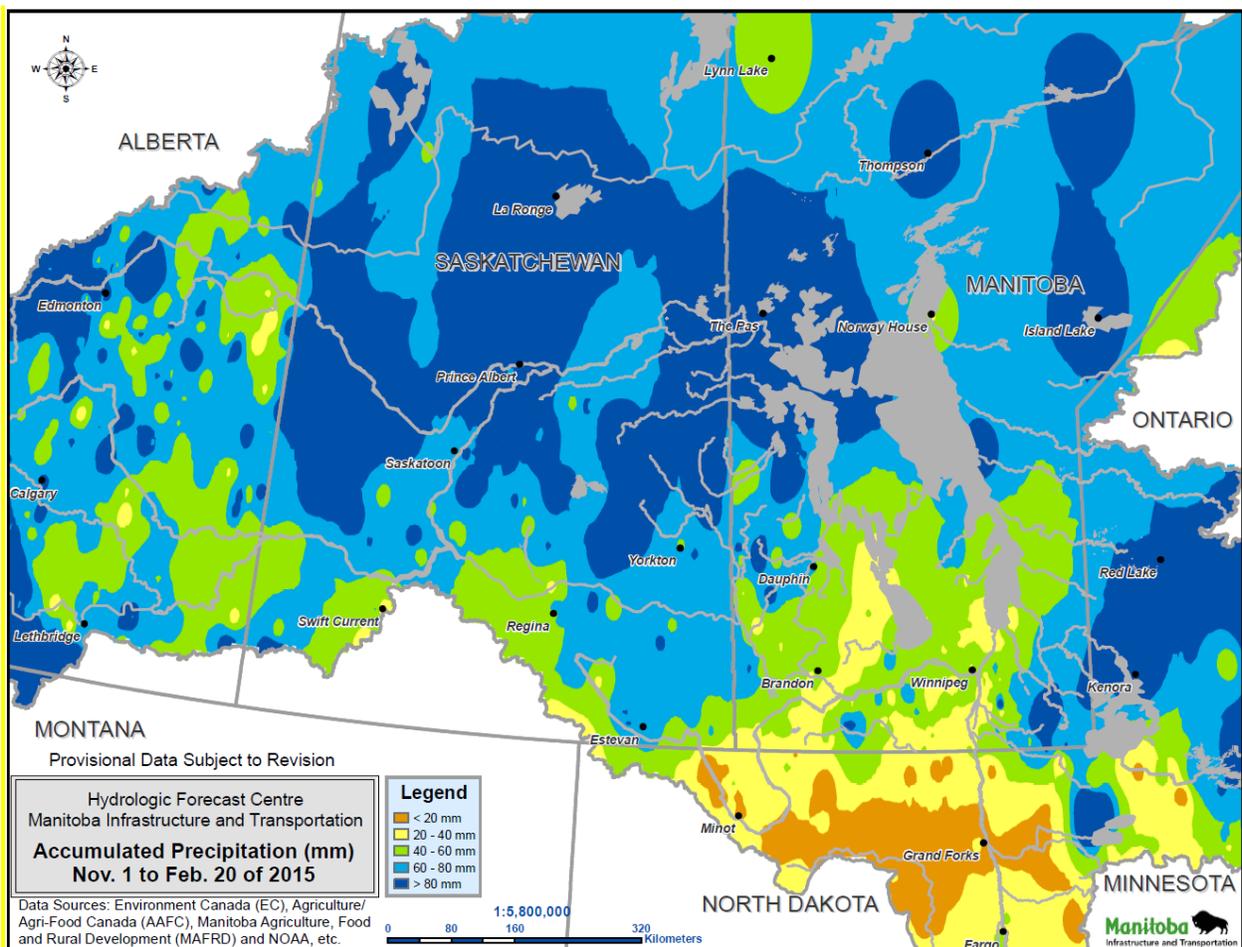


Figure 3 - Accumulated precipitation between November, 2014 to February, 2015.

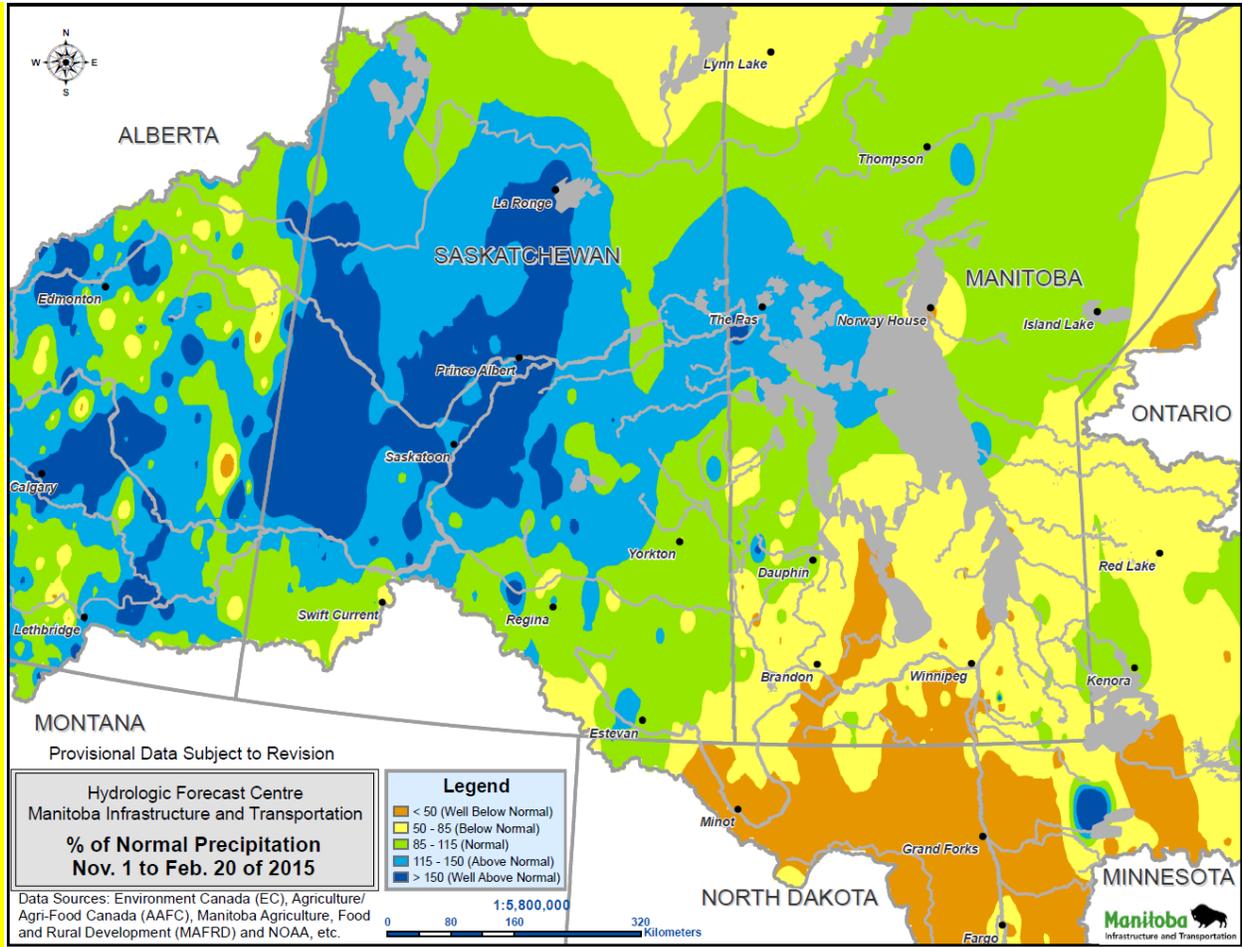


Figure 4 - Percent of Normal Precipitation from November, 2014 to February, 2015.

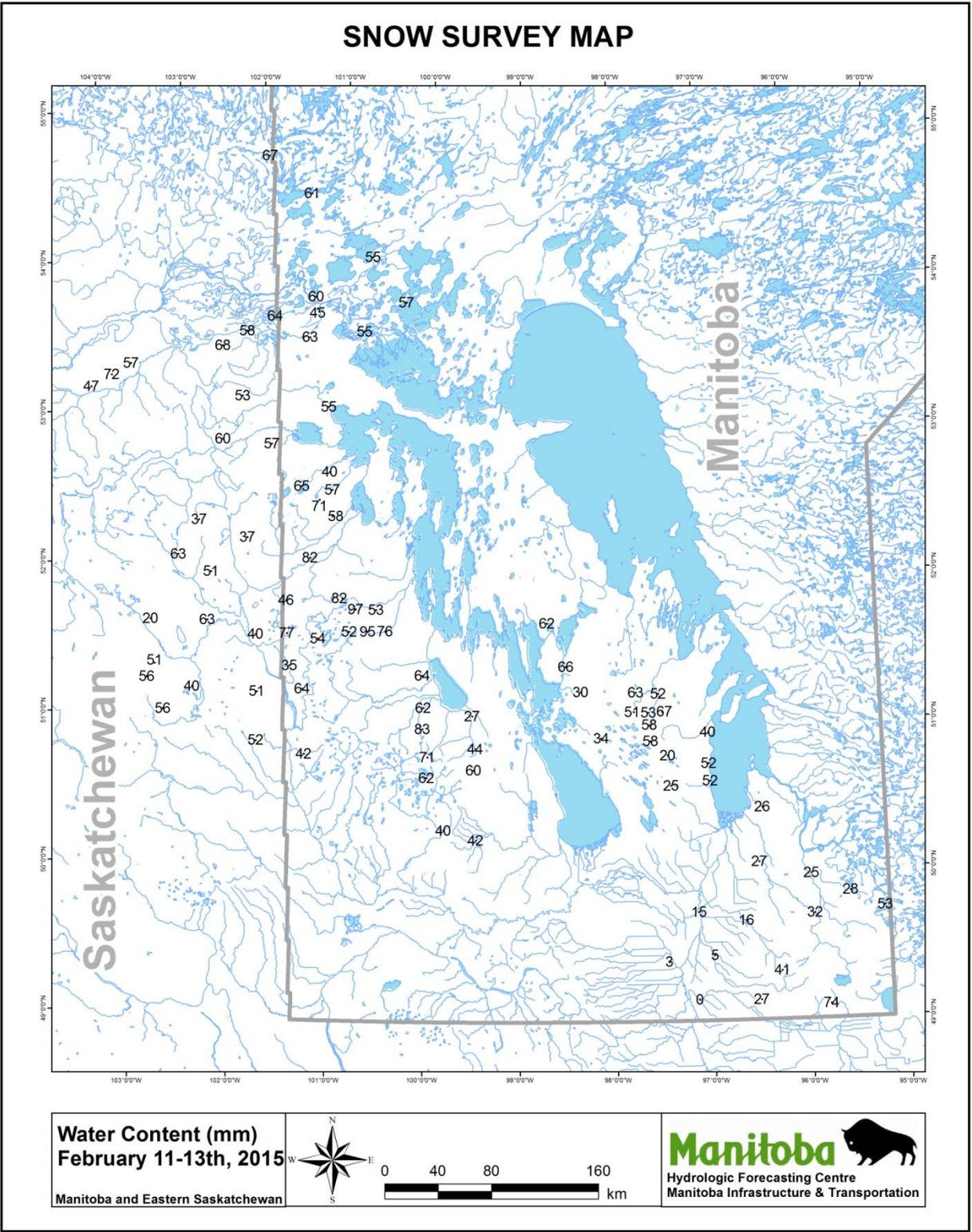


Figure 5 - February 11th – 13th, 2015 snow survey results in millimetres of water content.

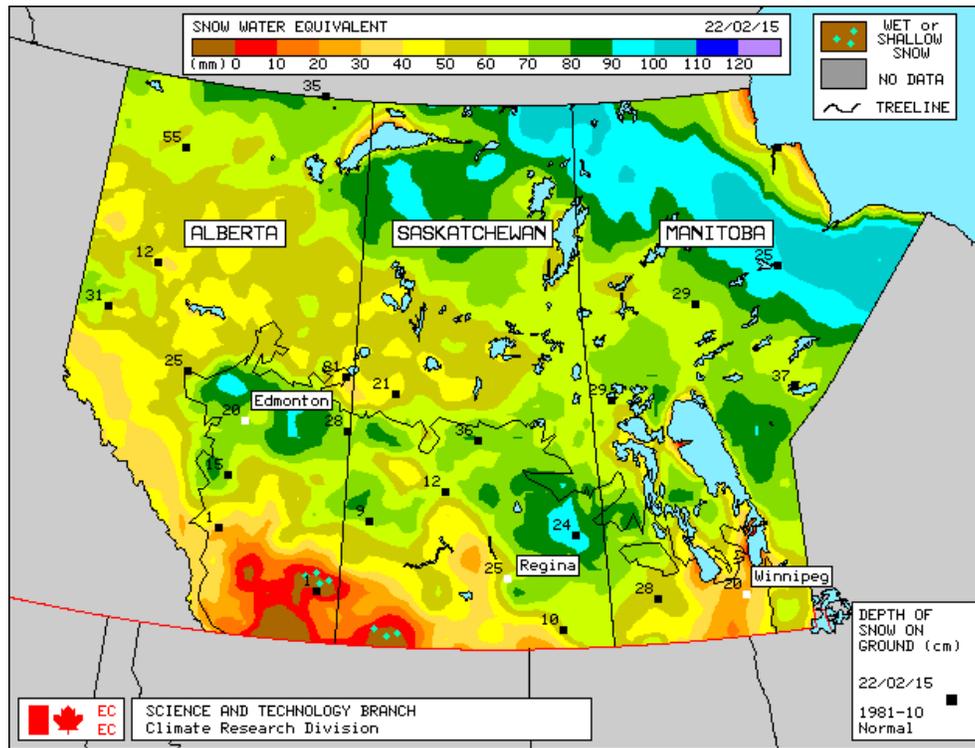


Figure 6 - Environment Canada satellite-derived snow water equivalent (SWE) for February 22nd, 2015.

Lake Level and River Flow Conditions

Water levels/flows at freeze-up:

- Assiniboine, Souris, and Qu'appelle Rivers: well above normal;
- Red River: near normal; and,
- Major lakes, such as Dauphin, St. Martin, Winnipegosis, Manitoba, and Winnipeg: well above normal levels.

Current river flow conditions:

- Red River, Roseau River, Pembina River: generally flows are normal or near normal for this time of year;
- Northern Rivers (including Red Deer, Saskatchewan, and Carrot Rivers): flows are near normal to above normal for this time of year;
- Assiniboine River, Souris River, Qu'Appelle River: flows are well above normal for this time of year; and,

- Interlake major rivers (including the Waterhen, Fisher, and Fairford Rivers): flows are well above normal for this time of year.

River Ice Conditions and Ice Jamming¹

The Red River has thicker than normal ice cover due to periods of well below freezing temperatures and lower than normal snow cover. A lack of snow cover results in a lack of insulation for the ice, and therefore enhanced ice thickening. Based on late-February measurements this year, ice thickness ranged between 66 cm (26 inches) and 107 cm (42 inches). Normal ice thickness varies according to the size and the location of the river and typically ranges 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 extensive ice cutting and the Amphibex ice breaking activities ice jamming and related flooding on the lower Red River will be reduced.

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

Runoff Potential²

The expected 2015 spring runoff potential (Figure 7) is based on:

- 2014 measurements of soil moisture at freeze up;
- Snowpack conditions as of mid-February 2015; and,
- The average future weather conditions.

The runoff potential is variable across Manitoba and Saskatchewan, with striking differences between the Assiniboine, Souris, and Qu'Appelle systems in the west and the Red River system in the south. The runoff potential is described for the following areas:

- Red River Basin: below to well below-normal;
- Pembina River: below-normal;
- Southeastern Manitoba: near-normal;

¹ See Appendix A for 'Ice Jam' definition

² See Appendix A for 'Runoff Potential' definition

- Upper Assiniboine River basin: near-normal to above-normal conditions upstream of Shellmouth Reservoir;
- Qu'Appelle River basin: primarily above-normal;
- Canadian portion of the Souris River basin: near-normal to above-normal conditions in the headwater region, near-normal at the confluence with the Assiniboine River;
- U.S. portion of Souris River basin: near-normal to below-normal;
- Interlake Region: primarily below-normal;
- Northern Manitoba: generally near-normal;
- North West (including the northern areas of Lake Winnipegosis, The Pas): below-normal to near-normal; and,
- Regions to the east of Lake Winnipeg (including Berens River) and Island Lake area: below-normal to near-normal.

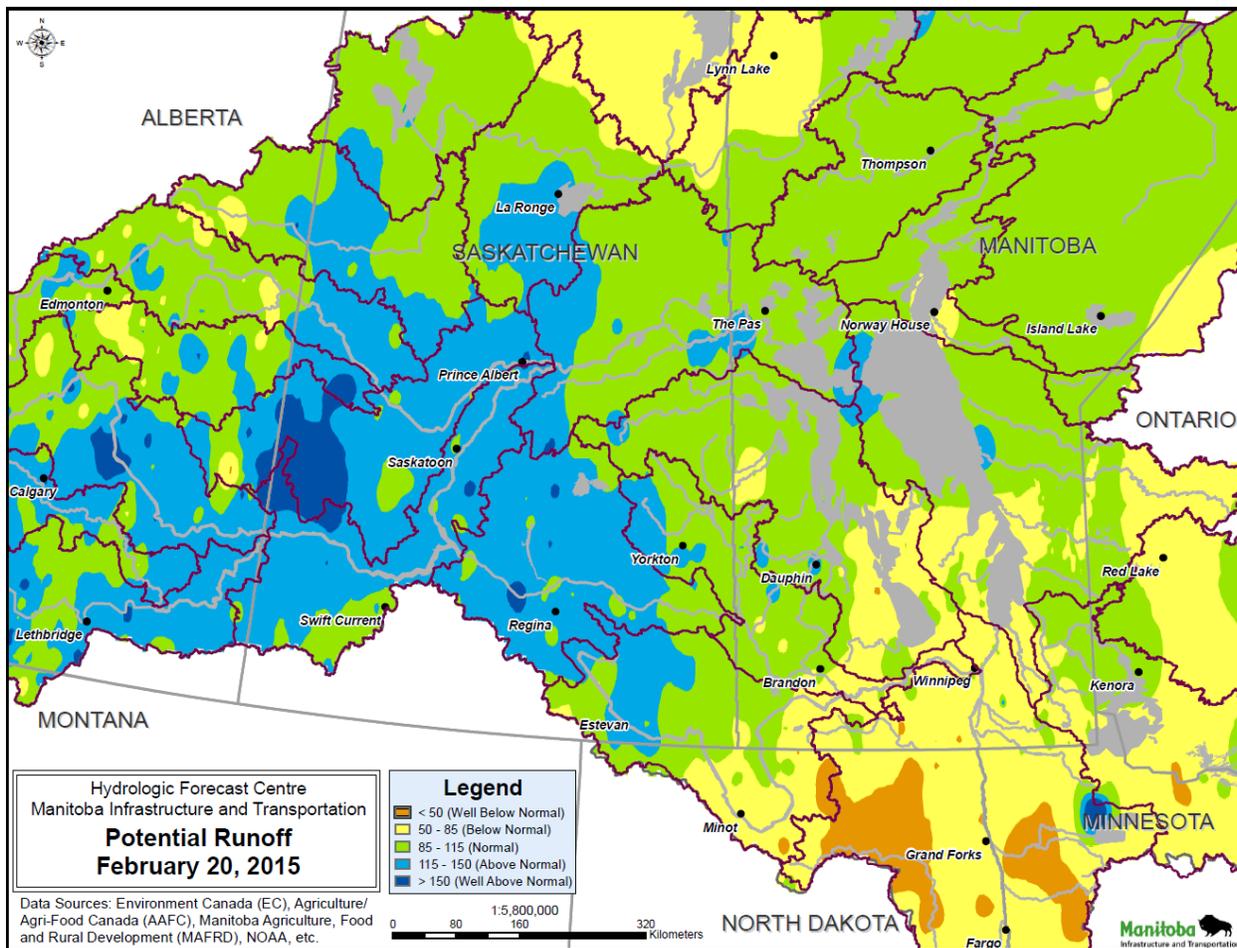


Figure 7 – Runoff Potential as of February 20th, 2015.

Flood Outlook³

Spring flood outlooks are estimated peak water levels and flows that are based on multiple sources of information. They are 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 to the upper decile condition. For further information see Appendix A: Definitions.

The risk of potential flooding is described by four categories: minor, moderate, major and severe.⁴

Numerous uncertainties exist with respect to this preliminary flood outlook. These include, but are not limited to the following³:

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

⁴ See Appendix A for ‘Minor Flooding’, ‘Moderate Flooding’, ‘Major Flooding’ and ‘Severe Flooding’ definitions

- Future weather uncertainties;
- 2015 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; and,
- Model prediction uncertainty.

Red River

- The potential for spring flooding on the Red River main stem remains minor for all weather scenarios due to normal to below normal soil moisture and well below normal snowpack water content throughout most of the basin.
- Favourable weather: minor risk of flooding
 - Levels would be slightly lower than spring melt levels observed in 1991 from Emerson to Ste. Agathe.
- Normal weather: minor risk of flooding
 - Levels would be slightly higher than spring melt levels observed in 2003 from Emerson to Ste. Agathe.
- Unfavourable weather: minor risk of flooding
 - Levels on the Red River main stem would be similar to 2008 from Emerson to Ste. Agathe.
- There is a minor 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 flows.

Red River Floodway

- The Red River Floodway has been operated for 31 out of the 46 years it has been constructed for the purpose of providing flood protection to the City of Winnipeg. However due to well below normal conditions throughout the basin, there is a less than 5% chance that the Floodway will be operated during the 2015 spring melt.
- The ice-induced peak at James Avenue is estimated between 3.4 m (11.3 feet) to 4.75 m (15.6 feet).
- Open water estimated levels at James Avenue are:
 - Favourable weather: 3.0 m (9.8 feet)
 - Unfavourable weather: 4.5 m (14.9 feet)

Pembina River and Roseau River

- The potential for spring flooding is minor on the Pembina and Roseau Rivers due to below normal soil moisture conditions and well below normal accumulated precipitation.
- Favourable to normal weather: minor risk of flooding.
 - Levels will be less than those experienced in 2012.
- Unfavourable weather: minor risk of flooding.
 - Levels will be less than those experienced in 2010.

Assiniboine River

- Flood risk ranges from minor to major due to above normal to well above normal soil moisture in the upper portions of the watershed and snow water equivalent ranging from near normal to above normal.
 - Favourable weather: minor risk of flooding
 - Levels will be slightly higher than 2008 from Shellmouth downstream to Holland.
 - Normal weather: moderate risk of flooding
 - Levels will be slightly lower than 2003 from Shellmouth to Miniota, and slightly above 2003 between Miniota to Holland.
 - Unfavourable weather: major risk of flooding
 - Levels will be slightly higher than 2005 from Shellmouth to Miniota, and similar to 2005 levels between Miniota to Holland.
 - Brandon flood protection levels are adequate for this scenario.
- The flood outlook for the Qu'Appelle River at St. Lazare:
 - Favourable weather: minor to moderate risk of flooding
 - Normal weather: moderate risk of flooding.
 - Unfavourable weather: major risk of flooding.
 - St Lazare flood protection levels are adequate.

Portage Diversion

- The Portage Diversion has been operated 33 out of the 45 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. The possibility of operating the Portage Diversion cannot be ruled out at this time.

Shellmouth Dam

- 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 is 423.85 m (1390.6 feet). The Shellmouth Liason Committee is continuing to manage operations to meet the summer target level of 427.5 m (1402.5 feet). The current outflow from the reservoir is 853 cfs (cubic feet per second).
- Level could reach the spillway crest under unfavourable weather conditions.

South West Region

- Although snow accumulation within the Souris River basin ranges between normal to below normal, soil moisture within the Canadian portion of the basin is considered to be above normal conditions. Estimated flooding for the Souris River and its tributaries is as follows:
 - Favourable weather: minor risk of flooding
 - Levels are expected to be slightly higher than 2003 levels at Wawanesa.
 - Normal weather: minor to moderate flood risk downstream of Minot along the main stem.
 - Levels are generally expected to be similar to 1992 levels at Wawanesa.
 - Unfavourable weather: moderate flood risk downstream of Minot along the main stem.
 - Levels are expected to be slightly lower than 2001 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 near normal throughout the Interlake region with below normal snow accumulation; however flows are well above normal for this time of year. 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

- Fairford Control Structure flows are well above normal and will remain at maximum discharge through the spring runoff period.

Eastern Region

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

Manitoba Lakes

- Current lake levels are provided with indication of how levels are trending with long-term average levels. Further forecast information for lake levels will be provided in the March Spring Flood Outlook. Currently, all major lakes are well above normal levels.

Lake Manitoba

- Lake Manitoba's current level is 247.83 m (813.1 feet).
- The current level is well above normal for this time of year, and is outside the operating range of 247.0 m (810.5 feet) to 247.7 m (812.5 feet).

Lake St. Martin

- Lake St. Martin is currently at 244.45 m (802 feet).
- The current level is 1.05 m (3.46 feet) above normal for this time of year.

Lake Winnipeg

- Lake Winnipeg's current level is 217.73 m (714.35 feet).
- The current level is 0.38 m (1.26 feet) above normal for this time of year, however is still within the operating range of 216.71 m (711 feet) to 217.93 m (715 feet).

Lake Winnipegosis

- Lake Winnipegosis is currently at 253.85 m (832.84 feet).
- The current level is 0.69 m (2.27 feet) above normal for this time of year.

Dauphin Lake

- Dauphin Lake's current level is 260.69 m (855.28 feet).
- The current level is 0.44 m (1.44 feet) above normal for this time of year, but within the upper regulation range is 260.5 m (854.8 feet).

Shoal Lakes

- The Shoal Lakes current level ranges from 261.6 m (858.28 feet) on North Shoal Lake to 261.67 (858.50 feet) on East Shoal Lake.
- These current levels are ~1.34 m (4.4 feet) above normal for this time of year.

Whitewater Lake

- Whitewater Lake's current level is 497.65 m (1632.7 feet).
- The current level is 1.4 m (5 feet) above normal for this time of year.

Northern Manitoba and The Pas Regions

- Soil moisture is generally normal throughout the Saskatchewan River Basin, with regions of below normal conditions in central Alberta, and above normal conditions in southern Alberta and Saskatchewan. However, the accumulated snowpack is above normal to well above normal throughout much of the basin, with the exception of some areas within Alberta and south western Saskatchewan. 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 major when considering all potential weather scenarios.
 - Favourable to normal weather: minor risk of flooding.
 - Levels will be similar to 2002 levels
 - Unfavourable weather: minor to moderate risk of flooding
 - Higher flood potential exists in the upstream portions of the basin due to well above normal snow accumulation in these areas.
 - Levels will be similar to 2010 levels
- 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 moderate risk of flooding.
- Swan River estimated flows and flooding:
 - Unfavourable weather: moderate risk of flooding.

Flood Preparations

- 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 has begun with ice cutters and Amphibex machines working along the Red River to weaken the ice. Approximately 14 km of river ice-

cutting is complete and the Amphibex have broken a channel approximately 6 km long down the center of the river.

Future Forecast Information

- A second flood outlook will be published with updated information in late 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, 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 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.

⁷ FPL:

- 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 designated flood areas.
- In non DFA area, the FPL is recommended by the Province, but ultimately regulated by the local planning districts and/or municipalities.