# 2020 Manitoba Basins Fall Conditions Report

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**Date:**

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# EXECUTIVE SUMMARY

The Fall Conditions Report describes the hydrologic conditions of Manitoba basins at the time of freeze-up. Hydrologic conditions at the time of freeze-up and weather conditions in the winter and spring are the main factors that affect the risk and extent of spring flooding. This Fall Conditions Report describes the current state for various hydrologic factors for which data is available at the time of reporting. The two known factors covered in this report are the soil moisture at the time of freeze-up and base flows in rivers and water levels on lakes prior to freeze-up. Long term forecasted winter precipitation is also discussed as a general indication of probable future weather.

*Summer and Fall Precipitation*

The amount of summer and fall precipitation is the main factor that determines the amount of soil moisture at freeze-up. Following above average rainfall in most Manitoba basins in the months of June and July, most river basins in southern and central Manitoba received below normal to well below normal precipitation between August and October. In general, precipitation recorded between May and October was near normal to below normal in southern and central Manitoba and normal to above normal in northern Manitoba. Near normal precipitation occurred in localized areas near Brandon and parts of southeast Manitoba during this time. The Red River basin in the U.S. also received near normal summer and fall precipitation.

*Soil Moisture at Freeze-up*

Soil moisture at freeze-up is one of the major factors that affects spring runoff potential and spring flood risk. Due to normal to below normal summer and fall precipitation, the soil moisture at freeze-up is normal to below normal for most of southern, central and western Manitoba basins. Soil moisture is normal to above normal in the Little Saskatchewan River basin and in areas close to Brandon. Soil moisture is near normal to below normal in southeast Manitoba, including the Whiteshell Lakes area, and the Red River basin in the U.S. Soil moisture is normal to below normal in the Souris River basin. Northern Manitoba basins, including the Saskatchewan River and Churchill River basins, have normal to above normal soil moisture. Above normal soil moisture indicates a higher risk of spring flooding within these river basins, but flooding is still

strongly dependent on future weather conditions, including the amount of winter and spring precipitation, as well as melt conditions.

*River Flows and Lake Levels*

Another factor that affects the spring flood risk is the base flow in rivers and the water levels on lakes prior to freeze-up. Base flow is a portion of the stream flow that is not from surface runoff; it is water from the ground, flowing into the river channel over a period of time. Higher base flows and water levels indicate a higher risk of spring flooding, as there is more water already in the system before spring runoff occurs. Base flows on most rivers are normal to below normal for this time of the year, with the exception of northern Manitoba rivers where base flows are well above normal to record high.

Lake Manitoba and Lake Winnipeg are both within their respective operating ranges. Lake Winnipegosis and Lake St. Martin are lower than normal for this time of the year while Dauphin Lake is near normal. The inflow into Lake of the Prairies (Shellmouth Reservoir) is tracking near normal conditions for this time of the year. The Shellmouth dam is being operated in consultation with the Shellmouth Reservoir Regulation Liaison Committee (SLC) to draw down the reservoir to create sufficient storage for spring runoff.

*Long-term Precipitation Outlook*

Winter precipitation is another factor for spring runoff potential and flood risk. Although long-term weather forecasts are not very reliable, they provide an indication of potential future snowfall amounts. Environment and Climate Change Canada's December long-term precipitation forecast indicates precipitation will be normal to above normal from December to February for most of Manitoba and Saskatchewan. The National Weather Service (NWS) Climate Prediction Center's outlook indicates above normal precipitation within the U.S. portion of the Red River and the Souris River basins from December to March.

*Forecasted Winter Flows and Levels*

The Fall Conditions Report also contains forecasted flows on major rivers and forecasted water levels on major lakes for near normal winter weather conditions prior to the spring runoff. The Assiniboine River is forecasted to maintain near normal to slightly below normal flows until the spring runoff. Flows and levels on the Assiniboine River are affected partly by the sustained

release of outflows from the Shellmouth Reservoir, which is being drawn down to provide room for spring runoff. The Red River is expected to remain near normal flows and levels in the period prior to the spring runoff. Flows on the Waterhen River, Fairford River, and Dauphin River will remain below normal. Lake Manitoba is expected to remain near 811.0 ft throughout the winter. Lake Winnipegosis will remain near 830.5 ft throughout the winter. Lake St Martin is expected to reach near 798.0 ft before the spring runoff. Lake Winnipeg is forecasted to be between 713.0 ft and 713.5 ft by March 31, 2021.

The Hydrologic Forecast Centre (HFC) of Manitoba Infrastructure works in collaboration with Environment and Climate Change Canada, the National Weather Service (NWS), and flood forecasters in neighbouring jurisdictions to regularly monitor the winter precipitation patterns throughout Manitoba basins.

At this point in time, it is not practical or feasible to provide a reliable long-term flood forecast for spring 2021 as conditions could change significantly during the coming months. Areas with above normal soil moisture conditions and above normal base flow and lake water level conditions indicate a higher risk of spring flooding. However, with less winter or spring precipitation, or if a slow snowmelt rate were to occur, the risk of spring flooding would decrease. Conversely, the risk of spring flooding could increase if heavy winter precipitation occurs, or if a fast snowmelt rate or heavy rainfall were to occur in early spring.

Looking back at some of the most significant historic flood events, each flood is caused by a combination of unique circumstances. There is an inherent risk of over-estimating or under-estimating the flood potential if one considers the conditions and available precipitation four months in advance of the spring runoff. The Hydrologic Forecast Centre will continue to monitor watershed conditions closely and will release spring flood outlooks through the winter as required.

## BACKGROUND

The spring runoff potential is generally dependent on six major factors:

1. Soil moisture at freeze-up;
2. Base flow conditions;
3. Winter precipitation (snow accumulation);
4. Depth of frost;
5. Effective spring rain (April rainfall); and
6. Rate of melting.

All of the above factors combine to determine the magnitude of spring runoff, which could range from an extremely low runoff event to a major flood event. The combination of these factors is generally unique for each year and for each specific watershed across the province. Generally, the soil moisture at freeze-up and base flow conditions are well known in the fall and, combined with long term weather forecast, can give an indication of spring flood potential.

## SUMMER AND FALL PRECIPITATION

Following the very rainy months of June and July, precipitation recorded in most Manitoba basins between August and October was below normal to well below normal. Most Manitoba basins received normal to above normal precipitation in June, with areas in the southeast corner of the province and the Little Saskatchewan River watershed receiving very high to record amount of precipitation (Figure 1). The month of July was very wet as well with most Manitoba basins recording normal to well above normal precipitation (Figure 2). The weather pattern shifted after July as most Manitoba basins received below normal to well below normal precipitation between August and October (Figure 3).

The soil moisture at freeze-up is heavily dependent on the observed precipitation between May and October. Overall, most southern and western Manitoba basins, including the Assiniboine River, Souris River, Qu'Appelle River, and the Interlake received below normal precipitation between May and October. The United States portion of the Red River basin mostly received near normal precipitation during this time, whereas the Canadian portion of the basin received below normal precipitation. The Whiteshell Lakes region received normal to below normal precipitation

from May to October. The northern basins, including the Saskatchewan River, generally received normal to above normal precipitation during this period. Figure 4 shows the precipitation received between May 1 and October 31 as a percent of normal.

Precipitation records for November indicate all Manitoba basins, with the exception of Northern basins, received below normal to well below normal precipitation (Figure 5). Some locations in central Manitoba recorded the driest precipitation in November in the past 30 years. Northern Manitoba basins, including the Saskatchewan River and Churchill River basins, received normal to well above normal precipitation in November.

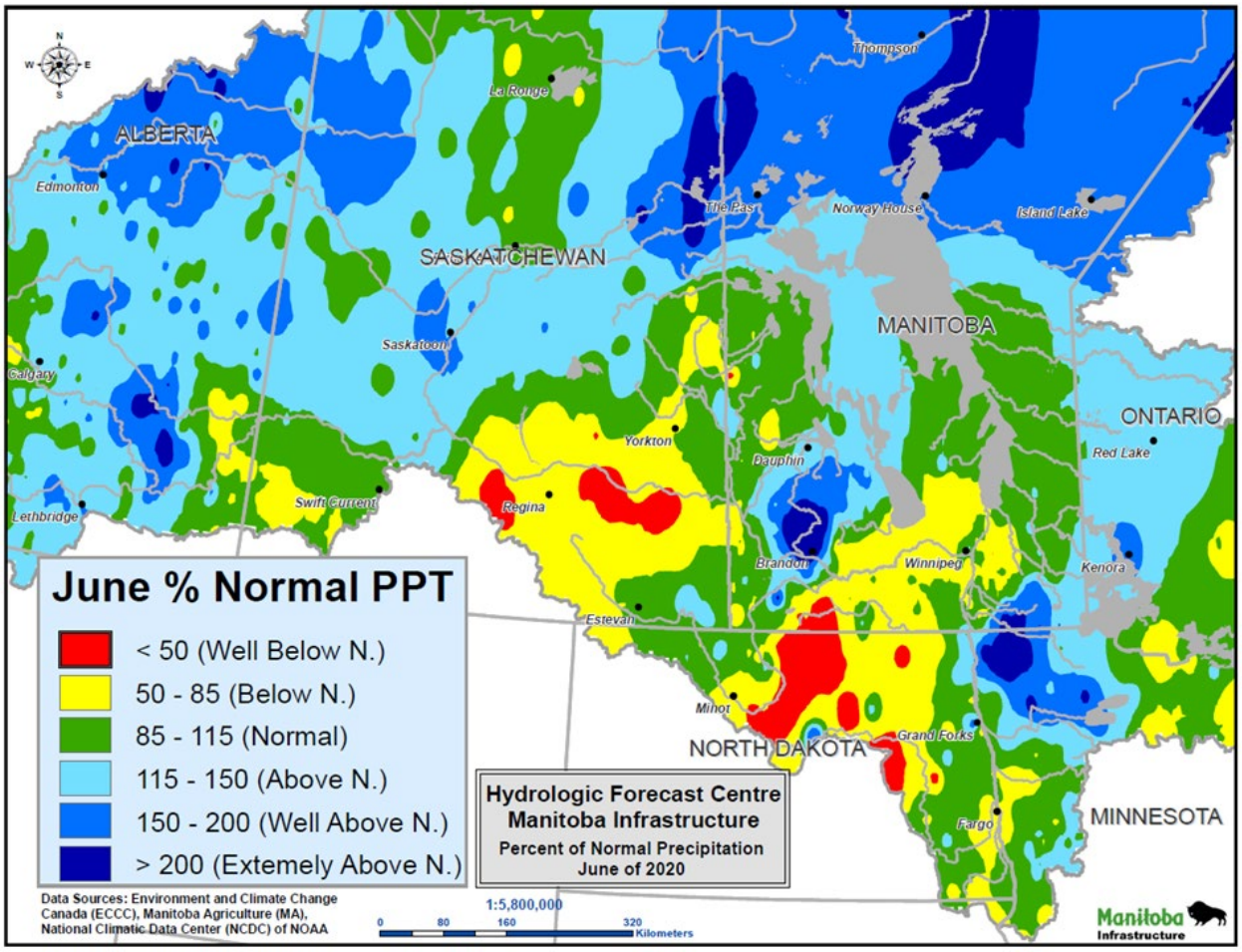


**Figure 1. Percent Normal Precipitation (%) June, 2020**

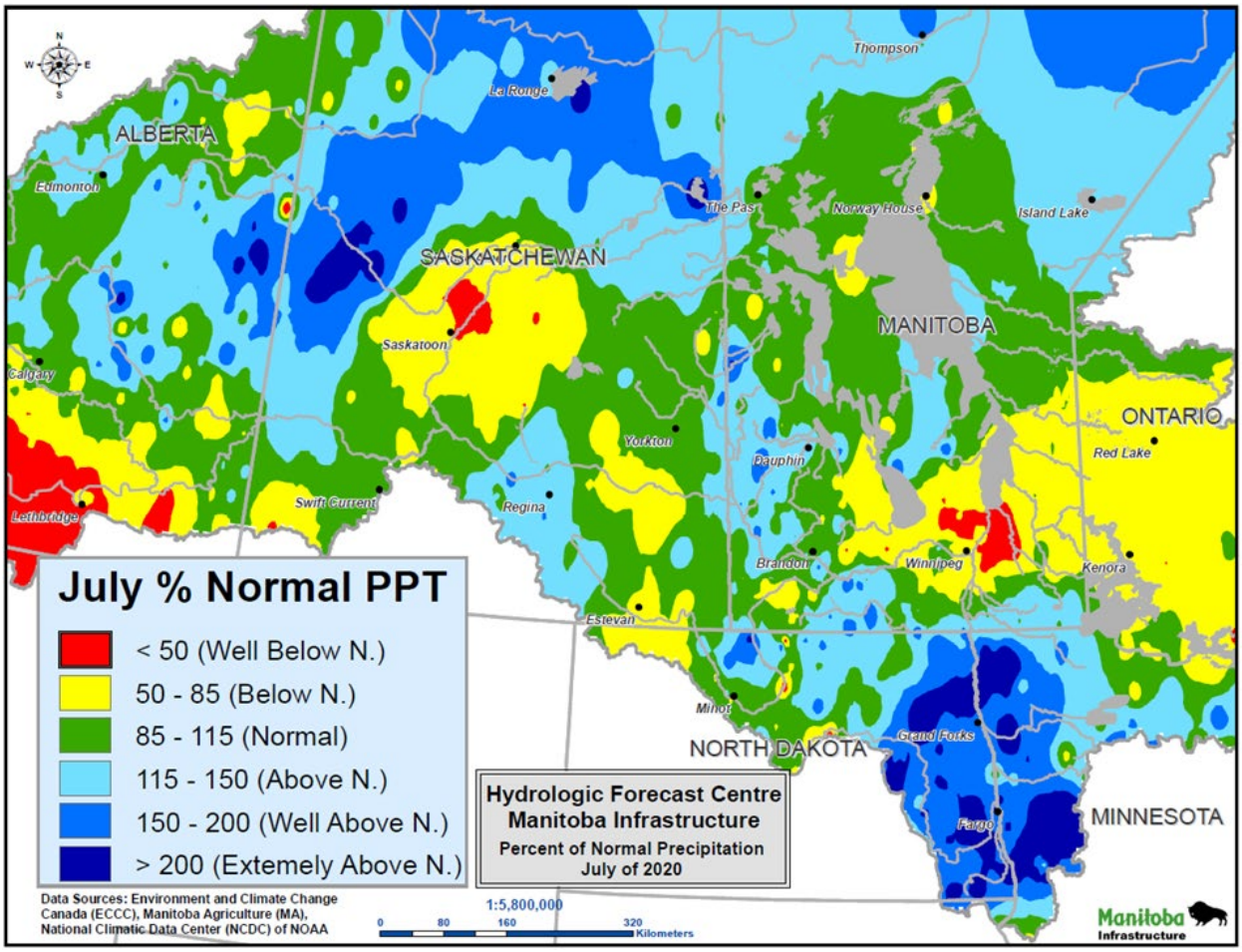


**Figure 2. Percent Normal Precipitation (%) July, 2020**

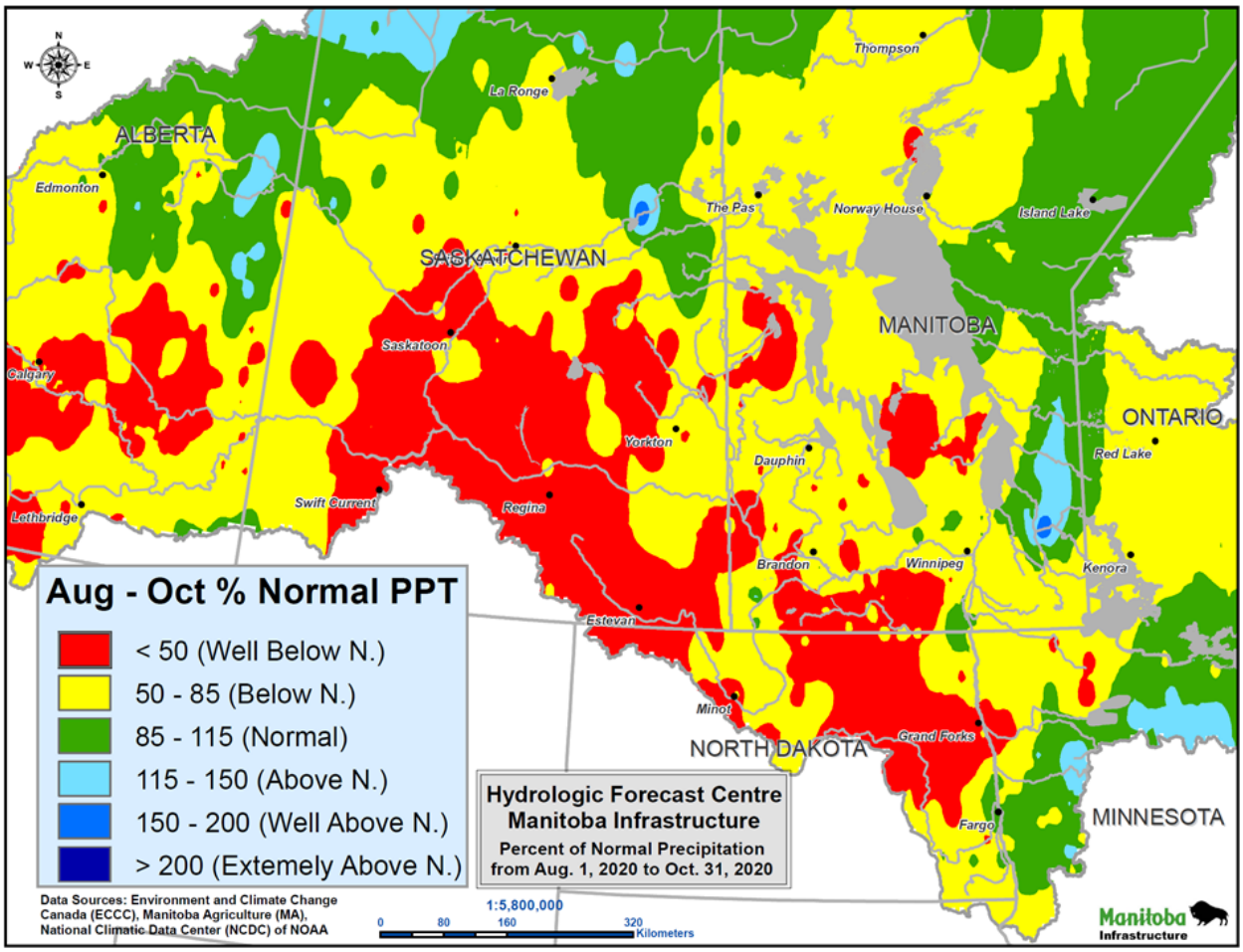


**Figure 3. Percent Normal Precipitation (%) from Aug 1 to Oct 31, 2020**

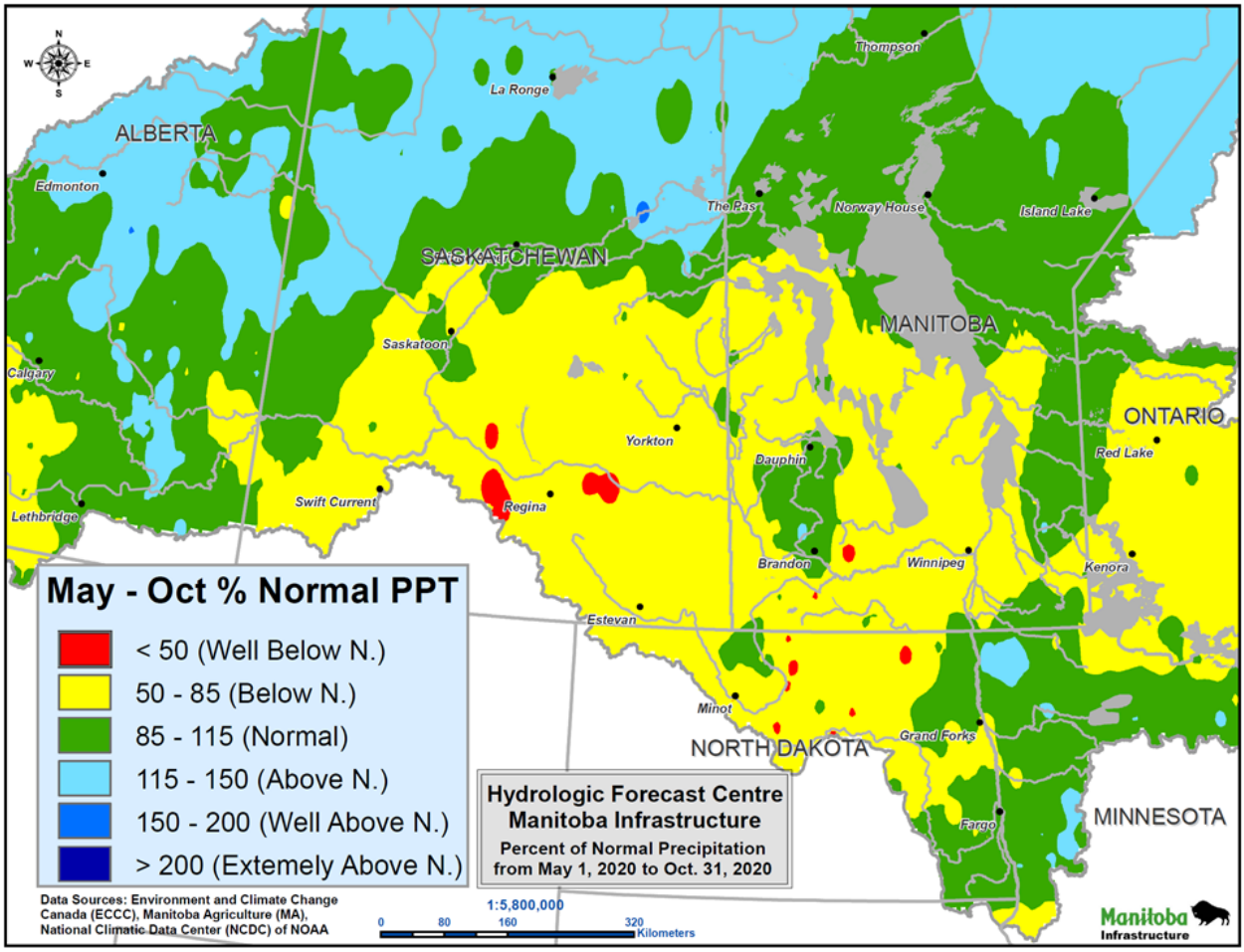


**Figure 4. Percent Normal Precipitation (%) from May 1 to Oct 31, 2020**

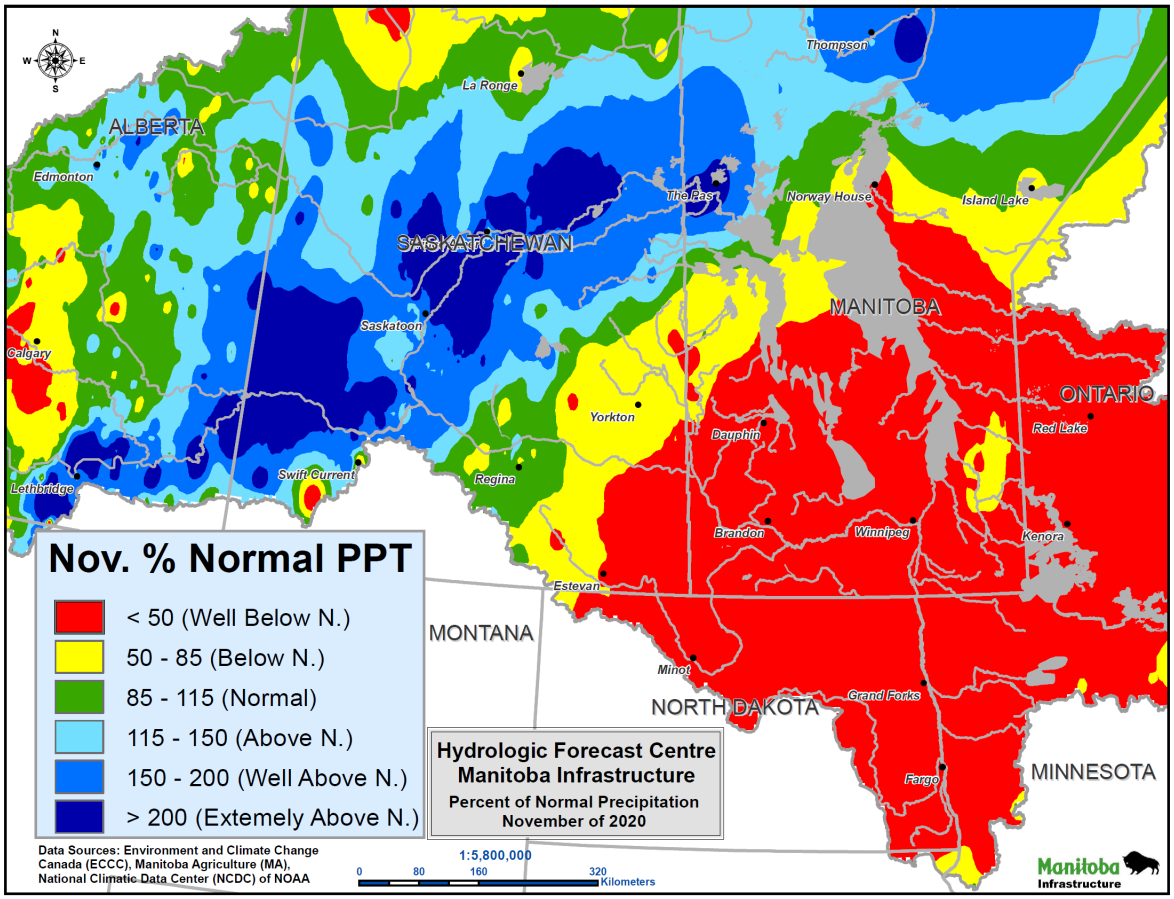


**Figure 5. Percent Normal Precipitation (%) for November, 2020**

## SOIL MOISTURE CONDITIONS

A number of different tools are used to determine the soil moisture at freeze-up. The most common method, which has been used for years, is Manitoba's MANAPI model which is expressed by the API (Antecedent Precipitation Index). The MANAPI model indicates the degree of saturation in the soil. This method uses the recorded precipitation at a large number of meteorological stations throughout the various basins to calculate the amount of summer and fall rain (May to October) that remains in the top soil layer and has yet to contribute to the spring runoff. Figure 6 shows the API map for the fall of 2020 expressed in percent of normal.

The API model results indicate that soil moisture is normal to below normal for most Manitoba basins, with the exception of northern basins, which have above normal soil moisture. The

Assiniboine River, Qu'Appelle River, and the Interlake areas have below normal soil moisture. Localized areas in western and southeastern Manitoba have normal to above normal soil moisture; this includes the Little Saskatchewan River basin and the Roseau River basin. Northern Manitoba, including the Saskatchewan and Churchill River basins, has normal to above normal soil moisture. The soil moisture is normal to below normal for the Red River basin (including the U.S. portion of the basin) and below normal to well below normal for the Souris River basin (including the U.S. portion of the basin).

Manitoba Agriculture also collects soil moisture measurements in the top 120 cm (47 inches) of the soil through its automatic weather monitoring stations located at various locations in the province. Soil moisture measurements collected in the top 120 cm through monitoring sensors indicate optimal (40 – 70% saturation) to dry (20 – 40% saturation) soil moisture conditions for most of Manitoba (Figure 7). Soil moisture measurements do not extend into northern Manitoba as there are not many automated weather stations in the northern part of the province.

The U.S. National Weather Service (NWS) Climate Prediction Center indicates normal to below normal soil moisture for the U.S. portions of the Red and Souris River basins (Figure 8) based on soil moisture monitoring and modelling.

In summary, soil moisture is generally normal to drier than normal for most of southern and central Manitoba. Soil moisture is normal to above normal in northern Manitoba, including the Saskatchewan and Churchill River basins. Above normal soil moisture indicates higher risk of spring flooding within these basins.

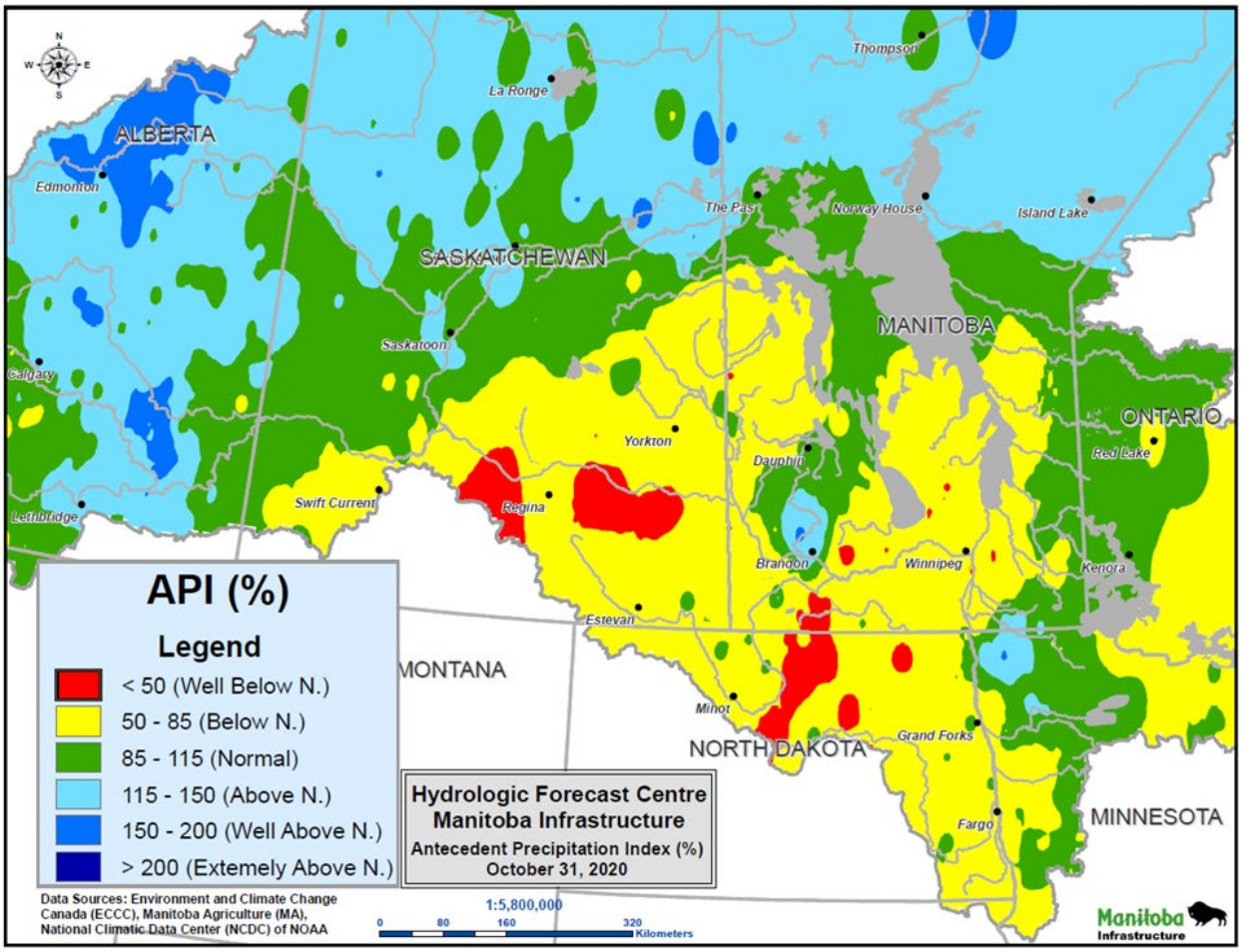


**Figure 6 Antecedent Precipitation Index (API) (%) for 2020**

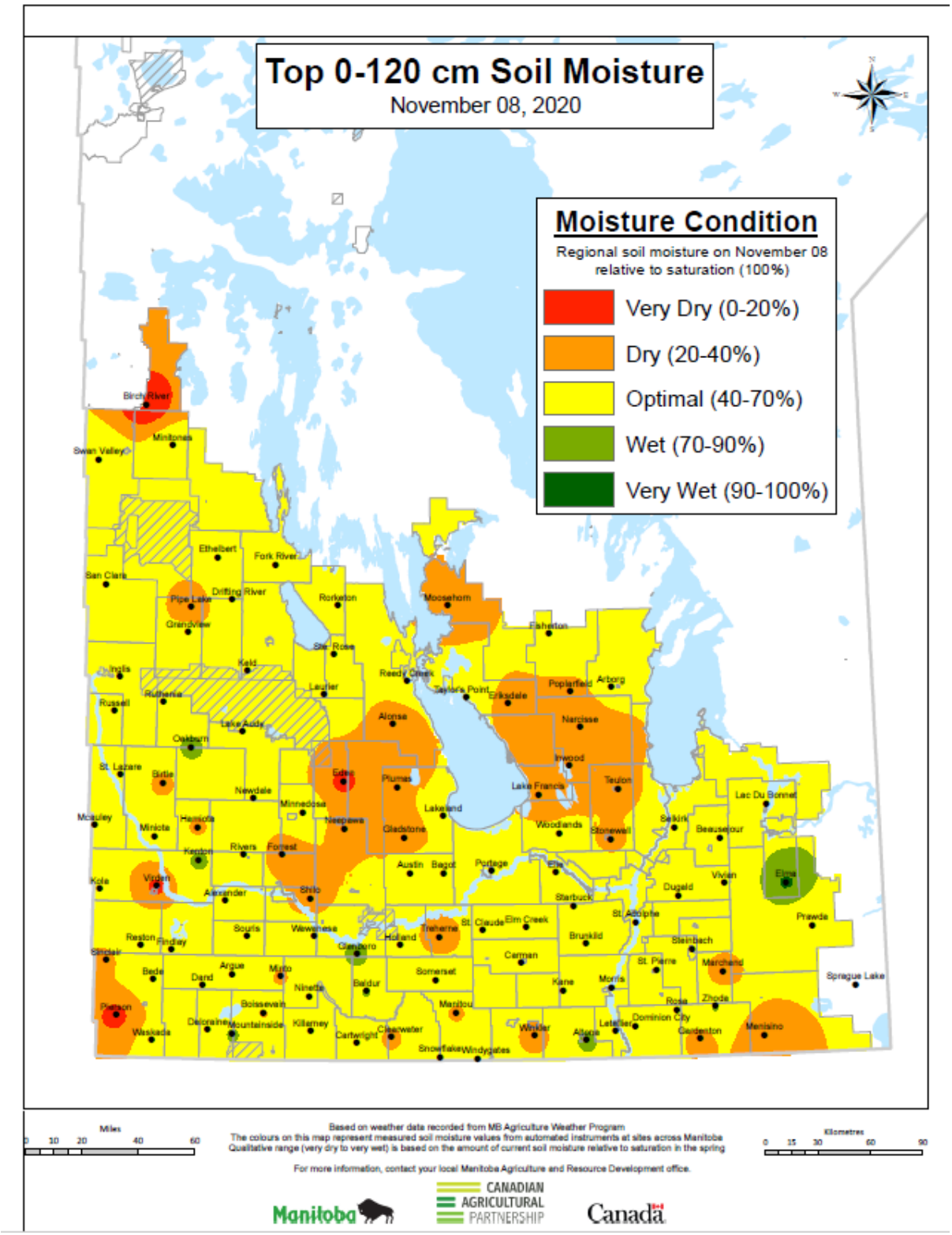


**Figure 7. Soil moisture in top zone (0 to 120 cm) based on field measurements**

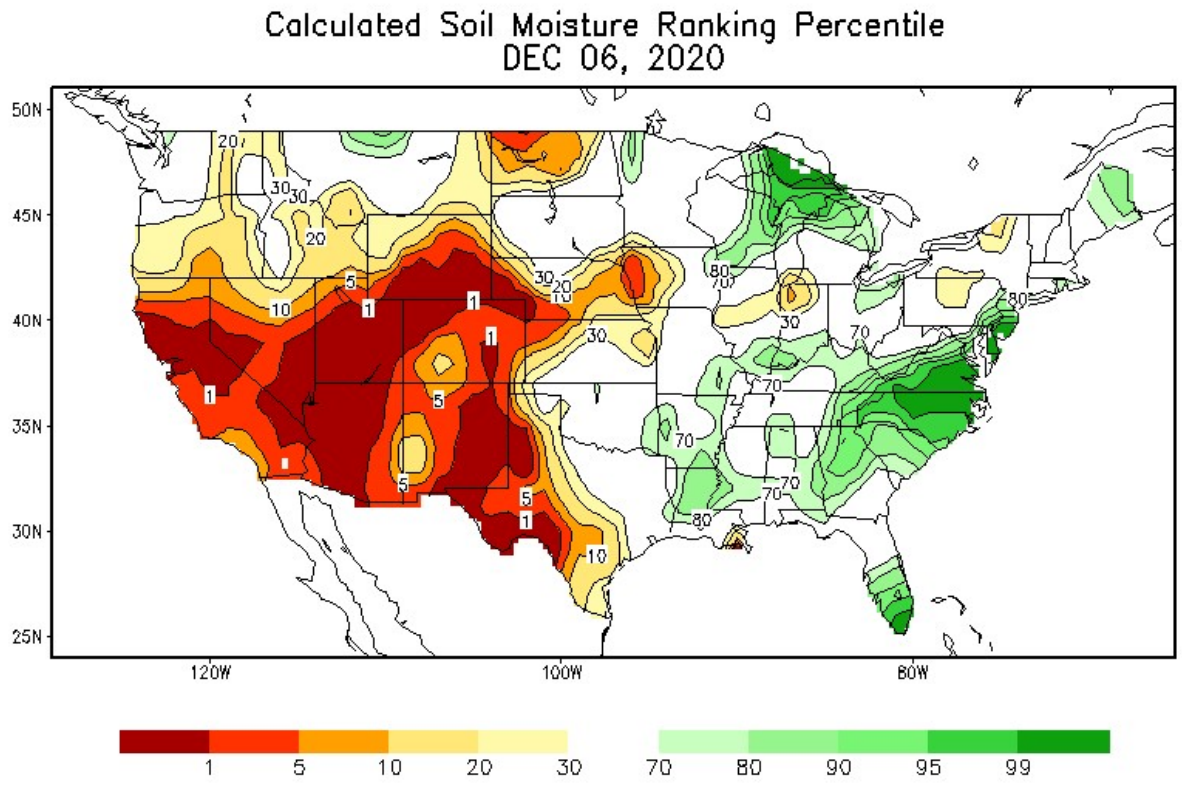


**Figure 8. Calculated soil moisture ranking percentile as of December 6, 2020, from the NWS**

# BASE FLOWS AND LEVELS CONDITIONS

## Rivers

Base flow is a portion of the stream flow that is not from surface runoff; it is water from the ground, flowing into the river channel over a period of time. Base flows and levels are normal to below normal in southern and central Manitoba basins. Base flows and levels are well above normal to record high in northern basins. Figure 9 shows current base flows in comparison with historic records. Hydrographs for the major rivers are shown in Figures 10 to 21. These figures show the measured or estimated flows on the rivers as of December 8, 2020. Near normal base flows indicate near normal ground saturations or near normal soil moisture content. Below normal base flows indicate below normal soil saturation while above normal base flows indicate above normal ground saturation levels. Above normal base flows and levels indicate higher risk of spring flooding in these basins. Current flows for main rivers at selected locations are listed in Table 1. (Note: Some flow readings might be affected by ice).

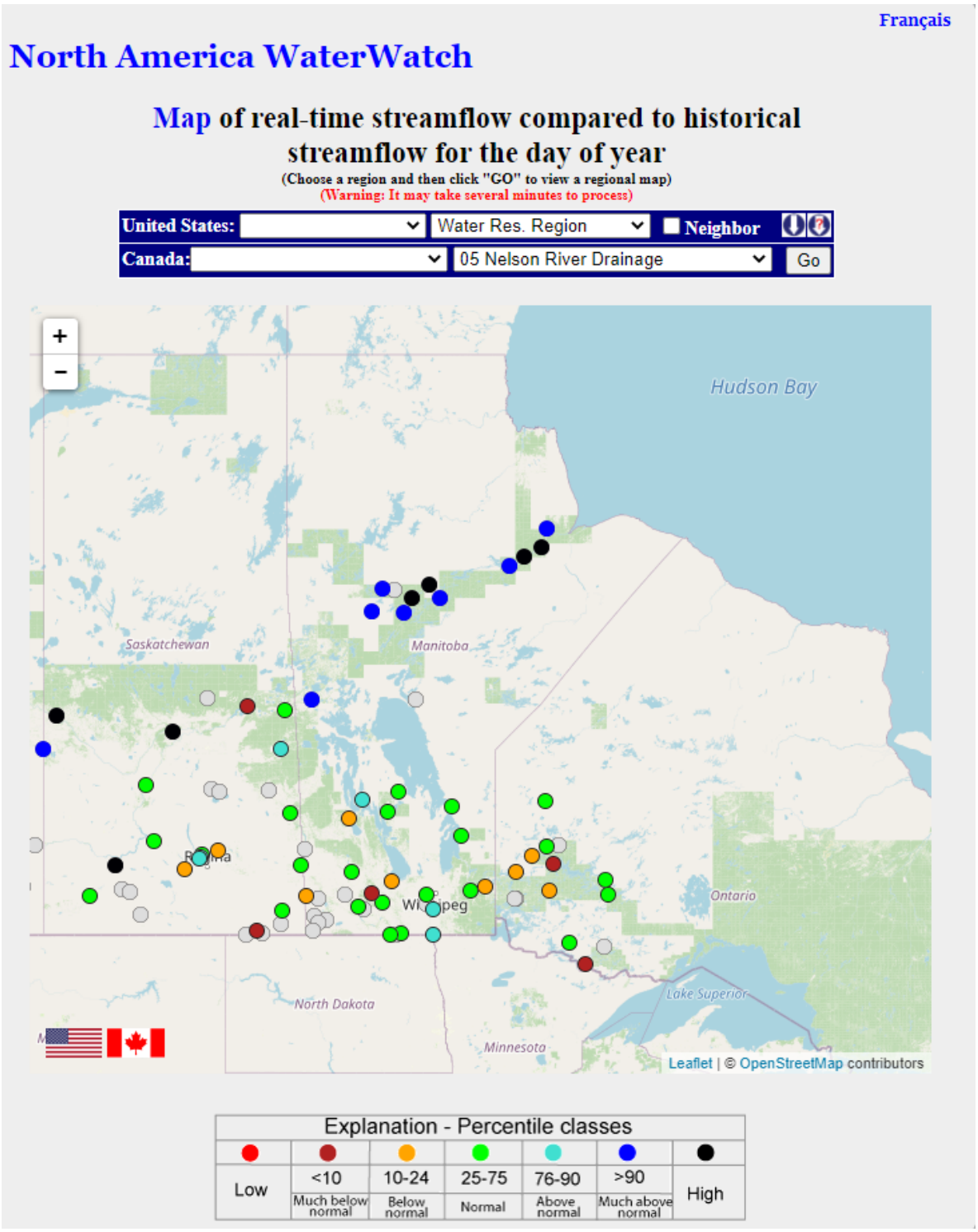


**Figure 9. Base flows and level conditions as of November 6, 2020**

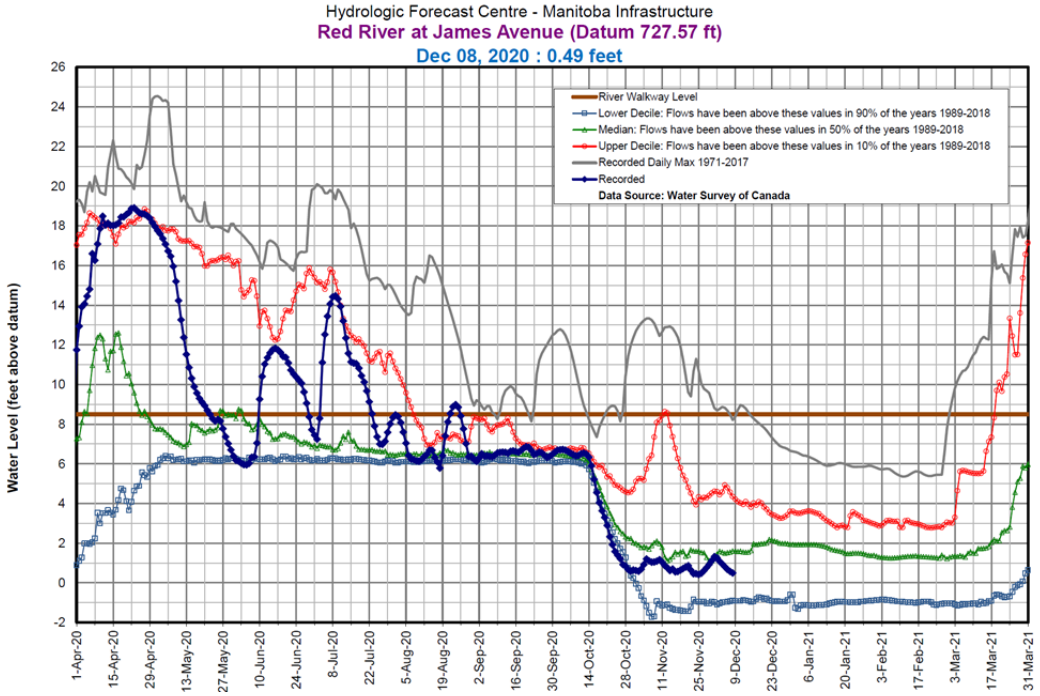


**Figure 10. Red River Water Levels at James Avenue**

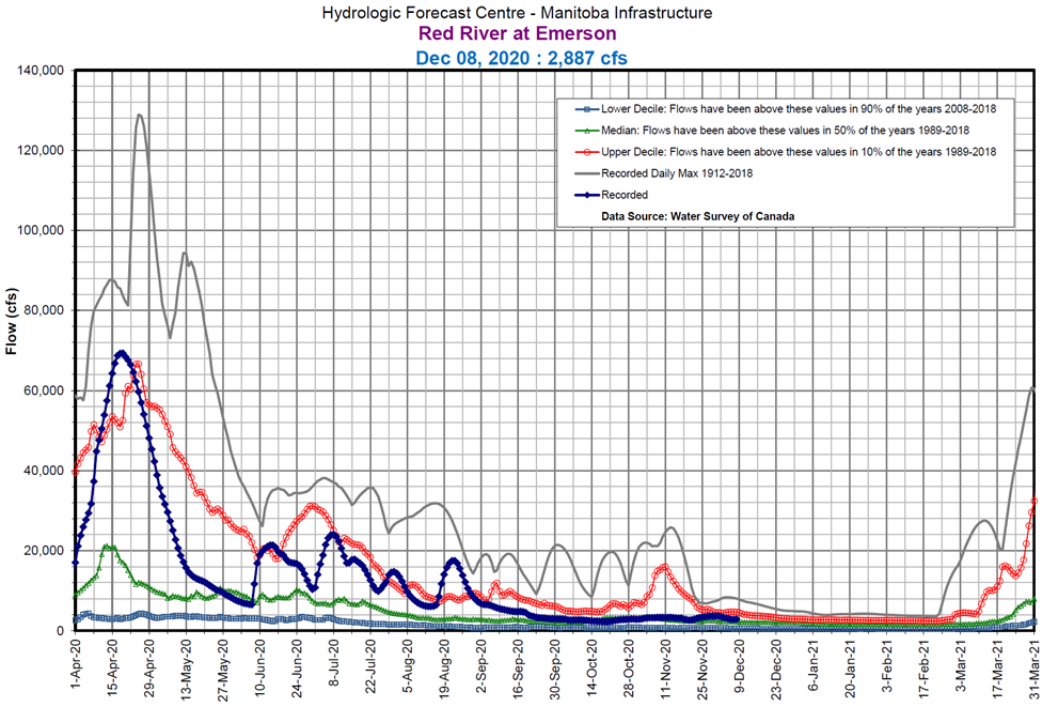


**Figure 11. Red River Flows near Emerson**

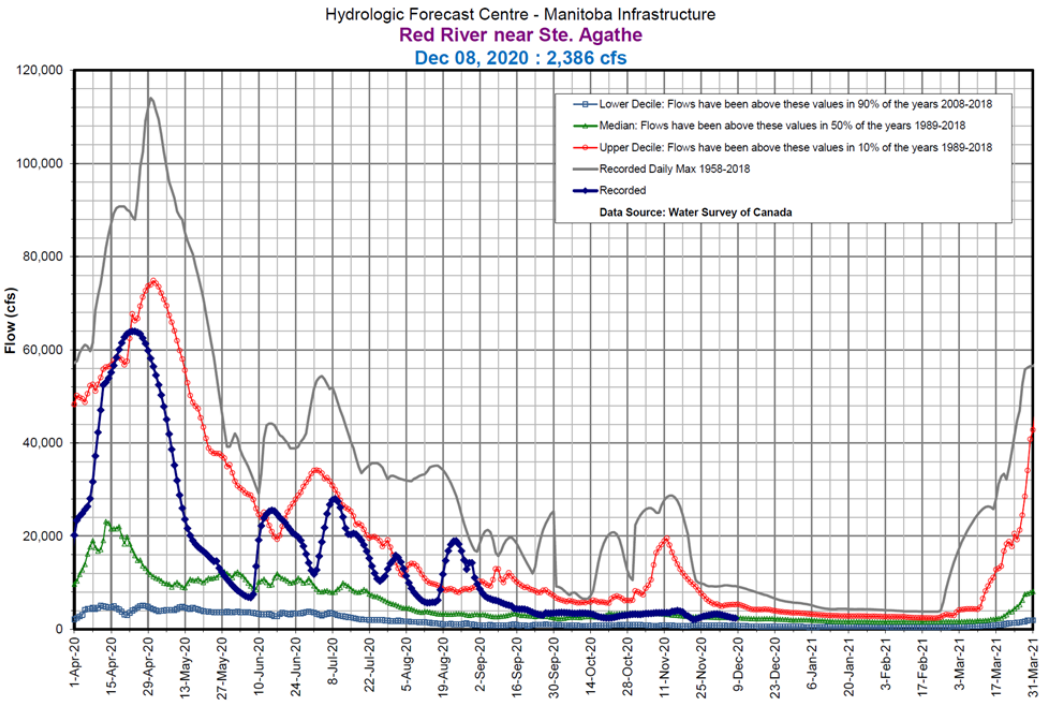


**Figure 12. Red River Flows near Ste. Agathe**

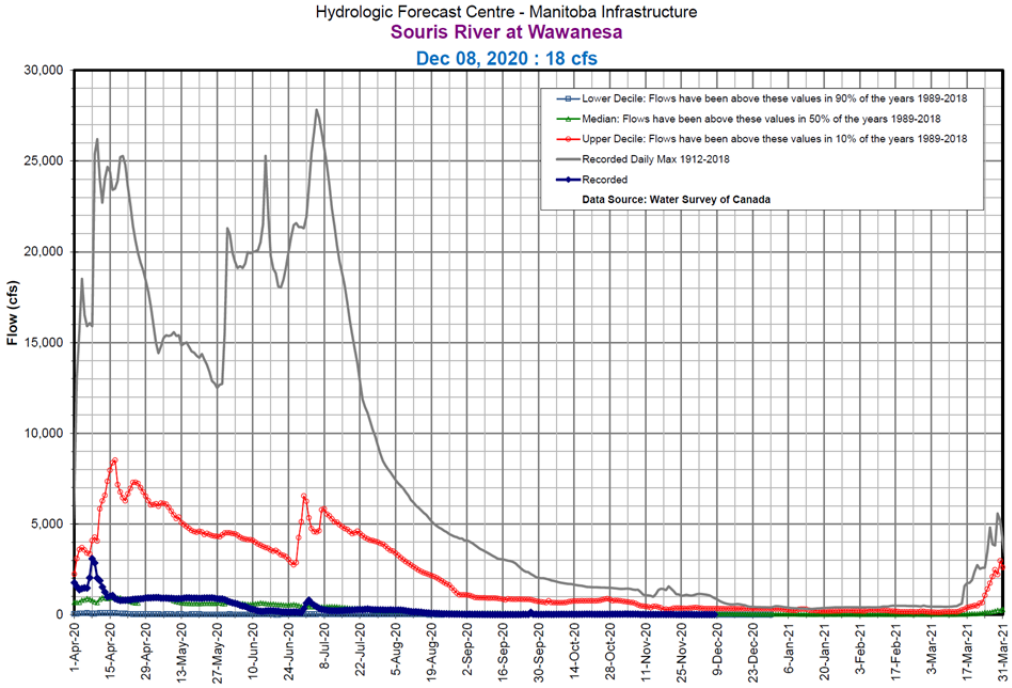


**Figure 13. Souris River Flows at Wawanesa**

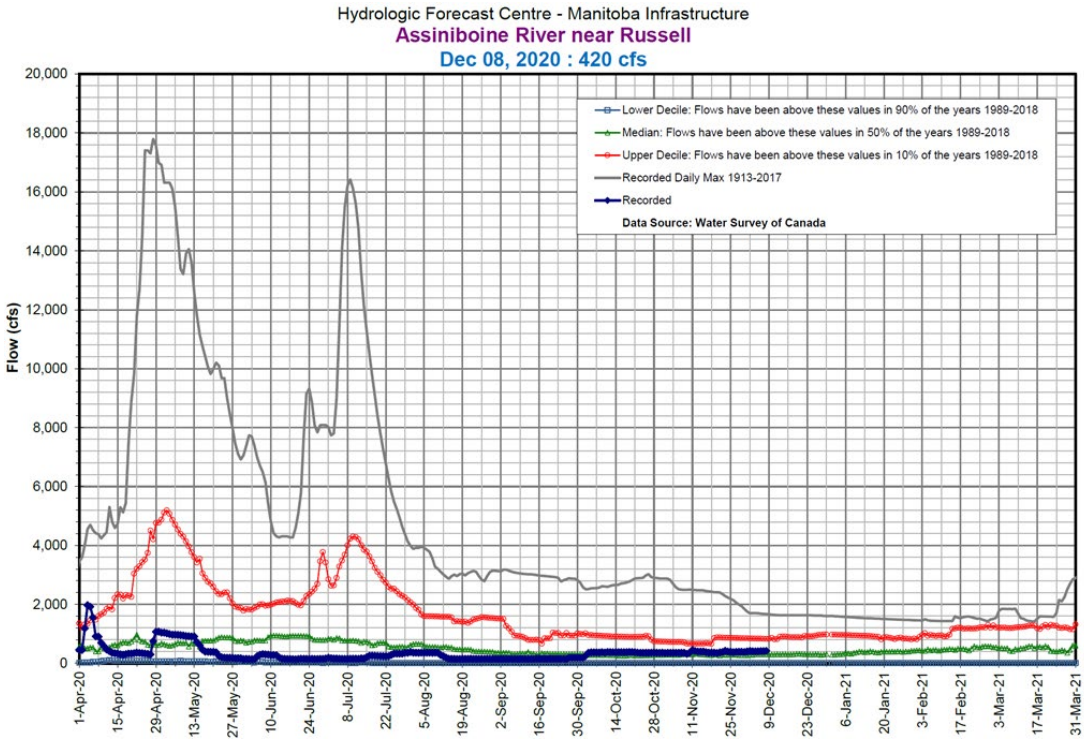


**Figure 14. Assiniboine River Flows west of Russell**

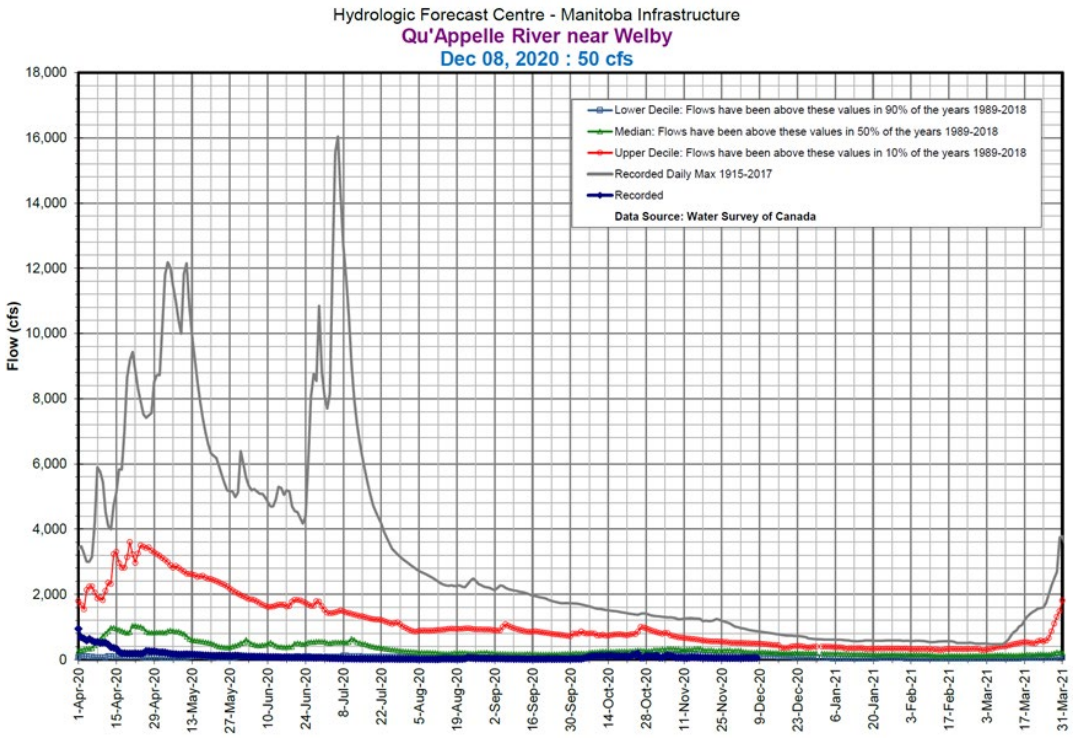


**Figure 15. Qu'Appelle River Flows near Welby**

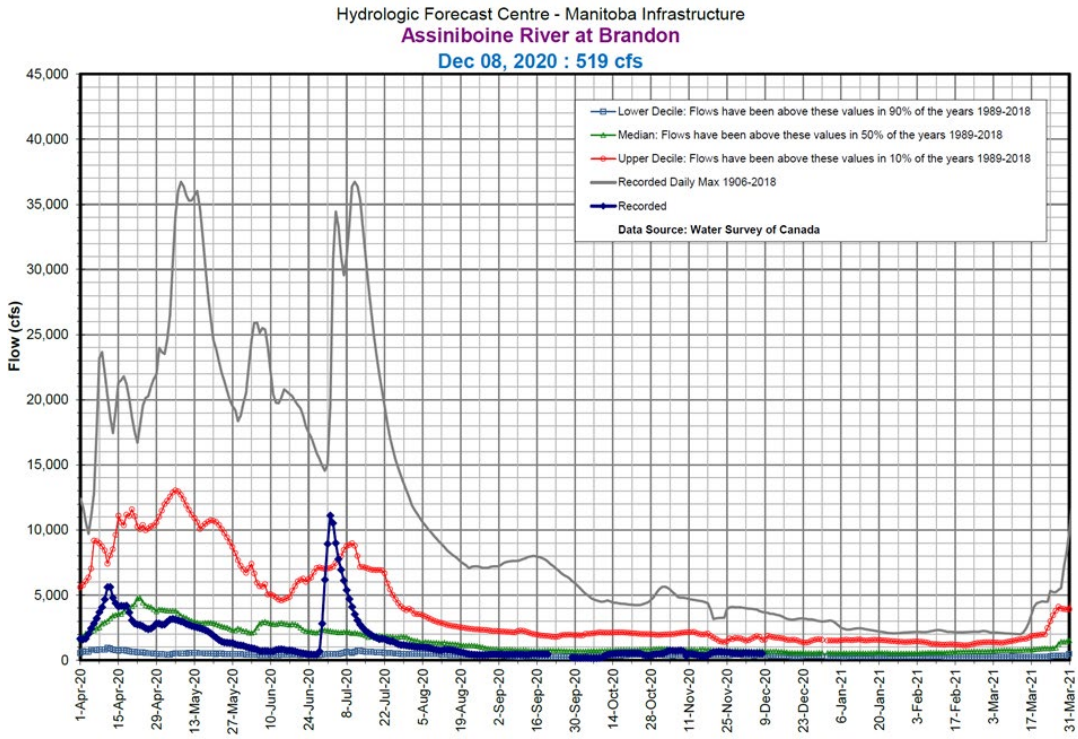


**Figure 16. Assiniboine River Flows at Brandon**

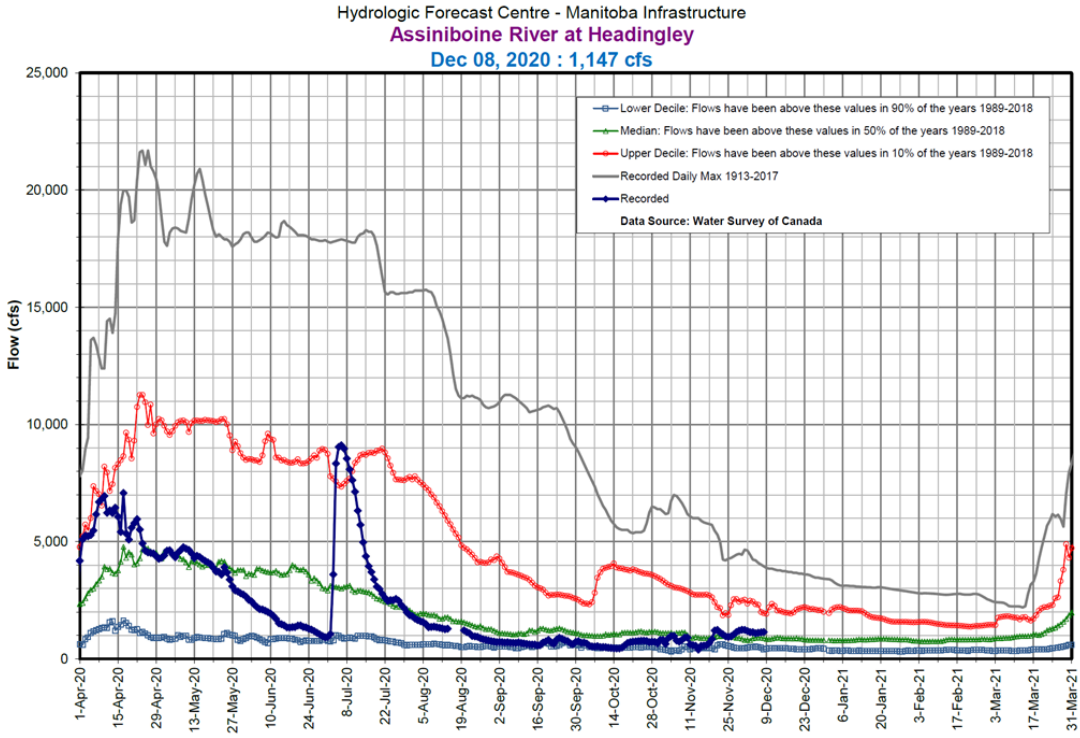


**Figure 17. Assiniboine River Flows at Headingley**

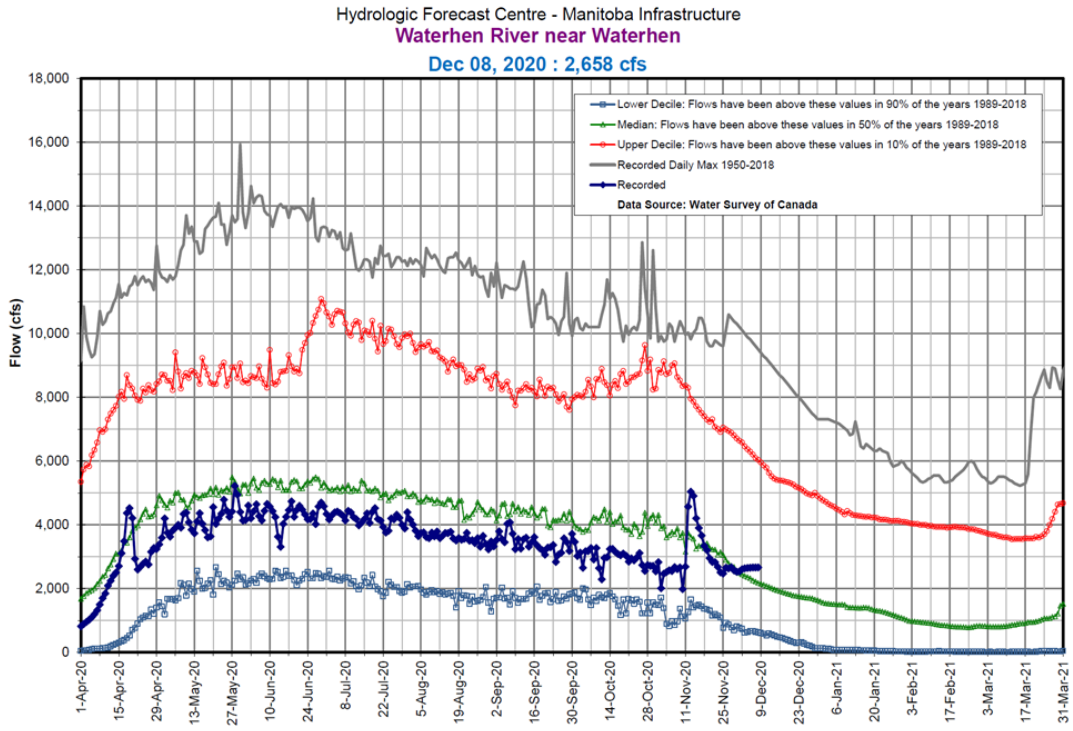


**Figure 18. Waterhen River Flows near Waterhen**

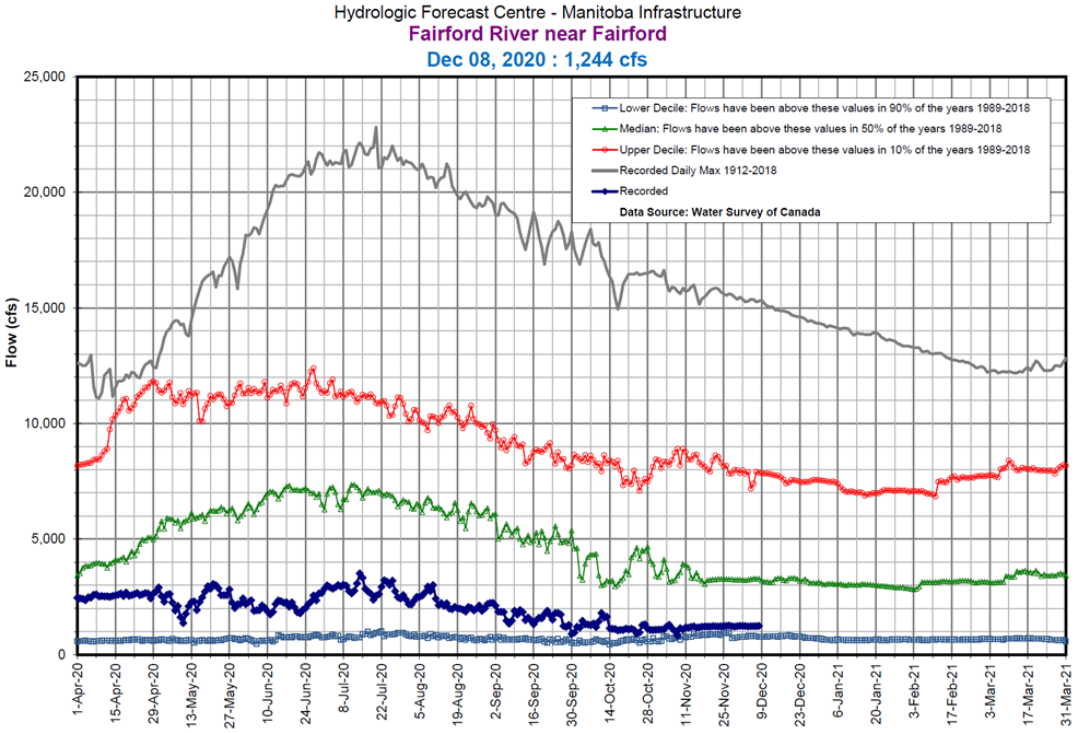


**Figure 19. Fairford River Flows near Fairford**

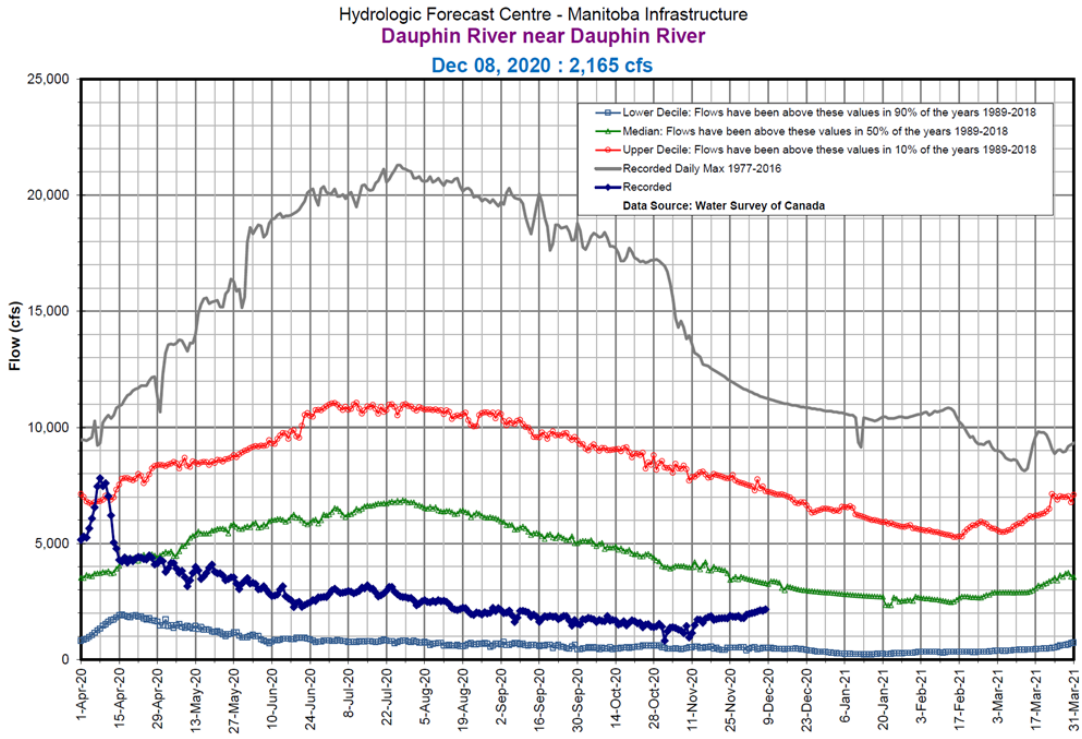


**Figure 20. Dauphin River Flows near Dauphin River**

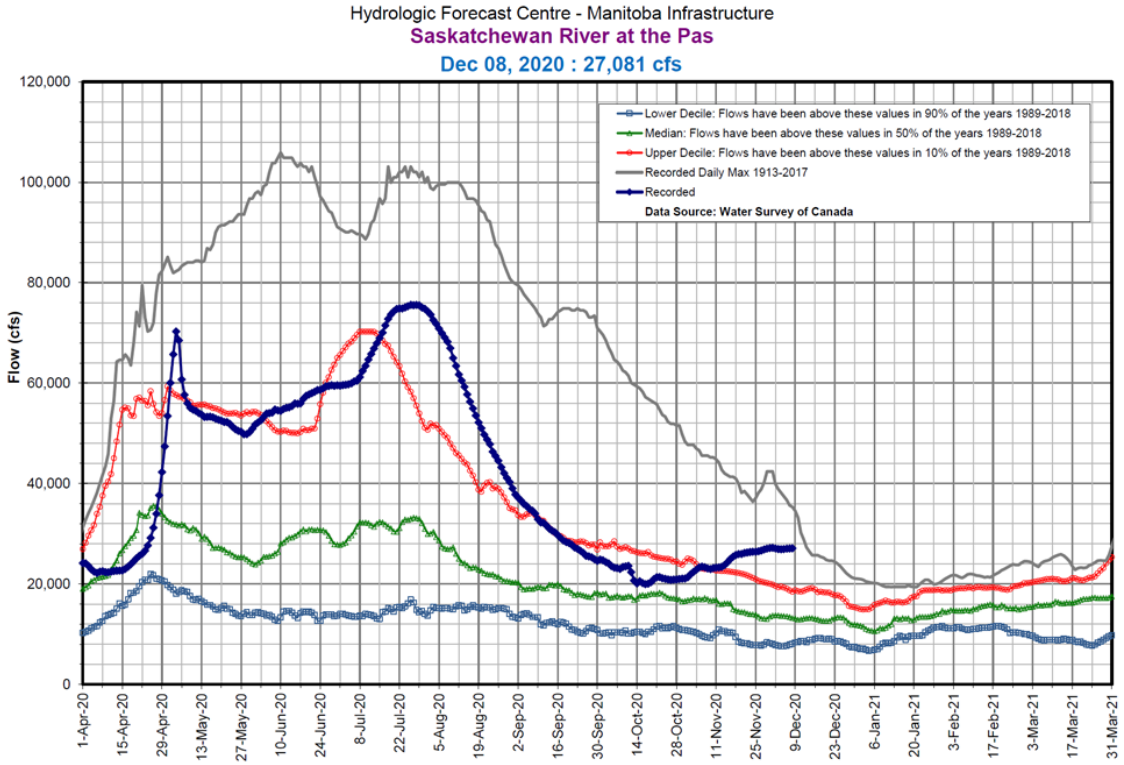


**Figure 21. Saskatchewan River Flows at The Pas**

**Table 1. Flows for main rivers at selected locations as of December 8, 2020.**

| Rivers | Location | Current Flow (cfs) | Historical Normal Flows December 8 (cfs) |
|---|---|---|---|
| Red River | Emerson | 2,887 | 2,165 |
| | Ste. Agathe | 2,386 | 2,131 |
| Assiniboine River | Russell | 420 | 310 |
| | Miniota | | 560 |
| | Brandon | 519 | 627 |
| | Holland | 1,077 | 821 |
| | Headingley | 1,147 | 784 |
| Shellmouth Dam Outflow | Shellmouth | 336 | |
| Souris River | Melita | 15 | |
| | Souris | 17 | |
| | Wawanesa | 18 | 65 |
| Qu'Appelle River | Welby | 50 | 200 |
| Fairford River | Near Fairford | 1,244 | 3,000 |
| Dauphin River | Near Dauphin River | 2,165 | 3,200 |
| Waterhen River | Near Waterhen | 2,658 | 2,000 |
| Saskatchewan River | The Pas | 27,081 | 13,000 |

## Lakes

Lake Manitoba is at 810.8 ft, which is within its operating range of 810.5 ft – 812.5 ft. Lake Winnipeg is also within its operating range at 713.4 ft (operating range is 711 ft – 715 ft). Lake Winnipegosis and Lake St. Martin are below normal for this time of the year while Dauphin Lake is near normal. Lake St. Martin is at 797.3 ft, which is close to the lower decile level for this time of year. Water level hydrographs for these lakes are shown in Figures 22 to 26. Whiteshell Lakes are near normal for this time of the year. Inflow into Lake of the Prairies (Shellmouth Reservoir) is near the normal inflow condition for this time of the year.

Shellmouth Dam is being operated in consultation with the Shellmouth Reservoir Regulation Liaison Committee (SLC). The lake level on December 8 was 1,399.7 ft. The operating guidelines recommend that the lake level be drawn down between 1386 and 1400 ft depending on the spring runoff forecast. Regular spring runoff forecasts will be issued and the lake level will be dropped

to the appropriate level prior to the spring runoff. Figure 27 shows the observed and forecasted lake levels, reservoir inflow, and reservoir outflow from September 3, 2020 to December 31, 2020. The outflow and level forecasts were made for normal to below normal future inflow conditions. As conditions on the ground change, a revised inflow forecast will be issued and the outflow will be adjusted accordingly.

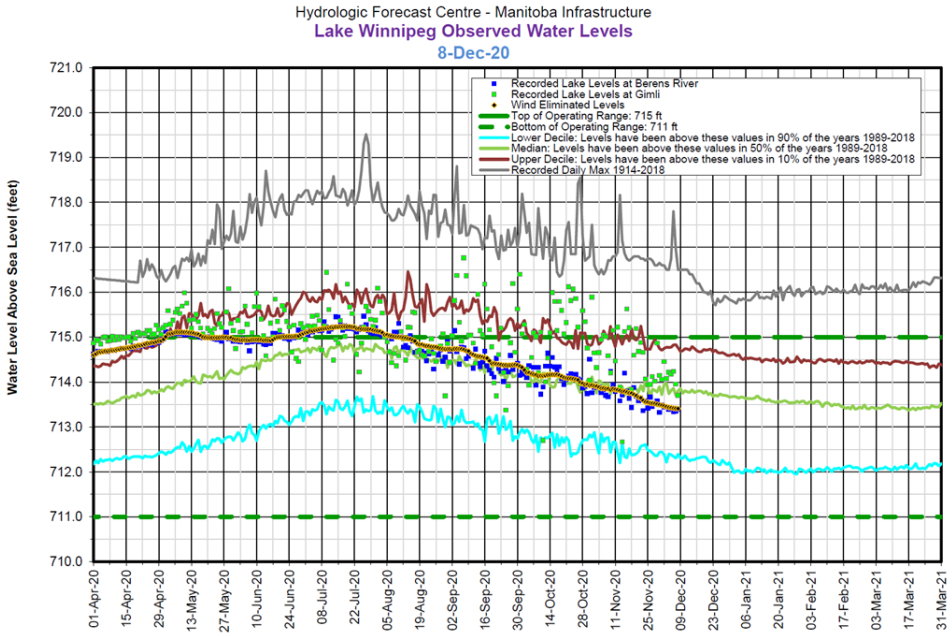


**Figure 22. Lake Winnipeg Water Levels**

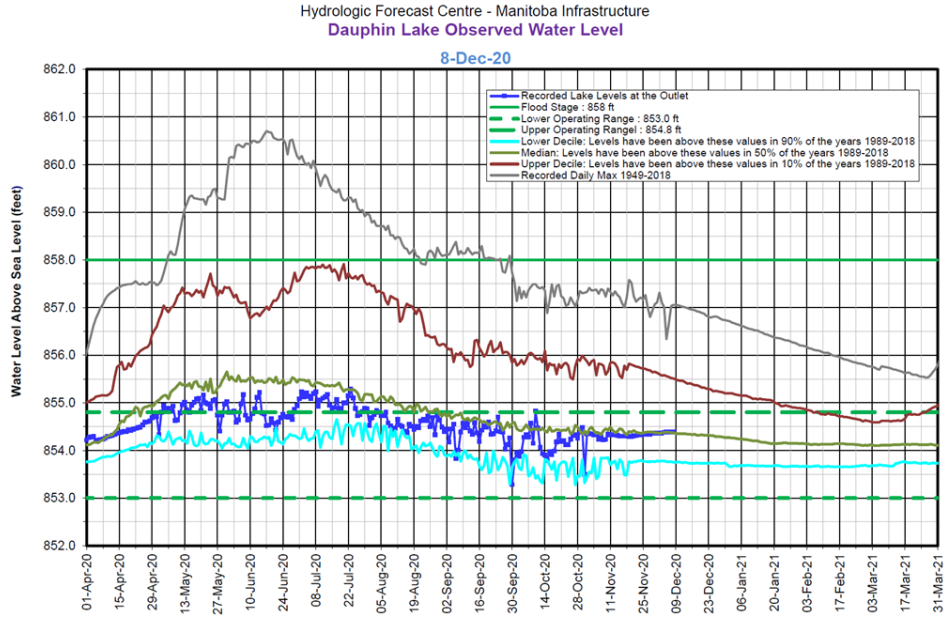


**Figure 23. Dauphin Lake Water Levels**

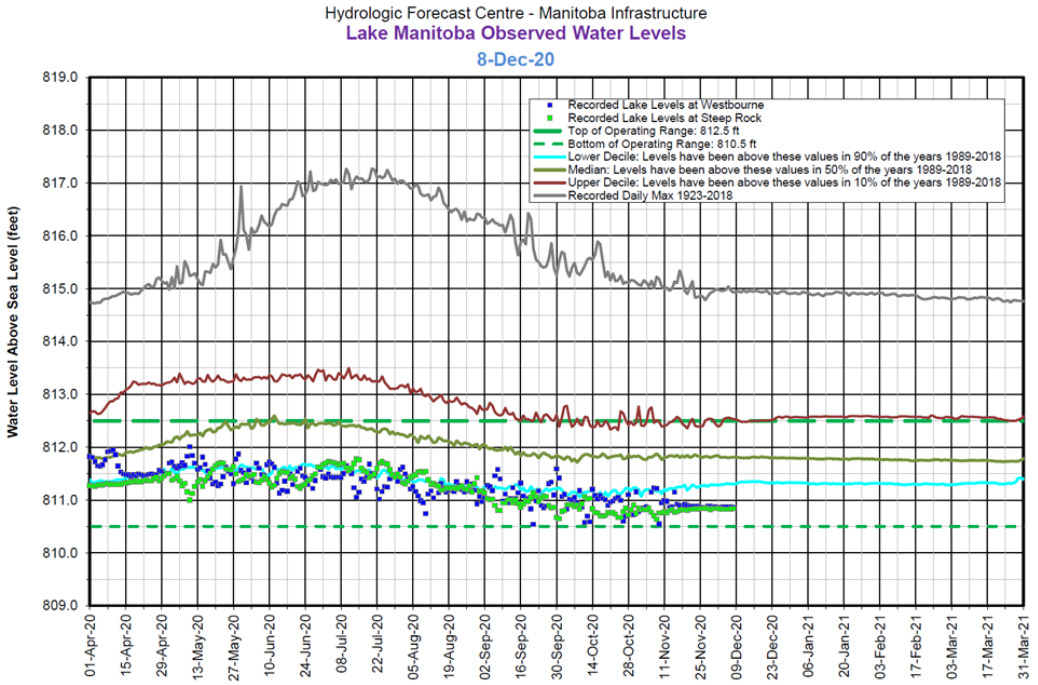


**Figure 24. Lake Manitoba Water Levels**

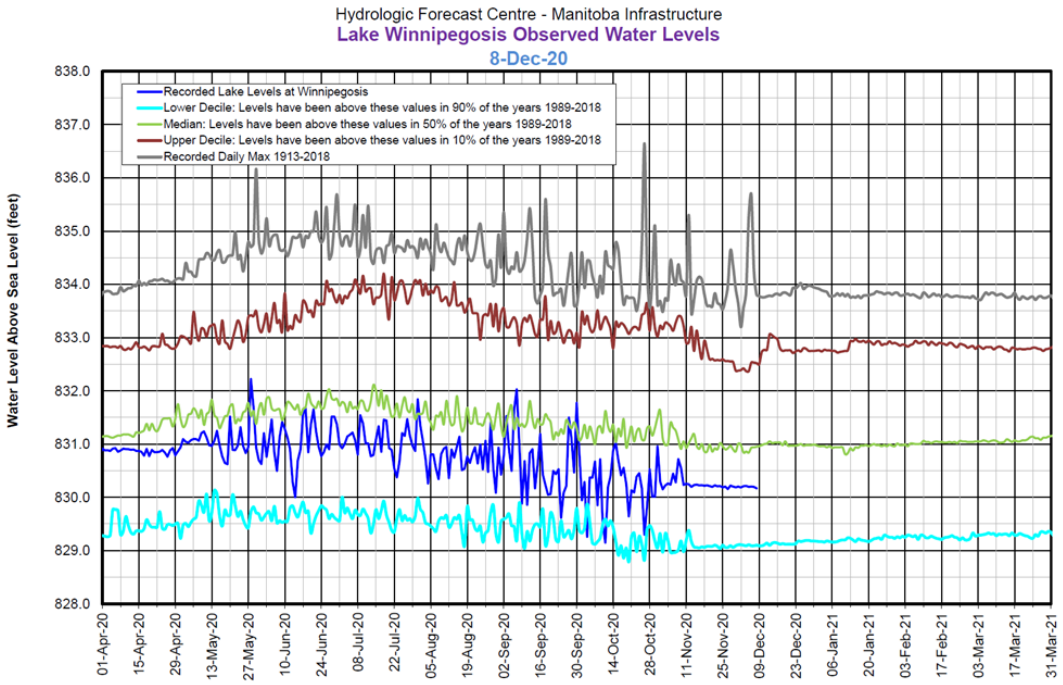


**Figure 25. Lake Winnipegosis Water Levels**

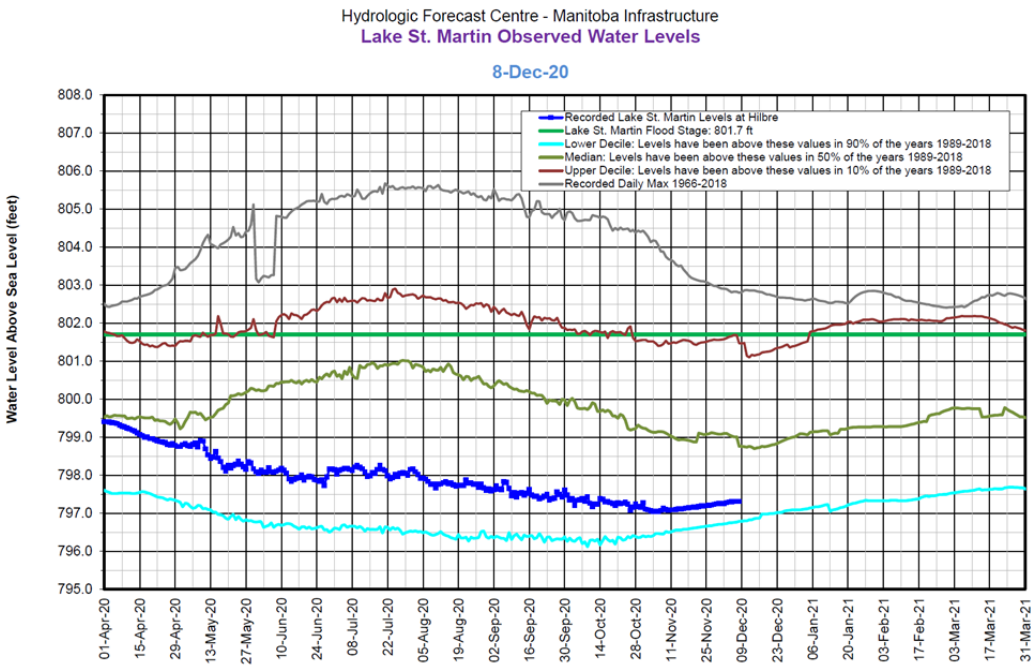


**Figure 26. Lake St. Martin Water Levels**

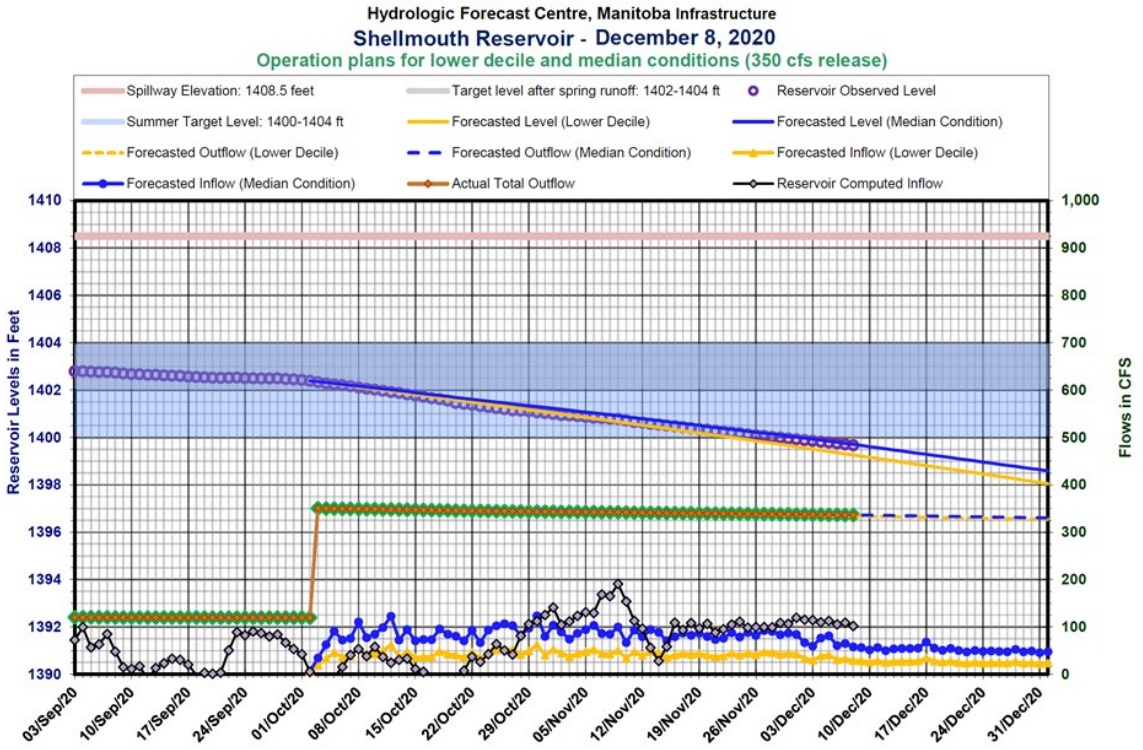


**Figure 27. Lake of the Prairies (Shellmouth Reservoir) Water Levels and Flows.**

## WINTER PRECIPITATION (LONG TERM PRECIPITATION OUTLOOK)

Environment and Climate Change Canada (ECCC) issued a long term precipitation outlook at the end of November for the winter period (Figures 28 and 29). Based on the outlook, precipitation is expected to be normal to above normal from December to February for most of Manitoba and Saskatchewan. The U.S. National Weather Service (NWS) Climate Prediction Center's outlook indicates above normal precipitation within the U.S. portion of the Red River and Souris River basins between December and March (Figures 30 and 31).

Experience indicates that long term precipitation outlooks are more accurate for the first month of the forecast time frame and forecast modelling results start to deviate significantly further into the future. Generally, long term weather forecasts are not as reliable as short term forecasts.

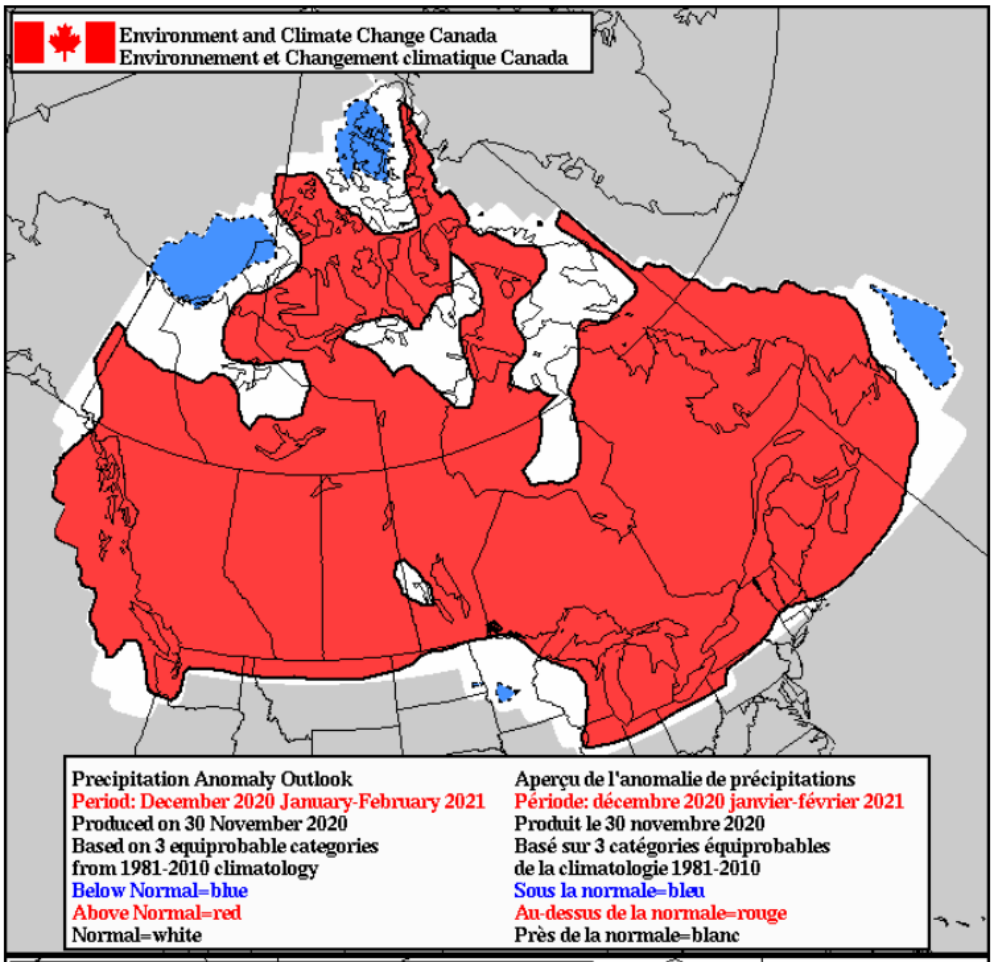


**Figure 28. Environment and Climate Change Canada's Deterministic Precipitation Outlook (December - February)**

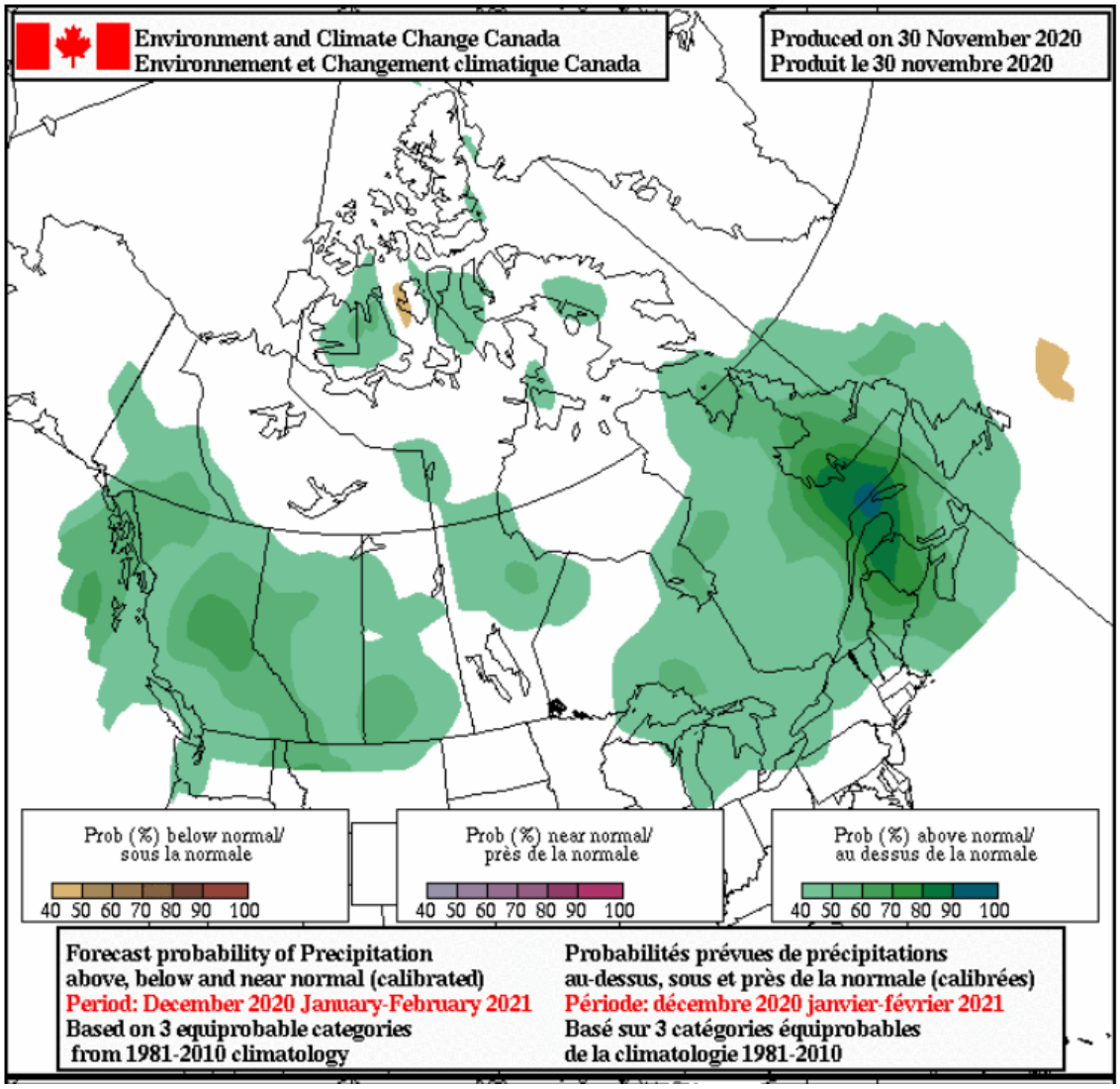


**Figure 29. Environment and Climate Change Canada's Probabilistic Precipitation Outlook (December - February)**

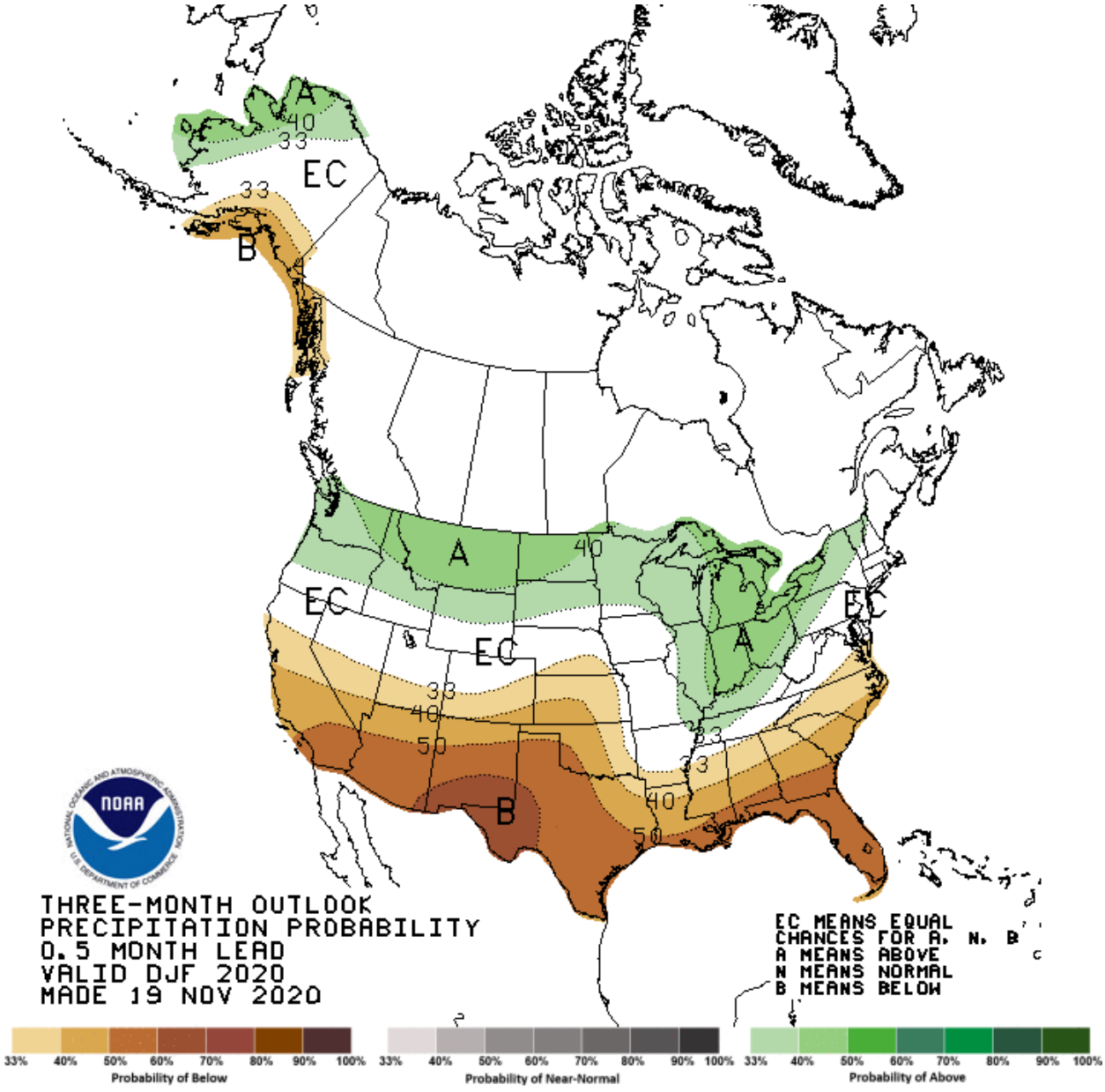


**Figure 30. National Weather Services' Precipitation Outlook (December - February)**

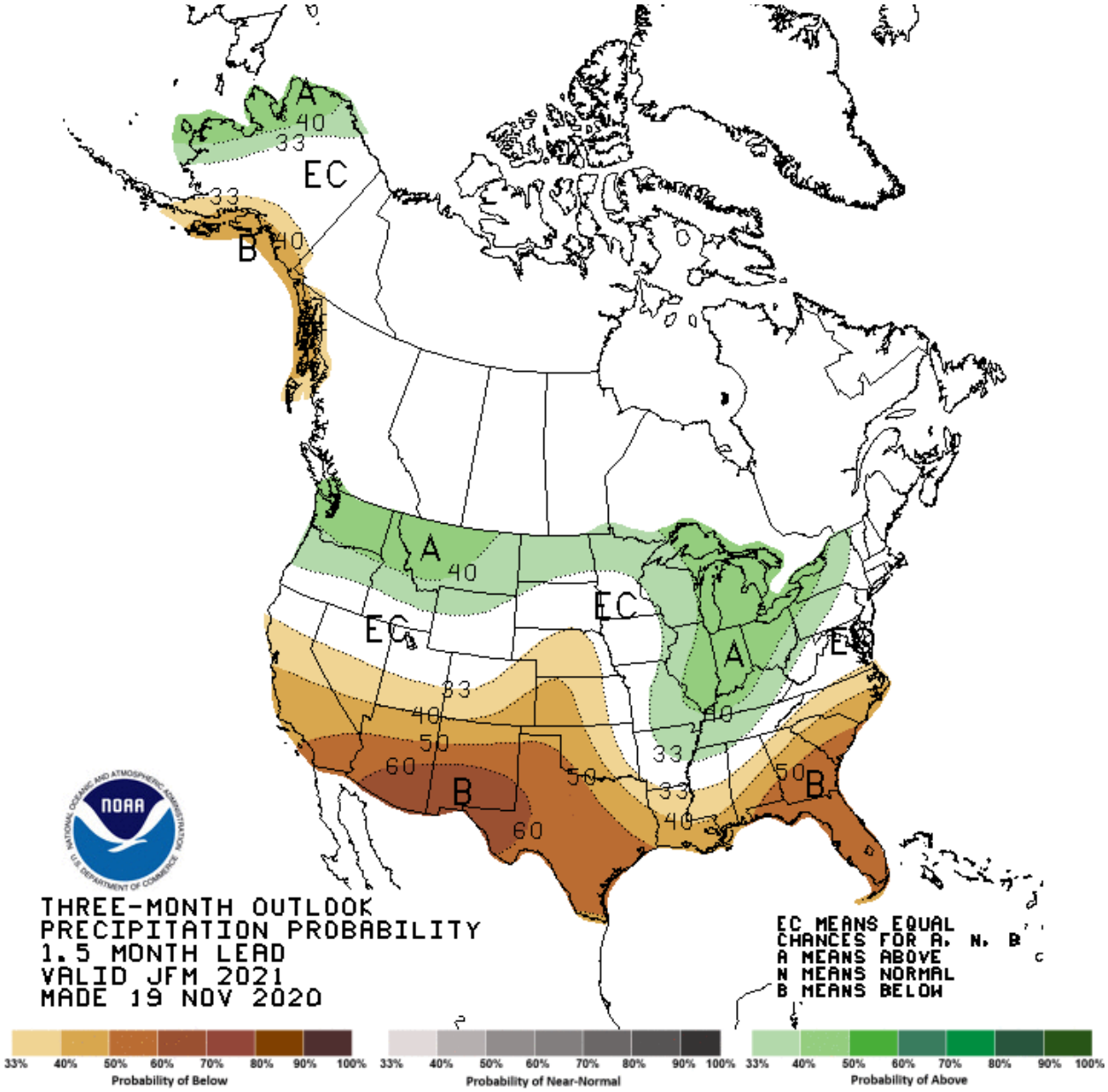


**Figure 31. National Weather Services' Precipitation Outlook (January - March)**

# FORECASTED LAKE LEVELS AND RIVER FLOWS OVER THE WINTER PERIOD

Providing reliable forecasts of river flows through the winter (which are also called base flows) is extremely difficult due to the frozen ground conditions and the effect of ice on flows and levels on rivers and lakes. The Assiniboine River is forecasted to remain at near normal flows and levels in the period prior to the spring runoff. This is partly due to the sustained release of outflows from the Shellmouth Reservoir in order to reduce the level in the reservoir in preparation for the spring runoff. Flows and levels on the Red River are also expected to remain near normal in the period prior to the spring runoff. Flows on the Waterhen River, Fairford River, and Dauphin River will remain below normal.

Lake Manitoba is expected to remain near 811.0 ft throughout the winter. Lake Winnipeg is expected to be between 713 ft and 713.5 ft by end of March, which will be near the historic average level. Lake Winnipegosis will remain near 830.5 ft throughout the winter and Lake St. Martin is expected to reach near 798.0 ft before the spring runoff. Recorded lake levels (as of December 8, 2020) and expected levels prior to the 2021 spring runoff (by March 31, 2021) are given in Table 2.

**Table 2. December 8 lake levels and the expected levels by March 31, 2021 (before the 2021 spring runoff)**

| Lakes | Current Level (ft) | Operating Range or Long Term Avg (ft) | Expected Level by March 31, 2021 (ft) |
|---|---|---|---|
| Lake Manitoba | 810.8 | 810.5 - 812.5 | 811.2 – 811.5 |
| Lake Winnipeg | 713.4 | 711 - 715 | 713.0 – 713.5 |
| Lake St. Martin | 797.3 | 799.0 | 797.9 – 798.2 |
| Lake Winnipegosis | 830.2 | 831.0 | 830.5 – 830.7 |
| Dauphin Lake | 854.4 | 853.0 - 854.8 | 854.0 – 854.3 |
| Lake of the Prairies | 1399.7 | 1386 - 1400 | 1386 - 1398 |
| Lake Wahtopanah Near Rivers | 1533.6 | Summer – 1536<br>Winter – 1535.5 | 1533 |