2016 Water Availability and Drought Conditions Report

Manitoba
Sustainable Development

Executive Summary

This Annual Water Availability and Drought Conditions Report provides an update on the implementation of the Manitoba Drought Management Strategy and a summary of drought conditions and impacts throughout Manitoba during 2016.

Since the release on the Manitoba Drought Management Strategy in January 2016, a significant amount of work has been undertaken to implement the 12 action items included in the Strategy. As of the end of 2016, 25 % of the action items have been completed or are ongoing, 42 % have some or significant progress made, and 33 % have little to no progress.

Generally speaking, there were minimal drought conditions heading into the freezup in 2015. El Nino conditions brought well below normal snowfall to much of the province over the 2015-2016 winter causing some water supply concerns, particularly in the southwest comer of Manitoba. By summer, above normal precipitation had alleviated any dryness and the province generally experienced above normal precipitation and flow conditions through fall and into the winter. At the end of 2016 no part of Manitoba was experiencing drought conditions.

There were generally very few drought impacts across the province in 2016. Drought impacts to agricultural operations were quite minimal during the 2016 growing season. Manitoba experienced below normal fire activity in 2016 with 202 wildfires and 38,408 hectares burned; about 20 % of the average area burned in a typical year. In Alberta and Saskatchewan, both the South and North Saskatchewan Rivers experienced very low flow conditions during June and July, resulting in low flows along the Saskatchewan River in Manitoba during this period. Local tributary runoff and above normal rainfall across much of the Prairies helped to alleviate any concerns over drought impacts occurring along the Saskatchewan River in Manitoba.

For more information on drought in Manitoba, please visit the Manitoba Drought Monitor website at http://www.gov.mb.ca/drought.

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Implementation of Manitoba's Drought Management Strategy

In January 2016, Manitoba released its Drought Management Strategy. The Strategy can be found at the Manitoba Drought Monitor website (www.gov.mb.ca/drought).

A number of action items are outlined in the strategy to increase Manitoba's resiliency to drought and minimize the impact of future droughts. Progress on the action items will be reported yearly through the Annual Water Availability and Drought Conditions Report. The action items and their current status of implementation are outlined below in Table 1 and summarized on Figure 1.

Table 1: Current status (as of January, 2016) of action items from the Manitoba Drought Management Strategy.

Action Items in Drought Strategy		Current Status
(1)	***Undertake studies related to water supply dams and reservoirs and the long-term effects of climate change on water supply and demand for river basins.***	**Little Progress.** In 2014, a study was conducted looking at long-term water supply planning in the Boyne River using regional climate model derived surface runoff.
(2)	***Establish drought committees to enable efficient information sharing and co-ordination of province-wide drought management efforts.***	**Some Progress.** The Manitoba Drought Assessment Committee is established and actively meets two times per year. The Red River Basin Drought Assessment Group is almost completely formed, while the remaining Basin Drought Assessment Groups will be assembled during 2017 to 2018.
(3)	***Collaborate with Manitoba Emergency Measures Organization to enhance the Manitoba Emergency Plan to include specific guidance for drought-related emergencies.***	**Some Progress.** Preliminary meetings have been held with the Emergency Measures Organization and a 'Drought Annex' to the Manitoba Emergency Plan will be developed over 2017-2018.
(4)	***Prepare regular Water Availability and Drought Conditions Reports which include drought indicators for each major river basin.***	**Ongoing.** Monthly conditions reports are published between March and October (more frequently if conditions require) and are available on the Manitoba Drought Monitor website. Annual summary reports will be available from 2016 onwards.
(5)	***Determine drought preparedness levels for each river basin.***	**Significant Progress.** A pilot drought preparedness assessment will be completed in 2017 for the Roseau River in southeastern Manitoba. A preparedness assessment has been initiated for the Boyne-Morris watershed and will be completed in 2017/2018. Other basins studies are to follow.
(6)	***Implement a drought stage approach to monitor drought and determine the necessary response to drought in Manitoba.***	**Little Progress.** Limited progress has been completed on this action item. More progress will follow as drought preparedness assessments are completed.
(7)	***Establish a Manitoba Drought Monitor website with up to date drought information.***	**Completed / Ongoing.** Website went live in early 2016: www.gov.mb.ca/drought. Conditions reports and other drought information are available. Flow monitoring charts for major streams and reservoir conditions are updated monthly.

(8)	***Undertake research to develop drought forecasting tools for Manitoba.***	**Some Progress.** In 2016, preliminary research was carried out to develop a statistical model based on climate data and antecedent moisture conditions to generate predictions of spring water supply availability in select agro-Manitoba watersheds.
(9)	***Evaluate and enhance meteorological, hydrometric, soil moisture, groundwater and other networks used for drought monitoring and drought indicator computation.***	**Some Progress.** A review of the existing network has been completed. Methods to enhance the current network such as integrating new data from other departments and sources are currently being explored.
(10)	***Participate in transboundary collaborations to better manage trans-boundary waters during drought.***	**Ongoing.** Manitoba currently has representatives on five transboundary committees or boards and is continually involved in transboundary drought-related management activity.
(11)	***Implement and promote drought mitigation strategies to increase drought resiliency and reduce long-term drought impacts. Prepare information and awareness materials regarding drought, water supply management and water efficiency.***	**Some Progress.** A component of the drought preparedness assessments is to make recommendations for viable drought mitigation measures based on sector-specific watershed vulnerabilities. Mitigation measures include a discussion on demand management and water efficiency.
(12)	***Periodically evaluate the Manitoba Drought Management Strategy to identify any gaps and update the strategy to incorporate new scientific methods and technologies.***	**Ongoing.** Every 5-10 years the Drought Management Strategy will be revisited to identify gaps and incorporate new scientific methods and technologies. Next update will be between 2021 and 2026.

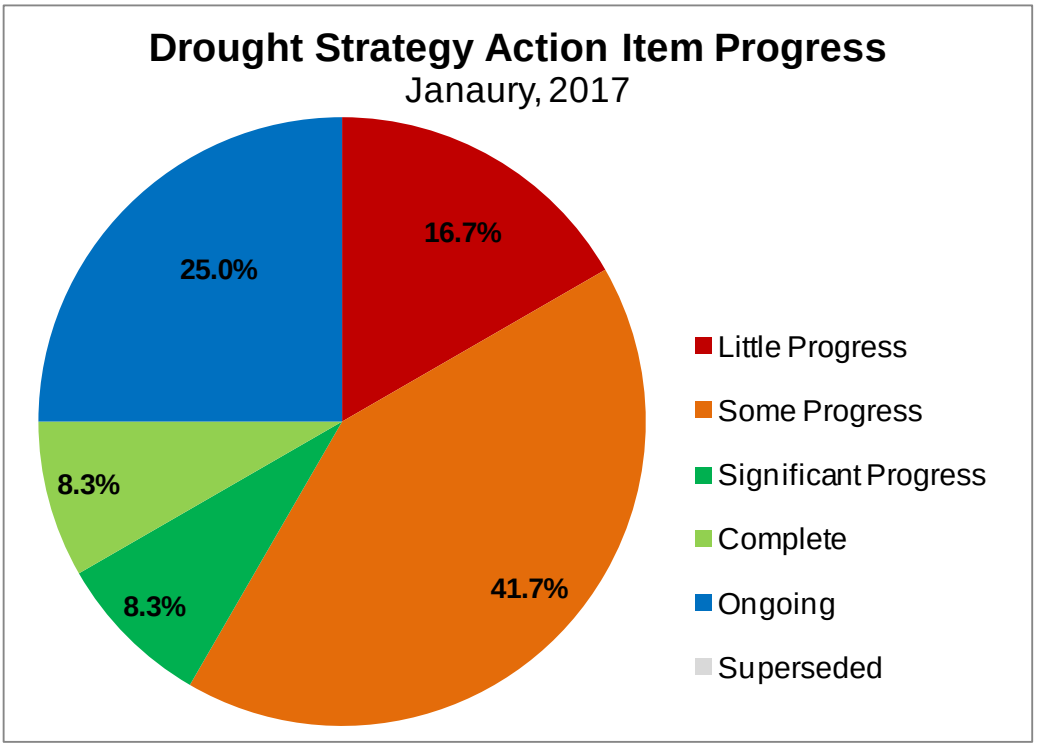

Figure 1: Manitoba Drought Management Strategy action item progress pie chart.

2016 Conditions Summary

Anticedent conditions (Fall Freeze-up, 2015)

Conditions at freeze-up can play a significant role in determining the amount of available water supply in the spring. Two key variables characterizing moisture conditions at freeze-up include soil moisture content and baseflows. Manitoba Infrastructure uses the Antecedent Precipitation Index (API; Figure 3) as a proxy for soil moisture at the time of freeze-up. The API is an indicator of wetness of a watershed as it is a weighted average of past precipitation amounts. Additionally, Manitoba Agriculture monitors soil moisture throughout agro-Manitoba, and publishes maps of the soil moisture content within the root zone just prior to freeze-up (typically early November; Figure 4).

Overall, most of Manitoba showed normal to above normal API during the fall of 2015. However, the southern portion of the Red River basin (major Manitoba river basins outlined on Figure 2) suggested below normal API conditions (50 – 85 % of normal). The upstream portions of the basins contributing waters to Manitoba (e.g. Saskatchewan, Assiniboine, Souris and Qu'Appelle Rivers) were generally classified as above normal API (115 – 150 % of normal) in Saskatchewan and normal API in Alberta. Manitoba Agriculture's soil moisture survey indicated that most of Manitoba was at 80 to 100 % of water holding capacity at the time of freeze-up, with some isolated pockets at less than 50 %. The survey results were confirmed by many local residents and producers.

As of December 1st, 2015, baseflow conditions along many of Manitoba's major rivers were much above normal. Generally, the tributaries and mainstem rivers within the Souris, Qu'Appelle, Assiniboine, and Saskatchewan watersheds were at or above the 90th percentile streamflow. Within the Red, Nelson, Hayes, and Winnipeg River basins, streamflows were still above normal; however they were closer to the 75th percentile. Conversely, in portions of the Churchill River Basin, most tributary and main-stem flows were generally normal or slightly above, except for the Cochrane River which was experiencing below normal conditions.

Overall, the normal to above normal soil moisture and baseflow conditions were cause for an optimistic outlook regarding spring water supply.

Winter 2015 / 2016 (December to March)

Strong El Niño conditions developed during fall 2015 due to warmer than normal sea-surface temperatures across much of the Pacific Ocean. These conditions persisted into spring of 2016 and significantly impacted temperature and precipitation patterns during this period. Over the 2015/2016 winter (November 1st, 2015 to March 30th, 2016), snowpack accumulation was lower than normal for much of Manitoba and temperatures were generally above average. Southwestern and central Manitoba, portions of the Interlake, and much of northern Manitoba received 40 to 85 per cent of average winter precipitation (Figure 5). This lack of snowfall caused some concerns for adequate replenishment of soil moisture, dugouts and water supply reservoirs from spring freshet flows.

Spring 2016 (March to May)

Spring came early in 2016 in southern Manitoba, with daily maximum temperatures well above zero beginning in early March, resulting in a mean monthly temperature difference of 3 – 5^{+} °C above

normal for the southern half of the province (Figure 6). These above normal temperatures in early and mid-March resulted in many of the southern tributaries reaching peak spring flows in mid-March, approximately one month earlier than normal (Figure 7). Although many rivers peaked at above normal flows, this was primarily due to the timing of the melt and not due the volume of melt water produced from the below normal snowpack. Additionally, high soil moisture and baseflows at freeze-up helped to supplement spring flows by offsetting the lack of snowfall observed over the 2015/2016 winter season. The Red, Boyne, Pembina, and Souris rivers had reasonably quick recessions, and therefore experienced moderately to extremely dry streamflow conditions for the month of April when compared to historical medians (Figure 7). Fortunately, widespread rains in mid-April (Figure 9) generated a second streamflow peak later in the month along these southern rivers and tributaries which brought them closer to normal. In May, most of southern Manitoba experienced normal (85 – 115 %) to above normal (>115 %) precipitation conditions. However, isolated pockets of moderately dry conditions did develop around Swan River, Gilbert Plains, and Fisher Branch.

Although much of southern Manitoba received above average precipitation during April, the central and eastern portions of northern Manitoba experienced severely (40 – 60 % of median) to extremely (<40 % of median) dry precipitation conditions in addition to a below normal winter snowpack. The main stem of the Churchill River upstream of the Churchill River Diversion experienced severely dry (between the 10th and 20th percentiles) to extremely dry (less than the 10th percentile) streamflow conditions during the spring of 2016 (Figure 8b). This translated into lower flows along the Burntwood River (the receiving river of diverted Churchill River flows) during the later part of this period. Downstream of the Churchill River Diversion along the Churchill main-stem below Fiddler Lake, streamflows remained closer to normal. Other northerly basins (i.e., Saskatchewan, Hayes, Taylor, Kettle, and Seal rivers; Figure 8) experienced normal to above normal (> 65th percentile) flows during March and April, which again were attributed primarily to above normal baseflows and the early start and quick timing of the melt. However, with the exception of the Seal River which was missing data, streamflow conditions in these watersheds decreased to below normal into the month of May due to a continued lack of precipitation. At the most severe point, both the Taylor and Kettle rivers dropped below the 10th percentile. There was an improvement in precipitation conditions in northern Manitoba during the month of May, as most of the region experienced normal amounts of precipitation with the exception of the areas surrounding Norway House and Gilliam which experienced moderately dry (60 – 85 % of median) to severely dry precipitation conditions. Missing data prevented reporting on conditions within the Hayes River Basin for much of 2016.

Summer 2016 (June to September)

The summer of 2016 was generally quite wet across southern Manitoba, with most of the region experiencing normal to above normal precipitation conditions from June through September (Figure 10; Figure 11). This above normal precipitation resulted in normal to above normal streamflow conditions in the Red River, Assiniboine River, Lake Manitoba, Lake Winnipeg and Winnipeg River basins throughout the entirety of the summer months and into the fall season (Figure 7). Although conditions were generally wet, in June 2016 much of the Interlake and portions of the Lake Manitoba Basin experienced moderately to severely low precipitation amounts. Fortunately, July and August brought normal to above normal precipitation within the region to alleviate the developing precipitation

deficit. However, the Interlake again saw a lack of precipitation during September 2016, when monthly totals dropped to as low as 40 % of median surrounding the Fisher Branch, Arborg and Gimli region.

During June and July 2016, upstream in Alberta and Saskatchewan both the South Saskatchewan and North Saskatchewan Rivers (and many of their tributaries) experienced very low flow conditions. Flows were at historical lows in some areas. These low flows upstream translated into decreasing flows along the Saskatchewan River in Manitoba. Towards the end of June 2016, the flow at The Pas was at approximately the 10th percentile for that date (Figure 8a). Although the larger Saskatchewan River Basin was very dry due to lower than normal 2015/2016 winter snowpack and spring precipitation, particularly in the Alberta headwaters (Figure 5), the Manitoba reach of the river benefitted from above normal flows entering the Saskatchewan River system from the Sturgeon-Weir and Carrot Rivers. Flows began to increase during the second half of July 2016 due to above normal rainfall throughout much of the Prairies that helped to alleviate some of the dry conditions. By the end of August 2016, the flow at The Pas was above normal.

In northern Manitoba, much of the western region experienced normal or above normal precipitation from June through August (Figure 10; Figure 11). However, the central and eastern regions continued to experience below average precipitation conditions during the same period. For example, in June 2016, the regions surrounding Thompson and Gillam were considered moderately to extremely dry. These conditions persisted around Gillam into the month of July, and extended south west throughout most of the Hayes River Basin (Figure 10). Due to these dry conditions, the Kettle River near Gillam dropped to extremely low flows during the months of June and July. The Churchill River Basin upstream of the diversion recovered in late July from the extremely low flows it was experiencing earlier in 2016. This was due to above normal precipitation in the basin's headwaters in north central Saskatchewan during June and July, 2016. Due to the low flows along the upper Churchill River and the operation schedule of the Churchill River Diversion, the Burntwood River also experienced severely low flows during this period. Diverted Churchill River outflows through Notigi Control Structure were increased to near maximum in late July and August in response to the recovery in inflows to Southern Indian Lake. Diversion flows were then decreased for the September to November period for Manitoba Hydro system needs, and later increased to maximum in December for the winter. The Burntwood River observed above normal flows from August onwards into fall. The lower Churchill River (below Fiddler Lake; downstream of the diversion) generally observed moderately to severely low flows during the summer, with periods of normal flows during late August and early September 2016. Unaffected by below normal precipitation, the Taylor and Seal Rivers typically observed normal to above normal flows through the summer and into fall. Missing data prevented reporting on conditions within the Hayes River Basin from June to September.

Fall Freeze-up and early winter, 2016 (November and December)

The Hydrologic Forecasting Centre's 2016 fall API (Figure 12) suggested that soil moisture conditions throughout most of Saskatchewan, southwestern Manitoba and most of northern Manitoba were above normal (115 – 150 %) to well above normal (> 150 %) at the time of freeze-up. Conditions were classified as normal within central and eastern Manitoba, with some pockets of below normal (50 – 85 %) within the Interlake region and an above normal region near the International Border. The United

States portion of the Red River Basin generally had normal API. However there were pockets of below normal conditions, and a region of above normal conditions in the centre of the basin.

Manitoba Agriculture's November soil moisture survey (Figure 13) indicated there were some drier regions (< 65 % soil moisture content) in the Interlake, central and southwestern parts of the province. However, most of southern Manitoba was estimated to be at 85 to > 95 % of soil moisture content, indicating very wet conditions overall.

Precipitation accumulation from November 1st, 2016 to December 31st, 2016 was generally normal (85 – 115 %) to above normal (115 – 150 %) across most of ago-Manitoba, with areas of above normal accumulation (150 – 200 %) in the Interlake, central and southeast regions (Figure 14). Regions of below normal (60 – 85 %) to well below normal (40 – 60 %) include northwest agro-Manitoba and a few small pockets in the southwest region of the province. The central and eastern portions of northern Manitoba had very low snow accumulation, with typical per cent of normal ranging from 60 % to below 40 %. Across most of Saskatchewan and large portions of Alberta, accumulated precipitation was also below normal (60 – 85 %) to well below normal (40 – 60 %), while some regions showed less than 40 % of normal.

As of December 31st, 2016 baseflow conditions throughout the province were essentially all above normal, with many rivers and lakes at record high flows and levels for this time of year (e.g., Figure 7; Figure 8).

2016 Drought Impacts

Water Supply Impacts

There were some initial concerns over water supply within regions of the Red and Souris River basins due to the below normal snowpack during the 2015/2016 winter. However, by May 2016, most Manitoba water supply reservoirs were close to or at 100 % of full supply level. Elgin Reservoir did not reach full supply level until late summer. The reservoir had been deliberately dewatered in the fall of 2015 for fish management purposes and low snow accumulation in southwestern Manitoba resulted in a lack of runoff in the region to refill the reservoir. The reservoir is used primarily for recreation and low levels did not cause any significant impacts.

Field staff indicated that irrigators along the Boyne River and tributaries of the Morris River (Buffalo Creek, Hespeler and Rosenheim Drains) in central Manitoba were for the most part successful in filling their irrigation reservoirs with runoff from the spring melt. Producers located along tributaries of the Whitemud River (Squirrel and Pine Creeks) also indicated adequate runoff to fill irrigation reservoirs.

Manitoba Agriculture reported that on-farm dugout conditions were generally adequate throughout the spring and summer months. Within the southwest region of the province, dugouts were about 70 - 80 % full after spring melt and by July 2016 were at full capacity or overfull in 95% of the province.

Agricultural Impacts

Agricultural impacts were assessed through Manitoba Agriculture's bi-weekly Crop Reports and the Agroclimate Impact Reporter (AIR). The AIR is a Canadian database of agroclimate impacts that is managed by the National Agroclimate Information Service of Agriculture and Agri-Food Canada. Overall, drought impacts to agricultural operations were generally quite minimal during the 2016 growing season.

As of May 2nd, seeding operations were underway in many areas of agro-Manitoba due to favourable weather and field conditions. Drier topsoil conditions were noted in some areas. During the month of April, three municipalities in southwest Manitoba (Winchester, Argyle, and Clanwilliam) reported minimal drought impacts on agricultural operations related to short-term dryness slowing crop/pasture growth.

By the end of May 2016, seeding was 96 % complete. Throughout most of agro-Manitoba, May rainfall helped alleviate the drier than desired soil conditions that were present earlier in the month. The exception was the northwest crop reporting district which received extremely variable and spotty precipitation during May. During this month, eight municipalities in southwest Manitoba (Wallace, Woodworth, Sifton, Arthur, Winchester, Daly, Clanwilliam, Killarney), four municipalities in central Manitoba (Lorne, Grey, Rhineland, Macdonald), and one eastern municipality (Stuartburn) registered minimal drought impacts on agricultural operations with the Impact Reporter related to short-term dryness. The RM of Macdonald indicated that some moderate drought impacts to agriculture had occurred including moderate damages to crops/pasture and some developing water shortages. The rainfall at the end of May alleviated any drought concerns in these regions.

Throughout June to September excessive moisture was the primary concern, as crops showed signs of yellowing and in some instances death due to wet and saturated soil conditions. One municipality within the Interlake region (Grahamdale) registered moderate drought impacts on agricultural operations and a second municipality in northwest agro-Manitoba (Minitonas) reported minimal drought impacts during June 2016 when moderately to severely dry precipitation conditions occurred in those regions (recall: Figure 10). Drought impacts in these municipalities were related to short-term dryness and potentially moderate damage to crops. No drought impacts to agriculture were reported in July or August 2016. However the RM of Wallace in southwestern Manitoba registered minimal impacts to agricultural operations due to drought conditions in September 2016.

Wildfires

The Provincial Wildfire Program reported that the unseasonably warm weather in early March seemed to indicate that 2016 would be a busy fire season. However, fire activity was slowed due to cooler weather until early May when two large fires ignited in southeastern Manitoba along the Manitoba-Ontario border. Mandatory evacuation orders were put in place during the first week of May for Beresford Lake and Wallace Lake cottage subdivisions, Caddy Lake (including Ingolf and West Hawk Lake), and Florence and Nora Lakes. Additionally, travel restrictions were implemented and some hiking trails were closed until wildfire conditions improved. Crews were successful in controlling the wildfires and mandatory evacuation orders were lifted in mid to late May. Timely rains in May and

June reduced the risk of wildfires, and dampened most activity through the month of June making what looked like a busy year slow down to a below average year.

In northern Manitoba, the community of Easterville and Chemawawin First Nation was evacuated on June 23rd due to smoke and threat from wildfires. However, no structures within these communities were damaged or lost to the fires. In early July 2016, the Provincial Wildfire Program indicated that fire activity was best characterized as being slow or stalled in the south and normally active in remote areas of the north for that time of year. Conditions throughout the remainder of the summer did not result in any additional fires occurring within the southern half of the province. As of early August, fire activity was classified as below normal in remote areas of the north due to rainfall and high humidity conditions. During August and September, only 15 wildfires ignited, burning just over 3,000 hectares.

Throughout Manitoba in 2016 there were a total of 202 wildfires and 38,408 hectares burned (Table 2). Comparing 2016 to historical wildfire data, this year's fire activity can be classified as well below normal. The total area burned equaled only 19 % of the average total area burned based on 101 years of data (Figure 15).

Table 2: 2016 wildfire activity (number of fires and total area burned) broken down by region.

Region	Northeast	Northwest	Western	Central	Eastern	Total
Total Fires	104	23	7	32	36	**202**
Total Area Burned (hectares)	19,130	685	120	1,789	16,683	**38,408**

Acknowledgements

This report was prepared with information from the following sources which are gratefully acknowledged:

- Manitoba Infrastructure: Reservoir level information:
  http://www.gov.mb.ca/mit/floodinfo/floodoutlook/river_conditions.html
- Environment and Climate Change Canada: Flow and lake level information:
  http://www.wateroffice.ec.gc.ca/index_e.html
- Manitoba Sustainable Development's Fire Program:
  http://www.gov.mb.ca/conservation/fire/
- Environment and Climate Change Canada three month climatic outlook:
  http://weatheroffice.gc.ca/saisons/index_e.html
- Manitoba Agriculture:
  http://www.gov.mb.ca/agriculture/crops/seasonal-reports/crop-report-archive/index.html
- Agriculture and Agri-Food Canada: Agroclimate Impact Recorder:
  http://www.agr.gc.ca/air
- Agriculture and Agri-Food Canada: Drought Watch:
  http://www.agr.gc.ca/drought
- Manitoba Infrastructure:
  http://www.gov.mb.ca/mit/
- National Oceanic and Atmospheric Administration: ENSO: Recent Evolution, Current Status and Predictions:

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf

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Past reports are available at: www.gov.mb.ca/drought

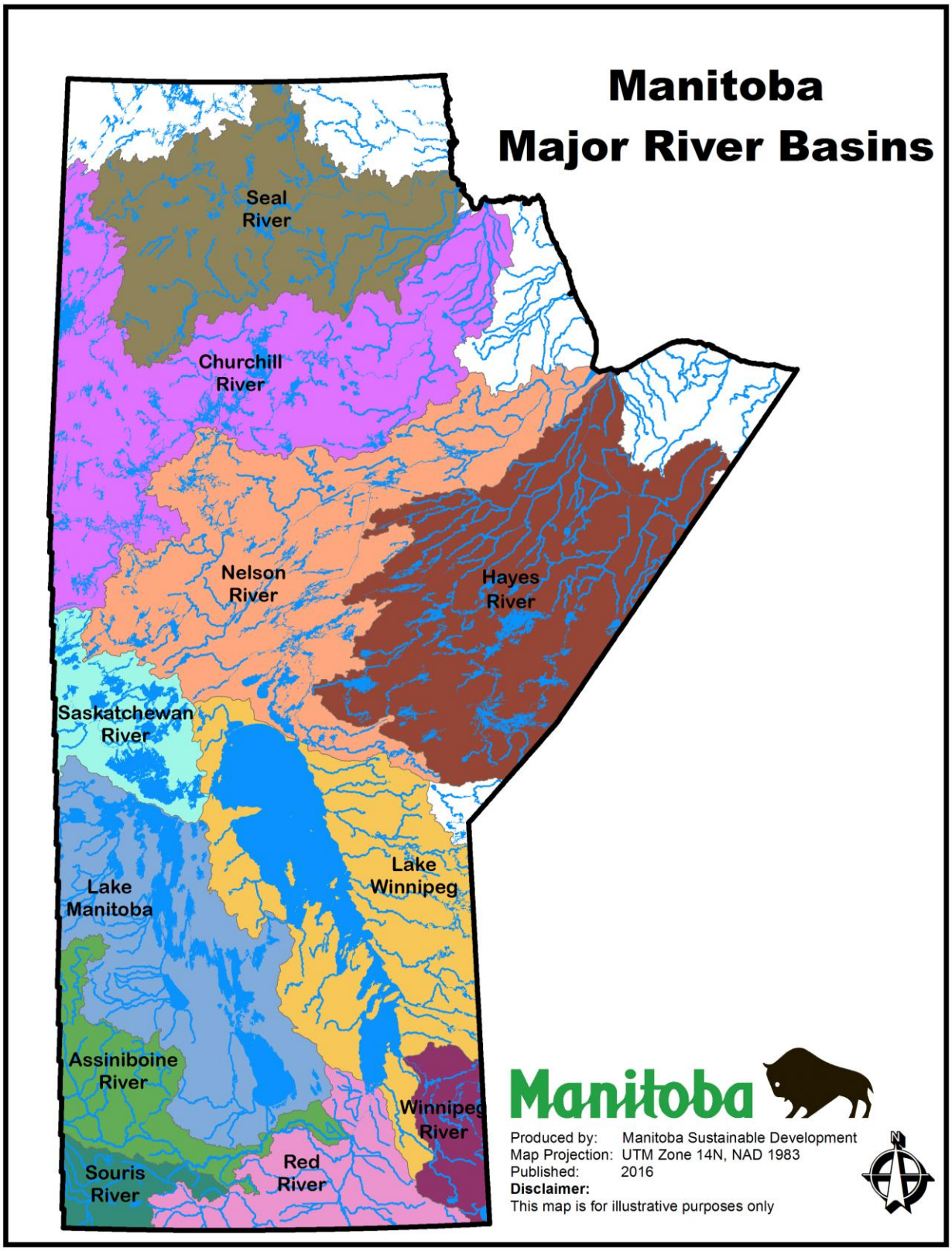

Figure 2: Major Manitoba river basins.

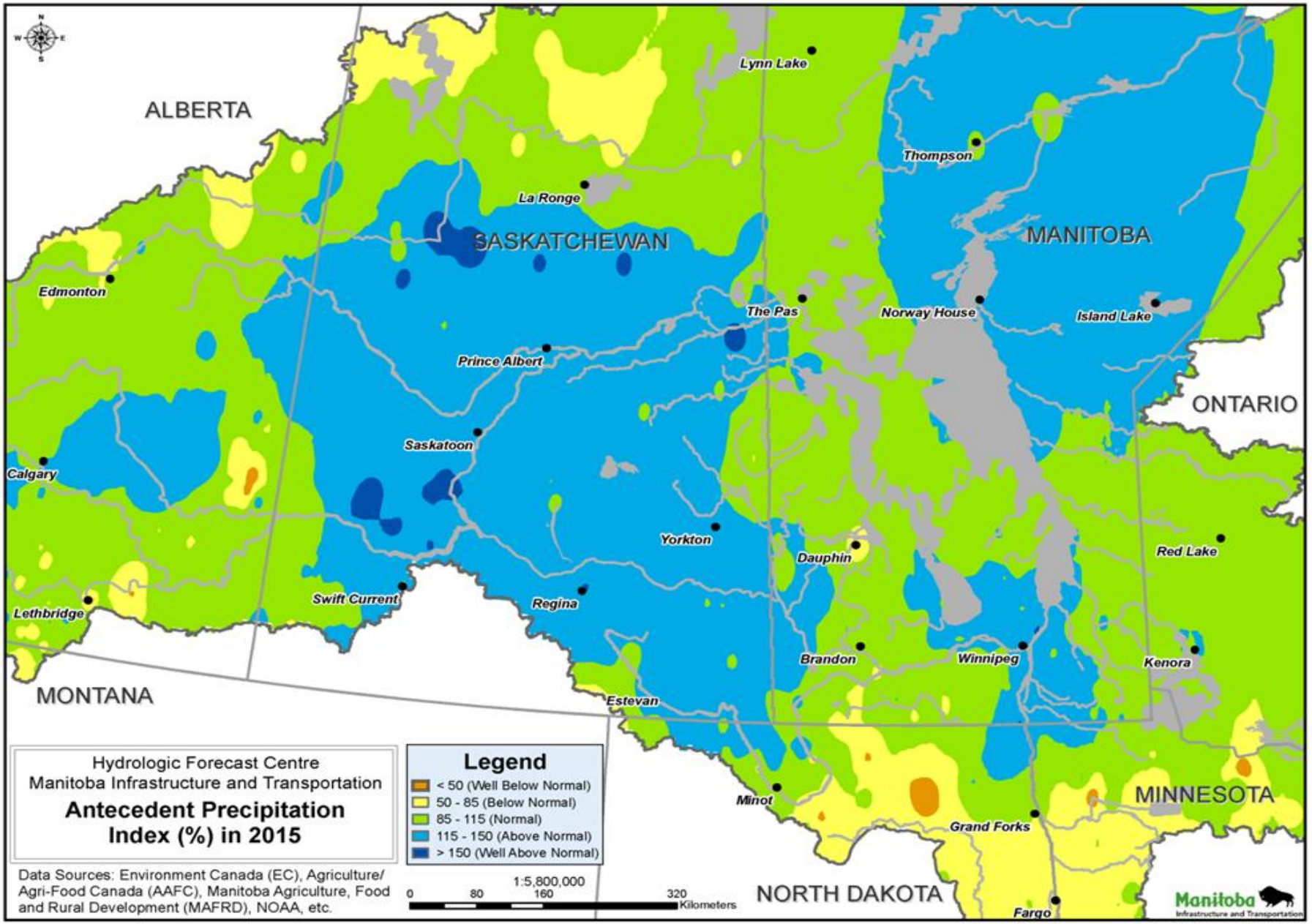

Figure 3: Manitoba Hydrologic Forecasting Centre's Antecedent Precipitation Index (API) for the fall of 2015.

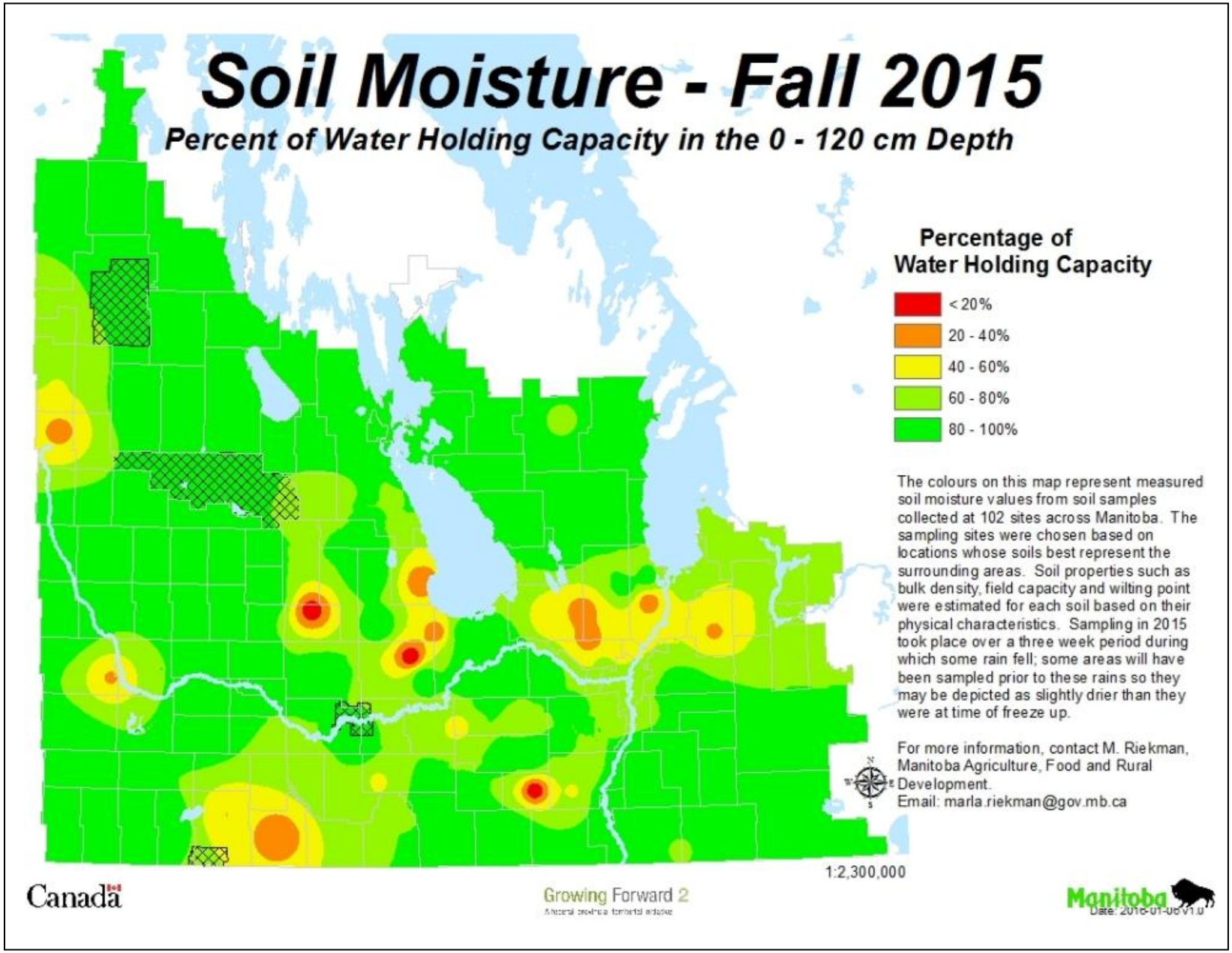

Figure 4: Manitoba Agriculture's fall 2015 soil moisture survey – per cent of water holding capacity (0 – 120 cm depth).

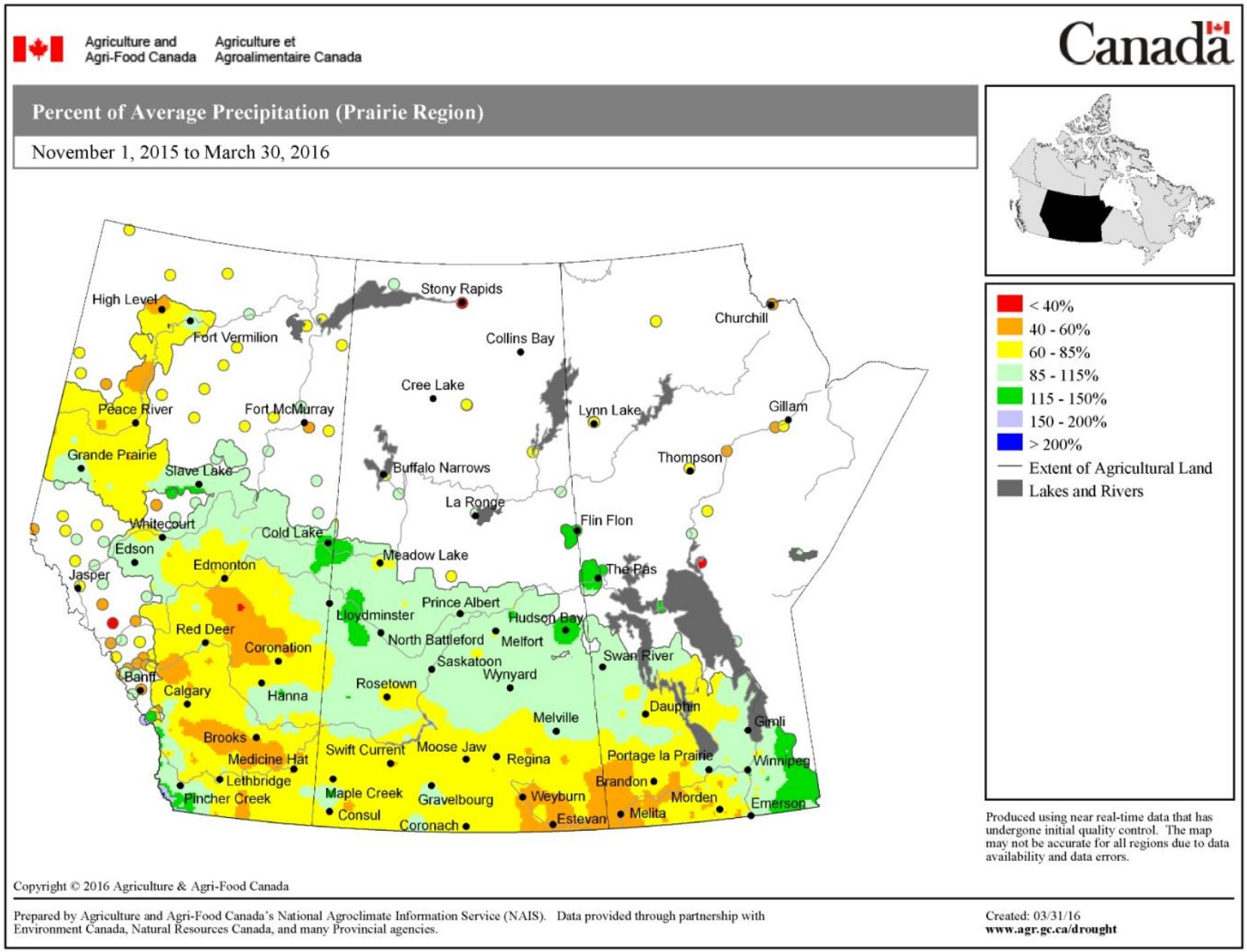

Figure 5: Agriculture and Agri-Food Canada's winter season (November 1st, 2015 – March 30th, 2016) percent of average precipitation.

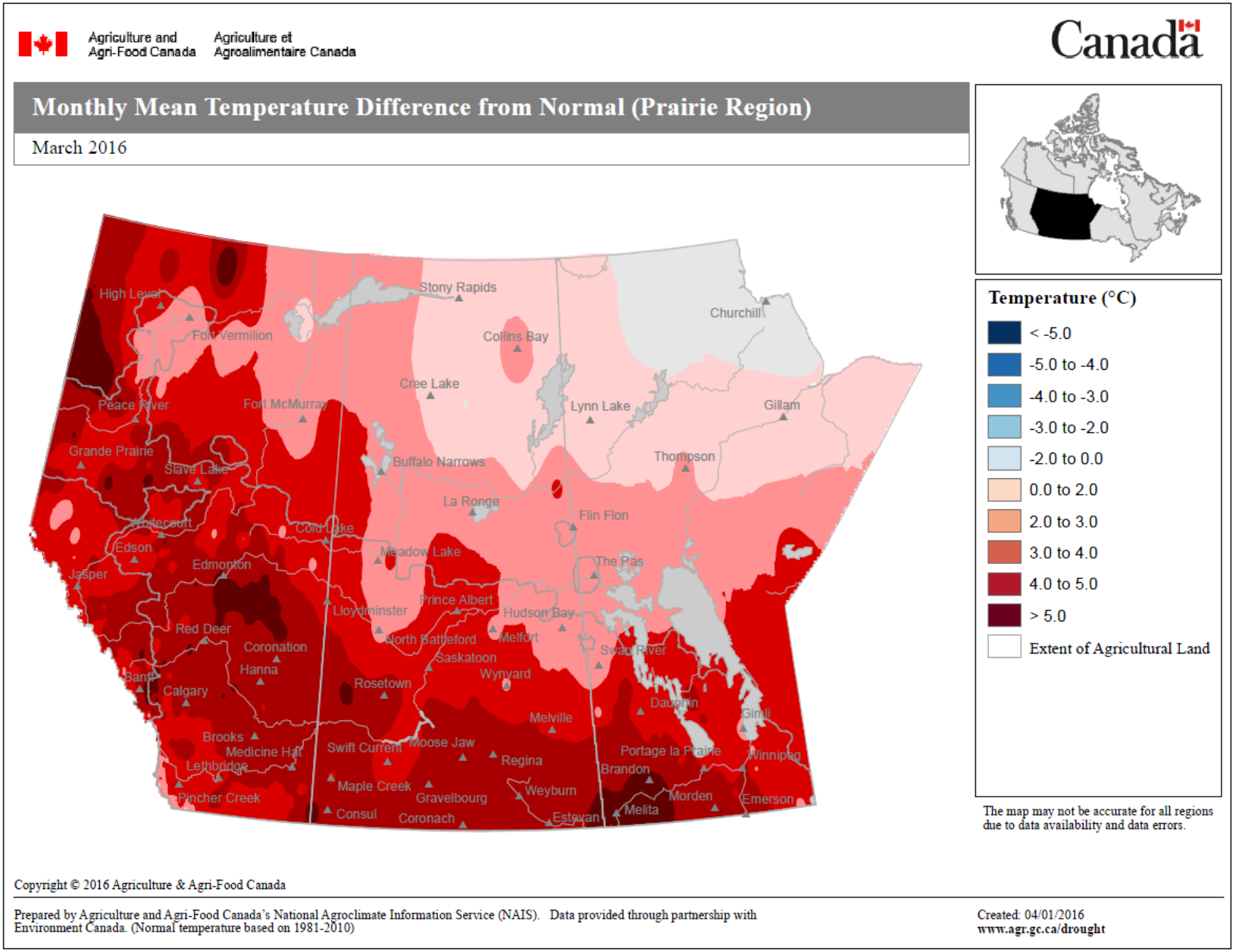

Figure 6: Agriculture and Agri-Food Canada's mean monthly temperature difference from normal for the month of March, 2016.

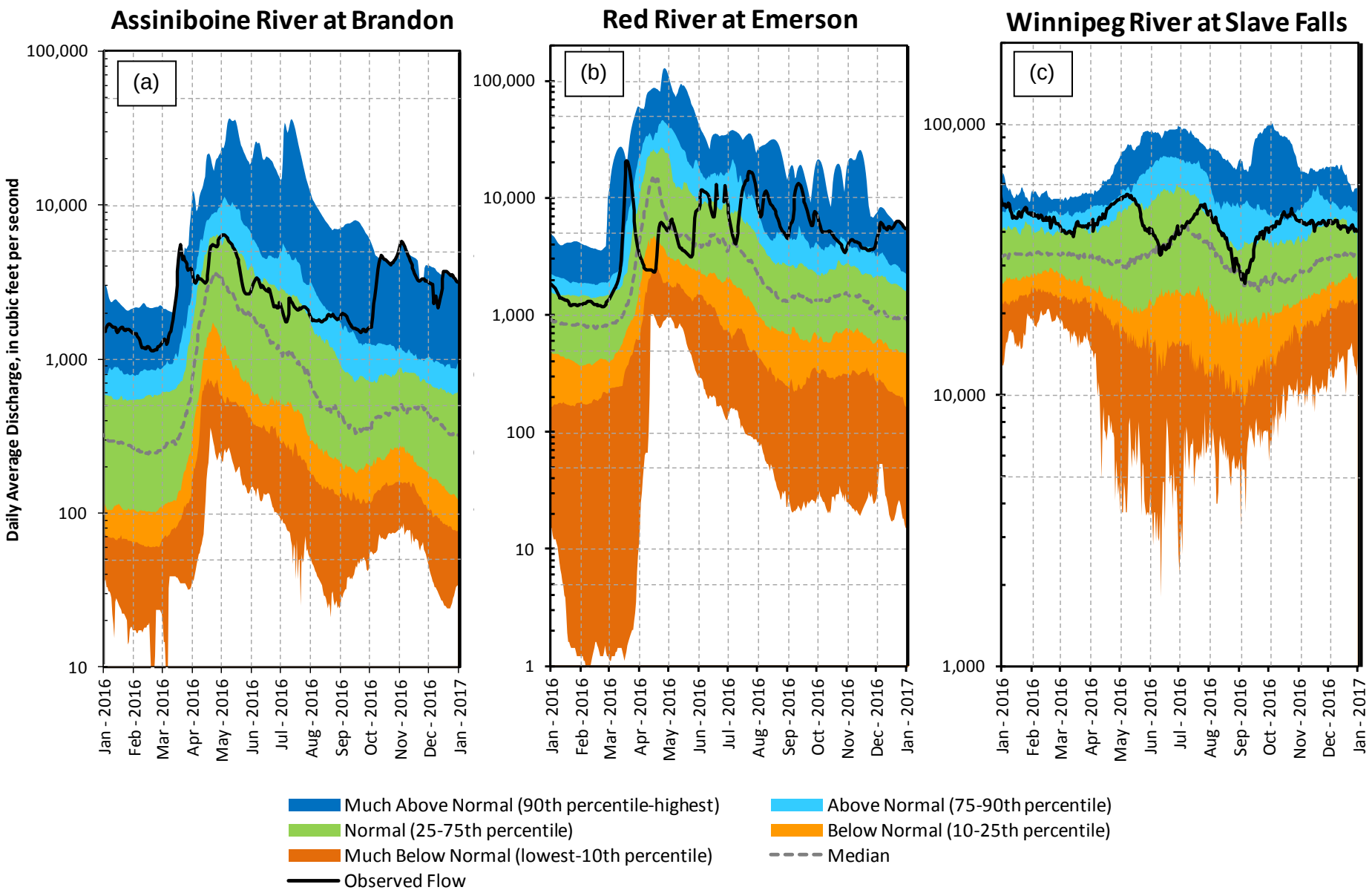

Figure 7: Daily streamflow percentile plots for the mainstem (a) Assiniboine, (b) Red, and (c) Winnipeg Rivers for 2016.

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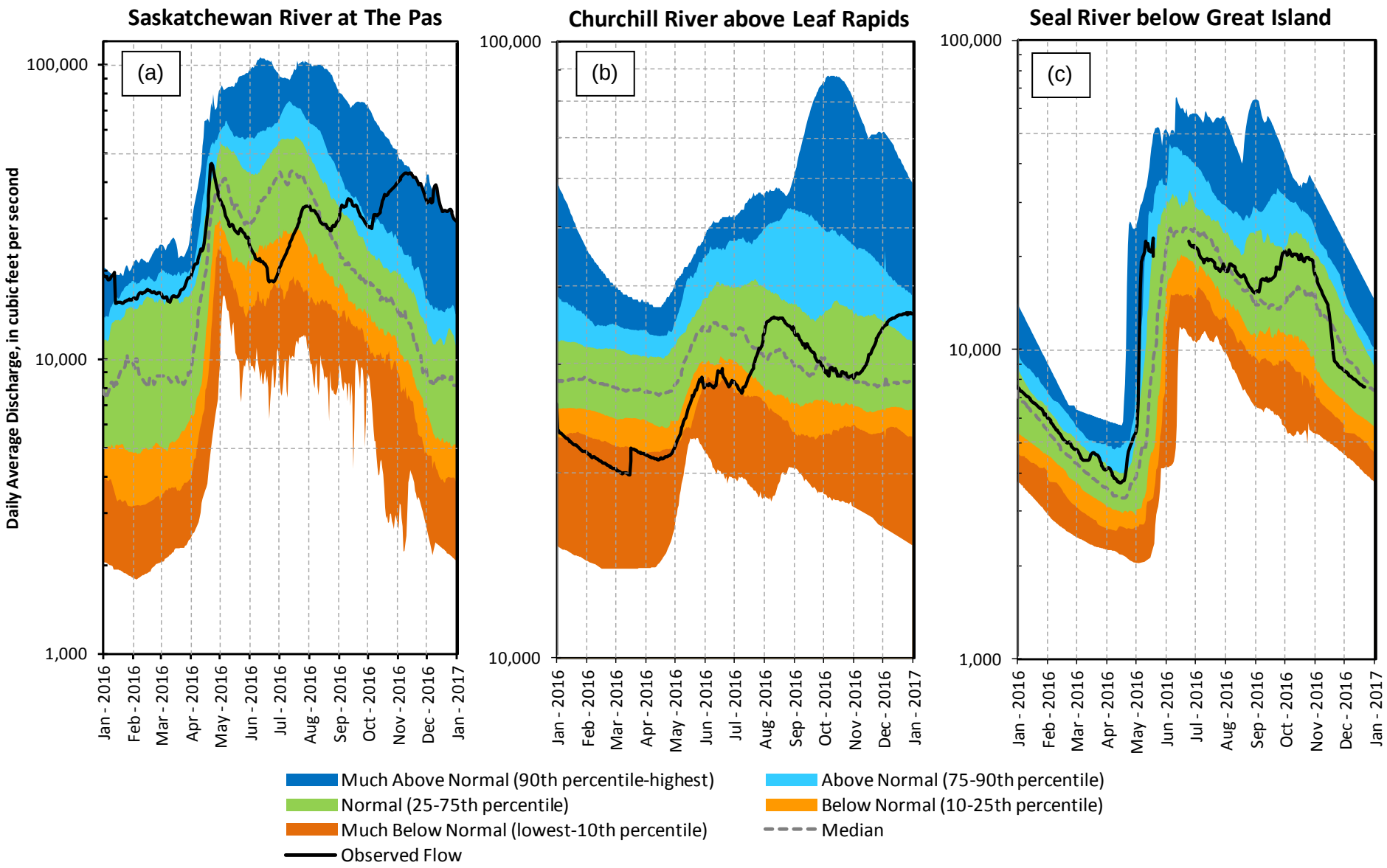

Figure 8: Daily streamflow percentile plots for the mainstem (a) Saskatchewan, (b) Churchill, and (c) Seal Rivers for 2016.

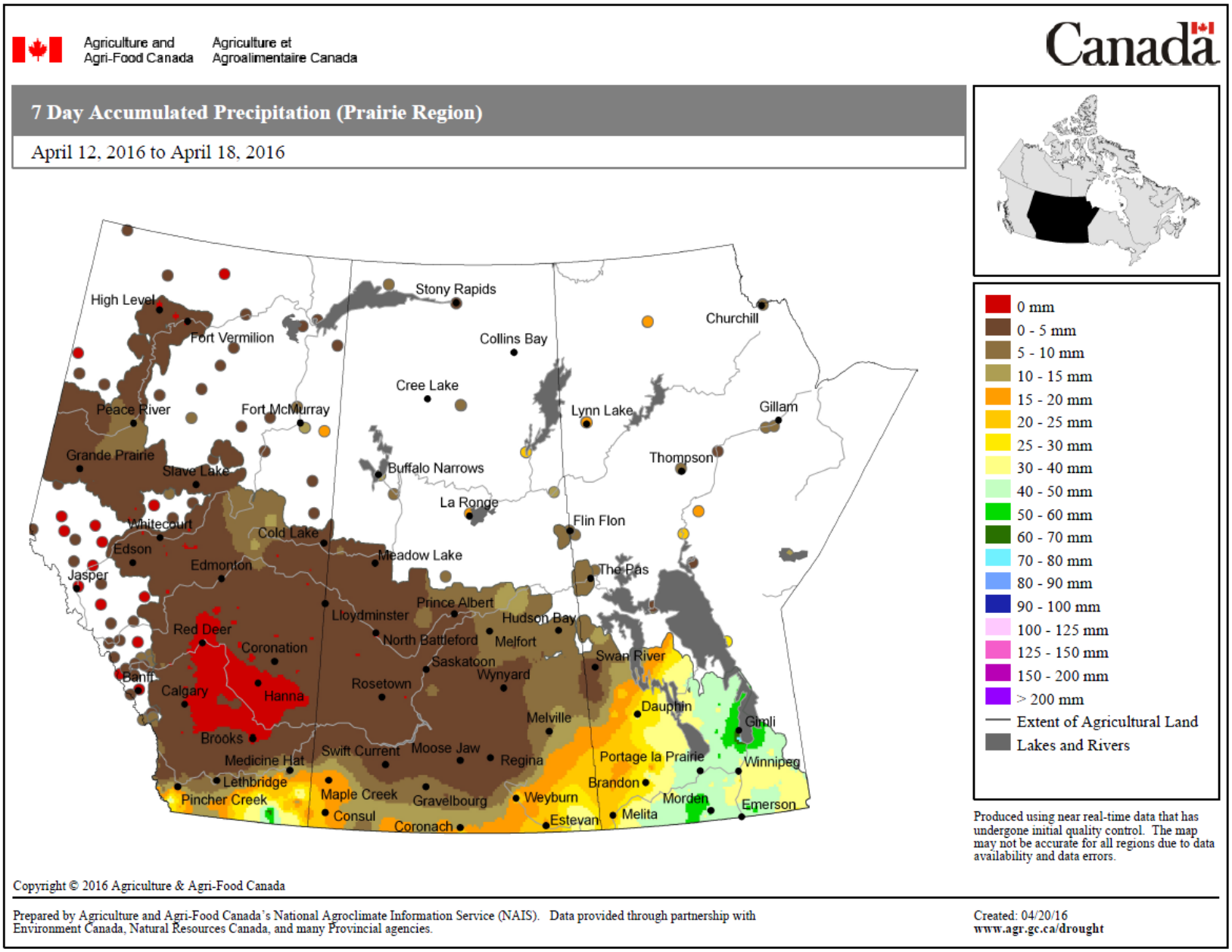

Figure 9: Agriculture and Agri-Food Canada's map of total precipitation from April 12th, 2016 to April 18th, 2016 (seven day total).

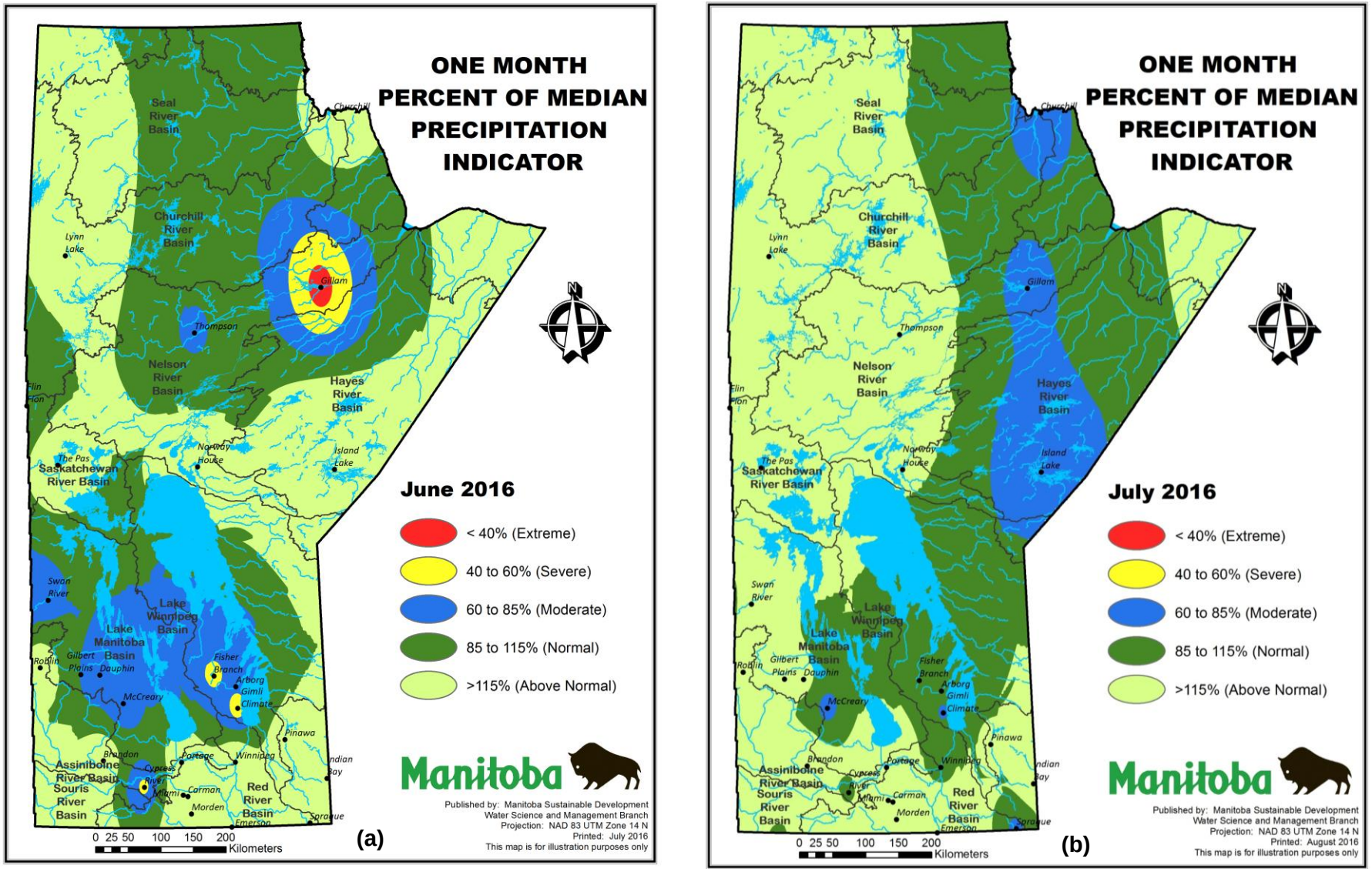

Figure 10: One month per cent of median precipitation indicator for (a) June 2016 and (b) July 2016.

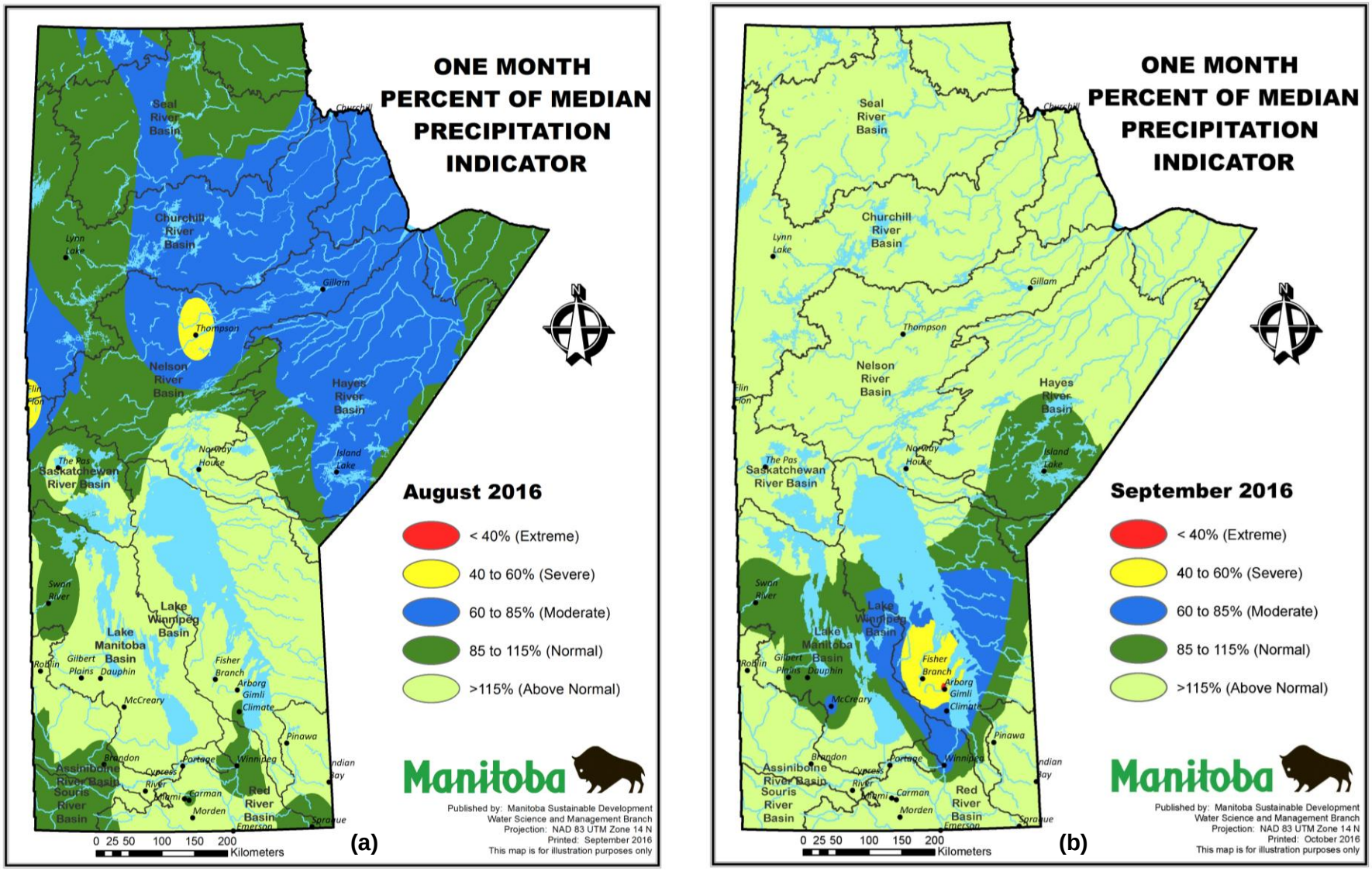

Figure 11: One month per cent of median precipitation indicator for (a) August 2016 and (b) September 2016.

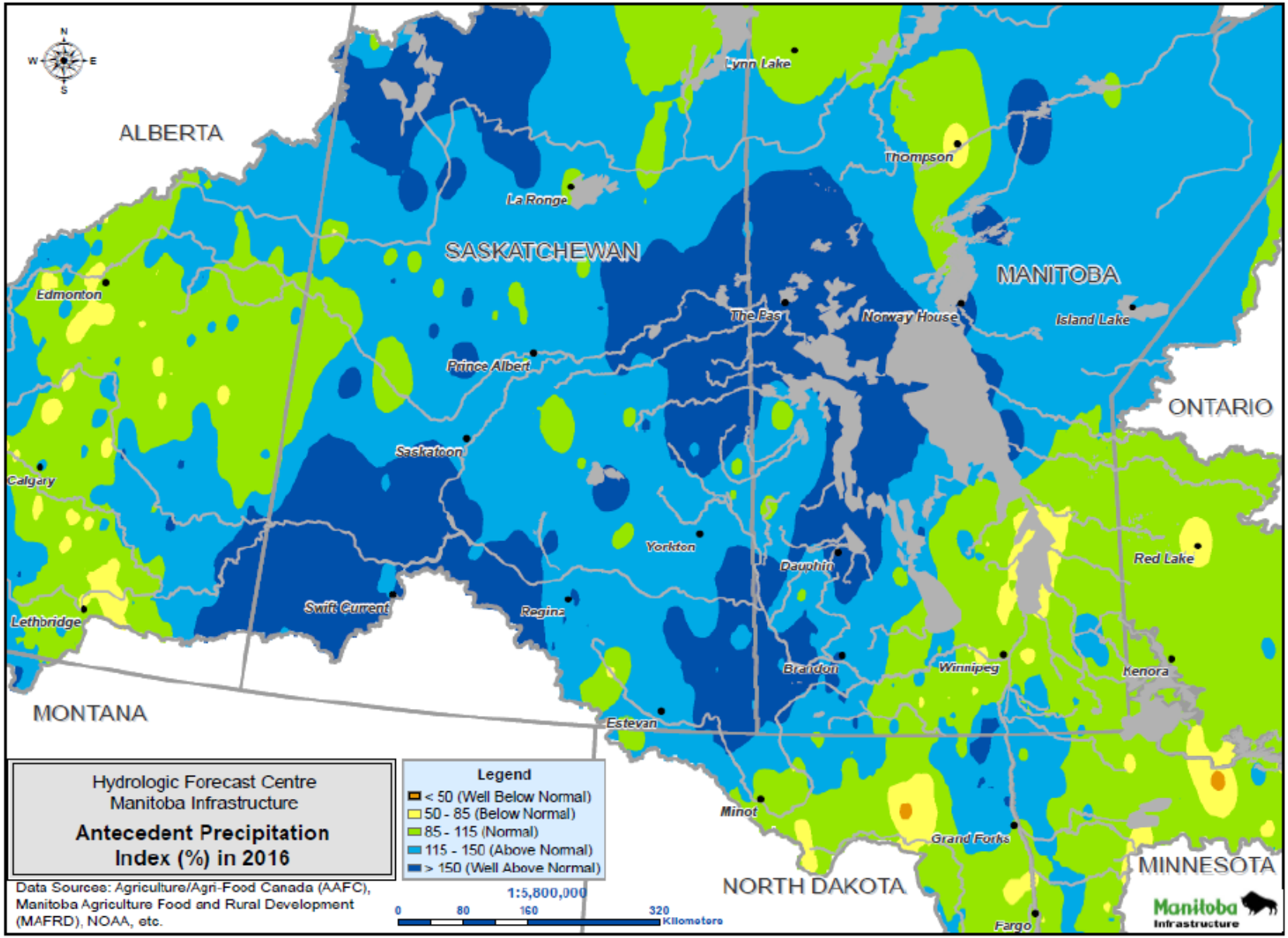

Figure 12: Manitoba Hydrologic Forecasting Centre's Antecedent Precipitation Index (API) for the fall of 2016.

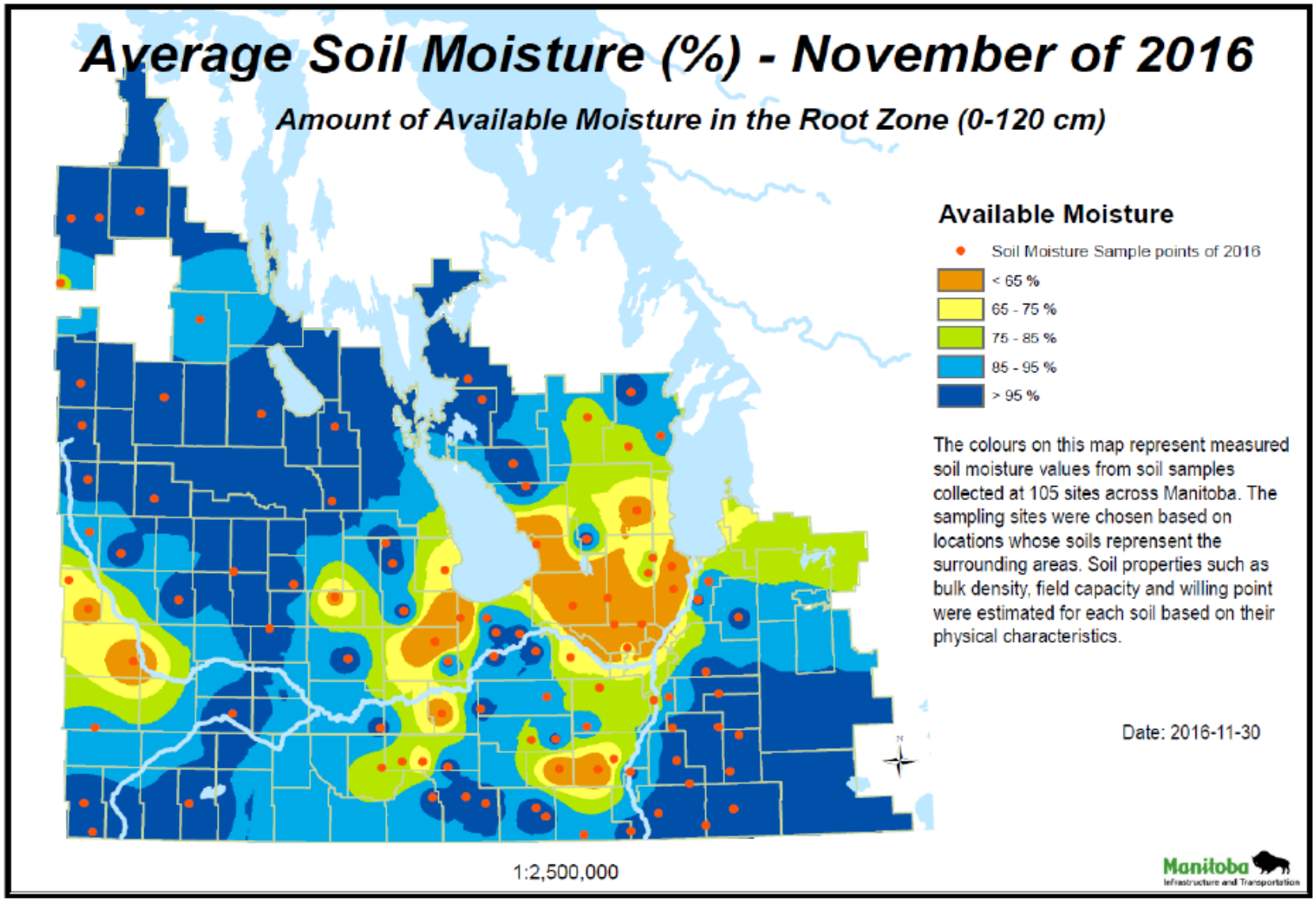

Figure 13: Manitoba Agriculture's fall 2016 soil moisture survey – average soil moisture (0 – 120 cm depth).

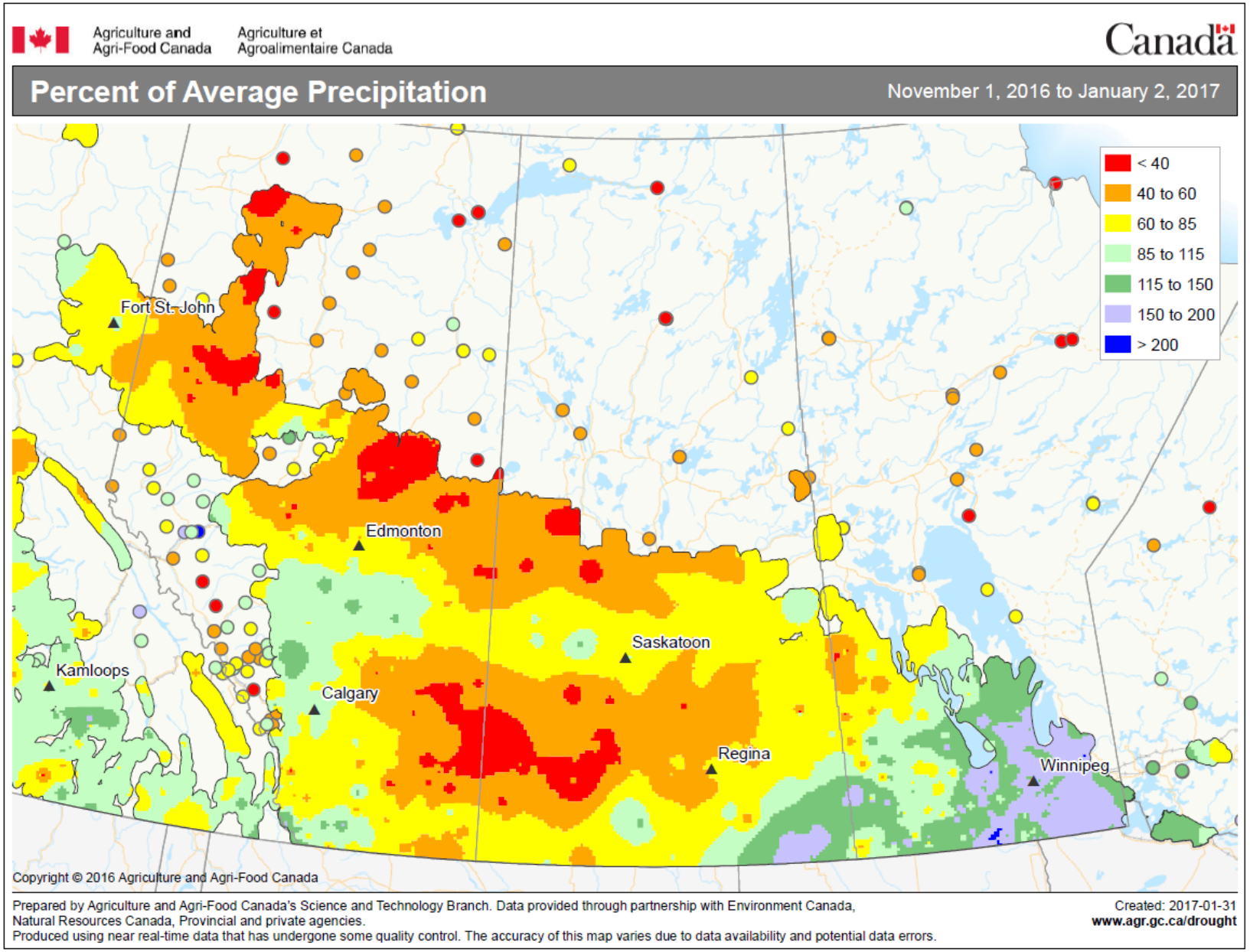

Figure 14: Agriculture and Agri-Food Canada's winter season (November 1st, 2016 – January 2nd, 2017) per cent of normal precipitation.

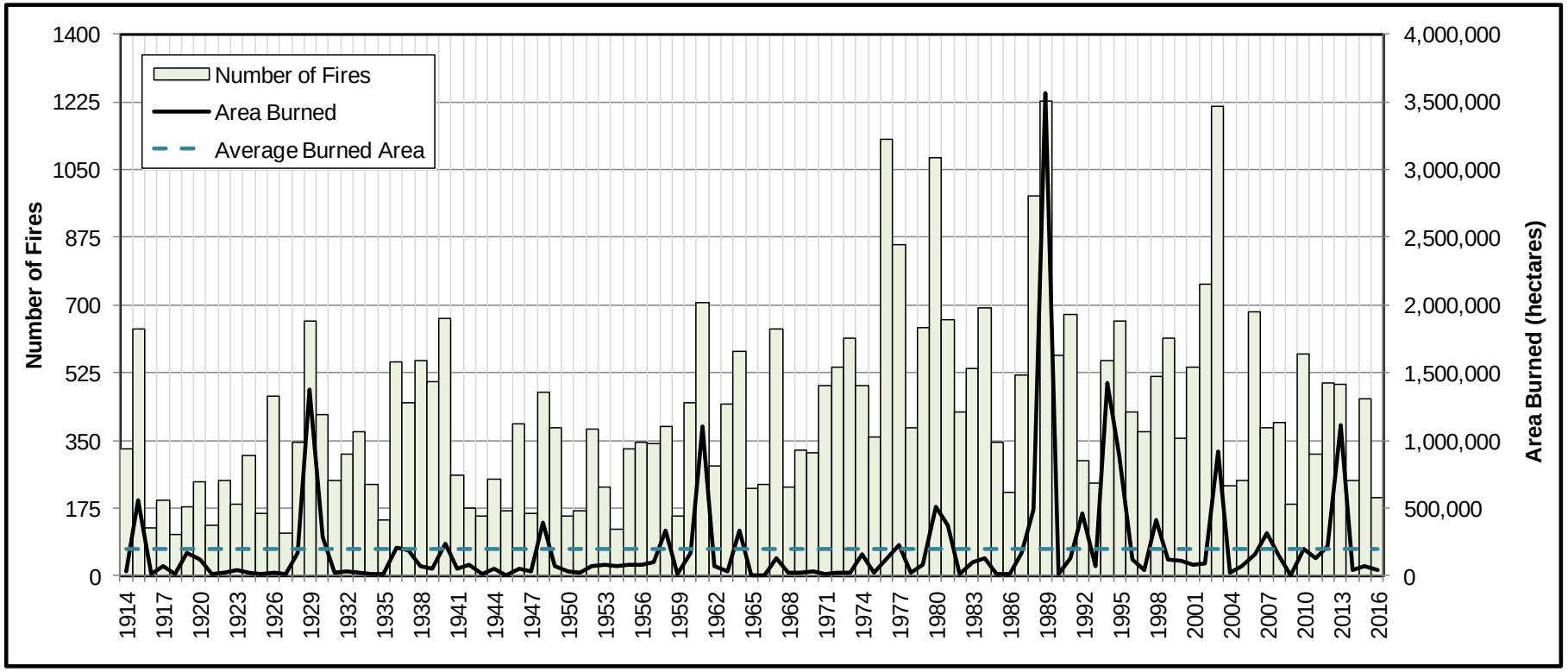

Figure 15: Manitoba Fire Program historical wildfire data from 1914 to 2016.