SASKATCHEWAN

Water Security Agency

Preliminary Runoff Outlook

February 1, 2024

Prepared by: Flow Forecasting and Operations Planning - Water Security Agency

Executive Summary

- The Water Security Agency continues to monitor moisture conditions and forecast weather patterns to prepare for spring runoff.
- Most of Saskatchewan experienced below-normal precipitation in 2023, leading to dry conditions before freeze-up, especially in the western region from Leader to Lloydminster.
- The current snowpack ranges from below to well-below normal. If below normal conditions persist, this could result in drier than normal conditions and localized water supply shortages, especially in the agriculturally significant western region.
- Despite dry conditions, major water supply reservoirs in southern Saskatchewan are mostly at or above normal levels, except for Avonlea and some in the southwest (e.g., Altawan and Cypress) that may face surface water supply concerns due to depleted snowpack.
- In anticipation of potential dry summer conditions, the agency has implemented a conservative overwinter operating plan for Lake Diefenbaker that focuses on retaining water supplies for all users including Moose Jaw, Regina, Saskatoon, other communities, industry and producers.
- In the Souris Basin, reservoirs are projected to be within normal operating ranges.
- In the Quill Lakes Basin, if normal snow conditions remain, well below normal runoff is expected.
- All lakes within the Qu'Appelle River Basin are at near normal levels for this time of year and are expected to remain in the normal operating range.
- Long-range forecasts predict near-normal precipitation and warmer temperatures than usual across Saskatchewan from February to April, with the southern areas experiencing the highest temperature increases.
- Indicators suggest that there is a higher risk of agricultural and hydrological drought this year. The Water Security Agency will monitor landscape conditions and water supply reservoirs closely to allow for timely response to dry conditions. The agency will also continue to work internally and across government to identify opportunities and programming to support communities and residents in times of drought.

Cover Photo: Sturgeon River January 18, 2024
Credit: Dylan McDonald, WSA

Spring Runoff Potential

To facilitate preparations for spring runoff in 2024, the Water Security Agency (WSA) issues a preliminary runoff outlook. The projected snowmelt runoff potential for the province, based on conditions as of February 1, 2024, is shown in Figure 1. Average climatic conditions between February 1 and the spring melt were assumed when developing the spring runoff potential map. The runoff potential was determined based on the conditions at freeze-up (Figure 2) and the snowfall received to date this winter (Figure 4).

Below average snow conditions, in combination with the generally dry fall conditions, has resulted in a well below normal runoff expectation across most of the province. The only exception is the far southeast, where soil conditions were a little better in the fall, and the snowpack is not as depleted as other areas, which has resulted in a below normal runoff expectation.

Snowfall throughout the remainder of the winter, and the melt rate, is expected to have a significant impact on runoff yields. A slow melt will result in most of the snowpack recharging the soil column. A rapid melt is likely needed to result in more runoff to replenish surface water supplies throughout the province. Without an above normal runoff, drought conditions are expected to persist or even worsen this spring across most of the province.

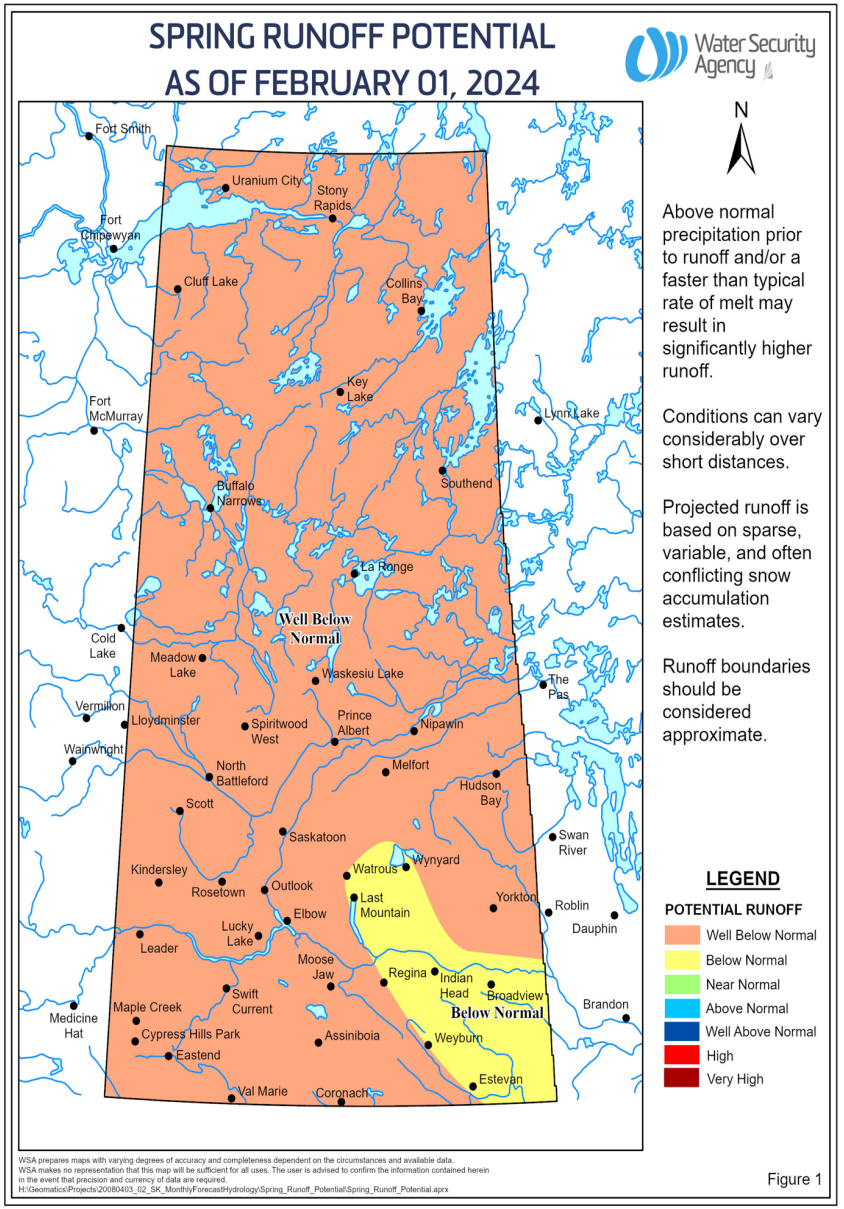

Figure 1: Spring Runoff Potential as of February 1, 2024

Fall Precipitation and Soil Moisture Conditions

As outlined in the 2023 Conditions at Freeze-up Report, across most of the province, precipitation accumulations in 2023 were well below normal, which resulted in generally dry conditions at freeze-up. Conditions were driest in the west, encompassing an area extending from the Leader region north to Lloydminster and west to Saskatoon. In this area, extreme agricultural drought conditions were present prior to freeze-up.

In the southwest and southeast corners of the province, heavier rainfall in the fall resulted in near normal soil moisture conditions going into freeze-up. Across the remainder of the province, topsoil moisture conditions were generally below to well below normal.

An early snowfall event in late October occurred across much of southern and east central Saskatchewan. This snowfall was followed by below normal temperatures, leaving a lot of these areas snow covered; however, thawing temperatures in November and into December melted a large portion of the snowpack. The early snowfall could result in two outcomes: 1) there is the potential in areas where the early snowfall melted for reduced infiltration capacity come spring because the topsoil will be frozen and sealed off, or 2) the early, heavy snow received could insulate the soil and reduce frost penetration, which would result in more infiltration in the spring, reducing the runoff in spring 2024. Snow surveys in February will help ascertain which scenario is likely to develop.

In fall 2023, WSA developed a map (Figure 2) that illustrates fall soil moisture conditions across the province. This figure shows that moisture conditions were much drier than normal across most of the western portion of the grain belt. Figure 3 shows the areas where there were reported impacts to water supply in the fall. The greatest impacts were seen along the western portion of the province.

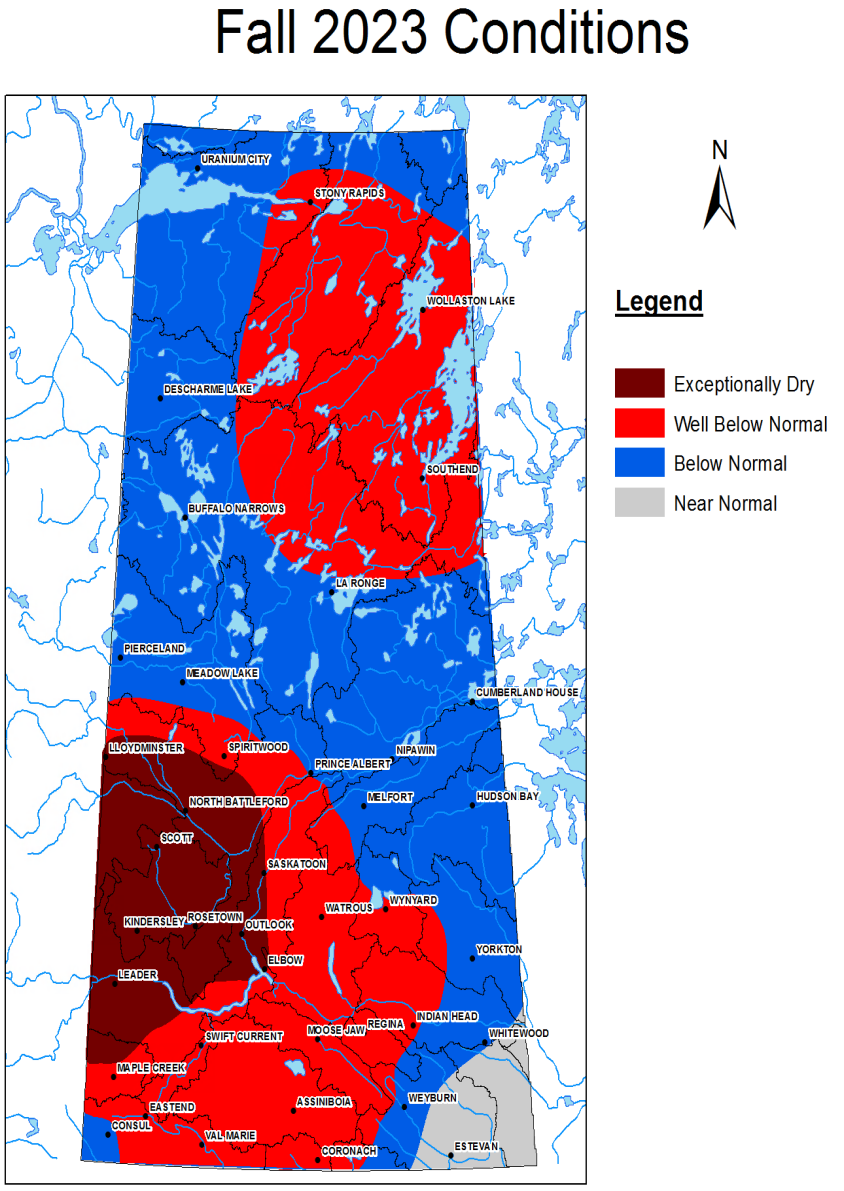

Figure 2: Fall Moisture Conditions as of October 2023

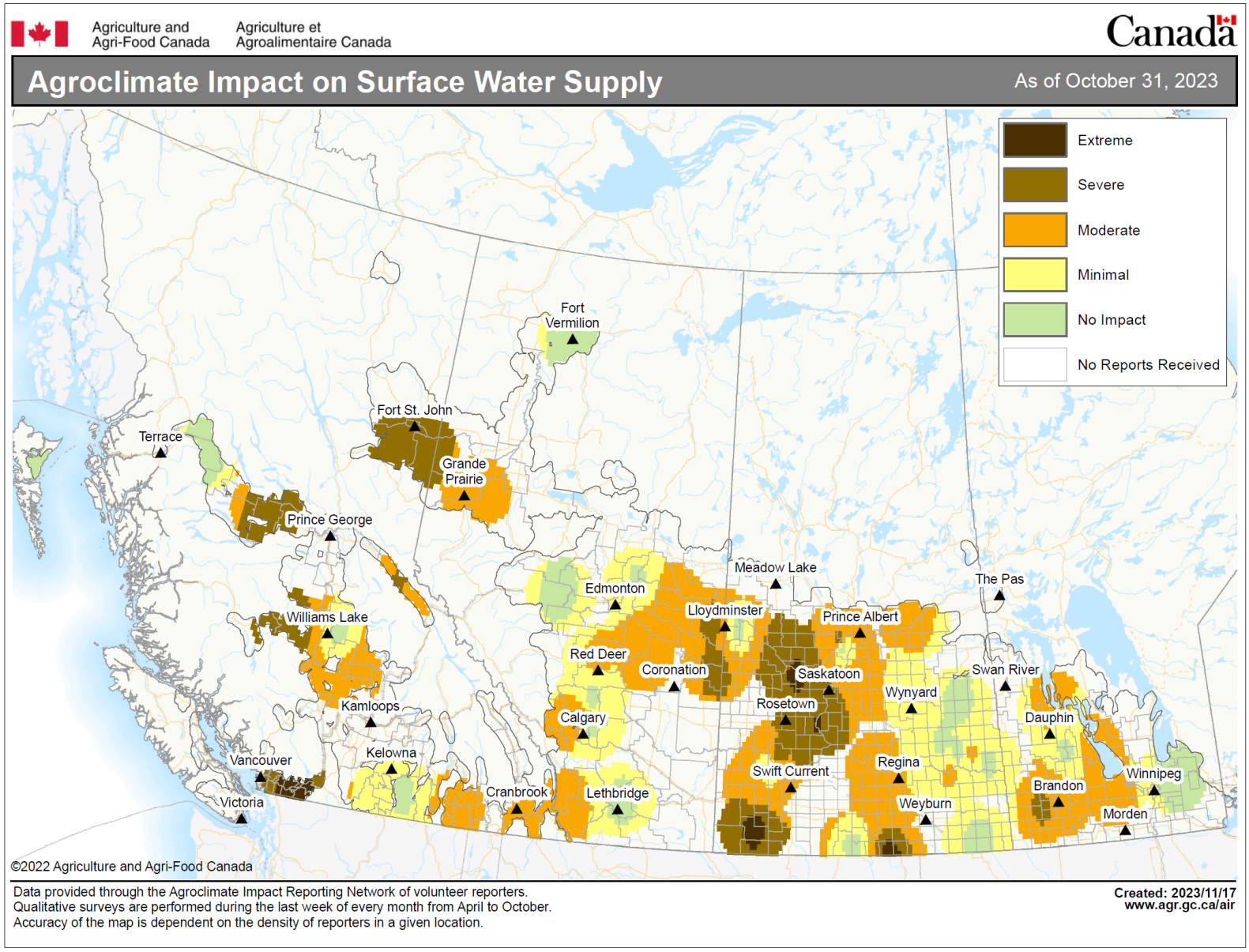

Figure 3: On-farm Surface Water Supply Conditions as of August 31, 2023
(Map courtesy of Agriculture and Agri-Food Canada)

Early Winter Precipitation

Point snowfall data, mapped as a per cent of average, is provided in Figure 4. This map is based on a relatively small number of sites across Saskatchewan. Based on this information, winter snowfall has generally ranged from near to below normal across most of southern Saskatchewan. Along the western edge of the province (Cold Lake, Meadow Lake and Lloydminster) and across the north, snowfall has been well below normal to date.

Unseasonably warm temperatures throughout November and December, as well as late in January across the province, have caused lots of the snowpack that was present to be lost to sublimation (when water from the snowpack returns to the atmosphere instead of melting first) and even the complete melting of snow in areas of the southwest. In some areas, melt from thawing temperatures throughout the winter has wetted the soil surface, which has the potential to reduce the infiltration capacity available to absorb late season snowmelt. This may result in more water running off during the spring thaw.

Manual snow surveys will be completed in late February to confirm snowpack conditions in advance of our early March Spring Runoff Forecast.

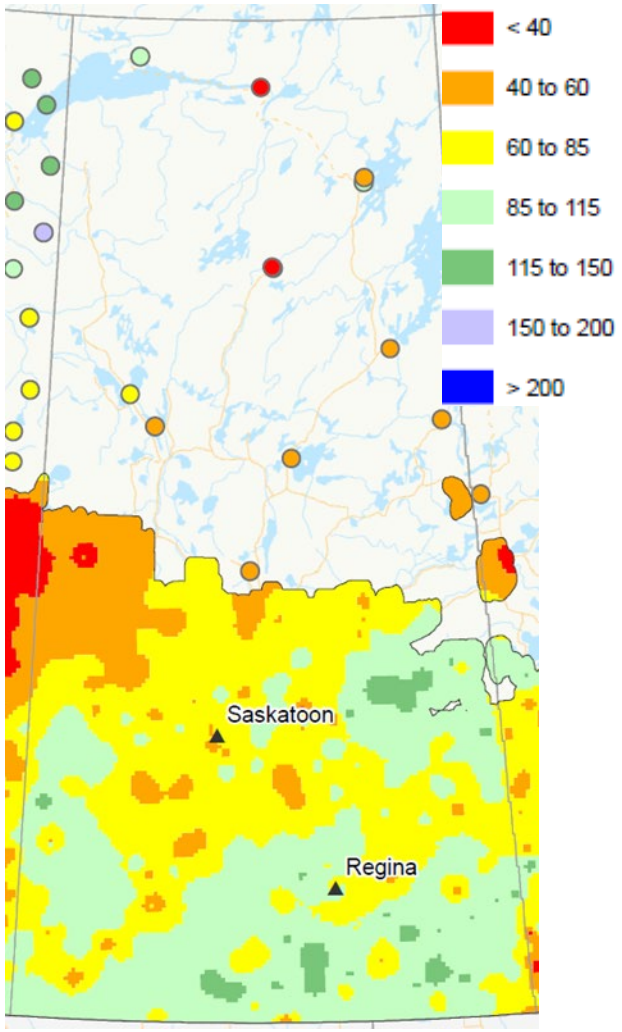

Figure 4: Per cent Normal Snowfall
(November 1, 2023 to January 29, 2024)
Map courtesy of Agriculture and Agri-food Canda

Drought Risk

The Canadian Drought Map from Agriculture and Agri-Food Canada defines drought conditions based on a multitude of different data sources, including factors such as temperature and precipitation indicators. The categories in this product range from abnormally dry, which signifies conditions that historically arise about once every three years, to exceptional drought conditions, which historically only occur about once every 50 years.

The Canadian Drought Map for January 31 is shown in Figure 5. This map shows that conditions are drier than normal across the province. Conditions are driest in the western portion of the grain belt where severe to extreme drought conditions are prevalent.

The six-month SPEI (Standardized Precipitation-Evapotranspiration Index) map is shown in Figure 4. SPEI is a normalized drought index that uses climate data to identify areas where drought conditions exist. The SPEI values are a relative measure of surface water surplus (positive values) or deficit (negative values) in an area. The values take the current precipitation minus the potential evapotranspiration and compare it to the mean value at a location. The result is normalized, so the higher the negative number, the drier the conditions are. This map shows that over the past six months, months prior to freeze-up, conditions had been warmer and drier than normal across most of western and south-central Saskatchewan.

Drought is monitored through multiple precipitation indicators including the six-month Standardized Precipitation Evapotranspiration Index (Figure 5), the per cent of normal precipitation (Figure 4) and the precipitation percentile indicator. Another factor taken into consideration when assessing drought conditions is the reservoir or lake water level percentiles (Figures 7-10).

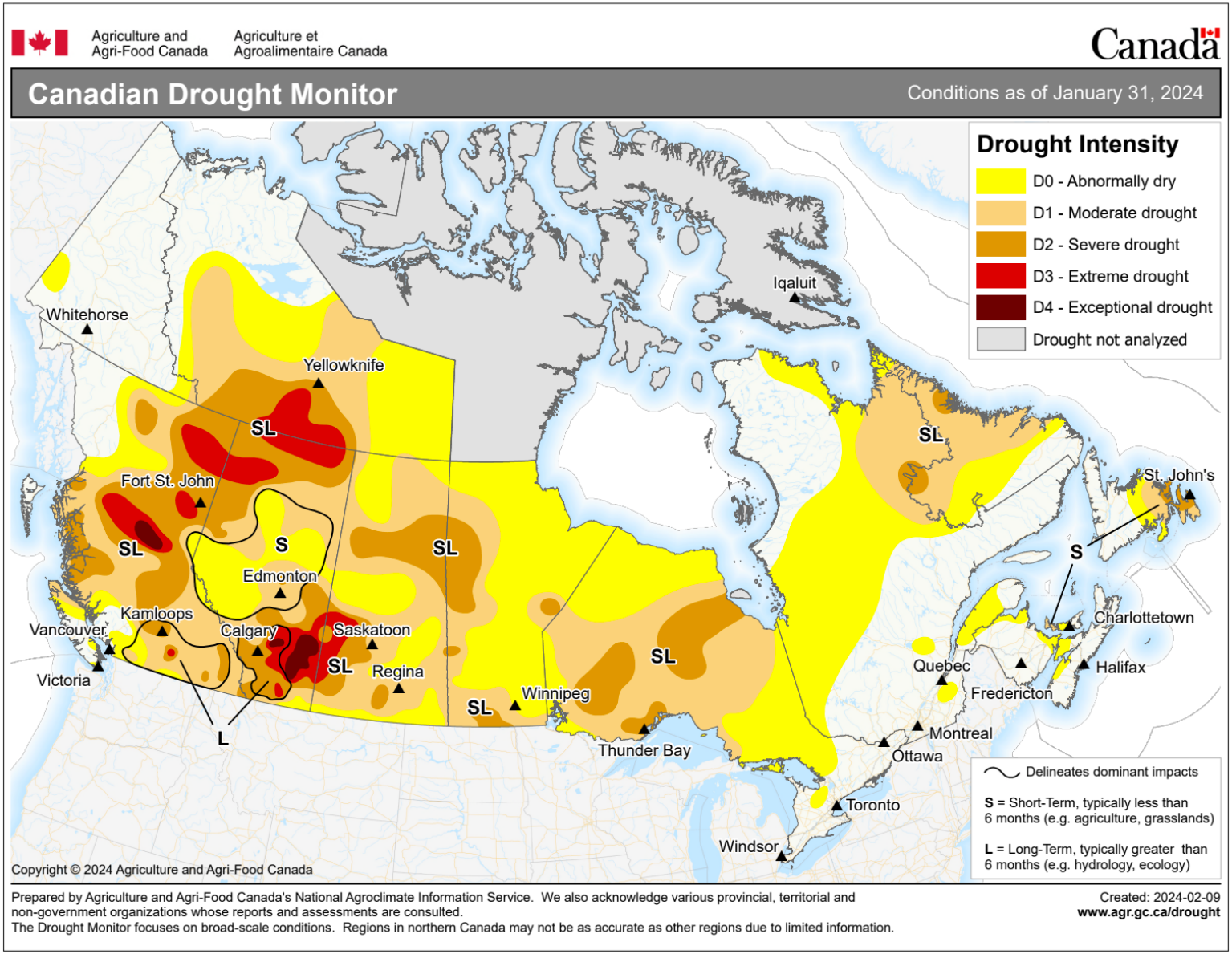

Figure 5: Figure 6: Canadian Drought Monitor – January 31, 2024
(Map courtesy of Agriculture and Agri-Food Canada)

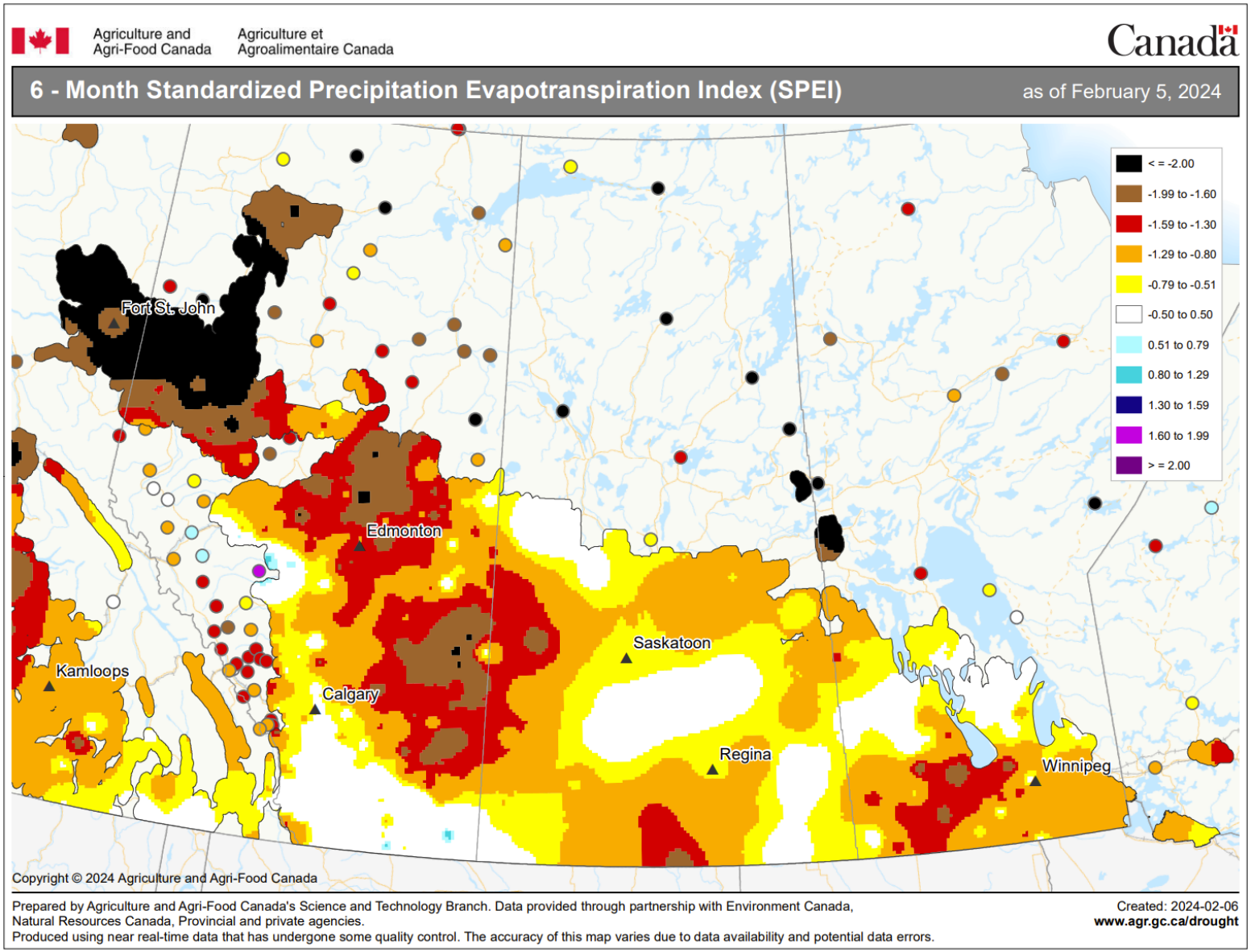

Figure 7: six-Month Standardized Precipitation-Evapotranspiration Index (SPEI) for February 5, 2024 (Map courtesy of Agriculture and Agri-Food Canada)

Water Supply Conditions

Even with the dry conditions across the province, most major water supply reservoirs across southern Saskatchewan are near or above normal operating levels for this time of year. Figures 7-10 show different reservoirs across the south compared to the historical average for this time of year. These figures show that nearly all reservoirs in the south were near or above historical average levels on February 1, except for Avonlea and some reservoirs in the southwest like Altawan and Cypress lakes for example.

There are some concerns of surface water supply issues in the southwest due to the depleted snowpack. If conditions remain dry, surface water users in the southwest who rely on smaller reservoirs or dugouts may be impacted.

At Lake Diefenbaker, the focus is currently on retaining water. Due to limited releases throughout the winter, Lake Diefenbaker's elevation is now only slightly below normal for this time of year. No water supply issues are anticipated at this time.

Current Reservoir Conditions

January 31, 2024

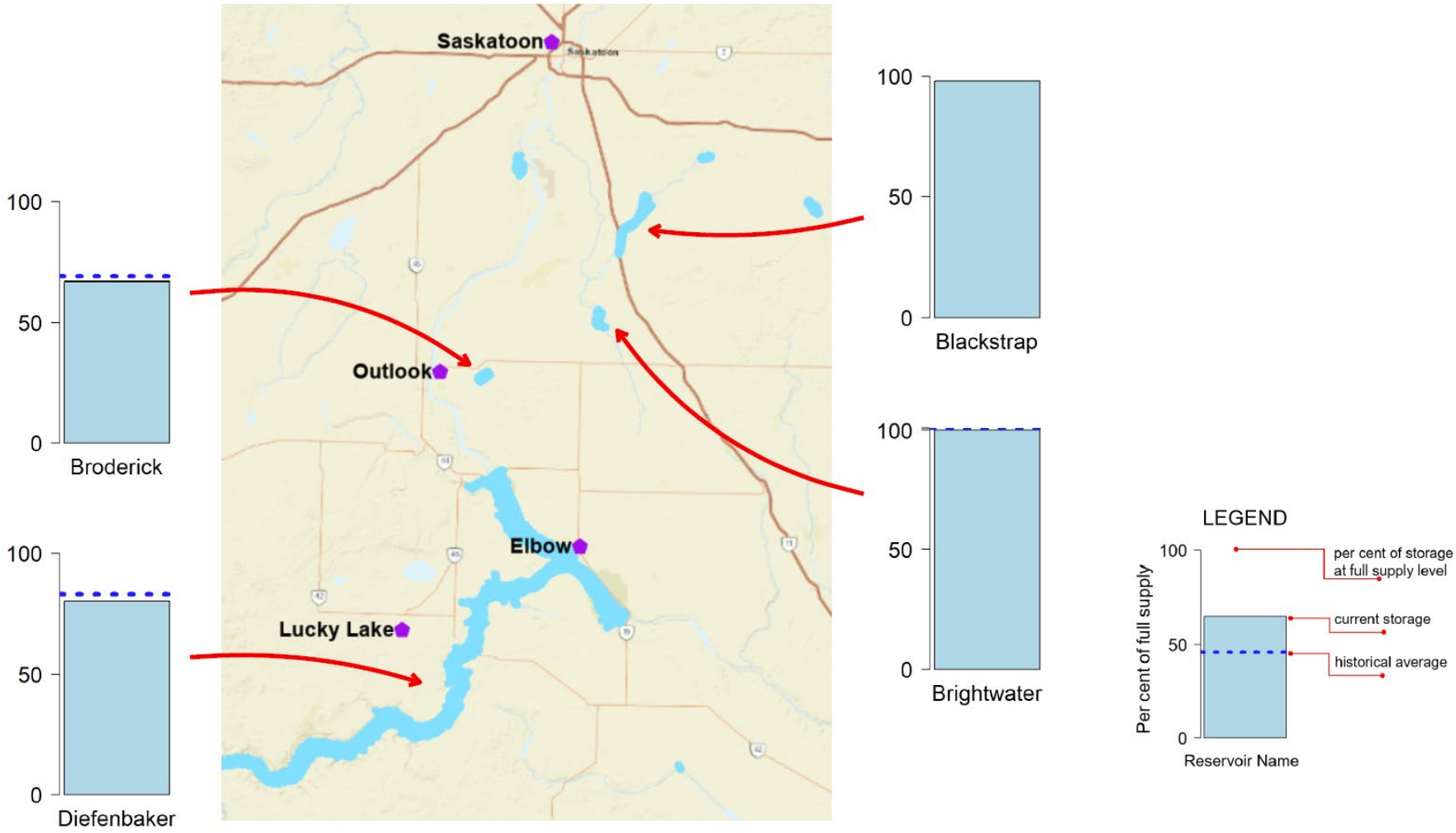

Figure 8: Reservoir Conditions in Central Saskatchewan as of Feb. 1, 2024

Current Reservoir Conditions

January 31, 2024

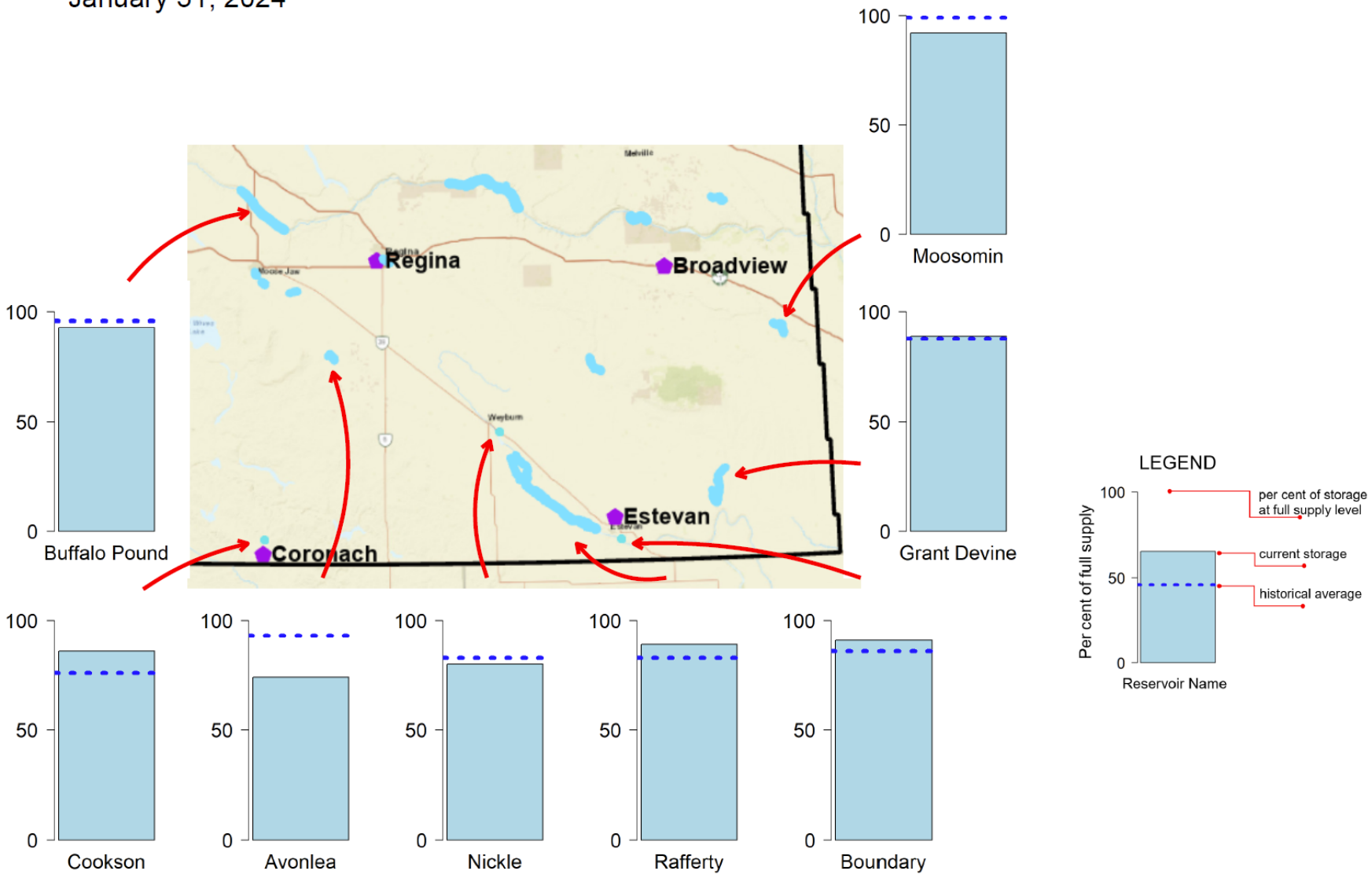

Figure 9: Reservoir Conditions in Southeastern Saskatchewan as of Feb. 1, 2024

Current Reservoir Conditions

January 31, 2024

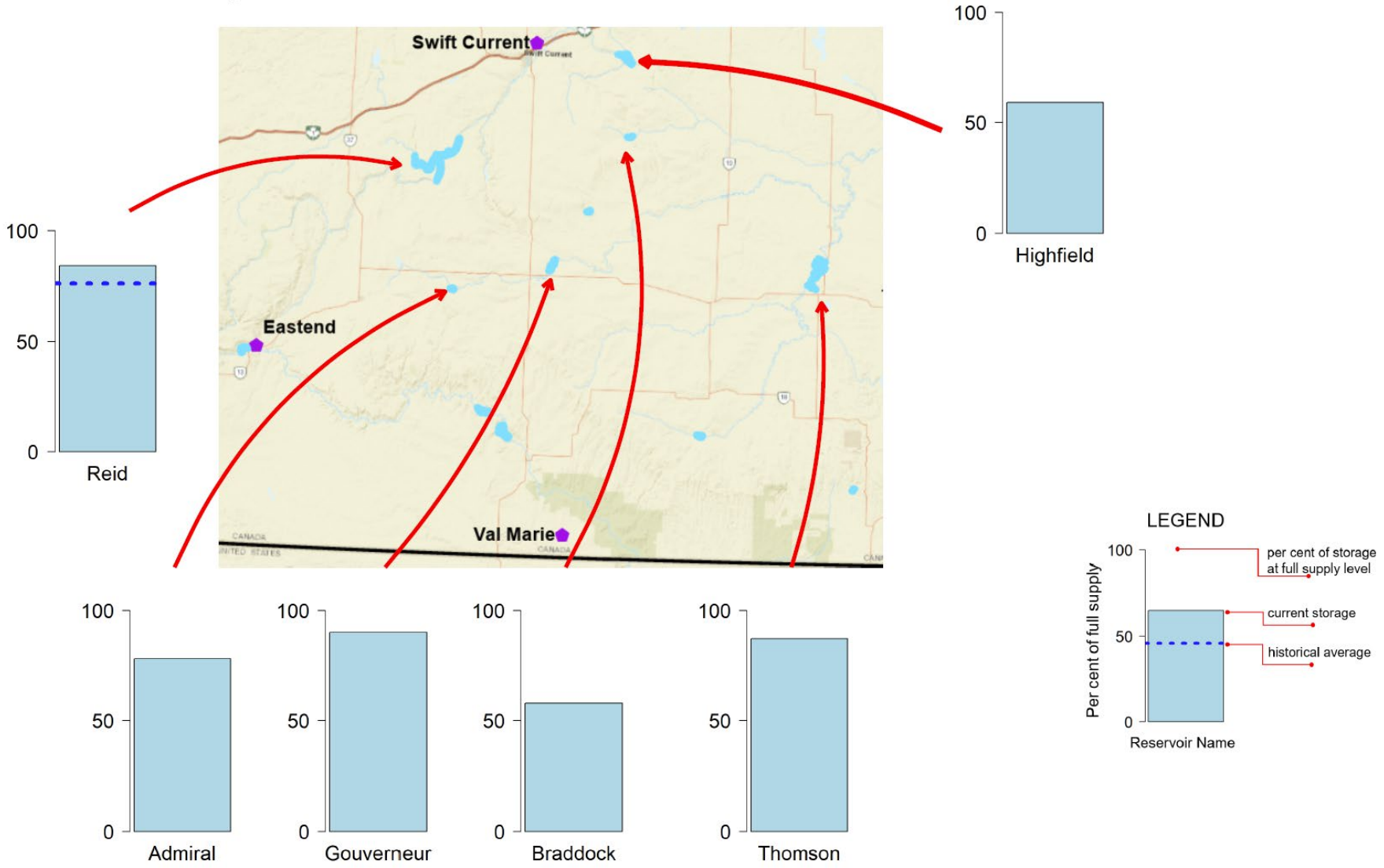

Figure 10: Reservoir Conditions in Southcentral Saskatchewan as of Feb. 1, 2024

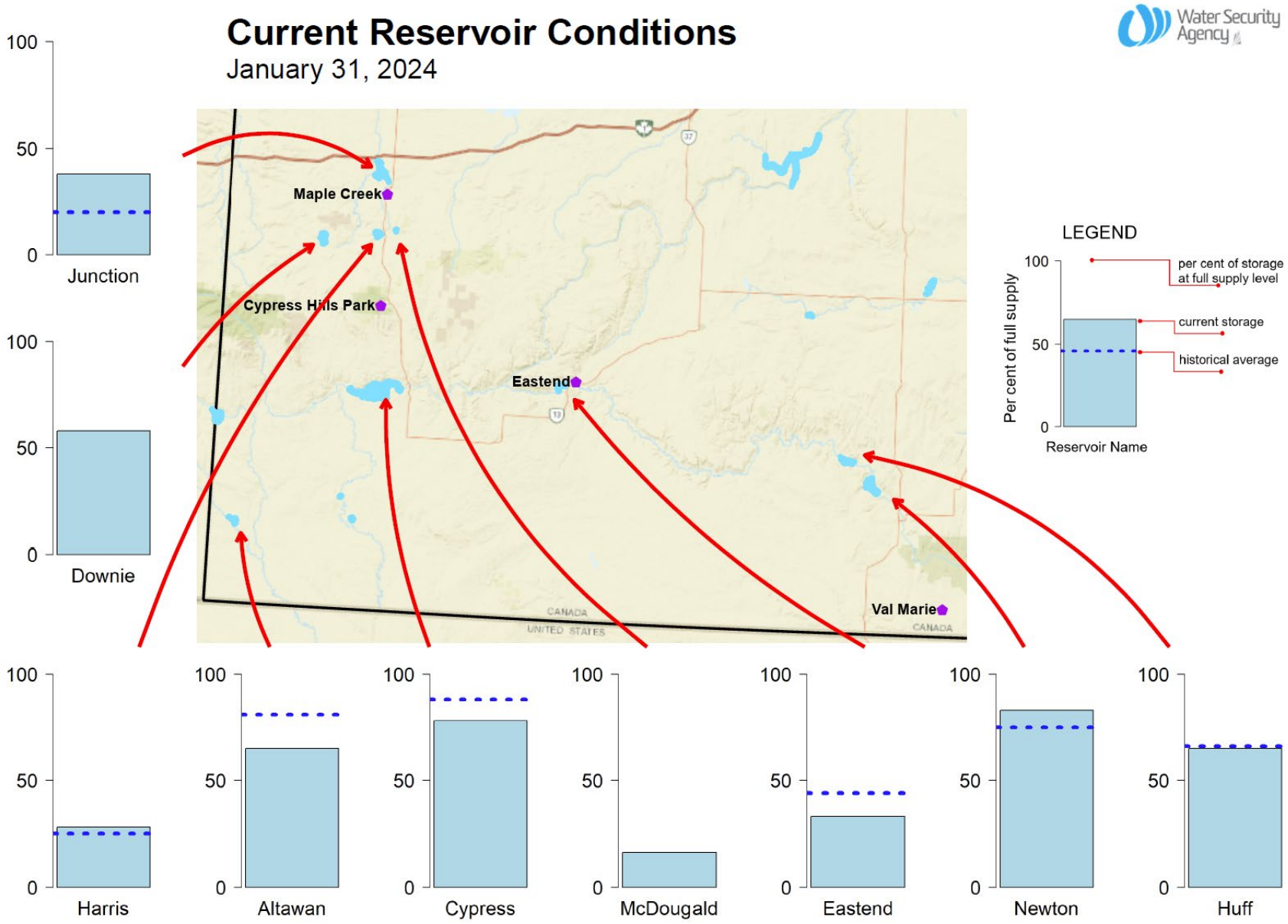

Figure 11: Reservoir Conditions in Southwestern Saskatchewan as of Feb. 1, 2024

Major River Systems
Souris Basin

WSA has achieved the regular February 1 drawdown elevations for Rafferty Reservoir and Grant Devine Lake. With near normal conditions at freeze-up in 2023 and what is currently projected to be below to well below normal snowpack, the snowmelt runoff response is expected to be below normal above the three reservoirs, and below normal below the reservoirs. With the dry conditions in the basin, no additional releases will be required. As of February 1, 2024, only Boundary Reservoir has a potential of to filling this spring. Any excess water from Boundary would be diverted to Rafferty. Currently, Rafferty Reservoir is expected to be in the normal operating range.

Detailed forecasts for the Souris River Basin are developed on or near the first and fifteenth of each month, beginning in February, up until the snowmelt runoff event. These forecasts can be found on wsask.ca.

Saskatchewan River Basin

Winter inflows to Lake Diefenbaker have been close to the historical low. With the low water levels experienced during summer and fall 2023, WSA has shifted its focus to retain water supplies by restricting winter releases to record low releases. Flows on the North Saskatchewan River have varied from below normal to above normal throughout the winter months (varying based on the releases from the upstream hydroelectric generating station in Alberta).

The current snowpack over the eastern slopes of the Rockies of the Saskatchewan River Basin's headwaters, which is responsible for much of the flow on the system in May and June, varies somewhat; however, the snow pillows operated by Alberta Environment are all showing well below normal snowpack accumulations so far this winter.

Although the mountain snow pillows in the headwaters indicate the potential for well below normal flows into Saskatchewan during May and June, water levels on Lake Diefenbaker will be sufficient to meet all user needs over the summer months. Rainfall accumulations over southern Alberta in late spring and early summer, which cannot be predicted at this time, have a greater impact on reservoir inflows. The reduced inflows will minimize the overall winter drop in water levels to one metre (m), the historical average drop in winter water levels is 4.5 m. WSA is targeting a drawdown level of 551.5 – 551.7 metres at Lake Diefenbaker for early March, which for that time is the upper end of the typical range. The target April reservoir level is 552 m,which is normally a May target; the goal here is to achieve the targeted level for irrigation and recreational users earlier in the season.

Southwest

As of February 1, following several consecutive days of above freezing, overnight temperatures and daytime highs above 10 degrees Celsius, much of the limited snowpack across the southwest melted. In the Big Stick Lake Basin near Maple Creek, the limited snowpack has melted with negligible inflow to reservoirs being observed. A similar situation exists in other areas of the southwest, where the snow cover has disappeared with minimal snowmelt runoff response being reflected in stream flows. More precipitation is needed through the remainder of the winter for many of the

reservoirs across the southwest to have a chance of reaching full supply level this spring.

Qu'Appelle System

All lakes within the Qu'Appelle River Basin are at near normal levels for this time of year. Release from the Qu'Appelle River dam has been reduced from 2 m^3/s to 1 m^3/s due to the low water levels on Lake Diefenbaker. Buffalo Pound Lake is currently 6 cm below the top of its winter operating range and is expected to drop a few centimetres before snowmelt runoff occurs. Much of the Moose Jaw River Basin is free from snow due to the combination of a below normal snowfall and above normal temperatures in December and late January. With the drier soil moisture conditions at freeze-up and a well below normal snowpack, the basin is expected to experience a well below normal snowmelt runoff response this spring.

Currently, the Echo Lake Control Structure is partially open with eight stoplogs in each bay, and the Crooked Lake Control Structure is fully open. Stoplogs will be installed in these structures as needed to bring the lakes up to desirable operating levels for the summer. The Craven Control Structure will also be operated to manage upstream water levels and assist in bringing Last Mountain Lake up to a desirable operating level for the summer months.

Buffalo Pound, Echo and Katepwa lakes are all expected to be in the normal summer operating ranges this year. Last Mountain Lake is anticipated to be near the middle of the summer operating range. Low water levels on Crooked Lake are expected this year primarily because four bays of the control structure are out of service due to the aging infrastructure. Round Lake is also expected to be low due to ongoing maintenance issues and the low runoff anticipated this spring.

At this time, we do not anticipate flooding within the system due to snowmelt runoff; however, that situation can change depending on the precipitation received and the rate of melt. Localized flooding due to ice jamming is also possible. The March 1, 2024 Spring Runoff Forecast will contain a more detailed forecast and operating plan for the system.

Churchill System

Flows throughout the Upper Churchill River Basin are currently between 10 and 15 per cent of normal for this time of year. In lower portions of the basin, flows are down to 5 to 10 per cent of normal. . With a below normal snowpack over the basin, flows are expected to remain well below normal into the summer months. Lac La Ronge is currently near the lower end of its operating range. Inflows into Reindeer Lake this fall and winter have been record lows. As a result, Reindeer Lake is currently well below normal for this time of year.

Quill Lakes

The Quill lakes are currently at an elevation of 519.53 m, which is slightly lower that their level at the same time last year (519.61 m). The November and December snowfall recorded at Wynyard was below normal (18.7 mm, 60 to 85 per cent of normal), but the area received further snow (18.6 mm) in January bringing winter accumulations to above normal condition (115 to 150 per cent of normal). As is the case across most of Saskatchewan, above freezing temperatures throughout the winter has depleted a lot of the snowpack in the area.

The runoff response to the Quill lakes will depend largely on the snow received over the next couple of months, the melt rate and the

conditions at the soil surface. Assuming near normal snow conditions going forward, a well below normal snowmelt inflow is expected.

Long Range Forecasts

Most long-range precipitation forecasts are predicting a near normal precipitation accumulation across the province for February, March and April. All long-range models are predicting 1-3° C warmer than normal temperatures across the province during this period. Southern portions of the province are expected to experience the highest deviation in warmer temperatures.

It is important to note that seasonal weather forecasts are statistically unreliable, and their skill is particularly poor for predicting precipitation. However, good agreement among various long-range products indicates a higher degree of confidence.

The three-month spatial anomalies maps for precipitation (Figure 11) and temperature (Figure 12 covering the Feb. 1 to April 30 forecast period show the expected long-range precipitation and temperature trends in relation to climate normals.

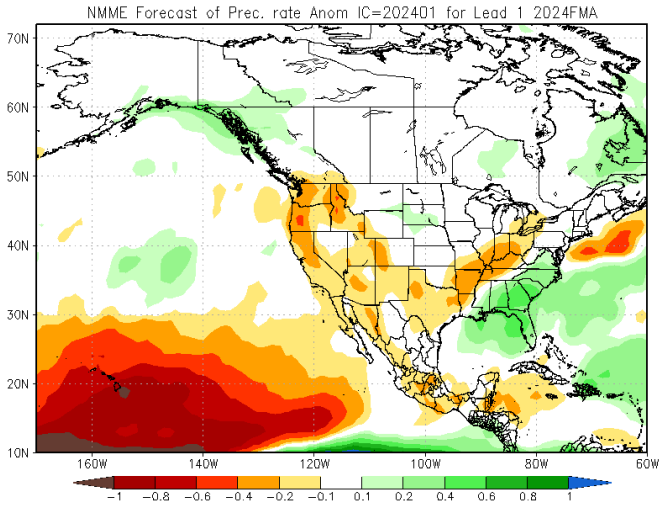

Figure 12: Multi Model Ensemble Precipitation Anomaly Forecast (Feb. 1, 2024 to April 30, 2024) (Map Courtesy of the US National Weather Service)

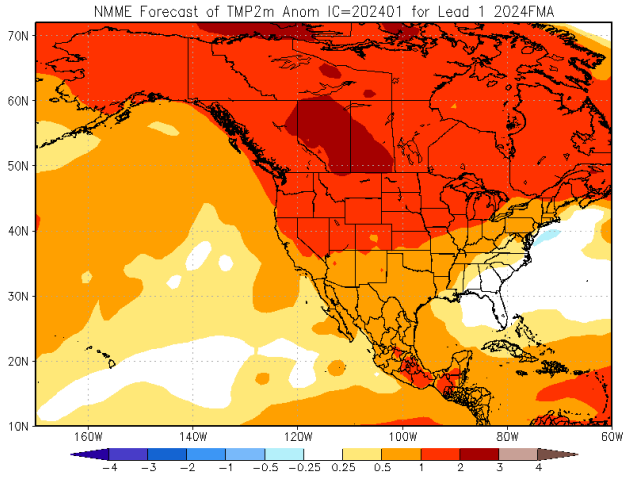

Figure 13: Multi Model Ensemble Temperature Anomaly Forecast (Feb. 1, 2024 to April 30, 2024) (Map Courtesy of the US National Weather Service)

Next Forecast

WSA will issue a Spring Snowmelt Forecast in early March.