



2018-2019

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# The Impact of Extreme Weather on the End-to-End Grain Supply Chain





# 2018-19 – The Impact of Extreme Weather on the End-to-End Grain Supply Chain

The impact of weather on the end-to-end grain supply chain can take many forms, whether it's rainfall preventing vessel loading, extreme cold restricting train lengths, or persistent wet weather delaying harvesting and impacting crop quality. Railroading and farming are both impacted by the weather - the following takes a look at the key weather events that have had a significant impact on the grain supply chain on CN so far this crop year.





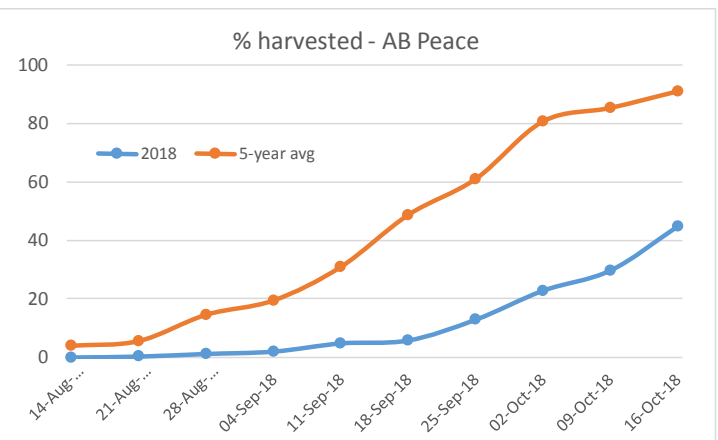
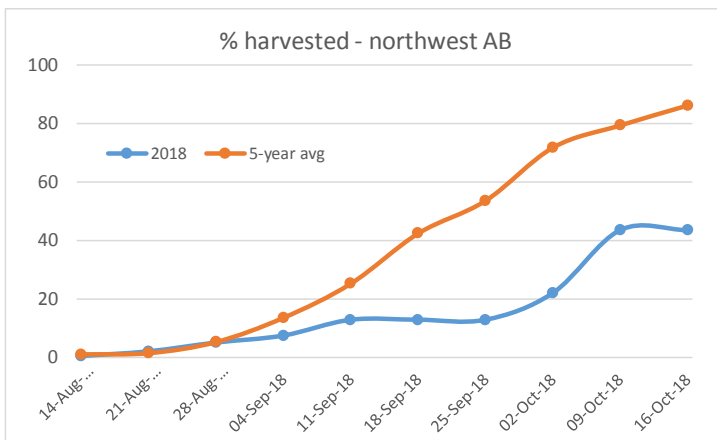


## Part 1: September – October 2018: Unprecedented Harvest Delays

Snowfall came early and often to the grain-growing areas of the Prairies this past harvest along with rain and poor drying conditions. Producers in Alberta and central and northern parts of Saskatchewan were hardest hit by the exceptionally poor harvest weather, with some areas registering next to no harvest progress for four to six weeks this fall. By the middle of October, only half of the Alberta harvest was complete overall, with only 35% to 45% complete in central and northern areas of the province.

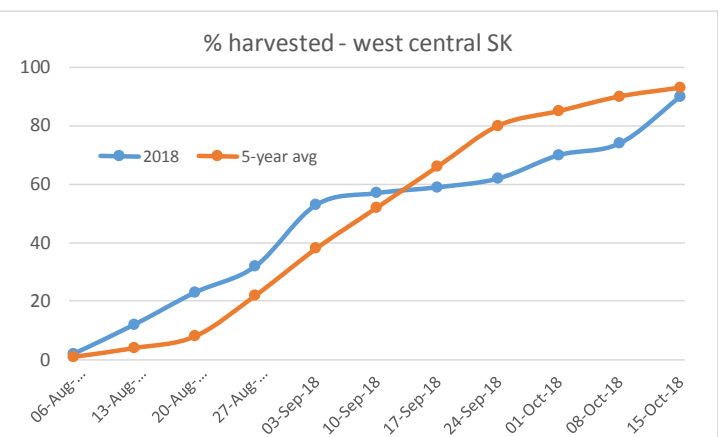
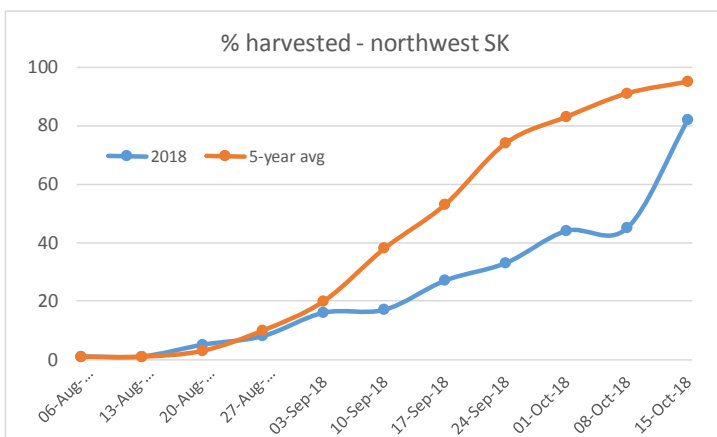


**Photo:** Standing oat crop near the Battlefords mid-September 2018 (courtesy R. Speer)



Source: Alberta Agriculture

In Saskatchewan, harvest delays were also pronounced in central and northern areas of the province, especially in northwestern Saskatchewan. Here, too, harvest effectively stalled for a month. As late as the end of September, various trade estimates pegged the amount of crop left to harvest in western Canada at 25 to 30 million metric tonnes.



Source: Saskatchewan Agriculture and Food

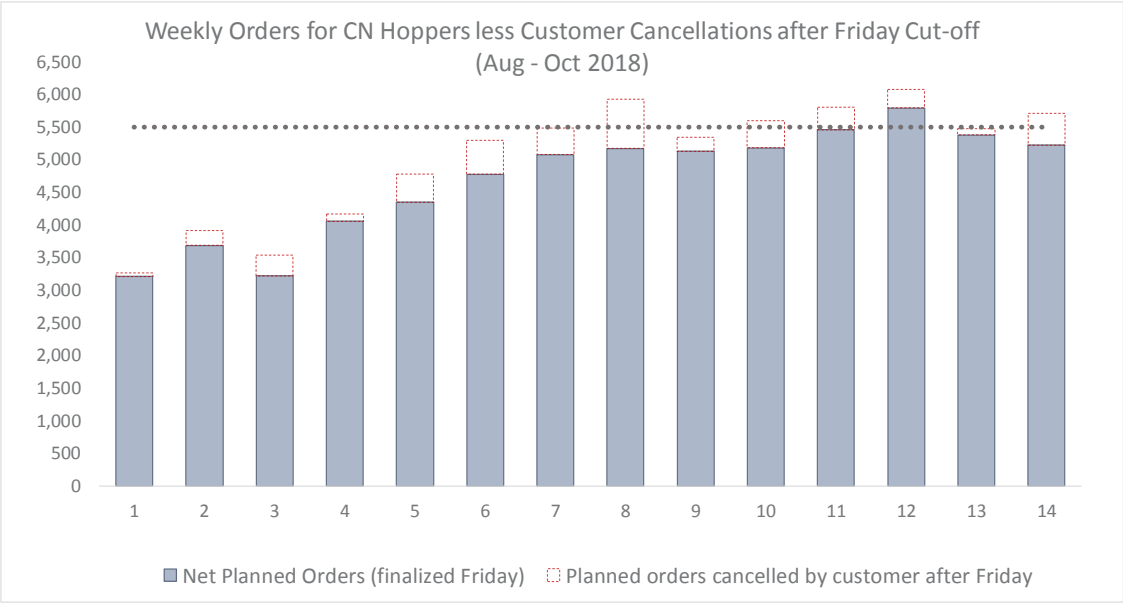
In a typical year, CN sees the first week of peak demand around grain shipment week 5-6, which is the first half of September. By that point in time, demand for CN-supplied equipment normally exceeds 5,500 per week, and it is not unusual to see demand spike well into the 6,000s or even 7,000+ for a given week. This level of demand usually persists until late December, when the port of Thunder Bay closes for the winter.

However, in the first three months of the 2018-19 crop year, there was only one week where the number of orders for CN-supplied equipment for a given week exceeded 5,500. Grain sales are made with an expectation of when grain will be available for shipment. Given the tremendous challenges with the harvest this past fall, the pattern of grain availability threw an unexpected curve ball to grain logistics planners. The pattern of grain availability failed to materialize as expected – either grain wasn't coming into elevators or the quality spec needed for sales wasn't available. This left grain shippers scrambling to make changes to their logistics plans. Higher volumes of tough and damp grain moved into and through the grain handling system, making it more difficult to hit export specs.

Thousands of orders for hopper car placed by grain shippers with CN were self-canceled by customers shortly after they were placed with CN, with more orders being self-canceled by grain shippers after the planned service for the week was finalized on Fridays. **In the first three months of the 2018-19 crop year, grain shippers self-canceled 7,809 orders for CN hoppers, the equivalent of over 700,000 tonnes of grain shipments.** The grain shipment hubs of Edmonton, Saskatoon, and Humboldt accounted for almost 5,500 customer self-canceled orders alone. Customer self-canceled orders in grain shipment weeks 6 and 7 amounted to over 2,100 orders.

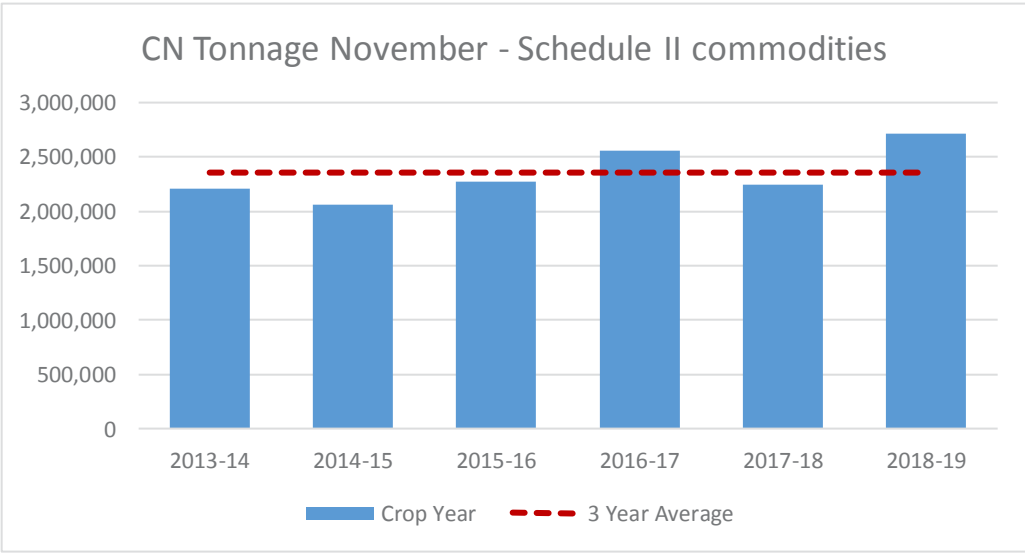


As a result, hundreds of thousands of tonnes of capacity available to ship grain went unused in September and October because of the impact of the exceptionally poor harvest weather. The greatest impact to overall movement was in Alberta given how widespread and persistent the harvest delays were. Thankfully weather improved in the last half of October, allowing almost all of the 2018 crop to be harvested.



Crop quality was adversely impacted in the areas where harvesting was delayed. This has resulted in a highly variable crop quality profile, meaning a wider variety of products being shipped to port compared to normal, and adding to the complexity of the grain supply chain. Grading variability presents challenges when crop quality is impacted significantly by poor harvest weather – the proportion of grain misgrading at port (i.e. the grade that the origin shipped differs from the grade assessed at export terminal) also increases in a year like this, making it more challenging to meet export sales and resulting in additional supply chain delays.

Regardless of the impact that poor harvest weather had on restricting grain availability through October 2018, CN and its supply chain partners, were able to deliver historically strong CN grain shipment performance. In November 2018, CN recorded not only its best November ever for western Canadian grain movement, but it recorded its best individual grain shipment month ever, as shipment volume reached **2.7 million metric tonnes** compared to the previous best of 2.55 million metric tonnes set in November 2016. Weekly bulk grain spots between CN-supplied hoppers and private customer-controlled hoppers ranged from 5,800 to 6,800 hoppers per week.





## Part 2: January to February 2019: Periods of extreme cold

Winter comes every year, but what is difficult to predict is the severity and persistence of extreme cold temperatures that can adversely impact grain supply chain performance. Extreme cold not only affects the rail infrastructure, rolling stock, motive power, and the people operating the railroad, it also affects operations at grain handling facilities, along with grain movement into the primary elevator system. The railways are not the only supply chain players employing the use of locomotives, and locomotives used by grain elevator facilities to move hopper cars within the plant for loading can also fail during extreme cold.

Entering the winter period, CN deployed 10% more high horsepower locomotives and had a 25% greater qualified crew base in western Canada compared to the same time in 2017. Furthermore, CN entered the winter having completed 25 new network capacity-enhancing projects, including 60 miles of double track, major yard improvements in Edmonton, Winnipeg, and Melville, and a number of siding additions and expansions. CN also tripled the number of air repeater cars deployed in the field, of which 40 of 60 were deployed in western Canada. All of these factors resulted in CN entering the winter of 2018-19 with greater network resiliency, meaning a greater ability to recover from weather-related disturbances and work around disruptions to the network.

The tipping point in terms of difficult operating conditions is -25°C. Below that temperature, railway technologies – steel rail, steel wheels, and long compressed air brake systems – become more vulnerable to problems that can disrupt normal operations. Welded rails become less flexible, frozen gaskets leak air at brakehose couplings, and ice crystals wear down wheel treads.

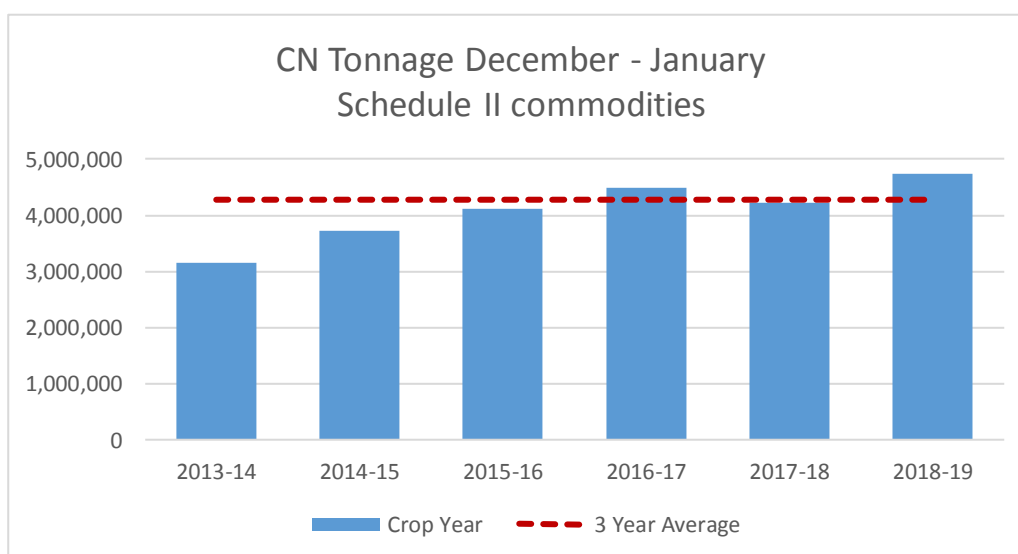
When temperatures reach -25°C, train lengths need to be reduced to maintain safe operation of a train's braking system. A train's brakes rely on sufficient air pressure through the length of the train, but extreme cold can interfere with that air pressure, making it harder to maintain. As a result, trains must be shortened for safety reasons.

- At -25 degrees Celsius, trains are up to 30% shorter (Tier 1 restriction)
- At -30 degrees Celsius, trains are up to 40% shorter (Tier 2 restriction)
- At -35 degrees Celsius, trains are up to 55% shorter (Tier 3 restriction)
- Below -40 degrees, CN stops operating (Tier 4 restriction)
- In some locations where the grade is steep, CN stops operating after -25 degrees Celsius

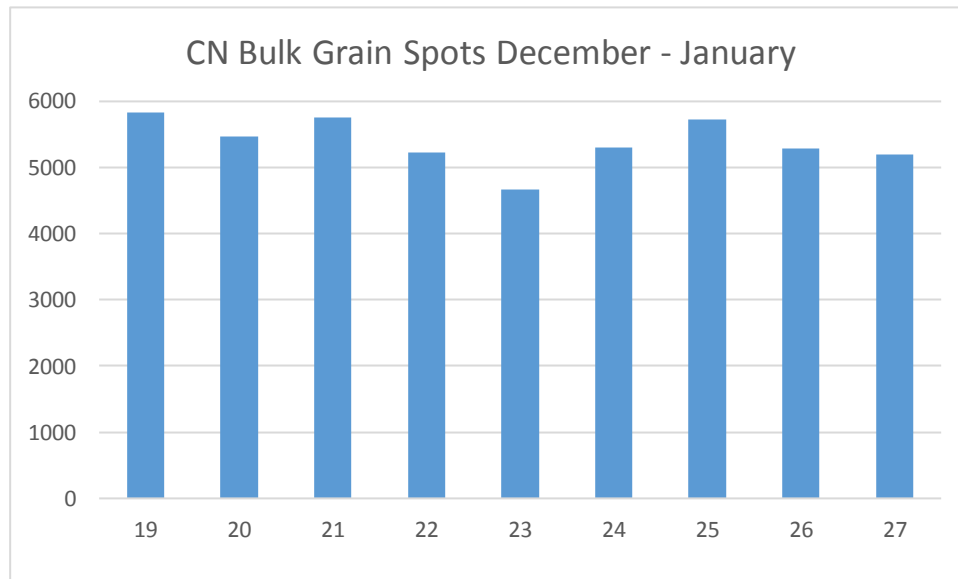
A 10,000-foot train restricted to 7,000 feet, for example, leaves 3,000 feet of left-behind traffic still needing to move on a new train. When trains are shortened, more crews and locomotives are required to move the same volumes of traffic. Resulting backups lead to congestion in rail yards and delays. When extreme cold conditions persist for long periods, there is a ripple effect. Across large parts of CN's network, resources to move additional trains are stretched and capacity is diminished. The shorter trains increase the number of trains, which are moving at slower speeds, which reduces the efficiency of the system during difficult operating conditions.

| Train Type | Temperature Range                          | Conventional                 | Distributed Power |
|------------|--|------------------------------|-------------------|
| Bulk       | <b>Tier 1</b> -25 to -30 C or -13 to -22 F | 2,438m / 8,000 ft            | 11,000 ft         |
|            | <b>Tier 2</b> -30 to -35 C or -22 to -31 F | 1,830m / 6,000 ft            | 9,000 ft          |
|            | <b>Tier 3</b> -35 to -39 C or -31 to -38 F | 1,275m / 4,500 ft            | 7,500 ft          |
|            | <b>Tier 4</b> Colder than -40 C or -40 F   | Train operations are stopped |                   |

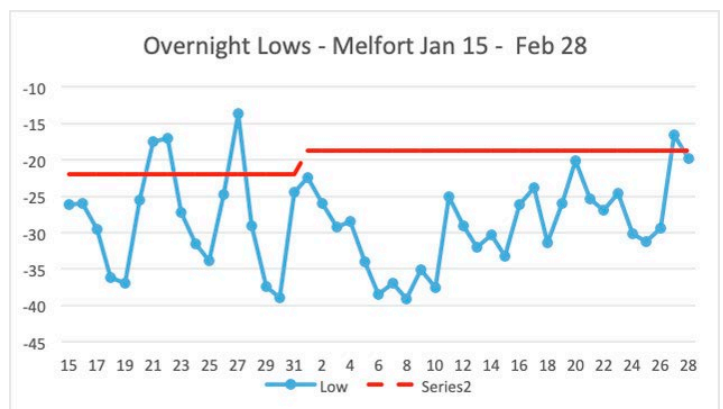
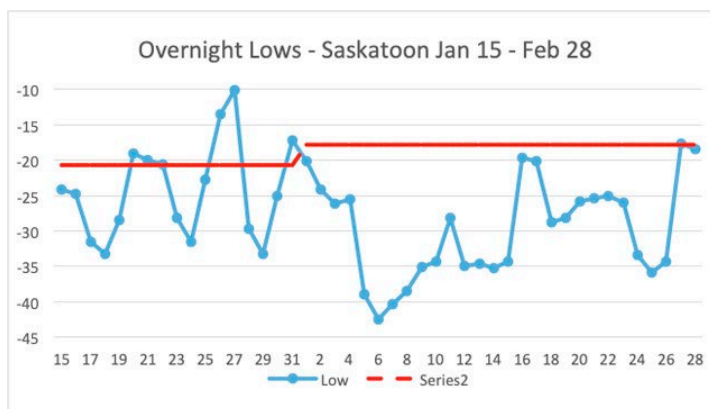
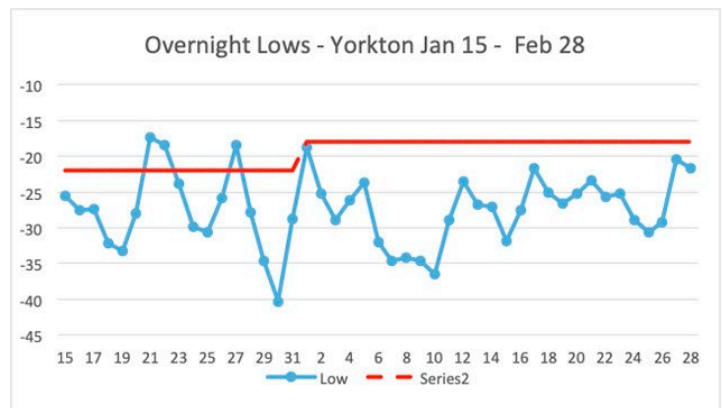
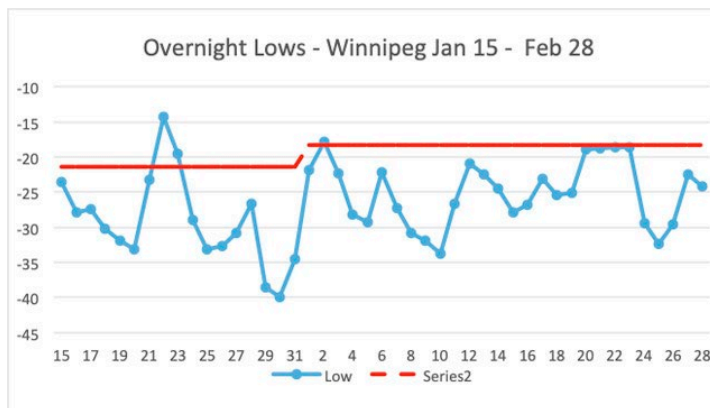
CN's actions in advance of winter 2018 to increase network resiliency by investing in locomotives, crews, and network capacity-enhancing projects, paid off through November, December, and January, even when Tier 1 restrictions were put into place. CN was able to move more traffic in winter conditions even harsher than last year. In December 2018 and January 2019, CN set records for western Canadian grain shipment performance, recording total movement of 2.5 million metric tonnes in December (previous best 2.28 million metric tonnes in 2016) and 2.23 million metric tonnes in January.



Through December and January, with the exception of the last week of December when grain shippers slow down carload shipments due to the Christmas and New Year's holidays, CN's grain spotting remained very strong. Combined weekly car spots for CN-supplied hoppers and customer-controlled hoppers for the movement of bulk grain consistently exceeded 5,000 hoppers per week versus maximum sustainable supply chain capacity for CN-supplied equipment during winter of 4,000 hoppers per week.



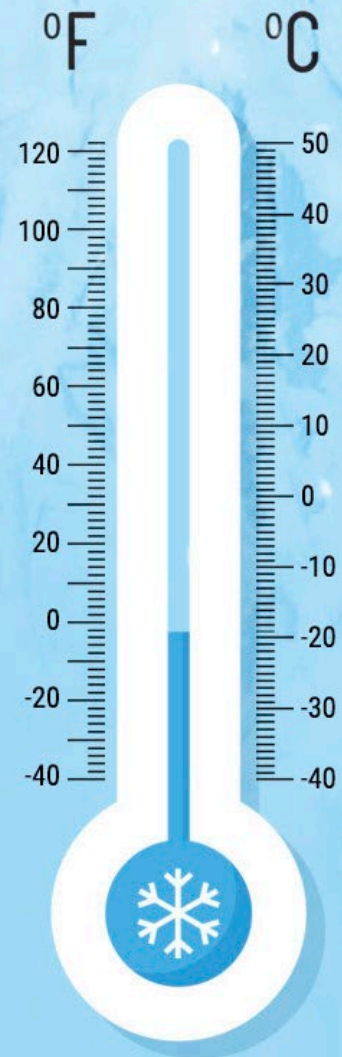
Conditions turned exceptionally cold in the last half of January, with extreme cold persisting well into the last half of February, and representing the worst cold snap in February in Saskatchewan in 80 years. In the first 15 days of February, Regina and Saskatoon experienced 11 and 10 days, respectively, where daytime highs failed to reach minus 20 degrees Celsius.





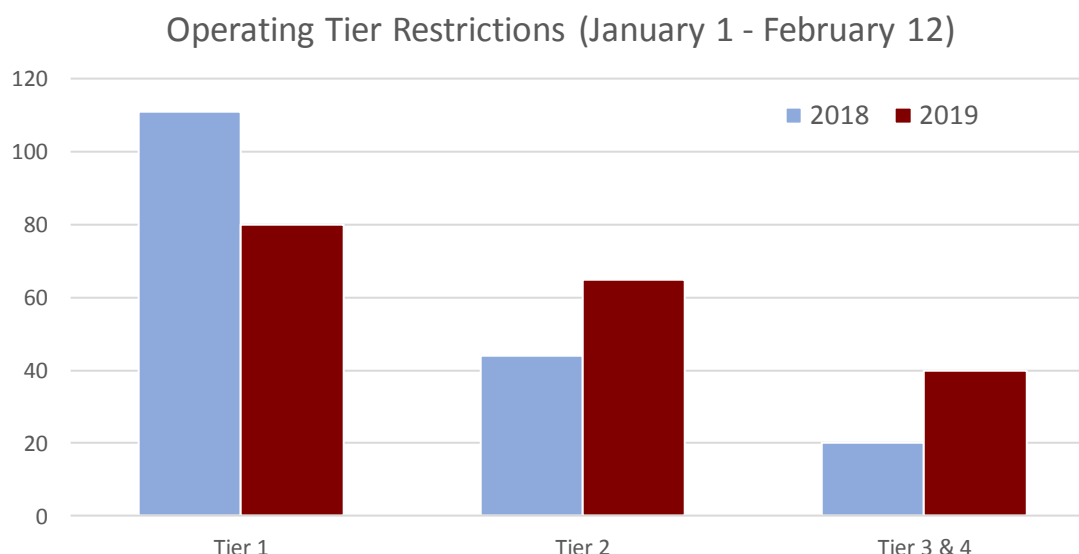
# Weather Impact in the Prairies

| Place                    | Date   | Minimum temp. | 30-yr avg. low for Feb. |
|--------------------------|--------|---------------|-------------------------|
| <b>Vegreville, AB</b>    | Feb. 5 | -44.6 C°      | -16.5 C°                |
| <b>Spiritwood, SK</b>    | Feb. 7 | -44.6 C°      | -18.7C°                 |
| <b>Nipawin, SK</b>       | Feb. 8 | -43.7 C°      | -20.3 C°                |
| <b>Camrose, AB</b>       | Feb. 5 | -43.2 C°      | -15.7 C°                |
| <b>Last Mountain, SK</b> | Feb. 8 | -43.0 C°      | -17.7 C°                |
| <b>Saskatoon, SK</b>     | Feb. 6 | -42.8 C°      | -17.8 C°                |
| <b>Moose Jaw, SK</b>     | Feb. 8 | -42.5 C°      | -14.2 C°                |



Source: National Agroclimate Information Service  
Agriculture Canada, Environment Canada

More importantly, however, overnight lows reached deep into the minus 30s and even into the minus 40s across various parts of the CN network in western Canada, Ontario, and Quebec. Compared to the first month and a half of 2018, the first month and a half of 2019 saw a 65% increase in the number of nights below minus 30 degrees Celsius. CN's network experienced 16 occasions where temperatures dipped below -40 degrees Celsius (versus zero instances over the same period in 2018) - temperatures where CN stops operations in order to keep employees safe and mitigate the risk of mainline disruptions.



The extreme cold weather resulted in a reduction in the volume of traffic of all commodities moving in western Canada. Typically, the Prairies may experience a cold snap for a short span but then it warms up enough to allow CN to catch up with the traffic if it was unable to move as a result of reduced train length. This winter has seen long stretches of extreme cold with minimal recovery time before being plunged back into extreme cold.

Regardless the overall size of the spotting program that CN has been able to deliver this winter compared to last winter, marks a sharp improvement in performance year-over-year. In the first two weeks of February, total spots for CN-supplied hoppers and private customer-controlled hoppers for the movement of bulk grain averaged over 1,000 cars per week higher compared to the same time last year, with combined spots reaching over 4,800 in the first week of February and over 4,200 in the second week of February.

Considering that normal winter operating conditions are one of the factors that is reflected in CN's winter maximum sustainable supply chain capacity of 4,000 hoppers per week for CN-supplied equipment, CN's overall grain spotting program has been faring well considering how extreme, persistent, and widespread the cold weather has been this February.





### Part 3: Inclement weather and loading at the port

Winter also brings persistent rainfall to the west coast of Canada, in turn impacting grain supply chain performance. Wet weather during cargo loading can adversely affect the condition of the cargo being loaded on board a vessel. A ship's Captain agreeing to load in the rain with open cargo holds is potentially taking on a lot of risk, as the Captain must sign off on bills of lading acknowledging that the cargo was loaded on board the vessel in good condition. Should an issue be identified with the condition of the cargo at the time of cargo discharge, contractual issues arise and insurers get involved. As a result, grain loading during inclement weather at the Port of Vancouver is minimal at best.

Up until February 2017, some grain export terminals in the Port of Vancouver loaded grain during inclement weather by either tarping cargo holds or loading grain through feeder holes. Feeder holes are round openings cut into a cargo hatchcover where a grain loading pipe can be positioned to allow loading during inclement weather when cargo hatchcovers cannot be opened. Not all bulk vessels are equipped with feeder holes, but often, grain shippers would ensure vessels being loaded in Vancouver were equipped with feeder holes. Although the load rate achieved by loading through grain feeder holes is roughly 60% of the load rate achieved loading into an open cargo hold, it's better than no grain loading at all.

In early 2018, loading grain through feeder holes and via tarping was halted in the Port of Vancouver. An arbitrator subsequently ruled that guard rails needed to be placed around feeder holes, and raised other concerns including electrical grounding and staffing levels during loading through grain feeder holes. While, the industry continues to work through protocols in an effort to allow the practice of loading through grain feeder holes to resume, the progress has reportedly been slow with no announcement from grain terminals respecting investments to allow loading during inclement weather.



## Summary

Despite weather-related challenges facing this crop year to-date, CN has delivered a record pace of grain movement out of western Canada. Through grain shipment week 29, which takes us to the middle of February, CN shipped 15.77 million metric tonnes of bulk grain and processed grain products out of western Canada. That compares to the previous record pace of 15.21 million metric tonnes set in the 2016-17 crop year (+0.56 million metric tonnes, or +3.7%) and 13.92 million metric tonnes at the same time last crop year (+1.85 million metric tonnes, or +13.3%). On a provincial basis, CN remains on record pace in Saskatchewan and Manitoba, while the pace of grain shipments out of Alberta continues to lag behind average pace due to the impacts of exceptional harvest delays this past fall on grain availability.

