2022–2023

CN Winter Plan

MEETING THE CHALLENGE

PHOTO ABOVE:
Redpass, BC

COVER PHOTO:
Grant Brook, BC

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Message from Tracy Robinson

At CN, our focus is clear. We are committed to delivering reliable service to our customers and to continuously improve our performance. We know that our capabilities can be tested, especially during the winter months, when cold, ice, snow and rain can severely impact the efficient operations of a railroad.

To support our goal of meeting our customers' service needs, we have put in place our detailed Winter Plan for 2022–23. The plan sets out the actions we are taking to improve our operation, increase our resiliency and enhance our recovery capabilities during periods when winter impacts our ability to operate the railway at normal levels.

The Plan is built on four cornerstones: **Operating Safely**, **Delivering the Best Possible Service**, **Increasing Network Productivity**, and **Improving Resiliency**. Bringing the Plan to life are CN's 23,000 employees who operate our 18,000-plus mile rail network who step, every day, into the challenges of outdoor operations.

Since joining CN in March, I have focused our team on servicing our customers' needs by getting back to basics. This means running a scheduled operation, aligning capacity with demand and working closely with our customers and stakeholders to maximize the effectiveness and efficiency of the full supply chain. This Plan reflects that focus. It reviews core aspects of CN's operations: how safety and greater efficiency work together; how we plan with customers to deliver service during winter on a sector-by-sector basis; how we invest to improve productivity; and, how we mobilize people and resources to enhance the resilience of our network.

As the Plan lays out, each of these factors must come together in a coordinated fashion to enable us to provide the service our customers expect, regardless of conditions.

"At CN, we are making the necessary efforts to play our part well and to enable our customers' products to move to where they need to be."

In spring and summer this year, and in anticipation of winter, we made significant changes to our rail planning and operations. These have improved rail network productivity and service to our customers. The Winter Plan takes the next steps. It describes how we are:

- increasing our locomotive fleet with the addition of 57 high-horsepower units;
- acquiring 800 more high-capacity box cars and 500 high-efficiency hopper cars;
- expanding our crew base; and,
- applying new technologies that advance safety and efficiency.

CN is North America's most northern Class I railway, with a network that stretches into the Northwest Territories and the northern region of Quebec. Our trains travel the breadth of Canada—from Prince Rupert, through the mountains, across the Prairies and northern Ontario, to Montreal and Halifax, all the way down to Louisiana in the U.S.—and often encounter every imaginable test that a North American winter can deliver.

We have more than 100 years of experience dealing with the challenge of winter operations. We know we play an important part in a much bigger supply chain effort. At CN, we are making the necessary efforts to play our part well and to enable our customers' products to move to where they need to be. The steps outlined in this plan will help ensure a more efficient and resilient CN network and an increasingly reliable and resilient supply chain. This Winter Plan puts into action how we are **meeting the challenge.**

Tracy Robinson
President and CEO

Executive Summary

This Winter Plan for 2022–23 is comprehensive and multi-dimensional. It is guided by four objectives: operating safely, delivering the best possible service, increasing network productivity, and improving resilience. The Plan sets out wide-ranging actions, initiatives, and strategies to help ensure CN has the capacity and resources to respond safely and efficiently to the needs of our customers in the coming months.

The Plan reflects the fact that, as by far the most northerly Class I railway operating in North America, the challenges of winter and its effects on rail transportation are deeply integrated into CN's operations and planning activities. The variety and severity of weather conditions, for example, that an intermodal train will experience transiting from the West Coast of Canada to Eastern Canada can be expected to change markedly within the trip. The weather conditions that the same scheduled intermodal train will experience on the next trip are likely to be completely different.

We know the challenges that extreme cold, snow, ice, and rain bring every winter. What we don't know is how persistent and severe winter conditions will be—the impact of one day of -30°C on the network is very different compared to extreme cold that persists for weeks. CN also learns from its experiences. In advance of this fall, CN has fundamentally changed its approach to deliver consistent results and improved network resiliency—and that includes during periods of extreme cold. In addition to changes to the operational planning model, CN has implemented other measures, such as acquiring new locomotives and rolling stock, investing in network infrastructure and expanding our crew base. The actions in this Winter Plan are designed to maximize efficiency and car utilization. These actions are based on four thematic objectives:

1. Operating Safely

At CN, safety is at the core of everything we do and factors into every decision we make, consistent with Transport Canada's safety requirements. Our vision is to be the safest railroad in North America, with an uncompromising commitment to the health and safety of our employees, the customers we serve and the communities and environments in which we operate.

Training, leadership and technology are the key pillars that support our safety vision and culture. To advance safety, CN has comprehensive training for employees and a detailed safety guide for our customers and supply chain partners. The Company has trained more than 1,400 leaders in behaviour-based safety leadership since 2020. We've also invested in the latest technology that helps not only improve safety, but also efficiency. For example, the use of Automated Inspection Portals (AIPs) with high-resolution imaging hardware and machine learning software allows trains to be inspected at track speed. Our Autonomous Track Inspection Program (ATIP) has railcars specially equipped with the latest technology to inspect rail infrastructure as the train travels. We continue to gain momentum on our safety journey to a zero-serious injury or zero-fatality workplace by leveraging our investments in training, leadership, and technology.

Redpass, BC

2. Delivering the Best Possible Service

Planning means working with our customers to anticipate and prepare for demand during winter on an individual commodity basis. Some examples include:

- **Propane.** Knowing propane demand grows significantly in winter, CN is advancing transload solutions across its North American network. The resulting options increase the number of car spots available to handle and offload propane during the peak winter season.
- **Forest products.** CN is the largest rail carrier of forest products in North America. Our Industrial Products team's focus in advance of winter, is maximizing the efficient utilization of rolling stock. CN works with shippers and receivers to pre-position inventory at strategic transload points before winter arrives. Strategic transload and storage points within CN's rail infrastructure network, along with CN partner shortlines, allow for faster overall transit times.
- **Grain.** We're incenting grain customers to invest in facility infrastructure so that loaded grain trains are fully charged with air, reducing end-to-end cycle time and increasing car velocity.

3. Increasing Network Productivity

Sustained capital investment through the years, planned for 17% of annual revenues in 2022, is increasing capacity and productivity. This winter, CN will have 1,950 high- and mid-horsepower locomotives, a total greater than each of the two previous years. CN recently acquired 57 high-horsepower locomotives, 47 of which will be operating this fall and another 10 in Q1 2023. As well, 800 new high-capacity boxcars will be delivered in early 2023, and 500 high-efficiency hopper cars will be delivered during the 2022–23 crop year. In terms of operating crew base, CN has continued its determined hiring program across the network to retain and attract employees, positioning them where we need them across the network. CN's employee head count as of the end of June 2022 was approximately 850 people higher compared to the beginning of 2022, with most of the increase in operating crew base. CN also anticipates graduating another 500 new conductors through the end of 2022 and will have rules-qualified managers available to protect and support operations during challenging winter conditions.

4. Improving Resiliency

CN's emphasis on precision with respect to running to schedule for manifest and intermodal train service, with a focus on increasing overall railcar velocity and improving customer experience for all rail traffic segments, is central to CN's plans in advance of this coming winter. Emphasis on running to plan, including during extreme cold when CN must shorten trains to continue to operate safely and comply with Transport Canada requirements, is expected to translate into more rapid recovery from periods of persistent extreme cold.

Multiple measures are also being taken to make the network more durable. They include investment in rail infrastructure such as sections of double track and the addition of rail sidings that allow CN to improve overall network fluidity. Many multi-year capacity de-bottlenecking projects specific to the ports of Vancouver and Prince Rupert that have either been completed or are in the process of being completed will also improve resiliency.

A key dimension underlying the Winter Plan is CN's commitment to collaboration and joint planning with our customers and supply chain partners. In addition to the fluidity of the rail network, CN is constantly monitoring the relative performance of activities at customer production facilities and export terminals. CN operates within an end-to-end supply chain with many moving parts, and what's happening at origin and destination has a real impact on overall supply chain performance. CN and its customers collaborate and adjust when there are issues because, by working together, we can ensure the system is performing to its full potential.

We believe the breadth of the comprehensive, coordinated, and collaborative actions we are taking, and have taken, position CN to deliver the best possible service during the challenging winter months, and throughout the year.

New Actions and Initiatives

1 **Running the plan.** Multiple operational changes put into effect in the spring and summer of 2022, such as renewed emphasis on on-time train departure from CN's major rail yards for scheduled train service, driving improvements in rail network capacity and improving fluidity and velocity.

2 **Bulk unit train slot planning.** CN has implemented scheduled slots for bulk unit trains in key corridors to increase rail capacity and velocity.

3 **Greater discipline.** Matching mainline capacity to feeder traffic volumes during persistent extreme cold stretches to avoid congestion.

Joffre Yard, QC

4 **New technology.** Acoustic bearing detectors at five locations across the network will reduce failures online; CN's third-generation automated track inspection program fleet cars were launched in advance of this winter, reducing risks of rail-related incidents.

5 **Communication initiatives.** Increasing frequency of internal co-ordination and planning calls between Transportation, Network Operations, Supply Chain team, Resource Planning team and Rail Traffic Control.

6 **Locomotive reliability initiative.** Winter is hard on motive power. CN's Mechanical team has taken multiple proactive steps in advance of winter to improve overall locomotive resilience and availability.

7 **More locomotives.** Recent acquisition of 57 high-horsepower locomotives brings CN's inventory of high- and mid-horsepower locomotives to approximately 1,950 locomotives, a total greater than each of the two previous two years. (see Figure 1, p. 22)

8 **Rolling stock acquisition.** 800 new boxcars will be delivered in early 2023, and 500 high-efficiency hopper cars will be delivered during the 2022–23 crop year.

9 **Developing and preparing our people.** CN overall employee count was 850 higher as of the end of June versus the beginning of the year, with most of the increase in operating crew ranks; graduating 500 additional new conductors through the end of 2022; rail operating rules-qualified managers will be available to protect rail traffic movement and support operations during challenging winter operating conditions.

CHANGES TO RAIL OPERATIONS AND PLANNING PRODUCING RESULTS IN ADVANCE OF FALL AND WINTER

Under the leadership of CN CEO Tracy Robinson, the Company has enacted fundamental changes to its rail operations and planning to effect improvements in operational performance. Those changes are translating into improved rail service delivery for CN's customers. CN has been making these changes during Q2 and Q3 2022 well in advance of the anticipated increase in rail traffic volumes this fall and winter. It all comes down to running on schedule and focusing on moving cars faster.

- In April 2022, CN brought renewed focus to ensuring scheduled trains (intermodal and manifest carload) leaving the four largest railcar traffic processing yards in its network (Winnipeg, MB, Toronto, ON, Chicago, IL, and Memphis, TN) depart on time with the right traffic blocked to destination.
- In May 2022, the same approach was applied to four smaller railcar processing yards (Vancouver, BC, Prince George, BC, Montreal, QC, and Fond du Lac, WI).

The focus on departing intermodal and manifest carload traffic on time from origin, making the right connections, building the right blocks, and focusing on destination train performance continues to drive strong operational results including increased car velocity. For example, in Q2 2022, CN car velocity in the Western Region reached its highest level since Q2 2017. Origin on-time train departures reached over 90% in June 2022, up 14% points versus June 2021. The improvement in on-time train departures has also translated into improved train connection performance, which was up 30% to roughly 80% in June 2022. These performance measures have remained strong through summer into early fall.

Running to plan improves overall CN rail network balance, which is critical to ensuring efficient rail operations and ensuring the right resources are in the right place at the right time.

To maximize overall network capacity and protect CN's core train schedule, strategic staging of unit trains will be key this winter to maximize utilization of planned train slots in CN's busiest rail traffic corridors. CN has identified three rail traffic staging locations at Edmonton, AB, and two rail traffic staging locations at Jasper, AB, to maximize the utilization of rail capacity. While unplanned staging of traffic negatively impacts overall train speed, car velocity and other rail performance metrics, having the right traffic in the right position to take advantage of network capacity opportunities and make best use of train slots in high-traffic areas (through planned staging of rail traffic) is critical. Always having a train available to launch when a rail slot is available is key to maximizing planned train slot capacity.

Vegreville, AB

Introduction

The CN Winter Plan for 2022–23 is prepared and submitted in accordance with, and as required by, section 151.01(2) of the *Canada Transportation Act*.

The Winter Plan details comprehensive, proactive actions, strategies and innovations. They are designed to help meet customer demand by optimizing operations during the coming winter months. It is about maximizing CN resources. The Plan is shaped by four thematic objectives: operating safely, delivering the best possible service, increasing network productivity and improving resiliency.

Winter is a defining feature of Canada's character. For its more than 100-year existence, CN has annually dealt with and learned from winter's harsh impact. The inevitable challenges that demand resilience and determination to overcome have become ingrained in CN's corporate identity. For CN's network, the impact of winter, whether it's extreme cold, ice, heavy snow, or rain, fundamentally affects what we do and how we do it. Winter weather also affects the productivity of processing facilities or export terminals, whether that is preventing production facility staff from performing their responsibilities during periods of severe wind chill, or whether heavy, persistent rain delays grain-loading operations at Canada's West Coast ports. For these reasons, we all must plan accordingly to deal with the challenge of winter. We know that no two winters are alike and that we should expect the unexpected. **Our goal is to ensure we have done everything possible to maximize CN's ability to deliver the best possible service.**

The lessons learned over the years have helped inform the steps we have taken, and will take, to mitigate winter's impact on our operations in 2022–23. Safety factors into everything we do and every decision we make, including those outlined in the Winter Plan. They are made in accordance with the requirements of the *Railway Safety Act*.

Looking back at winter of 2021–22 provides perspective and context on the scale of what we can face in the coming months. *A summary of the impacts of last year's winter operating conditions is included in* ***Appendix A***.

The Plan for Winter 2022–23

Challenges

As a starting point, to plan effectively requires acknowledging and understanding the challenges.

Winter comes every year and with it, recurring operational issues. However, the frequency, severity or exact locations where these conditions will occur vary from one winter to the other. The more variation, the greater the challenge. The winter conditions that CN must address in its Winter Plan can be summarized in four words: cold, snow, ice and rain. Individually and collectively, those factors fundamentally affect the operation of a northern rail network.

Kamloops, BC

- Extreme cold weather also affects people, as wind chill and extreme cold limit the ability of train crews, rail infrastructure maintenance personnel, and personnel at customers' facilities to work safely outdoors. We can all mitigate the impact of cold temperatures to a point—but -40°C is -40°C.
- Extreme cold dictates slower train speeds to ensure safety. CN's video "The Tipping Point"[1] concisely illustrates these challenges. Temperatures at -25°C and below affect the physical properties of steel, leading to increases of steel defects. When rail is cooled, it contracts, adding stress on the rail—this increases the likelihood of the rail pulling apart or breaking. Defects in the rail steel may develop more rapidly, creating surface fractures. Surface pitting on wheel treads increases with cold temperatures and can create very high impacts into the rail and wheel. Another impact of extreme cold is on the train's braking system. Freezing of hoses can cause stiffness and kinks preventing air from flowing freely. Leaks in brake pipe, reservoirs, cylinders, hoses or valves, and fracture of brake shoes can cause a loss of air brake pressure and result in longer air brake system charging/recharging times. Moisture can freeze anywhere in the brake system, leading to impaired functionality, which becomes a significant safety issue and forces train length reductions and reduced speeds, resulting in loss of network productivity.

[1] Available at https://www.cn.ca/en/your-industry/customer-reports/winter-situation-report/


Oyen, AB

- Snow slows rail operations as well. Heavy snowfall and ice impede operations in rail yards, limiting the ability to process railcars until snow can be cleared. Blizzard conditions make it difficult to move train crews and other rail operations personnel as needed. Switches, even those that are equipped with snow melters, can become overwhelmed with snow and need to be cleared along the mainline, branch line network and within customers' facilities. The accumulation of snow during winter also raises the potential for avalanches that can block the mainline from Edmonton to Vancouver and Edmonton to Prince Rupert.
- Ice, and the freeze-thaw cycle that causes it, is harmful to rail and track beds. Smooth ice caused by a frozen puddle is a slipping and tripping hazard for crews and equipment. Roadways need to be cleared of ice for safe walking and driving. A build-up of ice between the rail and the underside of its base can result in the rail becoming separated from its tie plate, leading to a possible track disruption. The freeze-thaw cycle, where snow thaws during the day and re-freezes at night, also poses a significant risk to trains. Ice in the flangeways, especially at customer facilities, can cause derailments. Ice in the switch points can prevent rail access to customers and lead to missed service. Along the mainline, ice jams can cause overland flooding that damages the roadbed, erode embankments, and potentially cause washouts.
- Then there is rain. During the winter months, particularly in British Columbia, whether on the coast or further inland, heavy rain can result in washouts along the mainline in the province's interior, severely impacting network fluidity. At the ports, rain can limit or prevent the ability to load ships with grain and other cargoes that cannot be loaded in inclement weather. All these factors lead to congestion at the port and a system stalled by the effects of winter weather. When a destination terminal, whether served directly by CN or by another rail carrier, cannot accommodate rail traffic, CN must hold trains at origin or along the route to Vancouver, slowing equipment cycle times and effectively reducing supply chain capacity.
- Recognizing that the North American rail network is interconnected, storms, avalanches, track washouts and other mainline disruptions due to extreme winter weather also impede the movement of rail traffic directed to or returning from connecting carriers.

Great Lakes Fleet

Beyond those challenges are other factors that affect the system's capacity during winter.

- The end of the vessel navigation season due to the closure of the locks along the Welland Canal, the Montreal–Lake Ontario section of the Seaway, and the Sault Ste. Marie locks means the loss of significant throughput capacity on the Great Lakes–St. Lawrence Seaway system. Average monthly cargo tonnage transiting the Welland Canal section of the Great Lakes–St. Lawrence Seaway system declines from roughly three million metric tonnes per month to zero during January, February and most of March. Grain terminal unload capacity in the Port of Thunder Bay declines from upwards of 3,000 cars per week to negligible levels. Potash shipments from the port of Thunder Bay cease.[2]
- At the same time, although capacity is reduced because of the closure of the locks, customer demand across all commodity sectors—grain, forest products, propane, potash, non-grain bulk—remains constant, and in some cases increases, during the winter months. The result is greater pressure on the western ports of Vancouver and Prince Rupert.

Winter is when demand from all commodity sectors is often at or near its peak, but also a time when rail system capacity can be reduced by poor operating conditions caused by extreme weather.

- A complicating factor is the continuing disruption of global supply chains resulting from the global pandemic and the war in Ukraine. Those disruptions limit the accuracy of sector supply chain forecasting and planning so crucial to network efficiency. Further global supply chain disruptions include continued export container shortages and constantly changing vessel lineups. If throughput on the West Coast remains limited, at the port or through freight forwarders, and demand to ship from the interior to the coast isn't reduced, shipments at origin need to be metered to match the capacity at destination.

Winter is when demand from all commodity sectors is often at or near its peak, but also a time when rail system capacity can be reduced by poor operating conditions caused by extreme weather. Recognizing that tension between demand and capacity, CN has put in place the following multi-dimensional winter action plan.

[2] Potash shipments from Thunder Bay are expected to reach record levels in 2022 due in large part to the commodity trade flow disruptions caused by the war in Ukraine.

The Actions

1. Operating Safely

As CN's core value, safety is embedded in everything we do, with an uncompromising commitment to the health and safety of our employees, the customers we serve and the communities and the environment in which we operate. This means our focus on safety during winter months is even stronger, when cold and winter elements can directly affect safe rail operations as well as operations at customers' facilities. First and foremost, we must ensure our employees have the necessary tools and training to work safely and control exposures in the workplace. CN railroaders wearing the appropriate cold-weather gear may have to slow down their activities. To prevent frostbite and other cold-weather injuries, as required, CN crews take warming breaks and receive frostbite awareness training. Finally, if extreme conditions prevent safe transit, like a blizzard, overland flooding, or extreme cold temperatures, CN may close sections of track or even suspend overnight train operations.

New innovative technologies enable CN to not only ensure and enhance safety, but also provide more efficient, fluid, and effective operations to serve our customers. Using advanced technologies, like predictive analytics to identify problems before they happen, helps avoid network disruptions and keep traffic on the network moving.

Automated inspection portal
Winnipeg, MB

For example:

Automated inspection portals (AIPs) feature ultra-high-definition panoramic cameras and high-intensity LED lighting that capture a full 360° view of the train and undercarriage as it travels at track speed through the portals. Artificial intelligence then helps experienced railcar mechanics identify railcars requiring repair before a train arrives at the yard. ATIP allows us to increase inspection frequency twentyfold. Due to the increase in frequency and quality of inspections, the AIPs help reduce accidents related to railcar defects. During winter, CN adjusts the equipment's algorithms to better detect what would be considered smaller issues in spring, summer and fall. At this time of year, those issues need to be detected and dealt with sooner to avoid problems. CN has seven AIPs in operation across its rail network, with more artificial intelligence development expected over the next few years. Currently, AIPs are used to supplement mechanical inspections, using technology to enhance inspection quality. CN is working closely with regulatory authorities in Canada and the United States to implement AIPs to their maximum potential. Using AIPs translates into safety, reliability and efficiency of our railroad operations. Designed to operate day and night, as well as during extreme temperatures, AIPs increase network capacity thanks to real-time train inspection as trains travel at track speeds.

Historically, track inspections have been done between train movements within specific sections of the network. With a network that is getting busier and busier, those inspections consume precious capacity. Inspections are typically done by a track inspector in a high-rail vehicle moving at 15 to 20 miles an hour plus stops along the way to have a look at potential problems. As an alternative, CN's **Autonomous Track Inspection Program (ATIP)** uses technology to inspect track and assign preventative maintenance. CN's ATIP consists of 10 railway cars equipped with multiple advanced measurement systems. The cars are operated within existing trains at track speed and allow for real-time measurement of track conditions under load.

Since their deployment in 2019, ATIP cars have travelled over 1.8 million miles across the CN network and have substantially improved CN's track safety metrics. In advance of this winter, CN has launched new technologies, including third-generation inspection systems that will be capable of inspecting additional components within track infrastructure. The data collected will be utilized to provide additional preventative maintenance recommendations, reducing risk and improving network fluidity. Besides a network productivity boost, ATIP cars unlock capacity and improve service reliability by reducing the incidence of track disruptions. A mainline disruption, especially during winter, consumes precious perishable capacity.

Automated Track Inspection Car
Abbotsford, BC

CN also uses ATIP to look for specific winter-related track conditions such as ice jacking, or ice plating. This is a phenomenon that begins to occur at temperatures between 0 and -7°C where swirling snow gets into the space between the base of rail and the rail plate (the plate is lagged into the rail tie and a spike holds the base of the rail to the plate). Snowmelt occurs due to the friction caused by the train operating over that section of rail and remains liquefied. When temperatures get colder, the accumulated liquid turns to ice, and through successive freeze and thaw cycles the rail is slowly lifted out of its seat and the rail spike can no longer hold the base of the rail to the tie. This condition is difficult to see from the surface, considering that it can occur under snowpack, or occurs gradually in small increments, much like the formation of an icicle over time. Because ATIP can measure rail head-to-rail head distance, CN is able to collect and use that data to create an algorithm that monitors locations for susceptibility to ice jacking.

New for this year, CN's third-generation ATIP fleet cars were launched in advance of this winter. Two CN ATIP cars are now equipped with the ability to analyze joint bars (metal bars bolted to the ends of two rails to join them in a rail track) on track and rail surface. The technology can assess the quality of rail-to-wheel contact, in turn optimizing and reducing risk associated with that type of rail-related incident. CN also introduced the use of ultrasonic testing to identify internal rail defects that lead to issues such as broken rails. Preventing a broken rail before it happens creates network resiliency and contributes to overall network productivity.

Hot box detectors located on the side of railway tracks monitor the condition of wheel bearings to identify overheated components before they reach temperatures that can lead to failure. With detectors situated every 15 to 17 miles along mainline track, CN links the data collected by the hot box detector network to increase the reliability of information provided by the network. This allows the data to be aggregated and trends identified as trains operate on CN lines. With the data, action can be taken before problems develop, improving safety, reliability, and efficiency. Our winter preparation program also includes the replacement of suspect wheel sets to prevent accidents.

Wayside detectors and algorithms measure mechanical component quality (e.g., wheels and wheel bearings) and component condition. These detector technologies and algorithms generate alarms and notifications when problems are discovered to prompt the repair or replacement of the component before it fails. Cold wheel detectors are placed at the bottom of long grades where trains are typically applying the brakes. The braking process generates heat as the brakes are engaged on the wheel. Wheel sets with a cold wheel profile get flagged for brake system inspection by the detector network. CN's dragging equipment detector network, deployed in concert with the hot box detector network, is very intense, looking for something that's dragging or running off the rails. Wheel impact load detectors measure the impact of each wheel going over the detector. High impact wheels are a problem because they can cause parts to rattle loose, and they can also cause serious damage to rail and ties. These wheels must be identified and addressed before they cause bigger issues.

As new initiatives in advance of this winter, CN recently added two technologies to provide early identification of failing wheel bearings. First, CN implemented an algorithm to track wheel bearings with unusual heat readings within the same car and same train. Second, CN installed acoustic bearing detector technology at five locations across the network to monitor the sound signatures of bearings exhibiting defects.

As new initiatives in advance of this winter, CN recently added two technologies to provide early identification of failing wheel bearings.

Acoustic bearing detectors are designed to identify internal defects in freight and passenger cars as they pass at normal operating speeds. The detectors tend to find bearing defects before they generate heat to be detected by hot box detectors and therefore form an additional and earlier layer of protection against bearing-related accidents. The system operates as a wayside detector with a bank of microphones capturing the sound signatures of each bearing as the car passes over the detector. The sound signatures of each bearing are recorded and matched against algorithms of known defects associated with failing bearings. Cars with identified bearing defects are then sent for repairs.

Broken wheel detectors are designed to find wheel defects. Broken wheel detection systems operate by using various technologies including wheel weight gauges, lasers, cameras, and machine pattern algorithms to identify defects. These systems provide an additional layer of detection to identify both urgent and emerging wheel defects. By monitoring the health of wheels, CN will have additional data points available to make operational decisions on whether to remove a car from service immediately or to allow the car to continue to the next mechanical shop location for repairs. CN has installed five broken wheel detectors across the network in advance of winter.

As a result of these innovations, CN has an even safer rail network. Network capacity has been enhanced by these technologies, translating into greater rail traffic movement. And the potential for major mainline disruptions due to track and equipment malfunction, particularly during winter, has been reduced, improving network resiliency.

2. Delivering the Best Possible Service

When considering capacity to move traffic, it is important to note that CN is one component of the supply chain, with other factors also affecting the overall global supply chain efficiency and capacity. For example, in the case of extreme cold and/or extreme wind-chill conditions, some customer facilities halt outdoor operations to protect the safety of their employees. This situation is the same for CN personnel. In both cases, the capacity of the supply chain is adversely impacted. If other supply chain partners experience delays due to challenging operating conditions, the impact will affect CN as well. As an example, if receivers are not able to unload railcars in a timely fashion, available equipment is reduced.

A significant amount of rail traffic originating on CN is also directed to connecting rail carriers to reach its final destination. A prime example is for shipments of forest products to the United States. The ability of rail traffic to move on the North American rail network depends on fluidity across all rail traffic carriers. Shipping, receiving, transloading and freight-forwarding facilities require the staffing, trucking, container availability and warehouse space to quickly unload railcars and maintain a balanced rail operation. Delays at the loader and unloader reduce car supply for all customers in the supply chain. Centrebeams, boxcars, and grain hopper cars are all equipment types where the majority of customers effectively share a pool of CN-supplied railcar fleet assets. Customers must take these realities into consideration when assessing supply chain performance, especially during winter.

Timely and reliable customer demand forecasts across all segments of CN's rail traffic are critical for the railway to accurately plan its operations. In the absence of accurate and up-to-date customer forecasts that stretch 6 to 12 months out, CN is required to make assumptions and rely upon historical data. Significant changes in demand levels or traffic flows that CN cannot anticipate hinder our ability to respond quickly to the new circumstances.

Improved short- and long-term customer demand forecasts will support the supply chain's ability to plan for growth.

Resource planning requires time. Long lead times are needed to acquire not only rolling stock (9 to 12 months, depending on production capacity), but to recruit and train crews (up to 12 months), acquire locomotives (12 to 18 months), and invest in track and other rail-related infrastructure (up to and sometimes in excess of two years, taking into account permitting process) to deliver the best possible service. Publicly reported gaps in customer service often could have been avoided with better forecasting and communication. The sharp uptick in demand for boxcars to move forest products this past year, for example, was not anticipated in advance by the market, which in turn hindered CN's ability to accommodate the additional demand. The situation worsened when the sector pivoted from export to domestic U.S. markets, doubling car cycle times and effectively halving the available car supply. Without sufficient lead time, CN cannot react to these sorts of changes in the supply chain.

Improved short- and long-term customer demand forecasts will support the supply chain's ability to plan for growth. CN will work with our customers' senior management teams to identify demand forecast enhancements and increase information sharing. Working together and closely coordinating activities with our customers is essential to maximize the efficiency of the end-to-end supply chain. CN is fully committed to maintain and increase communication to ensure this coordination and efficiency can occur.

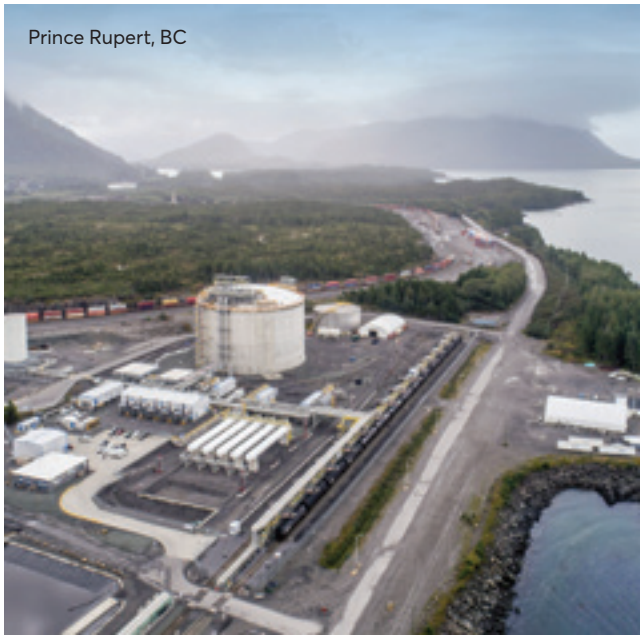
The full context of customer demand during the winter months requires assessing commodities on an individual basis. Each brings unique needs and requires that CN anticipate and be positioned to meet demands.

Following are examples of key sectors and the actions CN is taking to serve them:

PROPANE

With propane demand growing significantly during the winter months, CN is expanding transload solutions across its Canadian and U.S. network. This increases the total off-loading capacity available to propane shippers through the peak winter season. In addition, CN is working with multiple customers to increase the rail capacity of their facilities, including self-switching and additional self-storage capacity. Increased capacity enables greater propane volumes to be delivered to end-use customers during this critical season.

CN has identified and is working with customers and third-party loaded railcar storage facilities to provide more options to move product into and out of storage. Shippers can pre-position inventory closer to their end markets to offset cold and precipitation impacts on the supply chain during the heart of winter. This is important for the propane industry as we collectively rely on origins further away from end markets to meet domestic demand. Longer shipping distances are also more vulnerable to weather-related disruptions. As such, pre-positioning inventory enables shippers to meet their customer demand through the variable winter conditions experienced across Canada.


Prince Rupert, BC

INTERMODAL

More than any other supply chain, the global intermodal supply chain has been disrupted the most by the pandemic. This past spring and summer, container ground counts at many of Canada's ports increased due to constrained warehouse space at inland destinations. The CN intermodal team quickly mobilized to implement several supply chain solutions to increase import container throughput from Canada's West Coast, improving supply chain efficiency and fluidity leading up to winter. One of such solutions was establishing partnerships with off-site intermodal container storage locations in the Greater Toronto Area (GTA) and Greater Montreal Area (GMA). These efforts have helped maintain Canada's West Coast ports fluid ahead of winter season. CN continues to work collaboratively throughout the industry, as well as with Transport Canada and the Canada Border Services Agency, to maximize intermodal supply chain potential.

In addition to above, in June 2022, CN doubled intermodal train service between the Port of Halifax and points in Eastern Canada and the U.S. Midwest. This additional service supports shippers using the Port of Halifax, the only East Coast port that accommodates Ultra-class vessels, with extra capacity to move the goods to destination. It also takes advantage of CN's uncongested high-speed network from Canada's East Coast to Montreal, Toronto, and the U.S. Midwest. This initiative will help relieve supply chain congestion and improve overall supply chain fluidity.

Kamloops, BC

FOREST PRODUCTS

CN is the largest rail carrier of forest products in North America. Our Industrial Products team's focus in advance of winter is maximizing the efficient utilization of rolling stock. CN works with shippers and receivers to pre-position inventory at strategic transload points before winter arrives. Strategic transload and storage points within CN's rail infrastructure network, along with CN partner shortlines, allow for faster transit times.

For CN's western Canadian pulp export business, CN activates the **Terminal Authorization Program** for receivers located in the Port of Vancouver. This program stems from CN's ongoing efforts to maximize the throughput of boxcars at unloading terminals and avoid congesting the Port of Vancouver. It relies on the active participation and collaboration of our customers and terminals to coordinate inbound loads with warehouse space, vessel berths, and container availability.

As part of CN's Efficient Receiver Program, CN actively monitors and identifies locations outside of the CN rail network with offline car dwell exceeding five days. CN limits sending more CN cars into areas that show rail traffic build-up to help limit congestion at any one receiver or serving yard. This is a year-round program but is particularly important during the winter months.

FRAC SAND

In Western Canada, materials required to support drilling programs include frac sand and drilling pipe. In preparation for winter, CN works closely with customers to ensure product is shipped in advance of peak demand surges to fill frac sand storage silos and to have adequate drilling pipe inventories on-site. Transload locations are added to help manage inventories and CN provides additional car storage locations for sand (closer to destination) to support needs should there be any supply chain interruptions.

GRAIN

In 2014, CN began incenting grain customers to invest in their grain facility infrastructure to allow loaded grain trains to be fully charged with air, reducing the time required for CN crews to depart with a loaded train. In times of extreme cold, it can take 8–12 hours (or more) for a train to be fully charged with air by locomotives. Reducing the time required to charge trains with air reduces end-to-end train cycle times and improves car velocity. More than 95% of CN-served facilities capable of loading grain unit trains have participated in this program, representing a win-win situation for CN and its customers. This program has been extended to non-grain customer facilities as well.

Consistent with the evolution in grain handling infrastructure in Western Canada, CN's efficiency incentives have evolved to encourage more efficient grain handling infrastructure. Improved grain supply chain efficiency contributes to stronger overall grain movement, especially during peak grain demand in fall and winter. More efficient grain movement helps improve overall rail network efficiency. CN's rate incentives encourage high-efficiency unit train facilities that have a hook-and-haul model for grain trains that can be loaded in 15 hours or less. This model means the train does not occupy the mainline while spotting empties or pulling loads, which improves mainline efficiency. Most of the new grain handling facilities being built in Western Canada are hook-and-haul facilities, and most have loop tracks that allow more cars to be spotted in a single placement, which results in improved capacity utilization.

When considering the eligibility of orders for grain cars, CN works with customers to ensure grain car orders have shipment authorization from the receiving terminal. The terminal authorization program originally was specific to grain-only container stuffing facilities, considering that the receiving facilities were third-party service providers with no control over country origination assets. This program was subsequently extended across all receiving facilities to facilitate efficient hopper car order management and support overall rail network fluidity.

OTHER BULK COMMODITIES

In the case of potash mines, on-site air capability saves critical time for CN crews. Having potash trains charged with air at mine sites reduces the time needed to charge the train's braking system, especially in cold winter conditions.

For unit train shipments of coal, CN adjusts the length of specific coal trains to ensure continued safe handling during winter conditions. As well, side release agent is applied to coal cars prior to loading at coal mines. This practice allows for clean dumping of coal upon unload at terminal, reduces double dumping of railcars, and decreases coal carry-back in cars from unloading terminals back to coal mines.

PLANNING WITH CUSTOMERS

The supply chain is an inter-connected system. CN's rail network connects shippers to receivers, each with their own unique needs, challenges, and supply chain connections. Integral to meeting customers' needs are accurate customer railcar demand forecasts, especially during winter. For CN to plan effectively and allocate resources in an efficient way require up-to-date and accurate information from customers on their needs and expectations. It demands joint planning on a sector-by-sector basis with all stakeholders.

We all seek the same objective—a rail system that operates at peak efficiency. This means we must collaborate as business partners in a transparent manner, sharing information in pursuit of that common goal. CN is actively engaging with our customers and stakeholders to create more seamless planning that will maximize system capacity and fluidity. Customer feedback is used to adjust CN's operating plan and maximize productivity.

Customers can take steps to help avoid delays during the winter months. Some of these steps are outlined in CN's recently updated Customer Safety Handbook,[3] which includes a checklist of safety measures to deal with adverse winter conditions. CN and its customers also meet to prepare for winter operations. *A summary of key discussion points is included in* ***Appendix B***.


Skeena, BC

[3] https://www.cn.ca/en/customer-centre/safety-guidelines-and-regulations/

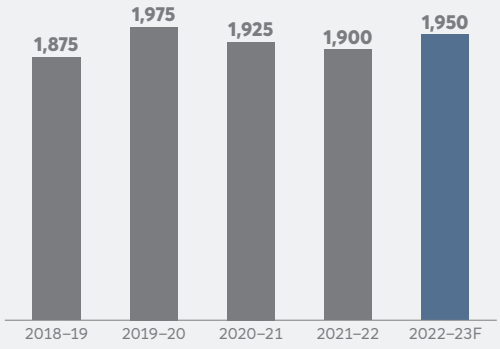
3. Increasing Network Productivity

CN is focused on improving the productivity of its network. The evidence is an aggressive capital investment program that totalled more than $13 billion from 2018–2021. In the current year, CN's capital investment is projected to represent approximately 17% of annual revenues. The investments are designed to increase CN's capacity and productivity.

LOCOMOTIVE-SPECIFIC INITIATIVES AND ACTIONS

This winter, CN's inventory of high- and mid-horsepower locomotives is expected to be approximately 1,950 locomotives. This fleet size is greater than the approximately 1,900 high- and mid-horsepower locomotives CN had as of late August 2021, and approximately 1,925 high- and mid-horsepower locomotives as of August 2020.

FIGURE 1
CN high- and mid-horsepower locomotive fleet available for winter



CN works hard to ensure it has the locomotive fleet required to operate its network and move the traffic offered for shipment by its customers. Because the lead time for acquiring new locomotives is typically 9 to 12 months, CN must plan acquisitions of new locomotives well in advance. This is another reason why accurate customer demand forecasts are important to support CN resource planning activities.

Recently, CN acquired 57 high-horsepower AC locomotives to augment its CN-owned locomotive fleet, of which 47 Tier 3 locomotives are operating on the CN network and 10 Tier 4 locomotives are expected to be operating on the network in Q1 2023. AC locomotives have significantly better adhesion, improved traction power effort and are less prone to traction motor failures compared to DC locomotives. The traction motors of AC locomotives are also less prone to mechanical issues due to snow compared to DC locomotives.

CN has also recently undertaken a modernization program for 100 locomotives between 25 and 30 years in age. These locomotives will be upgraded from DC-traction motors to AC-traction motors, and state-of-the-art technology will be installed to support improved productivity and reliability.

There is a difference between the size of the overall locomotive fleet and the number of locomotives available for use on any given day. As with any type of motive power, winter is harder on locomotives and the proportion of out-of-service locomotives tends to increase seasonally. For example, snow finds its way into traction motors and failures related to air components such as air dryers and compressors tend to increase during winter.

Locomotive winterization begins well in advance of winter and targets traction motors, air compressors, air systems and cooling systems. The scope of locomotive winterization work is adjusted using historical performance trends to mitigate causes of top winter failures and improve performance in harsh winter conditions.

Locomotives must also undergo periodic inspections, some of which are required by government regulators. By completing these inspections prior to the onset of winter, CN can keep locomotive repair shop space open to repair locomotive units rather than tying down shop space to perform inspections.

In advance of this fall, the CN Mechanical team has taken multiple actions to improve overall locomotive availability and increase the number of locomotives in service at any point in time. These initiatives include process improvements to reduce locomotive dwell times and improve reliability.

ROLLING STOCK / FLEET PLANNING AND MANAGEMENT INITIATIVES

Major CN investment initiatives specific to rolling stock include the following:

- The acquisition of 800 new high-capacity boxcars to be delivered in Q1 2023 to support customer demand for shipments of forest products, metals and minerals, and other commodities across its North American network; and,
- A multi-year hopper car modernization program that is under way and expects to take delivery of 500 high-efficiency hopper cars during the 2022–23 crop year. Since 2018, CN has taken delivery of 3,000 new-generation, high-efficiency hopper cars, including 500 new hopper cars during the 2021–22 crop year.

For many traffic segments that CN supplies equipment, such as for hopper cars, boxcars, centrebeams and gondolas, demand is cyclical, necessitating the storage of CN-supplied equipment for lengthy periods. When equipment is stored for prolonged periods of time, **comprehensive equipment inspections** are required. CN is proactive in inspecting these cars in advance of demand surges. For example, with more than 6,000 grain hopper cars in storage as of early August 2022, car inspections and repairs were undertaken between August and early September in preparation for the peak grain season that normally runs through the fall and winter months. CN's frequent inspections mean fewer equipment failures in winter.

CN-supplied rolling stock coming out of storage receives a full inspection by CN personnel. A pre-service work scope document is distributed well in advance to field leaders, and the document includes a focus on:

- Outlet gates (e.g., gravity dump hopper car outlet gates)
- Trucks (i.e., the wheel axle frame located under either end of a railcar)
- Side sills (longitudinal supports that constitute part of the railcar underframe)
- Hopper car hatch covers and boxcar doors
- Maintenance advisories (e.g., over-age brake valves and air tests)

High-capacity boxcar
Wabamun, AB

This summer, CN also implemented a **summer reliability-based maintenance program for car fleets**. This program uses repair data to identify cars with a high probability of failure and/or customer reject cars (gates, doors). Detector technology is also being implemented by CN to identify cars with partially applied hand brakes, reducing wheel defect frequency and improving fuel efficiency.

Private car customers should regularly inspect their cars in active service and perform a pre-winter inspection on cars coming out of storage, with particular attention paid to the air hoses and connecting gaskets. Carefully inspecting all railcars ensures safe operations and can reduce the likelihood of cars needing repairs en route.

Timely, accurate customer demand forecasts allow CN to make the right decisions around fleet size and composition and support capital decisions concerning the CN-supplied fleet. Like CN, the customer-supplied fleet needs to be sized and shipments regulated to preserve efficient movement throughout the whole supply chain. Customers shipping across the continent also need to be aware of the conditions at both ends of their supply chain, as well as the conditions en route.

CN handles a large portion of traffic interchanged to connecting carriers for delivery to destination, with forest products destined to the southern U.S. a prime example. This is a key consideration in CN's assessment of CN-supplied fleet size requirements in relation to overall demand itself. It is not just about how many orders there are—it is where those cars want to go and how long it will take them to return to CN's network to become available for the next load.

With respect to fleet monitoring, customers need to **actively monitor shipments** to ensure interline shipments make it to destination and are unloaded in a timely manner. The longer a car takes to return to CN, the fewer empty cars will be available for the next loaded movement. In addition to customers tracking their own shipments, the **CN Efficient Receiver Report** highlights destinations that are unloading cars slowly.

Active fleet management means holding cars out of areas experiencing extreme winter weather conditions to prevent congestion and enhance overall fluidity. In the case of major mainline disruptions, that means re-routing traffic, including over other railways' lines at CN's expense to meet our commitments to customers. Finally, reducing active fleet during periods of tier restrictions (see train length section) to maintain fluidity on the mainline and production in CN's classification yards is also critical to maintaining network fluidity. It is also important that proper documentation for billing and customs is completed to avoid delaying the movement of cars.


Kamloops, BC

INVESTMENT IN RAIL INFRASTRUCTURE

A significant portion of CN's investments in 2022 is dedicated to track maintenance to support safe and efficient operations, including the replacement of rail and ties, bridge improvements, crossing protection upgrades and maintenance, as well as other general track maintenance. Across Western Canada, the projects for this year include:

- 191 miles of rail to be replaced;
- Approximately 425,000 ties to be replaced;
- Close to 130 road crossing surfaces to be rebuilt; and,
- Over $1.1 billion of capital investment (CN has invested more than $4.7 billion over the past five years).

Close coordination is required between CN Transportation, Engineering and our Rail Traffic Control Centres to coordinate these construction projects at the same time rail traffic is moving 24 hours a day, 365 days a year. These projects are targeted for completion before both the onset of winter and the start of peak grain demand in Western Canada. Managing major infrastructure work on busy corridors is a highly complex task. It requires significant planning and resources and involves temporary disruptions of service to provide work crews with needed access to the network.

The Engineering team needs track time protected to be able to perform its work. During that track time, rail traffic cannot move through sections of the network where work is being performed or must pass through at a slower speed.

Specifics of the new rail infrastructure capacity enhancements expected to be in service in 2022 include the following:

Saskatchewan

- Upgrading of the rail infrastructure on the CN St. Brieux Subdivision between Humboldt, SK, and Melfort, SK, to 286,000-pound gross weight restriction.

Alberta

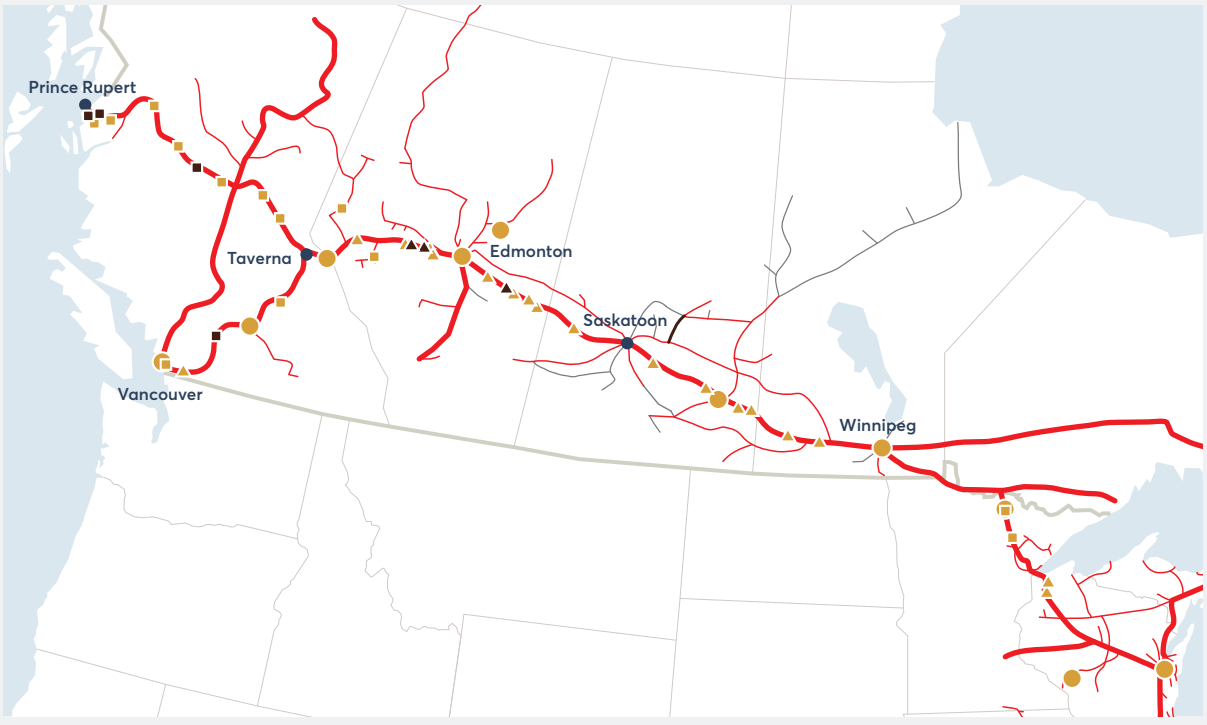
- Nine miles of double track east of Edmonton on the CN Wainwright Subdivision to increase train capacity along the subdivision.
- Seventeen miles (two separate sections) of double track west of Edmonton on the CN Edson Subdivision that will increase subdivision train capacity. All trains destined to or originating from Vancouver and Prince Rupert must transit through this subdivision.

British Columbia

- A 12,000-foot siding south of Kamloops on the CN Ashcroft Subdivision that will allow for more frequent passing trains and increase throughput along this subdivision. This siding is in the Directional Running Zone where CN and CP coordinate their activities and effectively operate their single-track rail infrastructure as a section of double track to increase overall capacity in the Vancouver corridor.
- A 12,000-foot siding between Smithers and Prince George on the CN Telkwa Subdivision that will increase capacity between Edmonton and Prince Rupert.
- Two 12,000-foot sidings near Prince Rupert on the CN Skeena Subdivision that will support current operations, support future Prince Rupert expansion, and provide broader port area resiliency.

FIGURE 2

Major CN capital infrastructure investments between 2018 and 2022



ADDRESSING BOTTLENECKS

To remove system bottlenecks and create new capacity in the area around the Port of Vancouver and the Port of Prince Rupert, CN has completed or is in the midst of several multi-year projects. Many are in conjunction with the port authorities and the Government of Canada. The projects include:

Port of Vancouver

- *Thornton Tunnel ventilation* – Installation of fans to improve exhaust ventilation and increase capacity of the CN Thornton Tunnel which leads to grain terminals and other facilities on the North Shore of the Port of Vancouver. This change will allow trains to pass through the tunnel more frequently (reducing the current 20 minute interval between trains to 5–10 minutes) and better utilize capacity when the CN Second Narrows Bridge is available for transit. **IN SERVICE**
- *Piper Douglas siding* – Addition of a third track (18,900 feet) to increase capacity between Thornton Tunnel and CN Thornton Yard for traffic to the North Shore. CN can now stage trains close to the CN Second Narrows Bridge instead of staging trains much further back at Thornton Yard. **IN SERVICE**
- *CN Thornton Yard bypass* – Construction of a 12,000 foot bypass and 6,000 feet of yard track to improve fluidity and yard capacity. **IN SERVICE**
- *Burrard Inlet road and rail improvement* – Construction of a 13,700 foot railway track parallel to the existing Burrard Inlet mainline on the CN New Westminster Subdivision. This project will make the Vancouver South Shore rail network more resilient to disruptions by ensuring an alternate route for South Shore access is maintained, improving the capacity and reliability of operations in the area. **ONGOING MULTI YEAR PROJECT**
- *Glen Valley double track* – The project will address a significant bottleneck—the last section of single-track infrastructure (3.7 miles) in the 25 mile double track rail corridor between the end of the CN/CP Directional Running Zone (DRZ) and CN's Thornton Yard, which supports industry and port facilities in the Lower Mainland. Corridor capacity will increase, making the network more resilient to disruptions by stabilizing grade slopes with a retaining wall. **ONGOING MULTI YEAR PROJECT**

Vancouver, BC

Port of Prince Rupert

- *Zanardi Bridge renewal project* – Bridge replacement and double tracking will increase the maximum number of trains daily that can enter and depart the Port of Prince Rupert. Bridge capacity expansion will reduce operational conflicts and increase rail capacity to the Port of Prince Rupert to accommodate future growth in import and export trade for all current and future terminals. **ONGOING MULTI YEAR PROJECT**
- *Road Rail Utility Corridor expansion* – Constructed prior to 2017, the expansion of the Corridor will support access to any future terminals on Ridley Island and facilitate unit train access. **ONGOING MULTI YEAR PROJECT**
- *Fairview–Ridley Island Connector* – A 5-km road between Fairview Container Terminal and Ridley Island will allow container trucks to move more efficiently and support future infrastructure growth. The route will reduce truck length of haul from 20 km to just 5 km, as truck traffic will no longer have to transit downtown Prince Rupert. The road will support current port operations and future terminal expansion and improve the resiliency of the broader port area. **COMPLETED AUGUST 2022**

PEOPLE INITIATIVES AND ACTIONS

Beyond hard network infrastructure is the need to invest in people. CN is focused on ensuring it has the right number of people to deliver the best possible service, especially during winter. CN assesses its operating crew base at the regional and individual terminal level, also taking into consideration the time required to train engineers and conductors, and others working on the network. It is also important to note that CN did not make any reductions to operating crew base last year. Many variables can affect rail operations. They range from major mainline disruptions to the impact of COVID-19 on our workforce and that of our customers.

CN's Q2 2022 ending head count was approximately 850 higher compared to January 1, with most of the increase in operating crew base. CN anticipates graduating another 500 new conductors through the end of 2022.

Heading into this fall and winter, CN will also have rail operating rules-qualified managers available to protect rail traffic movement and support operations during challenging winter operating conditions and periods of high demand. Based in part on rail network capacity demand forecasts, CN also expects there will be opportunities to temporarily deploy operating crew base employees from areas of anticipated crew surplus to areas where additional operating crews are needed. This segment of employees will assist in protecting train service during periods of abnormal winter operating conditions and augment overall rail capacity. CN also has additional rapid deployment teams of dedicated managers from relevant departments in place to take action as needed.

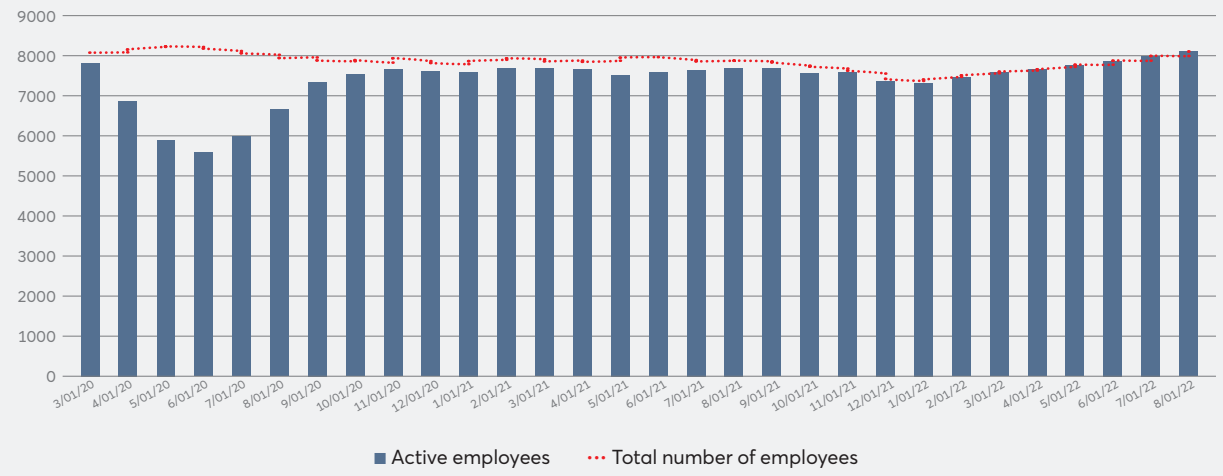
In an already challenging labour market with the lowest unemployment rate in decades, measures CN has taken to attract potential new employees include:

- Improved retention and signing bonuses in hard-to-recruit areas;
- New recruitment information sessions targeted during evenings and weekends;
- Increased participation in employment events such as job fairs;
- Working with post-secondary educational institutions to improve recruitment of graduates with transferrable skills; and,
- Pilot projects to try new online recruitment and interview tools to accelerate the hiring process for critical operational positions.

But the reality is unemployment levels are at five-decade lows and demand for employees with the skill set CN needs is very high in many sectors of the economy. Our customers and supply chain partners report the same challenges in hiring new workers.

FIGURE 3

CN network-wide operating crew base statistics



BUILDING AND RUNNING THE PLAN

Build the Plan: *Key areas of responsibility building the operating plan:*

- **Network Operations** efficiently delivers reliable service enabled by technology
    - The **Service Design** team designs the most efficient trip plans and train service package to consistently and reliably meet customer demand, maximize network capacity and asset utilization, and safely deliver service to CN's customers
    - **NOC** is responsible for dispatching and crew planning
    - The **Supply Chain** team is responsible for building and coordinating daily plans and future needs, both internally and externally. The Supply Chain team is also responsible for fleet planning, train reporting and customer service for all merchandise and bulk unit trains
- Effective operational planning, coordination and communication builds the plan to service our customers, meet customer demand and maximizes rail network capacity by making the best use of operating assets (i.e. crew base, locomotive fleet, rolling stock and rail infrastructure.)

MacMillan Yard, ON

Run the Plan: *Key areas of responsibility executing the operating plan:*

- The **Transportation** team (organized into Western, Eastern, and Southern regions) executes the plan in the field, with general managers each responsible for operations within their respective geographical areas of coverage;
- **Network Operations** (including Rail Traffic Control Centres (RTCs), Motive Power, Crew Planning) ensure the efficient operation of the overall network, aligning strategies across all three operating regions with business units across CN;
    - Within Network Operations, the **Supply Chain** team oversees and manages traffic movement and planning for individual business segments, providing end to end supply chain oversight to ensure fluid network operations and managing fleet size to maintain fluidity and maximize productivity;
    - There is close coordination with the **Resource Planning** team (locomotive, operating crew, and rolling stock) and the **RTCs** in Edmonton, AB, and Homewood, IL, that coordinate active train movement along the network with train crews, and;
    - **Service Design** reviews and refines the operating plan itself, optimizing transits, connections and schedules to optimize train operations, crews, and locomotives with network capability

In advance of this fall and winter, CN has increased the frequency of internal coordination and planning calls among these teams to enhance the impact of changes that CN made to its operations plan this past spring and summer (see a description of these changes on page 9). The morning call is focused on loaded train plans in CN's Western Region, given that traffic density and complexity is by far the greatest in this region. The call's primary purpose is to ensure CN has a fully charged pipeline sized to capacity and throughput. Each individual rail traffic segment (e.g., coal, grain, potash, sulfur, autos, crude oil, frac sand) is discussed with a focus on plans for power and crew resources for loaded trains. Any traffic flagged as critically urgent with respect to manifest traffic, such as traffic required to prevent a plant shutdown, are discussed as well. A similar call is held in the afternoon with emphasis on empties, including car spot plans, operating crews, anticipated rail traffic releases within the next 12 to 24 hours.

Then there is the day-to-day coordination and planning that occurs between CN and its customers. For example, in the potash supply chain, daily discussions between CN and its potash customers cover nearby and forward customer shipping plans and requirements on a rail corridor basis. They involve discussions about the plans and performance of potash mines and potash unloading facilities, the customer's rail transportation requirements of CN, and the customer's rail transportation requirements of connecting rail carriers, as required. Examples of potash customers communicating information to CN to support rail operations and planning activities include shipment deadlines to meet vessel cut-off times as well as end-use customer requirements.


Unity, SK

Based on these discussions, the plan is developed. CN's focus is on providing a solid weekly operations plan that takes into consideration all the goings-on in the end-to-end supply chain, from origin to destination and all points in between. When plans do not materialize as expected, a recovery plan is required. CN will place heightened efforts in developing recovery plans that have the highest probability of success. The changes to rail operations and planning activities that CN has made in advance of this winter (see below) will contribute to overall network performance and execution of the plan.

CN will also continue to advise customers of exceptional network conditions that impact shipments, like winter storms, persistent cold weather, and track outages.

CHANGES TO RAIL OPERATIONS AND PLANNING PRODUCING RESULTS IN ADVANCE OF FALL AND WINTER

Under the leadership of CN CEO Tracy Robinson, the Company has enacted fundamental changes to its rail operations and planning to effect improvements in operational performance. Those changes are translating into improved rail service delivery for CN's customers. CN has been making these changes during Q2 and Q3 2022, well in advance of the anticipated increase in rail traffic volume this fall and winter. It all comes down to running on schedule and focusing on moving cars faster.

- In April 2022, CN brought renewed focus to ensuring scheduled trains (intermodal and manifest carload) leaving the four largest railcar traffic processing yards in its network (Winnipeg, MB, Toronto, ON, Chicago, IL, and Memphis, TN) depart on time with the right traffic blocked to destination.
- In May 2022 the same approach was applied to four smaller railcar processing yards (Vancouver, BC, Prince George, BC, Montreal, QC, and Fond du Lac, WI).

The focus on departing intermodal and manifest carload traffic on time from origin, making the right connections, building the right blocks, and focusing on destination train performance continues to drive strong operational results including increased car velocity. For example, in Q2 2022, CN car velocity in the Western Region reached its highest level since Q2 2017, while the velocity levels during Q3 have been the best CN has registered since 2016. Origin on-time train departures reached over 90% in June 2022, up 14 percentage points versus June 2021, and have remained at or above those levels through the summer and early fall. The improvement in on-time train departures has also translated into improved train connection performance, which was up 30% to roughly 80% in June 2022. CN's local service operating plan has been performing better as well thanks in large part to these changes, in turn translating into better service to CN's customers.

Running to plan improves overall CN rail network balance, which is critical to ensuring efficient rail operations and ensuring the right resources are in the right place at the right time. This is especially true of CN's locomotive fleet. When locomotive power is in balance, CN has the optimal mix of locomotives across its network. A locomotive imbalance means that one part of the network is in deficit for motive power while another is in surplus, and assets must be redeployed. The Motive Power team monitors locomotive flows at key CN terminals and between regions and adjusts the power plan as required. The team interacts with locomotive power planners in the field to optimize the locomotive mix for individual trains, such as avoiding a mix of AC and DC locomotive units within the same train. Ensuring optimal flow of DC locomotives back to Canada and the northern United States is especially critical during the winter months to maximize the amount of DC units available in areas of colder operating conditions.

Limoilou, QC

Managing resource balance also comes down to effectively managing rail traffic flows across major rail corridors. A good example of managing resource balance is for CN's grain hopper car fleet. Demand planning goes far beyond the weekly demand for hopper car movement from the Prairies to major destinations such as Vancouver, Prince Rupert, and Thunder Bay. Corridor balance means that CN has a balance of loaded hopper cars moving to destination and empty hopper cars moving back to the Prairies for the next grain load. CN utilizes its serving hubs within the Prairies to maximize grain supply chain and network efficiency, and to do so means balancing loaded hopper car outbound movement and empty hopper car traffic inbound movement within individual regions in the Prairies. Surging demand into a specific region and exceeding the hub's capacity causes congestion and reduces network capacity.

To maximize overall network capacity and protect CN's core train schedule, strategic staging of bulk unit trains will be key this winter to maximize utilization of planned train slots in CN's busiest rail traffic corridors. CN has identified three rail traffic staging locations at Edmonton, AB, and two rail traffic staging locations at Jasper, AB, to maximize the utilization of rail capacity. While unplanned staging of traffic negatively impacts overall train speed, car velocity and other rail performance metrics, having the right traffic in the right position to take advantage of network capacity opportunities and make best use of train slots in high-traffic areas (through planned staging of rail traffic) is critical. Always having a train in hand to launch when a rail slot is available is key to maximizing planned train slot capacity.

PROTECTING CN'S MAINLINE FLUIDITY

The health of the CN mainline is critical to rail operations, and that is especially true during winter. Loaded and empty railcar traffic is directed by customers to and from their respective facilities along the CN mainline or within the CN feeder line network. Rail traffic is directed from the network to CN rail yards to build the longer trains that run along the mainline. Matching the capacity of the mainline to the feeder traffic is paramount to protect mainline fluidity and overall traffic movement.

When temperatures reach -25°C, the most immediate consequence is the need to reduce train length to maintain safe operation of a train's braking system and comply with Transport Canada requirements. When trains are shortened, more crews and locomotives are required to move the same volumes of traffic. The result is increased risk of congestion in rail yards and associated traffic delays. If extreme conditions continue for long periods, there is a ripple effect across the rail network.

This winter, CN will focus on ensuring that local rail service is adjusted to match the capacity of the mainline network to accept that traffic during periods of extreme weather. This will allow network productivity to recover much more quickly at the end of any prolonged period of widespread extreme winter weather.

CN uses advanced weather forecasts to predict geographic areas of the network that are expected to experience persistent extreme cold or other extreme weather conditions. In advance of these extreme winter weather conditions where CN will be required to implement train length restrictions, CN will advise customers in advance of the potential necessity of adjusting their individual local service to match mainline network capacity and communicate/coordinate those activities with customers. In addition, CN will continue to work with its customers to right-size customers' private railcar fleets, considering that surplus inventory cannot be stored on CN track in winter. Excess car counts jeopardize fluidity.

4. Improving Resiliency

Weather is often unpredictable and can vary dramatically across the breadth of CN's network. Last winter we dealt with the devastation wrought by B.C. floods, when rail bridges were washed away and portions of the mainline choked off by debris. It was an extreme example of what the unpredictable nature of weather can bring.

As noted previously, CN uses **advanced weather forecasts** to plan and develop contingencies for extreme weather events. With early warning, resources can be moved into the regions that are going to get hit the hardest by extreme weather, with emphasis on keeping yards fluid and preventing congestion. Decisions around train length restrictions are also driven by this advance weather information, considering that CN must plan for extreme cold conditions prior to train traffic entering affected areas. By utilizing this advanced information, CN can make informed decisions about crews, train movements, and locomotives that help to keep the network fluid without being surprised by significant snowfall or extreme cold events. This advanced weather information is even more critical when you consider the risk of avalanches along mountain corridors.

CN's avalanche control program has been in place since the 1980s, and is focused on **avalanche forecasting, control, avoidance, and detection**. From a relative risk perspective, the four core mainline CN subdivisions that see the most regular avalanche activity on an annual basis are the CN Albreda, Robson, Bulkley, and Skeena subdivisions located in northern British Columbia, and on the CN Chetwynd and Tumbler subdivisions north of Prince George, BC. CN's B.C. South region intermittently sees avalanche activity, with late December 2021 and early January 2022 being the most active periods since 1997, producing avalanche deposits on CN mainline track in multiple instances. In total, CN's avalanche atlas identifies **240 individual avalanche paths** that require monitoring. Many of the paths in the B.C. South region come from the existing rock cuts and not the natural mountain paths like in the B.C. North region.

CN works closely with its avalanche risk forecasting service provider throughout the winter snow season. Risk forecasting is based on weather information collected by CN and from other sources. Many of these weather stations are situated in very remote areas including at the tops of mountains, and CN must maintain these stations and ensure their effective operation. Wireless cellular is also required to transmit data, which presents its own unique challenges. CN is upgrading several of its weather stations in advance of this winter to ensure it can collect as much accurate weather information as possible to support avalanche risk forecasting activities.

Besides weather information, intelligence collected from various sources concerning snow conditions is also used to assess avalanche risk. A daily regional avalanche risk report is circulated early in the morning to CN Rail Traffic Control Centres, engineering track supervisors, and other individuals within CN involved in rail operations-related activities. The avalanche risk report details the level of risk associated with each avalanche zone, and the level of risk drives changes to train operations and the engineering track patrols.

Various types of infrastructure help to mitigate the impact of avalanches on train operations. **Snow sheds** are structures with sloped roofs employed in mountainous terrain to redirect snow away from rail track infrastructure. CN has one snow shed situated in the Western Region for this purpose on the CN Albreda Subdivision given that the area is prone to frequent avalanche activity. To protect from slides, CN also employs **rock sheds** in British Columbia in many areas that also protect from avalanches. **Berms** are also situated alongside track infrastructure to protect it, considering that rocks, trees, and other debris are also generated by avalanches. The area behind the berms is cleared periodically and prepared in advance of winter to maintain effective avalanche snow catchment. Depending on the location, CN also has **slide fence activity sites**, which are either trip wires or mercury switch tip-over posts that indicate when debris or heavy snow enters the right-of-way, alerting trains to restrict their speeds and be prepared to stop through the affected area.

While the threat of avalanches to train operations cannot be eliminated entirely through protective infrastructure, CN is very proactive in practicing active avalanche control in high-risk avalanche zones. The purpose of this exercise is to artificially trigger an avalanche prior to it developing enough potential energy to occur naturally and in an uncontrolled fashion.

Remote control avalanche management system
Northern British Columbia

CN employs two methods of active avalanche control. First, under favourable visibility and weather conditions, CN employs helicopters to drop explosive material over the avalanche start zone. This activity requires very close coordination, especially on core CN mainline track, between multiple CN business functions. This includes the engineering personnel required to be in position to potentially clear snow from tracks after the avalanche is triggered. Second, CN utilizes a unique remote control avalanche management system in high-frequency avalanche paths. CN has one of these systems employed on the CN Albreda Subdivision. The system is comprised of a tall tower equipped with explosive charges, and an explosive charge can be dropped into the start zone of an avalanche path at the press of a button with a line of sight to the tower. In advance of this winter, CN has built a second remote control avalanche control system on the CN Albreda Subdivision to support its active avalanche control activities and improve rail network resiliency.

Being ready to respond quickly to emergencies such as a washout or other track damage is key. We have done that by:

- Adding **track patrols** to identify problems and respond to them more quickly;
- **Deploying stand-by engineering crews** to remove debris or snow from track;
- **Staging emergency ballast and track panels** in strategic locations so as to be able to deploy these materials quickly in the event of a track disruption;
- Implementing **CN's Winter Situation Report**, a daily snapshot of current weather conditions across the CN network that is updated every morning at 9:30 a.m. ET. It includes the cold temperature tipping point and the effects it has on tracks, locomotives, and railcars.

RESPONSE READINESS

Key to dealing with adverse winter weather is advance planning to have the people and equipment necessary in place to respond as quickly as possible. Time is of the essence. CN has taken multiple steps so that it is ready to act when required. They include:

- **Mechanical repair teams** are sent to key locations across the network. For example, in the Edmonton area teams are situated in the field at places like Hinton and Wainwright to provide critical corridor coverage. Having teams deployed in the field rather than dispatching them out of a large central terminal saves time and preserves capacity.
- **Track and signals repair teams** are organized in much the same manner, ensuring that signals are operating properly along the network and responding to effect timely track infrastructure repairs. This includes ensuring that CN's 1,400-plus heaters, fans and other devices are operating properly to keep switches clear of snow and ice build-up. When train dispatchers receive notification of a potential rail break, there are typically two reasons why. It can either be a real problem with a piece of rail, or the result of a signal malfunction. Typically, signal maintenance employees are deployed first to investigate, followed later by track crews if a rail problem is identified. In winter, however, signal employees and track repair crews will be simultaneously deployed to the affected area to take immediate and effective action regardless of the type of failure.
- **Backup power generators** are deployed across the rail network in the event of public utility power failures, allowing critical operations to continue even during localized or widespread power failures.

Limoilou, QC

- **Maintaining critical inventory/part levels** is key. Having the right spare parts in the right place at the right time reduces repair shop dwell time and means more locomotive units and other pieces of equipment are out in the field at any point in time.
- **Strategic deployment of locomotives** means CN has the motive power needed to keep rail traffic moving. CN deploys locomotives with the objective of maintaining network fluidity, limiting delays caused by online locomotive failures, especially in critical corridors. When locomotive demand exceeds supply, a strategic reserve in the Edmonton area can be readily deployed to maintain rail operations in times of chronic extreme weather.
- Ensuring **snow fences** are in place to enhance track infrastructure is also important. Logically, the use of snow fences is especially key in remote and open areas and areas of high wind. Snow fences prevent switches from being compromised with snow and protect track from snow accumulation. Snow fences are simple but effective. The same is true for **pre-positioning snow clearing equipment** in the right areas.

SAFE OPERATIONS, MAXIMIZING TRAIN LENGTH DURING PERIODS OF EXTREME COLD

CN has several important methods to mitigate the impact of cold temperatures on braking systems and minimize train length reduction.[4] CN has implemented the following best practices, which increase capacity and resilience and maximize network fluidity while maintaining safe rail operations. CN employs a three-tier system to determine the maximum permissible train length allowed at certain trackside temperatures per the following chart:

FIGURE 4

Maximum Train Length (in Feet) Allowed at Specific Temperatures

				A – DP (1×1×0)		B – DP (1×0×1)	C – ADDITIONAL AIR SOURCES
TIER LEVEL	TEMPERATURE °C	TEMPERATURE °F	CONVEN-TIONAL	HEAD TO MID	MID TO END	HEAD TO END	3RD, 4TH, 5TH AIR SOURCE
Non Intermodal, Non Single Commodity Bulk Trains							
Tier 1	-25	-13	7,000	6,667	3,333	10,000	For each air source added beyond the configuration corresponding to columns A and B, train length can be increased by 2,000 feet (2,500 for Intermodal and Single Commodity Bulk Trains) per additional air source, up to a maximum length of 12,000 feet. A maximum of five air sources to be used on a train.
Tier 2	-31	-24	5,000	5,000	2,500	7,500	
Tier 3	-36 or lower	-33 or lower	4,000	4,000	2,000	6,000	
Intermodal and Single Commodity Bulk Trains							
Tier 1	-25	-13	8,000	8,000	4,000	12,000	
Tier 2	-31	-24	6,000	5,667	2,833	8,500	
Tier 3	-36 or lower	-33 or lower	4,500	4,500	2,200	6,700	

Notes:

1. *For the purposes of this table, Distributed Power (DP) can be remote locomotives or Distributed Braking Cars.*
2. *For manifest trains running DP 1x0x1, the maximum length allowed from head end to DP remote is 7,500 feet.*
3. *Iron ore trains on the former DMIR territory are excluded from these restrictions.*
4. *The specified temperatures refer to the coldest forecasted temperatures between the train's origin and destination.*
5. *Column C does not apply to key trains.*

[4] Available at https://www.cn.ca/en/your-industry/customer-reports/winter-situation-report/

Distributed power

CN runs trains as conventional power (meaning power at the head-end of the train only) or as distributed power (meaning power is also placed in the middle or the end of the train). Placing an additional locomotive in the middle or at the end of a train enables air pressure for brakes to be maintained at required levels, even in extreme cold temperatures. This is called distributed power and is very effective for winter operations because the distribution of locomotives can minimize the need to reduce train lengths for safety reasons. CN uses distributed power in its operations year-round. Beginning November 1, our usage increases, particularly on trains operating in Western Canada, positioning the right equipment early and prior to winter to limit impact on train operations whenever cold arrives.

Air cars

CN's air car fleet is unique among Class I railroads. In 2006, CN started with 10 air cars. Today, CN has more than 100 air cars strategically deployed throughout Canada and the Midwestern U.S. during colder months. Distributed air cars are CN-modified boxcars containing air compressors and associated equipment. They supplement the air supply to the train air brake system, in a similar manner to locomotives under distributed power and with similar benefits. The distributed air cars have proven to be one of the most effective innovations in dealing with cold.

CN will deploy approximately 100 distributed air cars across the network this winter, with emphasis placed on protecting train movements along the mainline. CN analyzes data from winter seasons to maximize the effectiveness of these cars, developing standards for air source configuration and location in trains. CN's air cars have travelled more than 5 million miles since being put into service.

CN's air car fleet is unique among Class I railroads.

St-Tite, QC

Air gaskets

Each air hose connector between cars contains a rubber gasket. As they wear down and freeze, they become less effective and more air escapes from the brake system. CN is changing gaskets systematically as part of its normal car inspections to increase effectiveness. We are continuing with our research to identify and implement additional options and new materials. CN is piloting a new technology in its Melville, SK, yard that will help identify air leaks.

Other air brake system-related initiatives

It is well known that air flow leakage is directly affected by cold temperatures. The various regional temperature regimes that traffic moving along the network might experience, whether moving north–south or east–west, can be quite different. As a result, trains can be subjected to drastic temperature changes along their route affecting brake pipe air flow. For example, a train that leaves a region experiencing -20°C heading towards a region experiencing -40°C will see its air flow demand increase by 4.5 times at points along its route. Because of this reality, cold weather operations become more challenging from a safety, efficiency, and customer service perspective. As such, CN has explored opportunities over the past three years to mitigate this challenge by adding additional air sources on trains.

At the time that the current train brake rules were written, the requirement for distributed power trains not to exceed a combined air flow (leakage) of 90 cubic feet per minute (CFM) did not contemplate the notion of inserting additional air sources beyond two or three. Technology has evolved and now supports up to five air sources, all controlled by a single locomotive.

Based on lab testing, static tests, modelling, and three test exemptions approved by Transport Canada, and carried out by CN in the winter of 2020, 2021 and 2022, CN demonstrated that by adding air sources to a train, the overall health of the brakes improves notwithstanding that the combined air flow will exceed 90 CFM. Data results consistently validated that braking response continues to be reliable even in high-flow conditions. CN is now asking Transport Canada to approve a more permanent exemption for future winter operations based on these testing results.

CN is a leader in this area. Investing in the purchase of additional air cars and carrying out testing to support exemptions has allowed CN to carry out its winter operating plan with improved safety and enhanced efficiency and customer service during cold weather.

Enhanced set-out

Enhanced set-out is another operational tool that CN has been able to utilize in previous years to enhance operational resiliency and performance during winter. Consider a train with distributed power heading into Saskatoon. With enhanced set-out, a portion of that train can be left behind, the locomotive is kept running and that segment of the train remains charged with air.

When the operating crew returns to hook back up to the set-out portion of the trains, with enhanced set-out the train makes a much quicker departure versus hooking up and spending considerable time to charge the train with air. The ability to use enhanced set-out, for example, would benefit non-unit train grain customers considering the nature of car spotting/pulling operations for these customers.

CN has upgraded distributed power locomotive software and made changes to other processes that have positioned CN to use enhanced set-out this winter. As such, CN is working closely with Transport Canada in advance of this winter to revisit the use of enhanced set-out procedures.

Key train speed restrictions

Revised Rules Respecting Key Trains and Key Routes approved by Transport Canada in 2021 target key trains and higher risk key trains, which are trains carrying 20 or more cars containing dangerous goods; or a train carrying one or more cars of toxic inhalation gas. The intent of the revised rules is to bring greater safety to trains carrying flammable liquids.

The maximum permissible speed of these trains is a function of whether the train is transiting signalized territory or not, whether the train is operating in census metropolitan areas, and the specific type of key train (key train or higher risk key train).[5] The revised rules also include an option for railways to submit a Winter Operations Risk Plan for Higher Risk Key Trains, which provides for different speed thresholds for those sections of track that meet specific safety requirements. CN has developed and implemented a Winter Risk Operating Plan that allows for more flexibility in its winter operations.

In its 2020–2021 Winter Plan, CN raised the issue that the previous Order, based on calendar dates, would have adverse unintended consequences on the fluidity of winter operations. The current version of the revised rules still limits the speed of these trains but, importantly, it does so based on ambient track temperature.

While being fully supportive of the need for safe operations, CN is concerned that the speed reductions of these trains will have the effect of slowing all trains on the network, which in turn reduces capacity and risks congestion at the time of year when CN already faces difficult operating conditions. The low speed of any given train creates the cumulative impact of limiting the speed of all trains behind it. This type of scenario is similar to highway traffic slowing down when passing through a construction zone. This situation further compounds the challenges of winter operations and inhibits the capacity of the entire network.

[5] https://tc.canada.ca/en/rail-transportation/rules/rules-respecting-key-trains-key-routes-0

5. Customer Guidance

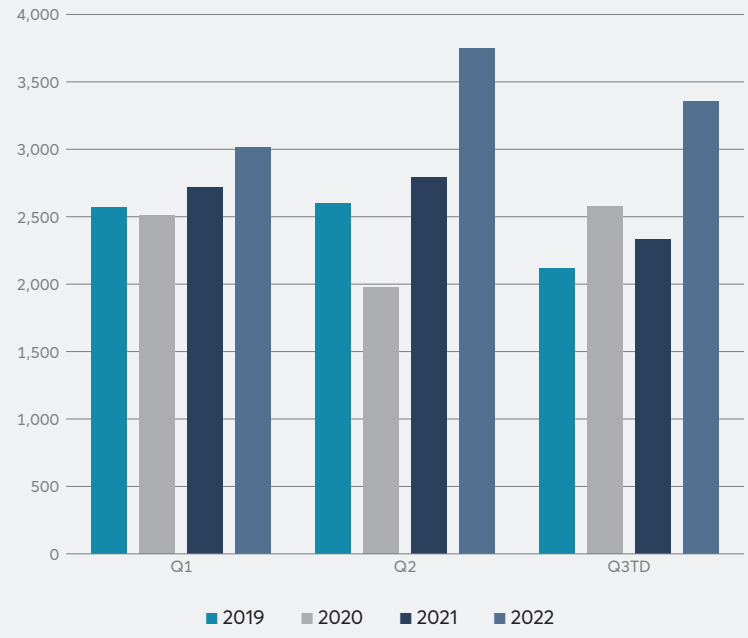
Demand for railway service is not constant and varies through time by commodity segment and market location. Global and national economic variations influence demand for railway service in Canada as well as the specific position of customers in their respective markets. Having to provide service to all customers on its network, and in the absence of long-term customer demand forecasts, CN establishes its capacity on the basis of historical and normalized demand. Capacity adjustments are possible but require sufficient lead time to meet changes in demand along with commercial arrangements to support the associated investments. If customers forecast increased demand for rail service, capacity may be added, but will only become available after the additional resources (cars, locomotives, and operating crews) have been acquired.

To illustrate the variations in demand and the need for changes to be forecasted with sufficient lead time to ramp up capacity, the following graph shows car requests from CN customers for the first three quarters since 2019. In 2022, customers have increased their car order requests for CN-supplied centrebeams significantly over previous years, and by more than 30% in Q3 2022. These demand levels were not forecast by the industry. The challenge with such a sudden increase in demand is the lead time required to increase capacity by the same margin. For example, CN's fleet of centrebeams is currently more than 10,000 cars, representing the largest railroad-supplied centrebeam fleet in North America.

Demand for railway service is not constant and varies through time by commodity segment and market location.

FIGURE 5

Average weekly customer orders for CN-supplied centrebeam cars at the time of weekly order cut-off



To meet the current demand, and based on current car cycle times, CN is estimating that it would involve the acquisition of 8,000 cars. Additional locomotives and crews and network infrastructure would also be required, representing an investment of over $1.25 billion. Realistically, the CN fleet of centrebeams and locomotives could not reach the number required to meet current demand for many years, assuming demand remains at current levels and that centrebeam car manufacturers could produce and deliver that number of cars. Those assumptions, however, are not supported by the important variations in demand that this sector has shown through the years. For example, at the time of writing this Winter Plan, demand for centrebeams in Western Canada had softened but remains high in Eastern Canada.

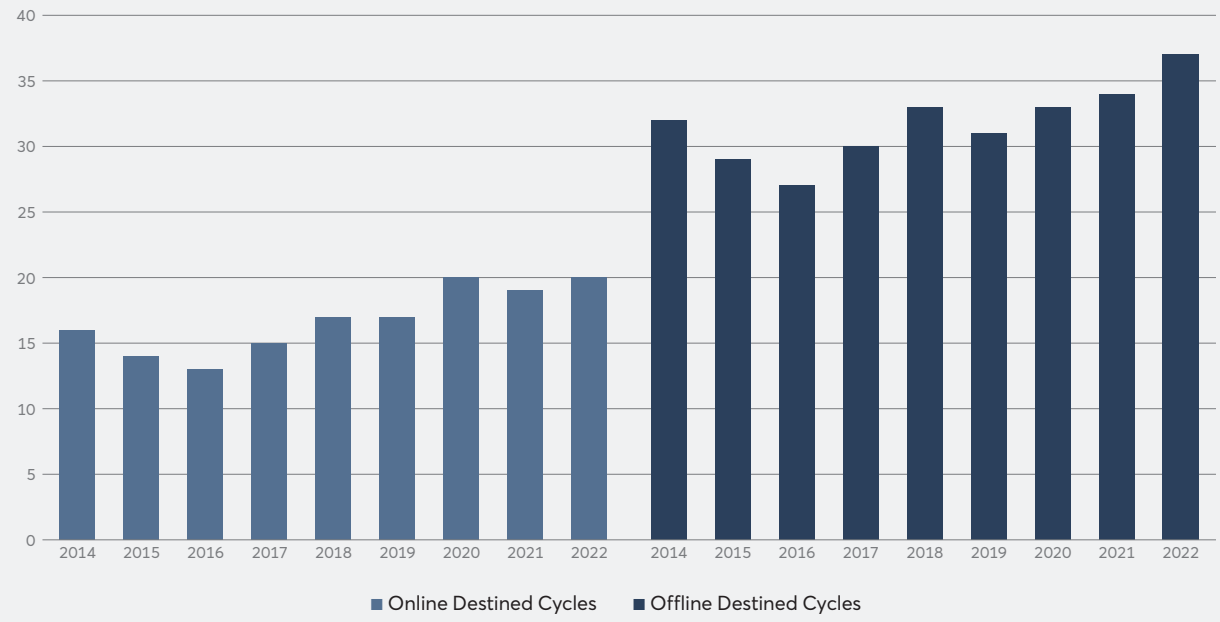
With respect to lumber movements, we must also note an important factor that influences the availability of equipment. More than 80% of lumber products, which originate on CN's network, are shipped to the U.S., with 60% interchanged by CN to a U.S. railway. The time that a car takes to be moved by a U.S. railway to its U.S. destination and returned to CN has a critical and direct impact on the number of cars that CN has available each week to supply against new customer car orders. The longer time that CN cars spend in the U.S., the fewer cars that CN can supply. Average centrebeam cycle times when cars are interchanged with U.S. railways are significantly higher than cycle times when the cars are moved exclusively by CN (Figure 6). Furthermore, the average overall cycle times of centrebeams that are destined to the U.S. market has increased significantly in recent years. Each single day added to cycle times reduces annual centrebeam shipments by 4,300. This speaks to the implications of the elongated cycle times shown above.

While CN continues to invest in new equipment and increase capacity, we must also be clear on the current challenges Canadian railways are facing with respect to the hiring of conductors. As we have noted, the lack of qualified personnel is a problem faced by many sectors of the economy, and which will likely affect its performance. This is the prevailing environment in which Canadian railways must provide railway service this winter.

FIGURE 6

Cycle times for CN-supplied centrebeams

traffic destined to direct CN-served destinations versus traffic destined to offline destinations



Considering the current economy, demand levels and experience in previous winters, CN will have to proceed with car allocation during the coming winter since meeting all demand every week will likely not be possible. Demand for rail service in Canada is presently very high and CN has all its available equipment and resources in operation serving customers. Car allocation is not new in Canada, especially in sectors where demand is cyclical such as grain and forest products.

One area where CN anticipates being able to improve its performance this winter when compared with last year is car velocity. The speed at which railways move their equipment has a direct effect on its weekly capacity because faster trains shorten cycles, thereby returning equipment for placement at origin more rapidly. Last year, the B.C. washouts and the cold temperatures had a devastating impact on CN's velocity and this impact remained present until the beginning of March 2022.

The following graphs show how challenging the situation was in 2021–22 when compared to the previous three-year average. In the previous three years, average velocity during January was nearly 210 car miles per day (Figure 7). In January 2022, network velocity dropped to 150 car miles per day, representing a decline of 29%. For identical reasons, during that same period, Industry train speed decreased significantly (Figure 8). Four-week rolling average Industry train speed declined to less than 20 miles per hour during January 2022 compared to the three-year average in the range of 23 to 24 miles per hour over the same period. Terminal dwell time (Figure 9) saw a dramatic spike from late December through early January compared to three-year average levels during the same timeframe.

The impact on CN's ability to spot cars to our customers suffered from these major changes in velocity and dwell time, and the volumes of traffic we could move was in turn reduced. Both CN and its customers share the frustration resulting from this loss of capacity.

The combination of two major weather events is not unique in Canadian history, but they do not usually happen each year. To the extent that this is the case, our capacity at origin should return to the level of previous years, providing more opportunities to our customers and CN. Commencing this winter, CN will initiate weekly supply chain reporting, which will include reporting of these performance metrics along with communicating issues affecting the end to end supply chain, including winter weather conditions.

FIGURE 7
CN four-week rolling average network car velocity
miles per day

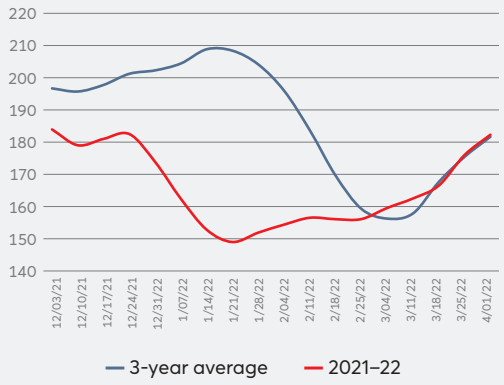


FIGURE 8
Four-week rolling average Industry train speed
miles per hour

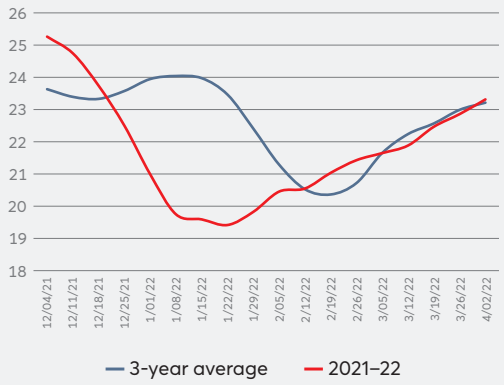


FIGURE 9
Four-week rolling average terminal dwell time
hours

Solomon, AB

Conclusion

By taking the comprehensive, coordinated, and collaborative approach detailed in this Winter Plan, we believe CN is as well positioned as possible to meet the challenge of winter head on. The breadth of the integrated actions and the scale of the planning are designed to ensure CN is able to deliver the best possible service during the winter months. The foundation for the steps we are taking and have taken is based on safety, delivering the best possible service, increasing network productivity and improving resilience.

It is important to recognize that the railway is only one critical part of a complex and integrated supply chain network. The challenges winter can and often deliver impact not only the railway's operation, but also our customers and partners. Each of us is integral to Canada's transportation system. It is why we work closely with all of them, sharing information and plans as part of designing an integrated approach to dealing with winter. Customers look for us to deal with and recover quickly from disruptions, as we did last winter when severe weather created massive challenges, especially in B.C. We believe this Winter Plan will help us to meet those expectations.

The Plan is also shaped by the knowledge that the rail system has physical limits and must respond to the needs of multiple economic sectors competing for service. They include forest products, grain, propane, potash, petroleum products, intermodal and bulk commodities. The scale of that task grows significantly in winter months when weather often slows and diminishes the capacity of the system, at a time when it is also hobbled by the loss of the Port of Thunder Bay.

With all those facts and factors in mind, CN is confident it has put in place a comprehensive, strong and realistic Winter Plan. It helps mitigate the harsh effects of a Canadian winter so that CN can deliver the best possible service and continue to power sustainable growth.

APPENDIX A

Winter 2021–22 Operating Conditions

From December through February, challenging operating conditions limited CN's ability to recover from the southern British Columbia rail outages that caused significant delays in the movement of all commodities across the network. While CN implements multiple measures to help mitigate the impact of extreme cold, heavy snowfall and blizzard conditions, the severity and duration of those conditions materially impacted CN's ability to transport traffic this past winter.

For example:

- In its Western Region, CN had to deal with temperatures below -30°C for over 50 of 65 days between late December and the end of February. To maintain the safety of our operations, and comply with applicable rules and regulations, temperatures below -25°C require CN to implement train length restrictions on all trains operating at that temperature threshold and all trains that will enter the affected parts of the network. These restrictions require significantly more resources (crews and locomotives) to move the same volume than under normal winter operating conditions.

Falls Creek, BC

- Along with restrictions on train length, a critical impact of the cold is slower train speed. Transport Canada's safety requirement restricting the speed of key higher risk trains based on cold temperature thresholds significantly reduces rail network capacity. Shorter trains operating at reduced speed in turn slow the train traffic moving behind them, cause congestion in rail yards, and materially reduce overall network capacity.
- Coupled with those mandated restrictions were significant weather-related disruptions. Southern British Columbia experienced three atmospheric river precipitation events and severe flooding in November 2021. Simultaneously, snowmelt in the mountains exacerbated run off issues, causing extensive damage to rail and road infrastructure. As a result, CN experienced 58 outages on its mainline between Kamloops and Vancouver and on the CN Squamish Subdivision between Prince George and Vancouver. The scale of the challenge was staggering. It took a massive amount of engineering and reconstruction work to get lines back in full operation.
- The past year also highlighted the need for improved communications and coordination with customers. To operate at optimum levels, particularly during severe winter weather, CN and its customers work together, sharing information and planning. Customers shipping across the continent need to be aware of conditions at both ends of the supply chain, as well as the conditions en route.

FIGURE 10

Frequency of -25°C – Hornepayne, ON

number of days per week below -25°C

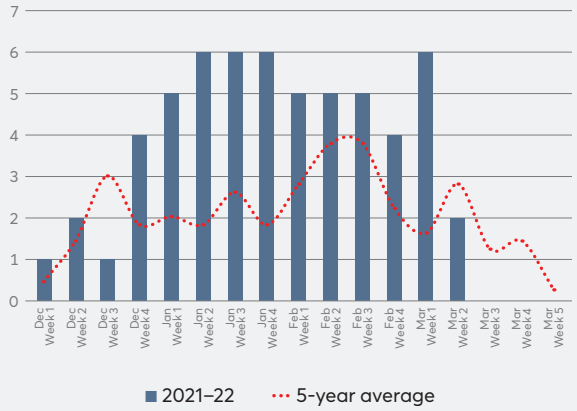


FIGURE 11

Frequency of -25°C – Winnipeg, MB

number of days per week below -25°C

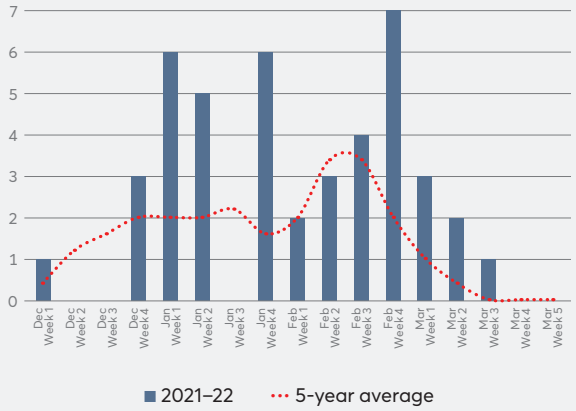


FIGURE 12

Frequency of -25°C – Yorkton (Melville), SK

number of days per week below -25°C

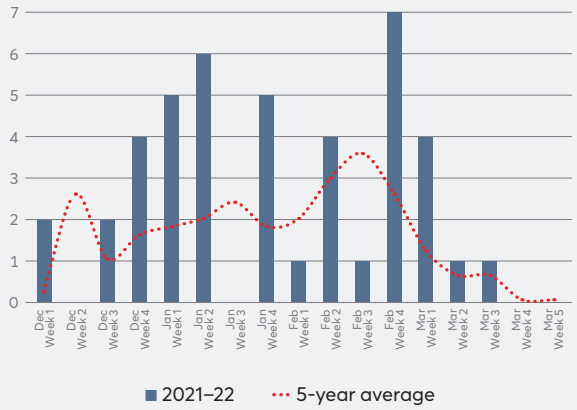


FIGURE 13

Frequency of -25°C – Saskatoon, SK

number of days per week below -25°C

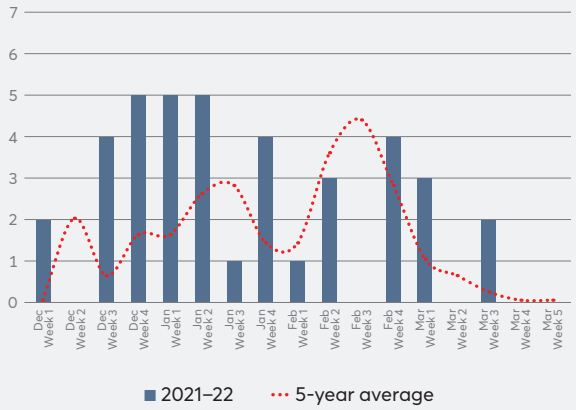


FIGURE 14

Frequency of -25°C – Edmonton, AB

number of days per week below -25°C

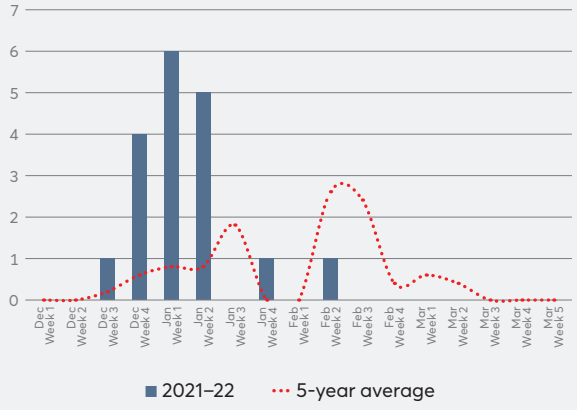
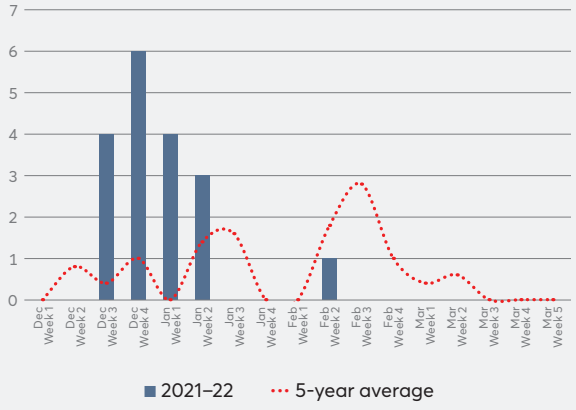


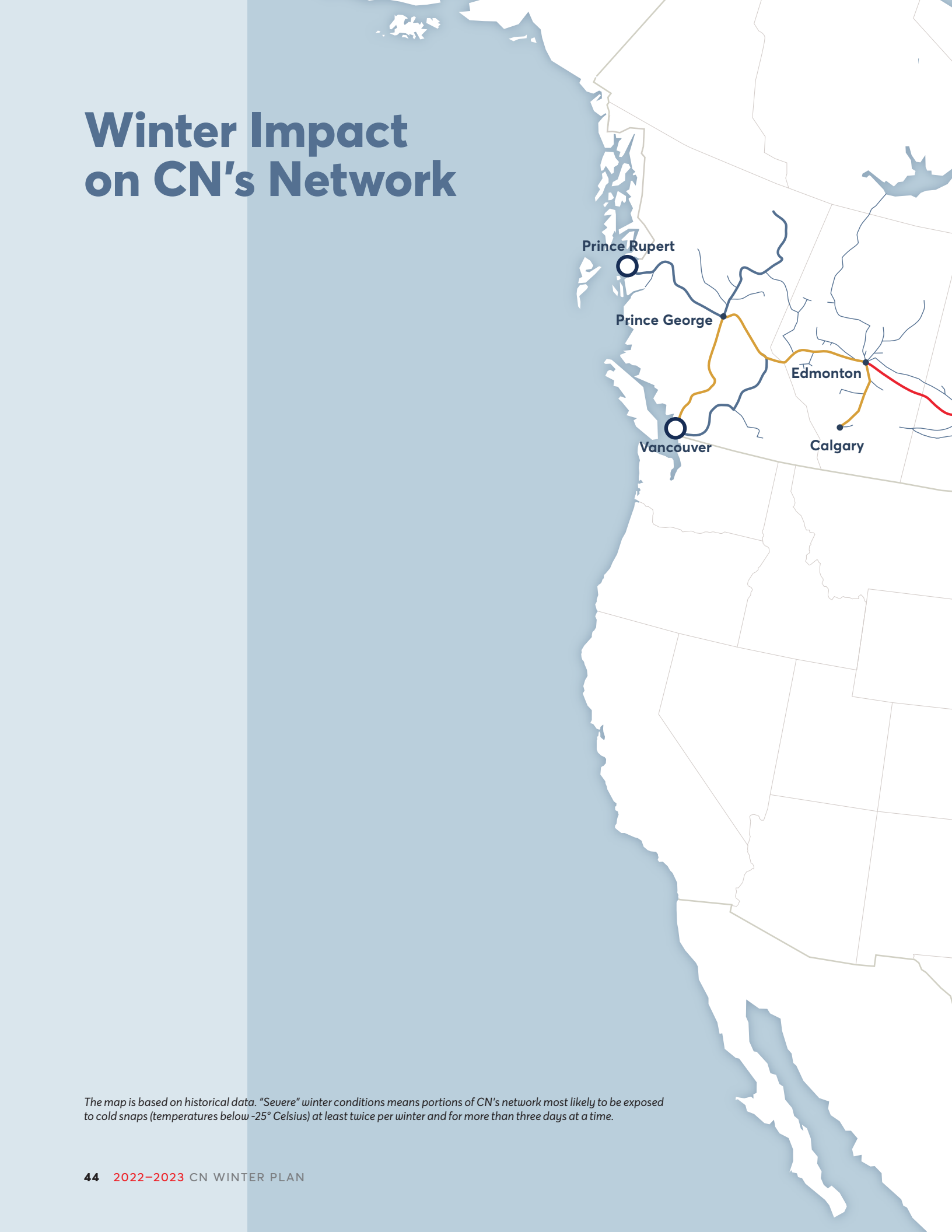
FIGURE 15

Frequency of -25°C – Prince George, BC

number of days per week below -25°C



Winter Impact on CN's Network



The map is based on historical data. "Severe" winter conditions means portions of CN's network most likely to be exposed to cold snaps (temperatures below -25° Celsius) at least twice per winter and for more than three days at a time.


Saskatoon
Winnipeg
Duluth
Toronto
Detroit
Chicago
Memphis
Jackson
New Orleans
Quebec
Montreal
Moncton
Halifax
Normal winter conditions
More difficult conditions
Severe conditions

APPENDIX B

Preparing for Winter

- Many service disruptions are due to the accumulation of snow and ice, which often constitute a problem in switches, as well as at crossings. Avoiding these issues by removing the snow and cleaning switches before CN operating crews arrive will minimize delays, the risk of injuries and derailments. CN's track management inspection checklist assists customers in assessing track condition and avoiding track-related disruptions
- Customers must be particularly vigilant maintaining flangeways, considering that these can become fouled with snow, ice or other material. At a minimum, they must be cleared to a depth of 1.5 inches to ensure equipment can be carefully operated. Crossings are more prone to these types of conditions
- Derails are devices used to prevent blocking or compromising of a rail track (or collision with anything present on the track, such as a person or a train) by unauthorized movements of trains or unattended rolling stock. They can become buried under snow and must be cleared so train crews can find them. All derails must be properly identified by a sign to allow them to be easily located. Customers must ensure that all derails have been cleared of snow prior to rail service.
- Snow must not interfere with operating crew visibility within a customer's facility and/or interfere with rail traffic movement. Snow should be moved at least 12 feet away from tracks and crossings. Excessive snow on tracks will prevent service if entering the track cannot be done safely.
- Injuries occur every year due to employees slipping and falling in winter conditions. Customers must ensure that icy walkways, particularly trackside, are sanded and/or salted. Furthermore, light snowfall can easily hide debris where crews normally walk. Ensuring the area is cleared before winter hits is essential for keeping the site safe.

Besides the Customer Safety Handbook, CN communicates many winter-specific resources available to customers, including the following as outlined on our website[6]:

- The Customer Track Maintenance Guide was developed to help bring attention to the additional hazards present during the winter months, especially for CN crews performing switching activities. A Customer Track Inspection Checklist is also available.
- The CN Switch Clearing Poster includes a three-step checklist illustrating proper switch clearing practices.
- For individuals entering CN's intermodal terminals, the Winter Safety Checklist provides details on operating within the terminal when snow and ice are present, and details requirements concerning snow removal from intermodal equipment.


Joffre Yard, QC

[6] https://www.cn.ca/winter

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