Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

RAIL TRANSPORTATION SAFETY INVESTIGATION REPORT R19T0191

CROSSING ACCIDENT

Metrolinx
GO Transit commuter train 3919
Mile 62.08, Guelph Subdivision
Kitchener, Ontario
13 November 2019

Canada

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 2 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

TERMS OF USE

Citation

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Executive summary

Although this transit company falls under provincial jurisdiction, the TSB conducted the investigation at the request of the Ontario Ministry of Transportation.

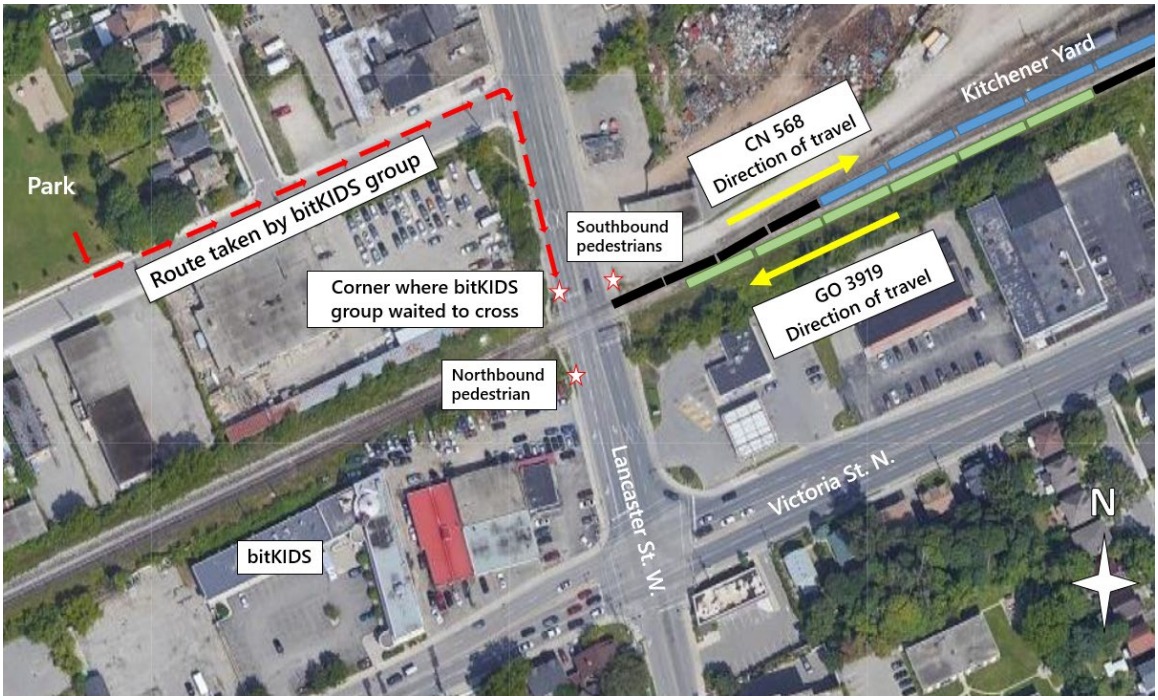
At about 1444[1] on 13 November 2019, while returning from a nearby park to their clinic on Victoria Street North in Kitchener, Ontario, a group of pedestrians (6 adult therapists and 5 child clients) from bitKIDS Behaviour Consulting (bitKIDS) encountered activated automatic grade crossing warning devices (GCWD) at the Lancaster Street West public crossing. The activated GCWD consisted of flashing lights, bells, and gates that extended across each side of the roadway, but not the pedestrian walkways.

At this location, Lancaster Street West crosses 2 sets of railway tracks, both owned by Metrolinx: the south track is the Guelph Subdivision main line, and the north track is a siding. The lead track to Canadian National Railway Company's (CN) Kitchener Yard joins the siding at Mile 62.05.

The group of pedestrians stopped at the crossing and stood on the northwest quadrant sidewalk for an estimated 5 to 10 minutes in cold weather to wait for CN freight train L56831-13 (CN 568) to clear the crossing as it slowly shoved eastward on the north track, back into Kitchener Yard. Just as CN 568 had nearly cleared the east end of the crossing, a pedestrian waiting on the southwest quadrant sidewalk walked northward over the crossing, toward the group of 11 pedestrians on the northwest quadrant sidewalk, while the GCWD were still activated (Figure 1).

[1] All times are Eastern Standard Time.

Figure S1. Map of the occurrence site showing the location of the pedestrians and the direction of travel of the trains (Source: Google Earth, with TSB annotations)



As the northbound pedestrian approached the north side of the crossing, a pedestrian waiting on the northeast quadrant sidewalk, as well as 4 of the 11 pedestrians from bitKIDS (2 adults and 2 children) on the northwest quadrant sidewalk, proceeded to traverse the crossing. At the east end of the crossing, the locomotive engineer of CN 568 verbally warned the pedestrian in the northeast quadrant of the approach of GO Transit commuter train 3919 (GO 3919) from the east on the south track, and that pedestrian turned back.

In the meantime, the 1st adult and child pair from the group on the northwest quadrant sidewalk ran across the crossing and made it to the southwest side of the track. A 2nd adult and child pair followed about 15 feet behind the 1st pair and, while traversing the crossing, they proceeded into the path of and were struck by westbound GO 3919, which was operating on the south track. The 2nd adult and child both sustained serious injuries and were airlifted to a local hospital.

The investigation determined:

- Since CN 568 was reversing slowly on the north track at the east end of the Lancaster Street West crossing, the 11 pedestrians waiting on the northwest quadrant sidewalk were unable to see GO 3919 as it approached from the east.
- Despite being aware of the activated GCWD (flashing lights, bells and gates), 4 of the 11 pedestrians (2 adults and 2 children) who were waiting on the crossing sidewalk proceeded to traverse the west end of the crossing.
- The adults in the group of 11 pedestrians attributed the GCWD activation solely to the freight train exiting the east end of the crossing and did not recognize that the activated GCWD could also indicate the approach of a second train on the south main track.

- The 1st adult and child pair of the group proceeded successfully to the south side of the crossing, unaware that GO 3919 was approaching from the east until they heard its train horn sound to signal an emergency.
- The 2nd adult and child pair followed immediately behind the 1st pair. Approximately 1.5 seconds after the GO 3919 train horn sounded, the 2nd adult began to react, but by that time they were already entering the south track. About 1 second later, they were struck by GO 3919.
- CN's use of the crossing for switching activities in Kitchener Yard resulted in the GCWD being activated frequently, sometimes for extended periods, which influenced some users of the crossing to adopt the risky behaviour of entering the crossing while GCWD were activated in order to avoid delays.
- CN freight trains continued to occupy the crossing in excess of the 5-minute regulatory limit, which resulted in corresponding delays for motorists, pedestrians, and cyclists that contributed to their behaviour.
- Although CN and Metrolinx had processes in place to identify safety concerns and assess risk, as required by the *Railway Safety Management System Regulations, 2015*, and performed some monitoring at the crossing, neither company identified the safety hazards and infractions occurring at the crossing, so the risks were not mitigated.
- The Ministry of Transportation of Ontario (MTO) is responsible for oversight of provincially regulated railways. If the MTO does not have the information and the capability to assess the quality of the Transport Canada (TC) inspections and the proposed remedial measures, and whether the measures implemented mitigated the deficiencies, the MTO will not be able to provide effective safety oversight.

Crossing safety oversight

The operation of a crossing is a shared undertaking between a railway and a road authority, with oversight provided by a regulator. Once a crossing has been constructed, all parties are responsible for ensuring its maintenance and safe operation.

A Metrolinx video recording of the Lancaster Street West crossing made over a 10-day period after the occurrence showed that pedestrians, cyclists, and motorists were routinely delayed by switching activities at the crossing throughout the day. Occasionally, the delay exceeded the 5-minute maximum permitted under the *Grade Crossings Regulations* (GCR). The video recording also showed many pedestrians and cyclists, and the occasional vehicle, passing through the crossing while the warning system and gates were still active, contrary to both the provincial *Highway Traffic Act* and the Metrolinx bylaws. Many vehicles were observed performing U-turns, some within 30 m (98 feet) of the crossing, which is also a violation of the *Highway Traffic Act*.

The video recording also showed many pedestrians entering or exiting the railway right-of-way at the crossing without authority. There were also occasions when motorists had

backed up onto the crossing as they waited for the traffic lights at the Victoria Street North–Lancaster Street West intersection to change.

All of these potentially hazardous events occurred at a crossing that had been designated an anti-whistling[2] crossing for many years. There were also occasions when a faster train, operating on the main track, would pass a slower freight train that was performing switching operations on the siding and was occupying the crossing.

None of the parties involved were aware of the observed hazards that existed at the crossing. Specifically:

- The Region of Waterloo was unaware of motorists backing up onto the crossing from the Victoria Street North–Lancaster Street West intersection.
- CN was unaware that its crew members were routinely delaying traffic beyond the maximum period permitted under the GCR.
- Metrolinx was unaware of the trespassing and violations by pedestrians and cyclists of the active grade crossing warning systems.

The Region of Waterloo did not have, nor was it required to have, a process to proactively identify traffic backing up onto the Lancaster Street West crossing, as prescribed by subsection 100(1) of the GCR, because the Lancaster Street West crossing was provincially regulated and not subject to federal legislation.

CN's crew monitoring program did not identify any non-compliant activities regarding switching movements delaying pedestrians and cyclists at the crossing for more than 5 minutes, and this was not highlighted as a risk in its risk assessment.

Metrolinx's monitoring programs and multiple risk assessments identified only a few safety-related incidents at the crossing, and so the crossing was not identified as requiring an increased level of scrutiny and no action plan was developed to address the hazards.

Transport Canada oversight of the Lancaster Street West crossing

In April 2019, TC responded to a complaint from the public regarding an extended occupancy at the crossing. After three inspection visits of 2 to 3 hours each, conducted over a period of about 5 months, TC considered the complaint resolved, and no further follow-up activities occurred. The accident occurred just over a month after the last inspection while the crossing was once again occupied for an extended period of time.

Metrolinx's continuous video surveillance of the Lancaster Street West crossing taken after the occurrence recorded crossing activity throughout the day over several days and very clearly showed that extended occupancies of the crossing by CN, and other safety infractions by the crossing users, continued to occur. The video provided more accurate and

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[2] As set out in section 14 of the *Canadian Rail Operating Rules*, train crews must sound the train horn as they pass through public crossings at grade. An anti-whistling designation in accordance with Section 23.1 of the *Railway Safety Act* means that train crews are not required to sound the train horn as they pass through a crossing with this designation.

useful information about the extent of crossing activity and safety infractions when compared to the TC inspection methodology that relied on limited site visits and visual inspections.

Province of Ontario oversight of provincially regulated railways

The MTO is responsible for regulatory oversight of Metrolinx's GO Transit and UP Express, a dedicated air–rail link that connects Union Station in downtown Toronto with Lester B. Pearson International Airport. However, the province has no safety-related regulations that govern provincial railway operations. Instead, the MTO relies on companion inspection agreements that it has with TC and Metrolinx to meet the requirements for engineering and operations set out in federal regulations, rules, and standards.

In accordance with the agreements, the MTO oversees the implementation of the *Metrolinx Act, 2006,* and the agreements for safety inspection services between Metrolinx and TC. As part of these agreements, the MTO was to receive all TC inspection reports and resolve any disputes that might arise from the implementation of the TC inspection agreement with Metrolinx. However, the MTO had not been receiving TC inspection reports. Furthermore, the MTO has no employees with the technical knowledge, expertise, and experience required to evaluate any TC inspection reports they receive.

SAFETY ACTION TAKEN

Transportation Safety Board of Canada

On 18 January 2021, the Transportation Safety Board of Canada (TSB) issued Rail Safety Advisory 01/21 that discussed second-train events at multi-track grade crossings. The advisory suggested that the parties involved identify multi-track crossings that experience frequent and extended crossing GCWD activation and that have a high level of pedestrian and cyclist traffic, assess the likelihood of a second-train event to occur, and consider implementing additional safety measures at the crossing to minimize the risk of an accident.

Metrolinx

Metrolinx made a number of safety improvements at the Lancaster Street West crossing including installing

- dedicated sidewalk pedestrian barrier arms, sidewalk tactile plate inlays for visually challenged pedestrians;
- dynamic LED second-train event signs; and
- static second-train event signage.

Metrolinx also requires train operators approaching the crossing to sound the horn if the crossing is occupied by another train.

It has also introduced a number of business processes to improve its risk management and oversight, and now requires that risk assessments be conducted for Metrolinx grade crossings every 12 months.

Metrolinx continues to monitor CN switching activities via closed-circuit television cameras and in-person observations at locations where CN trains interact with GO Transit trains. Problem crossings are identified and safety blitzes are conducted quarterly. Results from the observations and analyses of the crossings are shared with CN, and Metrolinx continues to work with CN to manage and reduce risks to railway operations and the public.

Ministry of Transportation of Ontario

The MTO now receives TC inspection reports, starting with the 2019 reports.

Both the agreement with TC and the agreement with Metrolinx were updated in January 2022 to include

- explicitly noting the MTO's authority to direct Metrolinx, where necessary, to address a non-compliance identified in an inspection report if Metrolinx has not taken appropriate corrective action. Metrolinx is required to comply with the direction issued;
- formalizing the process for and contacts within the MTO to receive inspection reports from TC inspectors; and
- updating the rules, standards, and regulations appendix to reflect the current applicable federal requirements.

bitKIDS Behaviour Consulting

bitKIDS moved from its Victoria Street North location to a new location that has its own fenced play area. Street-safety skills are taught in the fenced play area. Once children have learned the skills, they practise these skills daily outside the fenced play area. In addition, the bitKIDS Behaviour Consulting handbook has been updated to include the following statement: "Obey all traffic laws when crossing streets, railway tracks, and crosswalks with or without traffic signals at all times."

SAFETY CONCERN

Regulatory oversight of Ontario provincial railways

Metrolinx was created in 2006 to improve the coordination and integration of public transit train and bus service for the Greater Toronto and Hamilton Area. It oversees the operations of UP Express and the GO Transit regional public transit train and bus service. The GO Transit train service and UP Express operate over about 420 km of rail lines, 337 km of which are owned by Metrolinx. In 2019, they carried an average of about 229 000 riders each weekday, which represents the highest daily ridership in Canada.

In April 2020, the provincially regulated rail network in the Province of Ontario comprised 12 railways (including Metrolinx) that are governed by 3 provincial acts:

- the *Shortline Railways Act, 1995* (SRA), which outlines safety requirements by reference to the federal *Railway Safety Act* (RSA);
- the *Ontario Northland Transportation Commission Act*; and

- the *Metrolinx Act, 2006*, which prescribes corporate structure but has no safety requirements.

The MTO is responsible for the oversight of the provincially regulated railway system, but it has no overall provincial regulatory framework and has not issued any regulations pursuant to the SRA. The MTO also does not have employees with the technical knowledge, experience, and expertise required to oversee the safety of railway operations; rather, it relies on various agreements with other parties in an effort to provide oversight, specifically:

- The MTO has an inspection-services agreement with TC that requires TC to conduct inspections of Metrolinx and various shortline railways to federal regulations, rules, and standards.
- The Ontario Northland Transportation Commission conducts its own internal track inspections and hires third-party inspectors for some other inspections.

Metrolinx falls under the *Metrolinx Act, 2006* when operating on its own provincially regulated track. Because this Act does not include safety-related provisions or subsequent offence provisions for violating them, it does not provide the Province of Ontario with a framework for taking enforcement action for safety-related deficiencies, when appropriate, against Metrolinx or other provincial railways operating on Metrolinx-owned property. Furthermore, TC inspectors do not have the authority to compel Metrolinx or other provincial railways operating on Metrolinx-owned property to take action to address identified safety hazards.

With regard to enforcement, it is within the authority of the Ontario Minister of Transportation to require Metrolinx or the Ontario Northland Transportation Commission to implement any directives issued to either agency with respect to any matter arising under their respective legislation, including implementation of corrective action. For the provincial shortline railways that fall under the authority of the SRA, the Registrar of Shortline Railways can suspend or revoke a railway licence.

In accordance with its agreement with TC, the MTO was to receive all TC inspection reports and resolve any disputes from the implementation of the TC inspection agreement with Metrolinx. However, the MTO had not been receiving TC inspection reports and does not have employees with the technical knowledge, experience, and expertise required to evaluate TC inspection reports.

Given the current complex MTO regulatory framework that involves multiple agreements, there are gaps in the oversight processes that can lead to occasions when the MTO will not be able to provide effective safety oversight.

The MTO has identified a need to update the oversight framework for urban and regional rail transit in Ontario that would better support the province's growing rail network and the diversity of operators. Early in 2021, the MTO began a review of the safety oversight framework for provincial railways; this review was ongoing at February 2023. The review encompasses provincial shortline railways, the Ontario Northland Transportation

Commission, and urban and regional transit systems with rail service (i.e., the Toronto Transit Commission, GO Transit and UP Express [Metrolinx], OC Transpo, and ION light rail [Grand River Transit]).

The Board is encouraged that the MTO has identified a need to update the oversight framework for urban and regional rail transit in Ontario. However, although such a framework may include updated legislation and the creation of a regulator to provide oversight and support safety practices across the provincial railway sector, no such framework has yet been established. Therefore, the Board is concerned that the Province of Ontario does not provide effective safety oversight of provincially regulated railways.

1.0 FACTUAL INFORMATION

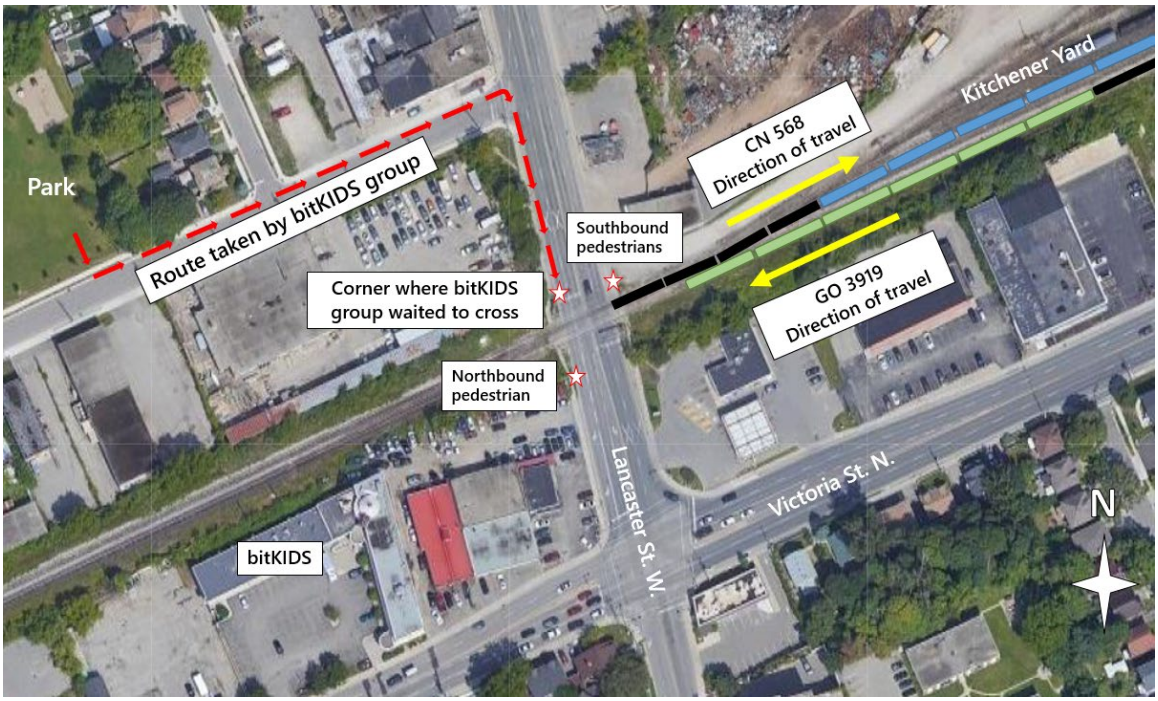
1.1 The accident

At about 1444[3] on 13 November 2019, while returning from a nearby park to their clinic on Victoria Street North in Kitchener,[4] a group of 6 adult therapists and 5 child clients from bitKIDS Behaviour Consulting (bitKIDS) encountered activated automatic grade crossing warning devices (GCWD) at the Lancaster Street West public crossing. The activated GCWD consisted of flashing lights, bells, and gates that extended across each side of the roadway, but not the pedestrian walkways.

At this location, Lancaster Street West crosses 2 sets of railway tracks. The south track is the Guelph Subdivision main line and the north track is a siding. Both tracks are owned by Metrolinx. The lead track to Canadian National Railway's (CN) Kitchener Yard joins the siding at Mile 62.05.

The north track was occupied by CN freight train L56831-13 (CN 568), which was backing up into the yard. The group of 6 adult therapists and 5 child clients waited on the northwest quadrant sidewalk for an estimated 5 to 10 minutes in cold weather for CN 568 to slowly clear the crossing and the GCWD to deactivate (Figure 1).

Figure 1. Map of the occurrence site showing the location of the pedestrians and the direction of travel of the trains (Source: Google Earth, with TSB annotations)



When CN 568 had just about cleared the crossing to the east, a pedestrian waiting on the southwest quadrant sidewalk crossed to the north before the GCWD deactivated. As this

3 All times are Eastern Standard Time.

4 All locations are in the province of Ontario, unless otherwise indicated.

pedestrian was approaching the north side of the crossing, one of 3 pedestrians waiting on the northeast quadrant sidewalk, as well as members of the group of 11 therapists and clients (the group) on the northwest quadrant sidewalk, began to cross, despite the activated GCWD.

The locomotive engineer in the cab of the CN 568 locomotive verbally warned the pedestrian in the northeast quadrant of the oncoming GO Transit commuter train 3919 (GO 3919) approaching from the east on the south track, and the pedestrian turned back.

In the meantime, the 1st adult and child pair from the group on the northwest quadrant sidewalk ran across the crossing and made it to the southwest side of the track. A 2nd adult and child pair followed about 15 feet behind the 1st pair and, while traversing the crossing, they ran into the path of, and were struck by, westbound GO 3919, which was operating on the south track. The 2nd adult and child both sustained serious injuries and were airlifted to a local hospital.

1.1.1 Sequence of events

The sequence of events in Table 1 was established based on an examination of the locomotive event recorder (LER) data from the leading locomotive on CN 568, the event-recorder data from the signal bungalow, the LER data and camera data from the leading cab car of GO 3919, the video-recording data from a nearby industrial unit, and information gathered through witness interviews. All times were synchronized with the data from GO 3919's LER and video recording.

Table 1. Sequence of events

Time	Event
1435 - 1440*	The therapists and clients departed from the park.
1440:05	CN 568 commenced a forward move westward toward the crossing on the siding track.
1440:38	The gates, bells, and lights were activated.
1443:09	CN 568 reversed direction (eastward).
1439 - 1444*	The therapists and clients arrived at the crossing.
1446:40	CN 568 travelled forward (westward).
1447:55	CN 568 reversed direction (eastward).
1448:17	GO 3919 activated its bell while travelling at 34.6 mph about 3400 feet from the crossing.
1448:59	GO 3919 occupied the main track east circuit 1640 feet east of the crossing, activating the crossing warning system.
1449:13	GO 3919 passed the tail end of CN 568.
1449:19	A northbound pedestrian entered the main track from the west sidewalk.
1449:30	CN 568's locomotive cleared the crossing roadway to the east.
1449:31	A southbound pedestrian on the east sidewalk began to cross, took 2 steps, then turned back after being warned by the locomotive engineer of CN 568.
1449:32	The 1st adult and child pair entered the crossing from the northwest quadrant.
1449:34	The GO 3919 bell was turned off and it was proceeding at 27 mph with the brakes released as the 1st adult and child pair entered the main track. The 2nd adult and child pair approached the crossing's siding track. The GO 3919 low horn and emergency horn were both activated in an area that was otherwise designated as anti-whistling (locomotive horn activation).
1449:35	The head-end of the lead locomotive from CN 568 was on the siding track reversing slowly and occupied only the east sidewalk portion of the crossing. GO 3919 entered the crossing.
1449:36	The 2nd adult and child pair reacted to the presence of GO 3919 about 1.5 seconds after it sounded its horn.
1449:37	The 2nd adult and child pair was struck by GO 3919.
1449:38	CN 568 stopped as GO 3919 turned its horn off.
1449:40	GO 3919 initiated a full service brake application.
1449:57	GO 3919 stopped.
1457*	Waterloo Regional Police Services arrived on scene.
1521*	The injured adult and child were airlifted to a nearby hospital.

* Times are estimated

1.2 GO Transit commuter train 3919

GO 3919 comprised a leading cab car (GO 329) followed by 5 coach cars and trailing locomotive GO 615. It measured about 580 feet in length and weighed about 505 tons. The

train crew was composed of a qualified commuter train operator[5] and a commuter train operator,[6] who were both located in the leading cab car, as well as a customer service ambassador who worked throughout the coaches.

At about 0800, the GO 3919 operating crew began their shift at the Willowbrook Crew Centre in Etobicoke. At about 1253, the crew took control of GO 3919 and departed westward on the Metrolinx Weston Subdivision destined for Kitchener. The journey took them along the Weston Subdivision, onto the CN Halton Subdivision, and then onto the Metrolinx Guelph Subdivision (Figure 2).

Figure 2. Map showing the GO 3919 route and the occurrence location (Source: Railway Association of Canada, Canadian Rail Atlas, with TSB annotations)

As GO 3919 proceeded westbound on the main track, it approached the Lancaster Street West crossing in Kitchener. During the approach, it was decelerating in order to abide by a 30 mph permanent slow order in preparation for a stop at the Kitchener GO Transit Station

5 A qualified commuter train operator is the locomotive engineer and is responsible for driving the train. (Source: M. Llywellyn, "Keeping it Rail Pt. 2: What it takes to be a GO Train conductor," *Metrolinx News* [blog], Metrolinx, at metrolinx.com/en/news/keeping-it-rail-pt.-2:-what-it-takes-to-be-a-go-train-conductor [last accessed 22 December 2022])

6 A commuter train operator is the conductor and is responsible for a majority of the signalling and communication work. (Source: Ibid.)

(Mile 62.7). The train bell was activated in accordance with Rule 13 of the *Canadian Rail Operating Rules* (CROR).[7]

When GO 3919 was near the crossing, its crew observed that CN 568 occupied the siding just north of the main track as it reversed eastward into the CN yard. The CN 568 lead locomotive was just about clear of the crossing when the GO 3919 crew also observed a pedestrian travelling northward through the crossing while the crossing warning system was active.

When GO 3919 was about 80 feet from the crossing, 2 pedestrians (the 1st adult and child pair) who were holding hands, appeared on the north side of the crossing from behind the CN locomotive. They ran southward onto the crossing (Figure 3), and the GO 3919 crew immediately activated the locomotive horn.

Figure 3. An image from the forward-facing video camera from GO 3919 train's cab car 329 showing the 1st adult and child pair traversing the Lancaster Street West crossing followed by the 2nd adult and child pair (Source: GO Transit with TSB annotations)

As the 1st adult and child pair cleared the crossing to the south, a 2nd adult and child pair followed immediately behind into the path of GO 3919 and were subsequently struck by the train. With the train proceeding at 27 mph, the GO 3919 crew initiated a full service brake application and the train came to rest with the tail-end locomotive occupying the crossing.

7 *Canadian Rail Operating Rules* Rule 13 (Engine Bell) states, "(a) The engine bell must be rung […] (iv) one-quarter of a mile from every public crossing at grade (except within limits as may be prescribed in special instructions) until the crossing is fully occupied by the engine or cars. At crossings where engine whistle signal 14(l) is applicable the engine bell need not be rung."

1.3 Canadian National Railway Company freight train L56831-13

At about 1205, CN 568 commenced switching activities in Kitchener Yard. These activities were primarily concentrated at the west end of the yard, in close proximity to the crossing.

An examination of the event recorder data from the crossing signal bungalow determined that CN 568 occupied the crossing several times while switching.

Between 1206 and 1440, the GCWD were activated 15 times by a train on the siding track (north) and 1 time by a train on the main track to the south of the siding track. During this time, the longest activation was 11 minutes and 40 seconds and involved a CN train on the siding track.

At about 1440, CN 568 began moving westward. At 1440:38, it travelled over the circuitry bond positioned 52 feet from the crossing, activating the GCWD. It then stopped at the crossing to wait until the gates had fully descended before proceeding onto the crossing. Without exiting the crossing, CN 568 stopped, then reversed. It stopped 2 more times during the reverse move before moving forward again. After the forward move, it reversed again.

At 1449:37, with the GCWD still activated, the CN 568 lead locomotive exited the east side of the road crossing. This occurred just as westbound GO 3919 passed by on the main track to the south and subsequently struck the 2nd adult and child who were attempting to traverse the west side of the crossing.

At the time of the accident, CN 568 was positioned on the siding track, the lead locomotive occupied the east sidewalk of the crossing, and the GCWD were activated. The rest of the train extended further east along the siding track, over the switch at Mile 62.05 and onto track H32. At this time, CN 568 consisted of 13 cars and 4 head-end locomotives.

1.4 Therapists and clients from bitKIDS Behaviour Consulting

At the time of the occurrence, the bitKIDS facility was located in a commercial building that was south of the Metrolinx main track. The bitKIDS staff teach new skills to children from 1.5 to 9 years old who are on the autism spectrum.

At about 1400, the bitKIDS staff prepared their child clients for an outing to a nearby park. Six therapists, including 1 senior therapist, accompanied 5 child clients to the park. There were 2 parks nearby that were available for the therapists and clients to visit:

- a smaller one at the intersection of Queen Street North and Lancaster Street West, on the same side as the bitKIDS clinic, south of the railway tracks; and
- a larger one (Major Park) on the north side of the tracks, on Breithaupt Street.

On any given day, the park they visited was determined, at least in part, by train activity at the Lancaster Street West crossing. If the crossing warning system was active, they went to the smaller park, which did not require them to cross the tracks. When returning from Major Park, if the crossing warning system was active for an extended period of time, they could use Saint Leger Street to the west, which took about ⅓ longer.

The group of 6 therapists and 5 child clients departed the clinic just after 1400 and chose to go to Major Park on the north side of the railway tracks since the crossing was unoccupied when they departed the clinic. When walking along the sidewalks, they always travelled in adult/child pairs, with the adult next to the roadway. The journey to Major Park takes about 10 minutes.

While at Major Park on the day of the occurrence, some therapists engaged in a conversation with a third party regarding the frustration caused by train-related delays at the crossing. The group stayed at the park for about 30 minutes and then began the return journey. As they turned the corner from Breithaupt Street onto Lancaster Street West, they could see that the crossing was occupied by CN 568 and the GCWD were fully activated.

The group approached the crossing from the north on the west sidewalk and waited by the gates for an estimated 5 to 10 minutes. By this time, the group had been outside in the cold for about 50 minutes, some of the children were cold, and there was an expectation to return to the clinic by 1500.

When CN 568 cleared the west side of the road crossing, a pedestrian on the west sidewalk travelled over the crossing from the south to the north side. While the CN 568 lead locomotive occupied part of the east sidewalk, a pedestrian began to walk on the east sidewalk from the north side to the south side of the crossing. However, the pedestrian turned back after being warned of the oncoming westbound GO 3919 by the locomotive engineer of CN 568.

As the group waited, they were only able to see CN 568 as it occupied the east sidewalk. Since the group had rarely encountered a GO train at the crossing in the past, the therapist in the 1st adult and child pair believed that the tracks were safe to cross and entered the crossing from the north, on the west sidewalk, while the GCWD were still activated.

The 1st adult, holding hands with the 1st child, ran across the right-of-way while visually focusing straight ahead, as did the 2nd adult and child pair who immediately followed about 15 feet behind (Figure 4).

Several of the adults in the group assumed that if there was a second train, it would come from the west, which was similar to the way vehicles travel on a 2-lane roadway network.

Figure 4. Lancaster Street West crossing looking northeast (Source: Autologix video, with TSB annotations)

1.5 Weather

At the time of the occurrence, the nearest Environment and Climate Change Canada weather station, located in Kitchener, recorded an ambient temperature of about −5 °C with the wind from the south at 17 km/h, resulting in a wind chill of −11. The sky was overcast and visibility was 16 km.

1.6 Guelph Subdivision information

The Metrolinx Guelph Subdivision consists of a single main track, oriented generally east–west, extending from Mile 30.0 (Silver Station near Georgetown) to Mile 65.1 (Sturm Station in Kitchener). The Guelph Subdivision, the CN Halton Subdivision, and the Metrolinx Weston Subdivision form Metrolinx's corridor for commuter rail service from Union Station in Toronto to Kitchener.

The Guelph Subdivision is classified as Class 4 track, according to the Transport Canada (TC)–approved *Rules Respecting Track Safety*. The authorized speed is 70 mph for passenger trains and 55 mph for freight trains. There is a permanent slow order between Mile 61.8 and Mile 63.52 that limits passenger train and freight train speeds to 30 mph.

Train movements on this subdivision are governed by the centralized traffic control method of train control, as authorized by the CROR, and dispatched by a rail traffic controller provided by RailTerm Inc. located in Dorval, Quebec.

At the time of the accident, a total of 23 GO trains and 4 VIA Rail Canada Inc. (VIA Rail) passenger trains (2 westbound and 2 eastbound) traversed the crossing each weekday.

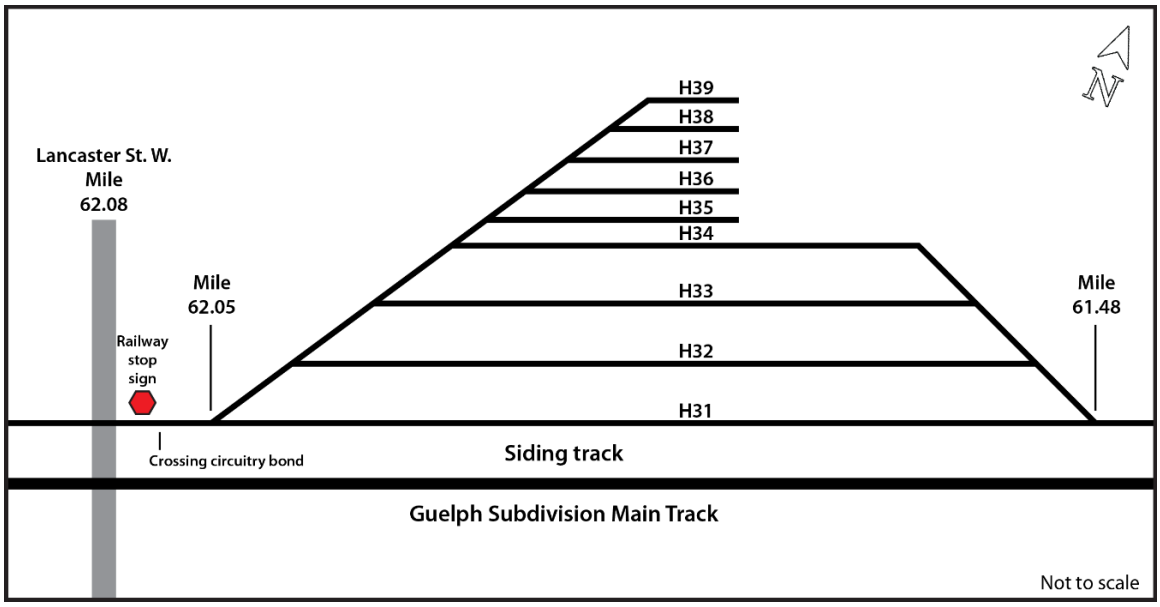
GO Transit commuter rail service operated 15 trips between Toronto Union Station and Kitchener GO Transit Station each weekday. Of these, 8 eastbound GO trains serviced

Kitchener at 0520, 0545, 0610, 0650, 0715, 0757, 1457, and 2057, and 7 westbound GO trains serviced Kitchener at 1447, 1743, 1840, 1930, 1947, 2047, and 2347. In addition, there were 4 eastbound and 4 westbound GO Transit equipment trains.[8] No GO trains operated on the weekend.

Prior to 31 August 2019, only 10 GO trains per day serviced the Kitchener station: 5 eastbound trains in the morning and 5 westbound trains in the evening. On 31 August 2019, 5 additional GO trains were added: 3 eastbound trains at 0757, 1457, and 2057, and 2 westbound trains at 1447 and 2347.

CN operates the yard east of Lancaster Street West (Figure 5). It is a busy switching yard with movements often occupying the siding and the crossing.

Figure 5. Schematic of Canadian National Railway Company's Kitchener Yard near the Lancaster Street West crossing (Source: TSB)



1.6.1 Subdivision ownership

Before September 2014, CN owned the Guelph Subdivision and Kitchener Yard; Goderich-Exeter Railway Company leased both from CN and operated both. In September 2014, Metrolinx purchased Mile 30.0 to Mile 65.1 of the Guelph Subdivision from CN, not including Kitchener Yard. Metrolinx honoured the lease agreement with Goderich-Exeter Railway Company, which continued operating over Metrolinx's portion of the Guelph Subdivision as well as in Kitchener Yard. On 16 November 2018, Goderich-Exeter Railway Company's lease expired, and Mile 30.0 to Mile 65.1 of the Guelph Subdivision reverted to Metrolinx's control, and Kitchener Yard reverted to CN's control.

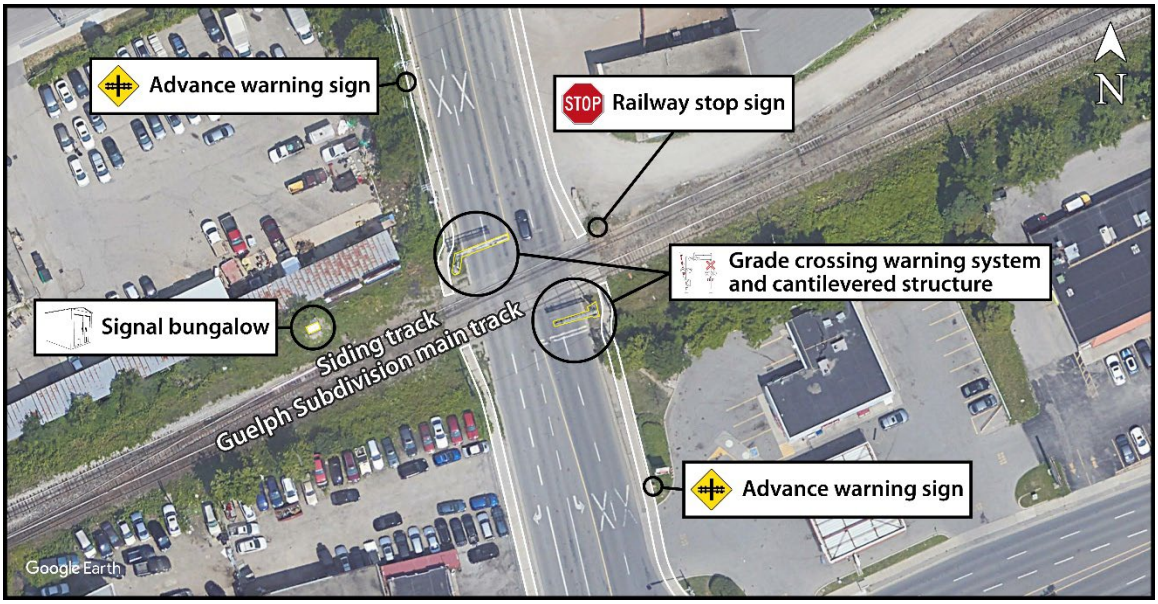
8 An equipment train is non-revenue-generating with no passengers, being moved for maintenance and operational purposes.

In the vicinity of the crossing, the main track and the siding track (H31) are owned by Metrolinx. CN owns and operates Kitchener Yard and tracks H32 to H39. Consequently, Metrolinx owns the crossing and is responsible for its maintenance.

1.7 Lancaster Street West crossing

Lancaster Street West is a paved 4-lane roadway, generally oriented in a north–south direction, that intersects the Guelph Subdivision at approximately 80 degrees (Figure 6).

Figure 6. Lancaster Street West crossing (Source: Google Maps, with TSB annotations)



The crossing consists of 2 railway tracks. The south track is the Guelph Subdivision main track, while the north track is a siding that provides access to CN's Kitchener yard located northeast of, and adjacent to, the crossing. GO commuter trains and VIA Rail passenger trains operate on the main track, while CN freight trains and CN switching assignments operate predominantly on the siding track. Since the CN rail yard is just east of the crossing, CN trains and switching assignments frequently occupy the crossing. It is not uncommon to have trains occupying both tracks near or on the crossing at the same time.

A roadway turning lane begins at the crossing and extends southward for 185 feet to Victoria Street North, where there are 3 southbound lanes. Advance warning signs identifying the presence of the crossing are located about 100 feet and 120 feet in advance of the crossing on the south and north roadway approaches, respectively.

The GCWD consist of standard railway crossing signs, flashing lights, bells, and gates that extend over the roadway surface. Additional flashing lights are mounted on cantilevered structures extending over the outside lanes of Lancaster Street West (Figure 7). The crossing lights flash and the bells sound starting approximately 11 seconds before the gates begin to descend. The crossing gates take approximately 11 seconds to descend fully. For trains on the main track, the gates are horizontal for at least 20 seconds before a train arrives at the crossing. The gates begin to ascend approximately 8 seconds after a train has cleared the crossing.

There is a sign on each crossing mast informing vehicle drivers of the number of tracks. An "Emergency" sign with a telephone number for the RailTerm rail traffic control centre is located on each crossing arm and on a signal bungalow situated in the northwest quadrant of the crossing along the right-of-way.

Figure 7. Lancaster Street West crossing, looking south (Source: TSB)

Sidewalks are located parallel and adjacent to the road in all 4 quadrants and extend past the GCWD up to the crossing. From the edge of each sidewalk, there is an extension over the crossing that is paved with asphalt. From a standing position on the sidewalk adjacent to the crossing mast on the northwest quadrant, with no trains present, the sightlines to the east are unrestricted and to the west are clear for about 300 feet.

The crossing has been designated as an anti-whistling crossing for at least 20 years. The whistle cessation order prohibits trains from sounding their horn when approaching the crossing unless the horn is required to warn of an emergency situation. Since the implementation of the whistle cessation order at the crossing, there has been considerable urban growth in the area.

At the time of the accident, the sidewalk surfaces were wet and the west side approaches had been cleared of snow, although the crossing surface was covered with snow. There were no pedestrian gates to protect pedestrians and cyclists using the sidewalks. There were also no roadway signs or alternate warning devices located at or approaching the crossing to warn pedestrians, cyclists, and motorists that a second train might approach or occupy the crossing while the GCWD were active. While these types of additional defences are not required by the TC *Grade Crossings Regulations* (GCR), there is nothing that precludes a railway and/or a road authority from taking additional measures to improve crossing safety for pedestrians, cyclists, and motorists at public crossings.

The crossing was compliant with all existing regulatory requirements.

1.7.1 Train operations in the area of the Lancaster Street West crossing

Locomotive engineers with experience at the crossing viewed it as a moderately busy crossing during the day in terms of vehicular, pedestrian, and cyclist traffic. It was common for them to see vehicles, pedestrians, and cyclists waiting at the crossing when the signals were active and the gates were down. In addition, pedestrians and cyclists, and occasionally vehicles, were known to enter the crossing when the gates were down. People were also known to enter the railway right-of-way without authority.

Since CN Kitchener rail yard is just east of the crossing, CN freight trains frequently occupied the crossing and it was not uncommon to have 2 trains near or on the crossing at the same time. If GO trains approached the crossing on the main track while a freight train was close to or on the crossing on the siding track, the GO Transit operating crews sometimes sounded the train horn in advance of the crossing to warn nearby vehicular, pedestrian or cyclist traffic of their approach. CN crews operating freight trains located on the crossing would sometimes delay exiting the crossing when a second train approached to reduce the likelihood of pedestrians or cyclists entering the crossing while the signals were still active and the gates were down. Both actions were informal operating practices.

When freight trains approached the crossing on the H31 siding track from the east, the crossing warning system activated when the train was 52 feet from the edge of the sidewalk. Since the CROR requires a train to wait for the warning system to operate for at least 20 seconds before entering a crossing,[9] a stop sign was positioned near the crossing, requiring trains to stop before entering.

1.8 Canadian National Railway Company Kitchener Yard

The CN Kitchener Yard acts as a central switching hub for customers to the north, east, and west. Six nights per week, rail cars are transferred from CN's MacMillan Yard in Toronto to Kitchener Yard where the cars are switched onto different trains for distribution to customers' facilities. Similarly, cars from these facilities are returned to Kitchener Yard and then usually taken back to MacMillan Yard.

CN operated 3 shifts out of its Kitchener Yard. A day shift operated 7 days a week from 0700 to 1500 with 2 crews sharing a Tuesday to Friday and a Saturday to Monday schedule. A night shift with 1 crew operated 5 days a week from Sunday to Thursday between 2100 to 0500 and a continental shift with 2 crews operated 7 days a week between 1130 and 2330. The 2 crews from the continental shift shared a 12-hour shift weekly rotating schedule: the 1st crew worked Monday, Tuesday, Friday, Saturday, Sunday, and the 2nd crew worked Wednesday and Thursday.

The continental shift crews serviced customers west of Kitchener, as far as London. The first 1 to 4 hours of each shift were spent building trains in the yard. This could entail pulling

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9 Transport Canada, *Canadian Rail Operating Rules* (CROR) (18 May 2018), Rule 103.1: Public Crossings at Grade with Warning Devices, paragraph d.

cars onto the siding and westward over the crossing, or onto the main track and shoving them back into a yard track. Because many of the yard tracks entered onto the siding track only from the west end, switching was frequently conducted at the west end of the yard in close proximity to the crossing. Once the train was built, the crew members brought it to customers' facilities, where they placed cars from the train onto the customer tracks or took cars on customer tracks and placed them back in the train. Once all scheduled customers had been serviced, the train travelled back to the yard, arriving near the end of the shift.

The day shift and the night shift also switched cars in the yard to build trains and serviced customers east of Kitchener as far as Guelph and customers north of Kitchener as far as Elmira.

When CN regained operational control of Kitchener Yard in November 2018, work that had been performed in Stratford Yard was moved to Kitchener Yard (the work accomplished by the continental shift).

Switching of cars in the yard occurred along the siding at both the east and west ends of the yard, and occasionally on the main track. Switching from the west end frequently required the cars to occupy the crossing. Because the east end of 5 of the 9 yard tracks did not connect to the siding track, switching on these tracks was conducted from the west end of the yard. A full yard, which was not uncommon, limited a crew's ability to avoid switching over the crossing. To increase efficiency, cars from Kitchener Yard, or cars coming from MacMillan Yard, would occasionally be taken to Stratford, where they would be switched in Stratford Yard in preparation for delivery to customers.

1.9 Examination of data from the signal bungalow event recorder

The event recorder in the Metrolinx crossing signal bungalow historically captured activation and deactivation times of the GCWD for the days leading up to the occurrence. The data covering the period from 30 October 2019 until the occurrence on 13 November 2019 were examined. A summary of the observations is provided in Table 2.

Table 2. Observations relating to the data from the event recorder at the Lancaster Street West signal bungalow

Day	Date	Crossing warning system activations				Activations longer than 5 minutes		Longest activation time
		Total activations	Main-track activation	Siding activation	No-train activation**	Between 0600 and 2200	Between 2200 and 0600	
Wednesday	2019-10-30	83	26	35	22	9	2	00:20:58
Thursday	2019-10-31	53	34	13	6	2	3	00:32:37
Friday	2019-11-01	48	31	16	1	1	2	00:24:53
Saturday	2019-11-02	24	12	8	4	2	1	00:20:56
Sunday	2019-11-03	24	15	8	1	0	0	00:03:08
Monday	2019-11-04	56	32	23	1	6	5	00:12:33
Tuesday	2019-11-05	64	29	35	0	4	7	00:43:14
Wednesday	2019-11-06	69	30	39	0	9	5	00:14:24
Thursday	2019-11-07	58	38	20	0	5	4	00:38:41
Friday	2019-11-08	52	31	21	0	5	1	00:56:55
Saturday	2019-11-09	28	13	15	0	6	4	00:52:21
Sunday	2019-11-10	51	12	39	0	9	1	00:17:39
Monday	2019-11-11	78	35	33	10	5	2	00:17:30
Tuesday	2019-11-12	76	32	21	23	4	3	00:21:29
Wednesday	2019-11-13*	36	14	22	0	2	2	00:19:04

* The 13 November 2019 data included only activations that occurred up to 1500.

** Testing of the warning system circuitry resulted in warning system activation without a train.

Table 3 identifies those instances when the signal circuitry indicated that both the main track and the siding track were occupied simultaneously by rolling stock.

Table 3. Dates and times when the signal was first activated when the main track and the siding track at the crossing were occupied simultaneously

Date	Time of initial activation	Time period that the siding track warning system island circuit was activated*	Time period that the main track warning system island circuit was activated*
2019-10-31	12:31:21	12:31:21 to 12:33:13	12:32:36 to 12:32:44
2019-11-04	21:55:33	21:56:08 to 21:56:36	21:56:07 to 21:56:15
2019-11-05	19:25:05	19:25:05 to 19:29:18	19:25:51 to 19:26:20
2019-11-05	20:57:57	20:58:49 to 21:01:17	20:58:33 to 20:58:58
2019-11-06	21:44:06	21:45:05 to 21:48:12	21:44:39 to 21:45:06
2019-11-07	12:23:16	12:24:02 to 12:24:57	12:23:53 to 12:24:02
2019-11-07	14:59:56	15:00:51 to 15:01:19	15:00:38 to 15:01:01
2019-11-08	14:38:42	14:38:42 to 14:52:44	14:48:09 to 14:48:30
2019-11-12	14:39:56	14:39:56 to 14:41:25	14:41:08 to 14:41:24
2019-11-13	14:40:56	14:40:56**	14:49:53**

* Signal activation times are 19 seconds ahead of the GO train video camera and locomotive event recorder times represented in Table 1.

** Occurrence signal activation time. The circuit remained activated for several hours.

The signal system will detect when a moving train comes within 1640 feet of the crossing on the main track, and within 550 feet of the crossing to the west and 52 feet of the crossing to the east on the siding track. Island circuit bonds are located in the main track and the siding track about 50 feet on either side of the crossing.

The GCWD activate when a train is detected on either track. On the main track, detection of a train is dependent on train speed. GCWD activation may be delayed when trains travel slower in order to provide a constant warning time of at least 20 seconds.

1.10 Examination of crossing video

In June 2020, Metrolinx installed 2 cameras at the crossing, and video was recorded continuously from 20 June 2020 until 29 June 2020. Metrolinx also installed 4 static second-train event warning signs at the crossing, 1 in each crossing quadrant, after the occurrence and before the cameras were installed. A summary of the observations made is included in Table 4, Figure 8, and Table 5. A complete list of the observations is available upon request.

Table 4. Video analysis of the Lancaster Street West crossing from 20 June to 29 June 2020

Day	Date	Total number of activations	With vehicles present	With vehicles turning around	Where vehicles that turned around were within 30 m (98 feet) of the crossing	With pedestrians or cyclists present	Longer than 5 minutes	Switching movements delayed crossing traffic for more than 5 minutes	Initiated by a freight train
Saturday	2020-06-20	41	38	18	11	15	3	2	34
Sunday	2020-06-21	13	11	6	4	3	0	0	7
Monday	2020-06-22	28	25	6	3	12	0	0	8
Tuesday	2020-06-23	46	39	18	12	11	7	4	32
Wednesday	2020-06-24	72	67	34	22	21	8	6	57
Thursday	2020-06-25	29	23	7	6	11	2	1	18
Friday	2020-06-26	31	28	7	4	7	1	1	16
Saturday	2020-06-27	13	13	5	4	4	2	2	10
Sunday	2020-06-28	23	19	15	13	11	7	7	19
Monday	2020-06-29	53	42	19	12	12	6	5	39
Total		349	305	135	91	107	36	28	240

Figure 8. Number and duration of signal activations (in increments or bins of 0.25 minutes) at the Lancaster Street West station for freight and non-freight trains, from 20 June to 29 June 2020 (Source: TSB)

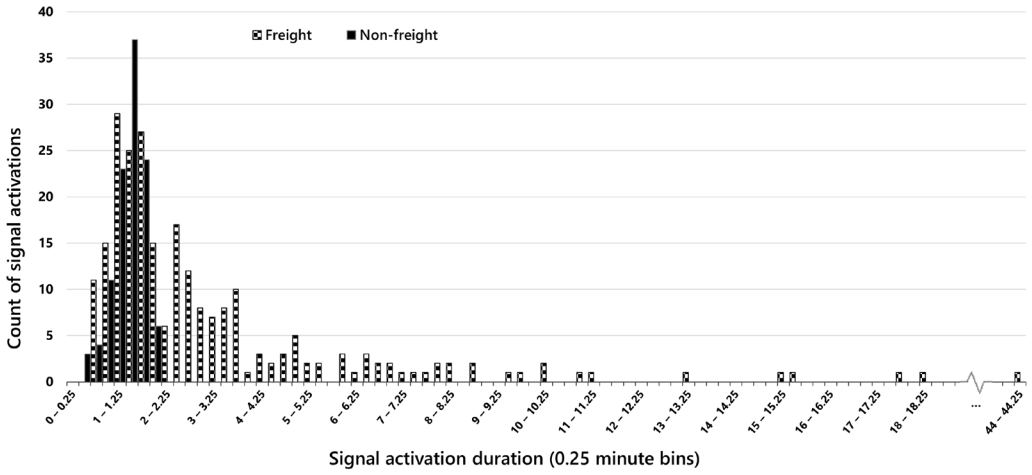

Table 5. Summary of signal activation duration by train type at the Lancaster Street West crossing

Train type	Signal activation duration less than 2 minutes	Signal activation duration from 2 to 5 minutes	Signal activation duration greater than 5 minutes
CN freight train	122	82	36
GO train	67	None	None
VIA Rail train	19	None	None

Note: There were 23 signal activation events where a train could not be seen from the camera's vantage point.

In addition, it was noted that

- 16 motorists entered the crossing while the gates were descending or when they were down;
- 66 pedestrians or cyclists entered the crossing while the gates were down;
- 39 people emerged from, or accessed, the right-of-way;
- 6 times, vehicles stopped on the crossing foul of the tracks while queuing for the Victoria Street North–Lancaster Street West intersection;
- 7 times, 2 trains occupied the crossing simultaneously; and
- 1 of the 36 activations that lasted more than 5 minutes occurred between the hours of 0730 and 1000.

The video recording was also examined to identify the habits of vehicular, pedestrian, and cyclist crossing users. As GO trains run only on weekdays from approximately 0400 until 2300, recordings from weekdays (from 23 to 29 June 2020) between those hours were reviewed. The review revealed the following:

- There were a total of 195 signal activations.
- Activation durations ranged from 31 seconds to 18 minutes.
- 131 signal activations (67%) lasted between 0 and 2 minutes.
- 44 signal activations (23%) lasted between 2 and 5 minutes.
- 16 signal activations (8%) lasted more than 5 minutes.
- 4 signal activations (2%) lasted for more than 10 minutes, 3 of which delayed vehicles, pedestrians, or cyclists for more than 10 minutes.
- 45 pedestrians or cyclists entered the crossing either before or while a train passed and the gates were down, or after a train had passed but before the gates had begun to ascend.
- 16 pedestrians or cyclists were observed entering the crossing from the north while a slow-moving, or stopped, freight train on the siding track blocked their view of the main track to the east. These pedestrians or cyclists did not turn their heads to the left (eastward, i.e., the direction of the approaching GO train in this occurrence).
- 1 cyclist was observed to ride around a stationary or slow-moving freight train from south to north.

1.11 Use of railway crossings by pedestrians and cyclists

Pedestrian and cyclist behaviour at railway crossings depends on many factors. These include:

- environmental factors, such as the type of road, surface material, and condition, as well as lighting;
- traffic factors, such as traffic volume, vehicle location, and vehicle activity (i.e., moving versus stationary);
- personal factors, such as physical and personal characteristics, mental state, motivation, and experience;
- social factors, such as the presence or influence of others and the purpose of the journey.

Pedestrian and cyclist crossing behaviour, whether it happens at the intersection of 2 roads or at a grade crossing, is complex and involves route planning, path navigation, detection of traffic and other hazards, judgment, and decision making.[10] When pedestrians or cyclists need to cross a road or a grade crossing, they must first scan the environment to receive information via the senses, then process that information, make a decision, and carry out the decided-upon course of action. Errors can result from deficiencies within any or all of these sub-tasks and for a variety of reasons, including individual and situational tendencies to take risks as well as poor speed estimation (their own speed as well as that of an approaching train or vehicle), among others.

Two important factors can influence a person's decision whether to comply with a warning device: the perceived costs of compliance, such as time, and the behaviour of others around them.[11]

1.11.1 Pedestrians' and other road users' knowledge of and experience with a crossing

When road users become familiar with a particular road environment, such as an intersection or a grade crossing, and they are frequently able to cross successfully or witness other pedestrians successfully crossing while the warning signals are active, they will expect that, on future encounters, the crossing may be safe to cross, despite the warnings being active.[12] Road users' knowledge of the rail traffic patterns for a grade

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10 R. Dewar, "Pedestrians and Bicyclists," in *Human Factors in Traffic Safety,* edited by A. Smiley (Lawyers & Judges Publishing, 2015), pp. 449–500.

11 K. R. Laughery and M. S. Wogalter, "A three-stage model summarizes product warning and environmental sign research," *Safety Science*, Vol. 61 (2014), pp. 3–10.

12 G. J. Alexander and H. Lunenfeld, FHWA-TO-86-1, *Driver Expectancy in Highway Design and Traffic Operations* (United States Department of Transportation, April 1986).

crossing informs their expectations. Rail traffic flow and long wait times[13] at grade crossings can contribute to "restless"[14] behaviour by pedestrians and other road users and influence their decision to cross against active crossing warnings.[15]

Pedestrians and motorists who anticipate being delayed for long periods at a railway crossing are more likely to make risky crossing decisions than those who do not.[16,17,18] Similarly, pedestrians who have to wait longer at road intersections are more likely to jaywalk than pedestrians who are presented with shorter delays.[19] While extended delays at grade crossings have generally been recognized as those that last longer than 5 minutes,[20,21] recent research[22] recommends that delays be limited to 3 minutes to reduce the likelihood of risky behaviour by road users.

1.11.2 Behaviour of other pedestrians at crossings

Research[23] has shown that, when attempting to cross a road, pedestrians use both non-social information, such as traffic lights and vehicle movements, as well as social information, such as the behaviour of other pedestrians, to inform their decision making. In some circumstances, pedestrians will disregard non-social information in favour of social

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13 I. Naish and D. Blais, paper GLXS2014-1085, "Mitigating risky behaviour of delayed road users at occupied highway-railway crossings: Review of research and issues," Proceedings of the 2014 Global Level Crossing Symposium, Urbana, Illinois, United States (4–8 August 2014).

14 Z. Zhang, A. Casazza, X. Liu, et al., "Railroad trespassing risk management: A literature review," presented at the 2019 American Railway Engineering and Maintenance-of-way Association (AREMA) conference, Minneapolis, Minnesota, United States (22–25 September 2019).

15 T. Stefanova, J. M. Burkhardt, A. Filtness, et al., "Systems-based approach to investigate unsafe pedestrian behaviour at level crossings," *Accident Analysis & Prevention,* Vol. 81 (2015), pp. 167–186.

16 J. Freeman and A. Rakotonirainy, "Mistakes or deliberate violations? A study into the origins of rule breaking at pedestrian train crossings," *Accident Analysis & Prevention*, Vol. 77 (2015), pp. 45–50.

17 G. Larue, R. A. Blackman, and J. Freeman, "Frustration at congested railway level crossings: How long before extended closures result in risky behaviours?" *Applied Ergonomics*, Vol. 82 (2020).

18 G. S. Larue, A. Naweed, and D. Rodwell, "The road user, the pedestrian, and me: Investigating the interactions, errors and escalating risks of users of fully protected level crossings," *Safety Science*, Vol. 110 (2018), pp. 80–88.

19 L. A. Jason and R. Liotta, "Pedestrian jaywalking under facilitating and nonfacilitating conditions," *Journal of Applied Behavior Analysis,* Vol. 15 (1982), pp. 469–473.

20 M. Hall and A. Somers, "Investigating efficiency at level crossings: Simulation of road and rail signalling improvements," Proceedings of the 25th Australian Road Research Board (ARRB), Perth, Australia (23–26 September 2012).

21 I. Naish and D. Blais, paper GLXS2014-1085, "Mitigating risky behaviour of delayed road users at occupied highway-railway crossings: Review of research and issues," Proceedings of the 2014 Global Level Crossing Symposium, Urbana, Illinois, United States (4–8 August 2014).

22 G. Larue, R. A. Blackman, and J. Freeman, "Frustration at congested railway level crossings: How long before extended closures result in risky behaviours?" *Applied Ergonomics*, Vol. 82 (2020).

23 J. J. Faria, S. Krause, and J. Krause, "Collective behavior in road crossing pedestrians: The role of social information," *Behavioral Ecology*, Vol. 21 (2010), pp. 1236–1242.

information, for example, when only limited non-social information is available and where there is strong motivation to cross.

Because pedestrians use social information when making decisions in the street crossing context, pedestrians who are in groups are more likely than those who are alone to make incorrect crossing decisions at intersections.[24] Grouped pedestrians are similarly less likely than a single pedestrian to look at traffic signals before crossing.[25]

Pedestrian behaviour at grade crossings shows similar characteristics. Compared with single pedestrians and pedestrians in pairs, groups of pedestrians are more likely to attempt to cross together against active grade crossing warnings.[26]

1.11.3 Pedestrian information processing and hazard detection

Because human information processing takes place constantly, and because there is so much information available in the environment, it is necessary to filter out the less important information to attend to what is important. However, while people can switch their attention rapidly from one information source to another, they can attend well to only one information source at a time.[27]

For people to interrupt what they are doing to react to a hazard, a condition or stimulus needs to be visible or detectable (available to the senses), perceived (assigned meaning), and recognized as sufficiently important. The perception response time that is used by road designers to estimate how long it will take for most road users to perceive and begin to respond under most traffic and environmental conditions is 2.5 seconds.[28] The time required for an average person to turn their head in response to a visual or auditory stimulus is approximately 0.4 seconds.[29]

The field of view of human vision is large, extending 90 degrees to the left and right (180 degrees total). The peripheral visual field makes up approximately 90% of the total; only a small area, a cone of approximately 2 to 3 degrees directly ahead of the viewer,

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24 J. J. Faria, S. Krause, and J. Krause, "Collective behavior in road crossing pedestrians: The role of social information," *Behavioral Ecology*, Vol. 21 (2010), pp. 1236–1242.

25 G. Ren, Z. Zhou, W. Wang, et al., "Crossing behaviors of pedestrians at signalized intersections: Observational study and survey in China," *Transportation Research Record: Journal of the Transportation Research Board*, No. 2264 (2011), pp. 65–73.

26 P. Metaxatos and P. S. Sriraj, Research Report FHWA-ICT-13-013, "Pedestrian/bicyclist warning devices and signs at highway-rail and pathway-rail grade crossings" (Illinois Center for Transportation, 2013).

27 D. Krauss and P. Olson, "Vision, Audition, Vibration and Processing of Information," *Forensic Aspects of Driver Perception and Response*, Fourth Edition (Lawyers & Judges Publishing, 2015).

28 Transportation Association of Canada (TAC), *Geometric Design Guidelines for Canadian Roads* (2017).

29 L. B. Oude Nijhuis, L. Janssen, B. R. Bloem, et al., "Choice reaction times for human head rotations are shortened by startling acoustic stimuli, irrespective of stimulus direction," *Journal of Physiology,* Vol. 584, No. 1 (2007), pp. 97–109.

allows for clear and accurate vision.[30] Outside of this cone, visual acuity and contrast sensitivity[31] drop rapidly, so it is important for road users to visually search for trains at grade crossings using eye and head movements. Once a train is detected visually, accurately perceiving its approach speed and distance is notoriously difficult. This is due to perceptual challenges whereby vehicles that are large and viewed from a generally head-on angle tend to be perceived as moving more slowly than smaller vehicles or those viewed from the side.[32]

Auditory cues can also improve hazard perception at grade crossings. However, while the primary purpose of crossing bells is to warn pedestrians and cyclists of the potential for an approaching train, they do not provide any additional warning of an impending second-train event. Similarly, locomotive train horns warn road users of an approaching train; however, the crossing in this occurrence was designated as "anti-whistling," meaning that train crews would activate the horn only in an emergency situation.

1.11.3.1 Sightline obstructions

For a pedestrian or cyclist to successfully detect a hazard that is visible in the road environment, sightlines need to be clear to allow an unobstructed view. The sightlines at a grade crossing between a pedestrian or cyclist and an oncoming train can be obstructed by stationary objects like traffic light poles, motor vehicles, or, where there is more than one track, another train.

1.11.3.2 Attention

Human attention and the capacity to process information are limited. These limitations can create difficulties because many activities require the division of attention among several tasks at the same time. Attentional resources are required to detect a hazard effectively[33] and to maintain situational awareness.[34]

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30 J. Osaka, "Speed Estimation Through Restricted Visual Field During Driving in Day and Night: Naso-temporal Hemifield Differences," *Vision in Vehicles II: Proceedings of the Second International Conference on Vision in Vehicles,* Nottingham, UK (14–17 September 1987), edited by A. G. Gale, M. H. Freeman, C. M. Haslegrave, et al. (Elsevier, 1988), pp. 45–55.

31 M. Green, "Visibility Analysis 2," *Forensic Vision With Application to Highway Safety,* 3rd Edition, edited by M. Green, M. J. Allen, B. S. Abrams, et al. (Lawyers & Judges Publishing, 2008), pp. 311–312.

32 D. Krauss and R. Dewar, "Railroad Grade Crossings," *Forensic Aspects of Drivers Perception and Response,* 4th Edition (Lawyers & Judges Publishing, 2015), pp. 203–212.

33 P. N. J. Lee and T. J. Triggs, "The effects of driving demand and roadway environment on peripheral visual detections," Proceedings of the 8th Conference of the Australian Road Research Board (ARRB) (23–27 August 1976), pp. 7–12.

34 Situational awareness is "the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future." Source: M. R. Endsley, "Toward a theory of situation awareness in dynamic systems," *Human Factors*, Vol. 37, No. 1 (1995), pp. 32–64.

The action of a pedestrian or cyclist passing through a crossing when the warnings are active involves a control task (e.g., walking or jogging), a guidance task (e.g., detecting an approaching train), and navigational tasks (e.g., avoiding trip hazards).

1.11.3.3 Expectations

Expectations about a situation can affect whether and how appropriately people respond to hazards in the environment. When people receive information that they expect to receive, their reaction tends to be quick and error-free. However, when they receive information that is contrary to their expectations, their performance tends to be slow or inappropriate.[35]

1.12 Responsibility for safety at the Lancaster Street West crossing

The operation of a crossing is a shared undertaking between a railway and a road authority, with oversight provided by a regulator. Once a crossing has been constructed, all parties are responsible for ensuring its maintenance and safe operation.

The GCR address the responsibilities of each party at the crossing. Both Metrolinx as the railway and the Region of Waterloo as the road authority followed federal regulations, standards, and rules.[36] According to the GCR, the road authority is responsible for the crossing design, the road approach (including the sidewalk, if any) on both sides of the crossing, the associated sightlines and roadway signage leading up to the crossing, and the roadway traffic control devices. The railway is responsible for the crossing surface, sightlines along the railway right-of-way, a warning system, the railway crossing signs, and the maintenance of a Stop sign if it is installed on the same post as a railway crossing sign.

As third-party railways operating on Metrolinx-owned track, CN and VIA Rail are responsible for the safe operation of their equipment by ensuring their crews follow the applicable rules and regulations.

Finally, the public has a responsibility to abide by the applicable rules governing vehicle drivers, pedestrians, and cyclists on the crossing.

1.13 Canadian National Railway Company

1.13.1 Operating crews' compliance with rules

To ensure its operating crews are respecting the rules governing train operations, including the CROR and CN's corresponding general operating instructions and special instructions, CN conducts safety engagements to evaluate crew compliance. In a safety engagement, a CN supervisor observes the actions of employees in the performance of various tasks. One safety engagement may result in observations of 1 or more employees to validate that the

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35 G. J. Alexander and H. Lunenfeld, FHWA-TO-86-1, *Driver Expectancy in Highway Design and Traffic Operations* (United States Department of Transportation, April 1986).

36 Although the crossing is a provincially regulated crossing, Metrolinx entered into an agreement with TC, through the Ontario Minister of Transportation, to be inspected to federal rules and regulations.

crew is complying with 1 or more rules or instructions. All supervisors have a minimum number of safety engagements they must complete each week; the 2 Kitchener Yard supervisors were required to complete 7 safety engagements each week.

During the normal conduct of operations, if an issue comes to light that brings compliance with a specific rule or instruction into question, then the safety engagements for the following few months are refocused to evaluate compliance with that rule or instruction.

From 16 November 2018, when CN reacquired control of Kitchener Yard, until 30 October 2019, the 2 yard supervisors made 1984 safety engagement observations and noted 20 instances of non-compliance. On average, 165 observations involving about 13 employees were made each month. Of the 1984 observations made, 8 evaluated compliance with CROR Rule 103: Public Crossings at Grade, and its corresponding CN special instruction. The CN special instruction for that rule focuses on minimizing the blocking of vehicular and pedestrian traffic and states:

> Unless otherwise indicated, a public crossing at grade must not be obstructed for more than five minutes when vehicular or pedestrian traffic is stopped waiting to cross. This instruction applies to:
>
> - a movement switching;
> - standing equipment; or
> - standing track unit(s).
>
> When emergency vehicles require passage, employees must cooperate to quickly clear the involved crossings.[37]

The 8 observations related to Rule 103 consisted of 1 observation of 2 crew members (2 observations in total) on 19 March 2019, 20 March 2019, 02 April 2019, and 28 August 2019. A total of 6 crew members were observed. All of the actions observed were compliant with Rule 103 and the corresponding special instruction.

In addition to the safety engagements, as soon as CN regained operational control of Kitchener Yard, the supervisors reminded the operating crews of the requirement to clear the crossings before pedestrians, cyclists, and motorists were delayed for more than 5 minutes. This reminder was followed by ad hoc crossing audits where supervisors attended the crossings while switching activities were being carried out. None of these ad hoc audits were documented or recorded as a safety engagement.

1.13.2 Train crew reports of crossing violations to Metrolinx

CN is a frequent user of the crossing, and operating crews were aware of the habits of pedestrians, cyclists, and motorists at the crossing. Pedestrian and cyclist incursions into a crossing with an active warning system were perceived by train crews as a common event. CN reported to Metrolinx instances of malfunctioning gates and trespassing in the vicinity of the crossing between January 2017 and November 2019. However, it did not report any

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[37] Canadian National Railway Company, Eastern Canada Region Great Lakes Division: Rule 83(c) Summary Bulletin (01 November 2020 – 30 April 2021).

instances of vehicle, pedestrian, or cyclist incursions entering the crossing while its warning system was active, nor was it a requirement to do so.

1.13.3 Canadian National Railway Company risk assessment involving the Lancaster Street West crossing

In July 2018, CN conducted a risk assessment in preparation for the resumption of operations on 3 segments of leased track in Southern Ontario; 1 of those segments was the Guelph Subdivision. The risk assessment identified 19 hazards, 1 of them being blocked crossings. It indicated that blocked crossings represented a danger to the public and risked non-compliance with the regulations. The frequency of occurrence was rated as unlikely, the severity as negligible, and the overall risk level as low. No inherent issues were identified. For a risk-level rating of "low," the risk assessment indicates that, "Although changes are not required at this level to reduce risk, changes may still be recommended to improve functionality."[38]

The risk assessment did not address the start of operations at Kitchener Yard and the potential for hazards created by moving train assignments from Stratford Yard to Kitchener Yard.

1.14 Metrolinx

1.14.1 Transit operations

Metrolinx is an agency of the Government of Ontario under the *Metrolinx Act, 2006* and was created to improve the coordination and integration of all modes of transportation in the Greater Toronto and Hamilton Area.[39]

Metrolinx oversees the operations of UP Express (a dedicated air–rail link between Union Station in downtown Toronto and Lester B. Pearson International Airport) and the GO Transit regional public transit train and bus service.

The GO Transit rail service and UP Express operate over about 420 km of rail lines, 337 km of which are owned by Metrolinx.[40] In 2019, GO Transit and UP Express carried an average of about 229 000 riders each weekday.[41]

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38 Canadian National Railway Company, *Risk Assessment on the Resumption of Service on SOR and GEXR Railway Lines* (12 July 2018).

39 Metrolinx, "About Us," at metrolinx.com/en/about-us (last accessed 17 January 2023).

40 GO Transit, "What is GO?" at gotransit.com/en/about-us/what-is-go (last accessed 09 January 2023).

41 GO Transit, "GO Transit: Fact Sheet" (April 2019), at gotransit.com/static_files/gotransit/assets/pdf/AboutUs/WhatIsGO/GO_InfoToGo_April%202019_EN.pdf (last accessed 09 January 2023).

1.14.2 Metrolinx risk assessments

1.14.2.1 Periodic corridor-wide crossing-assessment program (2015)

In November 2015, as part of a periodic corridor-wide crossing-assessment program, Metrolinx conducted a safety assessment of the crossing. The assessment involved a site visit where measurements were taken and observations made. The assessment reviewed vehicle and rail traffic volumes as well as the crossing design and warning systems. A list of recommendations was made to improve safety at the crossing location: these recommendations were aimed at the crossing surface, geometry, sightlines, signs and pavement markings, and warning system.

The report also indicated that queuing of vehicles from the Lancaster Street West–Victoria Street North intersection onto the crossing was observed. No recommendations were made targeted at eliminating the queuing of vehicles onto the crossing.

In May 2016, the recommendations were shared with the Region of Waterloo. The rest of the report, including the issue surrounding queuing of vehicles at the crossing, was not shared with the Region of Waterloo.

1.14.2.2 Acquisition of operational control of the Guelph Subdivision (2018)

In September 2018, Metrolinx conducted a risk assessment of the Guelph Subdivision in preparation for acquiring operational control in November 2018. The assessment identified 7 hazards relating to operating and track maintenance practices; radio communication capabilities; maintenance-of-way worker training; and the introduction of a new centralized traffic control location. Risk-mitigation measures were identified and the residual risks were evaluated as being low.

1.14.2.3 Network-wide change in service (2019)

In August 2019, Metrolinx conducted a risk assessment in preparation for its September 2019 service change, which included an increased frequency of trains on the Guelph Subdivision. The risk assessment considered the impact of this service change on train stations, capital projects, community relations, the network operations centre, rail fleet maintenance, rail corridor access, and corridor maintenance. Of the hazards identified in the risk assessment, 1 pertained to known safety concerns that would be exacerbated by the service change: the absence of pedestrian sidewalk barriers at 7 grade crossings where rail traffic would increase. The absence of barriers raised a concern that pedestrians and cyclists might not stop at crossings during train movements. Proposed mitigation measures included reaching out to community members to inform them of the service change, and installing pedestrian crossing gates and signals. The Lancaster Street West crossing was not part of the 7 crossings identified.

1.14.3 Metrolinx *Enterprise Safety Report*

To improve safety and foster the development of a safety culture, Metrolinx produces a comprehensive safety report each month entitled *Enterprise Safety Report*. This report

documents safety data from all aspects of its organization, encompassing the activities of Metrolinx employees, its passengers, its contractors, and the public. In addition to the safety data, it also reports on environmental hazards and the progress of all risk assessments initiated by any of its business units.

The activities of the rail business unit were addressed in the Engineering section of the report. Along with other data points, this section listed the number of incidents at public crossings, near-miss incidents, and trespassing incidents per month for each of the previous 12 months.

Data on near-miss incidents were generated from the activities of train crews and duty managers, and from reports made to transit safety officers (TSOs) from a variety of sources. They comprised incidents at or near crossings and train stations, locations where crossing arms were damaged or were malfunctioning, or where vehicles, pedestrians, or cyclists were involved in a near-miss incident with a train. During the first 10 months of 2019, 12 near-miss incidents occurred on the Guelph Subdivision, 1 of which occurred at the occurrence crossing where a transport truck damaged a crossing gate arm.

Trespassing incidents were tallied by corridor. The Kitchener corridor encompassed the Guelph, Halton, Pearson, and Weston subdivisions. For the first 10 months of 2019, Metrolinx recorded 111 people trespassing in the Kitchener corridor. A review of the underlying data, which were not displayed in the monthly safety report, showed that 58 trespassing incidents were recorded on the Guelph Subdivision, 1 of which occurred at the occurrence crossing.

The *Enterprise Safety Report* also listed action plans currently underway to reduce incidents at crossings with active warning systems. Trends or issues were identified and action plans for each were listed. Also, some individual crossings were identified as needing improved crossing warning systems. However, the Lancaster Street West crossing was not one of the crossings identified.

1.14.4 Metrolinx transit safety officers

Metrolinx employs about 105 TSOs to patrol all of, or portions of, 10 subdivisions. These subdivisions include 136 public crossings and 31 private crossings.

TSOs are special constables mandated to enforce the bylaws cited in the *Metrolinx Act, 2006,* as well as enforce the *Criminal Code of Canada*, the *Trespass to Property Act*, the Ontario *Highway Traffic Act*, and other related federal and provincial statutes, and arrest persons in contravention of these laws. Their position requires them to conduct patrols of GO Transit properties, facilities, and storage sites as well as the Metrolinx right-of-way and its equipment and passenger vehicles.

Regarding jurisdiction over crossings, TSOs work cooperatively with the local police force. There is an informal arrangement whereby TSOs respond to right-of-way issues while the local police force responds to road approach issues. Thus, trespassing issues and issues

where vehicles, pedestrians, or cyclists enter into an active crossing are the purview of the TSOs.

To oversee crossing safety, TSOs are alerted to crossing safety issues by operating crews, signal and maintenance personnel, local police, citizens, etc. If evidence is available, charges can be laid and fines issued.

The Ontario *Highway Traffic Act* states, in part:

> 143 No driver or operator of a vehicle upon a highway shall turn the vehicle so as to proceed in the opposite direction when,
>
> […]
>
> (b) on a railway crossing or within 30 metres of a railway crossing;[42]
>
> […]
>
> 164 No person shall drive a vehicle through, around or under a crossing gate or barrier at a railway crossing while the gate or barrier is closed or is being opened or closed.[43]
>
> […]

Section 3.6 of the *Metrolinx By-law No. 2* states:

> 3.6 No person, whether a pedestrian or the driver of a vehicle as defined in the *Highway Traffic Act* or the operator of a motorized snow vehicle, shall:
>
> (a) attempt to enter a railway crossing while the electrical or mechanical crossing warning devices are activated; or
>
> (b) go through, around or under a railway crossing gate or barrier while the gate or barrier is closed or is being opened or closed; or
>
> (c) cross a railway crossing while the electrical or mechanical crossing warning devices are activated; or
>
> […]
>
> until such time as the warning devices have ceased to operate and it is safe to proceed, or when permission to proceed is given by a flagperson or proper authority in control of the railway crossing.[44]

To identify problem crossings, Metrolinx monitors crossing incidents where crossing arms are damaged or are malfunctioning, or where a vehicle, pedestrian, or cyclist is involved in a near-miss incident. Once a problem crossing is identified, TSOs may attend the crossing to enforce the bylaws, to educate crossing users, and for visible deterrence reasons.

In 2018, TSOs issued 8 charges to individuals for crossing-related incidents system-wide. In 2019, they issued 18.

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42 Government of Ontario, *Highway Traffic Act* (R.S.O. 1990, c. H.8), section 143: U-turns prohibited.

43 Ibid., section 164: Driving of vehicles under crossing gates prohibited.

44 Metrolinx, *By-Law No. 2: A by-law regulating the use of the regional transit system*, at gotransit.com/static_files/gotransit/assets/pdf/Policies/By-Law_No2.pdf (last accessed 17 January 2023).

Metrolinx TSOs also hold public information sessions where they distribute rail-safety literature, work closely with Operation Lifesaver Canada during Rail Safety Week to promote crossing safety, and work with trucking associations to promote awareness to association members.

1.15 Region of Waterloo

1.15.1.1 Region of Waterloo crossing assessment

In May 2018, the Region of Waterloo began a program aimed at reviewing all grade crossings on regional roads under its jurisdiction to determine their compliance with the GCR and applicable standards. The program was also to identify engineering measures necessary to mitigate the identified non-conformities and deficiencies. The review was conducted in preparation for the Existing Grade Crossing section of the GCR coming fully into force in November 2021.[45]

In December 2018, the Region of Waterloo concluded a review of the occurrence crossing. It noted that the average annual daily vehicular traffic over the crossing was 16 834 and the average annual daily railway traffic was 44, resulting in a cross-product[46] of 740 696.[47] The review erroneously noted that whistling was required as trains approached the crossing. Remedial measures recommended by the review included installing "BUMP AHEAD" signs, relocating the "Railway Crossing Ahead" sign, installing an "Emergency Notification" sign, and improving the roadway and pedestrian crossing surfaces.

1.15.2 Metrolinx meeting with the Region of Waterloo

In September 2019, Metrolinx met with the Region of Waterloo to review grade crossings and discuss future plans. The Lancaster Street West crossing was one of the crossings discussed. Metrolinx advised that a grade separation was not warranted at that time based on the vehicle traffic–railway traffic cross-product.

1.15.3 Public reports of crossing violations via the emergency telephone number

The emergency telephone number posted at the crossing provides access to the railways, should the public want to contact them regarding unsafe conditions or operations at the

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45 In November 2021, TC amended the *Grade Crossings Regulations* to establish new compliance deadlines to meet the requirements of the regulation. Higher-risk public crossings received a 1-year extension; all remaining public and private crossings received a 3-year extension; very low-risk crossings were excluded from the construction and maintenance requirements.

46 Cross-product means the product of the average annual daily railway movements and the average annual daily traffic. It is used as a measure of the risk that vehicular and railway traffic poses at a highway–railway crossing. It is referenced in the TC *Grade Crossings Standards* when determining the appropriate warning system specification.

47 TC's *Grade Separation Assessment Guidelines* list 18 criteria to assess when considering installing grade separation. The guide provides thresholds for some of the criteria that, when exceeded, identifies grade separation candidates. The threshold for the average annual daily vehicular traffic is 100 000. The threshold for the average daily railway traffic is 150. The threshold for the cross-product is 1 million.

crossing. In the 12 months preceding the accident, Metrolinx received 2 calls from the public about the Lancaster Street West crossing. Both calls concerned the condition of the crossing and did not mention the operation of trains over the crossing.

There were no complaints from the public lodged with the Region of Waterloo regarding train-related delays to crossing users between January 2017 and November 2019. CN also did not receive any public complaints regarding train-related delays.

TC received 1 report from the public. On 12 April 2019, TC was informed that a CN train had been blocking the crossing from 0846 until 0858. TC sent an inspector to investigate the complaint.

1.16 Regulatory oversight

In April 2020, there were 12 railways that fell under Ontario provincial authority, including Metrolinx.

In Ontario, there are 3 provincial acts related to railways:

- the *Shortline Railways Act, 1995* (SRA), which outlines safety requirements for railway operation for shortline railways that are under provincial jurisdiction and which references the federal *Railway Safety Act* (RSA);
- the *Ontario Northland Transportation Commission Act*; and
- the *Metrolinx Act, 2006*, which is economic in nature, prescribing corporate structure but has no safety requirements.

1.16.1 Ministry of Transportation of Ontario

The operation and maintenance of a railway line to the highest level of safety is a complex task requiring highly skilled and trained employees. To oversee such railways and ensure they are being safely governed also requires highly skilled and trained employees with many years of experience.

Although the Ministry of Transportation of Ontario (MTO) is responsible for the oversight of provincially regulated railways, it has no overall provincial regulatory framework and has not issued any regulations pursuant to the SRA. The MTO does not have employees with the expertise to provide the requisite oversight but rather relies on the following for regulatory oversight:

- For Metrolinx, the Province has arranged for TC to conduct inspections in accordance with an inspection-services agreement between the MTO and TC.
- The Ontario Northland Transportation Commission conducts its own internal track inspections and hires third-party inspectors for some other inspections.
- For provincial shortline railways, TC conducts inspections in accordance with an inspection-services agreement between the MTO and TC, separate from the inspection-services agreement for Metrolinx.

With regard to enforcement, it is within the authority of the Ontario Minister of Transportation to require Metrolinx or the Ontario Northland Transportation Commission to implement any directives issued to either agency with respect to any matter arising under their respective legislation, including implementation of corrective action. For the provincial shortline railways that fall under the authority of the SRA, the Registrar of Shortline Railways can suspend or revoke a railway licence.

Although the MTO has arranged to receive the Metrolinx-related TC inspection reports, it has not yet identified a group or individuals within its organization who have the experience in railway operations and maintenance practices needed to review these reports and determine whether the safety action is adequate or whether additional safety action is required.

1.16.2 Oversight and inspection agreements for Metrolinx

Metrolinx falls under the *Metrolinx Act, 2006* when operating on its own provincially regulated track. Because this Act does not include safety-related provisions or subsequent offence provisions for violating them, it does not provide the Province of Ontario with a framework for taking enforcement action for safety-related deficiencies, when appropriate, against Metrolinx or other provincial railways operating on Metrolinx-owned property. However, if a systemic safety issue were identified, subsections 31(1) and 31(2) of the Act[48] provide the authority for the Ontario Minister of Transportation to direct Metrolinx to take corrective action until the Minister is satisfied the issue has been addressed. The Metrolinx Board of Directors is required to ensure that the Minister's directives are implemented promptly and efficiently. The *Metrolinx Act, 2006* only applies to Metrolinx, not to other railways that may operate on Metrolinx owned property or track.

While operating on federally regulated track, which comprises approximately 10% of Metrolinx's operation, Metrolinx is considered a local railway company[49] and thus subject to the federal regulatory rail safety oversight provided by TC, including all of the related regulations, standards, rules, policies, guidelines, and procedures.

In January 2013, the MTO entered into 2 companion agreements for the provision of inspection services for Metrolinx's rail operations: an agreement with TC and an agreement with Metrolinx. The agreement with TC was made under section 157.1 of the *Canada Transportation Act*.

The Metrolinx–MTO agreement was for the provision of safety oversight and inspection services, consistent with federal regulations, to ensure the safe operation of Metrolinx's GO Transit commuter rail system and the UP Express air–rail link system while operating on Metrolinx infrastructure.

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48 Subsections 31(1) and 31(2) of the *Metrolinx Act, 2006* provides the authority for the Minister to issue a directive on any matter under the Act, including safety.

49 A local railway company is defined in the federal *Railway Safety Act* and means a person, other than a railway company or an agent or mandatary of a railway company, that operates railway equipment on a railway.

The inspection services were to include engineering, operational, and equipment inspections, and safety management system (SMS) audits to determine compliance with an agreed-to list of railway rules, standards, and regulations. The agreement also required Metrolinx to implement appropriate corrective action to bring GO Transit's operation into compliance with the agreed-to list of rules, standards, and regulations, or to correct any identified deficiencies. If Metrolinx becomes aware of an immediate threat to the safe railway operations of GO Transit, it is to immediately take corrective action. Any disputes arising from this agreement are to be referred to the Deputy Minister of Transportation for Ontario and the Chief Executive Officer of Metrolinx.

The TC–MTO agreement was for the provision of TC railway safety inspectors to perform the safety oversight function on Metrolinx's GO Transit commuter rail system and the UP Express air–rail link system by providing inspection services for all associated rolling stock, railway lines, and railway operations. These inspection services were to determine whether Metrolinx was in compliance with the agreed-to list of rules, standards, and regulations. If during the course of providing these services a TC inspector became aware of an immediate threat to the safe railway operations of GO Transit, the inspector was required to immediately notify Metrolinx and the MTO. Reports on these inspections detailing the non-compliances were to be submitted to both the MTO and Metrolinx. TC inspectors were to also assist Metrolinx in evaluating any corrective action taken.

When performing inspection programs on Metrolinx property that is provincially regulated, federal acts and regulations do not provide TC inspectors with the authority to compel Metrolinx, or any other provincial railway operating on Metrolinx-owned property, to take action to address identified safety hazards. The TC agreement with the MTO for inspection services also does not provide such authority. However, TC does have regulatory authority over any federally regulated railway that operates on track that falls under either provincial or federal jurisdiction. The federal acts and regulations enabled TC inspectors to issue letters of non-compliance to CN while it was operating on Metrolinx track even though the track fell under provincial jurisdiction.

At the time of the occurrence, the Metrolinx agreement with the MTO had been last renewed in January 2018.[50] The revised agreement contained amendments to the original agreement, among which was an updated list of rules, standards, and regulations (Appendix A), notably:

- *Transportation Information Regulations* (SOR/96-334)
- *Railway Safety Management System Regulations, 2015* (SOR/2015-26)
- *Grade Crossings Regulations* (SOR/2014-275)
- *Canadian Rail Operating Rules*
- *Grade Crossings Standards*
- Procedure for Train Whistling at Public Grade Crossings

[50] The Metrolinx–MTO agreement was subsequently renewed in 2021 and 2022.

1.16.3 Transport Canada

1.16.3.1 *Railway Safety Act*

The *Railway Safety Act* (RSA) was introduced in 1985 and amended on 28 August 2019.[51] The Act applies to federally regulated railways. The objectives of the Act are to:

> (a) promote and provide for the safety and security of the public and personnel, and the protection of property and the environment, in railway operations;
>
> (b) encourage the collaboration and participation of interested parties in improving railway safety and security;
>
> (c) recognize the responsibility of companies to demonstrate, by using safety management systems and other means at their disposal, that they continuously manage risks related to safety matters; and
>
> (d) facilitate a modern, flexible and efficient regulatory scheme that will ensure the continuing enhancement of railway safety and security.[52]

To promote safe and secure railway transportation systems, TC has developed safety regulations and standards, and facilitates the development of rules by the rail industry. TC is then responsible for enforcing these regulations, standards, and rules.

1.16.3.1.1 *Railway Safety Act* enforcement tools

When overseeing railways on federally regulated property, TC uses a graduated enforcement approach to address issues of non-compliance under the RSA and its regulations, standards, and rules. This approach ties into the RSA's emphasis on all parties working to improve railway safety. When considering an enforcement action, rail safety inspectors start with the most appropriate tool and escalate an action based on necessity or risk.

TC uses several tools to implement its graduated approach:

- A **letter of non-compliance** is issued by a rail safety inspector. It identifies a non-compliance with the RSA or its associated regulations and rules, orders issued by the Minister or by a railway safety inspector, and emergency directives that apply to the company.
- A **notice of violation** is a formal notification to a company that it will be required to pay an administrative monetary penalty pursuant to the *Railway Safety Administrative Monetary Penalties Regulations.*
- **Prosecution** is pursued at the discretion of the Attorney General of Canada under section 41 of the RSA. This enforcement tool may be considered when a person or company contravenes a provision of the RSA, a regulation, an order from the Minister of Transport, an order from a railway safety inspector, a rule, or an

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51 This was the version in effect at the time of the occurrence.

52 Government of Canada, *Railway Safety Act* (R.S.C., 1985, c. 32 [4th Supp.], as amended 28 August 2019), section 3.

emergency directive made under the RSA. Other responses may be more appropriate and must be considered first.

TC also has the following enforcement tools:

- A **notice**, or a **notice and order**, is issued by a rail safety inspector under section 31 of the RSA to address a threat (notice) or an immediate threat (notice and order) to safety.
- An **emergency directive** is issued under section 33 of the RSA when the Minister of Transport believes there is an immediate threat to safe railway operations.

Suspension or cancellation of a Railway Operating Certificate is pursued at the discretion of the Minister of Transport if a company contravenes any provision of the RSA or its related instruments, or ceases to meet any of the prescribed conditions for obtaining the certificate, or if a company requests that its Railway Operating Certificate be suspended or cancelled.

The *Railway Safety Administrative Monetary Penalties Regulations* set out a list of sections and subsections of the RSA and of several regulations, including the GCR, the contravention of which can be subject to an administrative monetary penalty. Non-compliance with section 31 of the RSA is subject to an administrative monetary penalty, as is any non-compliance with subsections 97(1), 97(2), 98(1), and 100(1) of the GCR.

1.16.3.1.2 *Railway Safety Act* restrictions on road users

The RSA also governs the manner in which pedestrians, cyclists, and motorists conduct themselves at a railway crossing. Section 26.2 of the TC *Railway Safety Act* states that

> The users of a road shall give way to railway equipment at a road crossing if adequate warning of its approach is given.[53]

1.16.3.2 Transport Canada grade crossing inspections

Between 01 January 2018 and 13 November 2019, TC performed inspections of the Guelph Subdivision and crews that operated there. The inspections are summarized in Table 6, with additional details provided in Appendix B.

[53] Government of Canada, *Railway Safety Act* (R.S.C., 1985, c. 32 [4th Supp.], as amended 28 August 2019), section 26.2.

Table 6. Transport Canada inspections of the Guelph Subdivision

Date	Inspection type	Object of inspection	Results
2018-02-07	Operations inspection	GO trains	No exceptions were noted.
2018-02-12	Crossing inspection	Mile 57.0, Guelph Subdivision	TC issued a letter of non-compliance and concern. Issues noted with surface and signage.
2018-09-19	Operations inspection	GO train	No exceptions were noted.
2018-09-20	Operations inspection	Goderich-Exeter Railway Company (GEXR) train	No exceptions were noted.
2018-11-29	Operations inspection	CN train at Kitchener	No exceptions were noted.
2018-12-18	Operations inspection	CN train at Kitchener	No exceptions were noted.
2019-01-31	Operations inspection	GO train	No exceptions were noted.
2019-04-10	Operations inspection	CN train: Monitored performance at crossing, Mile 48.80, Guelph Subdivision	No exceptions were noted.
2019-04-23	Operations inspection	CN train: Monitored performance at crossing, Mile 62.08, Guelph Subdivision	TC issued a letter of non-compliance. Movement did not clear crossing as prescribed by subsection 97(2) of the GCR.
2019-05-01	Track inspection	Miles 30.10 to 63.40, Guelph Subdivision	TC issued a letter of non-compliance and concern. 37 non-compliances and concerns were identified.
2019-07-12	Operations inspection	CN train: Monitored performance at crossing, Mile 62.08, Guelph Subdivision	TC counselled the local CN management personnel. Movement did not clear crossing as prescribed by subsections 97(1) and 97(2) of the GCR.
2019-10-02	Operations inspection	CN train: Monitored performance at crossing, Mile 62.08, Guelph Subdivision	No exceptions were noted.
2019-10-17	Operations inspection	GO train	No exceptions were noted.

The inspection on 23 April 2019 (a Tuesday) was initiated by a complaint from a member of the public who reported having been delayed at the crossing for 12 minutes at 0846 by a train performing switching movements. TC sent an inspector to observe the yard activities unannounced and noted that, between 0830 and 1030, switching movements did not clear the crossing, as prescribed by subsection 97(2) of the GCR. TC issued a letter of non-compliance. In its response, CN indicated it had reviewed the requirements of the GCR with all Kitchener Yard operating crews and had issued a local notice containing the requirements of the special instruction for CROR Rule 103. Also, CN monitored switching activities at the crossing.

On 12 July 2019 (a Friday), TC inspected the crossing again to ensure the action taken by CN resolved the instance of non-compliance. The inspector, unannounced, observed from 0700 until about 1000 and noted that the crossing was not cleared as prescribed by

subsections 97(1) and 97(2) of the GCR. Instead of issuing a letter of non-compliance, as it did after the 23 April 2019 inspection, TC counselled the local CN management personnel, as provided for in TC's graduated approach to instances of non-compliance.

On 02 October 2019 (a Wednesday), TC inspected the crossing a 3rd time to ensure that CN was complying with the GCR. Again, the crossing was observed unannounced, from approximately 0730 until 1000. The inspector observed the switching of cars at the east end of the yard, away from the crossing. The switching continued until 0830, at which time the train departed the yard westbound over the crossing in one move. This last move to depart the yard was the only time the train occupied the crossing. After the train departed, no other switching movements were observed in the yard. As no non-compliances with subsections 97(1) and 97(2) were noted during this inspection, and as no additional public complaints had been received in the months following the April inspection, the issue was deemed to be resolved.

Copies of all inspection reports were filed with TC. Metrolinx also received copies of the inspection reports with the exception of the 23 April 2019, 12 July 2019, and 02 October 2019 inspection reports as they were not conducted under the TC–MTO inspection agreement, but rather as an inspection of CN operations. No copies of any inspection reports were sent to the MTO.

When deciding on the inspection methodology, timing, and frequency of inspections used to validate the existence of a regulatory infraction, TC takes into consideration issues such as resource management, program delivery, other emerging issues, frequency of recurrent complaints, level of risk as determined by data available, previous inspection findings, and an understanding of the stakeholder's operations. Based on the activity at the CN Kitchener Yard, TC decided that inspections would consist of unannounced inspections of the crossing for a duration of 2.5 to 3 hours beginning at 0700 or 0730.

1.16.3.3 *Railway Safety Management System Regulations, 2015*

The TC *Railway Safety Management System Regulations, 2015* (the SMS Regulations) came into force in April 2015, and established the minimum requirements with respect to the SMS that a company must develop and implement for the purpose of achieving the highest level of safety in its railway operations.

Section 13 of the SMS Regulations states, in part:

> A railway company must, on a continual basis, conduct analyses of its railway operations to identify safety concerns, including any trends, any emerging trends or any repetitive situations.[54]

Section 15 states, in part:

> A railway company must conduct a risk assessment in the following circumstances:

[54] Transport Canada, SOR/2015-26, *Railway Safety Management System Regulations, 2015* (as amended 01 April 2015), section 13: Process for Identifying Safety Concerns.

> (a) when it identifies a safety concern in its railway operations as a result of the analyses conducted under section 13;
>
> […]
>
> (c) when a proposed change to its railway operations, including a change set out below, may affect the safety of the public or personnel or the protection of property or the environment:
>
> […]
>
> (ii) the addition or elimination of a railway work, or a change to a railway work, […][55]

1.16.3.4 Transport Canada audit of Metrolinx's safety management system

TC took a phased-in approach to bring companies into compliance with the SMS Regulations, which included education and awareness, an initial inspection, targeted inspection, and a comprehensive audit.

On 15 June 2015, TC conducted an initial inspection of the Metrolinx SMS verifying that Metrolinx met the following mandatory provisions of the SMS Regulations:

- subsections 8(1), 8(2), and 8(3) referring to the appointment of an accountable executive;
- section 38 paragraphs 15(1)(b) and 15(1)(c) referring to the filing with TC of risk assessment documentation; and
- the requirement to conduct risk assessments.

On 10 February 2016, TC conducted a targeted audit of the Metrolinx SMS. The audit revealed 21 instances of non-compliance, including several revolving around the identification of risks and the implementation of the corresponding remedial action. TC issued a letter of non-compliance requiring corrective action from Metrolinx.

In February 2017, TC conducted a comprehensive audit of the Metrolinx SMS against the requirements of Part 1 of the SMS Regulations. The audit resulted in 16 findings of non-compliance and 10 observations. Several of the instances of non-compliance that were noted and the observations made related to the risk assessment process and the process for implementing and evaluating remedial action. The audit identified that these processes were spread across multiple sections and documents, which created situations where the processes overlapped and were contradictory. While risk assessments were happening in most areas, some were not being documented and a number did not follow the documented process. Metrolinx identified and implemented corrective action plans to address the findings of non-compliance. TC followed up on the action taken by Metrolinx and closed the audit in June 2018.

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[55] Ibid., section 15: Risk Assessment Process.

1.16.3.5 Transport Canada *Grade Crossings Regulations*

1.16.3.5.1 Requirements for railways and road authorities

The GCR were created pursuant to the RSA. Section 3 addresses compliance requirements for public grade crossings and lists those aspects of the crossing that railway companies and road authorities are responsible for so as to ensure compliance with the GCR.

Subsection 3(1) of the GCR states:

> **Public grade crossing**
>
> 3 (1) Unless otherwise specified in an order of the Agency [Canadian Transportation Agency] or in an agreement filed with the Agency under subsection 101(1) of the *Canada Transportation Act*, in the case of a public grade crossing,
>
> (a) a railway company must ensure compliance with the requirements of these Regulations respecting
>
> (i) a Railway Crossing sign, a Number of Tracks sign and an Emergency Notification sign,
>
> (ii) the maintenance of a Stop sign that is installed on the same post as a Railway Crossing sign,
>
> (iii) a warning system,
>
> (iv) a crossing surface, other than its design, and
>
> (v) sightlines within the railway right-of-way and over land adjoining the railway right-of-way, including the removal of trees and brush that obstruct the sightlines; and
>
> (b) a road authority must ensure compliance with the requirements of these Regulations respecting
>
> (i) the design, construction and maintenance of a road approach,
>
> (ii) traffic control devices, except for the maintenance of a Stop sign that is installed on the same post as a Railway Crossing sign,
>
> (iii) the design of a crossing surface, and
>
> (iv) sightlines within the land on which the road is situated and over land in the vicinity of the grade crossing, including the removal of trees and brush that obstruct the sightlines.[56]

1.16.3.5.2 Grade crossing sign requirements

The GCR go on to describe the requirements regarding new grade crossings and existing grade crossings. Each section addresses public and private crossings. Regarding existing public grade crossings, sections 62 to 67 detail the signage that must be placed along the road approaches and on the crossings.[57] These signs include the following:

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56 Transport Canada, SOR/2014-275, *Grade Crossings Regulations* (as amended on 01 March 2019), subsection 3(1).

57 These requirements were not in force at the time of the occurrence. They will come into force on either 28 November 2022 or 28 November 2024, depending on the crossing.

- Railway crossing sign
- Emergency notification sign
- Stop sign
- Stop ahead sign
- Railway crossing ahead sign and advisory speed tab sign
- Prepare to stop at railway crossing sign

1.16.3.5.3 Obstruction of grade crossings

The GCR address the obstruction of grade crossings. Subsection 97(1) states:

> It is prohibited for railway equipment to be left standing in a manner that causes the activation of the warning system at a public grade crossing other than for the purpose of crossing that grade crossing.[58]

Subsection 97(2) states:

> It is prohibited for railway equipment to be left standing on a crossing surface, or for switching operations to be conducted, in a manner that obstructs a public grade crossing — including by the activation of the gate of a warning system — for more than five minutes when vehicular or pedestrian traffic is waiting to cross it.[59]

The GCR also address safety concerns stemming from the obstruction of grade crossings. It provides for the municipality (or region) to initiate action to resolve the concern and states in subsection 98(1):

> If railway equipment is operated in a manner that regularly causes the obstruction of a public grade crossing, including by the activation of a warning system, and the municipality where the grade crossing is located declares in a resolution that obstruction of the grade crossing creates a safety concern, the railway company and the road authority must collaborate to resolve the safety concern.[60]

The GCR also address the potential for motor vehicles to stop on railway crossing surfaces and states:

> **100 (1)** A road authority must take measures to ensure that motor vehicles do not stop on the crossing surface of a public grade crossing, if there is evidence that queued traffic regularly stops on that crossing surface.[61]

1.16.3.6 Transport Canada *Grade Crossings Standards*

The TC *Grade Crossings Standards* (GCS) were made pursuant to the RSA. They are incorporated by reference in the GCR. Section 9 of these standards outlines the specifications for warning systems at new crossings and details the conditions where a

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58 Transport Canada, SOR/2014-275, *Grade Crossings Regulations* (as amended on 01 March 2019) subsection 97(1).

59 Ibid., subsection 97(2).

60 Ibid., subsection 98(1).

61 Ibid., subsection 100(1).

warning system with gates or without gates is required to warn pedestrians, cyclists, and motorists.

For sidewalks, paths, or trails, a warning system without gates is required for those sidewalks, paths, or trails that are outside an adjacent crossing warning system, and the railway design speed is more than 50 mph (81 km/h). If the crossing has 2 or more railway tracks and the design speed is more than 15 mph (25 km/h), gates are also required.

However, the GCR, and therefore the GCS, were not in force at the time the crossing was constructed.

1.16.3.7 Transport Canada *Grade Crossings – Handbook*

To aid in understanding the best practices and regulatory requirements for safety at or around grade crossings, TC has developed a guideline entitled *Grade Crossings – Handbook*.

Article 27 of the handbook addresses blocked crossings and indicates, in part, that:

> Blocking a public grade crossing should be always avoided. Not only is a blocked crossing a nuisance to road users; it can also create a safety concern […][62]

It goes on to state that:

> There is a safety concern if railway equipment blocks a public grade crossing on a regular basis and may consequently cause physical harm, property loss and/or an environmental impact, regardless of the length of time that it blocks the crossing.[63]

The handbook also addresses the risk of encountering a second train and suggests that the road authority install and maintain a second-train event warning sign on each road approach. It states:

> These signs should be used when two or more tracks allow for the movement of trains on both tracks at the same time and where the approach of a second train may immediately follow the departure of the first, such as near a train station or at a track junction and/or multiple track alignment (two tracks or more).[64]

1.16.3.8 Transport Canada *Grade Crossing Inventory*

TC's *Grade Crossing Inventory* is an inventory of the location and characteristics of the railway crossings in Canada, which includes grade crossings under provincial and federal jurisdiction. It provides a ranking of risk using a tool that compares crossings against each other, based on the following risk factors:

- TSB data on rail occurrences
- The volume of road and railway traffic
- The maximum train and vehicle speeds
- The number of tracks and lanes

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62 Transport Canada, *Grade Crossings – Handbook*, article 27: Blocked crossings.

63 Ibid., article 27.1: Blocked public grade crossing.

64 Ibid., article 8.7: Second train event warning sign.

- The urban or rural environment
- The warning systems in place at the crossing (i.e., gates, bells, lights)

Changes in the volume of road and railway traffic, and in the number of collisions, injuries, or fatalities, have the largest influence on the relative ranking.

The TC grade-crossing inventory of 22 819 public crossings that was current at the time of the occurrence, which was after Metrolinx assumed operational control of the Guelph Subdivision, ranked the crossing as 1565th of all crossings (93rd percentile)[65] or 540th of 3120 urban crossings (82nd percentile). Risk factors do not necessarily mean a crossing is unsafe; it means that when comparing 2 different crossings against these risk factors, 1 crossing may be deemed to be a higher risk than the other.

1.16.3.9 Whistle cessation

Currently, train whistling requirements are set out in section 14 of the CROR, which states that trains must whistle as they pass through public crossings at grade. Section 23.1 of the RSA provides for the restriction on the use of whistling on any railway equipment within a municipality, provided that the area meets prescribed requirements.

Section 104 of the GCR details the prescribed area and states, in part:

> (c) the area must not have repeated incidents of unauthorized access to the line of railway;[66]

The *Grade Crossings – Handbook* states that:

> Train whistling is essential in keeping drivers, cyclists, and pedestrians safe when using public grade crossings.[67]

It goes on to state that after a resolution for whistling cessation is passed:

> […] both the municipality and the railway company are responsible for maintaining and monitoring the conditions supporting the whistling cessation. […] In some instances, the railway company and municipality may decide to reinstate whistling.[68]

1.17 *Enhancing Rail Safety in Canada: Working Together for Safer Communities* — The 2018 *Railway Safety Act* Review

In 2018, the *Railway Safety Act* Review Panel released its report on Canada's rail safety regime entitled *Enhancing Rail Safety in Canada: Working Together for Safer Communities*.

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65 This ranking meant that the crossing was in the top 7% of the rated crossings, which indicated it was a higher-risk crossing.

66 Transport Canada, SOR/2014-275, *Grade Crossings Regulations* (as amended on 01 March 2019), subsection 91(1).

67 Transport Canada, *Grade Crossings – Handbook*, article 28: Whistling cessation.

68 Ibid., article 28.1.

The panel was struck to

> focus on the effectiveness of the federal rail safety legislative and regulatory framework, the operations of the Act itself, and the degree to which the Act meets its core objective of ensuring rail safety is in the best interest of Canadians.[69]

The panel conducted a series of consultations with stakeholders across the country, focusing on issues of proximity (crossings, trespassing, and land use around rail operations); fitness for duty (fatigue, training, distraction, and drug and alcohol use); infrastructure, technology, safety management systems, and safety culture; and the rule-making process.

Grade-crossing safety was a major issue raised throughout the consultations. In addressing transparency and technology, stakeholders indicated that a publicly accessible database listing the location and frequency of grade-crossing accidents would help identify high-risk areas for mitigation measures. The report indicates that:

> [v]ideo surveillance at grade crossings and in high-risk areas was another solution raised that could help identify problem areas, to inform the development of targeted intervention strategies.[70]

The report provided a recommendation that states, in part:

> Recommendation 6 – It is recommended that Transport Canada develop a comprehensive national initiative to improve grade crossing safety, in partnership with other levels of government, the railway industry and other key stakeholders. This initiative should aim to establish and prioritize crossing programming on a risk basis, taking into account safety, railway corridor efficiency and crossing use. It should build on existing efforts and include:
>
> […]
>
> D. pursuing technological solutions to reduce motor vehicle/pedestrian and train collisions; […][71]

1.18 Previous occurrence at Lancaster Street West crossing

TSB Rail Transportation Occurrence R13T0064: On 04 April 2013, VIA Rail passenger train 85, proceeding westward at 30 mph, struck and fatally injured a cyclist on the crossing, which was equipped with flashing lights, bells, and gates. The crossing warning system was active at the time. A slow-moving eastbound freight train had just cleared the crossing when a faster-moving westbound VIA Rail train entered the crossing, striking the cyclist.

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69 Transport Canada, TP 15145E, *Enhancing Rail Safety in Canada: Working Together for Safer Communities, The 2018 Railway Safety Act Review* (2018), p. 5.

70 Ibid., p. 62.

71 Ibid., p. 63.

1.19 Second-train events

1.19.1 TSB Railway Investigation Report R05T0030

On 17 February 2005, at approximately 1515, CN freight train 106, travelling eastward on the south main track of the Kingston Subdivision, approached the Bartholomew Street public crossing in Brockville at 60 mph. At the same time, westward CN freight train 532 was proceeding on the north main track at 40 mph and had nearly completed traversing the crossing. Two young pedestrians were standing on the sidewalk on the east side of the street, clear of the south main track.

The pedestrians stood directly east of the crossing-gate mechanism, facing north and looking east toward the approaching rear of CN freight train 532. As the rear car of train 532 cleared the crossing, the 2 pedestrians walked north onto the south track where they were struck by train 106. At the time of the accident, the roadway gates were down and the flashing lights and bell were operating. One pedestrian was fatally injured; the second received serious injuries. The investigation found that

> [t]he pedestrians, waiting on the sidewalk and preoccupied with their conversation, observed the passage of the westward train and walked into the path of the eastward train.

It also found that

> [t]he removal of the requirement to whistle at roadway crossings, without consideration of the danger to pedestrian traffic on adjacent sidewalks, may decrease the level of safety afforded to the pedestrians.

As a result of the investigation, the TSB issued 2 separate rail safety advisories. Rail Safety Advisory 04/05, dated 27 April 2005, addressed the identification of high-risk locations and the implementation of enhanced pedestrian crossing protection. Rail Safety Advisory 05/05, dated 05 May 2005, addressed the obstructed sightlines at the Bartholomew Street crossing due to a signal bungalow.

The City of Brockville installed a pedestrian gate at the crossing and CN reinstituted 24-hour-a-day whistling in Brockville. Subsequently, whistling was halted nightly, between 2000 and 0600, subject to a number of specific conditions.

In 2006, noting that pedestrian injuries or fatalities at grade crossings continued to exist, the Board recommended that

> the Department of Transport assess the risk to pedestrians at all multi-track main-line crossings, make its assessment public and implement a program, in conjunction with stakeholders, to mitigate the risk of second-train pedestrian accidents.
>
> **TSB Recommendation R06-02**

In 2011, the Board noted that TC had evaluated all of the multi-track main-line crossings identified in the TSB's report that had an elevated risk of second-train events. In addition,

TC had included projects in its Grade Crossing Improvement Program[72] targeted at pedestrian crossing safety and required that any pedestrian safety issues be resolved before approving anti-whistling at crossings. The Board reassessed TC's response to Recommendation R06-02 as **Fully Satisfactory** and closed the recommendation.[73]

1.19.2 Other second-train events

The dangers associated with second trains at crossings continue to exist. A review of the TSB database revealed that between 2005 and 2019, there were at least 12 occurrences[74] involving a second train on federally regulated public grade crossings that resulted in a total of 4 injuries (2 serious, 2 minor) and 6 fatalities. Crossing accidents, and in particular second-train events, are considered to be high-risk events because, although they are infrequent, when they do occur they can often have serious consequences.

1.19.3 Second-train event warning systems available in Canada

There are warning signs and systems currently in use that can inform pedestrian and cyclist crossing users of the possibility of a second-train event. These include static signs and dynamic second-train event warning systems, both with and without audible cues. Research into the effectiveness of second-train event warnings has been undertaken and the results, while not definitive, seem to suggest that dynamic systems may be effective in some instances in altering pedestrians' and cyclists' risky behaviour at railway crossings.[75,76,77] For example, although static signs are almost always more affordable, field testing research by the United Kingdom's Rail Research and Standards Board (RSSB)[78] showed that these signs yielded no safety benefits. In contrast, when volunteers watched a computer simulation and answered questions about what they would do next, the researchers found

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72 The Grade Crossing Improvement Program is a federal program available to federally regulated railways. Provincially regulated railways do not qualify for funding.

73 TSB Recommendation R06-02: Implementation of enhanced pedestrian protection, at tsb.gc.ca/eng/recommandations-recommendations/rail/2006/rec-r0602.html (last accessed 16 January 2023).

74 TSB rail transportation occurrences R18D0070, R16T0134, R15T0190. R13T0151, R13T0064, R11T0082, R08T0306, R08W0216, R08T0176, R07T0273, R06T0288, and R06D0041.

75 R. Stewart, R. Brownlee, and D. Stewart, TP 14228E, Second train warning at grade crossings (Transportation Development Centre, 2004), at publications.gc.ca/site/eng/273959/publication.html (last accessed 17 January 2023).

76 Transit Cooperative Research Program, "Second Train Coming Warning Sign Demonstration Projects," *Research Results Digest*, Number 51 (November 2002) at onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rrd_51.pdf (last accessed 17 January 2023).

77 S. H. Gabree and M. daSilva, DOT/FRA/ORD-14/21, *Effect of an Active Another Train Coming Warning System on Pedestrian Behavior at a Highway-Rail Grade Crossing* (U.S. Department of Transportation, July 2014) at railroads.dot.gov/elibrary/effect-active-another-train-coming-warning-system-pedestrian-behavior-highway-rail-grade (last accessed 17 January 2023).

78 Arthur D. Little Limited, report RSSB1259, Vol. 1, *Examining the benefits of 'another train coming' warnings at level crossings* (UK Rail Research and Standards Board, September 2008).

that combined (audible and visual) warnings were associated with the greatest reduction in crossing errors of 12 to 33%.

Similarly, an evaluation[79] of a pedestrian and cyclist second-train event warning system was carried out in Montréal, Quebec, where, in late 2002, a static second-train event warning system with active flashing beacons was installed at each quadrant of a public crossing equipped with flashing lights, gates and bells. The results of the before and after observational study demonstrated that the warning system, which was dynamic (train-activated), resulted in more than a 64% decrease in total crossing violations (a pedestrian or cyclist occupying the crossing surface before the completion of the warning system device activation). The dynamic warning signs remained in operation until 2021, when the tracks were removed.

1.19.3.1 Static second-train event warning sign

The second-train event warning sign (Figure 9) is promoted by TC as a way of warning or alerting pedestrians and cyclists of the potential presence of a second train at a crossing, especially in urban areas or near train stations where pedestrian and cyclist traffic is heavy.[80]

This sign was also included in the Transportation Association of Canada's *Manual of Uniform Traffic Control Devices for Canada* referenced by the provinces when they design and maintain crossings.

These signs are intended for vehicle drivers as well as pedestrians and cyclists. The installation and maintenance of the second-train event warning sign should be done by the road authority and coordinated with the railway company to ensure that the signs are placed and maintained in a consistent manner, and that they are highly visible to pedestrians and cyclists.

Figure 9. Static second-train event warning sign (Source: Transport Canada)

1.19.3.2 Dynamic second-train event warning system

In the early 2000s, TC installed and evaluated a dynamic second-train event warning system in Montréal, Quebec. It includes a static "ATTENTION 2 TRAINS" warning sign as well as alternately flashing beacons that are train-activated by a second train's proximity to the crossing (Figure 10).

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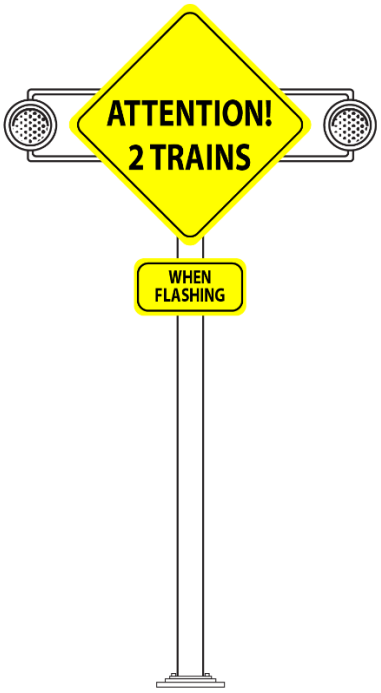
79 R. Stewart, R. Brownlee, and D. Stewart, TP 14228E, *Second train warning at grade crossings* (Transportation Development Centre, 2004), at publications.gc.ca/site/eng/273959/publication.html?wbdisable=true (last accessed 17 January 2023)..

80 Transport Canada, Rail Safety Bulletin 2012-001: Second Train Event Warning Sign, at tc.canada.ca/en/rail-transportation/rail-publications/rail-safety-bulletins-bulletin-2012-001#installation (last accessed 17 January 2023).

Figure 10. Static second-train event warning sign with flashing beacons sign (Source: TSB, based on Figure 17-2 of R. Stewart, R. Brownlee, and D. Stewart, TP 14228E, Second train warning at grade crossings (Transportation Development Centre, 2004)



1.19.4 Crossing warning design for vulnerable road users

Pedestrians and cyclists can be referred to as vulnerable road users because they lack the protection of an enclosed vehicle and do not benefit from vehicle safety features like seatbelts and airbags, and are therefore more likely to be injured or killed in a traffic collision.

The Safe System approach to road safety[81] integrates the needs of all users (including vulnerable road users) and seeks to improve safety through operational changes and an aggressive use of vehicle or roadway design rather than relying primarily on behavioural interventions like laws and regulations. The aim of the Safe System approach is to design and operate vehicles and road infrastructure in a manner that anticipates human error and accommodates human injury tolerances, with the goal of reducing fatal and serious injuries. This goal can be accomplished by separating road users in terms of time and space, increasing road user attentiveness and awareness, and by reducing vehicle speeds and impact forces.

Canada has adopted the Safe System approach in its Road Safety Strategy 2025.[82] The 2025 strategy is intended to encourage road safety stakeholders from all levels of government, as well as private-sector and non-governmental stakeholders, to collaborate in making Canada's roads the safest in the world and unite efforts to reach a long-term vision of zero fatalities and serious injuries on Canadian roads.

81 P. Larsson and C. Tingvall, "The Safe System approach: A road safety strategy based on human factors principles," *Engineering Psychology and Cognitive Ergonomics: Applications and Services,* pp. 19–28.

82 Canadian Council of Motor Transport Administrators (CCMTA), *Canada's Road Safety Strategy 2025: Towards Zero: The Safest Roads in the World* (January 2016), at roadsafetystrategy.ca/web/road-safety-strategy/files/public/docs/RSS-2025-Report-January-2016-with%20cover.pdf (last accessed 17 January 2023).

To date, the design of warning devices at grade crossings has not been considered within the context of a Safe System approach. There has been criticism internationally that traditional approaches to railway crossing equipment and warning devices and related safety efforts have not been designed in line with the Safe System approach or in such a way as to promote safety.[83]

There is a basic set of system-design strategies, known as the hierarchy of hazard control,[84] that can be used to prevent injuries from known hazards. The first strategy is to—whenever possible—"design a hazard out" by completely eliminating it, such as when a grade crossing is eliminated through grade separation. The second strategy, which is used in situations where designing a hazard out is not technically or economically feasible, is to guard against the hazard by implementing solutions that contain or control it, such as installing automatic pedestrian crossing gates to block pedestrians and cyclists from entering a crossing while the signals are active. The third strategy is to warn users of the hazard, such as by using signs, flashing lights, and bells to influence behaviour. Warnings are considered behavioural controls that can lessen the likelihood—but never completely eliminate the possibility—of human error.

Although it is most effective to use grade separation to design out the risk of pedestrians or cyclists interacting with rail equipment, it is also expensive and can take time. In those cases where the risk remains, guarding against the behaviour by, for example, installing dedicated pedestrian crossing barriers, can be an effective risk-mitigation strategy.[85] However, despite their proven effectiveness, pedestrian barriers such as gates and gate "skirts" (extensions) can be circumvented, which means that crossing users can illegally enter the crossing before the pedestrian gates deactivate.

1.19.4.1 Human-factor considerations for effective second-train event warnings

Though second-train events are rare, all in-use multi-track crossings are at risk of experiencing them. For crossings that are located near or next to a rail yard, or where delays to crossing users are common, pedestrians and cyclists may disregard automatic crossing warnings when stationary or slow-moving trains block their view of oncoming trains on adjacent tracks. In those situations, where a crossing user's sightline to potential oncoming trains is obstructed, a second-train event warning can be used to mitigate risk.

To be effective, second-train event warnings need to:

- attract attention (be conspicuous) to increase the likelihood the warning will be noticed by an observer who does not necessarily expect it to be present;

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83 M. G. Lenné, P. M. Salmon, N. A. Stanton, et al., "Actualising a safe transport system through a human factors systems approach," *Engineering Psychology and Cognitive Ergonomics: Applications and Services,* pp. 29–35.

84 M. R. Lehto and B. T. Cook, "Occupational Health and Safety Management," *Handbook of Human Factors and Ergonomics,* Fourth Edition, edited by G. Salvendy (John Wiley & Sons, 2012), pp. 709–710.

85 P. Metaxatos and P. S. Sriraj, Research Report FHWA-ICT-13-013, "Pedestrian/bicyclist warning devices and signs at highway-rail and pathway-rail grade crossings" (Illinois Center for Transportation, 2013).

- affect knowledge (be understandable); and
- influence behaviour (be credible) by motivating users to comply with the intended message.[86]

1.19.4.1.1 Conspicuity

The United Kingdom's RSSB[87] conducted research on "another train coming" warnings to identify and document human-factor issues that influence a crossing user's decision to potentially cross in front of another train. The research identified the following:

- Signs may be lost in visual clutter if surrounded by many pre-existing signs.
- The use of bright colours and/or flashing lights in sign design attracts attention but, once the novelty wears off, the warning may not have the same effect.
- Careful consideration needs to be given to sign placement, as users may be inclined to overlook a particular type of sign if they believe it is not relevant or if they do not detect its presence.
- The graphics and text size affect the likelihood of the sign being detected or viewed at distance.
- Audible tones and voice alarms need to be loud enough to be heard above ambient noise levels but not intrusive to local residents.

1.19.4.1.2 Understandability

Once a warning is detected or noticed, the information it provides must be understood. This information should be clear, explicit, and unambiguous, and provide users with accurate knowledge about the hazard(s) and potential consequences, so they can make informed decisions of whether—and how—to comply.[88]

The traditional grade crossing warning system is generic in that it "indicates the approach or presence of railway equipment at a grade crossing."[89] It does not warn of the specific risk of second-train events. Because generic warnings lack important details that can assist users to understand a situation, they can lead to confusion and slower reactions.[90]

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86 K. R. Laughery and M. S. Wogalter, "Designing effective warnings," *Reviews of Human Factors and Ergonomics*, Vol. 2, No. 1 (2006), pp. 241–271.

87 Arthur D. Little Limited, report RSSB1259, Vol. 1, *Examining the benefits of 'another train coming' warnings at level crossings* (UK Rail Research and Standards Board, September 2008).

88 K. R. Laughery and M. S. Wogalter, "Designing effective warnings," *Reviews of Human Factors and Ergonomics*, Vol. 2, No. 1 (2006), pp. 241–271.

89 Transport Canada, *Grade Crossings – Handbook*, Appendix L: Guideline for inspecting and testing pre-emption of interconnected traffic control signals and grade crossing warning systems.

90 S. Winkler, J. Kazazi, and M. Vollrath, "How to warn drivers in various safety-critical situations: Different strategies, different reactions," *Accident Analysis & Prevention*, Vol. 117 (2018), pp. 410–426.

The RSSB research (above) identified the following:

- Second-train warnings need to convey the message clearly that another train is coming, or that a dangerous situation for the crossing user still exists.
- Choice of wording and length of message (also applicable to audible warnings) need to be carefully designed so as to be concise but not ambiguous.

1.19.4.1.3 Credibility

Whether or not a user complies with a second-train event warning that they have detected and understood depends on still other factors related to both the design of the warning, as well as the characteristics of the people and situation involved. For example, warning credibility will be low in situations where users learn, through previous experience, that a warning does not accurately predict the timing or accuracy of a given hazard. In this way, a user's experience and familiarity with a product or situation, their competence or ability to carry out the action, and the perceived costs (effort, time, money) of complying all contribute to the compliance decision.[91]

The RSSB research (above) cited 2 critical decision points that need to be communicated by a second-train warning regarding the risk (that at least 2 trains will be occupying the tracks at the same time) and the required behaviour (to stop, then to wait):

- the decision to stop for the 1st train;
- the decision to wait until after the 1st train has passed.

1.20 Operation Lifesaver

Operation Lifesaver is a not-for-profit organization (funded by the Railway Association of Canada and TC) that works with the rail industry, governments, law enforcement, labour groups, the media, and many public organizations and community groups to raise awareness about rail safety. Its goal is to create safety-conscious attitudes toward railways, promote safe-driving skills, and encourage Canadians to adhere to railway signs and warnings. Operation Lifesaver delivers safety presentations to schools, youth clubs, drivers' associations, and other community groups to raise awareness about the hazards associated with railway tracks and trains.

To help promote safety, Operation Lifesaver has produced many presentations, blog articles, pamphlets, and videos, among other products, aimed at different demographic groups within the general population. The videos are available through its YouTube channel

[91] K. R. Laughery and M. S. Wogalter, "A three-stage model summarizes product warning and environmental sign research," *Safety Science,* Vol. 61 (2014), pp. 3–10.

and target many aspects of public-train interaction, including events involving double-track subdivisions.[92,93,94]

Two of the videos show an event where a member of the public crossed over the 1st track and encountered a train travelling from their right on the 2nd track. The caption in 1 of the 2 videos suggested that the pedestrian look to their left before crossing the 1st track and to the right before crossing the 2nd. The 3rd video showed 2 trains. The 1st train travelled from left to right on the near track and the 2nd travelled from right to left on the far track.

The Operation Lifesaver blog features an article from 16 November 2016 entitled "Today, #RememberRoadVictims, and drive rail safe with these tips." The article listed 5 lifesaving rail safety tips for drivers. One of the tips stated, in part:

> You know the saying, "look both ways before you cross the road"? The same goes for the tracks…[95]

92 Operation Lifesaver Canada, "I didn't hear a train (experience the VR)," YouTube (22 April 2017), at youtube.com/watch?v=s4I1IkdojUQ (last accessed 07 December 2022).

93 Operation Lifesaver Canada, "What train? (experience the VR)," YouTube (22 April 2017), at youtube.com/watch?v=dt91IhxYbR4 (last accessed 07 December 2022).

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2.0 ANALYSIS

Metrolinx is a provincially regulated company, and Canadian National Railway Company (CN) is federally regulated. Any railway company operating on track owned by a federally regulated company is subject to federal regulations while operating on that track. However, only provincially regulated railway companies are subject to provincial regulations while operating on track owned by a provincially regulated company; federally regulated companies are still subject to the federal regulatory regime even while operating on track owned by a provincially regulated company. Consequently, CN was required to abide by federal regulations, standards, and rules while operating on the Metrolinx-owned Guelph Subdivision, including over the Lancaster Street West crossing. Metrolinx was not subject to federal regulations when operating on Metrolinx-owned track; however, it had agreed to be subject to safety oversight performed by Transport Canada (TC) inspectors through the provision of inspection services using federal requirements for equipment, track, operations, etc.

The investigation determined that, at the time of the occurrence:

- The signal lights and gates at the crossing were functioning as designed and intended.
- GO Transit commuter train 3919 (GO 3919) was operated in accordance with company and federal regulatory requirements.
- CN freight train L56831-13 (CN 568) was performing switching activities and had occupied the crossing and delayed traffic for more than 5 minutes, which was contrary to federal regulatory requirements.
- Several pedestrians had entered the crossing while the grade crossing warning devices (GCWD) were activated, contrary to the *Railway Safety Act*. In particular, the pedestrians on the northwest side of the track were unaware that GO 3919 was approaching from the east on the main track.

The analysis will focus on

- the factors that influenced the decision-making process of the group of pedestrians who entered the crossing while the signal lights and gates were still active,
- the system that was designed to protect crossing users, which includes Metrolinx and CN risk identification and mitigation strategies and the warning systems at the crossing,
- government (federal, provincial) and company oversight of the crossing,
- whistle cessation, and
- safety promotional campaigns.

2.1 The accident

While returning from a nearby park to their clinic on Victoria Street North, a group of 11 pedestrians, consisting of 6 adult therapists and 5 child clients from bitKIDS Behaviour Consulting (bitKIDS), encountered activated GCWD at the crossing. They stopped at the

crossing and stood on the northwest quadrant sidewalk for an estimated 5 to 10 minutes in cold weather to wait for CN 568 to clear the crossing as it slowly shoved eastward on the north track, back into Kitchener Yard. Just as CN 568 had nearly cleared the east end of the crossing, a pedestrian waiting on the southwest quadrant sidewalk walked northward over the crossing, toward the group of 11 pedestrians on the northwest quadrant sidewalk, while the GCWD were still activated.

As the northbound pedestrian approached the north side of the crossing, a pedestrian waiting on the northeast quadrant sidewalk, as well as 4 of the 11 pedestrians from bitKIDS (2 adults and 2 children) on the northwest quadrant sidewalk, proceeded to traverse the crossing. At the east end of the crossing, the locomotive engineer of CN 568 verbally warned the pedestrian in the northeast quadrant of the approach of GO 3919 from the east on the south track, and that pedestrian turned back.

Findings as to causes and contributing factors

Despite being aware of the activated GCWD, 4 of the 11 pedestrians (2 adults and 2 children) who were waiting on the northwest quadrant sidewalk proceeded to traverse the west end of the crossing.

The actions of the northbound pedestrian, who had entered the Lancaster Street West crossing from the south and approached the 11 pedestrians waiting on the northwest quadrant sidewalk, reinforced the notion that it was safe to cross.

Since CN 568 was reversing slowly on the north track at the east end of the Lancaster Street West crossing, the 11 pedestrians waiting on the northwest quadrant sidewalk were unable to see GO 3919 as it approached from the east.

Although the GCWD (flashing lights, bells, gates) were activated and the bells at the crossing could be heard by the 11 pedestrians, the adults in the group attributed the activation solely to the freight train exiting the east end of the crossing and did not recognize that the activated GCWD could also indicate the approach of a second train on the south main track.

The anti-whistling designation of the crossing meant that the pedestrians at the crossing did not get an early warning of a second train approaching.

The 1st adult and child pair ran over the crossing with their focus aimed directly ahead of them and toward the ground. Not seeing a second train coming from the west, and not anticipating a second train coming from the east, they did not turn their heads to inspect the south track as they passed by the freight train on the north track.

Findings as to causes and contributing factors

The 1st adult and child pair of the group did not detect the presence of GO 3919 in their peripheral vision and ran successfully to the south side of the crossing, unaware that GO 3919 was approaching from the east until they heard its train horn sound to signal an emergency.

The 2nd adult and child pair followed immediately behind the 1st pair. Approximately 1.5 seconds after the GO 3919 train horn sounded, the 2nd adult began to react, but by that

time they were already entering the south track. About 1 second later, they were struck by GO 3919.

2.2 Decision to enter the crossing

Finding as to causes and contributing factors

The 2nd adult's decision to follow the 1st pair was consistent with what is known about pedestrian group behaviour and, more specifically, pedestrians' reliance on social information to inform their decisions despite the presence of other sources of non-social information that warn against their decisions.

The adults from the bitKIDS group of 11 pedestrians were all familiar with the crossing. Although the crossing had 2 tracks, the adults' experience with the crossing did not inform them of the possibility of 2 trains on the crossing at the same time. In fact, some of the adults believed that should a second train arrive, it would be eastbound (i.e., approach from the west) similar to the way that automobile traffic operates on roadways. Other adults in the group did not even consider the possibility of a second train.

Having 2 trains on the crossing occurred 7 times during the 10 days recorded by Metrolinx in June 2020. Thus, while it is not uncommon, it does not happen frequently. Although the GCWD system at the crossing and the signs that indicated the number of tracks met the requirements of the *Grade Crossings Regulations* (GCR) and *Grade Crossings Standards* (GCS), the system did not inform crossing users of the presence, nor the possibility, of an approaching second train.

Finding as to causes and contributing factors

Based on their experience at the Lancaster Street West crossing, the adults in the group attributed the activation of the GCWD to the CN 568 freight train that obstructed their view to the east and did not consider the possibility that a second train could be approaching from the east, nor were they prompted by the crossing warning system to do so.

The adults of the group were aware of the yard located east of the crossing and that a large number of freight trains would travel back and forth over the crossing during weekdays, creating delays. They were also aware that GO commuter trains used the crossing. However, they were not aware of the GO train scheduled for 1447 at the Kitchener station.

The adults' knowledge of and experience with the crossing led to a strong expectation that they would be delayed for an extended period of time before they would get an opportunity to cross. After waiting for 5 to 10 minutes in the cold for the crossing signal activation to end, their willingness to make a risky decision and enter the crossing heightened.

Finding as to causes and contributing factors

In the moments leading up to the accident, the group of 11 pedestrians had been outside for about 50 minutes and the children were getting cold, the adults were restless, and there was an expectation to return to the clinic by 1500, all of which increased the adults' motivation to enter the crossing.

2.3 Effect of crossing delays on high-risk road user behaviour

Examination of the crossing video recorded in June 2020 showed the crossing was busy both in terms of crossing users (vehicles, pedestrians, and cyclists) and railway activity. Railway activity at the crossing was frequent throughout the day, delaying vehicle traffic during 87% (305/349) of crossing signal activations, and pedestrian and cyclist traffic during 31% (107/349) of crossing signal activations. Although the delays were usually less than 5 minutes, 8% (28/349) of the crossing signal activation delays were longer. CN freight trains accounted for 69% of activations at the crossing (240/349), and for every activation that lasted more than 2 minutes.

An examination of the signal bungalow data leading up to the occurrence indicates that train traffic at the crossing was of a similar frequency at the time of the occurrence. The crossing video was recorded during a time when the public was encouraged by government authorities to remain at home due to risks related to the COVID-19 pandemic. Therefore, it is likely that the number of vehicle, pedestrian, and cyclist crossing users in the months leading up to the occurrence were greater than the number seen on the June 2020 video.

Research shows that a road user's knowledge of a grade crossing's rail-traffic patterns informs their expectations on future encounters. Those who anticipate being delayed for long periods may become restless and may be more likely to disregard active warnings. For motorists, this can mean driving around gates and/or over a crossing when the GCWD are activated. For pedestrians and cyclists using a sidewalk, this can mean walking (or cycling) past the gates and travelling around slow-moving or stationary trains.

A review of the crossing video shows that crossing users were becoming restless during many of the activations; during 44% (135/305) of the signal activation events with vehicles present, at least 1 motorist was seen performing a U-turn. The video also showed that motorists, pedestrians, and cyclists displayed higher-risk behaviour by continuing onto the crossing as the gates were descending or were horizontal and by not waiting for the gates to rise after a train had passed. Moreover, a visitor at a nearby park expressed frustration with the crossing delays during a casual conversation with the bitKIDS adults.

Finding as to causes and contributing factors

CN' s use of the Lancaster Street West crossing for switching activities in Kitchener Yard resulted in the GCWD being activated frequently, sometimes for extended periods, which influenced some users of the crossing to adopt the risky behaviour of entering the crossing while GCWD were activated in order to avoid delays.

2.4 Crossing warning system design for second-train events

The Safe System approach seeks to improve road safety through operational changes and an aggressive use of vehicle or roadway design. When a road–rail crossing cannot be removed, by grade separation, for example, the design and implementation of an effective and safe crossing warning system become paramount, especially for vulnerable road users like pedestrians and cyclists.

To be effective, second-train event warnings need to attract attention (be conspicuous), affect knowledge (be understandable), and influence behaviour (be credible). Traditional GCWD (flashing lights, bells, and gates) are designed to inform road users that railway equipment is in a crossing or about to enter a crossing. While traditional GCWD comprise features that are conspicuous and generally easy for users to detect, they affect knowledge but provide only generic information to road users about the actions of trains at a crossing. At multi-track crossings, these warning devices do not specifically warn of the impending arrival of a second train that may not be readily visible. Consequently, as in this occurrence, crossing users may attribute the crossing warning to only the train they can see directly.

While motorists, pedestrians, and cyclists are legally restricted from entering a crossing when the warning system is active, some crossing users will ignore this restriction. Instead, they will rely on their judgment of the risks involved to inform their crossing decision and attempt to traverse the crossing, despite the activated GCWD, and proceed into the path of a second train.

A review of second-train events shows that this type of occurrence occurs infrequently but has a high mortality rate, and that not all crossing users are fully aware of its dangers. The TC *Grade Crossings – Handbook* recommends the use of static second-train event warning signs to inform crossing users of the possibility of second-train events. However, static second-train signs alone may not always be effective. While these static signs can inform crossing users of the potential for 2 trains to occupy the crossing simultaneously, no specific warning is given when a second train is approaching.

After the accident, 4 static second-train event warning signs were installed at the crossing. A review of the post-occurrence video revealed that, despite the presence of these signs in each quadrant of the crossing, a significant number of pedestrians and cyclists were observed entering the crossing while crossing gates were down and a slow-moving, or stopped, freight train on the siding track blocked their view of the main track to the east.

Dynamic second-train event warning signs are another option; they provide additional information to crossing users when a second train approaches the crossing. However, neither static nor dynamic second-train event warning signs were mandatory and neither were installed at the crossing at the time of the occurrence.

Finding as to risk

If a crossing warning system does not communicate specific information about the impending approach of a second train at multi-track crossings, there is an increased risk that crossing users will proceed over the crossing while the GCWD are activated and will be struck by a second train.

2.5 Crossing safety oversight

The operation of a crossing is a shared undertaking between a railway and a road authority, with oversight provided by a regulator. Once the crossing has been constructed, all parties are responsible for ensuring its maintenance and safe operation.

Following the occurrence, Metrolinx video-recorded the events at the crossing over a period of 10 days to better understand the hazards that were present. The video recording showed a crossing where pedestrians, cyclists, and motorists were routinely delayed by switching activities throughout the day. Occasionally, the delay exceeded the 5-minute maximum permitted under the GCR. The video recording also showed many pedestrians and cyclists, and the occasional vehicle, passing through the crossing while the warning system and gates were still active, contrary to both the provincial *Highway Traffic Act* and the Metrolinx bylaws. Many vehicles were observed performing U-turns, some within 30 m (98 feet) of the crossing, which is also a violation of the *Highway Traffic Act*.

Unrelated to the railway's usage of the crossing and activation of the GCWD, but still a hazard at the crossing, the video recording showed many pedestrians entering or exiting the railway right-of-way at the crossing without authority. There were also occasions when roadway vehicles had backed up onto the crossing as they waited for the traffic lights at the Victoria Street North–Lancaster Street West intersection to change.

All of these potentially hazardous events occurred at a crossing that had been designated an anti-whistling crossing for many years. There were also occasions when a faster train, operating on the main track, would pass a slower freight train that was performing switching operations on the siding and occupying the crossing.

The safe operation of the crossing relies on

- the road authority (the Region of Waterloo) to ensure that the road approaches leading to the crossing are properly maintained to the appropriate standards;
- the railway crossing owner (Metrolinx) to properly maintain the crossing right-of-way and warning systems to the appropriate standards; and
- the crossing users (GO Transit, CN, VIA Rail Canada Inc., and the public) to abide by the appropriate rules and regulations.

When any aspect of the crossing or its use is non-compliant, the appropriate party needs to bring it back into compliance.

However, none of the parties involved were aware of the extent of the hazards that existed at the crossing. More specifically:

- The Region of Waterloo was unaware of motorists backing up onto the crossing from the Victoria Street North–Lancaster Street West intersection.
- CN was unaware that its crew members were routinely delaying traffic beyond the maximum period permitted under the GCR.
- Metrolinx was unaware of the trespassing and violations by pedestrians and cyclists of the active grade crossing warning systems.

Finding as to risk

If the manner in which motorists, cyclists, and pedestrians interact with railway traffic and the GCWD at a crossing goes undetected by the authorities responsible for its safety, an ongoing risk of accidents will remain.

2.5.1 Region of Waterloo

To maintain a safe environment, the Region of Waterloo relied on the railway and the public to inform them of safety issues regarding the day-to-day activities of the crossing. In 2018, the Region of Waterloo conducted a detailed crossing assessment to identify any non-conformities regarding the regulations and standards in preparation for the coming into force of certain portions of the GCR and GCS in 2021. Although the crossing was provincially regulated and not subject to federal legislation, it was maintained to the requirements of the GCR and the GCS. As well, because the crossing was provincially regulated, the Region of Waterloo did not have, nor was it required to have, a process to proactively identify traffic backing up onto the Lancaster Street West crossing as prescribed by the GCR. Consequently, the queuing of vehicles from the Victoria Street North–Lancaster Street West intersection onto the crossing went undetected.

2.5.2 Canadian National Railway Company

Some CN and GO Transit train crews were aware of the ongoing trespassing along the right-of-way and of the ongoing motorist, pedestrian, and cyclist incursions at the crossing when the warning systems were active. However, the CN crews reported trespassing only to CN supervisors and the GO Transit crews reported trespassing only to Metrolinx supervisors. Consequently, reporting of crossing infractions was not comprehensive, and an opportunity to make safety improvements and raise awareness was lost as no further action was taken.

In preparation for regaining operational control of the Guelph Subdivision in 2018, CN evaluated the risks posed by crossings along the subdivision. The assessment identified blocked crossings as a risk and rated the risk as being low. CN supervisors monitored their crews' actions at the crossing, both informally through everyday interaction and formally through safety engagements. At the time of the occurrence, the supervisors had completed 1984 safety engagements since CN regained operational control of Kitchener Yard in

November 2018. However, of these engagements, only 8 were targeted at switching movements that delayed pedestrians and cyclists for more than 5 minutes. Consequently, no non-compliant activities were noted regarding the crossing during the safety engagements.

2.5.3 Metrolinx

Metrolinx monitored and tracked the incidents, near-misses, and trespassing along its network of tracks, in keeping with its safety management system. In the first 10 months of 2019, only 7 incidents at the crossing were recorded in the monthly safety report:

- 3 train occupancy incidents
- 3 incidents due to gate damage
- 1 trespassing incident

Furthermore, Metrolinx did not receive any complaints from the public regarding the crossing being blocked. Consequently, its transit safety officers issued very few crossing-related charges, and no concerns were passed along to them from CN train crews.

Unrelated to the railway's usage of the crossing and GCWD activations but still a hazard, there were instances of vehicles backing up onto the crossing while waiting for a change of roadway traffic signals at the Victoria Street North–Lancaster Street West intersection. Although a Metrolinx 2015 crossing assessment determined that traffic was backing up onto the crossing, no further action was suggested, the Region of Waterloo was not informed, and an opportunity to improve safety and reduce the risk of a roadway or crossing accident was missed.

A 2018 Metrolinx risk assessment related to the acquisition of the Guelph Subdivision did not identify any safety-related issues at the crossing. Consequently, the crossing was not included in a subsequent August 2019 risk assessment related to a service change that required pedestrian crossing warning systems to be upgraded at 7 crossings.

Because there were so few safety events reported at the crossing, it was not identified by Metrolinx as requiring an increased level of scrutiny and no action plan was developed to address the hazards.

In contrast with the oversight activities of the Region of Waterloo, CN, and Metrolinx, Metrolinx's post-occurrence 10-day video recording showed that

- on 28 occasions, CN trains delayed crossing users by more than 5 minutes;
- on 16 occasions, motorists entered the crossing with the gates descending or down;
- on 66 occasions, pedestrians or cyclists entered the crossing while the gates were down;
- on 39 occasions, pedestrians or cyclists emerged from or accessed the right-of-way without authority; and
- on 6 occasions, vehicles stopped on the crossing foul of the tracks while queuing for the Victoria Street North–Lancaster Street West intersection.

Finding as to causes and contributing factors

Although CN and Metrolinx had processes in place to identify safety concerns and assess risk, as required by the *Railway Safety Management System Regulations, 2015*, and performed some monitoring at the crossing, neither company identified the safety hazards and infractions occurring at the crossing, so the risks were not mitigated.

Neither CN nor Metrolinx openly shared all of its crossing information and observations with the Region of Waterloo. For example, the Region of Waterloo was not advised about the roadway traffic backing up over the crossing.

Finding as to risk

Crossing safety is a responsibility shared among the railway, the road authority, and the regulator, and if these parties do not communicate with each other when hazards or contraventions are observed, there is a risk that an opportunity to improve safety and reduce the probability of a crossing accident will be missed.

2.6 Transport Canada oversight

In April 2019, TC responded to a complaint from the public regarding an extended occupancy at the crossing. A 2-hour inspection began at 0830 on 23 April 2019 and revealed CN switching movements blocked the crossing for extended periods. A follow-up 3-hour inspection on 12 July 2019 began at 0700 and noted 2 instances of non-compliance. A 3rd inspection began at 0730 on 02 October 2019 and lasted 2.5 hours, with no instances of non-compliance observed. After the October 2019 inspection, TC considered the complaint resolved, and no further follow-up activities occurred. The accident occurred just over a month later (13 November 2019) while the crossing was once again occupied for an extended period of time.

The CN Kitchener Yard operates 7 days a week, 24 hours a day. It has a day shift, a night shift, and a continental shift. Switching activities that result in extended crossing occupancies can occur at any time but most frequently occur when there is a high rate of yard-switching activity. For instance, the continental shift begins at 1130. Crews spend the first 1 to 4 hours switching cars to build a train, an activity that frequently requires the train to occupy the crossing.

In its 2018 report, the *Railway Safety Act* Review Panel indicated that video surveillance of high-risk grade crossings could help identify problem areas. The Metrolinx video taken after the occurrence recorded crossing activity throughout the day over several days and very clearly showed that extended occupancies of the crossing, and other safety infractions by the crossing users, continued to occur. It also showed that between 0730 and 1030, the time period that TC chose for its inspections of the crossing, there were few extended occupancies compared with other time periods throughout the day.

Finding: Other

Metrolinx's continuous video surveillance of the Lancaster Street West crossing provided more accurate and useful information about the extent of crossing activity and safety infractions when compared to the TC inspection methodology that relied on limited site visits and visual inspections.

2.7 Canadian National Railway Company oversight

After CN regained operational control of Kitchener Yard in November 2018, it reviewed the requirements of switching activities in the area with its operating crews. CN reinforced that switching activities should not delay crossing users by more than 5 minutes. Since that time, CN had received no complaints from the public about the crossing being blocked, and supervisory monitoring of train crews did not reveal any infractions. Consequently, prior to TC's inspection at the crossing on 23 April 2019, CN supervisors at Kitchener Yard were unaware of crossing occupancies where switching activities delayed motorists, pedestrians, or cyclists by more than 5 minutes. As a result, CN's safety engagement program, which is used to monitor its crews' compliance with the rules, did not focus on crossing activities, nor did it reveal any violations of the rules and regulations for crossing activities.

Following TC's 23 April 2019 inspection, TC issued a letter of non-compliance informing CN that it was not respecting the GCR, as extended occupancies were delaying crossing users by more than 5 minutes. After a follow-up inspection in July 2019, TC again informed CN that it was contravening the GCR at the crossing. Following each inspection, CN reminded its crews verbally and with a written notice of the requirements regarding clearing the crossing.

Although CN supervisors performed ad hoc crossing inspections, the CN safety engagement program, which is used to monitor and evaluate crew compliance with the rules, put little emphasis on crew compliance with crossing rules and regulations. Consequently, only 1 CN safety engagement was targeted at crew activities at crossings after TC's first inspection on 23 April 2019. On this occasion, the safety engagement evaluated only 2 crew members' adherence to CROR Rule 103: Public Crossings at Grade. Since CN had 3 assignments, operated by 10 different crew members (i.e., 5 crews) that switched cars and built trains over the crossing at all hours of the day and night, a single safety engagement was insufficient to inform CN about the activities of the other crew members at other times of the day.

Finding as to causes and contributing factors

As a consequence of CN's insufficient safety engagement monitoring of the train crews that worked at Kitchener Yard and operated over the Lancaster Street West crossing, CN freight trains continued to occupy the crossing in excess of the 5-minute regulatory limit, which resulted in corresponding delays for motorists, pedestrians, and cyclists that contributed to their behaviour.

2.8 Province of Ontario oversight

The Ministry of Transportation of Ontario (MTO) is responsible for regulatory oversight of Metrolinx's GO Transit and UP Express, which transport about 229 000 riders over 420 km of rail line each weekday. Metrolinx operations today now exceed those of some federally regulated railways. However, the province has no safety-related regulations that govern provincial railway operations. Instead, the MTO relies on companion inspection agreements that it has with TC and Metrolinx to meet the requirements for engineering and operations set out in federal regulations, rules, and standards.

The Region of Waterloo, Metrolinx, and CN all followed the federal rules and regulations when maintaining or travelling over the crossing and the Metrolinx Guelph Subdivision. The crossing was maintained to the requirements of the GCR and the GCS.

In accordance with the agreements, the MTO was to receive all TC inspection reports and resolve any disputes that might arise from the implementation of the TC inspection agreement with Metrolinx. However, the MTO had not been receiving TC inspection reports. Furthermore, the MTO has no employees with the technical knowledge, expertise, and experience required to evaluate any TC inspection reports they receive.

Finding as to risk

If the MTO does not have the information and the capability to assess the quality of the TC inspections and the proposed remedial measures, and whether the measures implemented mitigated the deficiencies, the MTO will not be able to provide effective safety oversight.

2.9 Safety promotional campaigns and roadway signage

Operation Lifesaver has developed many different products and initiatives to promote awareness among the general public of the hazards present at railway tracks, which includes crossing safety information. Despite these efforts to inform the public, members of the group of therapists remained unclear of the nature of railway operations on double-track subdivisions. Some of the group believed that trains would operate similar to vehicles on a roadway, in that trains on 2 separate adjacent tracks would face each other and operate in opposite directions. This belief contributed to the group's confidence that the south track was clear of traffic, as the freight train on the crossing was facing west and they saw no trains approaching from the west. They did not consider that a train would be approaching from the east on the main track and that they needed to look in that direction.

Some of the literature and videos addressing the dangers at double-track subdivisions developed by Operation Lifesaver could have inadvertently reinforced the notion that trains operate on railway tracks similarly to vehicles on a roadway where the near-lane traffic flowed from left to right and the far-lane traffic flows from right to left. Three videos on the Operation Lifesaver YouTube channel showed trains operating in this manner, including one addressing second-train events. One of the 3 videos suggests users look left at the near track and right at the far track, as would be done for vehicle traffic when crossing a roadway. As well, one of Operation Lifesaver's many blog articles directly relates roadway traffic operation to the operation of trains on a railway track.

In addition to the Operation Lifesaver promotional material, TC's second-train event warning sign could also be interpreted to reinforce the notion that trains operate similarly to vehicles on a roadway, showing 2 trains operating in opposite directions and passing each other on their left-hand sides.

Finding as to risk

Promotional material and roadway signage designed to improve public safety at railway crossings could inadvertently reinforce the pedestrian, cyclist, and roadway user notion that multi-track railway traffic operates similarly to roadway traffic, increasing the risk that crossing users will not look in both directions for a potential second train.

2.10 Whistle cessation

Whistle cessation has been in effect at this crossing for at least 20 years and was implemented before the current GCR and the associated GCS came into force. The current GCR stipulate safety requirements that the crossing must meet before an application for whistle cessation can be granted. One such safety requirement is for the crossing not to have repeated incidents of unauthorized access. This crossing did not meet this requirement at the time of the occurrence.

There is no regulatory requirement to periodically reassess the appropriateness of the whistle cessation order. However, there is nothing that precludes a railway and road authority from conducting their own review and implementing whatever steps they deem appropriate to improve safety, which could include rescinding the whistle cessation order. However, neither the Region of Waterloo nor Metrolinx were aware of the safety hazards present at the crossing, including the extent to which the public accessed the crossing while a train (or trains) occupied the crossing and the GCWD were activated.

Finding: Other

Since the hazards at the Lancaster Street West crossing were undetected by both the Region of Waterloo and Metrolinx, an opportunity to review the crossing conditions and evaluate the appropriateness of a whistle cessation order was missed.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are conditions, acts or safety deficiencies that were found to have caused or contributed to this occurrence.

1. Despite being aware of the activated grade crossing warning devices, 4 of the 11 pedestrians (2 adults and 2 children) who were waiting on the northwest quadrant sidewalk proceeded to traverse the west end of the crossing.

2. The actions of the northbound pedestrian, who had entered the Lancaster Street West crossing from the south and approached the 11 pedestrians waiting on the northwest quadrant sidewalk, reinforced the notion that it was safe to cross.

3. Since Canadian National Railway Company (CN) freight train L56831-13 (CN 568) was reversing slowly on the north track at the east end of the Lancaster Street West crossing, the 11 pedestrians waiting on the northwest quadrant sidewalk were unable to see GO Transit commuter train 3919 (GO 3919) as it approached from the east.

4. Although the grade crossing warning devices (flashing lights, bells, gates) were activated and the bells at the crossing could be heard by the 11 pedestrians, the adults in the group attributed the activation solely to the freight train exiting the east end of the crossing and did not recognize that the activated grade crossing warning devices could also indicate the approach of a second train on the south main track.

5. The anti-whistling designation of the crossing meant that the pedestrians at the crossing did not get an early warning of a second train approaching.

6. The 1st adult and child pair of the group did not detect the presence of GO 3919 in their peripheral vision and ran successfully to the south side of the crossing, unaware that GO 3919 was approaching from the east until they heard its train horn sound to signal an emergency.

7. The 2nd adult and child pair followed immediately behind the 1st pair. Approximately 1.5 seconds after the GO 3919 train horn sounded, the 2nd adult began to react, but by that time they were already entering the south track. About 1 second later, they were struck by GO 3919.

8. The 2nd adult's decision to follow the 1st pair was consistent with what is known about pedestrian group behaviour and, more specifically, pedestrians' reliance on social information to inform their decisions despite the presence of other sources of non-social information that warn against their decisions.

9. Based on their experience at the Lancaster Street West crossing, the adults in the group attributed the activation of the grade crossing warning devices to the CN 568 freight

train that obstructed their view to the east and did not consider the possibility that a second train could be approaching from the east, nor were they prompted by the crossing warning system to do so.

10. In the moments leading up to the accident, the group of 11 pedestrians had been outside for about 50 minutes and the children were getting cold, the adults were restless, and there was an expectation to return to the clinic by 1500, all of which increased the adults' motivation to enter the crossing.

11. CN's use of the Lancaster Street West crossing for switching activities in Kitchener Yard resulted in the grade crossing warning devices being activated frequently, sometimes for extended periods, which influenced some users of the crossing to adopt the risky behaviour of entering the crossing while grade crossing warning devices were activated in order to avoid delays.

12. Although CN and Metrolinx had processes in place to identify safety concerns and assess risk, as required by the *Railway Safety Management System Regulations, 2015*, and performed some monitoring at the crossing, neither company identified the safety hazards and infractions occurring at the crossing, so the risks were not mitigated.

13. As a consequence of CN's insufficient safety engagement monitoring of the train crews that worked at Kitchener Yard and operated over the Lancaster Street West crossing, CN freight trains continued to occupy the crossing in excess of the 5-minute regulatory limit, which resulted in corresponding delays for motorists, pedestrians, and cyclists that contributed to their behaviour.

3.2 Findings as to risk

These are conditions, unsafe acts or safety deficiencies that were found not to be a factor in this occurrence but could have adverse consequences in future occurrences.

1. If a crossing warning system does not communicate specific information about the impending approach of a second train at multi-track crossings, there is an increased risk of crossing users will proceed over the crossing while the grade crossing warning devices are activated and will be struck by a second train.

2. If the manner in which motorists, cyclists, and pedestrians interact with railway traffic and the grade crossing warning devices at a crossing goes undetected by the authorities responsible for its safety, an ongoing risk of accidents will remain.

3. Crossing safety is a responsibility shared among the railway, the road authority, and the regulator, and if these parties do not communicate with each other when hazards or contraventions are observed, there is a risk that an opportunity to improve safety and reduce the probability of a crossing accident will be missed.

4. If the Ministry of Transportation of Ontario (MTO) does not have the information and the capability to assess the quality of the Transport Canada inspections and the proposed remedial measures, and whether the measures implemented mitigated the deficiencies, the MTO will not be able to provide effective safety oversight.

5. Promotional material and roadway signage designed to improve public safety at railway crossings may inadvertently reinforce pedestrian, cyclist, and roadway user notions that multi-track railway traffic operates similarly to roadway traffic, increasing the risk that crossing users will not look in both directions for a potential second train.

3.3 Other findings

These items could enhance safety, resolve an issue of controversy, or provide a data point for future safety studies.

1. Metrolinx's continuous video surveillance of the Lancaster Street West crossing provided more accurate and useful information about the extent of crossing activity and safety infractions when compared to the Transport Canada inspection methodology that relied on limited site visits and visual inspections.

2. Since the hazards at the Lancaster Street West crossing were undetected by both the Region of Waterloo and Metrolinx, an opportunity to review the crossing conditions and evaluate the appropriateness of a whistle cessation order was missed.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 Transportation Safety Board of Canada

On 18 January 2021, the TSB issued Rail Safety Advisory 01/21, which discussed second-train events at multi-track grade crossings. This advisory cited the risks posed by multi-track crossings situated near rail yards where slow-moving trains and switching assignments frequently occupy the crossing and delay pedestrians or cyclists, sometimes in excess of the regulatory limit (5 minutes).

The advisory indicated that, when delays involve a slow-moving switching assignment, crossing users may incorrectly assess the risks as being low, enter the crossing before the grade crossing warning devices deactivate, and proceed into the path of an oncoming second train.

The advisory suggested that it may be prudent for the parties involved to identify those multi-track crossings that experience frequent and extended crossing signal activations and that have a high level of pedestrian and cyclist traffic, assess the likelihood of a second-train event to occur, and consider additional safety measures to minimize the risks of an accident.

4.1.2 Transport Canada

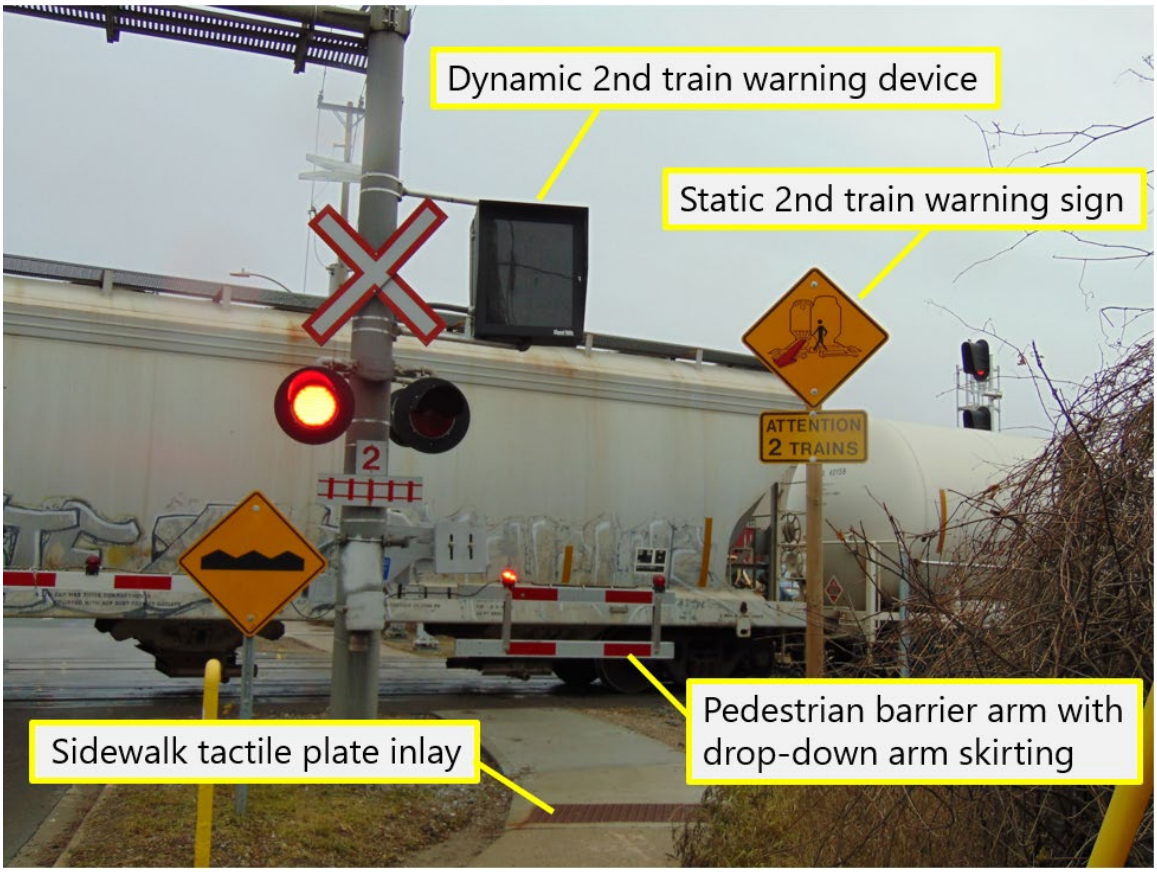
On 02 March 2021, Transport Canada (TC) responded to the TSB Rail Safety Advisory indicating that the accident occurred at a grade crossing that falls under provincial jurisdiction and that the *Grade Crossings Regulations* apply only to grade crossings under federal jurisdiction. Notwithstanding, TC indicated that Canadian National Railway Company (CN) and Metrolinx had begun performing joint audits of the Lancaster Street West crossing, and that they had been working collaboratively to identify possible improvements and action plans.

In an effort to raise the safety concerns associated with conducting switching operations in the vicinity of crossings with double tracks, TC asked the Railway Association of Canada to share Rail Safety Advisory 01/21 with its members and recommend that they assess their crossings to determine if additional measures are needed to reduce the risk of a similar accident occurring in the future.

4.1.3 Metrolinx

Since the accident, Metrolinx has made a number of safety improvements at the crossing (Figure 11).

Figure 11. Lancaster Street West crossing safety improvements (Source: TSB)



Metrolinx has installed

- dedicated sidewalk pedestrian barrier arms with drop-down arm skirting on all 4 quadrants;
- sidewalk tactile plate inlays on all 4 crossing quadrants to identify the crossing approach to visually challenged pedestrians and to delineate a safe stopping point for them to wait for passing movements;
- dynamic LED signs displaying “Danger – Multiple Trains Expected” that are activated when a second train enters the crossing circuit; and
- static second-train event signage in all 4 quadrants of the road approach.

In addition, it has

- issued instructions to Metrolinx operating crews approaching the Lancaster Street West crossing who observe another movement, or equipment, on an adjacent track, occupying, or in the vicinity of, the crossing, to abide by Rule 14(f) of the *Canadian Rail Operating Rules* requiring a succession of several short sounds from the train whistle;
- developed and implemented a grade crossing safety plan to provide a standardized framework for grade crossing oversight, and incident review and analysis; and
- provided on-site education and hazard awareness information to crossing users while also enforcing safety regulations.

Metrolinx has also introduced a number of business processes to improve its crossing oversight:

- a Road and Rail Interface Risk Management and Oversight Committee chaired by the Chief Safety Officer and the Chief Engineer that meets monthly to review progress on annual risk assessments for all grade crossings, and actions and action plans for each crossing;
- the Incident Investigation Recommendation Review Committee chaired by the Chief Risk Officer that ensures recommendations from investigations are implemented and tracked, and information is shared with internal and external interested parties;
- a new regulatory oversight office with a Director of Regulatory Oversight to create a third layer of corporate assurance. This office is under the leadership of the Vice President of Audit Regulatory Compliance reporting directly to the Board;
- a practice of requiring all grade crossings to be risk assessed a minimum of every 12 months. Metrolinx is currently reviewing the effectiveness of whistle cessation and the risks associated with the practice, and a requirement for buses, other than school buses, to stop at all crossings;
- a new bylaw to enable fines to be issued by Metrolinx to vehicle drivers committing offences at grade crossings. This is part of a grade crossing camera enforcement program to reduce unsafe behaviours and non-compliance.

Metrolinx continues to monitor CN switching activities via closed-circuit television cameras and in-person observations at locations where CN trains interact with GO Transit trains, which includes the Lancaster Street West crossing. Results from the observations and analyses of the crossings have identified non-compliances, which have been shared with CN management. As of February 2023, Metrolinx continues to work with CN to manage and reduce any safety risk to railway operations and the public.

4.1.4 Ministry of Transportation of Ontario

Since the accident, the Ministry of Transportation of Ontario (MTO) has begun to receive TC inspection reports, starting with the 2019 reports.

Both the agreement with TC and the agreement with Metrolinx were updated in January 2022, and each contains amendments and additions to the original agreement, such as:

- explicitly noting the MTO's authority to direct Metrolinx, where necessary, to address a non-compliance identified in an inspection report if Metrolinx has not taken appropriate corrective action. Metrolinx is required to comply with the direction issued;
- formalizing the process for and contacts within the MTO to receive inspection reports from TC inspectors;
- updating the rules, standards, and regulations appendix to reflect the current applicable federal requirements.

In making these updates to the agreements, the MTO worked closely with TC to strengthen the MTO's accountability role in the agreement, with respect to Metrolinx, to verify that non-compliances and deficiencies that may arise are appropriately addressed.

The MTO has identified a need to update the oversight framework for urban and regional rail transit in Ontario that would better support the province's growing rail network and the diversity of operators. Early in 2021, the MTO began a review of the safety oversight framework for provincial railways; this review was ongoing at February 2023. The review encompasses provincial shortline railways, the Ontario Northland Transportation Commission, and urban and regional transit systems with rail service (i.e., the Toronto Transit Commission, GO Transit and UP Express [Metrolinx], OC Transpo, and ION light rail [Grand River Transit]).

4.1.5 bitKIDS Behaviour Consulting

Since the accident, bitKIDS Behaviour Consulting moved from its Victoria Street North location to a new location that has its own fenced play area. Street-safety skills are taught in the fenced play area. Once children have learned the skills, they practise these skills daily outside the fenced play area. In addition, the bitKIDS Behaviour Consulting handbook has been updated to include the following statement: "Obey all traffic laws when crossing streets, railway tracks, and crosswalks with or without traffic signals at all times."

4.2 Safety concern

4.2.1 Regulatory oversight of Ontario provincial railways

Metrolinx was created in 2006 to improve the coordination and integration of public transit train and bus service for the Greater Toronto and Hamilton Area.[96] It oversees the operations of UP Express, the dedicated air–rail link between Union Station in downtown Toronto and Lester B. Pearson International Airport, as well as of the GO Transit regional public transit train and bus service. The GO Transit train service and UP Express operate over about 420 km of rail lines, 337 km of which are owned by Metrolinx. In 2019, they carried an average of about 229 000 riders each weekday, which represents the highest daily ridership in Canada.

In April 2020, the provincially regulated rail network in the Province of Ontario comprised 12 railways (including Metrolinx) that are governed by 3 provincial acts:

- the *Shortline Railways Act, 1995* (SRA), which outlines safety requirements by reference to the federal *Railway Safety Act* (RSA);
- the *Ontario Northland Transportation Commission Act*; and
- the *Metrolinx Act, 2006*, which prescribes corporate structure but has no safety requirements.

[96] Metrolinx, "About Us," at metrolinx.com/en/about-us (last accessed 17 January 2023).

The MTO is responsible for the oversight of the provincially regulated railway system but it has no overall provincial regulatory framework and has not issued any regulations pursuant to the SRA. The MTO also does not have employees with the technical knowledge, experience, and expertise required to oversee the safety of railway operations; rather, it relies on various agreements with other parties in an effort to provide oversight. Specifically:

- The MTO has an inspection-services agreement with TC that requires TC to conduct inspections of Metrolinx and various shortline railways to federal regulations, rules, and standards.
- The Ontario Northland Transportation Commission conducts its own internal track inspections and hires third-party inspectors for some other inspections.

Metrolinx falls under the *Metrolinx Act, 2006* when operating on its own provincially regulated track. Because this Act does not include safety-related provisions or subsequent offence provisions for violating them, it does not provide the Province of Ontario with a framework for taking enforcement action for safety-related deficiencies, when appropriate, against Metrolinx or other provincial railways operating on Metrolinx-owned property. Furthermore, TC inspectors do not have the authority to compel Metrolinx or other provincial railways operating on Metrolinx-owned property, to take action to address identified safety hazards.

With regard to enforcement, it is within the authority of the Ontario Minister of Transportation to require Metrolinx or the Ontario Northland Transportation Commission to implement any directives issued to either agency with respect to any matter arising under their respective legislation, including implementation of corrective action. For the provincial shortline railways that fall under the authority of the SRA, the Registrar of Shortline Railways can suspend or revoke a railway licence.

In accordance with its agreement with TC, the MTO was to receive all TC inspection reports and resolve any disputes from the implementation of the TC inspection agreement with Metrolinx. However, the MTO had not been receiving TC inspection reports and does not have employees with the technical knowledge, experience, and expertise required to evaluate TC inspection reports.

Given the current complex MTO regulatory framework that involves multiple agreements, there are gaps in the oversight processes that can lead to occasions when the MTO will not be able to provide effective safety oversight.

The MTO has identified a need to update the oversight framework for urban and regional rail transit in Ontario that would better support the province's growing rail network and the diversity of operators. Early in 2021, the MTO began a review of the safety oversight framework for provincial railways; this review was ongoing at February 2023. The review encompasses provincial shortline railways, the Ontario Northland Transportation Commission, and urban and regional transit systems with rail service (i.e., the Toronto

Transit Commission, GO Transit and UP Express [Metrolinx], OC Transpo, and ION light rail [Grand River Transit]).

The Board is encouraged that the MTO has identified a need to update the oversight framework for urban and regional rail transit in Ontario. However, although such a framework may include updated legislation and the creation of a regulator to provide oversight and support safety practices across the provincial railway sector, no such framework has yet been established. Therefore, the Board is concerned that the Province of Ontario does not provide effective safety oversight of provincially regulated railways.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 23 November 2022. It was officially released on 09 February 2023.

APPENDICES

Appendix A – Appendix A of the Ontario-Metrolinx Agreement outlining the statutes, standards, rules, regulations, policies, guidelines and procedures for the purpose of Transport Canada inspection services

Appendix A of the Ontario-Metrolinx Agreement

RULES

The following statutes, standards, rules, regulations, policies, guidelines and procedures are the RULES for the purpose of the INSPECTION SERVICES:

Statutes
Canadian Transportation Accident Investigation and Safety Board Act
Railway Safety Act
Canadian [read: *Canada*] *Transportation Act*

Regulations
- *Transportation Information Regulations* (SOR/96-334)
- *Railway Safety Management System Regulations, 2015* (SOR/2015-26)
- *Mining Near Lines of Railways Regulations* (SOR/91-104)
- *Notice of Railway Works Regulations* (SOR/91-103)
- *Railway Prevention of Electric Sparks Regulations* (1982-8 Rail) (SOR/82-1015)
- *Grade Crossings Regulations* (SOR/2014-275)
- *Ammonium Nitrate Storage Facilities Regulations* (No. 0-36) (C.R.C., c. 1145)
- *Anhydrous Ammonia Bulk Storage Regulations* (No. 0-33) (C.R.C., c. 1146)
- *Chlorine Tank Car Unloading Facilities Regulations* (No. 0-35) (C.R.C., c. 1147)
- *Flammable Liquids Bulk Storage Regulations* (No. 0-32) (C.R.C., c. 1148)
- *Handling of Carloads of Explosives on Railway Trackage Regulations* (SOR/79-15)
- *Liquefied Petroleum Gases Bulk Storage Regulations* (No. 0-31) (C.R.C., c. 1152)
- *Railway Safety Appliance Standards Regulations* (No. 0-10) (C.R.C., c. 1171)
- *Service Equipment Cars Regulations* (1986-9 Rail) (SOR/86-922)
- *Wire Crossings and Proximities Regulations* (No. E-11) (C.R.C., c. 1195)
- *Prevention and Control of Fires on Line Works Regulations* (SOR/2016-317)
- *Railway Employee Qualification Standards Regulations* (1987-3 Rail) (SOR/87-150)

Rules
- *Work/Rest Rules for Railway Operating Employees*
- *Railway Freight and Passenger Train Brake Inspection and Safety Rules*
- *Railway Locomotive Inspection and Safety Rules*
- *Canadian Rail Operating Rules*
- *Railway Medical Rules for Positions Critical to Safe Railway Operations*
- *Railway Equipment Reflectorization Rules*
- *Railway Passenger Car Inspection & Safety Rules*
- *Railway Rules Governing Safety Critical Positions*
- *Railway Passenger Handling Safety Rules*
- *Rules for the Installation, Inspection & Testing of Air Reservoirs (Other than on Locomotives)*
- *Railway Freight Car Inspection & Safety Rules*
- *Rules Respecting Track Safety*
- *Pull –By Inspection Rules*, Rule R-41300 1.22
- *Rules Respecting Key Trains and Key Routes*

Standards
- *Engineering Standards for Grade Crossing Warning Systems Used at Restricted Grade Crossings*

- *Engineering Standards for "Walk Light" Grade Crossing Warning Systems*
- *Grade Crossings Standards*
- *Railway Signal & Traffic Control Systems Standards*
- *Transport Canada Standard for LED Signal Modules at Highway/Railway Grade Crossings*
- *Standards Respecting Pipeline Crossings Under Railways*
- *Standards Respecting Railway Clearance*

Guidelines & Procedures

- Compendium of Survey Data Record Layouts (TP-14930)
- Fatigue Management Plans – Requirements and Assessment Guidelines
- Guideline for Bridge Safety Management
- Guideline for Culvert Safety Management
- Guideline on Applying for an [*sic*] Exemption or Filing of a Notice of Exemption
- Guideline on Requesting Approval to Undertake Certain Railway Works
- Guideline on Submitting Proposed Engineering Standards or Revisions to Engineering Standards
- Guideline on Submitting a Proposed Rule or a Revision to a Rule [*under the* Railway Safety Act]
- Minimum Railway/Road Crossing Sightline Requirements For All Grade Crossings Without Automatic Warning Devices G4-A
- Guideline [for] Engineering Work Relating to Railway Works (section 11 of the *Railway Safety Act*) (TP 13626)
- Procedure for Train Whistling at Public Grade Crossings

Policies

- Railway Right of Way Access Control Policy

Appendix B – Transport Canada inspections of the Guelph Subdivision between 01 January 2018 and 13 November 2019

Date	Inspection details	Results	Action taken
2018-02-07	Operations inspection on multiple GO trains over several subdivisions, including Mile 30.0 to 62.7 on the Guelph Subdivision	No exceptions were noted; specifically, there were no exceptions noted regarding movements over crossings.	No action required.
2018-02-12	Crossings inspection on the Goderich-Exeter Railway (GEXR) at Mile 57.0 on the Guelph Subdivision	Issues noted with surface and signage.	Transport Canada (TC) issued a letter of non-compliance and concern. GEXR informed TC of corrective action taken for each.
2018-09-19	Operations inspection on a GO train between Mile 30.0 and Mile 62.7 on the Guelph Subdivision	No exceptions were noted; specifically, there were no exceptions noted regarding movements over crossings and use of engine headlights, ditch lights, and bells.	No action required.
2018-09-20	Operations inspection on a GEXR train between Mile 50.0 and Mile 67.0 on the Guelph Subdivision	No exceptions were noted. Engine headlights, ditch lights, and bell/whistle were used properly at crossings. No trespassing was noted.	No action required.
2018-11-29	Operations inspection on a CN train on the Guelph Subdivision at Kitchener	No exceptions were noted. The crossings were properly cleared. No trespassing was noted.	No action required.
2018-12-18	Operations inspection on a CN train from Mile 48.8 to Mile 62.7 on the Guelph Subdivision	No exceptions were noted. No trespassing was noted.	No action required.
2019-01-31	Operations inspection on a GO train over several subdivisions, including Mile 30.0 to Mile 62.7 on the Guelph Subdivision	No exceptions were noted. There were no mention of crossings.	No action required.
2019-04-10	Operations inspection on a CN train at Mile 48.8 on the Guelph Subdivision	No exceptions were noted. The crossings were properly cleared. No trespassing was noted.	No action required.

Date	Inspection details	Results	Action taken
2019-04-23	Operations inspection on a CN train at Mile 62.08 on the Guelph Subdivision	Movement did not clear crossing as prescribed by subsection 97(2) of the *Grade Crossings Regulations*.	TC issued a letter of non-compliance and concern. CN responded, indicating that it had reviewed the requirements of the Regulations with all Kitchener operating crews and had issued a local notice containing the requirements of the special instruction to CROR Rule 103. Also, CN observed switching activities on Lancaster Street West and indicated that it was in the process of reviewing opportunities to extend tracks H035 to H039 to assist in switching opportunities from the east end of the yard.
2019-05-01	Track inspection from Mile 30.1 to Mile 63.4 on the Guelph Subdivision	A total of 37 non-compliances and concerns were identified.	TC issued a letter of non-compliance and concern. GO Transit informed TC of the corrective action taken for each and TC issued a letter of sufficient action.
2019-07-12	Operations inspection on a CN train at Mile 62.08 on the Guelph Subdivision	Movement did not clear the crossing as prescribed by subsections 97(1) and 97(2) of the *Grade Crossings Regulations;* no trespassing was noted.	No action required. TC counselled the local CN management personnel.
2019-10-02	Operations inspection on a CN train at Mile 62.08 on the Guelph Subdivision	No exceptions were noted. The crossings were properly cleared. No trespassing was noted.	No action required.
2019-10-17	Operations inspection on a GO train over Oakville and Guelph subdivisions	No exceptions were noted.	No action required.

Note: Copies of the inspection reports were filed with TC and sent to Metrolinx. No copies were sent to the Ontario Minister of Transportation.