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

Collision between OC Transpo bus and VIA passenger train: Executive summary

This summary of the Transportation Safety Board of Canada's (TSB) Railway Investigation Report R13T0192 contains a description of the accident, an overview of the analysis, findings, and safety action taken to date, as well as the five key recommendations that highlight what more needs to be done to help ensure an accident like this does not happen again.

The investigation focused on many issues, including the human factors associated with the accident, environmental factors and the crashworthiness of the bus. It also examined the influence of organizational issues such as OC Transpo speed enforcement, operating procedures and training. Historical grade separation issues in the vicinity of VIA's Fallowfield Station and the practice of requiring buses to stop at all railway crossings were also analyzed.

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Canada

The accident

On the morning of September 18, 2013, OC Transpo double-decker bus No. 8017, operating as Express Route 76, arrived at the OC Transpo Fallowfield Bus Station in South Ottawa at 0846:24. The bus was en route toward downtown Ottawa along the Transitway, a private two-lane roadway dedicated to commuter bus traffic. From the bus station, the northbound Transitway extends east to a left-hand curve which turns sharply north and then runs parallel to Woodroffe Avenue. The bus was in good mechanical condition. The bus driver was fit for duty and familiar with the route.

The driver's workstation included standard controls and several in-vehicle displays. One of the displays was a video monitor screen measuring about 6 inches by 4 inches and further divided into four smaller quadrants, each displaying a view from one of four on-board video cameras. The bottom right quadrant displayed a rearward-facing view of the upper deck. OC Transpo required drivers to monitor this screen at station stops and while in service, and to announce that no standing was permitted on the upper deck if they saw passengers standing.

As passengers entered and exited the bus, the driver looked at the video monitor and announced that there were empty seats on the upper deck.

At 0847:17, the automatic warning devices (flashing lights, bells, and gates) at the Woodroffe Avenue and Transitway crossings were activated.

At 0847:27, the bus departed the OC Transpo Fallowfield Station almost four minutes behind the scheduled departure time with about 95 passengers on board. One passenger was standing near the top of the stairs, in view of the upper deck camera and visible on the driver's video screen.

At about 0847:57, the driver was busy negotiating the left-hand curve ahead as some passengers continued conversations regarding the availability of seating on the upper deck. During this period, the driver looked upward and to the left toward the video monitor.

Meanwhile, VIA passenger train No. 51, which was heading west to Toronto, was approaching the Woodroffe Avenue and Transitway crossings. Although the crossing flashing lights, bells and gates had been activated more than 30 seconds earlier, the bells were not audible within the bus, and the driver's view of the gates and flashing lights was obstructed by trees, shrubs, foliage, Transitway signage, and the front corner pillars of the bus.

At 0848:02, the bus approached the crossing at 67.6 km/h (42 mph), which was in excess of the posted speed limit of 60 km/h (37.3 mph). Passengers on both the upper and lower decks, seeing the approaching train, began to shout, "stop, stop" and "look out".

The driver refocused attention to the road ahead and applied the brakes in accordance with bus operator training. The training, however, primarily focused on smooth braking to minimize passenger discomfort, so maximum braking force was not initially applied. This increased the stopping distance.

At 0848:06, with its speed reduced to 7.7 km/h (4.8 mph), the bus collided with the train.

As a result of the collision, the bus was extensively damaged. The driver and five passengers sustained fatal injuries, nine other passengers were seriously injured, and about 25 passengers incurred minor injuries. Although the train derailed, none of the VIA crew or passengers were injured.

Aftermath and emergency response

Within minutes of the accident, OC Transpo staff, members of the Ottawa Police Service, Ottawa Fire Services and Ottawa Paramedic Service arrived on scene. A Unified Command was quickly established to coordinate the emergency response activities. This included triage and transport of 34 patients to hospital, protection of the site, and ensuring the safety of other passengers and the public. The overall effort was well coordinated and carried out according to the City of Ottawa's Emergency Management Plan.

Source: Ottawa Police Service

Key issues in the investigation

The investigation looked at many issues to determine what happened, why it happened, and what needs to be done to prevent it from happening again. This section describes some of the key issues.

Expectation and driver perception

Over the previous 12 months, the driver had dozens of shifts in a double-decker bus, and had driven over the Transitway crossing approximately 60 times. However, given the varied schedules of OC Transpo buses and VIA trains, the driver would rarely have encountered a train at this crossing. Drivers who are familiar with a crossing and who have a "no trains" expectation tend not to look in either direction while approaching a crossing and are less likely to reduce their approach speed than drivers who are unfamiliar with a crossing.

Moreover, studies measuring driver eye movements show that, when negotiating a curve, drivers tend to look in the direction that the vehicle is turning. Visually, they rely on a "tangent point" on the inside of the curve, and they tend to make only anticipatory glances toward the "occlusion point," or the nearest point where the view of the road ahead is blocked. In this occurrence, this was an area that was obstructed by trees, shrubs, foliage, and Transitway signage, as well as by the frame of the bus itself.

Braking force and stopping distance

An examination of the bus braking system, along with observations at the site, found no brake-related defects present at the time of the accident.

The bus driver initially applied the brakes with the bus travelling at 67.6 km/h (42 mph). This would have required an estimated stopping distance of 35.9 m (117.8 feet). The bus, however, was 35.6 m (116.8 feet) from the point of collision. Moreover, data from the bus's engine control module showed that deceleration was progressive, indicating that, at first, the brakes were not fully applied.

If full braking force had been applied from the beginning of the brake application, the stopping distance was calculated to be 34.3 m (112.5 feet)—or just short of the collision point.

To understand the influence that speeding might have had, calculations were also performed with a similarly loaded bus travelling at the posted speed limit of 60 km/h. In such a scenario, with all other factors remaining the same, the stopping distance was calculated to be 29.5 m (96.8 feet), or 6.1 m (20 feet) short of the collision point. This demonstrates that even a small increase in speed can greatly increase the required stopping distance for any vehicle, which can lead to an accident.

Speed monitoring and enforcement

The Ontario Ministry of Transportation's Driver's Handbook states that drivers approaching any railway crossing at-grade should always slow down, be prepared to stop, and yield the right-of-way to a train. The investigation revealed that it was not uncommon for OC Transpo bus drivers to exceed the posted speed limit in the area of the crossing as they accelerated toward a section of the Transitway with a 90 km/h speed limit, north of the crossing, to make up time.

For public transit agencies, it is important that buses run on time. At OC Transpo, there were a number of factors that could have increased the pressure for an operator to speed. These included pressure from passengers, the schedule-adherence indicator on a driver's workstation display, and, if a route was completed early, the possibility of a longer break before starting the next route.

OC Transpo special constables are responsible for monitoring bus speed on the Transitway. Generally, OC Transpo considered speeding to be 12 km/h or more in excess of the posted speed limit. Prior to the accident, however, there is no record of special constables having issued any ticket or citation to a bus driver for speeding violations.

Following the accident, speed monitoring in the vicinity of the Transitway crossing conducted by the TSB determined that about 25 percent of buses still travelled above the posted speed limit, despite its reduction from 60 km/h to 50 km/h (31 mph). Consequently, the TSB determined that OC Transpo speed monitoring and enforcement on the Transitway in the vicinity of the crossing were not sufficient to prevent drivers from exceeding posted speed limits when approaching the crossing.

View of the approach to the crossing on the Transitway. The arrow identifies the tangent point of the curve. The circle identifies the occlusion point toward which drivers would make anticipatory glances. Note the large sign in the occlusion point.

Distracted driving

Drivers are constantly processing information and, although they can switch attention among multiple information sources, they can only pay attention well to one source at a time. Distraction occurs when a driver's attention is diverted away from activities that are critical for safe driving and toward a competing activity. In this occurrence, it is likely that two types of distraction played a role: visual and cognitive.

Visual distraction

To monitor the video screen above and to the left of the driver's workstation, a driver has to periodically glance upward at a significant viewing angle. This task is made more difficult by the small size of the displayed images, likely resulting in prolonged glances away from the roadway ahead.

OC Transpo required drivers to monitor this screen at station stops and while in service, and to announce that no standing was permitted on the upper deck if they saw passengers standing. However, some passengers would remain moving or standing on the upper deck after the bus was in motion as they continued to look for a seat. Therefore, a driver would need to periodically glance at the screen while the bus was in motion to monitor the small image of the upper deck.

Research has determined that a driver's glances away from the forward visual scene, especially glances lasting two seconds or longer, are significantly associated with accidents and near accidents.

Cognitive distraction

Just prior to departing the OC Transpo Fallowfield Station, the driver spoke to at least one passenger about the availability of seating on the upper deck. Once the bus was moving, the driver would have also been able to hear nearby passengers on the lower deck involved in similar conversations about seating; and the upper-deck view on the video monitor displayed a standing passenger near the top of the stairs. This combination of factors, along with the perceived need to make a no-standing-on-upper-deck announcement, created a situation where the driver was likely cognitively distracted in the seconds prior to the accident.

Research has shown that cognitively distracted drivers have slower reaction times, are more likely to miss critical visual stimuli, and may not adequately monitor their driving environment. They are also less likely to visually search intersections for approaching traffic and make fewer anticipatory glances when entering a curve on rural roads.

Distracted driving guidelines

In 2009, the Province of Ontario enacted distracted driving legislation that bans the use of in-vehicle display screens and hand-held devices while driving. Exemptions are permitted for drivers of certain commercial vehicles, such as bus drivers, provided the screen is securely mounted and its use is considered essential for the operation of the vehicle.

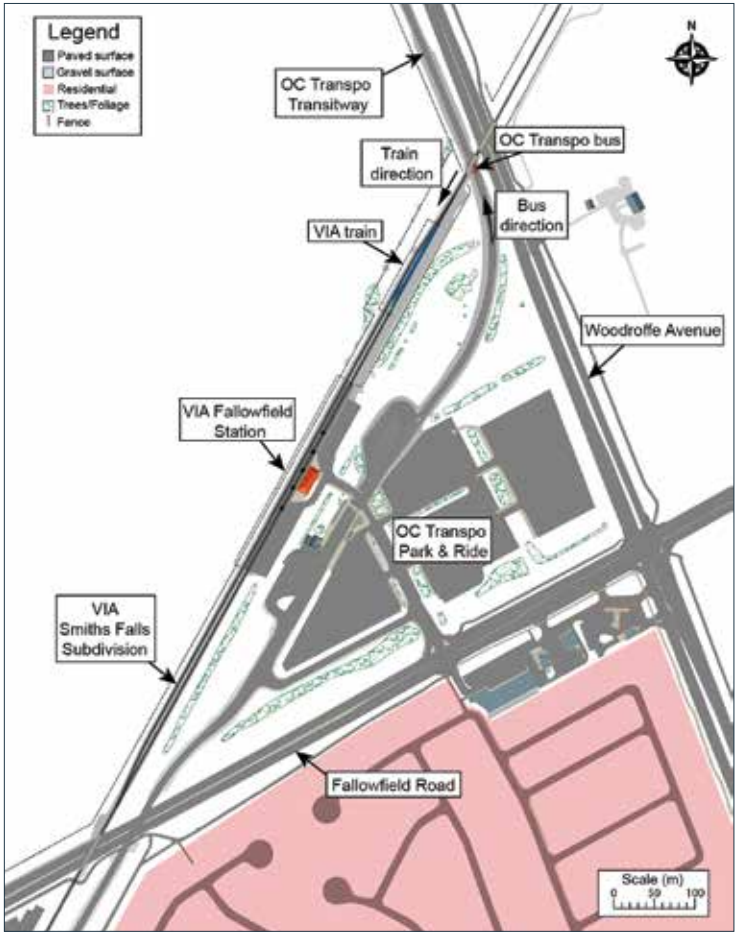
In 2013, the United States introduced driver distraction guidelines based on the principle that a driver should be looking at the road ahead rather than at an in-vehicle device. These guidelines, which are voluntary and apply only to light vehicles, include a recommendation to disable certain in-vehicle systems—such as video displays—unless a vehicle is parked. The guidelines also recommend that any active displays be positioned as close as practicable to the driver's forward line of sight.

Canada has no similar national standards or guidelines.

Configuration of the area

The railway tracks traverse Woodroffe Avenue and the Transitway at an angle of 50 degrees. Both crossings are equipped with active warning devices that include flashing lights, bells, and gates. At the time of the accident, these operated as designed; the bells and lights were activated about 49 seconds before the train arrived at the crossing, and the gates were fully horizontal at least 26 seconds prior to the accident.

Although the Transitway was built in accordance with established standards, its configuration, with a significant left-hand curve and relatively short approach to the crossing, proved to be problematic. For a bus travelling at the posted speed limit of 60 km/h, the recommended stopping sight distance (SSD) was 130 m (426.5 feet). At the time of the accident, the flashing lights and gates—even though they were activated before the bus left OC Transpo's Fallowfield Station—were obstructed by trees, shrubs, foliage, and Transitway signage. This reduced a northbound driver's SSD to 122.5 m (402 feet).



The new Transport Canada *Grade Crossings Regulations* (November 2014) now require that an approach with similarly reduced SSD be equipped with an active advance warning sign with lights that are interconnected with the crossing signals, to provide the driver advance warning of the train's approach.

Bus crashworthiness

The bus design met all applicable Canadian and United States legislative requirements, including the *Canada Motor Vehicle Safety Standards* (CMVSS). These standards vary according to a vehicle's weight and type. However, very few of these standards apply to the largest vehicles on today's roads, including tractor trailers, and most transit and inter-provincial buses.

By contrast, school buses must meet additional safety standards such as increased body strength, rollover protection, reinforced joints, and an interior free of sharp edges. Such features are designed to improve accident survivability by absorbing or directing impact forces away from occupants.

In this occurrence, the bus had no front bumper, and its front-end frame was not designed to provide impact protection. Unlike automobiles, which must meet stringent crashworthy performance testing requirements, the CMVSS contain no requirements for frontal impact, side impact, rollover, or crush protection for buses in this category. Although not required by regulation, a more robust front structure and crash energy management design might have reduced the damage to the bus and prevented the loss of a protective shell for the occupants.

Event data recorders

The lack of a dedicated event data recorder on the bus added months to the TSB's investigation, as investigators sought other sources of information and performed additional detailed, complex analyses.

In Canada, locomotives, as well as many commercial aircraft and vessels, are required to be equipped with data recorders. These units, often referred to as "black boxes," log numerous performance variables and are designed to withstand the forces involved in a crash.

Data recorders can provide valuable information about the circumstances and timing of an accident, allowing investigators to understand more fully what happened. The information can also be used proactively, in driver-training programs or in conjunction with company safety programs, to identify problems before an accident occurs.

The ongoing absence of event recorders on buses will continue to deprive all accident investigators of valuable information, which may prevent or delay safety action, and increase the risk that other bus accidents will occur in the interim.

Grade separation guidelines

There are approximately 15,000 public level crossings in Canada. Where daily train and vehicle traffic cross-product* is high enough, grade separation (i.e., overpasses or underpasses) should be considered. Historically, a cross-product of 200,000 was the accepted threshold used by Transport Canada and industry for considering grade separation. However, there is no indication of when, why, or how this threshold was established, nor is there any research to support it.

In Canada, the new *Grade Crossings Standards* (November 2014) identify cross-product thresholds at which level crossings are required to be protected by active warning devices (AWD) such as flashing lights, bells, and crossing gates; however, there are currently no regulations, standards or guidelines that identify when grade separation is mandatory—or even when it must be considered. In contrast, the United States Department of Transportation's *Railroad-Highway Grade Crossing Handbook* (2007) provides specific guidance as to when grade separation should be considered.

* The number of trains multiplied by the number of vehicles per day.

Grade separation

Originally, grade separations had been planned for Woodroffe Avenue, the Transitway, and Fallowfield Road using environmental assessments conducted in the late 1990s. There was public opposition to any roadway overpass structure, and the National Capital Commission (NCC) supported the public position. Consequently, overpass options were not considered in the environmental assessments, and the plan focused instead on the preferred option of a roadway underpass for each location. By February 2003, subsurface testing had determined that conditions were not suitable for underpass construction, and overpass alternatives were then reconsidered.

Although overpasses could have been built, the need to reopen the environmental assessments, the possible loss of time-limited funding, and the public and NCC preference for underpasses limited the options considered. Consequently, the City of Ottawa decided to install the level crossings with enhanced AWD protection based on known risk factors present in 2004.

By 2013, the area's population had increased by 45 percent, with a similar increase in the number of vehicles and average number of vehicle occupants. The number of passenger trains had increased by 130 percent, and some VIA trains travelled at two or three times the speed to which they had been limited in 2004. The cross-product for the Fallowfield Road crossing increased 116 percent, to just over 400,000, and the cross-product for Woodroffe Avenue increased 285 percent, to just under 700,000. The Transitway cross-product during that same period rose from 0 to over 23,000, with a corresponding train/vehicle/occupant cross-product of 532,703.

Since these risk factors will only increase with further urban and railway development, the existing crossing protection may no longer be adequate.

Safety action following the accident

Shortly after the occurrence, the TSB conducted a re-enactment of the accident and identified a number of safety issues. Over the following weeks and months, the TSB communicated critical safety information regarding the issues identified during the re-enactment, the monitoring of bus speeds in the vicinity, the importance of minimizing driver distraction, and the reported malfunction of some automated crossing protection.

The City of Ottawa has since improved driver sightlines in the vicinity of the Transitway crossing by trimming or removing trees, shrubs and foliage. Signage has also been enhanced—including by the addition of an advance warning sign with a light that continuously flashes—and the posted speed limit in both directions approaching the crossing has been reduced to 50 km/h.

OC Transpo and the transit union issued written directives to drivers, reminding them to follow the *Ontario Highway Traffic Act*, and to follow defensive driving practices.

Drivers were also reminded to watch for flashing lights at railway crossings, to follow the posted speed limits, and to always be prepared to stop. Transit supervisors and special constables have also undertaken speed monitoring in the area.

With respect to the risk of driver distraction, the City of Ottawa contracted consultants to review driver workload and other ergonomic aspects of bus operation. OC Transpo and the bus manufacturer are also exploring possible changes to the use and operation of video monitors on double-decker buses, and warning labels have been installed stating that standing is not permitted on the upper deck.

Finally, the City of Ottawa and VIA have developed standard operating procedures to better ensure safe operations in the event of a railway crossing malfunction. These procedures include a joint communications strategy and reporting protocols that would provide direct contact between the OC Transpo control room and VIA.

Watchlist – Railway crossing safety

The Watchlist is the TSB's list of issues that pose the greatest risk to Canada's transportation system. One of these issues is railway crossing safety, where the risk of trains and vehicles colliding remains too high.

Warning signs at both public and private crossings are the first line of defence to help reduce risk, by making drivers aware of crossings. Approximately one-third of public crossings in Canada have crossing gates and/or flashing lights and bells. Despite these warning devices, collisions between vehicles and trains continue to occur, including this one.

Transport Canada has recently implemented new *Grade Crossings Regulations;* however, a comprehensive solution must also include consultation with provincial authorities and further public driver education on the dangers at railway crossings.

Findings as to causes and contributing factors

The report also contains 17 findings as to risk. Although these did not lead directly to the accident, they are related to unsafe acts, unsafe conditions or safety issues with the potential to degrade rail safety, including:

- the lack of mitigating strategies to reduce bus driver distraction
- the lack of guidance as to when grade separation for crossings should be considered
- the lack of adequate crashworthiness standards for transit buses
- the lack of crashworthy event data recorders on passenger buses
- the lack of guidance as to whether buses should stop at all railway crossings

TSB Recommendations

Recommendation	The Board recommends that
R15-01 (December 2015)	the Department of Transport, in consultation with the provinces, develop comprehensive guidelines for the installation and use of in-vehicle video monitor displays to reduce the risk of driver distraction.
R15-02 (December 2015)	the Department of Transport develop and implement crashworthiness standards for commercial passenger buses to reduce the risk of injury.
R15-03 (December 2015)	the Department of Transport require commercial passenger buses to be equipped with dedicated, crashworthy event data recorders.
R15-04 (December 2015)	the Department of Transport provide specific guidance as to when grade separation should be considered.
R15-05 (December 2015)	the City of Ottawa reconsider the need for grade separation at the Woodroffe Avenue, Transitway, and Fallowfield Road level crossings**.**

Conclusion

This accident was not caused by one single person, action, or organization. Many factors played a role, and addressing the safety issues will take a concerted effort from the City of Ottawa, OC Transpo, bus drivers, provincial authorities and Transport Canada. Although this investigation is complete, the TSB will continue to monitor actions taken on these recommendations and report publicly on any progress—or lack of progress—until these recommendations are fully addressed.

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