RAILWAY OCCURRENCE REPORT
R96S0106

TRESPASSER FATALITY

VIA RAIL CANADA INC.
TRAIN NO. 76
MILE 98.65, CHATHAM SUBDIVISION
TECUMSEH, ONTARIO
12 JULY 1996

Transportation Safety Board
of Canada

Bureau de la scurit des transports

du Canada

Railway Occurrence Report

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Synopsis

On 12 July 1996, at approximately 1450 eastern daylight time, VIA Rail Canada Inc. eastward passenger train No. 76 struck and fatally injured a pedestrian at about Mile 98.65 of the Canadian National Chatham Subdivision in the town of Tecumseh, Ontario.

The Board determined that the pedestrian used the railway right-of-way as a short cut and that this placed her in imminent danger. Further, the sound of the locomotive horn of the approaching train did not become audible in time for the pedestrian to localize its source, decide on a course of action and execute the action before being struck by the train. The ineffectiveness of the locomotive horn as a warning device was a result of some combination of factors related to the attention-demanding qualities of the horn, as well as its forward-projecting intensity in the existing circumstances. These factors include the pedestrian's responsiveness to the sound of the horn, the spectral composition of the sound, competing background noise, the wind and the position of the horn on the locomotive.

Contributing factors in this accident include the absence of adequate fencing, signage and enforcement to act as a deterrent to trespassing, and the ineffectiveness of community, societal and formal educational efforts to equip the pedestrian with the necessary knowledge to have chosen an alternative route.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 The Accident

At approximately 1450, the locomotive engineers of eastward VIA Rail Canada Inc. (VIA) train No. 76 (VIA 76) observed two pedestrians walking eastward on the track as the train approached the Tecumseh Road public level crossing at Mile 99.13 of the Canadian National (CN) Chatham Subdivision in Tecumseh, Ontario. The locomotive engineer at the controls sounded the locomotive horn for the crossing and continued to sound short blasts after the crossing to warn the pedestrians of the approaching train. Noting that the pedestrians were not responding to the horn, he initiated a full service application of the train brakes, followed almost immediately by an emergency application of the train brakes. The pedestrians attempted to move clear just as the train was upon them. One pedestrian jumped to the south of the tracks and was not hit. The other, holding a bicycle, attempted to jump to the north but was struck by the left front corner of the locomotive and fatally injured.

The two pedestrians, sisters, ages 11 (deceased) and 15, were on their way from their home on the south side of the track to a restaurant on the north side of the track. They were engaged in conversation as the train approached and were not actively listening for the sound of a train. When the older sister heard the train's horn coming from behind them, she told her sister that they would have to get off the tracks; however, she did not say it with great urgency because she thought that the train was much further away. They immediately began to exit the tracks and turned to see that the train was upon them.

It was common practice for the older sister and her friends to use the railway right-of-way as a shortcut; however, the younger sister had not previously used this route. Although the older sister was aware that trains were potentially dangerous, she had used this route successfully on many occasions, without adverse consequences, and therefore believed that the risk was minimal.

Neither of the sisters had any known hearing impairment.

1.2 Weather

At the time of the accident, the weather conditions were observed as clear, with moderate variable winds gusting from the south-east, a temperature of 21 degrees Celsius and no precipitation.

[1] All times are eastern daylight time (Coordinated Universal Time (UTC) minus four hours) unless otherwise stated.

1.3 Train Information

VIA 76, a Light, Rapid, Comfortable (LRC) passenger train consisting of locomotive No. 6421 and four coaches, was travelling from Windsor, Ontario, to Toronto, Ontario. It weighed 370 tons and was about 400 feet in length. The train was travelling at approximately 83 mph when the brakes were first applied. Maximum permissible speed for that train at that location was 95 mph.

1.4 Personnel Information

VIA 76 had a crew of four, consisting of a conductor in the second car behind the locomotive, an assistant conductor in the last car of the train, and two locomotive engineers in the locomotive. They were qualified for their respective positions and met fitness and rest standards.

1.5 Chatham Subdivision

The CN Chatham Subdivision extends from Windsor (Mile 105.6) to Komoka, Ontario (Mile 7.1), the junction with the CN Strathroy Subdivision. According to the current timetable, the speed limit for eastward and westward passenger trains between Mile 105.6 and Mile 104.4 is 30 mph, increasing to 45 mph between Mile 104.4 and Mile 103.6, 50 mph between Mile 103.6 and Mile 101.0, then to the maximum speed of 95 mph between Mile 101.0 and Mile 75.6.

1.6 Engine Whistle Signal

Rule 14, subsection (iii) (l) of the Canadian Rail Operating Rules (CROR) requires the sounding of two long blasts, one short blast and one long blast of the locomotive horn, as follows:

> (i) At every whistle post.
>
> (ii) At least one-quarter of a mile from every public crossing at grade, (except within limits as may be prescribed in special instructions) to be prolonged or repeated according to the speed of the movement until the crossing is fully occupied by the engine or cars.

Subsection (iii) (f) of Rule 14 requires the sounding of a succession of short sounds as:

> Alarm for persons or animals on or near the track.

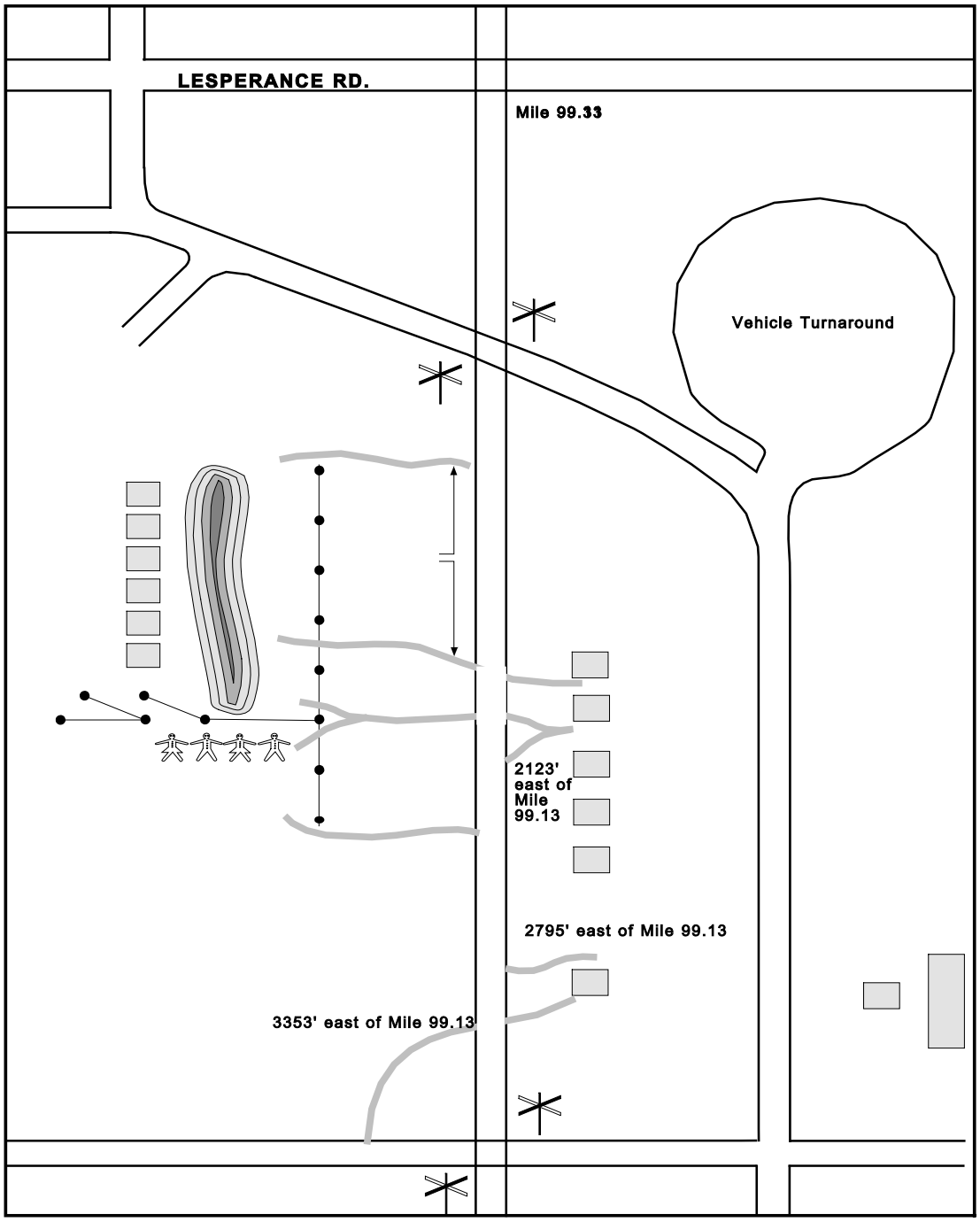
1.7 Recorded Information

Data extracted from the event recorder of the locomotive indicate that the locomotive horn was sounded frequently approaching the point of collision. At a recorded time of 1449:06.0, the bell and horn were activated, the throttle was in the No. 8 position and the speed was 47 mph. At 1451:14.9, the bell and horn were activated, the throttle was reduced to the idle position and speed was 83 mph, brake cylinder pressure was at 0 pounds per square inch (psi) and brake pipe pressure was at 92 psi. Between 1451:15.9 and 1451:24.7, the bell and horn continued to activate, the throttle remained in idle, speed decreased from 83 mph to 80 mph, brake cylinder pressure increased from 0 psi to 57 psi and brake pipe pressure decreased from 92 psi to 68 psi. One second later, at 1451:25.7, a digital automatic brake valve indicator appeared, indicating an emergency brake application. The horn was sounded until 1451:33.0, after which only the bell was sounded until the train stopped at 1452:15.0.

1.8 Method of Train Control

The Chatham Subdivision is governed by the Occupancy Control System (OCS) of the CROR and supervised by a CN rail traffic controller (RTC) located in Toronto.

1.9 Occurrence Site Information



In the immediate vicinity of the occurrence site, the subdivision consisted of a single, tangent, east/west main track. Tecumseh Road intersects the main track at Mile 99.13 and turns east approximately one block north of the right-of-way. The road then parallels the main track, separated from the track by private lands. There were no barriers to restrict access to the railway right-of-way. Between Mile 99.13 and the Manning Road crossing,

Mile 98.42, land north of the right-of-way was zoned commercial although both private dwellings and commercial operations were evident.

A residential subdivision was under construction on the south side of the main track, approximately 380 feet east of the Tecumseh Road crossing. A six-foot chain-link fence began at this point and extended east for 2,125 feet, separating the railway right-of-way from the residential land and a community park and outdoor playground that was just east of the neighbourhood. The fence had been previously cut through at one location, and holes had been dug under it at two other locations. A berm had been constructed south of the fence to act as a visual and auditory barrier between the railway right-of-way and the houses. At the east end of the fence, a well-worn path led from the playground to the main track. The two pedestrians walked through the playground and entered the railway right-of-way at this location. Further east, a distance of 285 feet, another well-worn path led north to privately owned property and a cluster of commercial outlets. This was the intended exit path of the two pedestrians. From the east end of the chain-link fence eastward to Manning Road, access to the railway right-of-way was unrestricted. The land was vacant and zoned residential. Immediately adjacent to the track, there was a swampy ditch with considerable underbrush extending to the Manning Road crossing.

The railway main track separated a variety of businesses on the north side of the track from the residential area on the south side. These businesses included coffee shops, restaurants, a video store and arcade, fast-food outlet, ice cream parlour, drug store and other merchandising outlets.

West of Mile 99.13, access to the main track was unrestricted. Adjacent land use was a mix of commercial and residential on both sides of the track.

The site is within several miles of Windsor Airport and in the direct flight path of arriving and departing aircraft. Noise generated by aircraft frequently passing over this area can be heard from the ground.

1.9.1 Foot Paths

Eastward from Tecumseh Road toward Manning Road, a total of five paths were identified on the south side of the track extending from the adjacent land to the railway right-of-way as follows at:

1) 380 feet east, a path extended around the west end of the fence to the track;
2) 1,250 feet east, a path extended through a hole cut in the chain-link fence to the track;
3) 2,073 feet east, two paths extended from two separate holes dug under the fence, converging into one path to the track;
4) 2,507 feet east, a path extended around the end of the chain-link fence to the track (used by the two pedestrians to enter the railway right-of-way); and
5) 3,353 feet east, a path extended from the track eastward, parallel with the main track, for 395 feet to Manning Road.

On the north side of the track, three of the five south-side paths continued across and onto adjacent land. These paths were at 1,250 feet, 2,073 feet and 3,353 feet from Tecumseh Road. Two additional paths were at 2,123 feet and 2,795 feet east of Tecumseh Road.

1.10 Locomotive Horn and Human Response

1.10.1 VIA 6400 Series Locomotive Horns

The horn used on VIA 6400 series locomotives is a K-3-L AirChime. A full blast of the K-3-L AirChime produces acoustical energy in three frequencies: 311, 370 and 470 Hz (cycles/second). The horn comprises three trumpets, each facing forward. The horns are mounted approximately 6.5 m from the front of the locomotive on the top of the engine compartment. The mounting bracket is directly behind the exhaust stacks. The exhaust stacks rise approximately 15 cm above the engine compartment and above the bottom portions of the flutes.

1.10.2 Regulatory Requirements

General Order 0-25 of the Canadian Transport Commission, Regulations Respecting Devices for the Sounding of Engine Whistle Signals and Respecting Engine Bells, specifies the current requirements for such devices on federally regulated railways in Canada. The regulations state, in part:

> Road Service
>
> Motive Power A units operated regularly or temporarily in road service, including road-switching units, shall be equipped with horns having tonal characteristics simulating the sound of conventional steam locomotive whistles. The horns shall be tuned in chords of not less than three tones to produce a harmonious sound, and the grouping and location of the horns shall be such as to make the sound practically omnidirectional and suitable for the effective sounding of the prescribed engine whistle signals.

The regulations do not set requirements either for the sound frequencies or for the amount and pattern of acoustical energy that must be present at specified distances omnidirectional from a stationary or moving locomotive.

In consultation with the Railway Association of Canada, Transport Canada has developed a draft rule entitled Rules Respecting Devices for the Sounding of Engine Whistle Signals and Respecting Engine Bells. The most current draft is dated 16 May 1990. This rule would require that locomotives be equipped with an air-operated warning device that will produce, in advance of the motive power unit, in the direction of travel, a minimum sound level of 96 dB(A) at any location on an arc of 30.5 m radius subtended at the front of the motive power unit by angles 45 degrees to the left and to the right of the centre line of the track in the direction of travel.

The requirements of this standard are consistent with Federal Railroad Administration (FRA) requirements, which all road locomotives built in North America are designed to meet.

1.10.3 Relocation of Locomotive Horns

Historically, locomotive horns (whistles) were mounted on the front of the locomotive. Subsequent to concerns raised by operating crews about hearing loss, the railways commissioned a study in the early 1980s to determine the effects of alternative placement of locomotive horns. The study found that, although a mounting similar to that on the VIA 6400 series locomotives resulted in decreased sound levels in the cab environment, there was also a decrease in the level of sound measured at a distance of 30.5 m (100 feet) from a stationary locomotive, reducing its effectiveness as a warning signal. Consequently, the study concluded that the ideal placement of locomotive horns was "as high and as far front as reasonably practicable," and horn noise levels within the cab could be reduced by rubber-mounting the horn/bell assembly and sound-proofing the cab. At a distance of 30.5 m (100 feet) from the stationary locomotive, sound levels were approximately 108 dB with the horn mounted on the top front of the locomotive operating cab, 2.7 m behind the front of the locomotive, and approximately 102 dB with the horn mounted 7 m behind the front of the locomotive.

1.10.4 Reaction to Locomotive Horn

It is generally assumed that an individual on or near a railway track, on hearing a locomotive horn, will take appropriate action to avoid the approaching train. An effective warning device provides sufficient time for an individual to identify and respond to the danger. In the case of a locomotive horn, "sufficient warning time" is a factor of two types of variables: train-related and variables associated with human response to auditory warnings. Train-related variables include direction of travel, speed and distance from point of impact. Variables associated with human response to auditory warnings involve the processing of information through a series of stages. These stages include sound identification, sound localization, decision making and response execution.

1.10.4.1 Identification of Sound

Early information processing stages rely primarily on the senses to "detect" a warning. Researchers use the term "detection" to denote an awareness of the presence of a sound, while the term "audibility" is used to denote the recognition of the identity of a sound, hence involving higher order cognitive processes such as long-term memory. A number of factors are known to affect a normal hearing listener's capability of hearing a sound, including:

1) actual sound level;
2) competing sounds that attract the attention of the listener;
3) responsiveness of the listeners (e.g., are they preoccupied?); and

[2] Robert E. Swanson and Associates. 1982. *The Loudness in the Cab vs. Loudness at RRY Crossings.*

4) background sounds that might mask the warning sound.

Research has shown that, for a signal to be audible, the sound must be 9 to 10 dB greater than the level of detectability. However, if 100 per cent detectability is desired, a level of up to 18 dB greater than the level of detectability is recommended. It should also be noted that a listener frequently exposed to the same sound may eventually become less cognizant of its presence.

1.10.4.2 Localization of Sound

In addition to identifying the sound as a warning signal, as in the case of a locomotive horn, the sound must be localized by the listener. The ability to localize sounds depends primarily on differences in intensity and arrival time between the two ears. However, localizing a sound source is much more difficult if the sound source is directly in front of or behind the listener, since differences in intensity and arrival time are minimal. Under these conditions, there are a number of factors that can influence judgements of sound location, including:

1) individual expectations of the source of the sound, which can result in a reversal in apparent location;
2) spectral composition (frequencies) of the sound with respect to determining direction, with higher frequencies (>7,000 Hz) being more accurately localized;
3) spectral composition of the sound with respect to determining distance, with the perception that sounds composed primarily of low-frequency components originate from a more distant source than the perceived location of higher frequency sounds; and
4) head movements, which will enhance localization by providing differences in intensity and arrival time.

Thus, when the sound is directly in front of or behind the listener, the main cues used to localize the sound source are differences in intensity and arrival time at the two ears, generated by head movements. Without head movements, one study reported a 20 per cent error rate for normal hearing subjects in their ability to localize a sound source.

1.10.4.3 Decision Making

After detecting and identifying an auditory warning, the individual must make a decision regarding appropriate action. It should be noted that, as the number of actions from which to choose increases, so too does response time. Furthermore, in unrestricted or ill-defined "choice" circumstances, as may be the case when the individual is in a novel situation, the increase in decision time can be quite significant.

1.10.4.4 Response Execution

[3]Blauert (1983), cited in K. R. Boff and J. E. Lincoln. *Engineering Data Compendium: Human Perception and Performance*. AAMRL: W

If the individual decides an action is necessary, time is required to initiate and carry it out. The time required to execute the response action depends on the complexity of the action to be taken and the physical ability of the individual involved.

1.11 Tecumseh Train Audibility Study

The Transportation Safety Board of Canada (TSB) and the Defence and Civil Institute of Environmental Medicine (DCIEM) conducted a collaborative study to determine the physical characteristics of the auditory environment at the Tecumseh occurrence site and to develop a better understanding of why the pedestrian did not respond in time to avoid being struck by the approaching train. Over the course of two days at the occurrence site, nine regularly operating VIA passenger trains were recorded using calibrated microphones. DCIEM measured the time interval between when observers, instructed to listen for the sound of a locomotive horn, first detected the train and when the train passed the observers, based on a train travelling at the nearest tested train speed of 84 mph. The study revealed three important findings regarding detection of the locomotive horn for subjects expecting this auditory warning.

1) The background noise at the site was approximately 55 dB. Under these conditions, observers detected the locomotive horn approximately 25 seconds before the train passed. Peak intensity of the locomotive horn did not exceed 57 dB until approximately five seconds before the train passed, at which point intensity climbed up to the maximum level measurable on the instrument, 110 dB.

2) The sounds of female conversation and a moving bicycle increased the background noise to approximately 62 dB. However, this increase in background noise did not decrease the time between when observers first detected the horn and when the train passed them.

3) The sound of an aircraft flying overhead increased the background noise, which peaked at approximately 75 dB, 16 seconds before the train passed. In this condition, observers detected the locomotive horn only nine seconds before the train passed.

It is important to note that, unlike the two pedestrians, the test subjects were specifically listening for a locomotive horn. Studies indicate that human reaction times are significantly improved when the subject anticipates the stimulus.

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[4] A sound level of 57 dB is still slightly below the 60 dB level of normal conversation (at 1 m). *Fundamentals of Physics, Extended*. (4th Edition) by David Holliday, Robert Resnick & Jeasl Walker / John Wiley & Sons Inc. 1993 [page 511]

[5] C.D. Wickens (1992). *Engineering Psychology and Human Performance*. New York, Harper Collins Publishers Inc.

1.12 Additional Audibility Considerations

The DCIEM study addressed a number of factors related to background noise and the time required to detect a locomotive horn. However, there are a number of other factors that directly concern the audibility of locomotive horns. It was noted subjectively that the sound projected from the locomotive horn in the forward direction, through the hot exhaust gases and over the front of the locomotive, was garbled; while at right angles to the track, at a distance of approximately 100 feet, it sounded clearer. A study conducted for the FRA concluded that, for optimum projection of sound, the streams of cooling air or stack gas should not be in the path of the sound (i.e., in front of the horn's trumpets).

Wind blowing in the opposite direction from the train could attenuate the sound of the locomotive horn by as much as 20 dB at distances beyond 1,800 feet (15 seconds away).

The Doppler effect refers to the fact that the sound waves emanating from a moving object tend to cluster in front of the object, thereby decreasing the distance between successive waves and increasing the frequency. Higher frequency sound waves correspond to higher pitch sounds for a listener. It is expected that the effect of the Doppler shift on the sound spectrum would be very small because of the relatively slow speed of the locomotive (84 mph) compared to the speed of sound in air, approximately 770 mph.

The DCIEM study did not investigate the time required to localize the locomotive horn, decide upon a course of action and execute that action. Additional studies would be required to determine the approximate range of reaction times expected under the particular circumstances of this occurrence.

1.13 Trespassing

1.13.1 Regulatory Provisions and Past TSB Recommendations

The *Railway Safety Act*, proclaimed on 01 January 1989, superseded portions of the *Railway Act* dealing with safety. Under section 384 of the *Railway Act*, it had been an offence to trespass by foot on railway properties as follows:

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[6] J.P. Aurelius and N. Korobow (1971). *The Visibility and Audibility of Trains Approaching Rail-Highway Grade Crossings*. Report No. FRA-RP-71-2 prepared for the Federal Railroad Administration, U.S. Department of Transportation, Washington, D.C.

[7] B. Seshagiri and B. Stewart (1992). *Investigation of the Audibility of Locomotive Horns*. Am. Ind. Hyg. Assoc. J., 53, 726-735.

> 384. (1) Every person who without authority therefore from the company enters on or trespasses on the yard or track of the company, except where the yard or track is laid across or along a highway, is liable on summary conviction to a penalty not exceeding twenty dollars.

At the time of its proclamation, the *Railway Safety Act* did not contain any similar prohibition.

The National Transportation Agency of Canada (NTA) investigation reports of accidents involving persons fatally injured on railway property, 07 January 1989, at Sault Ste. Marie, Ontario, and 08 January 1989, at Keith, Alberta, recommended to Transport Canada that section 384 of the *Railway Act* should be reinstated to allow enforcement activity to deter unauthorized transit on railway rights-of-way. Amendments to the *Railway Safety Act*, effective in 1994, included the following:

> No access to line works
>
> 26.1 No person shall, without lawful excuse, enter on land on which a line work is situated.

An accident on 30 May 1990, near the community of Cobourg, Ontario, resulted in a nine-year-old child losing his leg while attempting to ride the side of a moving train. Following the investigation, the Board recommended that:

> The Department of Transport establish minimum standards for the type, location and requirement for fencing along railway rights-of-way approaching railway bridges and any other areas where frequent pedestrian incursions are known; and
>
> (R91-01, issued February 1992)

> The Department of Transport take whatever measures are necessary to ensure that law enforcement officers have the necessary legal basis to take deterrent action against unauthorized persons on railway rights-of-way or trestles.
>
> (R91-02, issued February 1992)

Transport Canada had proposed the inclusion of reference to the trespassing provisions, section 26(1) of the *Railway Safety Act*, into the amendments to the regulations pursuant to the *Contraventions Act*. These measures would make it possible for a police officer to use federal legislation to issue a ticket to a person

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[8] "line work" means
(a) a line of railway, including any structure supporting or protecting that line of railway or providing for drainage thereof;
(b) a system of switches, signals or other like devices that facilitates railway operations; or
(c) any other structure built across, beside, under or over a line of railway, that facilitates railway operations, but does not include a crossing work.

trespassing on railway rights-of-way. At the time of this occurrence, this amendment had not been passed into law.

The Rail Safety Directorate of Transport Canada prepared a guideline entitled "Procedures for Prevention of Trespassing" on 07 December 1992. The guideline presents, through a number of preventive measures, a procedure to prevent trespassing before a problem exists and after a problem has been identified through accident history. These measures focus on education, enforcement, fencing, access, signage, train operations and urban planning as well as working with municipalities, land developers, railways and regulators.

At the time of the occurrence, the Town of Tecumseh was not aware of the existence of Transport Canada's guideline "Procedures for Prevention of Trespassing." During the planning stages of the housing development adjacent to the accident site, the Town of Tecumseh had contacted Transport Canada for guidance respecting the railway right-of-way. Transport Canada provided advice on the requirements for developing land adjacent to a "line work." The municipality's request was made to Transport Canada before the guideline was available. No other information on the prevention of trespassing was provided to the Town of Tecumseh by Transport Canada at that time.

1.13.2 Operation Lifesaver

Operation Lifesaver is a program designed to educate students and municipalities in the dangers inherent to train operations. It is operated through the Railway Association of Canada and its member railways and is supported by Transport Canada. Programs offered by Operation Lifesaver incorporate input from accident victims, railway employees, police officers and educators. The program targets locations identified as high risk through accident history and responds to individual requests from schools and municipalities. The community of Tecumseh had not been visited by Operation Lifesaver for several years before the occurrence. Since this occurrence, Operation Lifesaver has targeted and delivered its program to the school that the pedestrian had attended.

1.14 Fencing

1.14.1 Federal Requirements

Section 217 of the *Railway Act* stated in part:

> (1) The company shall erect and maintain on the railway
>
> (a) fences of a minimum height of four feet six inches on each side of the railway;
>
> (3) Fences, gates and cattle-guards shall be suitable and sufficient to prevent cattle and other animals from getting onto the railway lands.

> (4) The Commission may, on application made to it by the company, relieve the company, temporarily or otherwise, from erecting and maintaining fences, gates and cattle-guards where the railway passes through any locality in which, in the opinion of the Commission, those works and structures are unnecessary.

Section 217 of the *Railway Act* was repealed in October 1995. Railways under federal jurisdiction had agreed to abide by the principles of this statute and any exemptions that had been issued until new legislation became effective. Transport Canada has consulted stakeholders on proposed regulations for fencing to address trespassing on several occasions; however, no regulations have been finalized.

1.14.2 Municipal Requirements

Tecumseh Municipal By-law No. 1934, respecting fencing to be erected within the municipal limits of the town, was passed on 11 December 1989. The following summarizes elements of the by-law relevant to this occurrence:

1) a permit to erect a fence is required;
2) any fence erected must be lawful;
3) all fences must be ornamental or chain-link type or wire fencing construction not out of conformity with the character of the neighbourhood;
4) a fence cannot be constructed which is inherently dangerous;
5) a fence cannot be constructed within 30 feet of a roadway or intersection;
6) a fence is not permitted in side or rear yards greater than six feet above adjoining ground level; and
7) a fence is not permitted composed wholly or partly of barbed wire or other barbed material, except along the top of any fence enclosing commercial or industrial property providing said fence is seven feet in height or greater.

No municipal by-laws for the application and maintenance of signage involving trespassing, caution or the warning of danger involving the railway property existed at the time of the occurrence.

1.15 Information from the Ontario Provincial Police (OPP)

The police investigation of this accident concluded that one of the two pedestrians on the railway right-of-way was struck by a train and sustained fatal injuries.

A local police effort in the schools, called the Values, Influences, Peers (VIP) program, is aimed at educating school children in the cost of vandalism, social influences and peer pressures. This program briefly touches on the dangers of playing near railway tracks (i.e., throwing stones and debris at passing trains and other very broad subjects relating to trains). The school that the pedestrian had attended hosted this program in the

1995-1996 school year. The OPP is considering increasing the content of this program to include a more in-depth look at trespassing and the dangers associated with trains and railway tracks.

1.16 Municipal Development Agreement

On 14 January 1992, the Town of Tecumseh entered into an agreement with a land developer respecting the land adjacent to, and south of, the railway right-of-way, granting approval for the residential development. The following items were gleaned from the agreement that reflect involvement of the railway and the railway right-of-way. The following references do not quote the actual items of this agreement but rather paraphrase the contents:

1) installation of berm and fencing is required to separate the railway right-of-way from residential properties;
2) fenced walkways are required within designated parklands;
3) purchasers of properties must be notified of berm and fence requirements;
4) lots 217, 218 and 219, approximately 2.43 hectares, must be designated as parkland;
5) no habitable portion of any building may be closer than 30 m from the CN lands;
6) alterations of existing drainage patterns affecting the CN property or right-of-way are prohibited;
7) a community noise study must be performed; and
8) a separate noise study must be performed on the designated parkland by an acoustical consultant.

The agreement also requires that the following CN concerns be addressed:

1) a noise and vibration study to be performed must be acceptable to CN;
2) a safety berm, minimum 2.5 m above grade, parallel to the CN right-of-way, shall be constructed;
3) all offers to purchase or lease dwellings will include a clause advising of the railway right-of-way; and
4) owners will install and maintain in good condition a six-foot chain-link fence along the mutual property line.

1.17 TSB Trespasser Accident Statistics

TRESPASSER ACCIDENTS AND RATE - 1992-1997 (Total Freight and VIA Passenger as Reported to the TSB)

	Occurrence Year						
Train Type	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**Avg.**
FREIGHT (AND OTHER)*	73	80	82	90	100	74	83
TRESPASSER ACCIDENT RATE (PER MTM) **	1.07	1.15	1.08	1.26	1.45	1.04	1.2

VIA PASSENGER	20	20	12	17	21	15	17.5
TRESPASSER ACCIDENT RATE (PER MTM)	3.09	3.07	1.84	2.73	3.25	2.27	2.71

* Track units, work trains, mixed freight

** MTM - million train-miles

2.0 Analysis

2.1 Introduction

There were no facts to suggest that the operation of VIA 76 was not in compliance with existing regulations and company operating instructions just before the occurrence. The eastward train had entered the 95 mph speed zone and had not achieved the maximum allowable speed. While sounding the locomotive horn for the public level crossing at Mile 99.13, the operating locomotive engineer noticed two pedestrians walking eastward pushing a bicycle between them. He continued to sound the locomotive horn with a succession of short blasts. When he felt that they were not responding, he initiated a full service application of the brakes, followed almost immediately by an emergency application of the train brakes, while still sounding the locomotive horn. One of the two pedestrians responded in time to move clear of the approaching train. The other was struck and sustained fatal injuries.

In this occurrence, two apparently normal-hearing pedestrians, walking on train tracks, were not alerted to the approach of a train by conventional warning devices in time for both of them to avoid being struck. Although it is indisputable that the deceased pedestrian and her sister were on private railway property without permission, safety systems in place to prevent this occurrence were unsuccessful. Further, the frequency of accidents with similar consequences across Canada and the emotional toll on the families, communities and railway operating crews involved warranted an in-depth investigation.

The analysis will address the locomotive horn as an auditory warning, societal views regarding trespassing on railway property, deterrents to trespassing, municipal responsibilities and regulatory overview.

2.2 Failure of Locomotive Horn to Provide Adequate Warning Time

The DCIEM study indicated that, under reasonably similar background noise conditions, observers instructed to identify the sound of the locomotive horn could do so, on average, 25 seconds before a train arrived. However, the test study also suggests that the sound intensity of the horn did not exceed that of the background noise (approximately 60 dB) until five seconds before the pedestrian was struck. The most significant difference between the DCIEM scenario and the one encountered by the two girls is that they were not actively listening for the sound of the locomotive horn; they were pushing a bicycle and talking to each other. Under these circumstances, individuals would take longer to recognize the presence of an audible warning. They would then also have to localize the sound source, decide on a course of action and execute that action. Consequently, the amount of time the pedestrians had to react to the locomotive horn was considerably less than 25 seconds.

There are a number of additional factors that may have reduced the effectiveness of the locomotive horn as a warning device. Competing sounds in the environment can mask the auditory warnings or attract the attention of the listener, or both. The occurrence site is in direct line with one of the flight paths to the Windsor Airport. There were no scheduled aircraft taking off or landing at the time of the occurrence, but the possibility exists that there were aircraft in the vicinity. The sound generated by an aircraft was measured during TSB/DCIEM

testing at Tecumseh. When superimposed on the sound of an approaching train and played back for a number of listeners instructed to discern the sound of a locomotive horn, the aircraft noise effectively masked the sound of the horn. If such a situation existed at the time of the occurrence, it is likely that the two pedestrians would have had very limited time to respond. An almost infinite number of sources, both environmental and man-made, could have been potential sources of competing noise, including the bicycle being pushed along the ballast and ties between the two pedestrians, vehicular traffic and discussion between them.

It must also be considered that the pedestrians, who resided in proximity to the tracks, were accustomed to the sounding of the locomotive horn. Day-to-day exposure to the auditory warning of the locomotive horn may have diminished its ability to actively draw the attention of the pedestrians to the approaching train, thereby reducing its effectiveness as an alerting or warning device.

The location of the horn on VIA locomotive No. 6421, midway back on the top of the locomotive, recessed below a barrier and directly behind the exhaust stack, does not optimize the intensity of forward-projected sound. To increase the probability that an auditory warning is heard, its intensity should be as loud as practicable. Despite studies indicating that, for optimum effectiveness, locomotive horns should be mounted as far forward on the locomotive as possible, the railway industry continues to mount the locomotive horn midway back. This position results in a decrease in the intensity of sound projected forward, although the measured intensity still exceeded the 96 dB FRA standard. It is recognized that this location was chosen to alleviate noise within the locomotive cab during sounding of the horn. However, it is also recognized that alternative intra-cab noise reduction measures, such as insulation of the locomotive cab against sound penetration or rubber-mounting of the horn, were rejected in favour of relocation of the locomotive horn.

Several studies suggest that the projection of sound through the exhaust gases has a negative impact on the transmission of the sound. In addition, attenuation of sound from the locomotive horn caused by the moderate south-east winds toward the approaching locomotive might have delayed the detection and identification of the locomotive horn by the pedestrians.

Localization of the train may have been compromised by the relative location of the pedestrians and the train. The train was directly behind the pedestrians, creating an auditory environment in which humans are notably poor in localizing sound sources, particularly sounds composed of

frequencies below 7,000 Hz, such as the locomotive horn (311, 370 and 470 Hz). The low frequencies of the locomotive horn would have resulted in the pedestrians' perceiving the train to be farther away than it was.

When the pedestrians finally responded to the locomotive horn, one person made the decision to jump south of the right-of-way and did so, narrowly evading the train. The other pedestrian's chosen course of action was to move to the north of the right-of-way and may have included removing the bicycle from the track. The additional task of removing the bicycle would have increased the time necessary for the pedestrian to escape from the train's path.

It can be concluded that the sound of the locomotive horn did not become audible to the pedestrian in time for her to recognize the danger and then escape it. Several factors that could have reduced the horn's effectiveness have been identified. Considered individually, these factors can only be described as possibly contributing to the accident. However, when considered collectively, it is almost certain that some combination of these factors degraded the horn's effectiveness.

2.3 Deterrents to Trespassing

2.3.1 Education

The presence of numerous foot paths, holes cut into or holes dug under existing fences and observations of additional trespassers in the vicinity of the occurrence site indicate that pedestrian use of the railway right-of-way was very common in this area. In the absence of adequate deterrents, the characteristics of this location, with a main track separating a residential subdivision and playground from commercial outlets, resulted in an environment in which trespassing flourished.

Several strategies commonly used to deter trespassing are education, fencing and law enforcement. In the face of public perception, education as a deterrent to trespassing is a very difficult task. Popular culture often depicts pedestrian use of railway rights-of-way in a non-threatening, even glamorous manner. Movies, music videos, television, newspapers and art often show people on train tracks engaged in everyday activity. These influences, along with the absence of negative consequences to repeated incidences of trespassing, may desensitize people to the potential danger and unlawfulness of trespassing.

Educational deterrents include programs such as Operation Lifesaver and the OPP's VIP program. The target audience of these programs is school children, who are at an age when they are more likely to engage in risky behaviour and who often do not perceive the danger as being real or applicable to them. The demands on the limited resources of Operation Lifesaver are such that this program is unable to educate continuously on a proactive basis but must

sometimes focus on communities in which accidents have recently occurred. In addition, the curriculum of the OPP's VIP program is broad-based, limiting its coverage of train-related danger.

2.3.2 Fencing

Fencing separates people from danger or acts as a barrier to prevent the unlawful occupancy of land. However, fencing alone will not completely deter trespassing, particularly if the population fails to recognize the danger and unlawfulness of traversing railway rights-of-way. In the vicinity of the occurrence site, the existing limited fencing was not an effective deterrent. Despite the relative newness of the fencing, a hole had been cut through it, holes dug underneath it and nearby structures used to climb over it.

Federal requirements for fencing of railway rights-of-way from roughly 1900 are still being used today. Their focus was to keep livestock and other animals off the tracks. While this may have satisfied the railways' past needs, it did little to enhance public safety then, or now.

While the regulator has drafted several alternate fencing regulations starting before 1995 (when section 217 of the *Railway Act* was repealed), the extensive consultations with stakeholders have not yet resulted in an acceptable document. A regulatory gap has unintentionally opened. This gap has partially been closed by the railways' agreeing to continue to adhere to the provisions of section 217. However, the standard page wire four-foot six-inch farm fence does little to prevent pedestrian access to the railway right-of-way or to deter pedestrians from ultimately walking along the tracks.

Responsibility for fencing of railway rights-of-way has historically been a contentious issue. The cost of fencing large parts of rights-of-way, if borne by the railway or any one level of government, was seen to be prohibitive. However, the cost may not be prohibitive if it is treated as an integral part of a systems approach to deterring trespassing and if it is shared by government, industry and property owners.

Municipal by-laws regarding fencing specify a number of criteria that must be met in fence construction. However, there is nothing specific to fencing intended to separate municipal lands from railway rights-of-way nor any requirement that such fences be constructed. The municipal development agreement for the construction of the residential subdivision adjacent to the south side of the right-of-way dealt with a number of concerns expressed by the railway. As a result, a six-foot-high chain-link fence between the residences and the railway was constructed. This agreement did not otherwise call for measures to deal with potential dangers of residences so close to a railway right-of-way.

The pedestrians gained access to the railway right-of-way around the end of the fence at the east end of the playground. Although they were not actively playing on the play structure immediately before entering the right-of-way, the location of such a structure adjacent to this right-of-way undoubtedly draws children to the area. The Town of Tecumseh indicated that the proposed zoning, including the location of the playground, had been approved by the Province of Ontario. Regardless of the process that led to the location of the play

structure, the wisdom of locating it and other such areas in proximity to a railway right-of-way can be questioned.

2.3.3 Enforcement

The process to achieve federal anti-trespassing provisions that are both convenient for a police officer to use and provide a more realistic penalty had not been completed at the time of this occurrence. It had been approximately seven years since the proclamation of the *Railway Safety Act*, which effectively superseded the portion of the *Railway Act* making trespassing on the right-of-way an offence. By 1994, approximately five years later, the *Railway Safety Act* had been amended to include trespassing on a "line work" as an offence. The offences portion of that Act then applied, providing a range of fines and imprisonment more consistent with the times. However, at the time of the occurrence, trespassing on railway rights-of-way was still excluded from the regulations pursuant to the *Contraventions Act*.

2.4 Regulatory Approach to Trespassing

Transport Canada's Rail Safety Directorate guideline, "Procedures for Prevention of Trespassing," integrates education, enforcement and fencing, as well as signage, train operations and urban planning. This document sets a framework for municipalities, railways and regulators to prevent trespassing, both proactively through the identification of potential problems and reactively through occurrence data. Unfortunately, this document was not known to the Town of Tecumseh. Such a multi-faceted approach can result in an effective deterrent to trespassing and enhance public safety if it is fully implemented.

2.5 Assessment of TSB Trespasser Accident Statistics

Over the six-year period from 01 January 1992 to 31 December 1997, a total of 604 freight and VIA train trespasser accidents were reported nationally to the TSB. Over this period, passenger trains accounted for an average of 2.71 trespasser accidents per million train-miles annually while freight trains accounted for an average of 1.2 trespasser accidents per million train-miles. The higher proportion of trespasser accidents per million train-miles for passenger trains is likely due, in part, to the shorter warning time in which a trespasser can react to the locomotive horn because of the higher speeds of these passenger trains. However, it must be considered that the bulk of the passenger train-miles travelled in Canada are in regions of higher population density, potentially exposing passenger trains to trespassers more often. Thus, the greater speeds at which passenger trains travel and their operation through more densely populated regions likely result in a higher rate of trespasser accidents nationally.

2.6 Risk Factors

The town of Tecumseh is one of many urban areas in Canada that began and developed around the railway right-of-way, and where citizens are now exposed to the safety risks posed by high-speed trains as a consequence of this evolutionary process. Growing populations, increasing rail traffic and increasing train

speeds have exacerbated these risks. In the aftermath of this accident, there was much discussion within the community about train speed and the suggestion that such accidents could be prevented by requiring passenger trains to operate at lower speeds. The Board recognizes that speed was a factor; however, it also notes that this train was travelling at more than 10 mph below the maximum permissible speed. Furthermore, a reduction in train speed through urban areas would have a severe impact on the viability of passenger rail service. The Board is of the view that, to reduce public exposure to the risks associated with high-speed rail service, public awareness, insightful urban planning, adequate fencing, improved train auditory warning and vigorous trespass law enforcement activity may all be necessary. In the absence of safety initiatives involving all stakeholders, i.e. the community, local officials, the railways and the regulator, unauthorized use of the railway rights-of-way will continue to result in the unnecessary loss of life.

3.0 Conclusions

3.1 Findings

1. There were no facts to suggest that the train was not operated in accordance with company procedures and government safety standards just before the occurrence.

2. The nature and timing of the action taken by the locomotive engineers indicate that they were attentive to the track ahead and took appropriate action to prevent the accident.

3. The two pedestrians were walking on the railway right-of-way without authority and in contravention of federal law.

4. The sound projected from the locomotive horn of the moving train was not at a level of intensity sufficiently in excess of competing background noise to become audible to the pedestrians in time for the pedestrian to move clear of the approaching train.

5. The pedestrians' familiarity with the sound of the locomotive horn may have limited the horn's effectiveness as a warning.

6. Localization of the sound of the locomotive horn by the pedestrians was made more difficult by the fact that the train was approaching them from directly behind.

7. The low-frequency locomotive horn sounds may have contributed to the pedestrians' perception that the train was not close.

8. The moderate south-east winds may have attenuated the sound of the locomotive horn relative to the location of the two pedestrians.

9. Conversation between the two pedestrians, the sound of the bicycle being pushed over the railway ties, and the usual background noise of community activities and vehicular traffic diverted their attention and reduced their ability to hear the locomotive horn.

10. The placement of the locomotive horn on VIA locomotive 6421 (midway back on the locomotive, recessed below a metal barrier and directly behind the exhaust stack) limits the intensity of the sound projected forward, reducing the horn's effectiveness as a warning device.

11. Current federal regulations do not set requirements either for the sound frequencies generated by locomotive horns or for the amount and pattern of acoustical energy that must be present at specified distances omnidirectional from a stationary or moving locomotive.

12. Operation Lifesaver's educational program aimed at deterring trespassing on railway rights-of-way had not been at the schools attended by the two pedestrians in recent years before this occurrence.

13. There were no signs to deter trespassers and there was no significant enforcement activity in the area, despite the presence of numerous trespasser paths across the area about the occurrence site.

14. Enforcement of the trespassing provisions of the *Railway Safety Act* was impeded by their exclusion from the regulations pursuant to the *Contraventions Act*.

15. Transport Canada's Rail Safety Directorate guideline "Procedures for Prevention of Trespassing" (1992) was not known to the officials of the Town of Tecumseh.

16. The presence of numerous commercial outlets on the opposite side of the track from a residential subdivision and playground and the absence of adequate deterrent to trespassing created an environment in which unauthorized use of the railway right-of-way by pedestrians flourished.

17. The cost associated with fencing may not be prohibitive if it is shared by government, industry and property owners.

18. There are no federal requirements for fencing as a deterrent to trespassing. Current railway commitments for fencing of railway rights-of-way relate to a requirement to prevent livestock and other animals from getting onto railway property.

19. The Town of Tecumseh fencing by-law makes no provision for the erection of fencing to separate any municipal lands from the railway right-of-way.

20. There are no municipal by-laws involving the application and maintenance of signage warning of the danger of the railway right-of-way.

21. The municipal development agreement for the lands south of the track near the occurrence site did not restrict the development of parkland/playground adjacent to the railway right-of-way.

22. Public awareness, insightful urban planning, adequate fencing, improved train auditory warning, and vigorous trespass law enforcement activity may all be necessary to mitigate safety risks associated with high-speed train traffic through urban areas.

3.2 Cause

CONCLUSIONS

The pedestrian used the railway right-of-way as a short cut and this placed her in imminent danger. Further, the sound of the locomotive horn of the approaching train did not become audible in time for the pedestrian to localize its source, decide on a course of action and execute the action before being struck by the train. The ineffectiveness of the locomotive horn as a warning device was a result of some combination of factors related to the attention-demanding qualities of the horn, as well as its forward-projecting intensity in the existing circumstances. These factors include the pedestrian's responsiveness to the sound of the horn, the spectral composition of the sound, competing background noise, the wind and the position of the horn on the locomotive.

Contributing factors in this accident include the absence of adequate fencing, signage and enforcement to act as a deterrent to trespassing, and the ineffectiveness of community, societal and formal educational efforts to equip the pedestrian with the necessary knowledge to have chosen an alternative route.

4.0 Safety Action

4.1 Action Taken

Subsequent to this occurrence, a number of initiatives were taken to reduce the risk of trespasser accidents on railway rights-of-way especially in the vicinity of the town of Tecumseh.

An extensive ongoing safety program was introduced to all seven area schools by Operation Lifesaver. The railways (CN and VIA) repaired the existing fencing and installed some new fence. CN erected signs warning of the danger of high-speed trains at footpaths on both sides of the right-of-way. A roadway and sidewalk linking the residential area south of the tracks to Manning Road was completed and the construction of a pedestrian walkway for the Manning Road crossing was planned.

On 19 May 1998, Transport Canada issued a "Notice" to VIA, CN and the Town of Tecumseh pursuant to the *Railway Safety Act* advising that the corrective measures taken to curtail unauthorized access to the right-of-way in Tecumseh were inadequate. The Notice was issued after a Transport Canada inspector observed that the new fencing and signs had not curtailed trespassing in the targeted area.

The action plan adopted by VIA and CN's response to the "Notice" is still ongoing and is being monitored by Transport Canada for effectiveness. On 03 September 1998, the railways advised that:

- an additional 1,750 m (5,680 feet) of fencing had been installed on both the north and south sides of the right-of-way (fencing now extends on both sides of the tracks from Manning Road to Lesperance Road and beyond);
- repairs have been made to areas of the fence that had been breached or cut; and
- public service notices have been placed in the local paper to alert children and their parents of the trespass enforcement provisions of the *Railway Safety Act* and of the dangers of trespassing on railway rights-of way.

As of 23 April 1998, trespassing on railway property is an offence captured by the *Contraventions Act*. By agreement with the federal Department of Justice, the provinces of Nova Scotia, Prince Edward Island, New Brunswick, Ontario and Manitoba are actively using *Contraventions Act* provisions. Peace officers (provincial police, municipal police forces, railway police) may now use federal legislation to ticket persons trespassing on railway rights-of-way. Such tickets provide a $100 fine. CN police have adopted a zero tolerance policy for anyone found trespassing and have broadcast this message to local schools and the media. A number of trespass enforcement blitzes have also been conducted in the Tecumseh area.
The Board is pleased that the *Contraventions Act* can now be applied to the trespass provisions of the *Railway Safety Act* but notes that not all provinces have embraced this important enforcement tool. Trespasser deterrence will be hindered in those jurisdictions.

4.2 Action Required

The Board is concerned over the number of accidents involving trespassing on railway rights-of-way. Over the past 10 years, such accidents on railway tracks under federal jurisdiction have resulted in an average of 55 fatalities per year. Proactive initiatives and programs, involving all stakeholders, are necessary to deter pedestrian use of railway rights-of-way that continues to result in unnecessary loss of life.

The Board recognizes that initiatives to reduce the incidence of trespassing are ongoing. However, as has been seen in this instance, such accidents tend to result mainly in local safety shortcomings being addressed; i.e., repair or installation of fencing, the posting of "no trespassing" signs, stepped-up Operation Lifesaver activity and increased trespass enforcement. While such activity is laudable and the incidence of trespassing in the targeted area decreases, such measures do not appear to reduce the frequency of trespasser accidents over time nor do local initiatives mitigate the country-wide trespasser accident issue.

The Board notes that the development of comprehensive fencing regulations for railway rights-of-way in urban areas remains elusive. While it is appreciated that the railways and municipalities may have conflicting positions relative to shared responsibilities and costing formulas, stakeholders must develop and embrace mandatory fencing requirements. The lack of proper fencing of railway rights-of-way in populated areas is a priority safety issue.

It is also noted that new urban development along rights-of-way is not captured by a comprehensive and mandatory urban safety strategy. For example, the Tecumseh development resulted in a children's play area being established next to the right-of-way and there was no apparent consideration for a legal and safe way for the likely increasing pedestrian traffic to make their way alongside or over the tracks. The Board believes that any new urban development along rights-of-way must be subject to comprehensive requirements relative to the dangers inherent with the local population being drawn into conflict with trains.

Transport Canada adopted a goal to reduce the number of crossing and trespasser accidents by 50 per cent by the year 2006 (Direction 2006). Transport Canada officials, in partnership with the railway industry, provincial and local governments and safety associations, are developing a plan of action. Meetings with the interested parties have led to the identification and progression of seven key result areas: education, enforcement, engineering, research, bureaucratic and legislative framework, resources and communication.

Consistent with this initiative, and recognizing that the development of a plan of action and its effective implementation will take time, the Board believes that priority should be given to the development and implementation of the key result areas that could bring dividends in the short term, such as comprehensive fencing regulations, active and widespread application of the trespasser provisions of the *Railway Safety Act*, and education programs. The early implementation of these key result areas would not only assist Transport Canada in attaining its long-term target (50 per cent reduction in trespasser accidents) but realize an immediate short-term gain. Therefore, the Board recommends that:

The Department of Transport, together with all the partners involved in the safety initiative known as Direction 2006, assess the seven key result areas identified and strive to implement, in a priority fashion, those that are likely to provide immediate benefits; and

R99-01

The Department of Transport, together with its partners, use Direction 2006 and related consultation mechanisms to improve public awareness of the hazards inherent in walking across and along railway tracks, especially in high-speed train corridors.

R99-02

4.3 Safety Concern

The measured sound intensity from VIA locomotive horns meets Transport Canada's draft rule on engine whistle signals and FRA standards which provide for a minimum specified sound level at a given specified distance. Although the forward-projecting intensity is an important factor in identifying the sound as a warning signal, the effectiveness of the locomotive horn as a warning device is also a result of factors related to the attention-demanding qualities of the horn. These factors include the spectral composition of the sound, the effects of competing background noise, and the effect of the wind. Also, sound frequency can influence judgement of sound location, in that the low-frequency sound of the locomotive horn may result in a train being perceived as being further away than it actually is. It is also noted that the frequency of the horn evolved from the requirement to sound similar to a steam whistle and that the horn placement has been dictated by crew considerations. The Board is concerned that the lack of a comprehensive approach toward the requirements of the locomotive horn has compromised its effectiveness as an adequate warning device. The Board recognizes that there are various constraints that must be taken into consideration before any change can be made to the "traditional" horn design, e.g. familiar (identifiable) sound, cab noise level, urban anti-noise issues. An alternative approach might be the development of an auxiliary auditory warning for use only in emergencies. Such a warning could be of far-reaching intensity, and emit an attention-gathering modulating sound at high frequencies.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 23 February 1999.

Appendix A - Glossary

cm	centimetre(s)
CN	Canadian National
CROR	Canadian Rail Operating Rules
DCIEM	Defence and Civil Institute of Environmental Medicine
dB	decibel(s)
FRA	Federal Railroad Administration
Hz	hertz
LRC	Light, Rapid, Comfortable
m	metre(s)
mph	mile(s) per hour
MTM	million train-miles
NTA	National Transportation Agency of Canada
OCS	Occupancy Control System
OPP	Ontario Provincial Police
psi	pound(s) per square inch
RTC	rail traffic controller
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VIA	VIA Rail Canada Inc.
VIP	Values, Influences, Peers
’	feet