



Office of the Chief Investigator  
Transport and Marine Safety Investigations

**Rail Safety Investigation  
Report No 2009/11**

**Derailment of V/Line Passenger Train 8243**

**Stonyford**

**12 September 2009**





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## **THE CHIEF INVESTIGATOR**

The Chief Investigator, Transport and Marine Safety Investigations is a statutory position established on 1 August 2006 under Part V of the *Transport Act 1983*.

The objective of the position is to improve public transport and marine safety by independently investigating public transport and marine safety matters.

The primary focus of an investigation is to determine what factors caused the incident, rather than apportion blame for the incident, and to identify issues that may require review, monitoring or further consideration. In conducting investigations, the Chief Investigator will apply the principles of 'just culture' and use a methodology based on systemic investigation models.

The Chief Investigator is required to report the results of investigations to the Minister for Public Transport and/or the Minister for Roads and Ports. However, before submitting the results of an investigation to the Minister, the Chief Investigator must consult in accordance with section 85A of the *Transport Act 1983*.

The Chief Investigator is not subject to the direction or control of the Minister(s) in performing or exercising his or her functions or powers, but the Minister may direct the Chief Investigator to investigate a public transport safety matter or a marine safety matter.



## EXECUTIVE SUMMARY

At about 2050<sup>1</sup> on Saturday 12 September 2009 a Melbourne to Warrnambool V/Line passenger train collided with trees lying across the track about 500 metres east of the Stoneyford Road<sup>2</sup> level crossing, in the locality of Stonyford. The trees had been felled by strong winds.

The collision resulted in the derailment of the locomotives and four of the five passenger cars. There were minor injuries to both locomotive drivers and one passenger. The track structure beneath the train sustained significant damage.

Early in the investigation the Chief Investigator recommended to V/Line that they conduct an immediate assessment of the remaining pine trees in the area, which could potentially obstruct the rail line if they fell, and that they consider assessing trees near other rail lines where there is a potential for the trees to obstruct the line if they fell.

V/Line has since carried out a system-wide risk assessment of the physical condition of trees both on the rail reserve and adjacent to it and have amended their risk management system related to vegetation management.

This report makes a recommendation to VicTrack to develop guidelines for the Victorian rail industry regarding the management of vegetation in the rail reserve and on adjacent land.

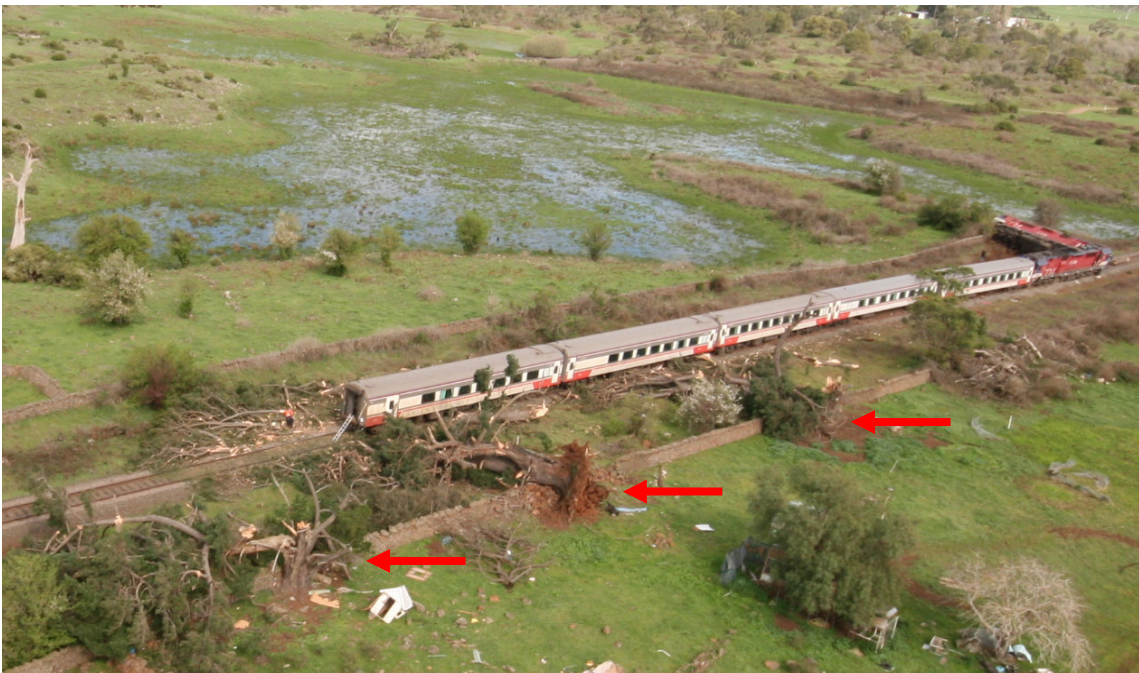


Figure 1 – Overview of derailment showing three fallen trees

<sup>1</sup> All times are expressed as Australian Daylight Saving Time.

<sup>2</sup> Note: The spelling discrepancy reflects map nomenclature and local signage.





## 1. CIRCUMSTANCES

V/Line train 8243 was the 1840 service from Southern Cross Station in Melbourne to Warrnambool on 12 September 2009. The train departed Melbourne on time and ran to time and without incident until the collision with the trees at a location about 500 metres prior to the Stoneyford Road (Stonyford to Cobden) level crossing. There were 71 passengers on board.

The train consisted of two locomotives and five passenger cars. The second locomotive was being conveyed to Warrnambool to be used the next day for track circuit testing in connection with the commissioning of several newly-upgraded level crossings. It was under power and being used to assist with operating the train.

The train collided with two trees which had been felled by high winds, and the derailed locomotive diverged completely from the permanent way and rolled almost onto its side. The rest of the train remained within the confines of the permanent way with all but the last passenger car derailed.



Figure 2 – Locality map

Both locomotive crew members sustained minor injuries while exiting the locomotive cab and making their way to safety across approximately 10 metres of rough, rock-strewn terrain and bramble thicket. One passenger suffered a minor injury during the collision. All were taken by ambulance to Camperdown Hospital and released after examination.



## **2. FACTUAL INFORMATION**

### **2.1 Personnel**

#### **2.1.1 Train crew**

The train crew consisted of two locomotive drivers and two conductors (one of whom was responsible for operating the on-board buffet). Preliminary Breath Tests for both locomotive drivers were negative.

Prior to impact, the driver placed the train brake valve to the Emergency position and exited his seat. Following the collision impact, and after the train came to a stand the driver placed the locomotive throttle handle to the Stop position. This is an emergency action by which the diesel engines of all locomotives-in-consist can be shut down.

Both drivers were adequately rested, well within fatigue assessment limits, and possessed of current medical status.

All train crew members were appropriately qualified for their duty and current in all required aspects.

#### **2.1.2 Passengers**

All of the 71 passengers were held on board by the conductors immediately following the collision. Several of the passengers made their own arrangements for pick-up and onward travel; the remainder were later escorted to road coaches with the assistance of emergency services personnel. One elderly female passenger was conveyed to hospital by ambulance, suffering from abrasions and a sore shoulder, and later discharged.

#### **2.1.3 Local residents**

Three local residents were interviewed about their observations of the weather conditions on the day. One farmer with a property and residence bordering the incident location stated that there had been strong, gusty winds during the day and that at about 1800 a 'willy-willy' had come through very quickly and felled several trees on his property. As well as this, the strong wind he estimated occurred at about 1800 had blown-over a free-standing stock-feed silo that had otherwise stood solidly on the property for 15 years. This resident stated that he was aware of the neighbouring trees that fell on the rail line as being aged and had often wondered about their condition. For this reason he 'kept an eye on them' as he thought they might be prone to falling.

The farmer said he left the property soon after 1800 and noticed — when he paused at the rail level crossing on his farm access road — that the track was clear in both directions. When he returned to his property later, the derailment had occurred.

The resident who owned the property upon which the trees that fell across the rail track had been standing also reported to investigators that there had been some extremely strong wind gusts during the day. She informed investigators that some similar trees on her property had been purposely felled previously as she had become concerned about their condition and the safety of children playing beneath them. She also stated that she had likewise become concerned about the age and condition of the pine trees standing against the stone fence along-side the rail reserve and had recently informed 'some people working on the track' of this. She did not know if her concern had been escalated by the track maintenance personnel or if V/Line intended any action. She had been loath to have them felled herself as she had not wanted to damage the historic stone fence; however, she had eventually decided to use the contractor who had felled her other trees to also fell these in the interests of safety. Unfortunately, the contractor had been injured in another incident and was unavailable so the work had not been carried out.

#### **2.1.4 The train**

The train was comprised of:

- Locomotive (1) N452 (all wheels derailed on both bogies)
- Locomotive (2) N456 (all wheels derailed on both bogies)
- Car-set VN4 including:
  - BTN264 - economy class car (all wheels derailed on both bogies)
  - BZN266 - economy class car (all wheels derailed on both bogies)
  - BN11- economy class car (all wheels derailed on both bogies)
  - BRN44 - economy class with snack bar (all wheels derailed leading bogie)
  - ACN12 - first class car with conductor's accommodation (not derailed)



**Figure 3 – The second locomotive (N456) and passenger cars remained upright**

The second locomotive, N456, was multi-coupled to the lead locomotive, N452. N456 was not specifically required for the operation of the train but was on-line<sup>3</sup> and under power throughout the journey from Melbourne. Being the locomotive attached next to the passenger cars, it was also providing a Head-End Power supply to the train<sup>4</sup>.

Both locomotives and the passenger car-set had undergone their most recent scheduled maintenance during August and September 2009 and were fit for traffic.

Locomotive N452 sustained impact and derailment damage to the headstock, cab, hood structure, bogies and traction motor gear cases as well as to some engine-room equipment. The N class locomotives are fitted with 6800 litre fuel tanks and N452 lost a significant amount of diesel fuel into a line-side drain as a result of a punctured fuel tank.

Locomotive N456 sustained scuff and abrasion damage to wheels, lower traction motor portions, and the fuel tank, from ploughing — in a derailed state — through ballast.

The derailed passenger cars sustained minor wheel and bogie damage as well as some minimal damage to underslung equipment.



**Figure 4 – The path of the derailed lead locomotive (N452)**

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<sup>3</sup> A diesel-electric locomotive is 'on-line' when its prime mover is running and the locomotive is electrically configured (by use of a crew control switch) to develop tractive power. It is 'off-line' when the prime mover is running (idling) but the locomotive has been configured not to produce tractive power.

<sup>4</sup> Head-End Power (HEP) is provided by a separate, dedicated engine/generator unit installed on the locomotive. The generator provides power for car lighting, environmental control, food service, and other utility requirements.

## 2.2 Rail infrastructure

The track structure between Geelong and Warrnambool is single-line broad-gauge (1600 mm), Class 2 track<sup>5</sup>. The line is owned by the Victorian Government business enterprise VicTrack and is leased to V/Line Passenger Corporation which is responsible for track maintenance. Between Winchelsea and Warrnambool (which includes the incident location) the line is worked under the Train Order<sup>6</sup> system of safeworking control.



Figure 5 – Fallen tree coverage across track

## 2.3 Recorded information

Locomotive N452 was equipped with a Fischer Mk 2 event recorder, which recorded a number of parameters associated with the performance and operation of the locomotive. A review of the recorded data found that the train had departed Colac on time at 2037. At 2050:34, when the locomotive was travelling at a recorded speed slightly in excess of 111 km/h, an Emergency air brake application was made, prior to the train coming to a stand 14 seconds later.

About 250 metres prior to the incident site, the train had negotiated a curve with a 95 km/h permanent speed restriction. The next curve, about 100 metres ahead of the derailment location was an open curve permitting the 115 km/hr track speed.

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<sup>5</sup> Specifying the Nominal Operating and Infrastructure Parameters for Victorian railway track categorised as Major Passenger Lines. These include 115 km/h speed for passenger trains of up to 21-tonne axle load, 47 kg/metre continuously welded rail, timber sleepers, non-resilient rail fastenings, and track ballast of 300 mm depth/400 mm shoulder width.

<sup>6</sup> Railway safeworking by Train Order involves the use of a paper instrument (the Train Order, issued by the train controller) as the train driver's authorisation to proceed into and through the nominated single-line section. The object of the system is to prevent more than one train being in the section at any one time.

## 2.4 Weather

Weather data obtained from the Bureau of Meteorology (BOM) automatic weather stations at Mortlake (about 50 kilometres to the WNW of Stonyford) and Mount Gellibrand (about 40 kilometres to the ENE) was reviewed. This data indicated no rainfall on the day of the incident and winds averaging 19.4 and 26.7 km/h respectively over the period between 1700 and 2130 on 12 September 2009 for the Mortlake station and between 1230 and 2359 on the same day for the Mt. Gellibrand station, with gusts approaching 50 km/h between 1700 and 1800 recorded at both.

The region to the northwest of Stonyford and Colac is part of the Western Plains of Victoria. The central plains region (where most of the lakes, including nearby Lake Corangamite, are found) is otherwise relatively flat and featureless and its broad geological characteristic is that of a shallow basin across which there is little to obstruct the flow of north-westerly winds.

State Emergency Service and Country Fire Authority personnel spoken to at the incident site reported random instances of property damage and destruction of vegetation across the local area caused by wind gusts and whirlwind activity.

## 2.5 Tree inspection

Although three adjacent trees had fallen at this location, only two of them had impacted and obstructed the railway track structure (see Figure 1). The investigation engaged the services of an arborist to conduct an examination of the latter two trees. Due to the nature of trees and the practical limitations in accurately assessing the structural integrity of all parts of a tree it was not possible to make a completely accurate assessment of their condition. The recommendations in the arborist's report are based on visual assessments and external indicators and include some degree of subjectivity.

The trees described in this report could only be assessed in the manner in which they presented on the day of inspection; all being assessed by visual observations from the ground. Height and canopy spread were estimates only, due to the fact that the trees had been substantially damaged by the impact of the train and had been bulldozed into a heap as part of the clean-up program.

The two trees assessed were Monterey Pine (*pinus radiata*) between 18 and 20 metres high, girth approximately 4.5 metres (multi-trunked), and each with a canopy spread of 12 x 10 metres. Apart from a degree of environmental scarring and some borer infestation, the trees were described as being mature and healthy for their age. What remained of their foliage and limbs appeared to be of good colour and coverage for this type of tree and age.

The country to the north-northwest of Stonyford is open and relatively flat, and presents little in the way of restriction to the flow of wind across it. Both of these trees were growing in close proximity to a stone fence and on very rocky (volcanic) ground and it was observed that one had a root system of shallow depth and assumed that the other would be likewise (Note that one of the felled trees assessed had been completely uprooted while the other had been snapped off at the trunk about 3.2 metres above ground level).



**Figure 6 – Uprooted tree**



**Figure 7 – Break in trunk of tree (note also its proximity to rock wall)**



With this shallow root system and the existence of sustained, gusty winds from the north-northwest, it was the view of the arborist that these conditions — along with their assumed height (18-20 metres), age (estimated at 90-110 years), and sail area (estimated at 120 square meters) — rendered it likely that these trees would fail.

Although assessed as 'healthy', it was apparent that both of the fallen trees exhibited physical conditions affecting their sturdiness, including, scarring, borer infestation, and fire burns. *Scarring* (also known as 'wound response'), relates to certain events happening to the anatomy of a tree, affecting either the outer bark (the trees' protection from the outside world), inner bark (the conduit by which nourishment is passed to other parts of the tree), the cambium layer (the growing or 'living' part of the trunk), sapwood (the conduit by which moisture is conveyed within the tree) and heartwood (the supporting pillar of the tree). The trees' biological response is to attempt to 'wall off' infection to the different layers of the trunk at the affected site; this process being referred-to as 'codit' (compartmentalisation of decay in trees). The scarring evident on these trees affected all of the above-mentioned layers to different degrees.

The report concludes that it would have been difficult for any casual and untrained observer to determine these faults prior to the trees falling. The evidence suggests that both pine trees failed due to weather conditions, their age, and structural faults either at ground level (shallow root system) or higher ('included' bark<sup>7</sup>).

In the case of this incident, the three trees that fell did so during a period of strong, gusty wind. Under normal weather conditions trees sway in the wind, however, gusty conditions provide circumstances whereby a tree may be alternately wind-loaded then released during a sporadic period of calm. Such conditions imposed upon a tree that may suffer from an internal structural weakness in one sector of its stem (trunk) might cause it to succumb to wind release<sup>8</sup> by fracturing at a stem fault or area of mechanical frailty, and a tree with a root support deficiency in one direction might succumb to being uprooted in that direction. In this incident, two of the trees suffered fractures of the stem and one was uprooted.

## **2.6 Risk management**

### **2.6.1 Rail Safety Act 2006**

The *Rail Safety Act 2006* requires that rail operators (rail infrastructure managers and rolling stock operators) — in pursuit of accreditation — identify incidents that could occur in the conduct of their business and identify hazards that might cause or contribute to causing such incidents.

Section 50 of The Act specifies how this will be achieved. The requirements include that a comprehensive and systematic assessment in relation to all possible identified incidents and hazards be conducted to provide the rail operator with a detailed understanding of all aspects of risk to safety associated with the incidents and that all aspects of this risk identification process be appropriately documented.

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<sup>7</sup> Bark inclusions are areas of bark on adjacent parts of a tree, typically on the inner faces of a narrow fork, which become grown-over to occupy part of the internal joint. The bark-to-bark contact is weaker than the more usual woody union.

<sup>8</sup> *Wind release* is the sudden removal of a sustained wind loading, when the crown and stem snap back to a normal position.

Section 51 of The Act requires that a rail operator adopt measures that will eliminate or reduce the likelihood of any such incident occurring, or if such an incident were to occur, its magnitude and severity of consequence.

Section 52 of The Act — in support of s51 — requires rail operators to prepare and test an emergency plan for infrastructure controlled and operations undertaken.

### **2.6.2 Rail Corporations Act 1996**

Sections 60 and 60A of the *Rail Corporations Act 1996* provide for the responsible entity (in this case, the Accredited Rail Operator, V/Line) to arrange for the felling or removal of any tree or wood in the vicinity of a railway track operated or maintained by that entity that poses a safety risk to occupiers or users of the railway. The responsible entity may require this action of the owner or occupier of any land on which the tree or wood is situated or may clear such growth themselves if necessary, without the need to obtain any permit that might otherwise be required.

### **2.6.3 Vegetation control**

A publication entitled *Vegetation Management Guidelines for Rail Corridors* and based on an interpretation of relevant Federal and Victorian Government Legislation and Regulations was developed by the Victorian Rail Industry Environmental Forum in 2007. The aims and/or goals of the document are described as being;

1. ‘...a reference for the management of vegetation on Victorian rail land and other linear reserves.’ (Page iv).
2. ‘To foster an integrated, cost-effective and environmentally sound approach to vegetation management on rail land...’(Page 1)
3. ‘...to achieve a net economic and environmental benefit resulting from improved vegetation management works within Victoria’s rail network.’ (Page 1)
4. ‘...to provide practical guidance on legislation, how maintenance activities can be carried out with minimal negative impacts, adoption of a more effective long-term approach to weed and fire management and promote the conservation of native vegetation and threatened communities.’ (Page 1)
5. ‘...to minimise environmental damage, destruction of and/or disturbance to native plants and animals, occurring in or near rail reserves that are the subject of routine maintenance or construction works.’ (Page 17)

Under a heading, ‘Vegetation Fouling Track’ (page 20), the Guidelines state (in part); *“Trees and branches falling onto tracks present a risk for train drivers. A clearance envelope must be maintained to prevent vegetation growing too close and fouling passage of trains. To avoid future occurrences, keep new plantings a safe distance...away from the track...equal to the mature height of the tree...as shown.”* (Figure 8).

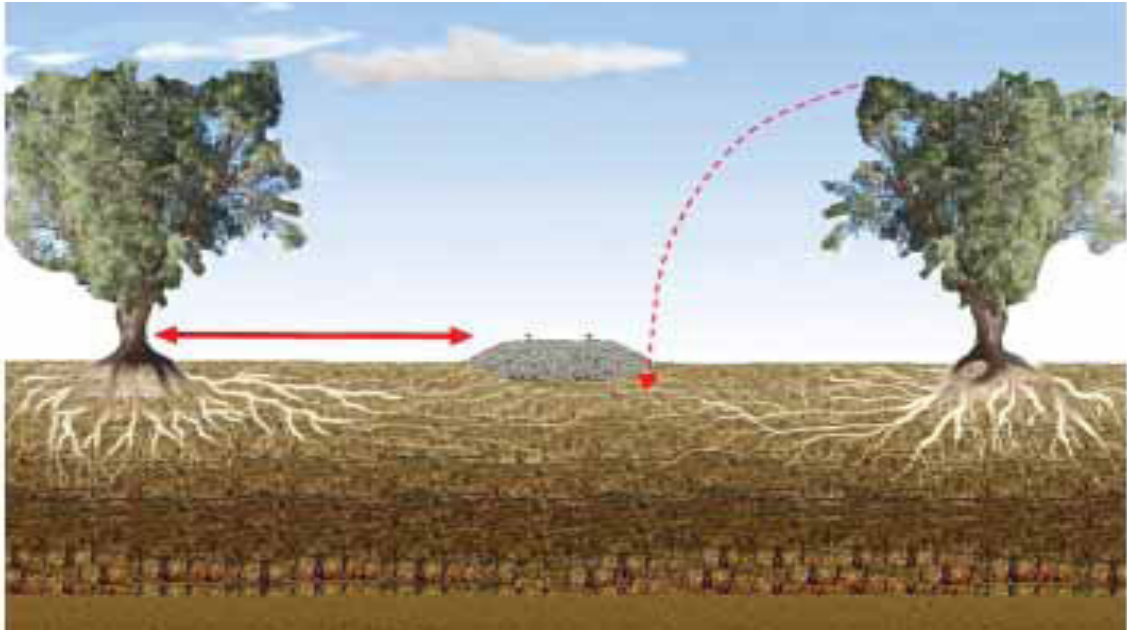


Figure 8 – Guidelines for new plantings (*Vegetation Management Guidelines for Rail Corridors*)

#### 2.6.4 V/Line infrastructure management

V/Line advised that the management systems of its infrastructure, including vegetation management, were originally established by the Public Transport Corporation and after privatisation carried through to the next two infrastructure managers until May 2007 when the management of the infrastructure was transferred to V/Line. Specific tasks and timeframes for the management of infrastructure are outlined within these maintenance systems in the TMP (Technical Management Plan).

A TMP schedule was in place for the 'Right of Way' but this schedule did not take into consideration assessments of trees adjacent to the rail reserve.

Traditionally, trees that had a potential to foul the train operational envelope were observed and monitored as part of the track patroller's visual inspections. However, it is not clear from company archival documentation that any assessment had been undertaken on trees outside the rail reserve. The TMP valid at the time of the incident referred specifically to inspections and assessments of the 'Right of Way' and while it mentioned the "risk of falling trees or limbs obstructing the track" there was no indication that trees beyond the rail reserve should be assessed.

The investigation has been informed by V/Line that subsequent to the incident they contracted an arborist to examine the three felled pine trees. After receipt of the report the company amended the TMP to include three-monthly assessments by a qualified arborist of trees on the rail reserve and adjoining land throughout its network. The TMP also included guidelines to staff on the risk mitigation required as a result of the arborist's findings.



### **3. ANALYSIS**

#### **3.1 Train operations**

There is no aspect of the operation of the train that is considered to have affected the outcome of this occurrence. Neither is there evidence of any pre-existing contributory locomotive or passenger car condition.

#### **3.2 Track damage**

The trees that fell across the track suffered from various conditions due to their advanced age – all of which contributed to the existence of internal structural weakness. One tree exhibited these conditions most obviously by snapping off at a segment of the trunk 3.2 metres above the ground, a thick portion of the trunk. The other tree succumbed to the effect of its shallow root system and was blown over. A third tree that was also snapped off several metres above ground level fell towards but did not obstruct the track.

The train struck the felled trees at a recorded speed of approximately 104 km/h<sup>9</sup>. Much of the timber shattered upon impact, with a large amount of split and broken tree fragments deposited on each side of the collision site. The precise mechanism by which the derailment of the train occurred could not be established; however, it is probable that either the impact of the trees falling on the track structure disturbed its integrity prior to the arrival of the train or that the lead locomotive struck the fallen trees causing it and other vehicles in the consist to derail and in doing so disturb the track structure.

The nature of the obstruction presented to the locomotive was exemplified by a remnant portion of tree trunk about 5.8 metres long and 2.2 metres in circumference that remained ahead of the locomotives following the incident and was lying between the rails (see Figure 9). This log had been splintered at both ends and its exterior bark surface severely abraded as a result of its contact with the locomotive.

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<sup>9</sup> Train speed at impact is assumed by interpretation of the locomotive event recorder chart. The precise point of impact in relation to speed cannot be accurately determined.



**Figure 9 – Photo showing displaced log ahead of derailed train**

### **3.3 Weather conditions**

The data from BOM weather stations, which are a significant distance from the incident site, does not indicate significant high wind activity for the period immediately prior to the incident. However, evidence of wind damage to trees and a fallen silo on the property adjacent to the incident site indicate a high-wind event. It is apparent that the trees adjacent to the rail line were felled by the same high winds that caused the damage to the neighbouring property. The fact that the property owner advised that his silo had stood the weather conditions for some 15 years indicates that this event was unusual.

### **3.4 Vegetation management**

Under Victorian legislation, infrastructure managers are required to manage the risk to their infrastructure. In the case of managing risk from vegetation they are given legislative powers to enable them to manage such risks.

While the V/Line management system addressed the risk created by vegetation within the rail reserve it did not take adequate account of those risks from trees on adjacent property. V/Line has since taken steps to address this shortcoming of their system.

The publication entitled *Vegetation Management Guidelines for Rail Corridors*, contains little in the way of safety-related instruction or information. In fact, the numerous explanations contained within the document as to its purpose define it principally as an instruction manual for use by rail asset managers to ensure the conservation of native vegetation and threatened floral and faunal communities. There are minimal specific references to safety, and the removal of trees or other vegetation for safety reasons is only briefly addressed.

The Guidelines mention the need to maintain a 'clearance envelope' (this being presented in the context of new plantings rather than the management and control of existing growth) and the potential risk presented to train drivers of trees and branches falling onto tracks, however, there is no reference to a *public* danger. Specific mention is made in one passage of the need "...to prevent vegetation growing too close and fouling passage of trains...", but none is made of the danger of trees falling and then lying foul of the track. Any implicit warning of this potential danger relies upon interpretation of a singular illustration (Figure 8) depicting the relationship between the height of a tree and its distance to the track structure.

The document would appear to be an inadequate instrument for prescribing to a rail infrastructure manager the safety aspects pertinent to vegetation management and desirable practices to adopt.





## **4. CONCLUSIONS**

### **4.1 Findings**

1. Trees growing on private property adjacent to the rail reserve fence-line succumbed to high winds and fell across the rail line.
2. The condition of the rail track structure is not considered to have contributed to the outcome of the incident
3. V/Line had no formal hazard identification or risk management strategy to monitor and manage tree growth that is close to the line but outside the rail reserve. V/Line has since amended their risk register to include the assessing of trees adjacent to the rail reserve.

### **4.2 Contributing factors**

1. V/Line had no formal process for assessing the health of, or managing any threat posed by the potential to fall, of trees growing on private property but close to the rail reserve boundary.
2. The advanced age and physical condition of the trees.
3. The existence of localised, strong, gusty wind conditions.



## **5. SAFETY ACTIONS**

### **5.1 Chief Investigator's recommendation**

After expert arboreal advice, the Chief Investigator recommended — early in the investigation — that V/Line conduct an immediate assessment of the remaining pine trees in the area that could potentially obstruct the rail line if they fell, and that V/Line consider assessing trees near other rail lines where there existed a potential for the trees to obstruct the line should they fall.

### **5.2 Safety Actions taken since the event**

V/Line has undertaken a state-wide risk-assessment of trees growing in the rail reserve and on adjacent neighbouring property and has amended their risk strategy to include on-going assessments of trees adjacent to the rail reserve.

### **5.3 Recommended Safety Actions**

#### **Issue 1**

The purpose of the Victorian Rail Industry Environmental Forum document *Vegetation Management Guidelines for Rail Corridors* appears to be an instruction manual for use by rail asset managers to ensure the conservation of native vegetation and threatened floral and faunal communities rather than a prescriptive instruction manual on managing vegetation in the interests of public safety.

#### **RSA 2009011**

That VicTrack, through the Victorian Rail Industry Environmental Forum, develop and publish a formal process for managing vegetation growth both within and outside of rail reserve easements so as to control as much as possible any threat posed to public safety by this vegetation should it become physically degraded or be subject to a dangerous external condition (such as high winds or fire).