



Australian Government
Australian Transport Safety Bureau

Signals Passed at Danger by Train 1240

Marshall near Geelong, Victoria | 29 May 2015



Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation
RO-2015-009
Final – 12 December 2016

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Addendum

Page	Change	Date

Safety summary

What happened

On 29 May 2015, an empty VLocity type passenger train was being transferred from Waurn Ponds to Geelong, passing through Marshall and South Geelong stations enroute and without stops. The empty-cars train was following a Melbourne-bound service.

When the empty-cars approached Marshall, the Distant signal for this location was displaying Caution. This indicated that at least one of the Home signals in advance was at Stop. The train's speed was reduced in response to this indication, but was subsequently increased to above 100 km/h as the train continued towards Marshall Railway Station.

Nearing Marshall station platform, the driver observed the next Home signal at Stop and applied the train's brakes. However, the train could not be stopped before it passed this signal and the next, which were both at Stop.

Marshalltown Road level crossing intersects with the railway about 140 m beyond Marshall Station and the empty cars entered the crossing before the warning devices activated.

There was no collision at the crossing, no injuries, and no damage to any infrastructure as a consequence of this incident.

What the ATSB found

The ATSB found that the driver of the empty-cars did not respond appropriately to the two-position signal indications through the Marshall location, including the Caution indication on the Distant signal. The speed of the train was too high as it approached Marshall station and as a result the train could not be stopped in response to observing the next signal at Stop.

The driver had recently qualified to drive passenger services and this was his first shift driving without supervision. It was found that the training had not adequately prepared the driver for the sequence of two-position signals at this location. The predominant signalling on the Melbourne-Geelong corridor is three-position.

The ATSB also found that the rule that described the required driver response to a Distant signal at Caution in a two-position signalling system did not fully reflect the design principles for this type of signalling configuration.

Since the re-establishment of Marshall station, rail passenger traffic through Marshall had increased tenfold, and there was scope to enhance the signalling configuration.

What's been done as a result

Immediate actions by V/Line included imposing temporary speed restrictions for this location and retraining the driver in two-position signalling. V/Line also developed a simulator session to improve driver training in two-position signalling.

V/Line advised that funding has been secured for the development of a business case and feasibility study for a track and signalling upgrade of the South Geelong – Waurn Ponds section.

ATSB has recommended that V/Line amends the rule for the required driver response to a Distant signal at Caution.

Safety message

Operating rules and Driver training should align with the underlying principles of a network's signalling infrastructure.

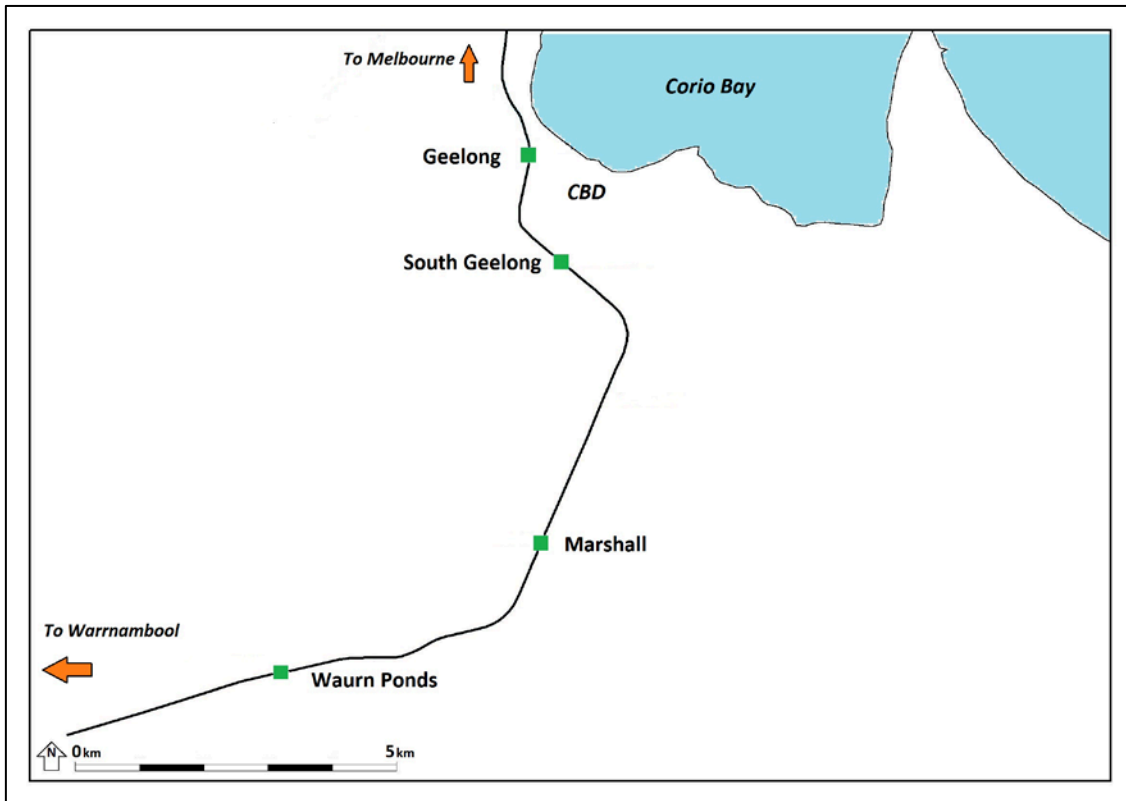
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The occurrence

At about 1900 on 29 May 2015, the 1744 passenger service from Melbourne arrived at Waurn Ponds. Waurn Ponds is a suburb of Geelong, a regional city about 65 km southwest of Melbourne, Victoria. The section between Geelong and Waurn Ponds station is about 12 rail km and passes through South Geelong and Marshall Stations (Figure 1).

Figure 1: The route between Geelong and Waurn Ponds stations

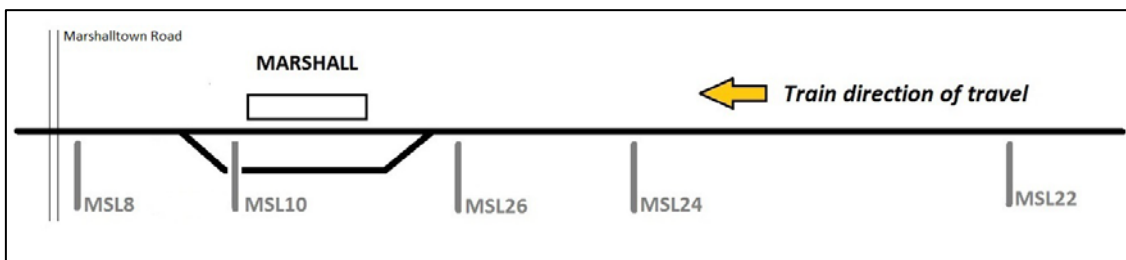


Source: PASS Assets (Public Transport Victoria) adapted by Chief Investigator, Transport Safety (Vic)

The car-set and its driver was scheduled to return empty-cars to Geelong where the train would form a service to Melbourne. To allow a Melbourne-bound service from Warrnambool to pass through the section, the empty train was shunted into the siding at Waurn Ponds.

After the passage of the Melbourne-bound train (Train 8250), Train 1240 (the empty-cars) was signalled onto the mainline towards Marshall. It increased speed and travelled at between 80 and 90 km/h as it passed Waurn Ponds station. About a kilometre past Waurn Ponds, the train encountered Distant signal MSL22. This signal, about 3.6 km before Marshall Station, was the first of five signals that controlled Geelong-bound traffic on the mainline through Marshall (Figure 2).

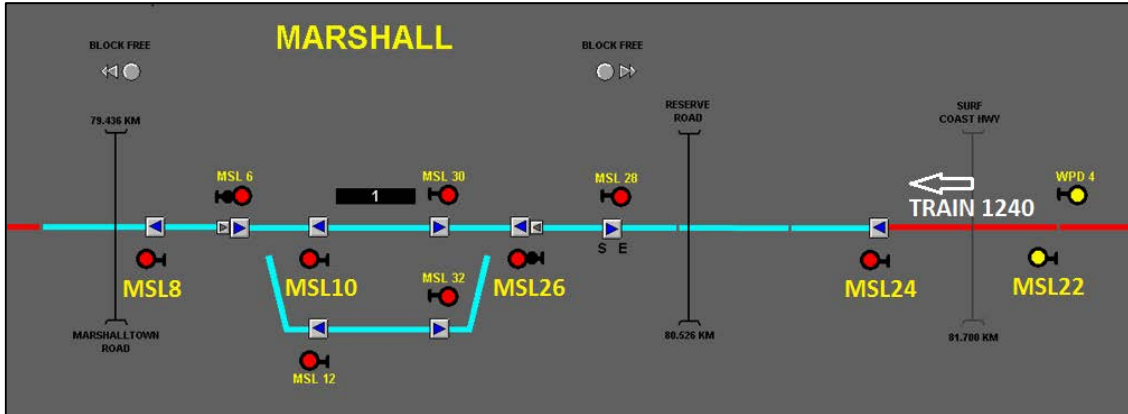
Figure 2: The signals controlling Geelong-bound rail traffic through Marshall



Source: Chief Investigator, Transport Safety (Vic)

Distant signal MSL22 was at Caution when the train passed, and the signals ahead were at Stop (Figure 3). In response to the Caution indication of MSL22, the driver reduced the speed of the train from 83 km/h to 67 km/h.

Figure 3: Signal status when Train 1240 passed Distant Signal MSL22. MSL22 was at Caution (yellow), and other signals ahead were at Stop (Red). The red highlight on the line adjacent to MSL22 is indicating that Train 1240 is detected in the section.



Source: Geelong Regional Signalling Centre, extract and annotation of VDU recording by Chief Investigator, Transport Safety (Vic)

The next signal, Home signal MSL24, was located 2,276 m past the Distant signal. As the train travelled towards it, the signal indication changed from Stop to Proceed. Signalling through this section was two-position, meaning that Stop was indicated by a red light, and Proceed by a green light. Home signals in a two-position signalling system do not provide information on the required train speed, nor the condition of the next signal.

When the train was about 900 m from MSL24 and following the driver’s observation of its Green (Proceed) aspect, the speed of the train was increased. The train’s speed was about 90 km/h passing signal MSL24. As the train continued towards Home signal MSL26 that was 1,280 m away and at Proceed, its speed further increased. The train’s speed peaked at 105 km/h shortly after passing signal MSL26.

Soon after passing signal MSL26, the driver observed Home signal MSL10 at Stop, and probably also the next Home signal, MSL8, that was also at Stop. Both were at Stop because the train ahead had not yet cleared into South Geelong.

In response to the Stop indications, the driver made a brake application that within about five seconds progressed to an emergency application. Train 1240 could not be stopped in the distance available and passed Home signal MSL10 travelling at about 80 km/h and then Home signal MSL8 at about 60 km/h. In each instance, the signal was passed at Stop without authority resulting in a Signal Passed at Danger (SPAD) event.

The train then entered the Marshalltown Road level crossing travelling at about 50 km/h. The warning devices (lights and bells) began with the train on the crossing and the boom barriers lowered about 10 seconds later. There were no road vehicles nor pedestrians attempting to cross as the train entered the unprotected crossing. However, shortly prior, a route bus and light truck had traversed the crossing, 30 and 15 seconds prior respectively.

The train came to a stand with its leading cab about 80 m past the crossing. There were no injuries resulting from the incident. The incident occurred at about 1932.

After reporting the incident, the driver was authorised to shunt the empty cars back into the crossing loop at Marshall. He was then stood aside from driving duties. A breath test was conducted with a zero alcohol result. Testing for the presence of drugs was not conducted.

Context

Marshall and surrounds

Development in southern Geelong

Marshall Railway Station had been closed in 1958. It was re-established in 2004 to serve the expanding southern suburbs of Geelong, and the demand for commuter services to Melbourne.

The re-development of Marshall was a State funded and managed project. During this period, lease arrangements and management of the regional network was transferred (in 2004) from Freight Australia Limited to Pacific National. Track management of the network was subsequently transferred to V/Line in 2007.

Marshall Station was re-established with a single platform serviced by the bi-directional mainline. The development included the introduction of a loop to cater for the crossing of trains and terminating locomotive hauled passenger trains from Melbourne. The loop allowed the locomotive to be 'runaround' the consist for the return trip to Melbourne. The signalling was designed to allow this locomotive movement to occur without the fouling or activation of the Marshalltown Road level crossing. There was nothing unusual about this configuration for these operations.

With the introduction of VLocity type DMU trains into the Geelong corridor, the use of locomotive hauled trains terminating at Marshall diminished significantly.

Waurm Ponds Railway Station was established in September 2014. A holding siding to shunt trains clear of the mainline was provided about two kilometres from this station, towards Warrnambool.

Waurm Ponds became the normal terminating point for trains travelling to the southern suburbs of Geelong and as a result, terminations at Marshall became less common.

Safeworking system background

Prior to the re-establishment of Marshall Station, *Train Order Working*¹ was in place for the single line section between South Geelong and Winchelsea (about 40 km west of Geelong). When re-established, Marshall became an *Intermediate Terminal Station* for the two sections South Geelong - Marshall and Marshall - Winchelsea.

Then, in September 2005, the *Train Staff and Ticket Safeworking System*² was introduced between South Geelong and Marshall and Marshall was made an attended *Train Order Station*. The signalling system at Marshall was to be operated locally and manned for all trains.

In December 2005, further changes to the safeworking arrangements were made. The sections between South Geelong and Marshall were altered to operate under the *Track Block Safeworking System*, and the operation of the signalling at Marshall was transferred to the Geelong Regional Signalling Centre.

¹ Train Order working is a Safeworking system that involves the use of a paper instrument issued by the Train Controller as the train driver's authorisation to enter and proceed through the nominated single-line section. It is used on low volume single lines.

² Train Staff and Ticket system is a Token based Safeworking system on low volume single lines.

Track Block Safeworking System.

The operating rules and procedures applicable to the Track Block Safeworking System were described in Section 32 of the 1994 *Book of Rules and Operating Procedures*. The object of the system was to prevent more than one train being on the same line in the section between two adjoining locations. This was achieved by the signaller not being able to place the signal controlling the entrance to the Track Block single line section to the Proceed position until the preceding train had exited the section.

The Track Block Safeworking System was in use on the Victorian broad-gauge network between:

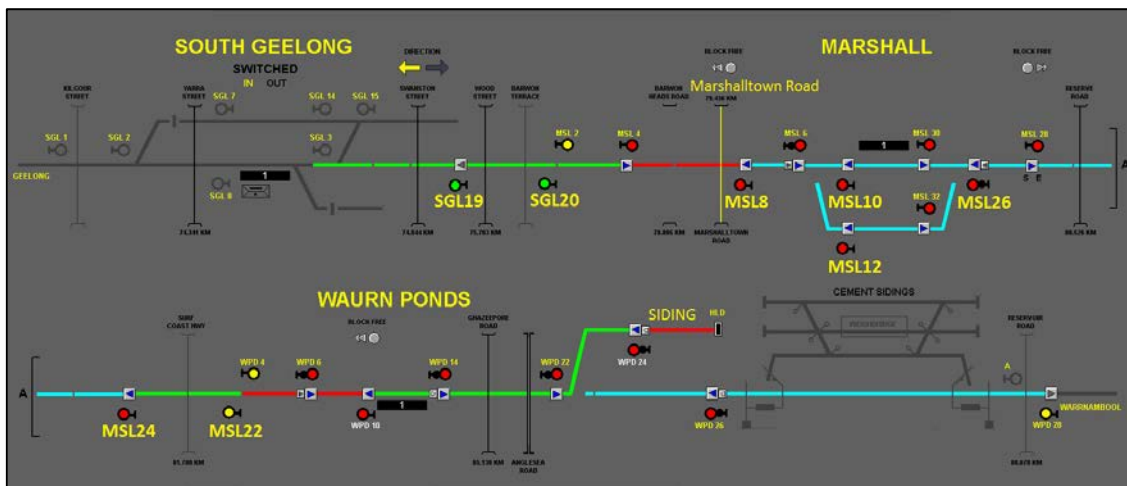
- Newport - Brooklyn (West line)
- Brooklyn - Sunshine
- Geelong – Waurn Ponds

The Geelong-Waurn Ponds section was the only passenger line where it applied.

Signalling arrangements through Marshall

Two-position coloured-light fixed signalling was in place between South Geelong – Marshall – Waurn Ponds. The signal numbers relevant to this event are shown enlarged on an extract of the signalling control display (Figure 4).

Figure 4: Extract of signalling control display South Geelong - Marshall - Waurn Ponds



Source: V/Line Geelong Regional Signalling Centre, extract and annotation of VDU recording by Chief Investigator, Transport Safety (Vic)

The Marshall location had a signal sequence on the mainline in each direction of a Distant signal followed by a series Home signals. For Geelong-bound traffic, the signal sequence through Marshall was:

- MSL22 (Distant signal)
- MSL24 (Home signal)
- MSL26 (Home signal) that had signals for the mainline and the loop track
- MSL10 (Home Signal) and MSL12 (on the Loop track)
- MSL8 (Home signal).

Signal control through Marshall

At the time of the incident, signalling control for Marshall was managed from the Geelong Regional Signalling Centre. This control function has since been relocated to Centrol³ in Melbourne.

At Geelong, the relevant control workstation provided for remote control and monitoring of the signalling system between South Geelong⁴ and Waurn Ponds. Signallers could observe the status of all the signalling in the area of control by means of a VDU Panel. The VDU panel also provided the means of operating the points and signals.

The signaller had control of all Home signals at Marshall. For Geelong-bound rail traffic, the Home signals could be operated individually or a *through-route* set such that signals would clear when the section ahead became available for following trains.

The signaller cannot control distant signal MSL22. The aspect of MSL22 was governed by the status of the Home signals through the location and functioned automatically. If all mainline Home signals at Marshall were clear, MSL22 would indicate Proceed (Green aspect), and if any was at Stop, MSL22 would indicate Caution (Yellow aspect).

Marshalltown Road level crossing activation

For trains approaching from Waurn Ponds when signals were at Proceed, a fixed track circuit activated the Marshalltown Road level crossing protection. This ensured that the crossing protection was activated in sufficient time prior to the arrival of the train.

When signal MSL8 was at Stop, the level crossing warning circuits were inhibited. This was to allow locomotive runaround movements without activating the crossing protection. Because of this configuration, Train 1240 did not trigger the crossing protection until it was beyond signal MSL8.

System protection for a train exceeding its authority

The two-position signalling system at Marshall did not include any additional controls to protect against a train exceeding its authority.

Waurn Ponds was commissioned about 10 years after Marshall and did include additional features to manage this risk. All Home signals at Waurn Ponds were fitted with Train Stop TPWS⁵ to stop trains that passed a signal at Stop.

Signalling playback – recording of sequence of events

The status of signals and the movement of trains through the section were captured on the recording of the signaller's display located at Geelong. The colour of the track section also provides an indication of its status with:

- Red indicating the presence of a train in the section
- Green indicating the track is clear and the route is set
- Blue indicating the track is clear but no route is set.

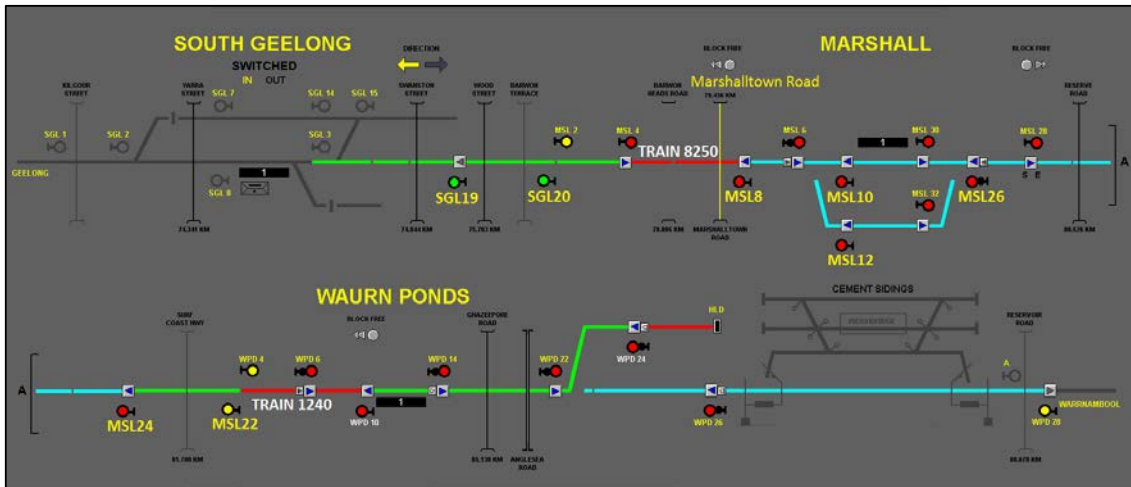
At about 1922 after departing the siding, Train 1240 was travelling between Waurn Ponds and Marshall (Figure 5). At this time Train 8250 (the train ahead) had passed through Marshall Station and the Marshalltown Road level crossing had activated (road shown highlighted yellow). Another train was in the Waurn Ponds siding waiting to follow 1240.

³ The operational control centre for the V/Line network.

⁴ At South Geelong, signals are operated locally.

⁵ Train Protection Warning System.

Figure 5: Extract of VDU screen at 19:22:07 showing train 1240 travelling between Waurn Ponds and Marshall, approaching Distant signal MSL22 at Caution. The signals through Marshall are at Stop. The train ahead (8250) has passed through Marshall Station.

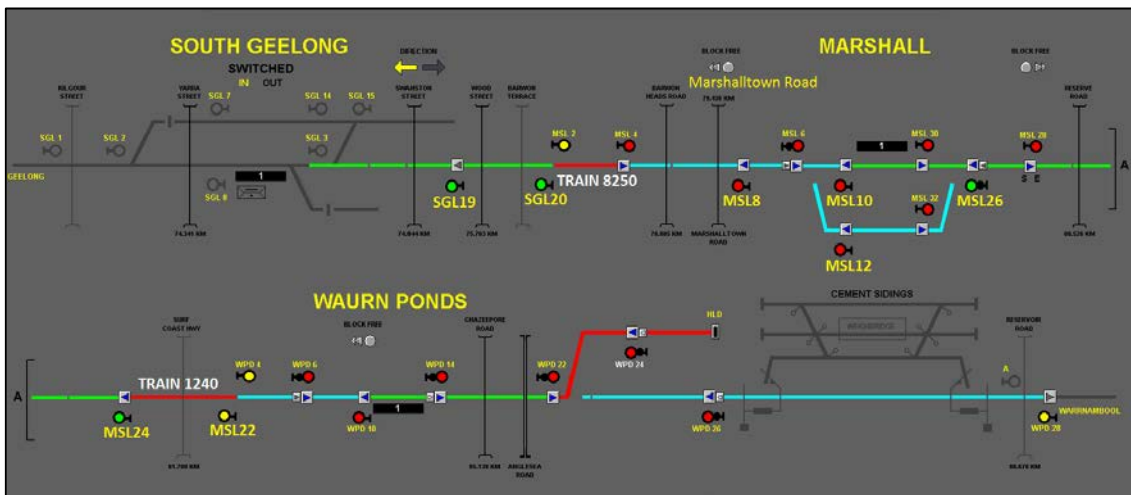


Source: Geelong Regional Signalling Centre, extract and annotation of VDU recording by Chief Investigator, Transport Safety (Vic)

After Train 1240 passed Distant signal MSL22, MSL24 went to Proceed. The VDU screen at 19:23:03 showed MSL24 at Proceed and MSL26 still at Stop. All other Marshall signals were also at Stop.

Before Train 1240 passed MSL24, Home signal MSL26 also went to Proceed (Figure 6). At this point, the train ahead was approaching the Distant signal for South Geelong (SGL20), that was at Proceed (Green). Because this train was still occupying the section between MSL8 and SGL20, signals MSL10 and 8 were not yet cleared to Proceed.

Figure 6: Extract of VDU screen at 19:23:05 showing MSL26 now at Proceed. MSL10 and MSL8 are at Stop.



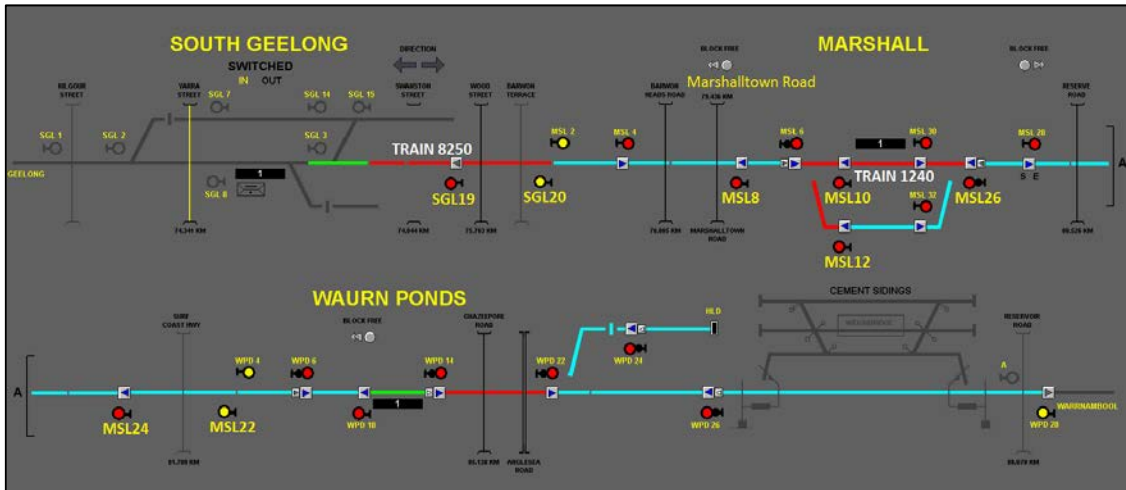
Source: Geelong Regional Signalling Centre, extract and annotation of VDU recording by Chief Investigator, Transport Safety (Vic)

The VDU screen at 19:24:31 shows that the preceding train (8250) had passed the Distant signal for South Geelong, SGL20, at around the time Train 1240 had passed MSL24. Train 8250 had not yet passed SGL19 and signals MSL10 and MSL8 had not yet cleared to Proceed.

The VDU screen at 19:25:26 shows that Train 1240 had passed Home signal MSL26, which had reverted to Stop. MSL10 was still at Stop and soon to be passed by Train 1240 without authority. Marshalltown Road level crossing had not yet activated.

A few seconds later, Train 1240 had passed MSL10 at Stop (Figure 7) and was soon to pass MSL8 at Stop. Train 8250 was still progressing past SGL19. The headway between the two trains was such that Train 1240 needed to stop at Marshall to wait for Train 8250 to clear the section ahead.

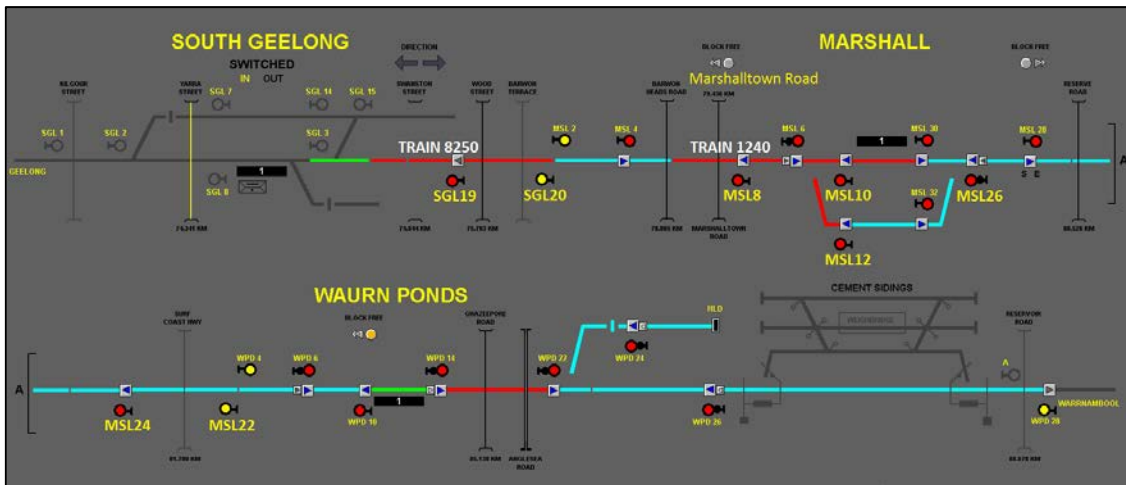
Figure 7: Extract of VDU screen at 19:25:29 showing Train 1240 had now passed signal MSL10 at Stop.



Source: Geelong Regional Signalling Centre, extract and annotation of VDU recording by Chief Investigator, Transport Safety (Vic)

A short time later, MSL8 had also been passed at Stop (Figure 8). The Marshalltown level crossing protection was not yet active.⁶

Figure 8: Extract of VDU screen at 19:25:34 showing that Train 1240 has now passed signal MSL8 at Stop. The Marshalltown Road level crossing warning protection has not yet activated. Train 8250 has not completely cleared SGL19.



Source: Geelong Regional Signalling Centre, extract and annotation of VDU recording by Chief Investigator, Transport Safety (Vic)

⁶ Crossing is shown yellow when active.

Two-position signalling

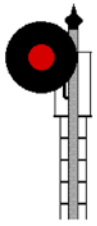
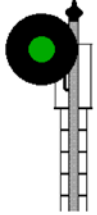
Background

Two-position signalling was once common in Victoria but its use had declined. Two-position signals are route signals that apply to a single route. They do not provide drivers with information on the aspect of the next signal, nor specific guidance on the train speed to the next signal.

Home signals

Two-position Home signals are displayed as light signals or semaphores, although semaphore signals have become increasingly rare. Light signals come in various configurations and show either a red or green aspect (Figure 9).

Figure 9: Aspects of two-position Home signals

Signal number	Signal aspect	Signal meaning
Home signals: MSL24 MSL26	STOP 	Train must Stop at Signal
MSL10 MSL8	PROCEED 	Train can Proceed to next Signal

Source: ATSB

Home signals with two indications on the same signal post

Where multiple routes are available, signals are mounted either on a bracket post or arranged vertically on a single post. MSL26 was fitted with lights on brackets (Figure 10). A Proceed aspect (Green) is only shown for the route for which the points are locked and detected.

Figure 10: Multiple route two-position signal MSL26, with two light signals.

- The right hand signal provided an indication for the straight route and had a Green aspect (Proceed) for the passage of Train 1240.
- The left hand signal provided a signal indication for the loop track and was red for Train 1240.

Source: Chief Investigator, Transport Safety (Vic)



Distant Signals

Configuration

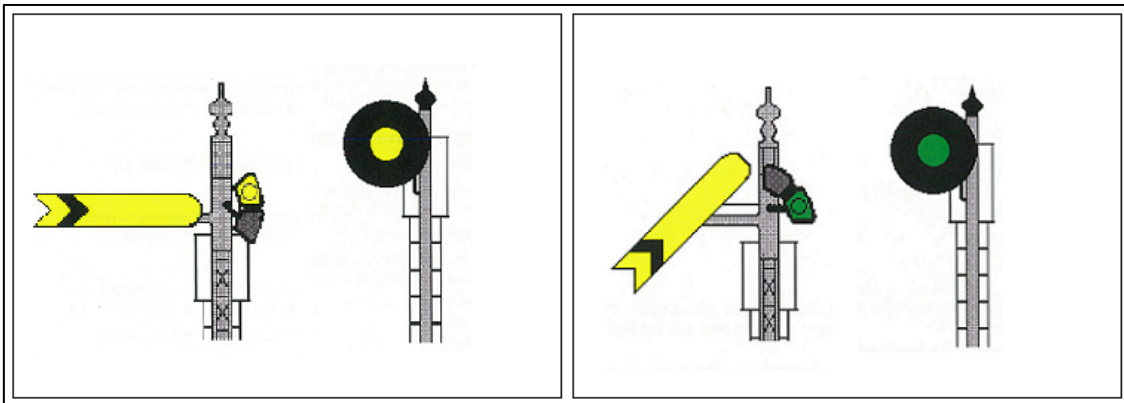
Distant signals are located ahead of the first home signal for a location and provide information to drivers on the indication of Home signals on the through route. Distant signals are located no less than the braking distance for the line speed ahead of the first home signal at the location.

Distant signals (Figure 14) can be displayed as light signals or semaphores, although the use of semaphore Distant signals has become increasingly rare on the V/Line network.

Distant signals display two aspects:

- Yellow, indicating Caution and meaning that one or more of the Home signals applicable to the same line at that location may be at Stop.
- Green, indicating Proceed and meaning that all Home signals applicable to the same line at that location are at Proceed.

Figure 11: Distant signal aspects, Yellow (indicating Caution) and Green (indicating Proceed), as they appear in V/Line training material. The semaphore configuration, shown on the left for each aspect, is used for V/Line assessments on Distant signals.



Source: V/Line driver training courseware

Rules and Procedures pertaining to Distant signals

Section 2 part 5 of the *Book of Operating Rules and Procedures 1994*⁷ stated in part:

- A Distant signal at the Proceed position indicates all other signals applicable to the same line as the Distant signal are also at Proceed.
- When the driver observes a Distant signal at Caution, the train must be slowed to a precautionary speed to allow the train to be safely stopped at the next signal if that signal displays Stop.

In the description of the driver's response to a Caution indication, there was no reference to the possibility of subsequent Home signals through the location being at Stop.

Victorian Rail Industry Operators' Group (VRIOG)

The Victorian Rail Industry Operators' Group (VRIOG)⁸ was a collaborative committee made up of rail operators and transport agencies. The purpose of the group was to establish standards to facilitate the interoperability of operations and infrastructure to enhance network safety.

VRIOG Standard 012.0 *Victorian Signalling Principles* Section 4 described signalling principles, signals, and points, interlocking, track vacancy detection, level crossings, and signalled single lines and proceed authorities.

⁷ Used by V/Line and Metro Trains Melbourne.

⁸ This group has been disbanded and a new approach to standards is being developed by Public Transport Victoria (PTV).

Section 4.1.5 of this VRIOG standard described, in part:

- Two position signals are route signals. Each signal applies to one route only. Two position signals do not provide information about what speed the train should travel; nor do they provide information about the aspect of the signal ahead.
- Distant signals provide information regarding the state of Home signals on the through route at an interlocking:
 - If all of the signals ahead are at Proceed, the Distant signal can display a Green aspect.
 - If any one of the signals ahead is at Stop the Distant signal will display a Yellow aspect.

Three-position signalling

Three-position signalling was the predominant signalling type in the Melbourne metropolitan and RFR (Regional Fast Rail) areas and was in use between Melbourne and Geelong.

Three-position signals use a minimum of two lights to convey the signal indication that may apply to several routes in advance. The multiple light configuration differentiates a three-position signal from a two-position signal that will only display a single light.

Three position signals convey information to a train driver regarding the:

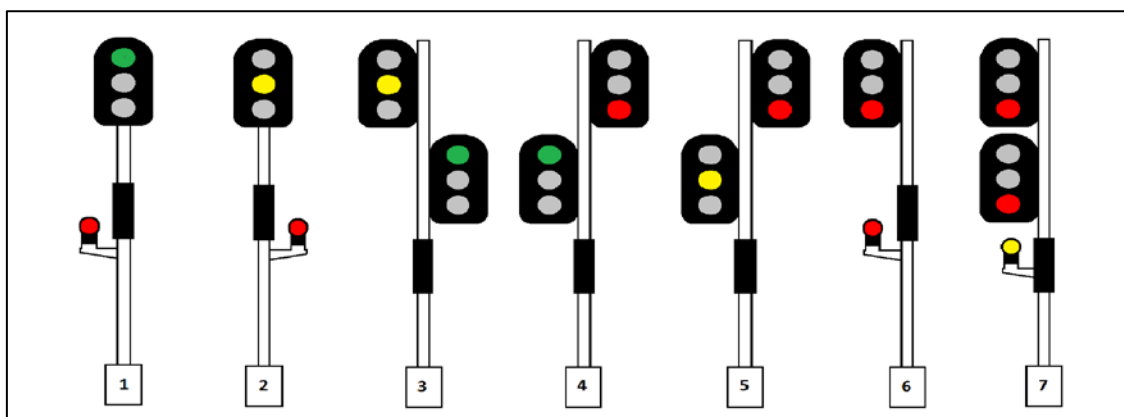
- permitted speed of the train over the block ahead
- aspect of the signal ahead.

Three position-signals come in a range of physical configurations and the possible aspects of a particular signal will be tailored to the needs of a location. There are seven indications⁹ that can be displayed by three-position signals in Victoria, in all instances using at least two lights (Figure 12).

⁹ Three-position signalling indications corresponding to the aspects shown in Figure 12:

1. Clear Normal speed – the train may proceed at the maximum speed allowed for the locality and that the next fixed signal is at Proceed.
2. Normal speed warning – the driver must be ready to stop at the next fixed signal.
3. Reduce to Medium speed – the train may proceed at the normal speed but must reduce to medium speed before the next signal.
4. Clear medium speed – the train must not exceed 40 km/h and that the next fixed signal is displaying a Proceed aspect.
5. Medium speed warning – the driver may proceed at medium speed and must be prepared to stop at the next signal.
6. Stop.
7. Low speed Caution – the points are set in the correct position for the driver to proceed. It does not indicate that the line is unoccupied and the driver must be prepared to stop short of any obstruction. The speed of the train must not exceed 15 km/h.

Figure 12: Three-position signal aspects. Three-position signals can have various physical configurations. The illustrated signals are to present the light aspects only.



Source: Chief Investigator, Transport Safety (Vic)

The driver

Prior to joining V/Line, the driver had about five years experience operating freight trains between Echuca and Deniliquin. This territory was low traffic volume and low speed. Signalling was two-position, but without Distant signals.

The driver commenced employment with V/Line in October 2014 and was assigned to the Southern Cross driver's depot. He had recently qualified to operate V/Line passenger trains on all lines worked by Melbourne based drivers. His medical was current with no restrictions recorded.

Prior to the incident shift, the driver had been rostered on shifts of eight hours duration working in and around Southern Cross Station on non-passenger services. His previous shift on 27 May 2015 was rostered to finish at 2000. He then travelled to Echuca to visit his family, returning to Melbourne on 29 May to be in position for the start of his shift at 1400. Roster induced fatigue is not considered to be a factor in this incident.

The shift on 29 May was the driver's first operating passenger services without supervision.

Driver training

Scope

This driver commenced his training with V/Line in October 2014. Because of his previous operational experience, the driver was enrolled on the V/Line Conversion Driver Training Plan (Freight Train SCS-Regional Centres Conversion Training Plan). This training had a minimum duration of 21.4 weeks and comprised both classroom and in-field practical training.

He was required to complete all training modules covering train operations on the V/Line network including signalling and Safeworking. Some exemptions in subjects were provided in recognition of the driver's freight experience, but none in subjects relevant to the circumstances of this incident.

The training module and assessments completed for two-position signals was the same as for any other new V/Line employee in training to be a driver.

Practical driving training comprised several stages as the driver progressed from guided driving (with supervisor guidance and explanation), through unguided driving (with supervision), and finally assessment of driving competency.

Training materials on two-position signals including Distant signals

The training material for two-position fixed signals described different signal types including Home signals and Distant signals, and included diagrams of both the older style semaphore signals and light-only signals. The training material addressed possible signal configurations, aspects, and indications. With respect to the application of Distant signals, the course notes were consistent with the published network rules and stated:

- A Driver passing a Distant signal at Proceed would expect to find all other fixed signals applicable to the same line also at Proceed, but must read all signals and be prepared to act accordingly if the Home or Starting signal is at Stop.
- A Driver having passed a Distant signal at Caution must slow the train to a precautionary speed to allow the train to be safely stopped at the next signal if this signal displays Stop.

There was no other guidance within the course material that described the design principles associated with Distant signals, and the specific scenario of a Distant signal at Caution and Home signals other than the first encountered being at Stop. Instructors may have explained these principles in class and during the practical training, but there is no supporting material within the training courseware.

Route knowledge training for Marshall

Route knowledge was taught through classroom and in-field training. The in-field component included a requirement that the driver undertake a minimum of three runs on each corridor. It was reported that this driver had four or five runs on the Waurn Ponds-Geelong sector, the last about two weeks before the incident. None of the familiarisation trips through Marshall were conducted at night.

Assessment

The driver assessment was conducted over several stages of the training program. Three written signal exams were conducted, all multiple-choice answer format. Assessment pertinent to Distant signals included:

- Stage 2 Signal Exam – questions pertained to the two possible aspects of a Distant signal. The answer option for a driver's response to a Distant signal at Caution was consistent with the published rule that the driver be prepared to stop at the next fixed signal.
- Stage 10 Signals A Exam – similar to Stage 2 assessment.
- Stage 10 Signals B Exam – limited to the identification of a Distant signal.

All photographs of Distant signals used in the written assessments were of the older style semaphore signals. There were no samples of light-only Distant signals in the assessment materials.

Practical assessment included train handling under guidance and check rides with an independent assessor. The Graduation stage included computer based route knowledge assessments and practical in-field assessments on all five regional corridors.

This driver had successfully completed all components of assessment by 25 May 2015, including the final route knowledge and practical in-field assessments on the five corridors, which included Marshall.

Safety analysis

Train handling

Human response

Human performance is by its nature highly variable. Our ability to perceive, pay attention to, and to hold and manipulate information in our memory is limited by our finite cognitive capacity, and is subject to a number of influencing factors.

One way of describing human performance is by reference to the level of conscious control applied to that performance. That is, the extent to which our actions in any given situation are governed by conscious attention or by developed habit patterns; automatic processes which operate largely outside of our conscious control.

Some tasks require a high level of conscious attention, such as whenever we are learning how to perform a new task, or are problem solving in unanticipated circumstances. Other tasks, as people become familiar and then expert at them, require less and less conscious effort, and become increasingly automated, habitual responses to a known set of circumstances, such as perceiving and interpreting a signal indication.

Errors at reduced conscious control levels, sometimes called rule based and skill based performance levels, can occur when the current circumstances require the operator to do something different to usual. The error occurs when the stronger habitual response associated with these particular situational cues dominates, thus producing an inappropriate action for the current situation. This has been referred to in the human performance literature as a 'strong but wrong' response.

When the driver of Train 1240 approached the Marshall Distant signal (MSL22), it was displaying a Caution indication, providing warning that any of the following signals through Marshall may be at Stop. The driver slowed the train accordingly, ready to stop at the next signal, the outer home (MSL24) if necessary. However, on observing Home signal MSL24 at Proceed and then MSL26 at Proceed, the driver mistakenly believed that he had a clear run through Marshall. In fact, further Home signals at Marshall, MSL10 and MSL8, were at Stop.

Knowledge

Distant signal MSL22 displayed a Caution indication signifying that any of the signals through Marshall may have been at Stop. This required the driver to operate the train at a speed that would allow the train to be safely brought to a stop at any signal within the Marshall location.

Evidence indicated that the driver did not have a clear understanding of the meaning of Distant signal MSL22 at Caution and its application through this two-position signalling location.

Distraction

The driver reported that as the train approached signal MSL26 he was looking towards the facing points to confirm they were correctly set for the straight route. However, because the MSL26 signal was indicating Proceed for the straight, there was no need for the driver to confirm the points setting. This unnecessary focus on the points setting possibly contributed to the driver's late observation of signal MSL10 at Stop.

Driver training

Training program for this driver

The driver was in training with V/Line from October 2014 through to 25 May 2015. The scope of this training was based on a gap analysis, with consideration of the driver's previous experience. Reduced training scope was generally limited to locomotive train handling and mechanical inspections, and there was no reduction in requirements for training and assessment in signalling systems or route knowledge. As a result, there was no identified reduction in training that may have influenced the driver's knowledge of two-positioning signalling and its application at Marshall.

Training materials

The training materials for two-position signalling reinforced the application of the published rule for a driver's response to a Distant signal at Caution. The course materials did not expand on the design principles associated with Distant signals nor describe the scenario of a Distant signal at Caution and a Home signal, other than the next, being at Stop.

Assessments

Written assessments focussed on the identification of different types of two-position signals and the associated rules, including the rule when a driver encounters a Distant signal at Caution.

Written assessments also exclusively used photographs of the semaphore Distant signal that is an older configuration. Assessments should reflect the contemporary arrangements and signal configurations that a driver will encounter in the field.

In-field training and route knowledge

The driver's in-field exposure during his training was predominantly to three-position signalling systems. Conversely, his exposure to two-position signalling on the V/Line network was limited. While the driver's previous freight experience was with two-position signalling, this was on low speed, low traffic lines where Distant signals were not used.

The driver had successfully completed the assessments and met the minimum criteria for route knowledge on this corridor. However, he had not encountered a sequence of signal indications at Marshall like those presented to train 1240 on the night of the incident. In addition, he had no familiarisation with driving this route at night.

Rule

The *1994 Book of Rules and Operating Procedures* described the required driver response to a Distant signal at Caution. The rules referred to the condition of the next signal beyond the Distant signal, but were silent on the possible condition of other Home signals through the location.

Mixture of signalling arrangements

The use of different signalling systems within the same high volume commuter corridor created a local condition that was potentially error provoking. The section between Melbourne and South Geelong incorporated three-position signalling, while South Geelong to Marshall and Waurn Ponds was two-position signalling.

Human performance is such that habitual tasks that are consistently practised in the same fashion and in the same sequence become largely automatic,¹⁰ which for the most part has the positive

¹⁰ Loukopoulos, L.D., Dismukes, R.K. & Barshi, I. (2009). *The Multitasking Myth. Handling Complexity in Real-World Operations*. Ashgate: Farnham. p90.

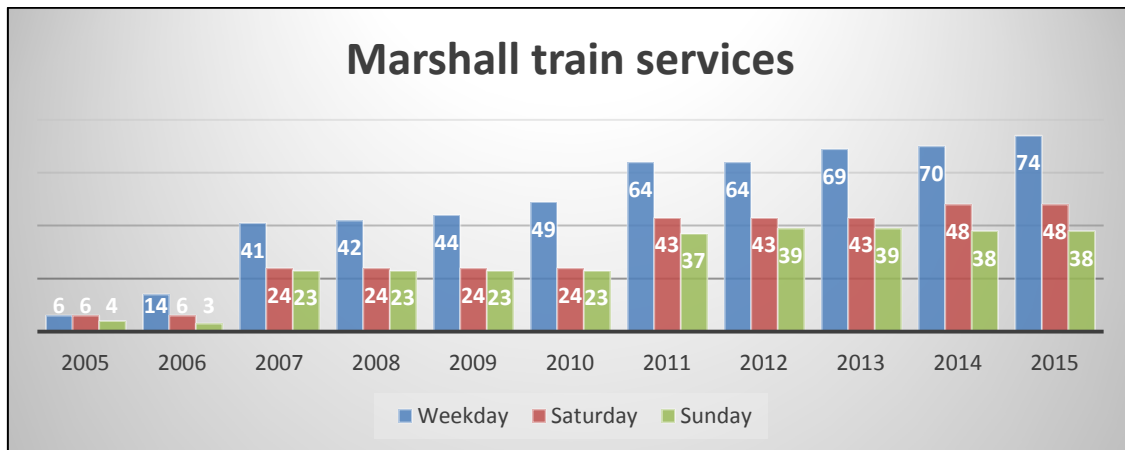
effect of freeing our conscious attention to manage unexpected or novel events. This can also have the undesirable effect of limiting our capacity to recognise when we need to switch to less common operating modes, leading to errors. The likelihood of these errors increases further when there are insufficient cues (either internal or external) to trigger the switch; often referred to as a ‘strong but wrong’ response.¹¹

Thus, in a corridor that predominantly operated with three-position signalling, correct interpretation of a short section of two-position signalling required a driver to override their habitual response and to respond in a different way. The safe operation with this configuration was dependent on a driver’s route knowledge, and on the driver successfully remembering that the interpretation of the two-position signals required a change to their common practice.

Changing traffic profile

When re-opened, the only passenger services through Marshall were the Melbourne-Warrnambool services. Commuter demand led to services through Marshall steadily increasing (Figure 13).

Figure 13: Passenger train services per day to or through Marshall (total)



Source: Based on data supplied by V/Line Pty Ltd

Marshall was re-established with infrastructure that catered for the relatively small number of passenger services. However, over a ten year period, rail traffic increased significantly (16 in 2005 to 160 services per week in 2015), altering both the operating environment and the risk profile of the location.

To improve the control of traffic through this location, there was scope to upgrade to three-position signalling and potentially introduce measures to mitigate against SPAD events.

¹¹ Reason, J. (1990). *Human Error*. Ashgate: Aldershot. p57.

Findings

The following findings are made with respect to the Signal Passed at Danger (SPAD) events by train 1240 at Marshall, near Geelong, Victoria on 29 May 2015. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance.

A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- The driver of train 1240 did not respond appropriately to the Caution indication on Distant signal MSL22 and subsequent two-position Home signals through the Marshall location.
- The speed of train 1240 approaching Marshall station was too high for the driver to respond in sufficient time to the Stop indications displayed by signals MSL10 and MSL8.
- **The training and assessment of the driver did not ensure that he had an adequate understanding of the two-position signalling through Marshall. [Safety Issue]**

Other factors that increased risk

- **The rule describing the required driver response to a Distant signal at Caution in a two-position signalling system did not fully reflect the signalling system design principles. [Safety Issue]**
- The presence of a section of two-position signalling on a corridor that was predominantly three-position had the potential to increase human error. There was a high reliance on driver route knowledge to manage this risk.
- Since the re-establishment of Marshall station, rail passenger traffic had increased markedly, raising the risk profile of the location. There was scope to enhance the signalling configuration to better control these risks.

Safety issues and actions

The safety issues identified during this investigation are listed in the Findings and Safety issues and actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the [aviation, marine, rail - as applicable] industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

Driver training

Number:	RO-2015-009-SI-01
Issue owner:	V/Line
Operation affected:	Rail: Passenger - Regional
Who it affects:	Drivers operating on the V/Line network

Safety issue description:

The training and assessment of the driver did not ensure that he had an adequate understanding of the two-position signalling through Marshall.

Proactive safety action taken by V/Line

Action number: RO-2015-009-NSA-023

Action status: Closed

V/Line has developed a two-position signalling simulator session to practically train drivers in two-position signalling.

Current status of the safety issue

Issue status: Adequately addressed

Justification: The safety action taken by V/Line should address the gap in training identified in the safety issue.

Network rule governing Distant signals

Number:	RO-2015-009-SI-02
Issue owner:	V/Line Regional Network and Access
Operation affected:	Rail: Network Operations
Who it affects:	Drivers operating on rail networks using this rule

Safety issue description:

The rule describing the required driver response to a Distant signal at Caution in a two-position signalling system did not fully reflect the signalling system design principles.

ATSB safety recommendation to V/Line

Action number: RO-2015-009-SR-029

Action status: Released

That V/Line amends the rule for the required driver response to a Distant signal at Caution. The amendment should bring the rule into alignment with the signalling system design principles.

Current status of the safety issue

Issue status: Not addressed

Justification: V/Line has not yet finalised its response to the safety issue.

Additional safety action

Action number: RO-2015-009-NSA-028

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised by V/Line of the following additional safety actions in response to this occurrence:

- On 19 June 2015, a 70 km/h speed restriction was introduced for Up (Geelong-bound) traffic approaching Marshalltown level crossing.
- On 22 June 2015, V/Line issued a notice to drivers advising of the SPAD incident and lessons learned.
- On 4 September 2015, a 40 km/h speed restriction was also introduced for Down trains approaching Marshall Station.
- The driver underwent a detailed return to work plan that included a two-position signals theory and assessment, and an extended period of safety audits.
- SPAD investigation findings recommended a three-position signalling upgrade for the Geelong - Waurn Ponds section of track. Subsequently, the 2016-17 Victorian State budget has funded the Business Case Development and Feasibility Study for Track Duplication South Geelong - Waurn Ponds.

General details

Occurrence details

Date and time:	29 May 2015 1932 EST	
Occurrence category:	Incident	
Primary occurrence type:	Signal Passed at Danger (SPAD)	
Location:	Marshall, Victoria	
	Latitude: 38° 11.918' S	Longitude: 144° 21.294' E

Train details

Train operator:	V/Line Pty Ltd	
Registration:	VL 1141	
Type of operation:	Empty-Cars	
Persons on board:	Crew – One	Passengers – Nil
Injuries:	Crew – Nil	Passengers – N/A
Damage:	None	

Sources and submissions

Sources of information

The sources of information during the investigation:

- V/Line Pty Ltd
- the train driver.

References

- Loukopoulos, L.D., Dismukes, R.K. & Barshi, I. (2009). *The Multitasking Myth. Handling Complexity in Real-World Operations*. Ashgate: Farnham.
- Reason, J. (1990). *Human Error*. Ashgate: Aldershot.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report Rail Occurrence Investigation

Signals Passed at Danger by Train 1240
Marshall near Geelong, Victoria on 29 May 2015

RO-2015-009

Final – 12 December 2016