



INDEPENDENT
TRANSPORT
SAFETY
REGULATOR

Mitigation measures for tool B - rolling stock operators

ITSR

Safe transport for NSW

Mitigation measures for tool B – rolling stock operators

Instructions

- This tool links to tool B – Appendix B – SPAD data collection tool B for rolling stock operators.
- A number of possible mitigation measures are presented below for consideration by the rolling stock operator.
- Measures have been grouped according to the contributory factors that they relate to.
- Mitigation measures presented in italic text are more applicable to the infrastructure manager of the relevant network.

The potential mitigation measures presented below are:

Part 1.1 General measures for consideration after every SPAD

Part 2.1 Where factors associated with the driver's history contributed to the SPAD

Part 2.2 Where decreased alertness or fatigue contributed to the SPAD

Part 2.3 Where factors associated with the driver's physical and mental state contributed to the SPAD

Part 3.1 Where the work schedule impacted on the driver's alertness/opportunity for recovery

Part 3.2 Where the driver experienced unusual or unfamiliar circumstances

Part 3.3 Where there were internal distractions

Part 3.4 Where there were external distractions

Part 3.5 Where the driver's view of the signal was obscured

Part 3.6 Where something affected the driver's perception of the signal

Part 3.7 Where the driver made an incorrect early assumption about the signal aspect

Part 3.8 Where recent changes or other factors affected driver braking behaviour or judgement

Part 3.9 Where other railway personnel or system processes contributed to the SPAD

Part 3.10 Where the driver attended to the wrong visual cues which they took as evidence that they could proceed

Part 4 Data logger information

Part 1: General measures

1.1 For consideration after every SPAD

- Investigate the SPAD according to the guidance provided in the SPAD guidance document to identify possible contributory factors.
- Ask the driver to recount how they could have better managed the situation and reinforce procedures and/or professional driver behaviours as required.
- Maintain a list of all SPAD traps that are identified on each route, show them on a route hazard map and display it in relevant depots. If there is sufficient evidence, consider adding the SPADed section of track to the list of SPAD traps. Include all SPAD traps in the driver route knowledge training.
- Review the driver's history, including the number of previous SPADs or other safety related incidents. Consider the potential for similar situations to arise.

Part 2: Driver factors

Part 2.1: Where factors associated with the driver's history contributed to the SPAD

2.1.1 If the driver has less than two years experience

Consider dividing drivers into categories according to age/experience. Analyse SPAD data according to category of experience and SPAD type. If inexperienced drivers are involved in a greater number of SPADs than would be expected consider the following:

- A review of training programs for new drivers and periodic driver training.
- The need to implement some form of applied human factors training program, such as rail resource management (RRM) training to address the risk of human error¹.
- To reduce the number of SPAD occurrences, the following training requirements should be considered:
 - training in degraded driving scenarios (for example, using simulators)
 - route geography knowledge
 - route SPAD traps/specific route hazards
 - signal knowledge
 - speed restriction knowledge
 - train braking knowledge
 - train protection systems
 - communication systems and emergency procedures.
- Implement a mentoring scheme for young and newly qualified drivers.
- Consider developing a tool that compiles information about previous safety related incident and highlights drivers who may be at greater risk of a SPAD.
- Review driver selection methods to ensure that they are appropriate and take into account the non-technical skills that are required for the role².

¹ The RRM project has developed best practice applied human factors training for rail safety workers across Australia. It includes a best practice review, comprehensive guidelines and generic training materials (<http://www.transportregulator.nsw.gov.au/publications/rrm.html>).

² Non-technical skills - the specific interpersonal skills, behaviours and attitudes associated with safe, proficient performance

2.1.2 If the driver is less than 25 years of age – consider measures as described in 2.1.1

2.1.3 If the driver's training and competency records are incomplete or not up to date

- Arrange for driver training as necessary.
- Review competency management systems: Competency management systems should flag training renewal dates ahead of their expiration and ensure that training records are complete. Systems should be in place to prevent drivers driving trains without current required competences.
- Consider the organisational culture issues: Did the driver feel comfortable reporting training issues?
- Ensure drivers are aware that they should inform management when they know that training is required or competency is due for renewal.

2.1.4 If the driver's record of safety related incidents indicate that the driver has been involved in more incidents than average

- Review the driver's record and use knowledge of the underlying causes of the incidents to generate an appropriate action plan. This should take into account the contributory factors of any previous SPADs to see whether risk taking behaviour was involved or whether other personal factors may have played a role.
- As necessary, arrange for driver skill/knowledge training in:
 - applied human factors training such as RRM.
- Degraded driving scenarios
 - route geography knowledge
 - route SPAD traps/specific route hazards.
- Signal knowledge.
- Speed restriction knowledge.
- Train braking knowledge.
- Train protection systems.
- Communication systems and emergency procedures.
- Consider developing an improved driver selection process based on a detailed understanding of the non-technical skills required for the role.

2.1.5 If the SPAD occurred on the driver's first shift back after returning from leave/prolonged sickness

- Consider a pre-work briefing for the driver's first shift back that highlights the risks.
- If practical, change rostering procedures to give drivers easier routes/lighter duties or later starts on the first day back.
- Ensure drivers are aware of the effects of a long break from duty. Drivers should be briefed on reducing fatigue, skill erosion effects and possible coping strategies. Reinforce their duty to return to work fully rested.
- Driver training or awareness programs should consider highlighting times when drivers are more likely to have a SPAD (for example, *Did you know that you are more at risk of a SPAD when you have just got back from holiday?*).
- In the case of leave taken overseas, ensure drivers are aware of circadian (jet lag) effects of crossing time zones and encourage them to take additional days of leave to acclimatise to local time prior to return to work.

2.1.6 If the SPAD occurred on the driver's last shift prior to commencing a period of leave

- Consider a pre-work briefing in the week prior to leave to highlight that accident risk may be elevated before and following leave periods.
- Consider alerting drivers to risks when they get notice of leave approval.
- Consider timely briefings/presentation of information.
- Ensure that drivers do not work excessive overtime in the lead up to annual leave.
- Driver training, information and awareness programs highlighting times when drivers are more likely to have a SPAD (for example, *Did you know that you are more at risk of a SPAD when you are just about to go on holiday?*).

Part 2.2: Where decreased alertness or fatigue contributed to the SPAD

2.2.1 If the driver had less sleep duration than usual over the previous 72 hours (see response to Form B - 2.2.1) and or:

2.2.2 If the driver's previous 72 hours sleep was lower quality than usual (for example, fragmented or disturbed)?

- Investigate if the reduced quality and quantity of sleep was due to the work schedule (for example, night work) or if there were personal factors that impacted on sleep prior to the SPAD. Factors associated with the work schedule are addressed in Part 3.1. If the reduced sleep was due to personal factors, try to ascertain if the circumstances were one off or potentially ongoing.
Strategies include:
- Ensure the driver understands operational requirements, for example:
 - need to prioritise sleep, where schedules allow sufficient opportunity for it
 - fitness for duty requirements.
- Ensure driver has appropriate knowledge in fatigue management including
 - impact of fatigue on safety and health
 - lifestyle factors and managing work and non-work conflicts
 - maintaining good sleep habits and sleeping environment
 - short term countermeasures such as breaks, napping, caffeine and bright light
 - stress management techniques
 - effects on alertness of drugs, alcohol and medications
 - effects on alertness of health problems and illnesses.
- If the investigation process yields gaps in the driver's knowledge or skills in fatigue management, consider reviewing organisational procedures for fatigue management training.

2.2.3 If quality of rest was influenced by the sleep environment or other unusual events

- Ascertain if the circumstances were one off, or an ongoing problem. Investigate if it is practical to improve the quality of the sleep environment (whether home, barracks or motel etc). Ensure the driver is aware of good sleep habits.

2.2.4 If the driver had been awake for over 16 hours at time of the SPAD (excluding naps)

- Minimise length of night/early morning shifts where practical. Ensure the driver is aware of the benefits of a nap in the afternoon prior to commencing the first night shift. Consider provision of relief where delays or laybacks may cause extended time awake.

2.2.5 If the SPAD occurred during a low point of alertness, that is, at night (00:00 to 06:00) or in the afternoon 14:00 – 16:00

- Ensure the driver is aware of the symptoms of fatigue, implications of sleepiness for safety and importance of practical management strategies such as a short break from the cab, caffeine and seeking assistance from others.

- Advise driver to avoid swaps that increase successive night/early morning shifts. Ensure weekly breaks are timed for adequate recovery between blocks of shifts.
- Optimise crewing arrangements to allow for adequate breaks from driving during the shift.
- Encourage drivers to take advantage of available breaks during the early morning hours and mid-afternoon rather than working through them.
- Investigate if it is practical to enhance operational facilities and procedures for alertness management such as napping, bright light and access to caffeine and food.

2.2.6 If a driver experienced feelings of sleepiness or had difficulty sustaining attention during the shift prior to the SPAD

- Look for opportunities to provide variety in driving tasks to avoid monotony where possible.
- Ascertain if the driver employed any alertness management strategies with onset of symptoms.
- Review procedures for management of sleepiness in train crew³. Determine awareness of procedures among train crew, signallers, controllers and supervisors.
- Encourage a reporting culture to avoid stigma associated with drivers identifying as fatigued.

2.2.7 If driver had an extended period of commuting that may have impacted on sleep opportunity

- Ascertain what circumstances lead to the extended commuting. Discuss if there are reasonably practicable options for instances where an extended commuting period could impact on recovery sleep (such as alternative accommodation, remote sign on or shorter shift).

Part 2.3: Where factors associated with driver's physical and mental state at time of SPAD contributed to the SPAD

2.3.1 If the driver reported a lapse in concentration due to personal worries or having other things on their mind

- Where stress or personal worries are identified as contributing to concentration lapses:
 - ensure that the driver is aware of the effects of stress on performance and has the opportunity to discuss any issues with his/her manager
 - ensure the driver is aware of services such as an Employee Assistance Program (EAP)
 - in some cases it may be necessary to recommend that the driver attend a psychological consultation (such as EAP)
 - consider reviewing monitoring procedures (that is, the *chain of care*), and the management arrangements
 - assess if there were cultural factors that discouraged the driver from seeking help. Look for practical ways to de-stigmatise stress and psychological issues such as through briefings and mentoring programs.

2.3.2 If a driver's drug and/or alcohol test is positive or they indicate use of an over the counter medication that may cause drowsiness

- Follow organisational procedures to seek further information from the driver and pathology service provider regarding the test results.
- If necessary consider disciplinary action in line with *just culture* guidelines⁴ and ensure that the just culture discipline process is enforced consistently.

³ More details of mitigating measures can be found in Rail Safety and Standards Board 2008. Review of coping strategies to mitigate fatigue of train drivers. Report No T059 Human Factors Study of Fatigue and Shiftwork.

⁴ The RRM guidelines describe a just culture as one element of safety culture. In a just culture, acceptable and unacceptable behaviour is clearly defined and people are not blamed for normal errors. Equally importantly, those who intentionally violate established rules and procedures should be held accountable for their actions. Such a policy encourages people to openly discuss errors and even routine violations, so that other people can learn from them and improvements can be made to the error tolerance of the system. (RRM Guidelines, pp. 27)

- Refer driver to confidential counselling or to their general practitioner if medications are involved.
- Promote a culture where drivers are seen as key team members with important safety responsibilities and high performance standards.

2.3.3 If driver was using medication at the time of the SPAD that may have adversely affected his/her vigilance or reaction times

- Consider educating the driver on the possible side effects of medication and suggest that they obtain advice from their general practitioner.
- Consider disciplinary action in line with *just culture* guidelines and ensure that the *just culture* discipline process is enforced consistently.
- Consider awareness programs that highlight the over-the-counter drugs that could cause a driver to fail a drug test.
- Driver training should highlight that drivers must make themselves aware of the possible side effects of medications they may be taking (including side effects from combinations of drugs), and should not work if these include drowsiness or other effects that may impair alertness and performance.

2.3.4 If the driver was suffering from pain, illness or a health issue that may have impacted their sleep or alertness

- Encourage the driver to see their general practitioner.

2.3.5 If the driver is experiencing excessive daytime sleepiness or difficulty falling or staying asleep

- Encourage the driver to seek medical assessment to determine if there is a sleep disorder. Check that they are up to date with the requirements of the Health Assessment Standards.

Part 3: Operational/organisational factors

Part 3.1: Where the work schedule impacted on the driver's alertness/opportunity for recovery

3.1.1 If the 14-day work schedule history contains dimensions that reduced the opportunity for recovery sleep

- Review actual work history to determine consistency with operational rostering principles and procedures.
- Determine if any dimensions occurred due to changes to planned rosters, and if the changes were managed according to operational procedures and limits.
- Ascertain if this driver's roster is typical, by reviewing the overall roster system to ensure that distribution of night work/overtime is not leading to fatigue for particular drivers.
- Look for opportunities to restructure rosters against good practice guidance⁵ by reducing dimensions that may contribute to fatigue, for example:
 - excessive hours or night hours or long shift duration
 - excessive consecutive shifts (for example, RSSB analysis suggests relative risk of SPAD elevated after six consecutive shifts)
 - quick turnarounds between shifts (for example, double backs)
 - no weekly long break (two uninterrupted night sleeps with a day off in between).
- Ensure that proposed changes do not create problems elsewhere in the roster system.

⁵ Rail Safety and Standards Board 2008 'How to manage shiftwork problems – a research perspective'. Report no.T802 Understanding Human Factors a guide for the railway industry V1.0

- Review workforce projection processes to ensure that there is adequate staffing for foreseeable demand.
- 3.1.2 If the driver did not have adequate breaks in order to main alertness during the shift in which the SPAD occurred**
- RSSB research suggests that SPAD risk increases with time on task, particularly after 4.5 hours. Ensure that adequate breaks within shifts are built into schedules and that drivers take the breaks made available to them. Where possible, breaks should be taken outside the cab.
- 3.1.3 If there were workload factors (for example, demanding or monotonous tasks) which combined with prior sleep loss which degraded driver performance**
- Consider assessing workload associated with particular routes and times of day and developing tailored strategies. During periods of high and low workload performance can be impaired where there is a prior sleep debt from working night hours.
 - Consider integration of workload related management practices for particular routes into driver training and SPAD awareness initiatives.

Part 3.2: Where the driver experienced unusual or unfamiliar circumstances that contributed to the SPAD

3.2.1 If it was the driver's first experience of an unusual or uncommon situation

- Ensure that training for new drivers includes:
 - applied human factors training such as RRM, non-technical skills
 - degraded driving scenarios (for example, severe weather conditions)
 - route geography knowledge
 - route SPAD traps/specific route hazards.
- Experienced drivers should be given an opportunity to receive some training or experience in unfamiliar situations as part of periodic safety refresher training.

3.2.2 If the driver was facing time pressure

- Reinforce 'safety first' professional driving behaviours and enforce disciplinary action for risk taking behaviour or encouraging others to engage in risk tasking behaviours that are contrary to operational procedures.
- Minimise occasions of drivers having to drive under time pressure, for example, by timetable changes.
- Driver training or awareness programs should consider highlighting times when drivers are more likely to have a SPAD. (*Did you know that you are more at risk of a SPAD when...?* for example, when they are under time pressure).

3.2.3 If the driver felt that they were unfamiliar with the route or the location where the SPAD occurred

- Determine why the driver was driving an unfamiliar route and investigate the potential for similar situations to arise - consider associated risk mitigations.
- As necessary, arrange for driver skill/knowledge training in:
 - route geography knowledge
 - route SPAD traps/specific route hazards
 - signal knowledge
 - speed restriction knowledge
 - train braking knowledge
 - train protection systems
 - communication systems and emergency procedures.

- Implement a mentoring scheme for young and inexperienced drivers.
- Procedures should ensure that drivers report that they are unfamiliar with a section of track if they are rostered or re-routed onto it.
- Driver training or awareness programs should consider highlighting times when drivers are more likely to have a SPAD (*Did you know that you are more at risk of a SPAD when...?*, for example when they are driving an unfamiliar route).

3.2.4 If the driver reported that they were unfamiliar with the train controls or driving characteristics

- Determine why the driver was driving an unfamiliar train and investigate the potential for similar situations to arise - consider associated risk mitigations.
- Ensure that driver training covers the differences, and transitioning between, different set types and includes the use of simulators. Possible hazards to look out for when transitioning should be highlighted.
- As necessary, arrange for extra driver skill/knowledge training in traction types and handling and train braking knowledge (for example, types of trains, running brake test location, car markers, railhead condition, sandite locations, low adhesion areas, etc).

Part 3.3: Where there were internal distractions that caused the driver to have a SPAD

3.3.1 If the driver was distracted by physical discomfort

- Investigate the specific in-cab environmental issue and determine if it is reasonably practicable to rectify the issue without introducing new risks. Ensure that there is a mechanism for ongoing issues to be addressed in the design of any new rollingstock that is commissioned.
- Where possible ensure that cab environmental controls are set to the appropriate defaults.
- Ensure that all cabs comply with human factors/ergonomics guidelines concerning cab temperature, air quality, vibration and lighting.
- Ensure regular maintenance of cab environmental control systems.
- Ensure blinds are fitted and maintained.
- Ensure adequate supply of water and access to welfare facilities at regular points on the network.

3.3.2 If the driver was distracted by operating a radio system

- Consider refresher training on radio protocols, training in professional driving techniques and task prioritisation (for example, setting up train radio, when to answer radio).
- Investigate if the driver was trying to fix a radio system that was not working properly. If required initiate a check of the transponder equipment for that area.
- Ensure radio maintenance procedures are adequate.
- Encourage drivers to report faults and failures.

3.3.3 If the driver reported an auditory distraction within the cab

- Review in-cab alarms to ensure they are not too loud (for example, to cause startle effect), urgency mapping is appropriate, and that they are distinct enough to be differentiated, do not mask one another and are appropriately prioritised.
- Consider which alarms/broadcasts are safety-critical and which events require an urgent response from the driver.
- Ensure that only important faults are reported to the driver with an auditory alarm.

3.3.4 If the driver was distracted by other in-cab equipment or operational equipment

- Reinforce safety oriented professional driving behaviours and task prioritisation.
- Ensure that official documentation given to drivers is accurate and easy to read.

- Recommend briefings to increase driver awareness of the necessity for completing train preparation duties (head-in-cab duties) before moving off.

3.3.5 If the driver was distracted by an in-cab non-operational activity

- Consider putting in place a mobile phone policy and where such a policy exists, ensure adherence to it.
- Consider random checks to ensure that, whilst on duty, the driver does not attend to information that is not relevant to driving tasks (for example, reading newspaper, using mobile phone).
- Encourage drivers to leave sources of distraction (for example, newspaper, mobile phone) in a bag away from the primary driving interface area through awareness campaigns.

3.3.6 If there is evidence that another person in the cab distracted the driver:

- Consider counselling or disciplinary action if distraction by an in-cab passenger contravened protocols.
- Consider revising the in-cab protocol document issued with cab passes.
- Ensure Cab Passes are strictly controlled. Review issue lists to identify and withdraw unwanted passes.

Part 3.4: Where there were external distractions that caused the driver to have a SPAD

Review the need to include some form of applied human factors training such as RRM training to help drivers deal with distractions.

3.4.1 If the driver was distracted by activity at a level crossing

- Consider implementing a driver training and awareness programme for example, briefing sessions to raise awareness of risk and ensure route knowledge is adequate; poster campaign warning drivers of risk.
- Consider implementing a pre-journey briefing that requires drivers to go through potential hazards or SPAD traps on their route. This is similar to best practice in other industries.
- If there are level crossings on the network that are responsible for numerous SPADs perform a signal sighting to investigate and consider infrastructure changes if necessary.

3.4.2 If the driver was distracted trying to read lineside information

- Encourage drivers to report any sighting difficulties.
- Move lineside signage if it obscures the signal; consider removing it altogether if not useful.
- Remove sources of obstruction as much as possible.
- Where necessary, review anti-trespass and anti-vandalism measures in the surrounding area.
- All signs and other visual aids should be kept clean, which may require rigorous management of contractors by infrastructure maintenance management staff.
- Review maintenance arrangements and driver reporting procedures, to make sure that these are adequate.

3.4.3 If the driver was distracted by a non-operational lineside distraction

- Brief drivers on the fact that they can be distracted, make them aware of the kinds of distractions they may face, for example, pedestrians, livestock, advertisements etc.
- Consider including re-focusing techniques and risk commentary driving in driver training.
- Consider infrastructure changes such as fencing to deliberately obscure known distractions.

3.4.4 If the driver was distracted trying to control the train speed on a falling gradient

- Ensure that driver training includes effective training on different gradient profiles.

- If signals must be at points of significant change in gradient:
 - Recommend driver awareness briefings
 - Maximise the signal viewing time
 - Ensure that gradient signs are kept clean and clear of vegetations
 - Ensure that gradient signs are positioned correctly (facing the track in the direction of travel)
 - Consider the provision of repeaters or countdown markers, if an improvement cannot be achieved by other means.
- Consider relocating the signal along the track, as long as the risk is not transferred elsewhere.
- Consider a proactive program to maximise the viewing times, and/or provide repeaters or countdown markers for signals on steep gradients or where the gradient profiles change. However, caution should be used so as not to install too many signal reminder aids as this may be distracting and divert the driver's attention from the speed control task.

3.4.5 If the driver was distracted by a temporary speed restriction in close proximity to the SPADed signal

- Consider relocation of warning/clearance boards and/or expansion of temporary speed restriction area to eliminate the hazard.
- Improve driver notification of temporary speed restrictions through daily notices.
- Review temporary speed sign design to ensure that the signs are fit for purpose.
- Review temporary speed restriction placement guidelines - ensure they are considerate of potential SPAD risk. Develop appropriate rules and ensure that work crews are trained to place signs in suitable locations, for example, restrictions on nested temporary speed restrictions until designs of warning/clearance signs are improved.
- Consider the rules for warning board distance placement on non-freight train lines, it may not need to be as great as the present distance, which is based on freight braking distances. Lines that do not carry freight traffic could use shorter warning board distance placement.
- Where speed restrictions are introduced at different places along a route, consider reducing the whole route, or parts thereof, to the reduced speed to minimise the complexity and number of nested temporary speed restrictions.

3.4.6 If the driver was distracted by contractors or temporary lineside equipment/material

- Provide opportunities for drivers to discuss/look around major trackside building work that will be taking place on their route so that they understand what is going on.
- Depots should brief drivers about major trackside building work.
- Ensure that contractors are aware of the potential for distraction that they cause, and that they act appropriately to minimise this risk. Building contractors should be made aware of the hazard and take care not to position equipment where it may interfere with signal sighting, even temporarily (for example, ladders, tow trucks, etc).

3.4.7 If the driver was distracted by a passenger

- Consider covering re-focusing techniques in driver training.
- Brief drivers on the potential for distraction during major events and possible ways to deal with it.

Part 3.5: Where the driver's view of the signal was obscured

3.5.1 If the driver's blind obscured their view of the signal

- Ensure that drivers are provided with suitable polarising sunglasses and encourage use as an alternative to lowering of the blind in some instances.
- Ensure in-cab sun blinds are maintained.

- Driver training and awareness programme – consider briefing sessions to raise awareness of risk and ensure route knowledge is adequate; poster campaign warning drivers of risk, use of publications such as a regional newsletter (for example, Red Ahead – NSW).
- If the signal is multi-SPADed consider a signal sighting - it may be the location of the signal with respect to sunlight that is the real issue.

3.5.2 If the driver's view of the signal was obstructed by the presence of another train

- Consider raising the signal (if this does not introduce additional risk) or including a repeater signal. If the signal in rear of the SPADed signal is a permanent caution signal or does not provide the driver with information about the SPADed signal then consider resolving that issue.
- Consider proactive review of SPAD reports for different routes to identify at risk signals and consider signal sightings and relocation options for signals highlighted as being at risk (for example, raising signals, removing caution distant signals).

3.5.3 If the driver's view of the signal was obscured by temporary equipment or material associated with building work on or around the line

- Brief drivers about major trackside building work.
- Encourage drivers to report sighting difficulties urgently.
- Ensure that contractors are aware of the potential for distraction that they cause, and that they act appropriately to minimise this risk. Building contractors should be made aware of the hazard and take care not to position equipment where it may interfere with signal sighting, even temporarily (for example, ladders, tow trucks, etc).

3.5.4 If the driver's view of the signal was obscured by ground vegetation/foliage

- Ensure that foliage is cut back far enough from the running rail and for sufficient distance to allow the signal to be sighted from its specified sighting point. Check that this level of cut back is maintained throughout the seasons.
- Ensure that drivers have a clear view across left and right hand curves, if this is required to achieve the reading distance.
- Consider providing countdown markers where the signal has a history of being SPADed, or where drivers talk of difficult braking on final approach.
- Clear ground vegetation regularly, especially on lines with wheat trains. Check that vegetation remains cut back, throughout the seasons.

3.5.5 If the driver's view of the signal through the windscreen was limited (for example, by dirt)

- Remind driver it is his/her responsibility to ensure that they have a clear field of view.
- Arrange for a check of windscreen wiper condition and performance if required.
- Appropriate cleaning materials should be provided in all cabs. Ensure that the train's screen wash is regularly checked and filled as necessary.
- Ensure regular cleaning of windscreen.

Part 3.6: Where something affected the driver's perception of the signal

3.6.1 If the driver was wearing sunglasses that are not suitable for driving

- Ensure that the sunglasses/eye protectors worn by the driver are suitable for driving. Certain types of lenses are marked with a warning that they *must not be used when driving* if they are not suitable for driving (for example, if they are too dark or coloured in a way that could affect perception of colours).
- If the driver was wearing prescription sunglasses ensure that these comply with AS/NZS 1067:2003.
- Consider driver training and awareness programs or an article in a national magazine (for example, Red Ahead – NSW) warning drivers and asking them to check their sunglasses.

3.6.2 If the driver's vision was affected by direct glare from sunlight shining in their eyes

- Remind driver to use suitable sunglasses in sunny weather conditions. Issue driver with standard issue sunglasses as required.
- Ensure that in-cab sun blinds are maintained.
- Signals prone to visual interference from direct glare (for example, those facing directly east or west) should be recorded as SPAD traps.

3.6.3 If there was fog, mist or rain at the time of the SPAD

- Driver training should require competent train management in degraded conditions. Driver training or awareness programs should consider highlighting times when drivers are more likely to have a SPAD (*Did you know that you are more at risk of a SPAD when...?*), for example when they emerge from bad weather conditions and relax slightly.
- Consider implementing a pre-journey briefing if there is bad weather forecast when the driver signs on.
- Consider introducing higher intensity signals, for example, LED signals in risk areas, based on meteorological history of area.
- Ensure that the Infrastructure Maintenance Manager's staff and/or contractors clean lenses to a high standard and that lamping staff are competent in full duties.

3.6.4 If the driver misjudged the distance to the signal due to low light levels

- Consider reviewing rolling stock headlight maintenance as required.
- As part of professional driving program, train drivers to look for and use certain cues (for example, cross tunnel doors/wall lights/stanchions) to judge speed in low light levels.
- If the SPAD occurred in a tunnel consider introducing low level lighting or other mitigations, to help with speed judgement.
- If the external environment provides few visual references by which speed could be judged, provision of countdown markers could be beneficial (with spacing, and distance over which they are provided, appropriate to the speed and braking characteristics of the trains that they are designed to assist).

3.6.5 If the signal's visibility was adversely affected by sun glare shining off the signal lens

- Consider briefing drivers on the parts of the route that are known to be badly affected by sun glare.
- Consider using an LED signal as they are brighter and may be less affected by sun glare.
- Ensure that signal hoods are correctly fitted.
- Consider extending the hood length and lamp voltage (most signals run below maximum voltage to prolong filament life) to increase brightness.
- Consider providing lenses with better hot strips (to improve 'close-to' sighting).

3.6.6 If a signal-like light was in the driver's field of vision on approach to the signal

- Encourage drivers to report sources of distracting non-signal light sources. Recommend regular briefings and training to increase driver awareness and understanding of potential risks and problematic areas.
- Identify the owner of lighting or clutter and if practicable 'manage-out' the problem: by explaining the significance of the problem, the owner may agree to change, removal or screening of the light source. For instance, seek co-operation from third parties to use down lighter type lights and avoid the use of halogen and high pressure sodium lamps wherever possible.
- Consider using LED signals, as these are stronger and have a more directed beam
- Consider screening off non-signal lights from the track so that they cannot distract drivers.
- Consider using a large matt black background to increase the opportunity for the driver to both locate the signal and read the aspect.

- If signal cages are present, paint the structure, cages and gantry black and use a free standing backplate.
- Conduct a site visit to the signal and use standard solutions for problems of glare/ghost aspects (for example, where light reflections from buildings interfere with signal sighting). Shielding the source of glare may be effective with larger backboards or side screening.
- Reduce line speed, if absolutely necessary, to give drivers time to identify the correct signal.

3.6.7 If the driver mistook a parallel signal as his/her own (on a curved approach)

- Remove sources of obstruction as much as possible for the signal on the curved approach to increase the likelihood that drivers will recognise the correct signal.
- Consider using LED signals, as these are stronger and have a more directed beam.
- Consider the introduction of line identification plates to support the driver in associating a signal and a line.
- Consider the use of repeaters.

Part 3.7: Where the driver made an incorrect early assumption about the signal aspect

3.7.1 If the driver made an incorrect assumption about a signal indication because they only saw one of the aspect lights (for example, top or bottom aspect)

- Consider providing driver training to highlight the importance of reading both aspects and raise awareness of risks through case studies (for example, in a regional newsletter).
- Signal sighting committees should consider this hazard when sighting new signals near the brow of a hill.
- If signal is frequently SPADed because drivers cannot see one of the aspects a signal sighting should be triggered.

3.7.2 If the driver believed that the SPADed signal was showing a low speed indication

- Find out why the driver thought the signal was a low speed signal. Review communications log as required.
- Provide training to new drivers which emphasises the importance of always expecting a stop signal after a caution signal.
- Provide training which identifies multi-SPADed low speed signals.

3.7.3 If the driver had been driving on successive caution signals prior to the SPAD

- Consider interviewing the signaller/controller as required.
- Consider providing signallers with a briefing on signals with known SPAD traps. Ensure that Signaller training highlights the potential SPAD hazards that their actions can create.

3.7.4 If the driver focused on the turnout indication rather than the cautionary aspect of the signal in rear

- Consider driver refresher training.
- Junctions with significant differences between line-speeds for different routes should be flagged in driver training.

3.7.5 If the signal is normally (that is, more than 75% of the time) encountered at a proceed aspect

- Consider providing signallers with a briefing on signals with known SPAD traps. Ensure that Signaller training highlights the potential SPAD hazards that their actions can create.

3.7.6 If the driver expected the SPADed signal to conditionally clear

- Training and briefing for drivers to create awareness about risks from conditionally cleared signals.
- If it is not a conditionally cleared signal, ensure that drivers who use the same route are briefed that the signal is not conditionally cleared.
- If it is a conditionally cleared signal consider a signal sighting or review to determine whether the conditional clearing on the signal is still needed and justified. Ensure the signal clears at the earliest possible time, in order to give the driver an opportunity to correct any errors.
- Consider signalling arrangements that don't rely on or that eliminate conditionally cleared signals.

3.7.7 If the driver assumed that they could go past the SPADed signal at stop, for example, under Special Working

- Find out why the driver thought they could go past the signal at stop. Review communications log and consider interviewing the signaller/controller as required.
- Review Special Working procedures as required.
- Review procedures concerned with passing signals at stop for clarity.
- If the signal might be at risk of further SPADs because it or a nearby section of track will be affected by Special Working for a relatively long period of time, consider briefing all drivers who drive that route on the potential SPAD trap.

Part 3.8: Where recent changes or other factors affected driver braking behaviour or judgement

3.8.1 If the driver failed to account for low adhesion at the time and location of the SPAD consider:

- Management and reduction of lineside vegetation
- Erection of lineside fencing or netting
- Railhead conditioning (sandite)
- Low-adhesion warning signs
- Equipping rolling stock (especially disc-braked stock) with scrubber blocks or sanding equipment (smart sanders offer greater control of application)
- Management of rail/flange lubrication equipment
- Skid-pan training for drivers
- Arranging for driver skill/knowledge training in train braking knowledge (for example, types of trains, running brake test location, car markers, railhead condition, sandite locations, low adhesion areas, etc).

3.8.2 If the driver transferred from one train to another with different braking capabilities prior to the SPAD

- As necessary, arrange for driver skill/knowledge training in train braking knowledge (for example, types of trains, running brake test location, car markers, railhead condition, sandite locations, low adhesion areas, etc).
- Build strategies into driver professional driving techniques (running brake tests, highlight importance of drivers braking early until they have established the performance of vehicle).
- Change the format of depot certificate (if necessary) to ensure that the number of cars stands out when the form is displayed in the train.
- Increase the use of standardised car markers at all stations.

3.8.3 If, prior to the SPAD, the driver or train had recently switched between different types of braking system, for example, EP to auto or Auto to EP

- As necessary, arrange for driver skill/knowledge training in train braking knowledge (for example, types of trains, running brake test location, car markers, railhead condition, sandite locations, low adhesion areas, etc).
- If the switch between braking systems was automatic review the scenario and consider initiating an engineering/maintenance check of the train.
- Build in strategies into driver professional driving techniques (running brake tests, highlight importance of drivers always braking early until they have established performance of vehicle).

3.8.4 If the SPAD occurred shortly after the driver had changed ends

- Provide training/briefing to raise awareness of risks - as part of professional driving techniques drivers should be instructed to test the braking of the train immediately after changing ends, in case the characteristics have changed.
- Driver training or awareness programs should consider highlighting times when drivers are more likely to have a SPAD (*Did you know that you are more at risk of a SPAD when...?* for example when changing ends).

3.8.5 If there had been recent changes made to the landscape/non-operational infrastructure along the lineside (for example, landmarks, buildings, advertisements)

- Where possible, ensure that drivers are made aware of any changes to non-operational infrastructure when they sign on at the start of the day so that alternative signal sighting/braking strategies may be employed.
- If changes are significant, for example, changes to major landmarks used for braking, build into the scheme adequate provision for the information on the effect on the driver's route.
- Consider the provision of additional supporting landmarks if necessary.
- Consider increasing the use of standardised car markers at all stations.

Part 3.9: Where other railway personnel or system processes contributed to the SPAD

3.9.1 If the SPAD occurred shortly after a driver change

- Consider reminding driver of handover procedure and importance of good communications if there is information to convey to the incoming driver. Professional driving techniques should highlight the importance of a good handover.
- Consider introducing a formal *driver reminder* device that can be used voluntarily to remind drivers about important information for example, if previous signal at caution.
- At stations where the driver takes over a train and they cannot see the status of the next signal a repeater signal should be visible.
- All major changeover stations should be designed so that both the line speed and signal status are immediately apparent to the relief driver.

3.9.2 If any action of the guard/PSS contributed to the SPAD

- Interview guard/PSS to discover how their actions resulted in a SPAD. Investigate further using CCTV footage OR SIGNAL LOGS as required.
- For guards/PSS: Consider developing professional guard train management techniques to reflect driver train management techniques in training.
- Consider an upgrade of the guard's indicator lights to LEDs if the signal is regularly SPADed when starting away.
- If departure end signals are an issue - consider a signal sighting to investigate why they are an issue.
- Improve signal sighting at stations.

3.9.3 If there is evidence that the signaller contributed to the SPAD

- Interview the signaller involved to discover how their actions resulted in a SPAD. Investigate further using Signal Logs and Communications recording as required.
- If the signal is multi-SPADed consider performing a human factors assessment to look at the signalling controls for that section of track, for example, the signalling panel that is used to control the signal.
- Utilise all other relevant sections of the SPAD investigation checklist that may provide insight into factors that influenced the signaller's performance, such as experience and competencies, work schedules and fatigue, distractions, workload and mental state, etc.

3.9.4 Consider signaller training that places greater emphasis on understanding the role of the train driver: for example, ensure that signaller training increases awareness of critical periods when they should not phone drivers. If there is evidence that a failure in safety critical communications contributed to the SPAD

- Interview the appropriate people involved in the safety critical communications, for example, signaller, controller, worksite protection officer, etc and listen to the communications log to determine what happened. Reinforce communications procedures/protocol and/or professional driver behaviours as required.
- Remind the driver that they should bring the train to a stop before responding to communications if they are feeling overloaded.
- Review training on radio protocols and safety critical communications in line with industry best practice.
- Ensure that staff (drivers and signallers) work to the correct communications protocol.
- Ensure that signaller training increases awareness of critical periods when they should not contact drivers.

3.9.5 If there were recent infrastructure changes prior to the SPAD that were not effectively communicated in a timely manner to the driver

- Consider a briefing or note to alert drivers at depots prior to the infrastructure change.
- Ensure that minor changes are detailed in driver weekly notices leading up to the change and consider driver training using simulators for major changes (if possible).
- Do not implement novel signal sequences without adequate driver training/briefing.

3.9.6 If the driver believed that he/she was authorised to move

- Interview the appropriate people involved for example, signaller, shunter or hand signaller and listen to communications log (if appropriate) to determine what happened.
- Review and reinforce communications procedures/protocol and/or professional driver behaviours as required.
- Ensure that staff work to the correct communications protocol. Monitor and educate staff using recorded conversations.

3.9.7 If there was a service stop at an intervening station or a worksite after the caution signal and before the SPADed signal

- Consider introducing a formal 'driver reminder device' that can be used voluntarily to remind drivers about important information for example, if previous signal at caution.
- Review the need for a repeater at intervening station to provide the driver with an indication of the status of the upcoming signal.

3.9.8 If the signal layout had been altered in the recent past

- Consider a briefing or note to alert drivers at depots prior to the infrastructure change.
- Ensure that minor changes are detailed in driver weekly notices leading up to the change and consider driver training using simulators for major changes (if possible).
- Do not implement novel signal sequences without adequate driver training.

Part 3.10: Where the driver attended to the wrong visual cues which they took as evidence that they could proceed

- As necessary, arrange for driver skill/knowledge training in:
 - Applied human factors (RRM) training
 - Route geography knowledge
 - Route SPAD traps/specific route hazards
 - Signal knowledge
 - Speed restriction knowledge.
- Driver training should highlight the importance of reading signal aspects at all times and raise awareness of risks through case studies (for example, in a regional newsletter).
- If this hazard reoccurs at a multi-SPADed signal consider a signal sighting to review the infrastructure in the area.

Part 4: Data logger information

4.1 If there is evidence that the driver was powering against braking at the time of the SPAD

- As necessary, arrange for driver skill/knowledge training in:
 - Applied human factors (RRM) training
 - Route geography knowledge
 - Route SPAD traps/specific route hazards
 - Signal knowledge
 - Speed restriction knowledge.
- Ask driver to recount how they could have better managed the situation and reinforce procedures and/or professional driver behaviours as required.
- Ensure consistency across set types in control mechanisms.
- Ensure that driver training covers the differences and transitioning between, different set types and includes the use of simulators. Possible hazards to look out for when transitioning should be highlighted.
- Consider implementing an interlocking system (similar to that used in Queensland) that would prevent this hazard from occurring on relevant set types.

4.2 If there is evidence that the driver was exceeding the nominated track speed prior to the SPAD

- Try to discover why the driver was speeding (for example, due to the presence of another SPAD Hazard?).
- Investigate the causes of driver over speed. Consider more awareness campaigns, route knowledge training or more widespread use of speed compliance officers.
- Consider disciplinary action in line with just culture and/or referring driver for confidential counselling.
- If there are reports of many drivers speeding in one section of the network consider a review of the speed profile and speed sign locations for that section.

4.3 If there is evidence that the vigilance alarm went off at the time of the SPAD

- Check if there were any other indicators in the data that would suggest that the driver's performance may have been degraded.

- Obtain an account from the driver for a possible explanation for the vigilance alarm activation.
- Where no obvious explanation can be found consider that decreased alertness/fatigue may have contributed to the SPAD (see Part 2.2).