RISSB
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

INDUSTRY DISCUSSION PAPER

TRAIN WHISTLES – UNDERSTANDING THE RISKS AND OPPORTUNITIES TO ALL STAKEHOLDERS

FOR RAIL INDUSTRY SAFETY AND STANDARDS BOARD

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Executive Summary

Train whistles and their adverse impacts on the community have been of growing concern to rail transport operators, councils, and governments. Driving this concern includes increasing population living near rail corridors, increasing number of rail services, and increasing number of rail services operated at night, therefore increasing exposure to whistle noise.

However, whistles are integrated into rail operations. They are used as a form of communication, as a warning, and for emergencies. They are a commonly cited risk control in managing key rail safety risks – in particular for track worker safety and at level crossings.

The issue is one of conflicting risks – one where the whistle mitigates safety risks, but in doing so it is a nuisance and a health hazard itself.

While there is recognition that use in emergency scenarios is necessary, contemporary technologies or alternative controls could reduce whistle use, but ensure safety is managed. Quiet zones, quiet periods, rule reviews, etc. are all options that have been implemented on rail networks nationally or internationally.

In considering replacing whistles there are 2 critical aspects. The first is the need for rail transport operators to demonstrate that safety risks are managed so far as is reasonably practicable. In the United Kingdom, it has been estimated that whistle use mitigates 1-2 fatality weighted injuries per year and as whistles are inexpensive and available, a cost-benefit analysis would suggest whistles must remain.

However, this analysis does not consider the adverse health risks created by horn use. Environmental noise, including train whistles, has been shown to adversely impact sleep, cardiovascular health, and cognitive performance. Quantifying these effects is challenging given the indirect links between whistle use and health events and given number of other more prevalent and direct health risk factors.

Rail Transport Operators can seek to address these issues. For example, they can seek to alter operational rules or find alternative technologies to use in specific contexts to replace the train whistle. However, to optimally manage the risks it would be ideal to have alignment and support from governments and regulatory bodies to manage these shared risks.

This then has led to the question of what should the rail industry do? There are 3 options forward.

- Option 1: No change. Individual rail operators can pursue opportunities as they see fit.
- Option 2: Rail Transport Operator Aligned Approach. This would include the development of a code of practice or guidance document on how to mitigate the adverse impacts of whistle use (including how to eliminate need for use).
- Option 3: Systems Approach. This approach includes option 2, but also seeks engagement, support, and alignment from governments.

The information contained in this paper will help inform the discussion and selection of the appropriate option for the rail industry.

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1 Introduction

1.1 Purpose

This paper provides background to and articulates the risks associated with train whistle[1] use – both where it mitigates the risk (i.e., a control), and where the horn may be the source of risk (i.e., a nuisance or health hazard) – and explores potential ways forward for the rail industry.

The paper is intended help inform discussion and debate within the rail industry regarding whistle use and adverse effects to assist the rail industry identifying a unified way forward. As such, it provides options for the rail industry, not recommendations.

Further, while there are opportunities to mitigate the adverse effects of whistle use included within, this paper does not specify or suggest that these are the 'right' or 'best' opportunities.

1.2 Approach

The information contained in this paper has been obtained through:

- Available research literature,
- Other related literature (e.g., government and industry reports),
- Review of identified legislation,
- Review of approaches undertaken (nationally and internationally) to address whistle noise, and
- Discussions with stakeholders (see 1.3).

The above information is then integrated to formally define the specific risks that train whistles are associated with, along with a systems level view on the management of these risks.

1.3 Stakeholder Engagement and Discussions

Stakeholders engaged to inform this paper included representatives from state governments (and authorities), regulators (environmental, rail safety, and work health and safety), rail transport operators (RTOs)[2], and train drivers. This breadth of stakeholders was essential to ensure all perspectives on the risks and issues associated with whistle use are understood. Appendix 1 provides the stakeholder organisations that participated.

The discussions with stakeholders were semi-formal in nature. Each began with the author providing an overview of the scope of work and issue being considered, and then used a set of guiding questions to support the conversation. The guiding questions were:

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[1] The term 'whistle' is used throughout this paper, though it is also frequently called a 'horn'. Whistle is frequently used in network rules and procedures, and reflects the history of the early steam whistle.

[2] RTO engagement included both Rail Infrastructure Managers and Rollingstock Operators. It also included freight and passenger operators.

- What are your general perspectives, thoughts, and issues regarding train whistles?
- What are the risks or issues that concern you or your organisation?
- Are there specific contexts to consider that affects the risks or issues? (Examples: day vs. night, town vs. country)
- Are there any opportunities you see moving forward?
- What about interfacing parties – what role do they have in mitigating the whistle use risks? (Examples: developers, government / councils).

This discussion approach allowed for a clear understanding of the perspectives of the different stakeholders and their organisations to be obtained and allowed with specific thoughts / ideas etc. explored and expanded on.

Note that to maintain privacy (as requested by several stakeholders) specific statements, examples, and scenarios provided by stakeholders are not detailed, and have been anonymised.

1.4 Exclusions

This report does not:

- Explore the sound levels or other characteristics of whistles (i.e., dB or Hz). This is addressed in AS 7532.
- Recommend a specific approach or outcome that the rail industry should pursue. Rather, it provides several options and articulates what steps may be associated with each of these.
- Specify or recommend individual approaches to reduce rail whistle impacts in the corridor[3].

2 Context – The Issue of Conflicting Whistle Risks

This paper explores the use of train whistle and related but conflicting risks. At its simplest, the train whistle helps mitigate safety risk *but is also* a health hazard. That is, the train whistle:

- Is a control measure for safety risk. The whistle helps make people aware of an oncoming train or train movements.
- Creates a noise hazard, potentially leading to health effects. At the minimum it is an annoyance, and at worst it can have long-term health effects (e.g., disturb sleep and associated health effects).

There are several nuances to the above (as described in section 4), but this conflict between safety control versus health hazard is the essence of the issue associated with train whistles.

Train whistles have been used since the beginnings of rail operations for a variety of reasons (see section 2), and as such the conflicting risks have

[3] Approaches to minimise whistle use / impacts are identified, but it is not the intent of this paper to recommend or rate specific opportunities.

always been present. However, with increasing population living near rail corridors, increasing number of rail services, and increasing number of rail services operated at night, the exposure to the noise hazard has increased (and therefore the associated risks have also increased).

Associated, all rail industry stakeholders (government, regulators, and rail operators) have noted that there are increasing numbers of related complaints regarding whistle use. This presents a reputational risk to those organisations, with each aiming to appropriately respond and address the issue of whistle noise.

> *It must be emphasised early that there is no debate about the validity of the whistle in emergency scenarios. The use of the whistle in these events – such as when there is an obstruction on the line – is considered valid and to remain.*

3 History and Use of Train Whistles

This section provides a very brief history of whistle use, and then outlines the current use of train whistles.

Understanding the history of how and why things 'are' can provide insight into the risks being managed. It can also help identify opportunities moving forward by understanding what the original intent was. As noted by several stakeholders interviewed:

> *Every rule in the rule book has been developed to address an incident that has occurred.*

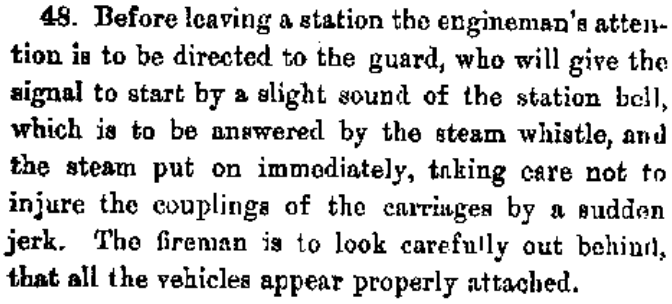
3.1 Brief History

Train whistles have been used in railways since at least the 1830's[4], and their use has been part of Australian and New Zealand railways since the steam locomotives of the 1850's. The purpose of the whistles has always been to provide a warning of train movements, and to provide the driver a means of communication to other locomotives and to rail workers.

Whistle use arose from a need's basis. That is, there was a need for a train driver to communicate a warning or general message to another party and the whistle provided a means to accomplish this effectively. For example, the rule shown in Figure 1 is from the 1846 rules applicable to the Eastern Counties Railway[5]. In this example, the whistle is an effective solution to ensuring that the guard knew that the train driver recognised their bell and was about to move the train.

[4] Sources such as Wikipedia.com suggest that whistles were first introduced in 1832. However, the source of this is unknown. https://en.wikipedia.org/wiki/Train_whistle.

[5] Discussed and presented in: Horne, M. A. C. (2019). British Railway Rule-Books – A brief History and Commentary. *Available at http://www.metadyne.co.uk/pdf_files/RULE_MAIN_V4.pdf*



48. Before leaving a station the engineman's attention is to be directed to the guard, who will give the signal to start by a slight sound of the station bell, which is to be answered by the steam whistle, and the steam put on immediately, taking care not to injure the couplings of the carriages by a sudden jerk. The fireman is to look carefully out behind, that all the vehicles appear properly attached.

Figure 1: Departing from a Station (1846)

As time progressed and railway technologies evolved, the use of whistles changed little. An illustration of this are the similarities between current and historical rule books as they relate to whistle use. For example, the current ARTC TA-20 suite of operating procedures[6] details (in section 29 procedure 1) a series of whistle codes for different types of movements (e.g., two short sounds of the horn = move forward; three = set back). Similar codes can be found in many current rule books across the world and can also be found in the 'Railway Clearing House Standard Rules and Regulations of 1897'.

The importance of understanding this history is recognising that whistles were used because there was no other practicable approach / technology to deliver on the same need. The whistle was available, and it worked. But it also presents opportunities:

- If these needs are no longer relevant, then no need to use the whistle.
- If there is a new technology that can deliver on the need similarly or better than the whistle, then these could replace the whistle.

3.2 Contemporary Uses of Train Whistles

As noted, whistle use has changed very little over time. It serves as either a warning of train movements OR as a means of communication. The third context of use is around testing, which is done to ensure it can achieve the first two contexts of use. The table below provides examples of use across Australian and New Zealand networks:

Table 1: Contemporary Whistle Use

Category	Example(s)

To warn of train movements	• Emergency scenarios. Examples:
	  ○ When an obstruction (or potential obstruction) is observed the driver may sound the whistle in hopes that the rail line will be clear as the train passes.
	  ○ If a train identifies an issue on adjacent lines, they may sound whistle to communicate / inform other trains of the hazard.

[6] https://www.artc.com.au/customers/operations/rules-procedures/vic/ta20/

Category	Example(s)
	• Whistle sounded prior to train movement from platform to warn passengers of train departure. • Whistle sounded prior to train movement (any location) to warn rail safety workers. • Whistle sounded on approach or at a level crossing to warn road users or pedestrians of train approaching. (Often associated with a whistle board). • Whistle sounded on entry to tunnels and curves to warn rail safety workers who may be ahead. (Often associated with a whistle board).
General communication	• To acknowledge a safeworkers hand signal or work crew presence. • To acknowledge that the driver recognises an audible track warning signal has been detonated. • To communicate and coordinate between two attached locomotives (but not operating as a multiple unit).
Testing	• Whistle sounded prior to entry into service to ensure it is functioning appropriately. • Whistle sounded for maintenance purposes (e.g., calibration purposes).

Note that the network rules and specific application of whistle use does vary across Australian and New Zealand railways. However, the categories defined above are consistent.

One interesting observation is that there is recognition of 'town versus country' train whistles, where the country horn is louder. However, during discussions with stakeholders (including train drivers), and review of various rules and standards there is no clear definition of when a town or country whistle should be used. Rather, it is left to the discretion of the train driver to select which to use.

4 Context

This section provides background and context relating to whistle use, including research overview, legislation overview, managing risks, and consideration of approaches (nationally and internationally) to address the conflicting risks of safety mitigation vs. noise hazard.

4.1 Research Overview

4.1.1 Effectiveness of Whistle Use at Level Crossings

The use of whistles at level crossings is to help ensure that any level crossing user (pedestrian or road user) will be aware of an approaching train.

The effectiveness of whistles in today's current environment is being challenged, with several similar avenues of research having been undertaken.

The RSSB has completed a suite of studies exploring whistle use[7]. Some key outcomes of that study:

- It has been suggested that train drivers do not use whistles at every level crossing (even if fitted with a whistle board).
- The increasing use of headphones is reducing the effectiveness of whistles for pedestrians.

Similar findings have been reported in recent Australian research[8]:

- Train horns are not always used when a train approaches a crossing, particularly a passive crossing.
- Train horns are often insufficiently loud at crossings with bells.

This latter research also gives a potential reason for inconsistency in whistle use – it is influenced by driver experience and other concerns (e.g., noise concerns).

The above research challenges whether horns will be used and therefore even perceived by a user at a level crossing.

It should also be recognised that simply being able to perceive a whistle is not sufficient – the level crossing user must still recognise it as a warning of a train approaching. This recognition is not automatic, and can be influenced by other noise, what the level crossing user expects (e.g., are there vehicle horns or other similar noises in the area?), and more[9].

4.1.2 Environmental Impacts of Whistles

The impacts of the whistle noise have 2 main impacts – annoyance and health.

Prior to discussing these impacts, two notes:

- Prior to discussing these impacts, research suggests that people are not equally affected, with some impacted more than others[10].
- Train whistles are omnidirectional. While the front of the horn does create the 'loudest' noise, noise radiated to the sides of the whistles and train is still significant and is affected by the whistle design and installation onto the train. It is this radiated noise that is the primary cause for environmental noise concerns, and some trains

[7] A summary of the result of this research is compiled in: RSSB. (July 2016). Quantifying the impact of train horn noise (S262).

[8] Larue, G., Lewis, I, Watling, C, Dehkordi, S. (2020). LC17 Investigating the use of train horns at rail level crossings. (summary findings obtained from https://research.qut.edu.au/carrsq/projects/lc17-investigating-the-use-of-train-horns-at-rail-level-crossings/)

[9] National Transportation Safety Board (1998), Safety at passive grade crossing; Volume1: Analysis. Safety Study NTSB/SS-98/02.

[10] Discussion notes are derived from: Department of Health, Commonwealth of Australia. (2018). The Health Effects of Environmental Noise.

may create a greater noise impact than others due to whistle design and positioning. [11]

- Stakeholders indicated that the primary concern / complaint is whistle use on the mainline. Use of whistles in yards, sidings, and depots tend not to be a key concern or source of complaints. One reason explaining this is that residences built nearby have acknowledged the risk and put in appropriate sound proofing proactively.

4.1.2.1 Annoyance

Focusing on annoyance, there has been modelling to show the level of annoyance based on distance away from the whistle source combined with the number of trains sounding their horn at a specific location[12]. This modelling is shown Figure 2 (and assumes night rail traffic at 50% of daytime).

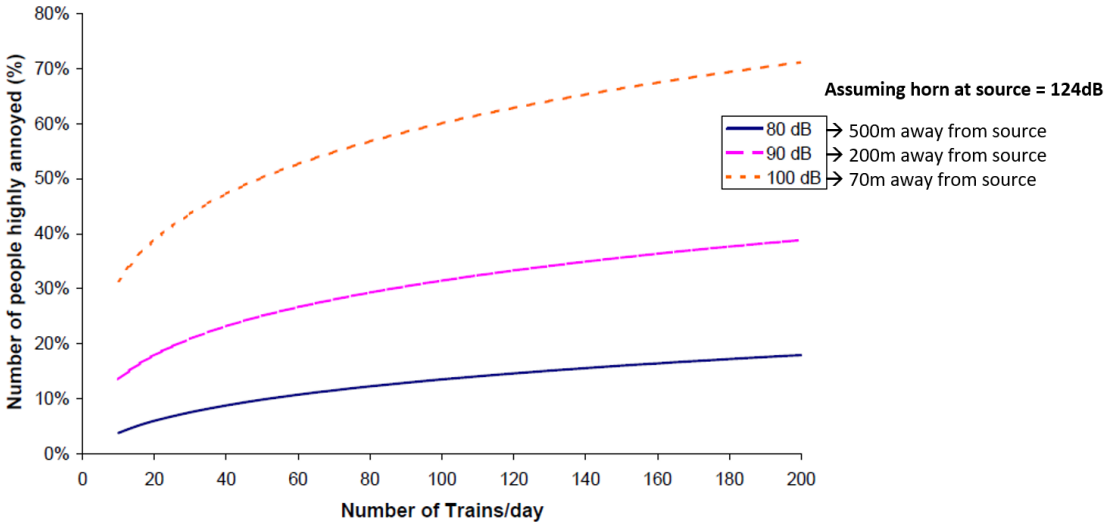


Figure 2: Modelled Annoyance based on Number of Trains and Noise Levels

While this modelling was based on a slightly higher source level than what is suggested in the relevant Australian Standard[13], this graph shows the combined impact of increasing population density around rail corridors and increasing number of trains. It is recognised that this was anecdotally known, but this provides a clearer picture of the impacts.

Anecdotally, stakeholders raised the point that complaints often related to a certain class or type of rollingstock, and that their assessment of this is that certain whistles are more annoying. One rail operator demonstrated that they received significantly more complaints about a particular type of rollingstock in comparison to others and showed that when that fleet changed to other portions of the network complaints also followed. There

[11] Hardy, AEJ. (April 2004). Audibility of Warning Horns, Final Report. Rail Safety and Standards Board.

[12] Hardy, AEJ. (April 2004). Audibility of Warning Horns, Final Report. Rail Safety and Standards Board.

[13] AS-7532

is research[14] which shows find that higher frequencies and whistles with greater 'musical dissonance' (i.e., harshness) create a greater urgency to respond. Another way to interpret this, is that higher frequency and harsher tones command attention more and therefore more effective as a warning device, but also more annoying if a bystander. This returns to the conflicting risk issue presented in section 2 – it is possible to reduce the environmental effects, but this will negatively impact rail safety, or vice versa.

4.1.2.2 12Health Impacts of Noise

There are three areas of health impacts that have been associated with environmental noise (of which train whistles are one contributor). These are outlined in the table below, along with a discussion focused on rail. [15]

Table 2: Environmental Noise Research - Summary

Impact	**Discussion**
Sleep	Research indicates that exposure to rail noise is associated with sleep disturbances, which can lead to cardiovascular disease, depression and obesity, workplace accidents due to fatigue, lost productivity.
Cardiovascular	Cardiovascular health impacts include any impact to heart and blood vessels, such as heart disease, stroke, and blood pressure. Rail noise and links with cardiovascular impacts has not been subject to significant research, and thus research evidence cannot demonstrate that rail noise (including whistles) impacts cardiovascular health. However, both aircraft and road traffic noise have been researched and shown to have small effects on cardiovascular health. These small effects are attributed to the fact that there are several other more prevalent risk factors (age, smoking, heredity, etc.). In short, while it is likely (but not currently proven by research) that rail whistle use does impact cardiovascular health, it is expected that this will be very small impacts in comparison to other risk factors.
Cognition	Cognition refers to thinking, understanding, memory, and decision making. Good cognitive performance is linked with higher quality of life, improved mental wellbeing, and improved job performance.

[14] Russo, FA, Lantz, ME, English, GW, and Cuddy, LL. (July 2003). Increasing the Effectiveness of Train Horns without Increasing Intensity. *2003 International Conference on Auditory Display.*

[15] Discussion notes are derived from: Department of Health, Commonwealth of Australia. (2018). The Health Effects of Environmental Noise. This is a recent meta-review of available research associated with health effects of Environmental noise, and also provides a range of recommendations for the Australian Government regarding traffic noise.

	The research evidence provides mixed results – there is some evidence that increased environmental noise does impact cognitive performance, but many studies were also inconclusive. The one study cited that specifically relates to rail found no impacts of rail noise on memory, listening, comprehension, written language acquisition, or visual recall.

In short, the research evidence does demonstrate that environmental noise does adversely affect health. The research review that informed Table 2 provides the following summary statement / recommendation for environmental noise:

> *There is sufficient evidence of a causal relationship between environmental noise and both sleep disturbance and cardiovascular disease, to warrant health based limits for residential uses.*
>
> *During the night-time, an evidence based limit of 55 dB(A) at the facade using the $L_{eq,night,}$ or similar metric and an eight-hour night-time period is suggested.*
>
> *During the day-time, an evidence based limit of 60 dB(A) at the facade measured using the $L_{eq,day,}$ or similar metric and a 16-hour day-time period is suggested.*

This statement provides clear guidance on environmental noise generally and could play an objective role in the pursuit to mitigate environmental impacts of whistles.

4.2 Legislative Overview

There are 2 primary forms of legislation relating to the use of train whistles – safety and environmental.

4.2.1 Safety

The Rail Safety National Law[16], imposes the duty to ensure, so far as is reasonably practicable (SFAIRP), that safety risks are:

- Eliminated SFAIRP.
- If not eliminated, minimised SFAIRP.

SFAIRP, in brief, requires a clear understanding of the risk, understanding what could be done to eliminate or minimise the risk, and putting in the mitigations that are practical (i.e., where the cost is not disproportionate to the risk).

If a risk mitigation is being considered for removal or reduced application (e.g., reducing or eliminating whistle use), then it is incumbent on the RTO to demonstrate 'reverse SFAIRP'[17]. A reverse SFAIRP argument must demonstrate one of the following:

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[16] Refer to Rail Safety National Law, Part 3, Division 1, *Section 46 – Management of risks* and *Section 47 – Meaning of reasonably practicable*..

[17] Refer to *ONRSR. (2016). Guideline – Meaning of Duty to Ensure Safety So Far as is Reasonably Practicable.*

- The cost of the control has substantially increased.
- The reduction of risk by the control has been reduced due to the addition of other controls.
- The risk control adversely impacts another risk control.
- The control is demonstrated to be redundant.

This is considered in more detail as it applies to whistle use in section 4.3.

Safety legislation does not prescribe the use of the whistle. The use of the whistle as a risk control is at the discretion of the rail transport operator who must demonstrate that risks are being managed safe SFAIRP.

It should be noted that work (occupational) health and safety across Australia has similar requirements to the Rail Safety National Law with respect to risk management and SFAIRP.

4.2.2 Environmental

There are two applicable perspectives regarding environmental noise – one being noise generated from railway developments and operations, and the second being developments occurring near railways (and transport corridors).

4.2.2.1 Railway Developments

From an environmental perspective the legislation differs across Australian states and territories with respect to environmental noise caused by rail (including whistles) and railway developments. The range is from reasonably prescriptive requirements through to not recognising operational rail noise as a nuisance or concern.

For example, in New South Wales there are very clear noise levels which if exceeded during rail developments requires additional mitigations to be provided to reduce level of noise (trigger levels shown in Table 3[18]), and any practical mitigations must be installed. If trigger levels cannot be met following mitigation then justification must be provided, along with an assessment of the acceptability of residual noise impacts.

[18] Extracted from: NSW EPA. (May 2013). Rail Infrastructure Noise Guideline.

Table 3: Heavy Rail Noise Triggers

Type of Development	Noise Trigger Levels dB(A) (External)	
	Day (7am – 10pm)	Night (10pm – 7am)
New rail line development	Predicted rail noise levels exceed:	
	60 $L_{Aeq(15h)}$ OR 80 L_{AFmax}	55 $L_{Aeq(9h)}$ OR 80 L_{AFmax}
Redevelopment of existing rail line	Development increases existing $L_{Aeq(period)}$ [5] rail noise levels by 2 dB or more, or existing L_{Amax} rail noise levels by 3 dB or more ***and*** predicted rail noise levels exceed:	
	65 $L_{Aeq(15h)}$ OR 85 L_{AFmax}	60 $L_{Aeq(9h)}$ OR 85 L_{AFmax}

Both South Australia and Victoria have similar policies in place for new rail developments or redevelopments[19][20]. There is clear evidence that these policies and guidelines are being applied, and during rail developments there is consideration of noise impacts to the community[21]. It should be noted that South Australian and New South Wales guidance applies to both freight and passenger rail operations, whereas Victorian guidance is limited to passenger operations.

Based on the above, it does appear that state governments are aligned in considering noise as part of rail developments and redevelopments However, they do not consider current and ongoing rail operations, and in particular whistle use. For example, the South Australian guidance explicitly states that the guidelines do not apply to … "*noise from safety warning devices during rail operations (e.g. warning horns on locomotives and bells at level crossings)*". Of course, if the infrastructure is modified to eliminate the need for the whistle (e.g., level crossing removed), then this will aid in mitigating whistle noise. However, this can be considered a 'secondary impact', not a primary aim.

When considering reducing operational rail noise, New South Wales EPA requires every RTO to be licensed[22] and demonstrate that they are actively exploring opportunities to reduce rail noise, including exploring opportunities to reduce whistle use. It is recognised that safety risks must continue to be managed SFAIRP, but this challenges RTOs to identify opportunities while maintaining safe operations.

[19] South Australian Environmental Protection Agency. (April 2013). Guidelines for the assessment of noise from rail infrastructure.

[20] State of Victoria. (April 2013). Passenger Rail Infrastructure Noise Policy.

[21] Level Crossing Removal Authority. (May 2016). *CD9 Preliminary Noise Report: P03-000-CTD-REP-XEV-0101.* Victoria.

[22] Licensing in NSW occurs under the 'Protection of the Environment Operations Act 1997' in NSW.

At the opposite end of the spectrum though, in Victoria rail noise emanating from rollingstock does *not constitute a nuisance*[23]. This means that (at least in Victoria) whistle use during rail operations and associated adverse impacts (see 4.1.2) is not, according to legislation, recognised as a concern to be actively managed.

In summary, there does seem to be alignment that new or modified rail infrastructure should not adversely affect residents, but there is disparity across states regarding whether whistle use as part of rail operations needs to be addressed.

4.2.2.2 Developments Near Railways

The above discussion focused on the legislation relating to railways, their operations, and developments. Taking the other perspective – some states have issued requirements for builders and developers to ensure that any new buildings near transport corridors meet certain requirements to minimise nuisance and impacts of environmental noise.

Queensland has a development code[24] NSW a guideline[25] placing responsibility on developers and builders to ensure that new buildings in a transport corridor meet certain requirements. Where buildings can not meet these requirements, treatment options are also provided for. It should be noted that while the NSW guideline includes a 'LAmax' noise limit (the maximum noise level in a measurement period), it prescribes the measurement to be done on 'slow' response time on a sound level meter which could result in the impacts of whistles being masked (as whistles are frequently short and sharp, and this may not be picked up on this setting effectively).

While other states and territories may have similar requirements, as part of this review they were not able to be identified. It should also be noted that the National Construction Code (which is adopted across Australia) does not specifically identify requirements relating to environmental noise reduction.

In short, while there are some positive and direct requirements on builders and developers to consider the impacts of environmental noise when building near rail corridors, this does not appear to be consistent across Australia.

4.3 SFAIRP and Whistle Use

The ability to quantify the benefits of whistle use is challenging given the range of operations, contexts, and even sub-culture of the public population in the area. While there are risk models[26] available which provide insight into risks like 'collision at level crossings' or 'collision with

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[23] Victoria. Transport (Compliance and Miscellaneous) Act 1983, Section 251B.

[24] Queensland Department of Housing and Public Works. (August 2015). *Queensland Development Code MP 4.4 – Buildings in a Transport Noise Corridor.*

[25] NSW Department of Planning. (2008). *Development near Rail Corridors and Busy Roads – Interim Guideline.*

[26] For example – The Australian Rail Risk Model. *Available at www.arrm.org.au.*

track-workers', these do not explore the effectiveness of specific controls (e.g., whistles).

Research, as presented in section 4.1.1, does challenge the effectiveness of the train whistle as a risk control at level crossings. If it is not being consistently used, and if the ability for a road user or pedestrian to hear it is questioned then is it effective?

Critically though, the challenge presented to the Australian rail industry is whether a given risk is being managed safe, SFAIRP (see 4.2.1). In managing a risk safe, so far as is reasonably practicable, a minimally effective control may still be justified if it is inexpensive and easy to implement.

In 2006 the RSSB published a report[27] that provided a cost-benefit estimate for the use of whistle boards. It was estimated that in the United Kingdom the use of the whistle would prevent 1-2 fatality weighted injuries per year, which based on their value of preventing a fatality equated to 1.5-3 million pounds. This contrasted with the negligible cost of providing whistle boards, and therefore use of whistle boards could easily be justified from a cost-benefit analysis perspective.

However, this work did not account for the health impacts of the surrounding population. As discussed in section 4.1.2, the degree of impact (either in FWI or financially) of whistle use cannot be easily quantified due to the number of confounding factors (e.g., other sources of noise, insulation of surrounding buildings, times of rail operations, etc.).

While it is impossible to directly compare the safety benefits to health risks associated with whistle use, it is possible to state that societal demands are increasing with respect to environmental noise management, and that it is necessary to ensure that both the safety and health risks are being managed moving forward.

Considering the requirements of 'reverse SFAIRP' (presented in section 4.2.1):

Requirement	**Discussion**
The cost of the control has substantially increased.	Cannot be demonstrated. Whistles have been and remain part of train design, and no demonstration that they have become more costly.
The reduction of risk by the control has been reduced due to the addition of other controls.	If the role of the whistle can be replaced by an alternative approach, then it may be possible to justify whistle reduction / elimination.
The risk control adversely impacts another risk control.	Whistles do create an environmental noise hazard. However, as discussed this is very difficult to quantify and compare. While this argument is theoretically possible, it is a

[27] RSSB. (2006). T668 Train Horns Risk Review. *Available from https://www.sparkrail.org/Lists/Records/DispForm.aspx?ID=9949.*

	significant task to clearly demonstrate that the adverse impacts are greater than the safety benefits provided.
The control is demonstrated to be redundant.	Whistles clearly provide safety benefit in certain contexts (see 3.2). However, if these contexts of use are found not to be safety related, then the use of whistle could be challenged.

Based on the above, the most viable approach to reducing whistle noise while still being able to demonstrate safety is being managed safe so far is practicable is by replacing the whistle with alternative mitigation measures. Additionally, if there are uses of the whistle that have no direct link to safety risk these can justifiably be eliminated.

4.4 Select Incidents

Table 4 provides a very select set of 4 incidents that relate to train whistle use. These investigations have been selected as the represent that the whistle can be effective, but it's effectiveness can also be affected by contextual factors.

There are numerous other investigations that could have been referred to where a whistle was used, most where a negative consequence resulted (e.g., injury or fatality). This is because in many scenarios the whistle has successfully altered behaviours and no injury occurred may be reported as a near miss (and subject to minimal or no investigation) or may not even be reported.

Table 4: Select Investigations

Date and Location	**Whistle Context**
7/12/20 – Torrens Road, South Australia[28]	A freight train entered and crossed Torrens Road without any of the active level crossing equipment working. The driver recognised the inoperative equipment, and continually sounded the whistle for ~8 seconds on approach and through the crossing. No collision occurred. Video of the incident shows road vehicles stopping at the crossing despite no active warning. It would appear that the whistle did draw attention to the danger and vehicles stopped.
3-10-11 - Mexico Footpath Crossing, Penzanze, UK[29]	A pedestrian was struck and fatally injured after being struck by a train on the pedestrian crossing. The train driver sounded the whistle on approach (but around a

[28] Information regarding this incident is based on review of video available at: https://www.abc.net.au/news/2020-12-08/freight-train-almost-hits-cars-after-crossing-boom-gate-failure/12959878 . The ATSB have opened an investigation into this incident (https://www.atsb.gov.au/publications/investigation_reports/2020/rair/ro-2020-021/)

[29] RAIB. (Oct. 2011). Fatal accident at Mexico footpath crossing (near Penzance). https://www.gov.uk/raib-reports/fatal-accident-at-mexico-footpath-crossing-near-penzance

	curve and not visible). It was considered that the individual likely saw the train too late. In this instance, the train driver did sound the whistle, but the individual did not hear it or associate it with a danger.
3-7-19 – Margam, UK[30]	3 track workers were performing work on a line that required hearing protection. They did not have in place formal lookouts to warn them of a train (or to warn a train of their presence). As a train approached the driver observed the workers and applied the emergency brake and sounded the whistle (~9 seconds prior to incident) but struck and fatally injured 2 of the track workers. While the track protection in place for the work can be considered the primary cause, the investigation also demonstrated that given the ear protection being worn by the workers it is unlikely that the workers could hear the whistle.
13-6-16 – Phalps Road, Victoria[31]	A prime mover stopped at Phalps Road level crossing (passive) to look for trains. Due to the acute nature of the crossing, the driver was unable to see an approaching train. The train driver sounded the whistle on approach and just before the crossing. However, it is believed that cabin noise within the prime mover and a closed window may have masked the whistle noise.

[30] RAIB. (Nov. 2020). Track workers struck by a train at Margam. https://www.gov.uk/raib-reports/report-11-2020-track-workers-struck-by-a-train-at-margam

[31] ATSB. (Jun. 2019). Level crossing collision between truck and passenger train 8753, Phalps Road, Larpent, Victoria, on 13 July 2016. https://www.atsb.gov.au/publications/investigation_reports/2016/rair/ro-2016-009/

5 National and International Approaches

Table 5 provides a brief outline of approaches that have been undertaken to address the issue of whistle noise. References are provided should further detail be sought.

Table 5: Whistle Reduction Approaches

Approach	Where	Discussion
Level Crossing Removals	All	The removal of a level crossing eliminates one of the primary needs for whistle use. Programs, such as the Level Crossing Removal Program in Victoria[32], are actively reducing the number of crossings in Victoria. One example shows that where an entire section of line (9 road level crossings removed along with associated pedestrian crossings) it was estimated that whistle use would halve[33].
Quiet Zones	USA, Canada	Quiet zones are a defined area of a rail network where whistles are not to be used, except in emergency scenarios. The process to establish a quiet zone must be initiated by the responsible local government (not the RTO), who must then work with the RTO to identify the necessary controls and changes necessary to ensure ongoing safety. Importantly, the cost to implement quiet zones is to be borne by the local government, and any increased risk due to no whistle must be mitigated. The process to establish quiet zones is clearly documented, including the steps necessary to take[34,35]. Part of the process is the identification of the minimum standard of infrastructure (including level crossings) which must be met to allow for a quiet zone creation and has a focus on ensuring if whistles are removed that equivalent controls are put in their place, and importantly the controls must also account for the specific crossing context.

[32] See https://levelcrossings.vic.gov.au/ .

[33] Level Crossing Removal Authority. (May 2016). *CD9 Preliminary Noise Report: P03-000-CTD-REP-XEV-0101.* Victoria

[34] See Appendix 3 for a visual representation of the process in the USA. This representation translates the requirements of *Code of Federal Regulations, 49 – Transportation, Volume 4, Chapter 2, Part 222.39*.

[35] The Canadian process is outlined at: https://tc.canada.ca/en/rail-transportation/grade-crossings/apply-stop-train-whistling-public-grade-crossing

Approach	Where	Discussion
		A study by the FRA in 2000[36] reported a 62% increase in accidents at crossings where horns were banned (but this was before the 'quiet zone' process was established which required specific mitigations to be in place). A more recent report[37] indicates that quiet zones are as safe as they were prior to being made quiet zones. This is caveated with the fact that crossing characteristics over time (train speeds, frequency, crossing use) was not accounted for in the analysis.
Freight Noise Attenuation Program	New South Wales	The NSW 'Freight Noise Attenuation Program'[38] aims to minimise the impact of freight noise on homes and 'sensitive use community buildings' (e.g., schools) near NSW Government managed rail corridors. To minimise the impact, the program provides noise reduction treatments to homes and buildings that meet the criteria. The program launched in 2015 and is a $50m ten-year initiative. Not to detract from the program and benefits, one criterion used for eligibility is the *average* noise levels measured during the day (7am-10pm) and night (10pm – 7am). Train whistles, given they tend to be short in duration, may not necessarily be addressed through this program as a result.
Train Driver Discretion at Level Crossings	New Zealand	Established practice within Australia is to have whistle boards associated with every level crossing, meaning that train drivers must sound whistles on approach to level crossings. Kiwirail (New Zealand) only require the use of whistles at certain crossings with known risk factors, and in other circumstances train drivers are to use their discretion (based on prior experience, at-risk behaviours observed, etc.) [39].

[36] As cited in RSSB. (July 2016). Quantifying the impact of train horn noise (S262).

[37] United States Government Accountability Office. (Oct. 2017). RAILROAD SAFETY – Quiet Zone Analyses and Inspections Could be Improved. https://www.gao.gov/products/GAO-18-97

[38] https://www.transport.nsw.gov.au/projects/programs/freight-noise-attenuation-program

[39] Note that the use of whistle boards in association with level crossings, as described in *AS 7658 – Level Crossings – Rail Industry Requirements*, is consistent with the application in New Zealand. However, RTOs and safeworking experts engaged as part of this work indicate that the normal practice in Australia is to always have these installed.

Approach	Where	Discussion
Night-time Quiet Periods	United Kingdom	Night-time quiet periods remove the requirement for a train driver to sound the whistle on approach to specific level crossings to reduce the impact on residents nearby while they are sleeping. The original approach saw quiet periods from 23:00-7:00, but this was subsequently reduced to 23:59-6:00 as a study found that 64% of near miss incidents were occurring on the 'shoulder hours'. Interestingly, prior research conducted by the RSSB[40] suggested that incidents at night are 15.4 times more frequent *per moment* (i.e., person using x train numbers) than daytime. This same report noted that there will be some locations which will contribute more to this risk than others, and individual crossing characteristics (including usage profile) needs to be well understood and quiet periods implemented on a local basis. It is noted that the RSSB have found that night-time quiet periods did not cause an increase in near misses or lead to incorrect usage[41].
Operational Rule Reviews – Whistles	NSW, Vic	Around 2008 Railcorp (as it was known) undertook a review of operational practices for sounding horns in 2008. A key focus of this review was to identify when and why the whistle was being used, with the intent to eliminate non-safety purposes. This review led to the elimination of the need to sound a whistle when departing platforms. (Note that this was initiated as part of RailCorps Environmental Protection License – see section 4.2.2). Conversely, in 2014 Metro Trains Melbourne explored the risk associated with sounding a whistle on departure and found that removing the requirement to sound the whistle on departure from platform would likely increase the risk. The difference between RailCorp and Metro Trains Melbourne outcomes can, in large part, be attributed to the nature of infrastructure. A key factor noted that many Melbourne train stations are adjacent to level crossings, and that the Melbourne network is unfenced. The NSW metro network has very few level crossings adjacent to stations and is largely fenced. Note that these approaches both focused on whistles or no whistles and did not explore alternative controls which could replace whistle use in specific uses. For example, the intent of a whistle at level crossings is to

[40] RSSB. (2006). T668 Train Horns Risk Review. Available from https://www.sparkrail.org/Lists/Records/DispForm.aspx?ID=9949

[41] RSSB. (July 2016). Quantifying the impact of train horn noise (S262).

Approach	Where	Discussion
		warn road users and pedestrians which can be achieved through wayside horns (see next). Similarly, it is possible to question whether using the whistle to communicate between train driver and rail safety worker is the best and most effective approach in the context of technologies available today.
Rail Signage – 'Please Minimise Noise'	NSW	ARTC undertook a study at Marquis Street level crossing, Gunnedah, NSW (a residential area), to identify the noise impacts of introducing signage to encourage train drivers to drive quietly in the area. Following signage installation, it was identified that while horn use remained relatively consistent (as this was required inline with network requirements), there were small but significant reductions in noise duration.
Wayside Horn	South Australia	A trial[42] was undertaken in South Australia exploring the potential for wayside horns to replace train horn use. This trial was formed on the basis that the train horn is intended to warn road users of a train, and if this function could be transferred to the wayside horn (which can better direct sound towards road vehicles) it would be possible to reduce environmental noise. The trial demonstrated that wayside horns do "provide a significant improvement to the audibility of the train horn at the existing level crossing, and also an improvement when compared to the audibility of a train sounding its horn at the whistle board of most other level crossings" while also reducing the environmental noise impacts

[42] Moore, S. (2012). *Wayside horn noise investigation.* Proceedings of Acoustics, 2012 – Fremantle. 21-23 November, 2012.

6 The System Level View on Managing Whistle Risks

This section clearly defines the risks associated with whistle use (section 6.1) and explores the overall 'system' which is influencing these risks (section 6.2).

6.1 Defining the Risks

While implied throughout this paper, the precise risks which are influenced by whistle use have not been clearly articulated. The below table provides a concise summary of the top-level risks associated with whistle use. The risks of concern are divided into two categories – rail safety and noise hazard.

Table 6: Risks associated with train whistle use

Risk	**Context**	**Whistle Role**
Rail Safety Risks (whistle is a control)		
Collision at level crossing (road or person)	Safety	Whistle can alert road vehicle or person to presence of train.
Collision NOT at level crossing (person / trespass)	Safety	Whistle can alert person to presence of train.
Collision with rail safety worker on mainline, depot, or siding.	Safety, Acknowledgement	Whistle can alert rail safety workers to presence of train. Whistle will be used to inform rail safety workers that the driver is aware of their presence and drive accordingly (providing rail safety workers ability to work as appropriate).
Passenger struck by train at a platform.	Safety	Whistle can alert person to presence of train. (People may step back from platform and allow a train to arrive or travel through)
Collision with obstruction on track.	Safety	Whistle can alert adjacent traffic about an obstruction within the rail corridor, and hopefully stop the other rail traffic prior to an incident.
Noise Risks (hazards; whistle is source of risk)		
Community annoyance	Reputation	Whistle can disrupt work, conversations, etc.

Sleep disturbance leading to health effects	Safety, reputation	Whistles are discrete sounds which can impact the quality of sleep in some individuals.

6.2 Systems Perspective View

The risks described in section 6.1 represent an immediate / direct view of the risks associated with whistle use. That is – the whistle directly mitigates rail safety risks and directly creates a noise hazard.

However, to properly understand and manage these risks it is necessary to consider the various system levels involved in rail operations, as there are decisions and actions across different organisations that influence the use of the train whistle, and influence opportunities moving forward.

An established system level risk framework has been adopted, shown in Figure 3[43]. This framework shows that operational actions (such as whistle use) can be influenced by decisions and actions at levels potentially reaching government level.

Figure 4 represents this framework in relation to whistle use and associated use. This diagram integrates information previously presented (i.e., sections 2 and 4.4) with stakeholder perspectives[44,45].

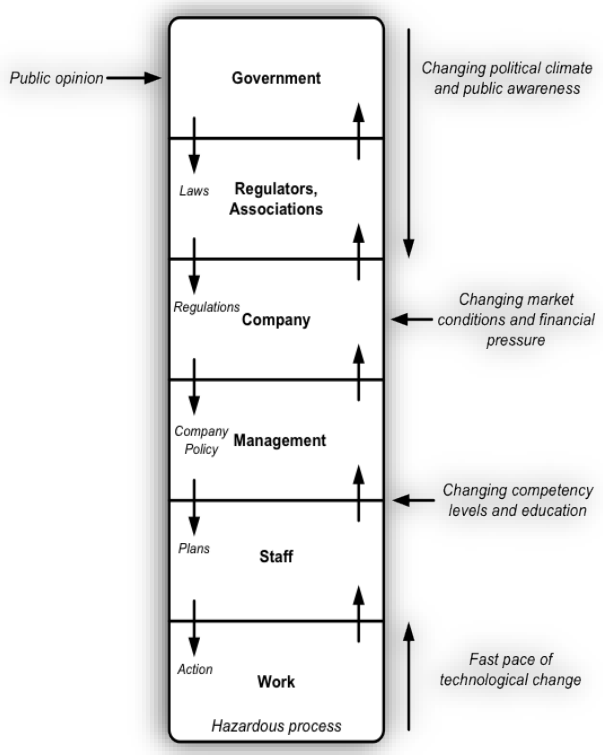

Figure 3: Rasmussen's Risk Management Framework (1997)

[43] Rasmussen's Risk Management Framework. *Adapted from Rasmussen, J, Svedung, I. (2000). Proactive Risk Management in a Dynamic Society. ISBN: 91-7253-084-7.*

[44] Aligned with the systems level framework, stakeholders engaged represented state governments (and authorities), regulators (environmental, rail safety, and work health and safety), rail operators, and train drivers. This provided the perspectives of all levels, as well as the interactions between the levels (i.e., the pressures and competing priorities).

[45] Note that this is a representation of a complex topic. There will be exceptions and nuances which this representation does not detail. However, it is effective at summarising the various perspectives for the purposed of this paper.

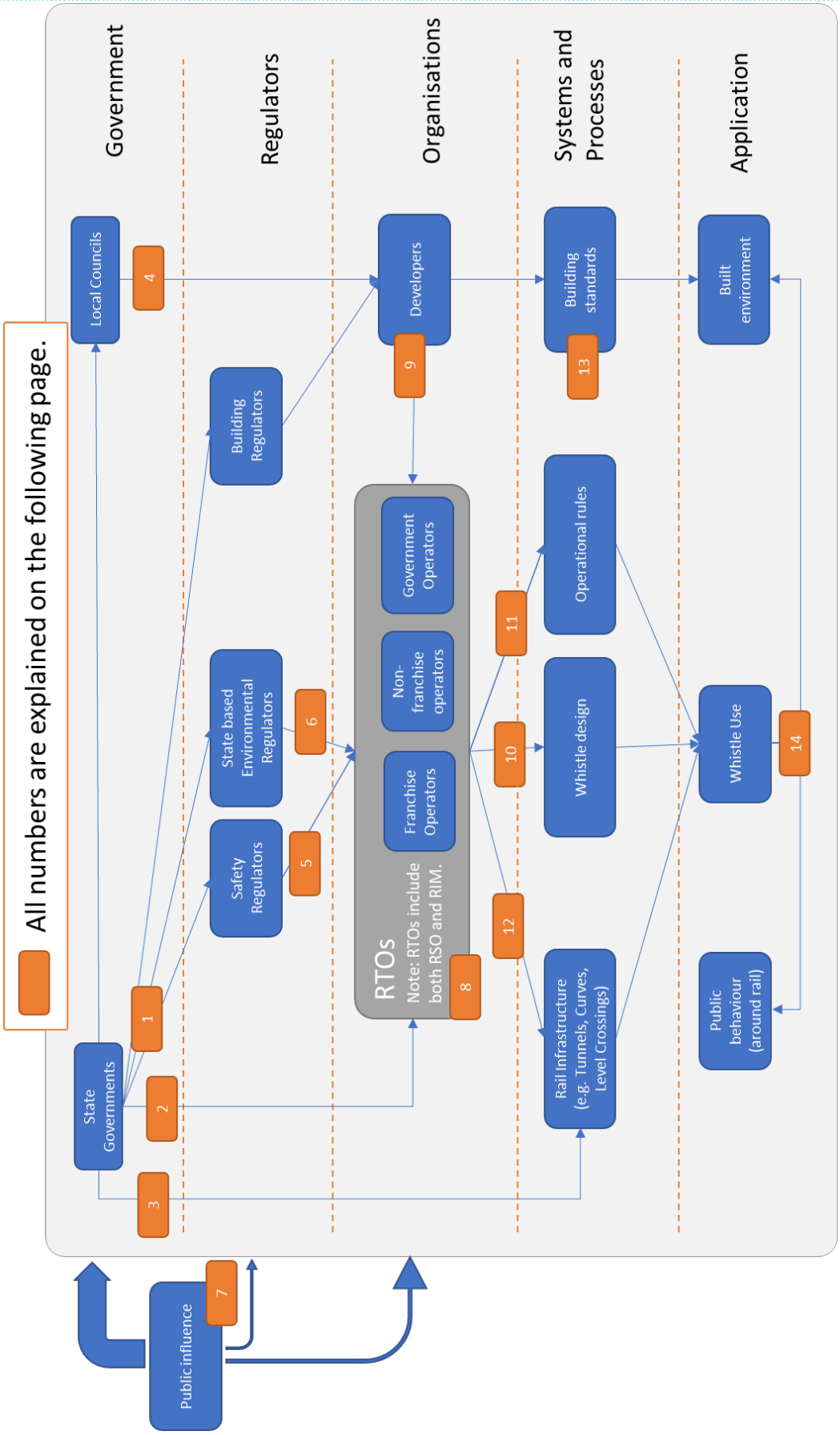

Figure 4: System view of actors involved in whistle use

The list below relates to the numbers shown on the prior page.

1. Legislative environment perspective:
    - Environmental policy and legislation regarding rail noise do vary state by state, in particular with respect to the RTOs responsibility.
    - Safety legislation, as related wo whistle use, is consistent across all states through a unified National Rail Safety Regulator.
    - Building legislation and structure does vary state by state, but are underpinned by a National Construction Code which supports consistency in built environment.
2. The relationship between governments and rail operators does vary.
    - Franchise operator contracts with government define how they must operate. These contracts *tend* to focus on safety and performance, normally with little / no regard to environmental noise. For a franchise operator to modify it's approach based on new / altered policy will typically require incentives to be provided.
    - Government operators inherit government policy directly and act accordingly.
    - Non-franchise operators do not have a direct relationship with government. (There normally is an indirect relationship).
3. Investment in rail infrastructure, such as level crossing removals, is heavily driven by state governments for state owned infrastructure, which represents the majority of infrastructure in urban areas and affected by whistle noise.
4. Local councils have a role to approve local developments. The intent is that they are to ensure local needs are understood and addressed in approving developments, and may set requirements for developers / builders to comply with.
5. There is a consistent requirement for RTOs to demonstrate management of risks SFAIRP, and the RTO may use the whistle. *NOTE: A myth that was raised several times is that the Rail Safety Regulator prescribes the use of train whistles. Their only requirement is whether the RTO can demonstrate safe SFAIRP.*
6. Due to the differences in environmental legislation, the approaches and degree of influence on whistle noise by state environmental regulators differs.
7. There is an increasing public pressure into state governments and councils (and a lesser extent to RTOs and regulators) regarding the need to reduce rail noise, including whistles.
8. RTOs will each have different 'incentives' which will drive behaviour relating to whistle use and impacts.
    - Corporate Citizenship: all operators wish to be a strong corporate citizen. However, the degree of their investment depends on the strategic focus of the organisation. Some will do what is 'easy', while others will seek to invest significant resources.
    - Whistle use needs to involve both rollingstock operators and infrastructure managers. The RIM will establish the rules (and where whistles must be used), but the RSO must still comply with the rules. As such, any whistle use change must be clearly communicated between the RIM and RSOs affected.
9. There is normally little engagement between developers and RTOs for new developments. RTOs indicate that they raise concerns with developers – not vice versa.
10. Standards for whistle design prescribe dB level, and also include a 'town vs. country' sound. However, there is no clearly available 'town vs. country' definition, meaning that the louder sound is often used by default except in the most built-up areas (where there tends to be less need

anyway due to fewer crossings). Further, there is opportunity to optimise the position of the whistle on rollingstock.

11. Many operational rules have been historically established, with few properly understanding the original intent. If the intent is properly understood, then alternative approaches (and perhaps non-administrative controls) can be applied.
12. Rail Infrastructure:
    - Current level crossing standards (e,g., AS 7658) provides the *option* to install whistle boards on approach to level crossings which would then require whistles to be used. While it is an option, it is typically implemented and even if not, most network rules require use of signals on approach to crossings.
    - Whistle use is also required where other risk controls may not be sufficient (e.g. around curves, tunnels) to warn workers of an approaching train.
13. Building standards provide guidance on noise proofing, but nothing specific relating to building near rail environments or impacts of whistles at a national level. NSW and Queensland (as noted in section 4.2.2.2) do place requirements on builders and developers.
14. There are the rules, but these are moderated by driver experiences (i.e. near misses) at locations and also knowledge of noise issues at the location, time of day, etc.

6.3 Integrating Risks and the Systems Perspective

It is possible to suggest that RTOs can unilaterally make decisions that will directly impact whistle use. For example, they can seek to alter operational rules, influence / modify whistle design, or provide training and awareness to train drivers to reduce unnecessary whistle use[46]. However, RTOs ability to 'engineer out' the need for whistle use in certain usage scenarios (e.g., at level crossings) is dependent on investment provided. While some RTOs may invest funds themselves where the outcomes align with their organisational goals, most RTOs rely on government investment in making significant infrastructure changes.

However, as shown in Figure 4, there are many other influences and on these decisions. For example, ensuring government policy is aligned[47] on environmental noise (and whistles) can lead to investment in related rail improvements, which will then allow RTOs greater opportunity to implement alternative engineering-based risk controls or operational practices which can reduce the reliance on whistles as a safety device.

In short – to optimally manage the risks associated with whistle use, there needs to be appropriate coordination across all levels of decision making

[46] Note that while this is possible, drivers engaged indicated that they already do this and while there may be some exceptional cases they do not use the whistle excessively. Rather they use the whistle as required by the rules established, and to the degree required of the situation.

[47] There is a relevant recommendation encouraging state, territory, and the Australian government to recognise environmental noise and health effects as a policy issue in *Department of Health, Commonwealth of Australia. (2018). The Health Effects of Environmental Noise.*

and appropriate action. Each level may, within its own remit, make some advances but the optimal approach is to be aligned.

7 Discussion – Moving Forward

This paper explores the conflicting impacts of train whistle use – a safety control and a noise hazard. The adverse impacts of whistle use creating a noise hazard have been steadily increasing due to increasing population, increasing number of services, increasing services at night, and increasing certainty around the impacts of environmental noise on health.

In exploring the issues, several opportunities can be identified that could ensure safety is maintained and the adverse impacts can be minimised and are presented in Appendix 2.

Prior to considering any of the opportunities identified, the rail industry must consider the following:

- Does the rail industry wish to pursue an aligned way forward to mitigate the adverse impacts of whistle use while maintaining rail safety?

If the answer is '**No**' **(option 1)**, then no further activity is necessary. RTOs may wish to consider the information presented in this paper, along with opportunities, within their own organisation.

If the answer is '**Yes**', there are 2 approaches – an 'RTO Aligned approach' **(option 2)** or a full 'systems approach' **(option 3)**. The primary difference is the degree of support and engagement received from governments.

7.1 Option 2 – RTO Aligned Approach

An RTO aligned approach would see industry develop a code of practice or guidance document which would assist RTOs in identifying and mitigating whistle noise when and where necessary.

These documents would identify available mitigations, many of which have been suggested within this document, and would assist in describing how these can be implemented while also enabling demonstration of ongoing safety SFAIRP.

To further describe what a code of practice versus guidance:

- **Option 2a**: A "Code of Practice to mitigating adverse effects of whistle use" would provide authoritative approach to identifying and managing changes to minimise whistle use. It could, for example, describe the required risk-based steps and activities along with potential solutions to consider which could be implemented to mitigate noise. It could also articulate what sort of evidence would be required to demonstrate that safety risks are managed SFAIRP (as per 4.3). For example, a code of practice could detail what steps are necessary to safely eliminate the use of a whistle at a particular level crossing or in a particular scenario.
- **Option 2b**: A "A Guideline to mitigating adverse effects of whistle use" is less authoritative than a code of practice. As such, it would

provide a discussion of the options available and what steps would be required to make any changes to whistle use but would not provide the level of detail provided in a code of practice.

Perhaps the main factor in choosing a code of practice versus a guideline is the degree of alignment that industry can reach. If there is significant alignment in the steps to take, then a code or practice is likely preferable. The benefit of a guide though is that the RTO can implement any of the options as they see fit, which may be more desirable for some.

7.2 Option 3 – Systems Approach

It is recognised that a critical barrier to an aligned approach is the support and commitment of various governments. While there are some 'easy' issues to address, to systematically address the issue will require investment and policy and legislative changes.

Option 3 includes and extends on option 2 (a or b) but extends by appropriately engaging with governments and encourage their support in the management of whistles. This support should not just be 'in principle', but also include investment in existing rail infrastructure (which could negate need for prescribed whistle use), ensuring appropriate standards for developments near rail infrastructure considers noise, etc.

If this option were to be pursued, the rail industry would not be acting in isolation. The Commonwealth Department of Health has published a report[48] on environmental noise (with a focus on road, rail, and air noise) with a series of recommendations which align to this systemic approach being undertaken. There are 4 recommendations with several sub-components, but importantly for the context of this paper the recommendations include:

- Inclusion of noise as part of strategic and local planning.
- Review consistency of legislation across all government levels
- Promote noise mitigation measures (including for residential buildings)
- Fostering national consistency for environmental noise mitigation and management

This small set demonstrate that there is recognition by the Commonwealth Department of Health that to properly manage and mitigate a systemic approach is ideal.

It should be highlighted that most of the options presented in section 5 have been achieved through a systemic approach to managing the risk. For example, the introduction of quiet zones is achieved by a process being established in legislation, has the support of the Federal Regulator, requires local council to engage with rail operators to achieve a safe outcome.

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[48] *Department of Health, Commonwealth of Australia. (2018). The Health Effects of Environmental Noise.*

7.3 Next Steps

It is suggested that feedback is sought on this discussion paper, with RTOs provide insight into their option preference, and perhaps even identifying alternative options not already considered.

This may be achieved by:

- An online discussion appropriately moderated
- A in-person forum
- E-mail request to receive feedback on this report (potentially followed up with a limited stakeholder discussion group).
- Identifying a 'development group' to discuss the options and select the appropriate way forward.

APPENDIX 1 STAKEHOLDERS

The following organisations have provided inputs to this document:

- Rail Industry Safety and Standards Board
- Office of the National Rail Safety Regulator
- WorkSafe Victoria
- Environmental Protection Agency – NSW
- TasRail
- Metro Trains Melbourne
- Queensland Rail
- Pacific National
- Department of Planning, Transport and Infrastructure (South Australia)
- Department of Transport (Victoria)
- V/Line
- Sydney Trains
- Transdev New Zealand
- Public Transport Authority of Western Australia

Stakeholders from the above have been a represented a range of different roles, including safety, operational, engineering, community and media relations, policy and planning, and environmental. This range was achieved across the list of organisations who have participated.

APPENDIX 2 OPPORTUNITIES IDENTIFIED

The following table of opportunities are those that have been identified to that can mitigate the adverse effects of whistle use. Note that the implementation of any of the items below must be done in association with the RTOs change and risk management approaches and must consider the local context of application.

Option	Description
Operational Rule Review	RTOs can review operational rules that require whistle use and eliminate the use of whistles for non-safety purposes. In reviewing the rules, RTOs could also explore whether the use of whistles in the context is appropriate, or if there are alternative approaches or technologies that may be more suitable (see next).
Train whistle testing review	Currently, it is normal practice for a train whistle to be tested prior to entry into service each day. Several stakeholders suggested that this is no longer required. This is on the basis that the whistle has been made more reliable, and that additional safety controls have been implemented in the rail network. It was suggested that the whistle could be tested less frequently and reduce testing in depots. It is noted that the whistle use may be tied to other tests (e.g., task-linked vigilance system), and as with any risk context of operation and the additional impacts need to be understood before removing a control.
Alternative Technologies	RTOs can explore the intent / need for the whistle use in certain contexts and seek alternative approaches or technologies that will fulfil that need without creating environmental noise hazard. Some examples[49]: • A train driver to acknowledge a rail safety worker by using lights rather than the whistle. • Use wayside horns at level crossings, with train whistles to be used as an additional warning in emergency or at-risk scenarios at the crossing. • Technology to warn track workers of oncoming train based as opposed to reliance on hearing a whistle as the train departs. • On approach to a level crossing at night, a train could use flashing ditch lights as opposed to a whistle (at night, flashing lights may be a more salient cue than a train whistle, particularly considering use of headphones etc.)

[49] These examples were derived as part of developing this report and / or provided as suggestions from stakeholders who were engaged as part of this work.

Option	Description
Town vs. Country definition	The Rail Industry can better define what is meant by town and country, and as such encourage the use of the appropriate horn in the right context.
Quiet Zones	A process to implement quiet zones can be developed and established by industry that ensures the Rail Safety National Law requirements are met (e.g., section 4.3) and whistle use is minimised.
Rail Whistle Placement	If whistles are to be retained, research has shown that the positioning of the whistle can impact the noise radiated. Optimal placement could reduce this radiated noise.
Night-Time Quiet Zones	One opportunity identified by many stakeholders, and as used in the UK, is night-time quiet zones. The suggestion is that given rail and road traffic is reduced at these times, that the risk is also reduced. There are 3 specific considerations: • It can be expected that an alternative control to train whistle would be necessary to demonstrate reverse SFAIRP (see 4.3). • Rail crossing risk is estimated to be greater than 15 times riskier than during the day (see 5), after normalising for exposure opportunities. • Given the UK experience of needing to reduce the quiet period, it is possible that over time the period will continue to be reduced as road and rail traffic continue to increase. As such, a quiet period may only provide a temporary mitigation.
Development Standards	Developments can work with Rail Transport Operators and seek to achieve noise levels such as those recommended in section 4.1.2.2.

APPENDIX 3 QUIET ZONE PROCESS

Process shown below from United States Government Accountability Office. (Oct. 2017). *RAILROAD SAFETY – Quiet Zone Analyses and Inspections Could be Improved.* https://www.gao.gov/products/GAO-18-97