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Level crossing accidents in Australia

Collisions between road vehicles and trains at level crossings remain one of the biggest safety risks for rail operations in Australia, accounting for about 30% of rail related fatalities¹ over the past five years. The human and economic cost of these accidents can be extreme, with individual collisions having the potential to cause multiple fatalities and damage costs exceeding tens of million of dollars.

ITSr is managing a project for the National Rail Level Crossing Group and the Australian Level Crossing Assessment Model (ALCAM) development group to assemble level crossing data from various sources to provide better understanding of the nature of level crossing accidents. This bulletin summarises important preliminary findings from this work.

Data collected

ITSr has collected national data on collisions between trains and road vehicles at level crossing over a 10-year period, 2000 to 2009. The primary

¹ Australian Transport Safety Bureau (ATSB), *Australian rail safety occurrence data 1 January 2001 to 31 December 2010*, 12/05/2011, ISBN 978-1-74251-158-0. Thirty percent comes from a comparison of total fatalities (excluding suicides) reported by the ATSB with level crossing road vehicle train collision fatalities determined by this study

source of data is railway safety occurrence notifications held by rail safety regulators ('rail safety regulator data')². This was supplemented by road vehicle crash data collected by road authorities ('road crash data')³ and level crossing inventory data collected by rail infrastructure managers ('inventory data')⁴.

The Australian level crossing collision statistics presented in this bulletin capture a broader range of occurrences than some previously reported statistics. This bulletin includes collisions at level crossings on both public and private roads. It also includes collisions between a road vehicle and train irrespective of consequences. This differs to road crash data which has a more restrictive definition such as an injury or damage threshold. Suicides and cane train collisions with road vehicles are excluded from the data.

² Rail safety regulator data is collected by each jurisdiction according to the standard *Occurrence notification standard one* and is categorised to the *Occurrence categorisation guideline one*

³ Road crash data is collected through police investigations by each jurisdiction to local standards. All states and territories have agreed to work towards the implementation of the minimum dataset described in Austroads Report No. AP126 *A minimum common dataset for the reporting of crashes on Australian roads* (Austroads 1997)

⁴ Inventory data is collected by periodic surveys according to the requirements of the LXM database that supports ALCAM

Overview of collisions and their consequences

A summary of collisions in Australia over the 10-year period is shown in Table 1. There were 695 collisions between road vehicles and trains resulting in 97 fatalities. About 13% of accidents occurred on private road crossings.

Table 1: Collisions between road vehicles and trains at level crossings in Australia, 2000–2009

Statistic	Public road		Private road		Total
	Active control	Passive control	Active control	Passive control	
Number of collisions	356	248	27	64	695
Number of people fatally injured	58	35	0	4	97

Changes in the count of collisions and fatalities over time are presented in Figure 1. There is a significant decrease in the number of collisions nationally, from an average of 85 per year to 54 per year over the 10-year period. The number of collisions in recent years is almost half of that cited for the five years prior to the period of this study (Cairney estimated about 100 per year for the period 1996-2000⁵).

⁵ Cairney P, Prospects for improving the conspicuity of trains at passive railway crossings *Road safety research report CR217*, ATSB, December 2003

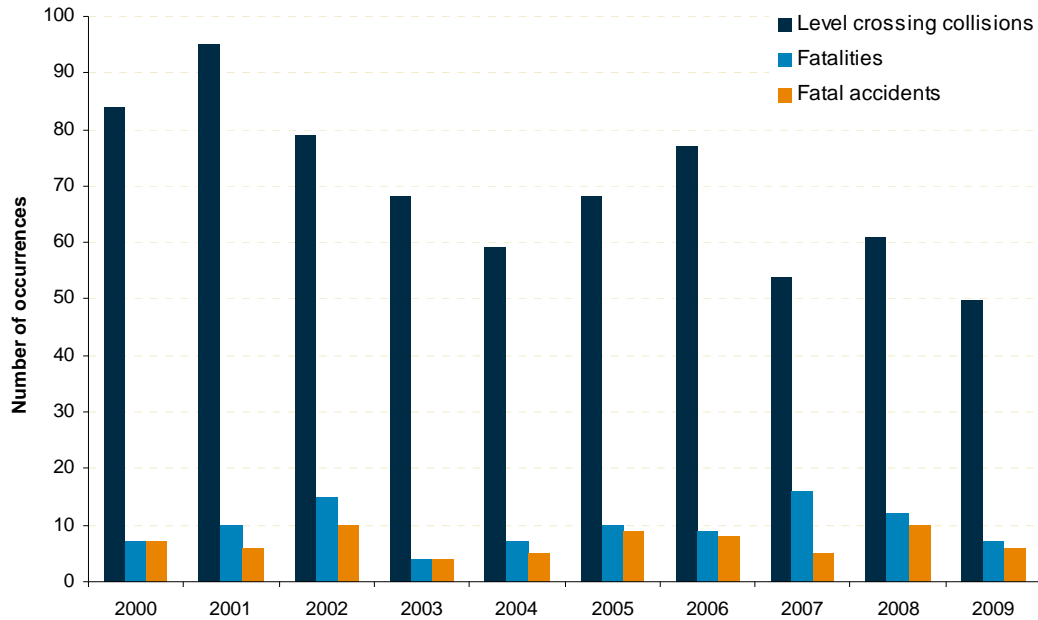


Figure 1: Annual number of collisions between road vehicles and trains with associated number of fatalities, 2000-2009

Despite the significant decrease in collisions, the number of fatalities and fatal accidents⁶ does not appear to have changed markedly over the 10-year period. Year to year fluctuation is apparent but the number of fatalities remains relatively constant at about 10 per year.

Types of road vehicles involved

The different types of road vehicles involved in level crossing collisions is shown in Figure 2. Over the full period 71% of collisions (64% of fatal collisions) involved light passenger and commercial road vehicles (to 4.5t gross vehicle mass)⁷. Another 20% of collisions (23% of fatal collisions) involved heavy freight vehicles (over 4.5t gross vehicle/combined mass). Austroads has also reported that 20% of crashes at level crossings involve heavy vehicles for the period 2003 to 2007⁸.

⁶ Fatal accident : An accident where one or more fatal injuries result

⁷ Occurrence notification standard one combines passenger vehicles, vans and freight vehicles to 4.5t gross vehicle mass into one category. Hence the term 'light passenger and commercial'

⁸ Austroads, *Measures for managing safety of heavy vehicles at passive and active railway level crossings*, November 2010, ISBN 978-1-921709-48-7

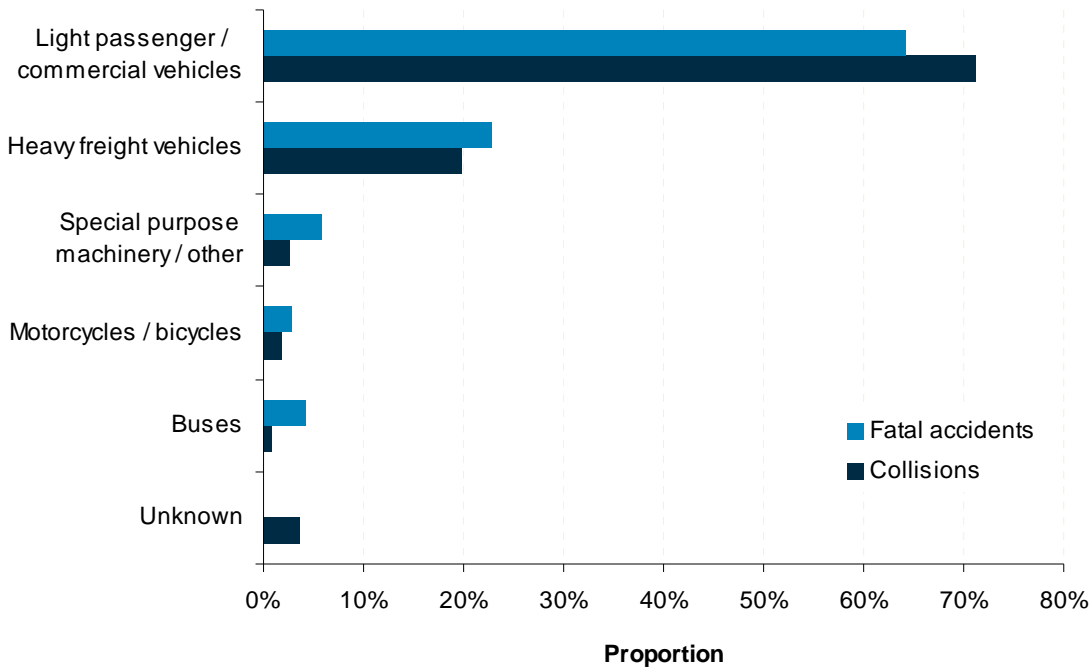


Figure 2: Type of road vehicle involved in collisions with trains at level crossings, 2000 to 2009

Previous studies have noted the significant role of heavy freight vehicles in major level crossing accidents⁹. For the period 2000 to 2009, the fatality rate¹⁰ for collisions involving heavy freight vehicles is double that for light passenger and commercial vehicles (0.22 and 0.11 fatalities per collision respectively).

There are also differences in the types of people affected between the two vehicle types. Almost all fatalities associated with light vehicle collisions were road vehicle occupants whereas more than half of the fatalities associated with heavy freight vehicles were train occupants; that is, passengers and crew.

While heavy freight vehicles were involved in 20% of crashes and 23% of fatal accidents over the period, they made up just 2.5% of registrations¹¹ and around 6% of kilometres travelled¹² in Australia. Comparison on this basis suggests they are over-represented in level crossing collisions per vehicle or per kilometre travelled on Australian roads.

The contribution of light and heavy road vehicles to level crossing collisions has also changed over time as shown in Figure 3. There is an overall decrease in the number of collisions involving light passenger and commercial

⁹ ATSB, *Railway level crossing safety bulletin*, April 2008

¹⁰ Fatality rate per collision: Total fatalities divided by the total number of collisions

¹¹ Australian Bureau of Statistics, *Motor vehicle census*, Australia, 31 March 2010

¹² Australian Bureau of Statistics, *Survey of motor vehicle use*, Australia, 12 months ended 31 October 2007

vehicles over the 10-year period. Changes in heavy vehicle collisions over time are less pronounced. However, the number of collisions in the most recent years appears lower than the longer term average.

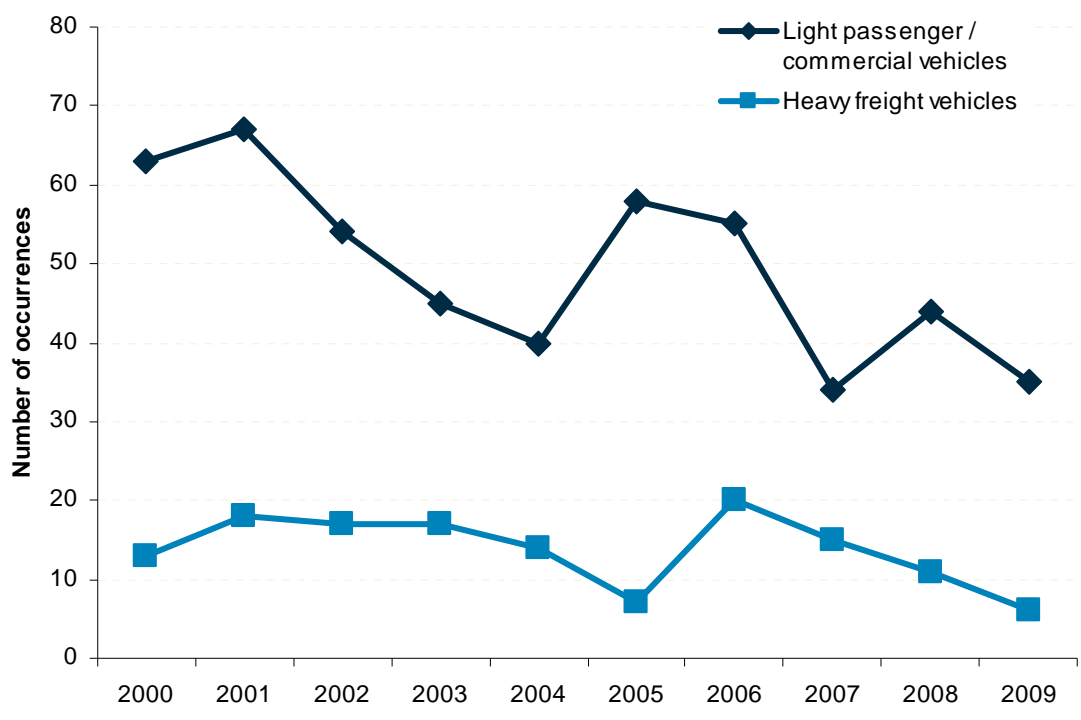


Figure 3: Collisions between road vehicles and trains at level crossings by vehicle category: light vs heavy vehicle, 2000-2009

Performance of crossing controls

Level crossings, like other road intersections, have standard road traffic controls. Such controls have an important influence on the likelihood of collisions at level crossings.

Collisions between road vehicles and trains at level crossings have been broken down according to the type of crossing control at the time of the accident and whether the road is public or private. Results for collisions and fatal accidents are shown as Figure 4. Of note is that while the greatest proportion of collisions is at boom gate crossings, the greatest proportion of fatal accidents is at flashing light and stop sign crossings.

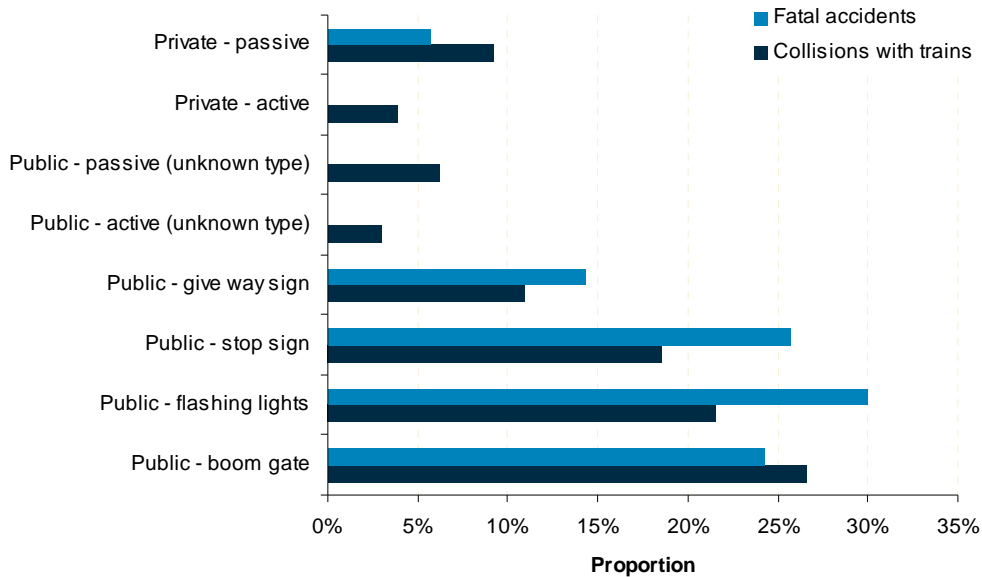


Figure 4: Collisions between road vehicles and trains by crossing control category, 2000-2009

The relationship between fatal accidents, crossing control type and road vehicle type is presented as Figure 5. It shows how within the category of light passenger and commercial road vehicles and also within the category of heavy freight vehicles, most fatal accidents occur at flashing light crossings. Also of note is how few heavy vehicle fatal accidents are occurring at boom gate crossings.

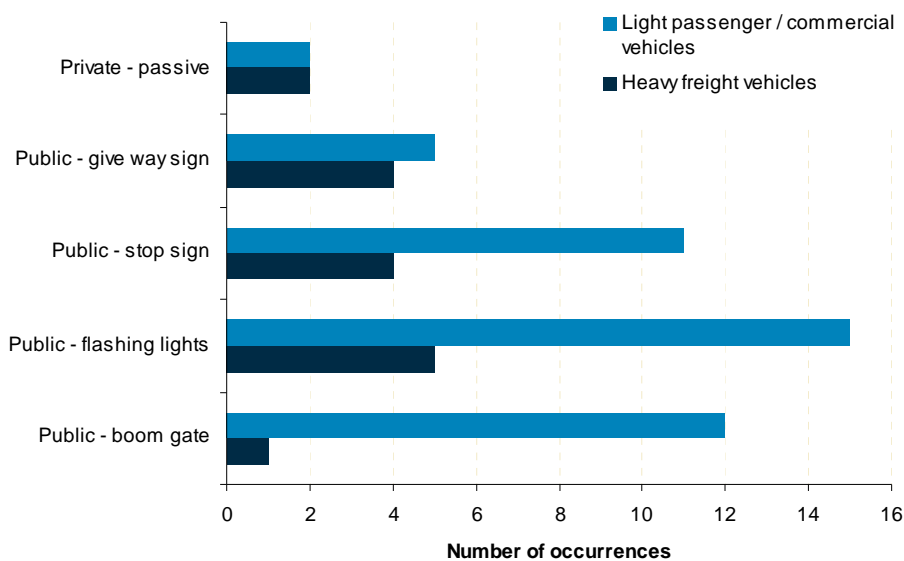


Figure 5: Fatal collisions between road vehicles and trains by crossing control category, 2000-2009

Performance of crossing controls adjusted for traffic

Collision data for public crossings¹³ has been linked to the level crossing inventory data for over 8,000 public Australian level crossings. The inventory includes data on basic characteristics of each crossing, such as means of traffic control and road and rail traffic levels. This has allowed a comparative performance assessment of different forms of crossing control after adjusting for the level of activity at the crossing, such as the differences in road and rail traffic volume. Expressing level crossing collision data in this way also allows comparison with data from other countries which assess performance using similar measures.

Two common measures of collision rate for the different forms of crossing control are shown as Figure 6. Collision data for the United States of America (USA)¹⁴ has been included for comparison because of similar notification requirements in that country; that is, any collision between a train and a road vehicle at a level crossing is reportable in the USA, as in Australia.

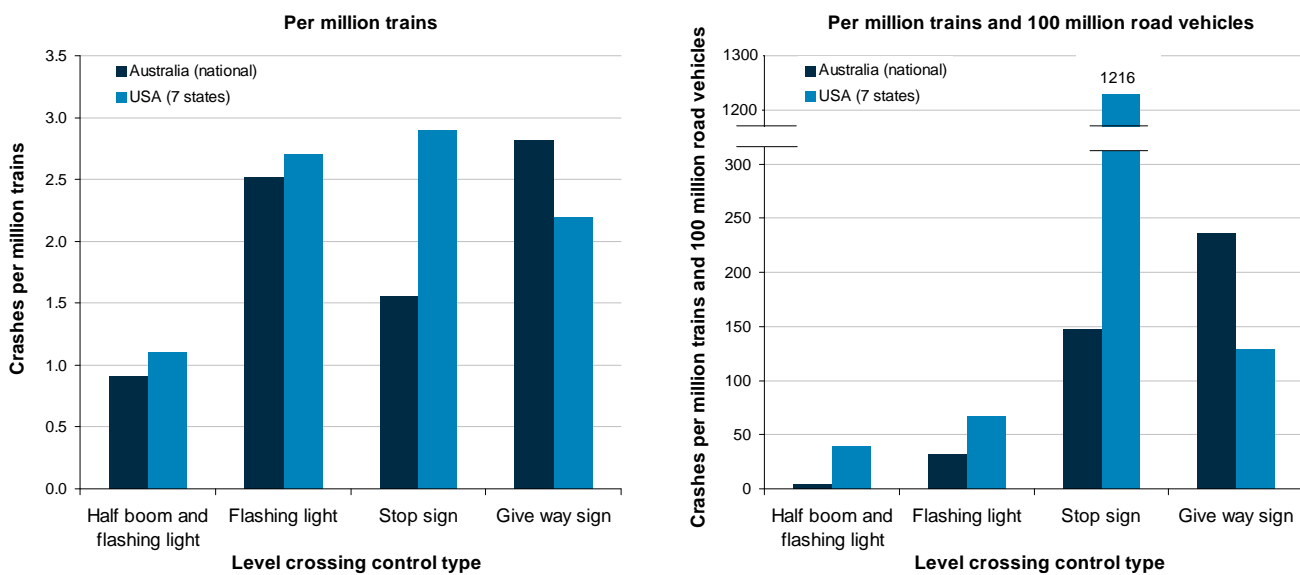


Figure 6: Comparison of normalised collision rates, USA and Australia

Note: USA figures for give way are derived from data on 'crossbuck signs' which are equivalent to give way for the purpose of comparison

There is general agreement between the Australian and USA collision rates shown in Figure 6, particularly so when the normaliser of per million trains is used. The data indicate that level crossings equipped with half boom crossings are the most effective in controlling collisions.

¹³ Level crossings on public roads

¹⁴ Raub, R. A. Examination of highway-rail grade crossing collisions over 10 years in seven midwestern states, Institute of Transportation Engineers, *ITE Journal*, April 2006

Level crossings equipped with flashing lights are more effective than stop sign and give way controlled crossings when both rail and road traffic volumes have been accounted for¹⁵.

With regard to passive controls, the Australian data suggests that stop signs are more effective than give way signs. In contrast the USA data suggests that stop sign controls are the least effective. However, this apparent poor performance may reflect the use of stop signs at crossings with unfavourable characteristics¹⁶.

Conclusions

While level crossing collisions only made up a small percentage of the national road toll (around 0.5%) from 2000 to 2009, the human and economic costs of particular events can be extreme, especially when heavy road vehicles and passenger trains are involved.

The number of collisions between road vehicles and trains has decreased significantly over the 10-year period. However, the 'average' picture for collisions fails to account for the fact that serious accidents are still occurring and the number of fatalities and fatal accidents associated with such collisions has stabilised after a long period of improvement.

Heavy freight vehicles made up 20% of collisions with trains and 23% of fatal accidents in a collision with a train, but such vehicles made up 2.5% of registrations and around 6% of kilometres travelled in Australia. This suggests they are over-represented in terms of the number of crashes at level crossings. Crashes involving heavy vehicles result in almost twice as many fatalities as passenger and light commercial vehicle crashes when considering the average fatalities per crash for both road vehicle groups. They are also more likely to fatally injure passengers or crew on the train. These findings suggest that efforts to improve level crossing safety should focus on heavy vehicles.

¹⁵ The use of both rail and road volumes is considered a more reliable indicator of exposure than either alone

¹⁶ Richards S, Yan X and Millegan H, *Effectiveness of stop-sign treatment at highway-railroad grade crossings*, September 2009

While the greatest proportion of collisions is at boom gate crossings, the greatest proportion of fatal accidents is at flashing light and stop sign crossings. Fatal accidents involving heavy vehicles are happening more at flashing light, stop sign and give way sign crossings than boom crossings. On a per million train and 100 million road vehicle basis, half boom crossings are more effective than flashing lights on their own. On this basis stop sign and give way crossings are the least effective controls, with the Australian data showing give way crossings to be the worst performers. Such results support the approach of the Australian Government's recent Boom Gates for Rail Crossings program which focused on upgrading flashing light, stop sign and give way sign crossings to boom gates.

ITSR and its contracted research partner Australian Road Research Board (ARRB) will continue to analyse the dataset now compiled. Through its membership of state and national level crossing strategy bodies ITSR will also continue to assist in developing safety improvement strategies, particularly in areas where this initial analysis highlights issues such as heavy vehicles and crossings without boom gates. ITSR is contributing to the development of a strategy to address these issues through the use of intelligent transport systems and other emerging technologies.

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