School Bus Safety

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Abstract

A safer systems approach has been taken to address concerns about the safety of the more than 100,000 children who use school buses each day. This research aimed to identify and advance those measures seen as having the most promise in terms of improving school bus safety in New Zealand. The scope of the research included both safety on school buses and safety when crossing the road to or from a school bus. The research team and project steering group led by the Ministry of Education and NZ Transport Agency, identified and evaluated a wide range of safety improvements. Detailed recommendations for improving school bus safety, including road engineering improvements around bus stops, bus-mounted warning signs that are activated when children may be crossing, enforcement, educational/information campaigns and bus design and management improvements were developed. The relative effectiveness of these different measures was investigated. The most immediate measure that should be implemented is to slow the traffic around school buses that are dropping off or picking up children. In the longer term, the other measures, such as improving bus stops, should be implemented.

Introduction

This project was initiated by the Bus Safety Technical Advisory Committee (BUSSTAC), which included representatives from the Ministry of Education (as lead organisation), NZ Transport Agency, Ministry of Transport, NZ Police, Bus and Coach Association, bus builders and bus operators. Before being known as BUSSTAC the 'Overview Group on School Bus Safety' reviewed all aspects of safety in order to determine the types of measures that would be effective in minimising the risk to children travelling by school bus. It took a long-term (20 to 30 years) holistic approach that included identifying the risks and risk management issues arising from catching the bus, the journey, disembarking and the immediate vicinity of the bus post-journey, and vehicle and driver standards (LTSA 2002). The purpose of this research was to advance the measures that were seen as having the most promise in terms of improving safety.

There is considerable concern in the community, especially the rural community, about the number of school bus users being killed or seriously injured. This concern has been highlighted by several recent events:

- Several recent coroners' reports have raised serious concerns about school bus safety and recommended that immediate action should be taken (Matenga 2008, Shortland 2009).
- The National Council of Women New Zealand recently passed a resolution calling for 'all school buses, while conveying children to and from school display distinctive and active signage, including the maximum speed at which a vehicle may pass a stationary school bus'.
- The New Zealand Society of Paediatric Surgeons, in a recent submission to government, expressed 'unprecedented concern at the increasing rates of admission for primary preventable conditions of a surgical nature in New Zealand children'. New Zealand has one of the highest death and injury rates in the OECD for accidents among children under 19 (Collins 2009).
- Rural Women NZ, NZPTA, NZ School Trustees Assoc, New Zealand Principals' Federation, local authority Road Safety Coordinators, Safekids and other groups have been doing what they can to improve school bus safety from their own resources.
- School bus crashes receive a high level of media attention.

Approximately 20% of all school pupils (106,000 pupils) are transported to school by Ministry of Education funded bus services (based on Ministry of Transport 2009, Schofield et. al. 2008).

In the 21 years from 1987 to 2007 inclusive, 22 children were killed, 45 were seriously injured and 91 received minor injuries when crossing the road to or from a school bus. This equates to, on average, one fatal, 2.1 serious and 4.3 minor injuries that are reported to the Police each year. Of the reported crashes:

- 85% occurred in the afternoon on the way home from school
- 86% of the fatal crashes but only 39% of all of the crashes (fatal and injury) occurred in speed zones greater than 50km/h
- a similar number of children appeared from the front as from the rear of the bus
- there were no reported crashes on unsealed roads.

In addition 6 children were killed, 35 seriously injured and 112 received minor injuries as passengers in school buses during that time. One crash, which occurred in 1987, accounted

for 5 of the 6 deaths to school bus occupants over the 21 year period. That crash was due to the bus losing control on a right-hand bend and going over a cliff. Most of the fatalities resulting from that crash were due to the bus structure failing which resulted in the occupants being ejected from the bus and crushed when it rolled on top of them. That crash led to the introduction of bus and coach structural strength requirements.

School bus safety can be divided into two parts:

1 The safety of children crossing the road to or from a school bus

2 The safety of children while travelling on a school bus.

This paper addresses the first of these.

The safety of children crossing the road to or from a school bus

After considering a wide range of options for preventing children from being run over when crossing the road to or from a school bus, BUSSTAC agreed that no single solution existed. Just as there is no single cause of accidents, an integrated package or range of measures is required to improve safety. It is standard health and safety practice to address hazards by eliminating them where possible; or if they can't be eliminated, isolating them; or if they can't be isolated, minimising them. In the context of the safety of children crossing the road to or from school buses, this translates to:

A. eliminating the need for students to cross the road

B. preventing children from running heedlessly across the road

C. minimising the consequences by slowing down the traffic when children are crossing.

When considering the options it needs to be remembered that children are poor judges of traffic speed and often impulsive. Connelly et al (1998) found that while some 11 to 12 year olds, especially girls, can be expected to make safe crossing decisions, younger school children are not able to reliably or consistently estimate approaching vehicle speeds, especially when speeds are over 60km/h. They primarily base their decisions on distance rather than both speed and distance. Connelly et al (1998) also note that children are often impulsive, distracted and delay decision making to the last moment.

A. Eliminate the need for students to cross the road

One very direct safety intervention is to eliminate the need for children to cross the road or, if they have to, that they do so with a responsible adult. The options for achieving this include:

- **Rearrange bus routes to reduce the number of children who have to cross the road.** The Ministry of Education and their service agents try to configure bus routes to minimise the number of children who have to cross the road. School bus routes are reviewed every two years. The limiting factors are: a) extra running costs if the routes need to be extended, 2) requiring students to stay on the bus longer, especially if the bus drives past their house on the other side of the road on the way out and they have to wait on the bus until it returns.
- **Improve bus stops.** Some road controlling authorities have been improving school bus stops in rural areas and around schools when they are able to. However most stops are still make-shift with inadequate facilities for children to wait safely, little room for caregivers to drop off or wait for the bus on the same side of the road that the bus stops on, and not enough carriageway width for the bus to be clear of the traffic. A draft bus stop guide has been developed to assist road authorities with upgrading bus stops, especially on major roads in rural areas (Baas et. al. 2010). The draft guide includes a brief summary of road safety practice and guidance on bus stop design. Typical

treatments for school bus stops at midblock, intersection and school locations are illustrated, with a summary of case studies and indicative cost information for the treatment options. Checklists to assist the review and audit of roadside and school-located bus stops are provided. It is recommended that the draft guide be adopted by the NZTA and that priority be given to upgrading bus stops on state highways and major local roads.

B. Preventing children from running heedlessly across the road

The next broad category of interventions is to provide children with help and supervision to prevent them from running across the road in the face of on-coming traffic. This includes: adults helping younger children to cross the road, teaching children how to cross the road safely and making children very aware of the dangers involved.

- Caregivers, bus drivers, schools and other stakeholders have a shared responsibility to do what they can to make sure children cross the road safely. While there have been some questions about the effectiveness of educational and awareness-raising interventions, there are things that can be done that are not difficult or expensive. For example, caregivers can be reminded regularly what safe road crossing is and that they need to model it to the children they are looking after. School community-based initiatives, such as bus wardens and neighbours taking turns to meet the bus should be encouraged. Children should be reminded of the need to take care. The Ministry of Education has produced a fact sheet that explains the responsibilities of all parties, including caregivers, bus drivers and schools.
- **Road safety education.** Improving attitudes to and knowledge of how to cross safely is taught by the NZ Police as part of its road safety education programme. While there is some evidence that attitudes towards safe behaviour may be improved, research has not yet demonstrated convincingly that raising awareness is sufficient on its own to reduce incidence of unsafe behaviour (Lobb et al 2003). The Ministry of Transport has recently initiated a review of the effectiveness of road safety education available for young people in New Zealand.

C. Minimising the consequences by slowing down traffic when children are crossing

The current speed limit of 20km/h when travelling past a school bus that is dropping off or picking up children is rarely observed despite being in the Road Code since, at least, the mid 70s. A Central Otago and Queenstown Lakes District Councils survey found that 95% of vehicles were speeding going past a school bus that had stopped on the side of a 100km/h speed limited road. The average speed was approximately 83km/h (pers com J Robinson, Central Otago and Queenstown Lakes District Councils). Surveys in other parts of the country have also found that very few motorists slow down to 20km/h. The aim of the evaluation of school bus sign options was to provide an indication of the speed reductions that could be achieved through the use of signs, flashing lights and other measures on school buses. The current means of alerting motorists to a school bus are the yellow and black ‘school bus’ or ‘school’ signs, that must always be displayed when a bus is being used as a school bus.

Evaluation of school bus signs

Following on from the safety intervention described above, an evaluation of bus-mounted signs was undertaken in two stages:

Effect on motorist speed and driving behaviour

The effect of the signs on traffic speed and behaviour was measured by trialling six signs on a school bus that was parked outside Te Kura Kaupapa Māori o Te Rau Aroha School on SH27 north of Matamata. This is a straight, flat section of road with a speed limit of 100km/h. To make the situation as realistic as possible, the bus was placed outside a school during normal school hours. The bus was parked adjacent to the northbound lane. It was not possible to undertake the tests during the times when motorists would expect children to be travelling to and from school because buses were not available then. The signs were placed on both the front and rear of the bus and tested for approximately 1.5 hours each. Traffic tube counters were placed on both sides of the road to measure traffic speeds and the number of vehicles passing in both directions. The behaviour of motorists was recorded on video. Table 2.1 shows the signs that were tested.

A perception survey was also undertaken to determine whether motorists consciously noticed flashing signs and to obtain their views on the effectiveness of the signs. The arrangements for the intercept were similar to those used by ACC for their roadside driver fatigue rest stop campaigns. Accident Compensation Corporation (ACC) and NZ Police assisted with the arrangements and conduct of the survey. Motorists were stopped by the police just past the intersection at the front of the school. They were invited to take part in the survey and were offered free coffee and food. Sign 4 (figure 2) was used for the intercept stop.

At the end of the survey, the motorists were invited to comment on the other signs. Figure 1 shows the intercept stop and the bus that was used.

Figure 1 Intercept stop location and bus and sign used for the survey

Results

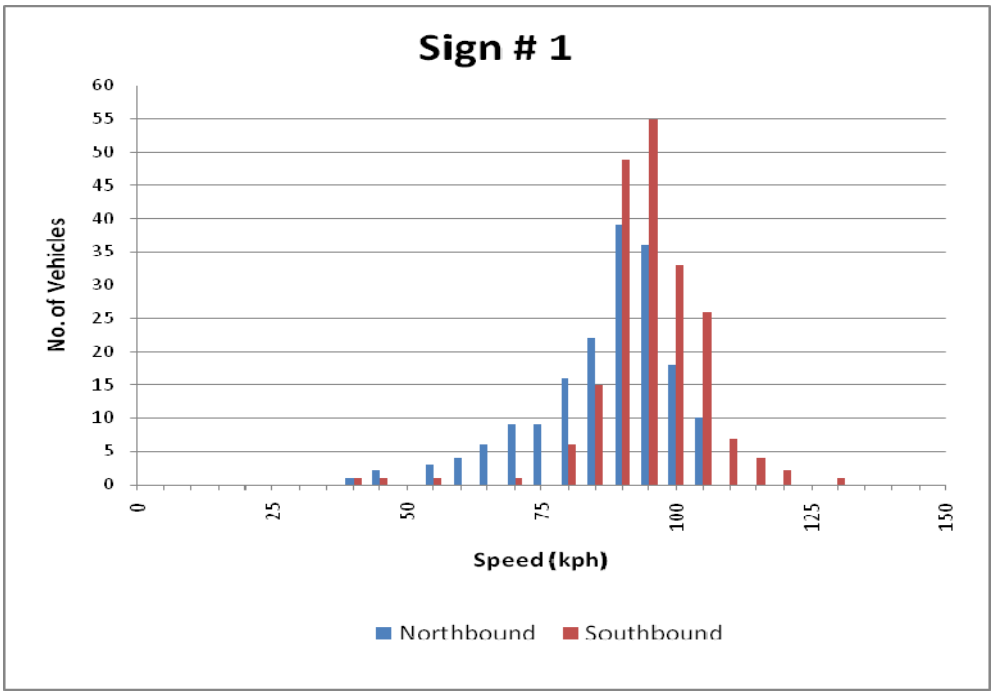
The results are summarised below.

In the analysis northbound traffic was on the same side of the road as the bus and southbound traffic was on the opposite side. Measured traffic volumes when the signs were being evaluated during school time were very similar to those measured before school on the same days between 7.30am and 9am (283 vehicles/h during the trial versus 304 vehicles/h between 7.30am and 9am). Dangerous driving incidents were selected from the videos. Those events included vehicles passing other vehicles while passing the bus. Some incidents involved light vehicles passing trucks. It is possible in those instances the light vehicle could not see the school bus signs because they were mounted relatively low on the rear of the buses.

Figure 2 Results for the six signs that were tested.

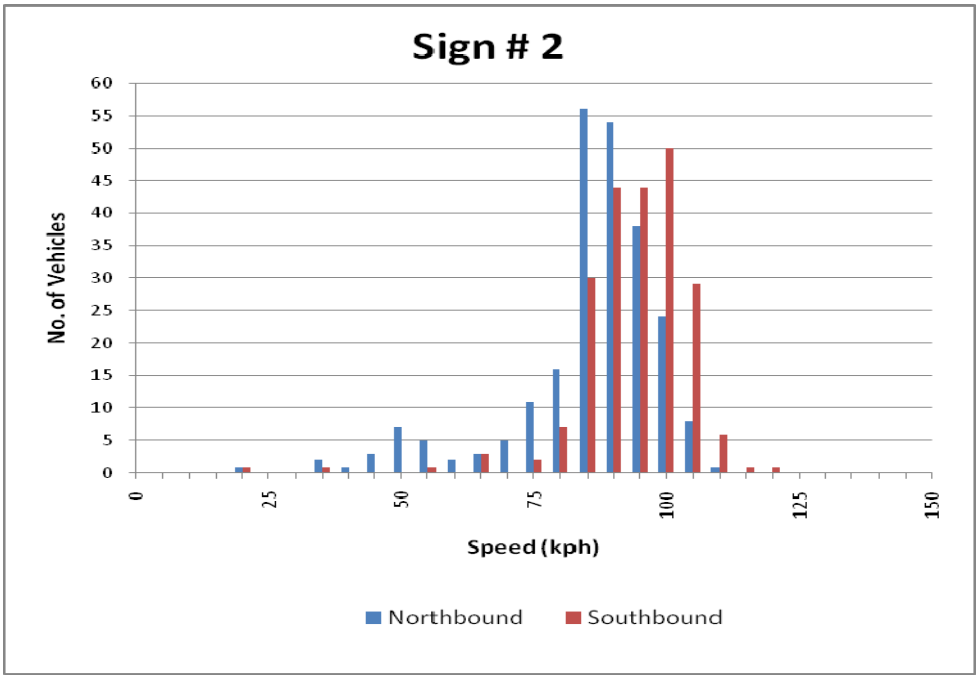
Sign 1: Baseline – (825 x 300) to establish 'status quo' (current sign)

Sign # 1	Northbound	Southbound
Vehicle count	175	202
Average speed	84	93
Standard deviation	13	10
Minimum speed	38	37
Maximum speed	104	129



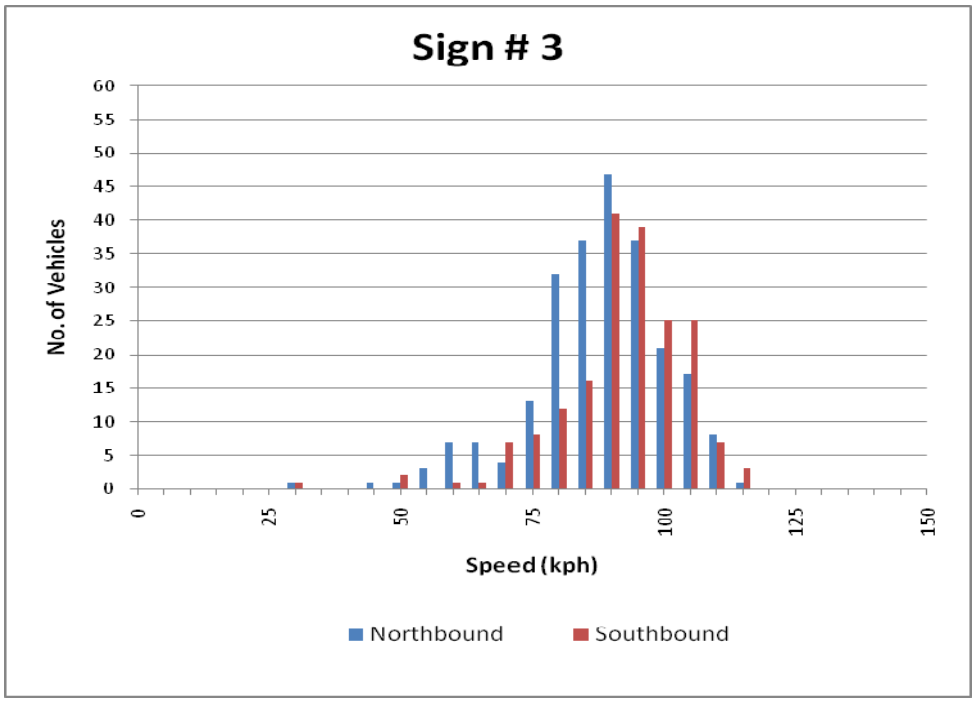
Sign 2: Current sign plus normal bus hazard lights flashing

Sign # 2	Northbound	Southbound
Vehicle count	237	220
Average speed	83.	91
Standard deviation	14	11
Minimum speed	16	19
Maximum speed	106	118



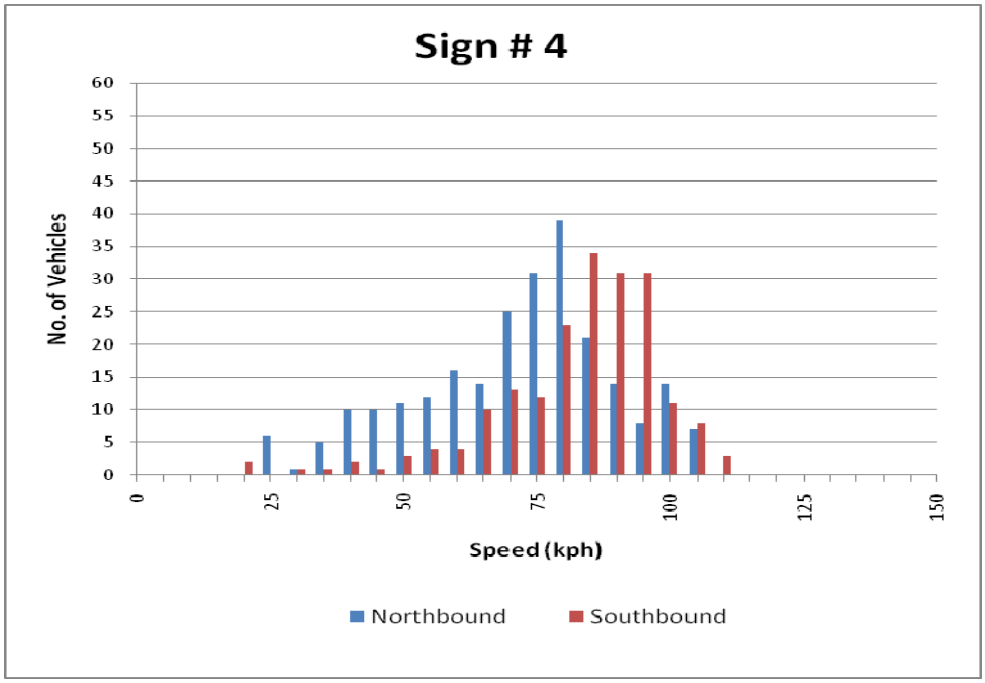
Sign 3: Symbolic sign (570 x 500) to establish value of using children symbol

Sign # 3	Northbound	Southbound
Vehicle count	237	188
Average speed	85	90
Standard deviation	13	12
Minimum speed	27	30
Maximum speed	113	113



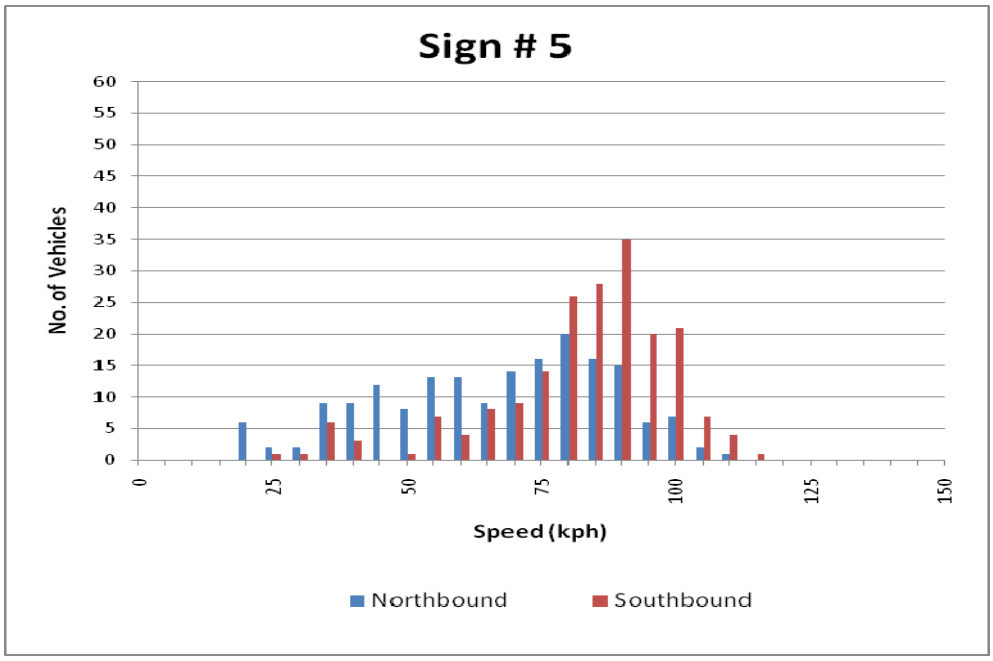
Sign 4: Dynamic sign (570 x 500) to establish value of symbol plus lights, and lights in proximity to signage

Sign # 4	Northbound	Southbound
Vehicle count	244	194
Average speed	69	80
Standard deviation	19	16
Minimum speed	20	15
Maximum speed	104	107



Sign 5: Sign 4 plus text to examine any benefits of the accompanying word message

Sign # 5	Northbound	Southbound
Vehicle count	180	196
Average speed	64	80
Standard deviation	21	17
Minimum speed	16	23
Maximum speed	106	111



Sign 6: Speed LED sign used for school zones

Sign # 6	Northbound	Southbound
Vehicle count	228	217
Average speed	57	67
Standard deviation	15	17
Minimum speed	30	27
Maximum speed	99	104

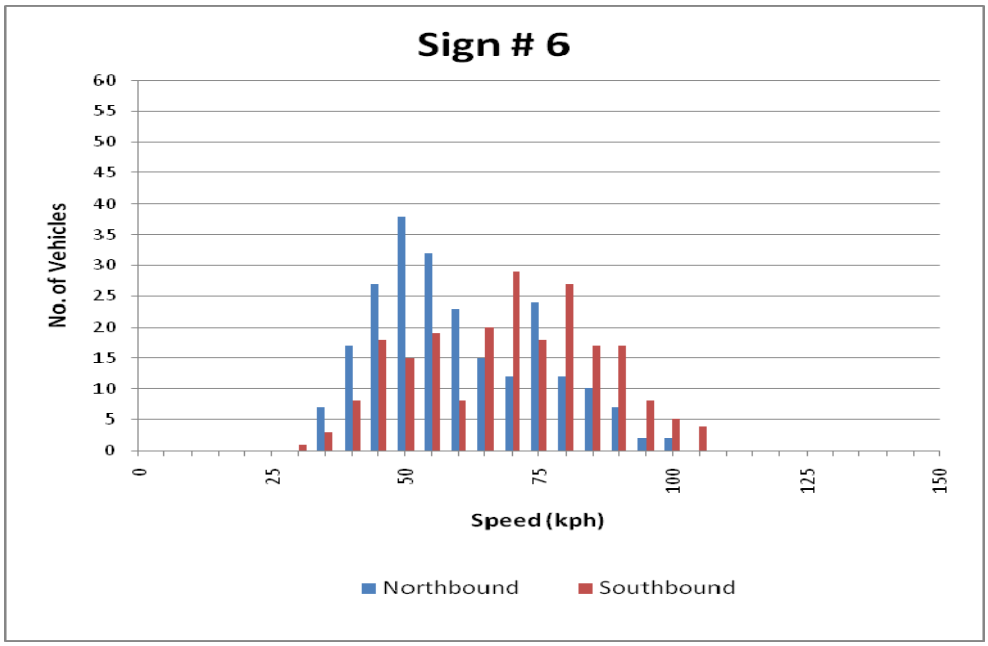
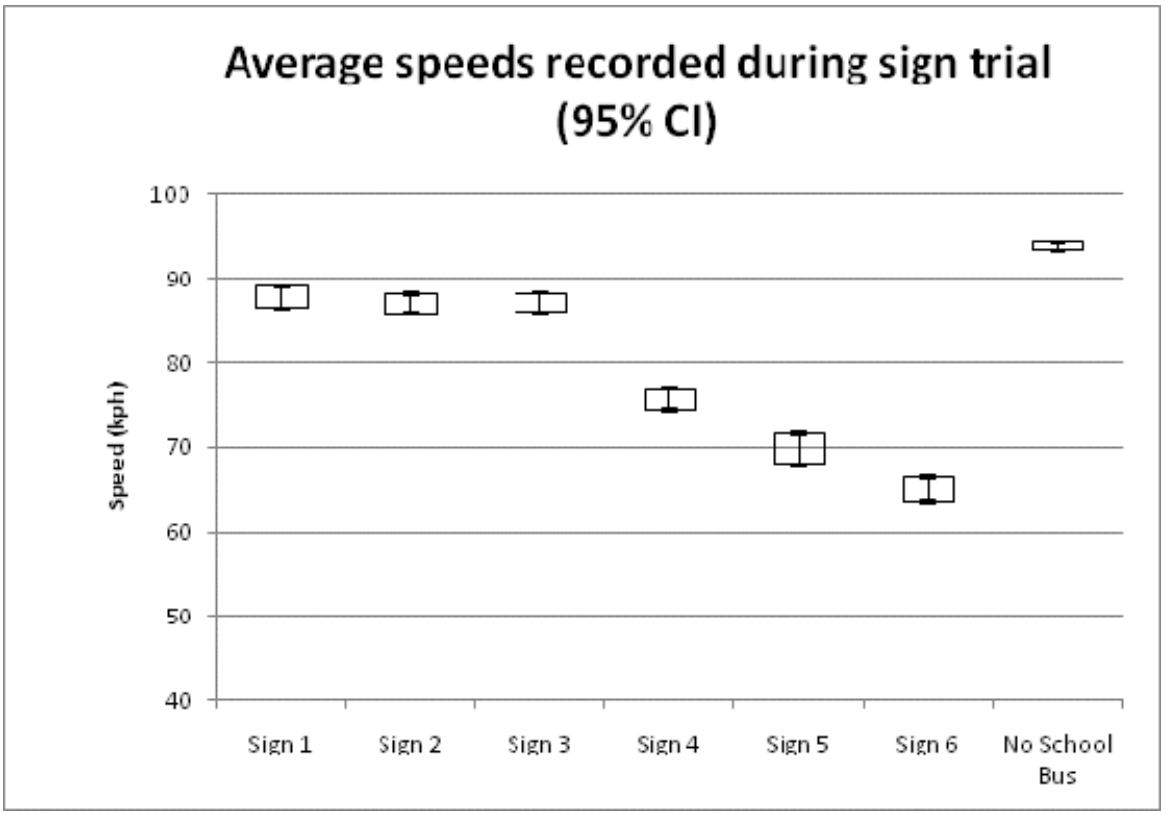


Figure 3 shows the average speeds for both directions of travel for the six signs and when no school bus was present. The boxes show the 95% confidence estimates of the average speeds. The results indicate that:

- in the presence of the bus with the current 'school' sign mean speeds were lower by approximately 6km/h
- there was no discernable difference in speeds in the presence of signs 1, 2 and 3
- in the presence of signs 4, 5 and 6 mean speeds were lower by 12km/h, 18 km/h and 23km/h respectively compared to the speeds when the school sign that is currently on nearly all school buses was present.

Figure 3 Average speeds passed a school bus with signs 1 to 6



The results suggest that:

- The current sign (sign 1) had only a small effect on vehicle speed, reducing speeds by approximately 6km/h. However this reduction may well have been simply because of the presence of the bus.
- The addition of the bus hazard warning lights on (sign 2) made no discernable difference to vehicle speeds.
- Replacing the current signs with the standard children walking symbolic sign (sign 3) also made no discernable difference.
- The children symbolic signs that included two closely spaced flashing lights (sign 4) reduced average traffic speeds by 12km/h compared with sign 1. Drivers surveyed said that they noticed the flashing lights because they were clustered together.
- The addition of words telling motorists to slow down (sign 5) slowed the traffic by a further 6km/h.

- The flashing LED '40' signs (sign 6) reduced average speeds by 23km/h compared with the current sign (sign 1).
- There were, on average, 1.5 incidences of 'dangerous' driving per hour during the trial. The sample size was too small to determine if there were any differences between signs.

There are several factors, other than the signs, that may have influenced the speeds and behaviour of motorists:

- The signs were evaluated during school hours because there were no spare buses or drivers available when the buses would normally be out on their school bus runs. This would have had some effect on vehicle speed as drivers may be more likely to slow down when they are expecting children to be getting on or off a bus.
- The bus was empty while the measurements were being made. Again it is expected that drivers would slow down more if they could see students on the bus.
- Average traffic volumes were slightly higher before and after school (329 vehicles per hour) than when the measurements were taken (276 vehicles per hour). This may have affected the number of passing opportunities but there was no sign that traffic speeds were affected by congestion before or after school because of the traffic volume.
- Sign 6, which displayed the '40' sign, would have suggested to motorists that the speed limit was 40km/h rather than 20km/h. It is common at road works and other speed restricted sites for motorists to slow down to a speed that is close to but higher than that posted.
- Most of the motorists interviewed during the intercept survey could not recall what the speed limit is when passing a school bus. They were generally in favour of having new signs that drew their attention and reminded them of the speed limit. Some motorists recommended that adoption of the US requirement that all traffic must stop.

Discussion and Recommendations

Potentially the greatest improvements in the safety associated with school bus travel will come from changes in bus routes, better bus stops and other measures that remove the need for children to cross the road. However, funding for engineering solutions and longer bus routes is limited and so these will take time to implement. In the absence of these measures, the next most effective approach is to slow down the traffic when children need to cross. This is because children of primary school age, in particular, are poor judges of vehicle speed, are impulsive and caregivers cannot always be present when children need to cross the road.

In order to be able to slow down the traffic, it is recommended that the legal requirements should be changed to enable effective enforcement. It is currently difficult for the NZ Police to enforce the 20km/h speed limit on motorists passing school buses that are picking up or dropping off students because of the way the Road User Rule is worded. This has meant that there have been virtually no prosecutions of motorists speeding past school buses despite the very high level of non-compliance. It is recommended that the Land Transport (Road User) Rule 2004 (SR2004/427) section 5.6 be amended to enable effective enforcement of the speed limit. A number of studies have found that punishment can be more effective than awareness-raising campaigns and education in changing behaviour (Lobb 2006). When considering amendments to the Rule it is recommended that:

- the speed limit be reviewed. The research suggests that the speed limit around school buses should be the same as that in other high-risk areas such as outside the school gate, in shared main street spaces and near road works. This uniformity is likely to increase driver awareness and the level of compliance
- the speed limit should apply whenever approved warning lights are activated, including when the bus is moving to or away from a bus stop
- the sign should only be activated when students are very likely to cross the road
- Active speed signs should be installed on school buses. A new active sign is being developed with the assistance of the Road Safety Trust. Cost, ease of installation and effectiveness are being considered. Ideally the new sign should be implemented in conjunction with a law change as proposed above, but if that is not possible, the sign will help to slow motorists on its own.
- If funds are limited, priority should be given to improving bus stops, installing the new active signs on school buses, and enforcement of the speed limit rather than driver awareness campaigns. Active speed signs are of direct relevance to motorists in that if they ignore them, there is a risk they may be prosecuted or, worse could kill a child. Billboards and other passive measures rely on remembering the message the next time they come across a school bus.

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