Contract Report

School Zone Alert System Evaluation

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for Roads and Traffic Authority, NSW

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School Zone Alert System Evaluation
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	Reviewed
Project Leader	
Quality Manager	

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Summary

Introduction

During 2007, the NSW RTA conducted a trial of flashing light school zone alert system technologies at 100 school zone sites across NSW.

The trial involved five categories of primary alert devices and four categories of supplementary alert devices, which were used in combination with the primary alert devices. Collectively, nine categories of alert systems were trialled across the 100 school zone sites.

The goal for the trial project was to establish a comparative performance of the ability of the technology categories to improve safety around schools through the lowering of traffic speeds in school zones. To permit this type of assessment the RTA collected traffic volume and speed data at each site prior to the installation of the trialled technology and again after several months of operation of the alert systems.

In October 2007 the RTA requested ARRB Group Limited (ARRB) to analyse the pre and post-installation traffic survey data to determine a ranking of the effectiveness of the trialled alert systems. ARRB was advised that a previous evaluation of the trial data reported on several performance parameters, however the output was inconclusive and a clear ranking was not achieved.

ARRB's evaluation was limited to the classified traffic survey data collected by the RTA. In consideration of the project goal, it was agreed that a reduction in the mean and 85th percentile vehicle speeds would provide adequate indications of effectiveness across the trialled technologies.

Changes in the level of speed zone compliance, in this instance compliance with the 40 km/h school zone limit, were also analysed and is presented in this report. This analysis assisted providing an indication of the prevailing driver behaviour of the surveyed traffic stream and provided an additional measure of the impact of the trialled systems.

Report Structure

The output of the data analysis has been presented as a series of tables in the appendix of this report. A discussion of the results of the analysis is provided in **Section 3** to provide the RTA and evaluation panel with an outline of key findings. Where appropriate, to aid in the discussion, extract tables have been provided in the **Section 3** also.

In accordance with the brief, ARRB has endeavoured to rank the treatments by apparent ability to improve safety, primarily through a reduction in vehicle speeds. This is discussed in **Section 4** and includes an outline of the constraints that ARRB came across during the analysis and that are relevant to the ranking.

Key Findings

Based on the analysis undertaken by ARRB, using the classified traffic count data supplied at the commencement of the project, a ranking of the nine technology types and combinations trialled has been prepared. ARRB cautions the reader in accepting this ranking as an absolute result. Analysis shows the ranking can and does vary depending on the criteria being used and the ranking will vary across speed zone and road environments.

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With this note of caution in mind, ARRB considers, based on the analysis conducted and presented in this report, that the reduction in 85th percentile and mean speeds produced a relatively consistent measure of effectiveness.

Based on the analysis conducted, the following ranking of the trialled technology categories is recommended to the RTA, being presented in the order of most effective to least effective treatment:

1. Type 3 variant 2 PAD with pre-zone supplementary alert device
2. Type 1 PAD with mast-arm supplementary alert device
3. Type 3 variant 2 PAD
4. Type 3 variant 3 PAD
5. Type 3 standard PAD
6. Type 3 variant 1 PAD
7. Type 1 PAD
8. Type 3 standard PAD with in-pavement supplementary alert device
9. Type 3 variant 1 PAD with in-pavement supplementary alert device

This ranking should be considered only after a full review of the report and consideration of the limits identified.

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Contents

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List of Tables

List of Figures

1 Introduction

1.1 The Project

The RTA approached ARRB Group Limited (ARRB) to prepare an evaluation of a trial of flashing light school zone alert system (SZAS) technologies at 100 school zone sites across NSW. The trial involved five categories of primary alert devices and four categories of supplementary alert devices in combination with primary alert devices. Throughout the analysis and this report, the technology categories are described as listed in the table below.

Table 1.1 SZAS technologies

Coding	*Technology Category*	*Trial sites*
1	Type 1 Primary Alert Device (PAD)	15
2	Type 3 Standard PAD	15
3	Type 3 Variant 1 PAD	15
4	Type 3 Variant 2 PAD	15
5	Type 3 Variant 3 PAD	10
6	Type 1 PAD with Mast-arm Supplementary Alert Device	10
7	Type 3 Standard PAD with In-pavement Supplementary Alert Device	5
8	Type 3 Variant 1 PAD with In-pavement Supplementary Alert Device	5
9	Type 3 Variant 2 PAD with Pre-zone Supplementary Alert Device	10
Total		100

Collectively, nine categories of technologies were trialled across the selected school zone sites. The Primary Alert Devices (PAD's) consisted of flashing lights attached or incorporated into the standard school zone sign erected at the commencement of all school zones. The five PAD's varied the design of the number and location of flashing lights on the standard school zone sign and varied the treatment of the annulus around the '40' numerals.

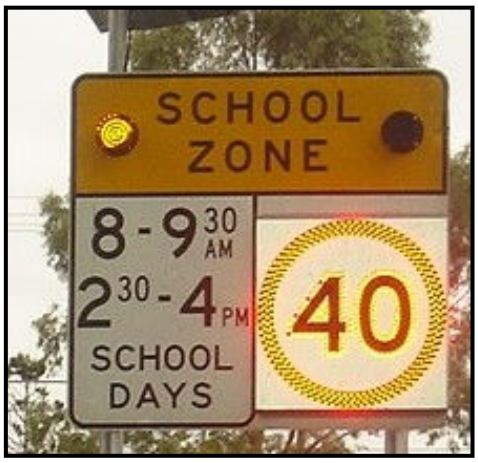
The supplementary alert devices used in combination with the PAD technology included:

- A mast arm arrangement with a flashing variable speed limit sign indicating 'zone 40' with a flashing red annulus
- A black and white flashing '40 Ahead' lantern
- Two types of in-pavement lighting, installed along the centreline of the carriageway for the length of the school zone.

Each of the primary and supplementary treatment devices used in the trial are illustrated below.

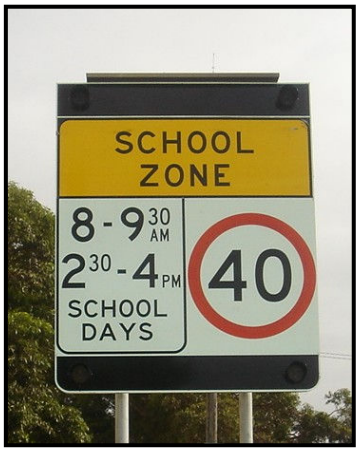
Type 1 Primary Alert Device

Type 3 Standard Primary Alert Device



Type 3 Variant 1 Primary Alert Device

Type 3 Variant 2 Primary Alert Device



Type 3 Variant 3 Primary Alert Device

Mast Arm Supplementary Device

Pre-zone Supplementary Alert Device

Type A In-pavement Supplementary Device

Type B In-pavement Supplementary Device

The goal of the project was to establish a comparative performance of the ability of the technology categories to lower traffic speeds in school zones and thus improve the safety around schools during morning and afternoon school zone periods.

The project brief listed specific analysis that the RTA sought from the project. The RTA also sought ARRB's advice as to additional analysis that would add value to the project goals and objective.

In this regard, ARRB has been able to prepare data tables that permit a differentiation between the apparent effectiveness of the alert systems trialled.

1.2 Report Structure

The output of the data analysis has been presented in a series of tables that are included in the appendix of this report. Table extracts have been provided in the body of this report where it is considered appropriate and useful for illustrating the discussion at hand.

The tables provide two sets of analysis, being firstly, the mean and 85th percentile speed analysis and secondly the speed compliance analysis. Within the speed compliance analysis three compliance categories of interest are provided:

- % of vehicles travelling less than or equal to (< =) the posted speed limit (PSL)
- % of vehicles travelling greater than or equal to (> =) 10 km/h above the PSL
- % of vehicles travelling greater than or equal to (> =) 20 km/h above the PSL

A brief overview of the method for the project and analysis is provided in **Section 2** of this report, whilst a discussion of the results, outlining key findings of the analysis is provided in **Section 3**.

A ranking of the technology categories, by apparent ability to improve safety and other key conclusions that ARRB has made based on the analysis is presented in **Section 4** of this report.

2 Method

2.1 Data collection

ARRB was provided all classified traffic volume data in electronic form, which covered .txt, .dbf, .EC0 and .tbl file formats.

As the project brief did not extend to any data collection phase, ARRB did not have any input to the design or collection of the traffic surveys. In project meetings, the RTA provided a brief outline of the traffic survey methodology, which has been presented in this report for completeness.

Traffic counts were undertaken at each school on a 24-hour continuous basis, generally over a period of one week during school term periods. There are several instances of data being collected over a longer period, up to two weeks. This has required consideration during the analysis phase to ensure results are not biased by larger sample sizes introducing a weighting unexpectedly.

Counts were completed prior to the installation of each school zone alert system and again following an introductory period of operation of the trialled system. This provided 'pre-installation' and 'post-installation' data sets for the analysis.

The traffic count data was collected at four points for each school zone in the trial, with data loggers established to detect vehicle speed and classification as well as the time day of the vehicle passing the count station.

Data loggers were established for each approach direction at the following locations:

- 100 m prior to the start of the school zone for 70km/h PSL zones and less (*pre-zone*)
- 200 m prior to the start of the school zone for 80km/h PSL zones and greater (*pre-zone*)
- 20 m after the start of the school zone at all sites (*in-zone*)

The typical arrangement for data logger locations is illustrated in **Figure 1**.

The RTA sought data for individual lanes on multi-lane approaches to improve the accuracy of the survey data to represent site traffic flow conditions. For analytical purposes, lane based data was combined to provide a single data set for each respective approach to the school zone.

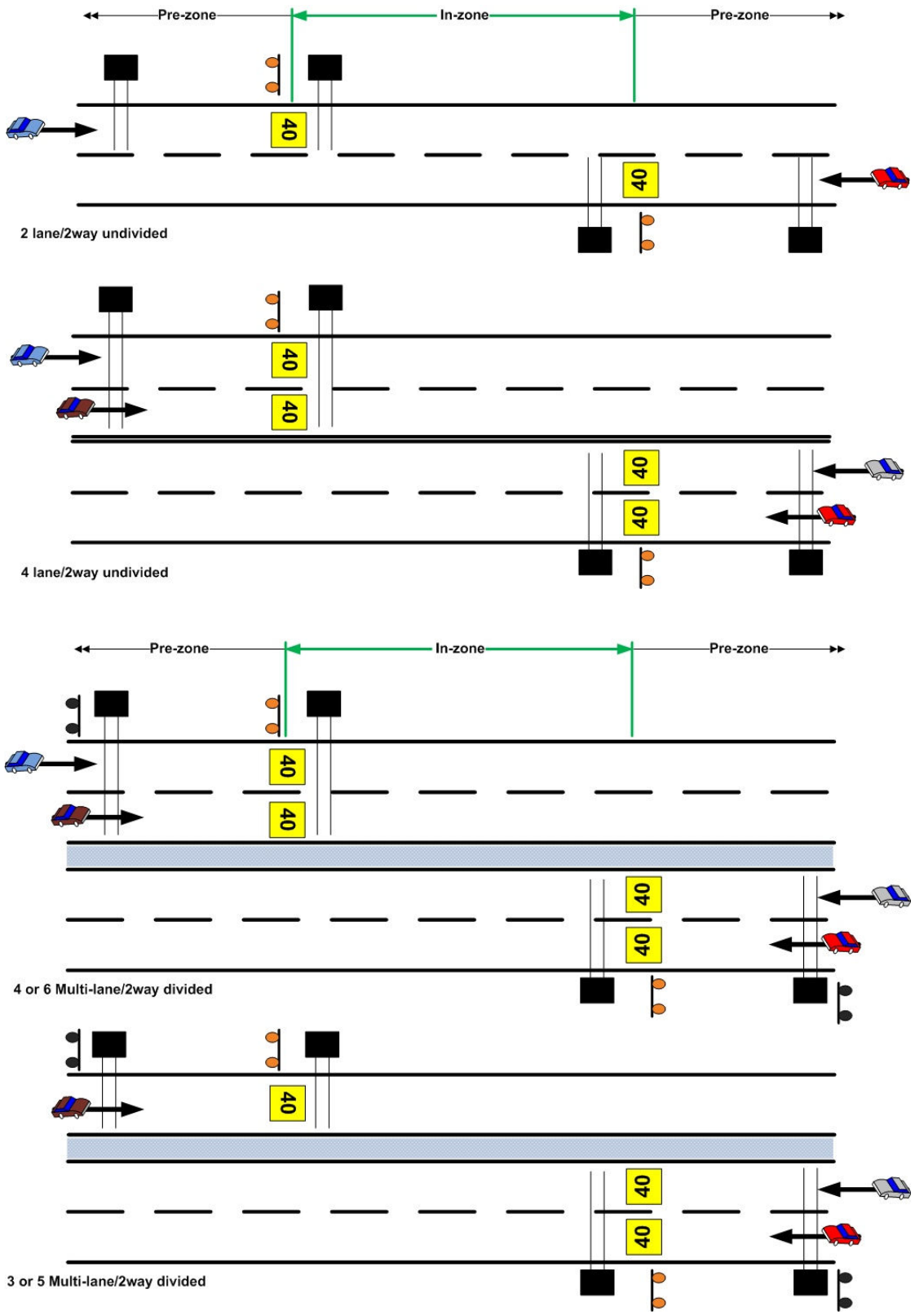


Figure 1 Indicative road and data logger layout

2.2 Data cleaning

For the purpose of this report, a 'site' is defined not as a school or school zone but rather as a traffic count of an individual data logger station during the morning or afternoon school zone period. On this basis the net result of the data collection phase should yield 1600 volume/speed/classification data sets (sites), that is:

100 schools x 2 approach directions *(N/S, E/W)* x 2 locations *(pre or in-zone)* x 2 collection periods *(pre or post-installation)* x 2 school zone periods *(AM or PM)*

However, during the initial data cleaning process ARRB found that data sets for 32 whole school zones and 4 partial school zones could not be included in the analysis. Exclusion of data-sets at this stage occurred for several reasons including missing files, incomplete count periods, a mismatching of data (i.e. data may be available for a site in one period (say pre-installation) but no data was available for the corresponding period (say post-installation), missing data labels etc.

Data that has been excluded from analysis and the basis for the exclusion is listed in the table in **Appendix B**.

Further data has been excluded after an initial analysis of the mean, 85th percentile and speed compliance profiles. The reasons for excluding selected sites are discussed in Section 2.4.

2.3 Data analysis

The data analysis requested by the RTA was to be undertaken on the cleaned data set, which included all vehicle types and road environments (divided/undivided, multi-lane, two-way roads across all speed zones ranging from 50 km/h to 100 km/h).

With regard to vehicle speeds travelling through each data collection site, the most influential aspect of the road environment was deemed the prevailing posted speed limit (PSL) on the pre-zone road approach.

In each case, the prevailing speed limit through the school zone during school zone operation times was 40 km/h.

In view of this, the analysis presented in this report grouped the technology categories by speed zone. This allows a comparison of the effect of the trialled technology categories on mean, 85th percentile and proportion of speed compliance within like speed zone environments.

It should be pointed out that the data and results of the analysis undertaken by ARRB have been presented in this report in a descriptive analysis manner to permit a good overview of driver behaviours pre and post trial period. Reported descriptive measures require further development if statistical analysis is necessary to rigourously demonstrate that changes in mean speeds are statistically significant. At a minimum the latter would require estimation of standard errors of mean speeds as opposed to standard deviations of individual speed observations as initially requested by the client. Standard errors underpin basic statistical tests of significance and computation of confidence intervals.

2.4 Methodological Problems

2.4.1 Data management issues

Several issues arose early in the project that caused delay in data analysis by ARRB.

The initial 'cleaned' data set provided to ARRB failed to include any time stamping information for the recorded vehicles. In project discussions, it was agreed with the RTA that ARRB would 'reconstruct' a suitable database, which included all relevant parameters to satisfy the analytical requirements of the brief and, in ARRB's view, to provide a robust and statistically valid evaluation.

In preparing the new cleaned data-set it was found that some data was not provided, that some data-sets omitted key variables and formatting/coding inconsistencies existed, including naming conventions, within the raw count data from the three survey contractors used.

These issues required ARRB to:

- construct a fresh database using the multiple raw traffic data files supplied in .dbf (database) format
- verify the presence/loss of trial sites
- verify the validity of the data for inclusion in the required analysis

Consequently, this component of the study took considerably longer to undertake than expected.

2.4.2 Data format

After review of the supplied files, it was found the database files (.dbf format) contained sufficient information to permit the required analysis. However, the format of the time stamping of each recorded vehicle was found to differ between suppliers. Data from two of the three contractors provided unique vehicle time stamps in hour:minute:second format, whilst data from the third contractor presented time stamping of individual vehicles in 15-minute intervals only.

A considerable amount of time and staff resources was required to convert the data into a uniform 15-minute aggregated time stamp format.

An additional limit of the data that needs to be considered is that the traffic surveys have been undertaken at different times of the school year. This is likely to introduce an effect on the consistency of traffic flows through the trial sites due to season affects at the various sites. The extent of this cannot be gauged based on the information provided and hence the affect on the analysis cannot be quantified.

2.4.3 Data control-group

With data collected both inside school zones (in-zone) and at a point on approach to the school zone (pre-zone), it was initially thought that pre-zone data would be of use as a 'control group' for the analysis, or as a way of detecting changes that may occur at the school zones that did not result from the installed treatment. Such issues may include changes in traffic volumes, changes to the road environment or general changes in driver behaviour due to enforcement campaigns etc.

Upon analysing the pre-zone data, it is apparent that data collected at the pre-zone locations may have been influenced by the treatments installed at the school zones. A consistent reduction in speeds at the pre-zones has been identified and it is likely that given the close proximity of pre-zone survey points to the trialled treatments (between 100-200 m) that drivers may have altered their behaviour in the pre-zone approach.

In several instances, significant variations were found between pre and post installation traffic volumes. In some cases, this was a result of count periods extending beyond a standard 7-day count. Other reasons for significant variation in volumes could occur include faulty or damaged data loggers or pneumatic tubes.

Due to the variability of results, ARRB has ruled out the use of pre-zone data as a valid control group.

It is then probable that information on speed reductions at the in-zone survey point may be affected by factors other than the installation of the treatment (at the in-zone location). Given the limitation of the data analysed, there is no way to identify these external factors or the extent of their effect on vehicle speeds in the school zones. Therefore, the reduction in speeds indicated for in-zone surveys may over- or under-estimate the true benefit for each treatment.

The pre-zone speed and volume data was used to review the remaining sites for suitability for inclusion in further analysis.

Following this review 256 sites across 66 schools remained within the analysis pool.

2.4.4 Other road environment issues

Fixed speed cameras were found to be present at several of the trial sites for either the whole or some part of the trial period.

The presence of a fixed speed camera is considered problematic for assessing the effects of an alert system, particularly if the camera is in close proximity to the traffic survey site. This is because a fixed speed camera is likely to be a more significant influencing factor for driver behaviour (vehicle speed) than the trialled alert system, effectively negating the effect of an independent alert system.

However, in discussion with the RTA project team it was considered that, in the case where the school zone is of considerable length and the fixed speed camera is not in close proximity to the traffic survey site, then the effect of the camera may not be such a significant influence on vehicle speeds.

The RTA subsequently reviewed each site and identified locations that should be excluded from further analysis due to the likely influence of fixed speed cameras.

2.4.5 Resulting data-sets

After review of each site, taking into account the issues outlined above, the final data set that formed the basis for the analysis and comparative evaluation of the technology groups contained data for 185 sites across 58 school zones.

This data set is presented in **Appendix A** of this report.

The baseline data set from which **Appendix A** was derived contained 256 sites across 66 school zones and is presented in **Appendix C** for completeness.

3 Results

The RTA has sought a comparative performance assessment of the trialled technology categories. In considering this, the data has been analysed to provide the mean and 85th percentile speeds for each technology group for each speed zone. Similarly, the analysis has provided the speed compliance profile for the technology categories for each speed zone in which it is was trialled.

The data and results of the analysis have been presented in this report in a descriptive analysis manner to permit a good overview of driver behaviour pre and post trial period.

Table 3.1 and **Table 3.2** provide an overview of the effect of the trialled technology categories for all road environments for mean speed, 85th percentile speed and the compliance profiles for both pre-zone and in-zone locations. A reduction in pre-zone mean and 85th percentile speeds was noted. Since these parameters were measured in advance of the site of the trial technology, it is expected that the results should remain relatively stable, assuming the road environment remains constant for the two survey periods. This was not the case and this suggests that it is not appropriate to use the pre-zone data as a control group for this evaluation.

Therefore, when considering the effectiveness of the alert system technologies, discussion of the results in this report are limited to differences between pre- and post-installation periods for in-zone surveys only.

In this regard, **Table 3.3** provides a summary of the change of in-zone mean, 85th percentile, and speed compliance profile parameters between the pre and post installation periods. Detailed data that provides the values for each site is provided in **Appendix A** of this report.

3.1 Results grouped by all sites and technology

With reference to **Table 3.1** and **Table 3.2**, the results based on 185 sites showed a reduction in mean speed at school zones of 5.0 km/h, while a reduction of 6.7 km/h occurred in the 85th percentile speed.

At the same time, reductions in mean and 85th percentile parameters of 2.8 and 3.0 km/h respectively occurred at pre-zone locations. This reduction is not an insignificant reduction and can be attributed, in part, to the proximity of the pre-zone sites to the school zones (in some cases only 100 m away). Discussion with the RTA project team indicates there is a likelihood the alert system treatments are influencing motorists before they enter the school zone, with instances of the treatment being visible well in advance of the school zone. This is particularly true for those sites with a mast-arm supplementary alert device or the pre-zone supplementary alert device.

The latter treatment is clearly exerting a downward influence on vehicle speeds. This should not be unexpected, as the very nature of the supplementary treatment is to advise the motorist well in advance that they are approaching the 40 km/h school zone.

Examining the figures in **Table 3.2** further; prior to the installation of school zone treatments, almost two-thirds (65.7%) of all vehicles were exceeding the prevailing school zone speed limit, with 10.4% travelling in excess of 20 km/h above the school zone speed limit.

However, post-installation of the alert systems, the data suggests significant improvements with less than half of motorists (44.3%) exceeding the 40 km/h school zone restriction, and the number exceeding this limit by 20 km/h or more had reduced to around 3.7%, a 6.7 percentage point drop from the pre-installation conditions.

Table 3.1 Mean speed and 85th% speed analysis - all sites

Trial Period	No. Sites in Analysis (N)	Pre-zone (50, 60, 70, 80, 100km/h)				In-zone (40km/h)			
		n	Mean speed	Std. dev.	85th% speed	n	Mean speed	Std. dev	85th % speed
Pre-installation	185	1,414,686	52.4	8.9	61.1	1,414,221	45.4	9.4	55.2
Post-installation	185	1,561,452	49.6	8.7	58.1	1,498,150	40.4	8.2	48.5
Change in speed parameters			*2.8*		*3.0*		*5.0*		*6.7*

Table 3.2 Speed compliance analysis - all sites

Trial Period	No. Sites in Analysis (N)	Pre-zone (50, 60, 70, 80, 100km/h)			In-zone (40km/h)		
		<=PSL	>= PSL +10km/h	>= PSL +20km/h	<=PSL	>= PSL +10km/h	>= PSL +20km/h
Pre-installation	185	85.3%	2.5%	0.3%	34.3%	32.2%	10.4%
Post-installation	185	90.7%	1.3%	0.1%	55.7%	14.0%	3.7%
Percentage point change		*5.4*	*1.2*	*0.2*	*21.4*	*18.2*	*6.7*

3.2 Results by posted speed limit

Table 3.3 presents the ranked change in mean, 85th percentile and speed compliance profile for each technology category by the PSL. The ranking in the table is by decreasing magnitude of change in the 85th percentile speed. Therefore, the first listed technology category represents the most effective treatment type for each PSL.

The final series of results in **Table 3.3** provides an assessment of each technology category across all PSL's. Again, these results have been ranked by decreasing magnitude of change in the 85th percentile speed.

3.2.1 50 and 60 km/h posted speed limits

The effect of the alert systems across 50 km/h PSL's generally indicate reasonable results for reducing both 85th percentile and mean vehicle speeds (4.9 and 4.5 km/h respectively) and a generally strong result for improving compliance with the 40 km/h school zone restriction (21.9 percentage point improvement).

The improved compliance is perhaps to be expected in lower PSL environments given small changes in vehicle speeds will represent a relatively larger proportion of the PSL.

Those sites where a supplementary alert device was used clearly provided superior results with respect to the key parameters. Both 85th percentile and mean speeds were reduced within a range of 7.0 to 9.0 km/h and the level of compliance with the 40 km/h school zone limit rose by 27.5 and 34.8 percentage points respectively.

For the 50 km/h PSL, the most effective technology category was found to be Type 3 Standard PAD with in-pavement supplementary alert device.

For the 60 km/h PSL, the most effective technology category was found to be Type 3 Variant 2 PAD with pre-zone supplementary alert device.

The 50 km/h and 60 km/h PSL environments shared just two technology categories – Type 3 Standard PAD and Type 3 Variant 1 PAD. In both speed zones, the relative ranking was found to be consistent, with Type 3 Standard PAD out performing the Type 3 Variant 1 PAD, which was also reflected in the *All PSL* category.

3.2.2 70 km/h posted speed limit

Across 70 km/h PSL environments changes of 7.6 km/h and 5.6 km/h were found to occur in 85th percentile and mean speeds respectively. The level of compliance with the school zone limit improved by just over 20 percentage points.

Type 3 variant 2 PAD was found to be the top performing treatment for this PSL environment with a change in 85th percentile and mean speed exceeding the grouped up numbers (8.8 km/h and 8.1 km/h respectively). Compliance rates for this treatment improved by 27.6 percentage points.

Type 1 PAD with mast arm supplementary alert device was found to be the next most effective treatment. Type 3 variant 2 PAD with pre-zone supplementary alert device was just pushed out of third spot by Type 3 variant 3 PAD (7.3 km/h versus 8.0 km/h respectively). However, it is noted the former treatment provides a superior result for reducing mean speeds (6.5 km/h versus 4.4 km/h respectively). This result is discussed later in the report and forms a part of the consideration for developing a final ranking of the technology categories.

3.2.3 80 and 100 km/h posted speed limits

Just one technology category was analysed for the high-speed PSL environment and therefore a relative ranking is not possible within this range of speed limits. Notwithstanding this, the analysis did indicate a positive effect on 85th percentile and mean speeds with 10.4 km/h and 5.9 km/h reductions respectively.

The level of compliance by motorists with the 40 km/h school zone limit showed a 13.8 percentage point improvement. An interesting result for these high speed environments is the indication that the level of motorists exceeding the 40 km/h school zone limit by 10 km/h or more was reduced by almost half (from 50% down to 26.6% - a 23.4 percentage point change). Further, those exceeding the limit by 20 km/h or more were reduced by more than half (from 26.8% down to 11.3% - a 15.5 percentage point change).

The results associated with improved levels of compliance are considered important influences for assisting the development of a ranking that improves safety around schools lowering traffic speeds. This aspect is discussed further in **Section 4**.

3.2.4 All posted speed limits

Across all PSL's the most effective technology category based on reducing 85th percentile speeds is Type 3 variant 2 PAD with pre-zone supplementary alert device. Reflecting similar results for individual PSL's the top three effective treatments is rounded out by PAD technologies that are supported by supplementary alert devices.

3.2.5 Summary

In each PSL group, the top three effective technology categories were found to contain treatments with supplementary alert devices. This prevalence of supplementary alert devices in the higher rankings is an important factor for settling on a final ranking of all the technology categories, which is discussed further in **Section 4**.

Over all PSL's the most effective treatment, using the change in 85th percentile speed as a basis, was found to be Type 3 variant 2 PAD with pre-zone supplementary alert device.

Equally, Type 1 PAD and Type 3 variant 1 PAD technology categories appear to be consistently ranked in the lower end of the effectiveness scale.

The remaining technology categories appear to vary in relative ranking across the PSL groups, however there is a tendency for them to remain 'middle of the pack' when it comes to the effectiveness to alter 85th percentile speeds.

Table 3.3 Ranked change in mean, 85th % and speed compliance

Posted Speed Limit (km/h)	Treatment	No. of sites	In-zone (Pre-installation) minus (Post-installation)					
		N	Mean Speed	Std dev	85th% Speed	<=PSL	>=PSL+ 10 km/h	>=PSL+ 20 km/h
50	Type 3 standard PAD with in-pavement supplementary alert device	4	8.2	0.1	7.5	-27.5%	3.4%	0.2%
	Type 3 variant 1 PAD with in-pavement supplementary alert device	8	4.2	0.9	5.3	-29.4%	11.9%	1.0%
	Type 3 standard PAD	7	5.2	0.2	5.1	-21.4%	7.1%	0.5%
	Type 3 variant 1 PAD	4	0.4	0.0	1.3	-2.0%	2.3%	0.0%
	Total	***23***	***4.5***	***0.4***	***4.9***	***-21.9%***	***7.3%***	***0.5%***
60	Type 3 variant 2 PAD with pre-zone supplementary alert device	4	7.0	1.4	9.0	-34.8%	33.3%	5.6%
	Type 3 standard PAD	20	5.3	1.7	7.5	-25.4%	19.7%	5.0%
	Type 3 variant 3 PAD	10	5.4	0.7	6.0	-22.1%	24.7%	8.7%
	Type 3 variant 1 PAD	27	4.6	1.0	5.9	-24.0%	16.0%	3.4%
	Type 3 variant 2 PAD	24	4.6	0.8	5.9	-22.5%	14.1%	3.7%
	Type 1 PAD	11	3.1	0.4	3.6	-15.3%	11.0%	2.8%
	Total	***96***	***4.7***	***1.0***	***6.0***	***-23.1%***	***17.4%***	***4.5%***
70	Type 3 variant 2 PAD	10	8.1	1.0	8.8	-27.6%	29.3%	16.8%
	Type 1 PAD with mast-arm supplementary alert device	15	4.3	2.5	8.3	-17.3%	19.7%	8.5%
	Type 3 variant 3 PAD	4	4.4	2.8	8.0	-20.0%	17.5%	6.2%
	Type 3 variant 2 PAD with pre-zone supplementary alert device	16	6.5	0.7	7.3	-20.6%	28.1%	14.5%
	Type 1 PAD	2	4.5	1.6	6.5	-15.1%	17.2%	7.6%
	Type 3 standard PAD	4	2.4	0.4	3.0	-12.7%	9.8%	2.4%
	Total	***51***	***5.6***	***1.5***	***7.6***	***-20.1%***	***23.2%***	***11.3%***
80-100	Type 3 variant 2 PAD with pre-zone supplementary alert device	15	5.9	2.5	10.4	-13.8%	23.4%	15.5%
	Total	***15***	***5.9***	***2.5***	***10.4***	***-13.8%***	***23.4%***	***15.5%***
All PSL	Type 3 variant 2 PAD with pre-zone supplementary alert device	35	6.3	1.6	8.8	-19.3%	26.7%	13.9%
	Type 1 PAD with mast-arm supplementary alert device	15	4.3	2.5	8.3	-17.3%	19.7%	8.5%
	Type 3 standard PAD with in-pavement supplementary alert device	4	8.2	0.1	7.5	-27.5%	3.4%	0.2%
	Type 3 variant 2 PAD	34	5.6	0.9	6.8	-24.0%	18.6%	7.6%
	Type 3 variant 3 PAD	14	5.2	1.3	6.6	-21.5%	22.6%	7.9%
	Type 3 standard PAD	31	4.9	1.2	6.4	-22.9%	15.6%	3.7%
	Type 3 variant 1 PAD	31	4.0	0.9	5.3	-21.1%	14.2%	3.0%
	Type 3 variant 1 PAD with in-pavement supplementary alert device	8	4.2	0.9	5.3	-29.4%	11.9%	1.0%
	Type 1 PAD	13	3.3	0.6	4.1	-15.2%	12.0%	3.6%
	Total	***185***	***5.1***	***1.2***	***6.7***	***-21.4%***	***18.2%***	***6.7%***

Note: treatments are ranked first by change in 85th percentile speed, and then change in mean speed – most effective to least effective treatment

4 CONCLUSION

4.1 Ranking

The analysis undertaken and discussed in this report suggests that the effectiveness of the trialled treatments differs depending on the prevailing posted speed limit. This may suggest that different treatments should be used for different speed zones. Such an approach as this however, would create some practical issues (not the least of which is cost-effectiveness) in application and consistency in message for motorists. Whilst ARRB has sought to provide a single ranking based on an assessment of effectiveness to reduce 85th percentile speeds, as agreed at the outset of the project, consideration has also been given to other factors to guide a ranking and which can influence safety around schools.

These factors include the effect on mean speeds, the change in levels of compliance with the 40 km/h school zone speed limit and suitability of the technology across a variety of road environments. The effects of the technology groups in these alternative safety factors may not immediately be clear or may be overwhelmed by the initial ranking criteria (i.e. change in 85th percentile speed) and so ARRB has endeavoured to account for them in the final ranking process.

As a final comment on the process of ranking the technology categories. Through the various data issues discussed in **Section 2**, the number of sites available for analysis has been reduced from the initial data pool. This may affect the strength of the results for some treatments and in some cases may have caused technology categories to be removed altogether. Without more rigourous statistical analysis to develop confidence limits etc, ARRB believes the number of valid sites included in the analysis is an indicator of the reliability of the results.

Thus, having regard to the above and in view of the analysis conducted for this project the following is presented as a ranking, from most effective to least effective technology category at improving road safety around schools:

1. Type 3 variant 2 PAD with pre-zone supplementary alert device
2. Type 1 PAD with mast-arm supplementary alert device
3. Type 3 variant 2 PAD
4. Type 3 variant 3 PAD
5. Type 3 standard PAD
6. Type 3 variant 1 PAD
7. Type 1 PAD
8. Type 3 standard PAD with in-pavement supplementary alert device
9. Type 3 variant 1 PAD with in-pavement supplementary alert device

4.2 Recommendations

It was noted, and discussed previously, that the ranking of treatments varied somewhat across individual speed zones. It is not inconceivable that different treatments could be applied in low speed zones compared with treatments in high-speed zones.

Should the RTA consider applying more than one technology category based on the PSL, then ARRB does believe there is merit to choosing a single primary alert device for use in both low and high-speed zone environments. A distinction can then be made between low and high speed environments by use of the preferred supplementary alert device.

The analysis indicates that the pre-zone supplementary alert device is an effective treatment in higher speed environments, with good reductions in 85th percentile and mean vehicle speeds and high changes in the level of compliance achieved.

As a final point, ARRB believes there are significant constraints embedded in the analysis undertaken for this report. These constraints have been briefly discussed in this report and ARRB believes caution must be applied when discussing the results or interpreting them as absolutes.

The constraints that have been discussed include site and road environment conflicts, limited availability of data, lack of a control group and not least, a significant time constraint to complete a full and comprehensive analysis. Further analysis of the current data sets may limit or remove altogether some of the issues that have lead to a variability of the ranking results.

It is recommended that the RTA consider further analysis if the nominated ranking results are not considered acceptable.

Appendices

Appendix A – Data analysis output tables

ALL TABLES PROVIDED ELECTRONICALLY IN .PDF FORMAT TO BE INSERTED AT THIS POINT FOR A HARDCOPY FORM OF THIS REPORT

Appendix B – Data excluded from analysis

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
All Saints Cath. Girls College (Bigge St)	Before / Pre-zone	N or E	Y	Y	All "S" data was excluded because "in-zone" data was missing in original survey files.
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	N	N	
All Saints Cath. Girls College (Elizabeth St)	Before / Pre-zone	N or E	N	N	There were no original survey files for this street location.
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Ascham Girls School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Ashfield Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Auburn North Public School	Before / Pre-zone	N or E	N	N	Eastbound before data missing
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Bankstown North PS/De La Salle (St Felix)	Before / Pre-zone	N or E	Y	N	Before sites were not labelled with Zone information
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Bellevue Hill Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Beverly Hills Girls HS/ Beverly Hills PS	Before / Pre-zone	N or E	Y	Y	All "S" data was excluded because "in-zone" data was missing in original survey files.
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	N	N	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Bexley Public School	Before / Pre-zone	N or E	Y	N	Westbound before Zone not labelled
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Bonnyrigg HS/Our Lady of Mount Carmel PS	Before / Pre-zone	N or E	Y	N	All "E" data was excluded because "pre-zone" data was missing in original survey files.
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	Y	Y	
Brigidine College/ Sydney Gramma St Ives	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Burke Ward PS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Burnside PS/ Redeemer Baptist/ The King HS	Before / Pre-zone	N or E	N	N	No Before data
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Callaghan College, Waratah Campus	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Canley Vale Public School	Before / Pre-zone	N or E	Y	N	No After Data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Caringbah HS and Edeavour Sports HS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Carramar Public School	Before / Pre-zone	N or E	Y	N	Both Before directions not labelled with Zone type
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Cecil Hills High School	Before / Pre-zone	N or E	Y	N	Missing After Data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Cerdon College	Before / Pre-zone	N or E	N	N	Before Zone type not labelled
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Chatswood Public School	Before / Pre-zone	N or E	Y	N	Missing After Sth Data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	N	N	
Chevalier College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Christ the King PS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Colyton High School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Condell Park PS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Coonabarabran PS & HS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
De La Salle College Ashfield	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Epping Epping Boys High School	Before / Pre-zone	N or E	N	N	No Data
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Epping West Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Fairy Meadows PS	Before / Pre-zone	N or E	Y	N	There was an insufficient number of original survey files to complete either direction.
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Frenchs Forest PS & The Forest HS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Gardeners Road Public School	Before / Pre-zone	N or E	Y	N	No Sth After Data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	N	N	
Gateshead PS/ Lakeside Special/Hunter Sports & St Marys HS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Georges River College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Gordon West Public School	Before / Pre-zone	N or E	N	N	Before files missing
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Granville South Primary School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Greenacre Public School	Before / Pre-zone	N or E	Y	N	After Data Missing
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Holy Cross College	Before / Pre-zone	N or E	Y	N	After Data Missing
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Illawarra Sports High School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Illawarra Sule College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
John Paul College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Killarney Vale Public School	Before / Pre-zone	N or E	N	N	All "E" data was excluded because "pre-zone" data was missing in original survey files.
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	Y	
Lindfield Primary School	Before / Pre-zone	N or E	Y	N	After Data Missing
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Liverpool Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Lochinvar PS/St Patricks Primary/All Saints College-St Josephs	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Macquarie Boys High School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Marayong Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Marcellin College	Before / Pre-zone	N or E	Y	N	Before West and After East missing files
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	Y	N	
Marist Catholic College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Marist College St Catherine	Before / Pre-zone	N or E	N	N	No Data
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Marsden Road Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Masada College - ST Ives	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Mascot Public School	Before / Pre-zone	N or E	N	N	No Before data
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Mater Dei Catholic Primary School	Before / Pre-zone	N or E	N	N	Missing Data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Mater Dei Catholic Primary School	Before / Pre-zone	N or E	N	N	
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
Millthorpe PS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Miranda Primary School	Before / Pre-zone	N or E	N	N	No Before data
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Model Farms High School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Moonbi Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Mount Annan Christian College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Mudgee PS/ Mudgee HS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Narrabeen Lakes PS	Before / Pre-zone	N or E	N	N	No Before data
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
New Lambton Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Newtown High School of the Performing Arts	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
North Beaches Secondary College	Before / Pre-zone	N or E	Y	N	No After Data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
North Sydney Girls HS/ North Sydney Demonstration	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Nowra Anglican College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Old Guildford Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Our Lady of the Rosary PS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Parramatta High School	Before / Pre-zone	N or E	Y	N	Before Zone type not labelled
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Pitt Town Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Prairiewood High School	Before / Pre-zone	N or E	Y	N	No After Data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Randwick Boys and Randwick Girls	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Rydalmere Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Sans Souci Public School	Before / Pre-zone	N or E	Y	N	Before Zone type not labelled
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Shelley Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Shellharbour Anglican College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
St Benedict's Primary School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
St Bernadettes PS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
St Catherine Laboure Primary School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
St Dominic's Catholic College	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
St Margaret Marys PS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
St Marys Primary- St Joseph PS	Before / Pre-zone	N or E	Y	N	No After Data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
St Mary's Star of the Sea School Miranda	Before / Pre-zone	N or E	N	N	No Data
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	N	N	
St Patricks PS /James Cook/Moorefield Girls	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Strathfield South Public School	Before / Pre-zone	N or E	N	N	Missing Zone info for Before E
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Sule College (Prestons Campus)	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Sydney Boys High	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Sydney Boys High School & Sydney Girls HS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Sydney Technical High School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Taren Point Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
The Illawarra Grammar School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Toongabbie Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Ulmarra PS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Warilla High School	Before / Pre-zone	N or E	Y	N	There was an insufficient number of original survey files to complete either direction.
	Before / In-zone	S or W	N	N	
	After / Pre-zone	N or E	N	N	
	After / In-zone	S or W	Y	N	
Warners Bay High School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Waverley Catholic College	Before / Pre-zone	N or E	N	N	No Sth Before data
	Before / In-zone	S or W	Y	N	
	After / Pre-zone	N or E	Y	N	
	After / In-zone	S or W	Y	N	
Woodport PS/ Erina HS	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Woolgoolga Public School & High School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	

School	Period/Period	Direction	Data Available (Y or N)	Used in Analysis: (Y or N)	Reason data was not used in analysis
Woy Woy Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	
Woy Woy South Public School	Before / Pre-zone	N or E	Y	Y	
	Before / In-zone	S or W	Y	Y	
	After / Pre-zone	N or E	Y	Y	
	After / In-zone	S or W	Y	Y	

Appendix C – Baseline data-set prior to site exclusion

ALL PLOTS PROVIDED ELECTRONICALLY IN .XLS FORMAT TO BE INSERTED AT THIS POINT FOR A HARDCOPY FORM OF THIS REPORT

Appendix D – SZAS evaluation project brief

Roads and Traffic Authority of New South Wales

SUBJECT: Expressions of Interest, RTA RFT No. 774 089
School Zone Alert System

Effectiveness Brief Details

Scope

This document is intended to define the analysis sought of the traffic speed data collected pre and post installation in order to support the evaluation of the EOI Respondent's proposed Alert Device systems.

Overview

The RTA commissioned the collection of traffic speed at the 100 selected School Zones both prior to and after the installation of a nominated set of technologies intended to alert drivers to the applicability of the School Zone 40km/h speed limit. The nominated technologies are classified in nine categories:

1. Type 1 Primary Alert Device
2. Type 3 Standard Primary Alert Device
3. Type 3 Variant 1 Primary Alert Device
4. Type 3 Variant 2 Primary Alert Device
5. Type 3 Variant 3 Primary Alert Device
6. Mast-Arm Supplementary Alert Device with Type 1 Primary Alert Device
7. Pre-Zone Supplementary Alert Device with Type 3 Variant 2 Primary Alert Device
8. In-pavement Supplementary Alert Device with Type 3 Standard Primary Alert Device
9. In-pavement Supplementary Alert Device with Type 3 Variant 1 Primary Alert Device

Initial analysis of the data and known environmental factors provides a requirement for additional details analysis.

Goal

The goal of the analysis is to establish a comparative performance of the various nominated technology categories in their ability to improve the safety around schools through the lowering the traffic speed within School Zones. This analysis needs to explore the consideration of:

1. confounding site factors
   This includes the close proximity of traffic signals and/or roundabouts to the speed measuring points and/or between them, the existent of fixed speed cameras, changes to the site other than the installation of the Alert Devices;
2. the posted approach speed;
3. volume of traffic;
   This needs to consider total volumes; and
4. compliance profiles
   That is, the proportion of drivers *x* km/h or y% above or below the speed limit.

The sites include 2 through 6 lane two-way carriageways, 50km/h through 100km/h posted approach speed limits, large and small traffic volumes, significant heavy vehicle traffic ratios and little or no heavy vehicle traffic.

Detailed Requirements

The analysis should include, but not be limited to:

1. Ranking of the 9 technology categories in their ability to improve safety;
2. Comparative improvement and significance thereof of the 4 Supplementary Alert Device technology categories;
3. Numerical representation of all vehicles for approach and in-zone data collection points of:
    a. 85th percentile speed;
    b. % of drivers <= 20km/h under the posted speed limit;
    c. % of drivers <= 10km/h under the posted speed limit;
    d. % of drivers <= posted speed limit;
    e. % of drivers > posted speed limit;
    f. % of drivers >= 10km/h over the posted speed limit;
    g. % of drivers >= 20km/h over the posted speed limit;
    h. % of drivers >= 30km/h over the posted speed limit;
    i. % heavy vehicles (all vehicle analysis only)
    j. the mean speed;
    k. standard deviation;
    l. N;
    m. quality of fit to the standard curve;

    against the following categories:

    n. all sites;
    o. site by site;

    sourced from the following data pools:

    p. all available data collectively (category n above only);
    q. all sites for which all four data collection points are available i.e. approach and in-zone speed data both pre and post installation (categories n and t only);
4. Numerical and graphic representation of:
    a. The change in compliance (% <= 40km/h in-zone) and 85th percentile speed reductions (approach to in-zone) between pre and post installation;