NSW MOBILE SPEED CAMERA REVIEW

Prepared by the NSW Centre for Road Safety

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EXECUTIVE SUMMARY

International and Australian research clearly demonstrates that increased travel speed is directly related to both the likelihood of a crash occurring and the severity of crash outcomes (see Elvik, Christensen & Amundsen, 2004).

Speed enforcement activities aim to increase the perceived threat of being caught speeding, and in doing so help to reduce the mean travel speed on our roads, thus reducing the risk of being involved in a fatal or injury crash for all road users. Speed cameras are commonly employed methods of speed enforcement in many best practice road safety jurisdictions throughout the world. Automated camera enforcement supplements enforcement conducted by police officers. A number of key international research reviews have clearly demonstrated the effectiveness of speed cameras in a range of countries throughout the world (see OECD, 2006).

The various types of speed cameras have different roles. In most jurisdictions, fixed speed cameras are located at specified road lengths or intersections, usually where there is a demonstrated crash history or where speed is considered to be a problem. Mobile speed cameras can be moved around the network at various times and locations and, like police enforcement, this mobility increases the deterrence effect due to the unpredictability of the exact location of speed enforcement.

The intended purpose of mobile speed cameras is to produce a sustained change in driver behaviour by creating a perception that speeding can be enforced anywhere at any time, thereby reducing speeding not only at identified enforcement locations but also across the road network, thus creating a general deterrence effect (Cameron & Delaney, 2006). This is because drivers are less able to predict where the enforcement will occur. The less predictable the enforcement, the more speed limit compliance can be achieved.

An overwhelming number of rigorous evaluation studies, conducted both internationally and in Australia, clearly demonstrate that mobile speed cameras produce significant reductions in mean travel speed, crashes, and casualties. For example, evaluations of the Victorian mobile speed camera program demonstrate a 25% reduction in casualty crashes in Victoria in the first two years as a result of the program (Cameron & Delaney, 2006).

Moreover, several studies have demonstrated that, not only do mobile speed cameras result in travel speed, crash and casualty reductions at actual camera locations, but they also produce reductions in these outcomes across the road network.

Currently, the NSW mobile speed camera program deploys approximately 930 enforcement hours per month, which is the smallest deployment of mobile speed cameras of all Australian jurisdictions, especially on a per population basis. The re-introduced small scale program in NSW has already provided some road safety benefits, with a 19% reduction in fatalities in the first 12 months following the re-introduction of the cameras and state wide speed surveys conducted in the months after the cameras were re-introduced found there was a significant reduction in the proportion of vehicles exceeding the speed limit in most speed zones. Whilst these results are positive, the limited scope of mobile speed camera enforcement in NSW will over time reduce its effectiveness. The current size of our mobile speed camera program, demonstrate that NSW is behind every other Australian jurisdiction on levels of mobile speed enforcement. An expanded mobile speed camera program should be considered in NSW.

1. Review of international and Australian evidence

1.1. Introduction

Current and past research in Australia and internationally provides compelling evidence that increased travel speeds are directly related to both the likelihood of a crash occurring and to the severity of crash outcomes.

A key Australian study (Kloeden, McLean, Moore & Ponte, 1997) found that the risk of crashing in a 60 km/hr speed zone doubled with every 5 km/hr increase in travelling speed above 60 km/hr.

Speed cameras have been demonstrated as effective in reducing speeding, and in turn reducing crashes. The intended purpose of mobile speed cameras is to produce a sustained change in driver behaviour by creating a perception that speeding can be enforced anywhere at any time, thereby reducing speeding not only at identified camera and enforcement locations but across the road network.

Section 1.2 examines the relationship between vehicle speed and crash severity and section 1.3 examines deterrence theory and why speed cameras are effective in influencing driver behaviours. Section 1.4 examines the effectiveness of speed cameras and Sections 1.5 and 1.6 review the international and Australian evidence regarding mobile speed cameras.

1.2. Speed and crash severity

The relationship between vehicle speed and crash severity is unequivocal and based on the laws of physics. The higher the speed in a crash, the greater the amount of kinetic energy that must be absorbed by the impact. Because kinetic energy is determined by the square of the vehicle's speed, rather than by the speed alone, the probability of death or injury, and the severity of injuries that occur in a crash, increase exponentially with vehicle speed. For example, a 30% increase in speed (e.g., from 80 to 105 km/h) results in a 69% increase in the kinetic energy of a vehicle.

The laws of physics and human performance dictate that small increments in speed result in large rises in the number of collisions, injuries and deaths on our roads. As driving speed increases, so does the time that a driver has to identify and react to a dangerous situation. The distance needed for that vehicle to stop also increases. High speeds are also associated with extremely high risks of losing control of the vehicle on corners, curves or if evasive action is needed.

Results from research on speed risk are consistent with the laws of physics and well-established knowledge in the field of biomechanics (see Elvik et al., 2004). Lower speeds:

- allow road users more time to assess hazards and avoid potential crashes
- reduce the distance travelled while reacting to the hazards
- reduce the vehicle stopping distance after application of the brakes
- provide a greater opportunity for road users to avoid a collision
- make it less likely that a driver will lose control

- reduce the impact forces in the event of a crash, making severe outcomes less likely.

Current and past research in Australia and internationally provides compelling evidence that increased travel speeds – even at low levels – are directly related to both the likelihood of a crash occurring and to the severity of crash outcomes.

A key Australian study (Kloeden, McLean, Moore & Ponte, 1997) found that the risk of crashing in a 60 km/hr speed zone doubled with every 5 km/hr increase in travelling speed above 60 km/hr.

1.3. General Commentary on Deterrence

Classical Deterrence theory proposes that individuals will avoid engaging in offending behaviours if they fear the perceived consequences of the act (Homel, 1988). This theory suggests that the most powerful deterrent effects on offending behaviour are produced by the perceived threat of the certainty of apprehension, in this context referring to the perceived likelihood of being caught speeding. Thus, in order for the "fear of punishment" to be effective, motorists must believe that the likelihood of being caught for speeding is relatively high (Davey & Freeman, 2011).

According to the classic driver decision-making model proposed by Naatanen and Summala (1974), drivers balance the subjective risk of the negative consequences of speeding with their motives for engaging in the behaviour when choosing their speed. Therefore, a principal objective of effective deterrence-based speed countermeasures is to increase the drivers' perception of the risks associated with excessive speed. This may be achieved largely via two processes: specific deterrence, and general deterrence.

Specific Deterrence – Occurs when a motorist who has been apprehended and punished for a speeding offence refrains from further speeding behaviour for fear of incurring additional punishment. This is the principle that supports penalties such as demerit points for specific driving offences.

General Deterrence – Occurs when a motorist refrains from speeding as a result of observing others being punished for a speeding offence or they are warned of the impending penalties for speeding or likelihood of being caught. Thus, the threat of enforcement influences the behaviour of motorists generally, irrespective of whether or not they have ever been apprehended.

While there is a strong understanding from drivers that speeding increases the risk of a crash (Petroulias, 2009), speeding remains a prevalent behaviour among motorists in most jurisdictions (see Wegman & Goldenbeld, 2006) including NSW (Taverner Research, 2008). This is likely due to driver overconfidence. Many studies internationally (e.g. Weinstein & Lyon, 1999) and in NSW (e.g. Fernandes et al., 2010) show that drivers tend to see themselves as superior than the average driver, with very few drivers rating themselves as below average. Thus, while drivers acknowledge the risk of speeding, they may believe that this risk does not apply to themselves due to their perceived superior skills. For this reason, enforcement-based deterrence would appear more effective than deterrence focused solely on highlighting crash risk for speeding.

A considerable body of evidence demonstrates that the threat of apprehension and subsequent legal sanctions, especially when supported by well-publicised media campaigns, can produce a deterrence effect on offending behaviour, as well as a beneficial effect on crashes and casualties (see Davey & Freeman, 2011).

1.4. Review of Evidence for Speed Camera Effectiveness

Speed cameras are an increasingly common method of speed enforcement. Many countries throughout the world employ speed cameras as part of their speed enforcement activities, including every state in Australia, the Netherlands, France, the United Kingdom, Finland, Germany, Hong Kong, Canada, the United Arab Emirates, Kuwait, Denmark, Spain, New Zealand, Italy and Norway. These are all worldwide jurisdictions with good road safety records, where speed cameras are considered an essential part of a best practice road safety strategy.

1.4.1. Background

There exists a wealth of studies examining the effectiveness of speed cameras globally. Thus, for brevity, the current section presents findings from a number of key meta-analytic reviews of the international evidence. Meta-analysis refers to the rigorous statistical analysis of a large collection of results from individual research studies, with the aim of pooling findings from similar studies in order to determine the mean effect across those studies (Elvik, Hoye, Vaa & Sorensen, 2009). The reviews of speed camera effectiveness presented below combine evaluations of both fixed and mobile speed camera programs, as well as the varying degrees of visibility of program implementation. This reflects the wide-ranging nature of speed enforcement activities throughout the world, and also reflects the international and national best-practice recommendations presented in the previous section of this report.

Moreover, studies failing to sufficiently account for confounding factors have been excluded from the reviews below, leaving only the methodologically more rigorous evaluations. Pilkington and Kinra (2005) reported that research studies consistently show that introducing speed cameras is effective in reducing crash outcomes, but that most studies do not include satisfactory comparison groups or suitable controls for potential confounding factors. Such studies simply examine the effectiveness of speed cameras via before-and-after methods (i.e. measuring change in travel speed/crash outcomes before and after camera operations at particular locations). This approach fails to account for some often-noted confounding factors, including regression to the mean (the tendency for an abnormally high or low treatment effects to return to values closer to the long-term mean: see Elvik et al., 2009), long-term trends in numbers of crash outcomes (e.g. a tendency for the number of crashes to rise or fall over a period of several years), other safety improvements, and changes in traffic volume.

Therefore, findings from the key reviews presented in this section are particularly robust, and support speed cameras as an effective method for enforcement of speed compliance. Generally, evaluation studies report positive effects of speed camera enforcement on speeding behaviour and the number of crashes (e.g. Diamantopoulou & Cameron, 2002; Elvik et al, 2009; Zaidel, 2002). However, the sizes of the reported effects vary from study to study. The safety benefits of speed camera enforcement are generally greater for fatalities than injuries, and in urban areas compared to rural roads. Pilkington and Kinra (2005) found that the increase in safety in the immediate vicinity of speed camera sites (in terms of crash and casualty reductions) varied between studies with ranges of 5-69% for crashes, 12-65% for injuries, and 17-71% for fatalities at camera sites. These differences are most likely caused by the type, intensity, and location of the enforcement activities.

1.4.2. Cochrane Review (2010)

Cochrane Reviews are systematic reviews of primary research in human health care and health policy. They are internationally recognised as the highest standard in evidence-based health care.

Narrative reviews of healthcare research have existed for many decades, but are often not systematic. A Cochrane Review is a rigorous scientific investigation comprising a pre-planned Methods section and an assembly of original studies. The results of these multiple primary studies are synthesized by using strategies that limit bias and random error. These strategies include a comprehensive search of all potentially relevant studies and the use of explicit, reproducible criteria in the selection of studies for review.

In the most recent Cochrane Review, Wilson, Willis, Hendrikz, Le Brocque & Bellamy (2010) assessed whether the use of speed cameras (both fixed and mobile) reduces the incidence of speeding, road crashes, and resultant road trauma.

A comprehensive selection of electronic databases was searched, covering all available years up to March 2010, although only eligible studies that met pre-set standard criteria were examined. Relevant interrupted time series studies and controlled before-and-after studies were eligible for inclusion. Thus, for these studies, the effect of speed cameras on speeding, road crashes, injuries and deaths was analysed by comparing outcomes on road areas before and after the introduction of speed cameras, and also by analysing outcomes on comparable road areas where no speed cameras were introduced during the study period (Wilson et al, 2010).

A total of 35 studies met the pre-set criteria and were selected for review. All studies reporting speed outcomes identified a reduction in average speeds after implementation of speed cameras. Compared with controls, the relative reduction in mean travel speed ranged from 1% to 15%. A reduction in the proportion of speeding vehicles over the posted speed limit was also observed, ranging from 8% to 70% with most studies reporting reductions in the 10-35% range. Twenty eight studies measured the effect of speed cameras on crashes. All 28 studies found a lower number of crashes in the speed camera areas after implementation of the program. In the vicinity of camera locations, the before-after reductions ranged from 8% to 49% for all crashes and 11% to 44% for fatal and serious injury crashes. Studies of longer duration showed that these positive trends were either maintained or improved with time (Wilson et al., 2010).

The results of this review provide strong evidence for the effectiveness of speed camera enforcement, with decreases in average speed, percentage speeding and crashes after the introduction of speed cameras consistently reported across the studies from a range of countries throughout the world.

1.4.3. OECD Review (2006)

In their report on effective speed management, the OECD (2006) assessed the extent and impact of speeding throughout member countries, reviewed relevant research findings regarding a range of speed enforcement methods, and made several recommendations regarding effective speed management principles.

In their review, the OECD (2006) note that the large majority of studies evaluating the effectiveness of speed cameras show positive effects on both the level of speeding and the number of crashes, but that the reported effects for individual studies differ widely depending on issues such as the type of road, the baseline level of speeding, the location of the speed camera, and on the research methodology. Elvik, Mysen & Vaa (1997, cited in OECD, 2006) report on a meta-analysis of the combined results of 10 methodologically-sound studies in the period 1984-1996. This analysis showed that speed cameras are associated with a 19% reduction in all degree of crashes.

Many of the more recent studies show very similar results (e.g. Goldenbeld & van Shagen, 2005; Jones, Sauerzapf & Haynes, 2008). In the UK, Gains et al (2005, cited in OECD, 2006) evaluated the safety effects of speed camera enforcement methods and estimated a 42% reduction in fatalities and serious injuries at the camera locations. Of particular note, OECD (2006) refer to the Australian experience as a benchmark, specifically the intensive speed enforcement program operating in Victoria, which included covert mobile speed cameras and speed-related mass media publicity. Evaluation suggests that this program was associated with a 41% reduction in fatal crashes (Cameron, Newstead, Diamantopolou & Oxley, 2003b).

1.4.4. Other Reviews

Other reviews of speed camera effectiveness have been conducted, all of which are consistent with the findings outlined in the previous key literature reviews.

Elliott & Broughton (2005) reviewed existing literature in order to examine the relationship between the level of enforcement and the numbers of road crashes and casualties. Studies employing rigorous research designs were identified, and 30 studies of primarily speed enforcement campaigns were included in the review. The review demonstrated that speed cameras are associated with significant reductions in mean travel speed and crash outcomes. Elliott & Broughton (2005) also refer to the meta-analysis conducted by Elvik et al (1997, cited in OECD, 2006), in which a 19% reduction in all crashes (and a 17% reduction in injury crashes) was observed upon speed camera implementation. Findings are reported to be consistent with outcomes from other studies in the Netherlands and Great Britain, where crash reductions of between 14% and 35%, and casualty reductions of between 20% and 55%, have been found following the introduction of speed cameras.

In addition, Wegman & Goldenbeld (2006) reviewed scientific evidence regarding the effects of various speed enforcement methods, and reported that speed cameras were associated with consistent reductions in average speeds and proportion of speeding drivers travelling over the speed limits for all crash types, with more marked effects observed near camera sites.

1.5. Summary of International Evidence for Mobile Speed Cameras

Mobile speed cameras work much like fixed speed cameras in that the actual enforcement is automated however mobile cameras can be moved around the network at various times and locations. This mobility increases the deterrence effect due to the unpredictability of the exact location of speed enforcement (OECD, 2006). The intended purpose of mobile speed cameras is to produce a sustained change in driver behaviour by creating a perception that speeding can be enforced anywhere at any time, thereby reducing speeding not only at identified camera and enforcement locations but across the road network (Austroads, 2001; Cameron & Delaney, 2006).

A summary of the road safety benefits observed for international studies of mobile speed cameras is present in the table below.

Study	Type of enforcement	Road Safety Benefits			
		Speed	Crashes	Fatalities	Injuries
Mara et al (1996)	MSC Christchurch, New Zealand, overt	n/a	- 23.3% reduction in urban site crashes - 10.9% reduction in rural site crashes - Overall 20% reduction in fatal crashes	n/a	n/a
Chen et al (2000)	MSC British Colombia, Canada, covert (first year of program)	- 50% reduction in proportion of seeding vehicles at camera locations - Mean speed fell by 2.4 km/h at camera locations	25% reduction in daytime speed-related collisions	17% reduction	11% reduction
Keall et al (2001)	MSC New Zealand, overt	Mean speed fell by 2.3 km/h in camera areas and 1.6 km/h in non-camera areas (1st year of trial)	11% reduction (1st year of trial)	19% reduction in casualty rate (1st year of trial)	
Chen et al (2002)	MSC British Colombia, Canada, covert (first two years of program)	Mean speeds fell by 2.8 km/h (3%)	- 14% (+/- 11%) reduction at camera locations - 19% (+/- 10%) reduction at non-camera locations - 16% (+/- 7%) reduction overall	n/a	n/a
Keall et al (2002)	MSC New Zealand, overt	- Mean speed fell by 1.3 km/h on all roads (over 2 year trial) - 85th percentile speeds on all roads fell by 4.3 km/h (over 2 year trial)	11% reduction (over 2 year trial)	19% reduction in casualty rate (over 2 year trial)	
Goldenbeld & Van Schagen (2005)	MSC Friesland, Netherlands, semi-covert	Average decrease of 4 km/h on enforcement roads, 1.5 km/h on comparison roads	21% reduction in injury and serious crashes (saving of 50 injury accidents)	n/a	Saving of 35 serious casualties
Gunarta & Kerr (2005)	MSC Christchurch, New Zealand, overt	Mean speeds fell by 1.7 km/h in normal conditions, 3.2 km/h when wet and 3.8 km/h when wet and poor visibility	Estimated reduction of 6% injury crashes and 12% fatal crashes	n/a	n/a
Cunningham et al (2008)	MSC, North Carolina, USA, overt	-Mean speeds fell by 1.1 km/h in the 1st year -Proportion of drivers exceeding the speed limit by more than 10 mph (16.1 km/h) decreased by 1.3%	10% reduction	n/a	n/a
Jones et al (2008)	MSC, Norfolk, England, overt	n/a	- 19% reduction overall - 44% reduction in fatal and serious crashes	Saving of 58 casualties (fatal and serious injury)	

1.6. Evaluations of Mobile Speed Camera Programs in Australia

Mobile speed cameras were first deployed in Australia in Victoria in 1985. South Australia subsequently employed mobile speed cameras in 1990, followed by Tasmania and Western Australia in the early 1990s, then New Zealand, Queensland, the Northern Territory and the ACT in the late 1990s. New South Wales first introduced a mobile speed camera program in 1991, but the program was stopped in December 2008. Mobile speed cameras were re-introduced in NSW in July 2010.

Mobile speed camera programs currently operate in all Australian jurisdictions. At present, Victoria currently has the largest program in absolute terms, followed by Queensland. However, the Western Australian Government recently announced that its program will significantly expand, making it the largest Australian program.

The sections below present evaluation findings for mobile speed camera programs in Australian jurisdictions. This evidence focuses on programs in Victoria, Queensland and Western Australia, given that these programs have operated more extensively. Note that, while evaluation of the Western Australia program has not been undertaken, estimated crash savings as a result of program implementation have been outlined.

Assessment of the performance of the mobile speed camera program currently operating in NSW is presented in a later section of this report.

A summary of the road safety benefits observed for each study is present in the table below.

Study	Type of enforcement	Road Safety Benefits			
		Speed	Crashes	Fatalities	Injuries
Anderson & Edgar (2001)	MSC ACT, overt	- 26% reduction in drivers exceeding speed limit at camera sites compared with 22% at non-camera sites (after 18 months of program) - 59% reduction in drivers exceeding speed limit by more than 10 km/h compared with decrease of 39% at non-camera sites (after 18 months)	36% reduction in fatal and injury crashes	n/a	n/a
Diamantopoulou & Cameron (2002)	MSC VIC: Comparison of overt and covert	n/a	71% reduction when a mix of overt and covert enforcement was present	n/a	n/a
Cameron et al (2003b)	MSC VIC, covert	n/a	3% reduction (associated with increase in infringements issued)	41% reduction in fatality risk (associated with increase in infringements issued)	n/a
Newstead & Cameron (2003)	MSC QLD, overt	n/a	- 21% reduction overall - 17% reduction	32% reduction in fatal crashes	n/a

			within 0-2km of camera - 11% reduction between 2-4km from camera - 10% reduction between 4-6km from camera		
Champness & Folkman (2003)	MSC QLD, overt	n/a	Speed-related crashes fell to 1.26 per 100,000 (from 1.83 per 100,000)	Reduction of 12 fatal crashes per year	n/a
Champness et al (2005)	MSC QLD, overt	- Mean speeds fell by 6.7 km/h compared to 2 hours before and after camera deployment - Reductions in speeds maintained for 1km downstream – 30.8% exceeded speed 0.5km downstream, 35.4% 1km downstream	n/a	n/a	n/a
Bobevski et al (2007)	MSC VIC, covert	n/a	Increase in camera hours associated with 3.3% reduction in monthly crashes	Increase in camera hours associated with 43% reduction in the risk of fatal outcome	n/a
D'Elia et al (2007)	MSC VIC, covert	n/a	- 3.8% reduction in casualty crashes overall - 4.6% reduction in metro areas - 6.1% reduction in casualty crashes in 40, 50 and 60 km/h zones	29% reduction in crash injury severity in 40, 50 and 60 km/h zones.	
Newstead et al (2008)	MSC QLD, overt	n/a	9% reduction	13-14% reduction in fatal and injury crashes	

1.6.1. Victoria

Currently, Victoria has a comprehensive speed management program that includes the use of mobile speed cameras, safety cameras, fixed speed cameras and point-to-point speed cameras. The mobile speed camera program currently involves 9,300 hours of enforcement per month, which represents 20.6 hours of enforcement per 1,000 population per year.

The mobile speed camera program in Victoria commenced as a trial in 1985. The program used a small number of visible cameras at high crash frequency sites which were identified with appropriate signage. An evaluation of the trail found limited effects on vehicle speeds close to the camera sites and no statistically significant reductions in casualty crashes (see Cameron et al., 2003b). Mobile speed camera operation was subsequently reintroduced in 1989 as a covert program using unmarked vehicles. In the first three years of the program, enforcement hours progressively increased from 1,500 to 4,000 per month, and remained at that level until 2000.

Early evaluations of the effectiveness of the mobile speed camera program showed significant reductions in casualty crashes. During the period 1991 to 1996, mobile speed camera infringement

notices were associated with a 15% annual reduction in serious casualty crashes in Melbourne and an 11% reduction across Victoria (Cameron et al., 2003b). Furthermore, between 1996 and 2000, the risk of fatal outcome of the casualty crashes reduced by more than 40% when the number of infringement notices issued were at relatively high levels (more than 30% greater than average) (Cameron et al, 2003b). Finally, an analysis of the program in the period 1998 to 2003 demonstrated that on average a 1% increase in mobile speed camera hours was significantly associated with a 2% reduction in the risk of a fatal outcome in a casualty crash (Cameron & Delaney, 2006).

A number of changes were implemented during 2001 and 2002 aimed at making the program more covert and unpredictable to speeding drivers. These included a progressive increase in the monthly enforcement hours from 4,200 to 6,000; the introduction of flash-less cameras during daylight hours; the use of a variety of unmarked cars; and the progressive reduction of the speeding offence detection threshold from 10 km/h to an unspecified amount. These changes were complimented by a program of speed-related advertising.

Overall, in terms of the effects on vehicle speeds, data show that as the number of speed enforcement hours in Victoria have increased, the rate of speeding by 10 km/h or more has decreased from 12% in 1990 to less than 1% in 2008 (these figures are derived from the TAC road safety statistical summaries). Regarding crash outcomes, Cameron & Delaney (2006) found that in the first few years that mobile speed cameras were introduced in Victoria (1990-1991) casualty crashes reduced by around 25%, saving hundreds of lives and many more injuries. The Victorian speed management package has also gained international recognition, with an OECD (2006) analysis showing that the package resulted in a 43% reduction in fatalities in Melbourne and a 22% reduction in fatalities throughout Victoria.

1.6.2. Queensland

The Queensland mobile speed camera program commenced in 1997 as a fully overt operation with marked vehicles and advisory signs placed within 10 metres past the vehicle. The primary criterion for the selection of an enforcement zone (1 km in diameter in urban areas and 5 km in rural areas) is crash history, and enforcement locations are randomly allocated across the approved sites. Between 1998 and 2002, mobile speed cameras operated 2,017 hours per month on average and in 2003 this increased to 5,993 per month (current levels). This represents 16.3 hours of enforcement per 1,000 population per year.

An evaluation of the Queensland mobile speed camera program between 1997 and 2001 (Newstead & Cameron, 2003), found evidence of diminishing crash reductions with increasing distance from speed camera sites, when examining a distance of zero to six kilometres from the camera sites. It was found that the program is most effective within two kilometres of the speed camera sites, with an estimated 32% reduction in fatal crashes and a 26% reduction in serious injury crashes. In addition, Champness & Folkman (2003) found that in the six year period during overt mobile speed camera operations in Queensland, the mean number of speed-related fatal crashes per year was 45, representing a drop of 12 fatal crashes per year since the introduction of the cameras. In a later controlled before-and-after evaluation, Champness et al (2005) found a statistically significant reduction of 6 km/h in mean vehicle speeds, and a reduction of 7 km/h in 85th percentile vehicle speeds during periods when the overt mobile speed cameras were operating.

Overall, the Queensland mobile speed camera program has achieved an annual reduction of 110 fatal and 3,300 injury crashes (hospitalisation and medically treated). In a review of the program in

2003, it was suggested that the continued overt mobile speed camera operation is likely to lead to localised effects on casualty crashes but not likely to have a general effect (Cameron, Delaney, Diamantopoulou, & Lough, 2003a).

As a result, in late 2009, the Queensland Premier announced that the program would be a mix of overt and covert operations with 30% of enforcement hours to be undertaken in unmarked vehicles. These vehicles will be a variety of models, makes and colours with no advance warning or departure signs at the camera site. Queensland's shift to 30% covert enforcement has coincided with a further approximate 25% reduction in the Queensland road toll last year.

1.6.3. Western Australia

The Western Australian mobile speed camera program is overt with cameras placed on a tripod near the vehicle and signage advising motorists that they have passed a camera in operation. Enforcement locations focus on 'black spot' areas with criteria including crash history, advice from the public, and areas frequented by vulnerable pedestrians. The program involves around 3,000 hours of enforcement per month.

In 2006 the Western Australian Government commissioned the Monash University Accident Research Centre (MUARC) to develop recommendations for the implementation of a best practice speed enforcement program in Western Australia. Following a review of best practice strategies in Australia and overseas, it was recommended that Western Australia implement a mix of overt and covert mobile speed camera enforcement, including 9,000 hours per month of covert mobile speed cameras on urban highways (in Perth) and 3,000 hours per month of overt mobile speed cameras randomly scheduled on rural highways.

When fully implemented with other recommended speed enforcement measures, the program is estimated to produce a 26% reduction in fatal crashes, 12% reduction in crashes resulting in hospital admission, and a 9% reduction in medically-treated injury crashes (Cameron & Delaney, 2006).

As a result of MUARC's recommendations, the Western Australian Government announced in 2010 that there would be an increase in mobile speed cameras to a total of 57 cameras, and 12,000 enforcement hours per month. This will result in Western Australia having the highest number of enforcement hours per 1,000 population, at 64.4 hours per 1,000 population per year.

1.6.4. Other Australian Jurisdictions

Mobile speed camera programs currently operate in all Australian jurisdictions, yet evaluations of programs operating in other jurisdictions are limited.

In a controlled before-and-after study in the ACT, Anderson & Edgar (2001) found that the percentage of speeding vehicles dropped at both mobile speed camera sites (from 40% to 25%) and at control sites (from 40% to 30%). However, the percentage of speeding vehicles later increased slightly at the camera sites (although remained lower than baseline levels). Anderson & Edgar (2001) found a 36% drop in fatal and injury crashes at the 22 speed camera sites, and no change in crashes on roads without speed cameras.

Assessment of the performance of the mobile speed camera program currently operating in NSW is presented in the next section of this report.

2. The Current NSW Mobile Speed Camera Program

2.1. Overview

On 19 July 2010 mobile speed cameras were re-introduced into NSW as part of a package of road toll initiatives aimed at addressing an increased road toll in 2009 and early 2010. The program consists of only six vehicle mounted mobile speed cameras conducting approximately 930 hours of enforcement per month across NSW. The program is managed by the Roads and Maritime Services with operations outsourced to a private contractor. This outsourced model is also used in Victoria and cameras are operated by technicians, freeing up police for hands on enforcement.

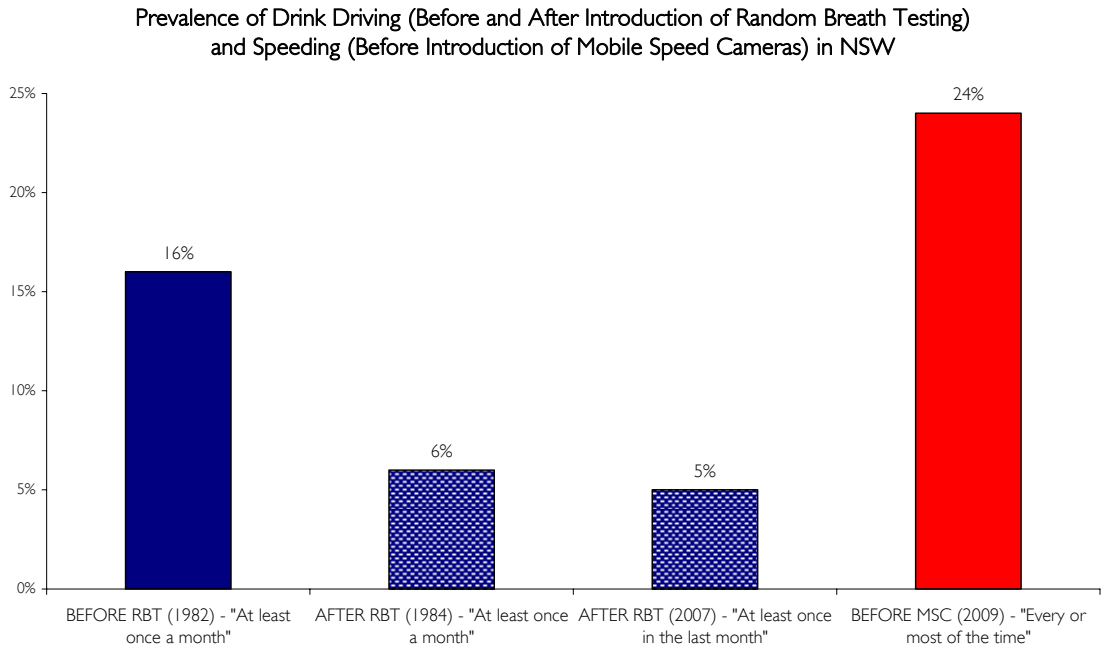
The approach to address speeding in NSW via mobile speed camera operation has drawn upon the success of random breath testing (RBT) in addressing drink-driving in NSW (see Job, Prabhakar, T. & Lee, 1997). The introduction of RBT has produced long-term benefits, with an estimated 726 lives saved over the three year trial period for RBT (Job, 1990). This reduction occurred at a time when there were no other substantial changes to road conditions or road safety legislation in NSW. As well, no other Australian state observed similar reductions in road trauma, suggesting that the reduction in NSW could be substantially attributed to RBT. Furthermore, it was estimated that over 1,500 lives were saved up to 1994 (Job et al., 1997), with substantial reductions in the number of alcohol-related crashes since the introduction of RBT.

RBT differed from other enforcement procedures in that drivers could be stopped by Police "at random" (i.e. without any suspicion of alcohol consumption due to overt driving behaviour) and tested for blood alcohol concentration (Prabhakar, Lee & Job, 1994). Many drivers believe that they drive well under the influence of alcohol, and therefore believe that they will not be detected: RBT forced drivers to assume that it doesn't matter how well they drive under the influence of alcohol, they could still be caught by the Police. This randomness and inevitability of drink-driving enforcement (particularly after a shift from stationary to mobile RBT) forced drivers to not drink-drive, despite many still holding a positive attitude toward the behaviour. This discrepancy forced a change in attitude from drivers (such that drink-driving is now viewed more negatively), thus aligning attitudes with the forced behaviour change, and has subsequently resulted in long-term increases in social disapproval of drink-driving. Prior to RBT, drivers were considered "unlucky" to be caught for drink-driving, whereas after RBT they were more likely to considered "stupid" (Prabhakar et al, 1994).

Several aspects of the approach to RBT can be successfully applied to addressing speeding behaviour. Speeding (particularly at low levels) is still viewed as socially acceptable, despite recent increases in speed-related fatalities. Speeding is an impulsive behaviour (i.e. a driver can choose to speed at various times throughout their journey), whereas drink-driving is generally an intended action (i.e. once a driver makes the decision to drink-drive, they do so for their entire journey). Thus, little effective disincentive to speed exists in this context. Currently, you could generally be a 'safe speeder' (i.e. perceived yourself to be safe despite speeding) and be safe from enforcement by slowing down at fixed speed cameras and known Police speed enforcement locations. Otherwise you could speed, and if caught you would be considered unlucky. Thus, the threat of more widespread and random detection of speeding is likely to force more consistent change in speeding behaviour on the entire network of NSW roads, rather than simply at precise locations that are

known to overtly detect driving speed. Currently, less than 1% of the NSW road network is enforced by any fixed speed cameras, safety cameras or operating mobile speed cameras. Therefore, motorists can potentially speed on around 99% of the road network and not be caught by any form of speed camera.

The graph below presents the change in prevalence due to the introduction of RBT in NSW, highlighting the sharp and sustained reduction in reported drink-driving at least once a month (more than 60% reduction immediately after as well as 25 years after implementation). The graph also shows the current prevalence of speeding, with around one-quarter of drivers surveyed in 2009 reporting speeding every or most of the time that they drive, which is a higher prevalence than drink driving pre-RBT. It is anticipated that the successful application of the RBT approach to speeding, anywhere anytime enforcement will result in a similar sharp and sustained reduction in speeding behaviour.



Broadly, the mobile speed camera program aims to reduce road casualty crashes and resultant road trauma by motivating and enforcing compliance with posted speed limits. This will achieved through the following mechanisms:

- Through site-specific deterrence – this involves targeting speed of the broad driving population over a relatively short length of road (such as effects achieved by fixed speed cameras).

- Through general deterrence – this involves affecting speeding behaviour of the wider population of drivers, as road users become aware that speed enforcement could occur at any time and at any place. It is produced by the road user's subjective risk of apprehension, and is provided most effectively by covert mobile speed cameras.

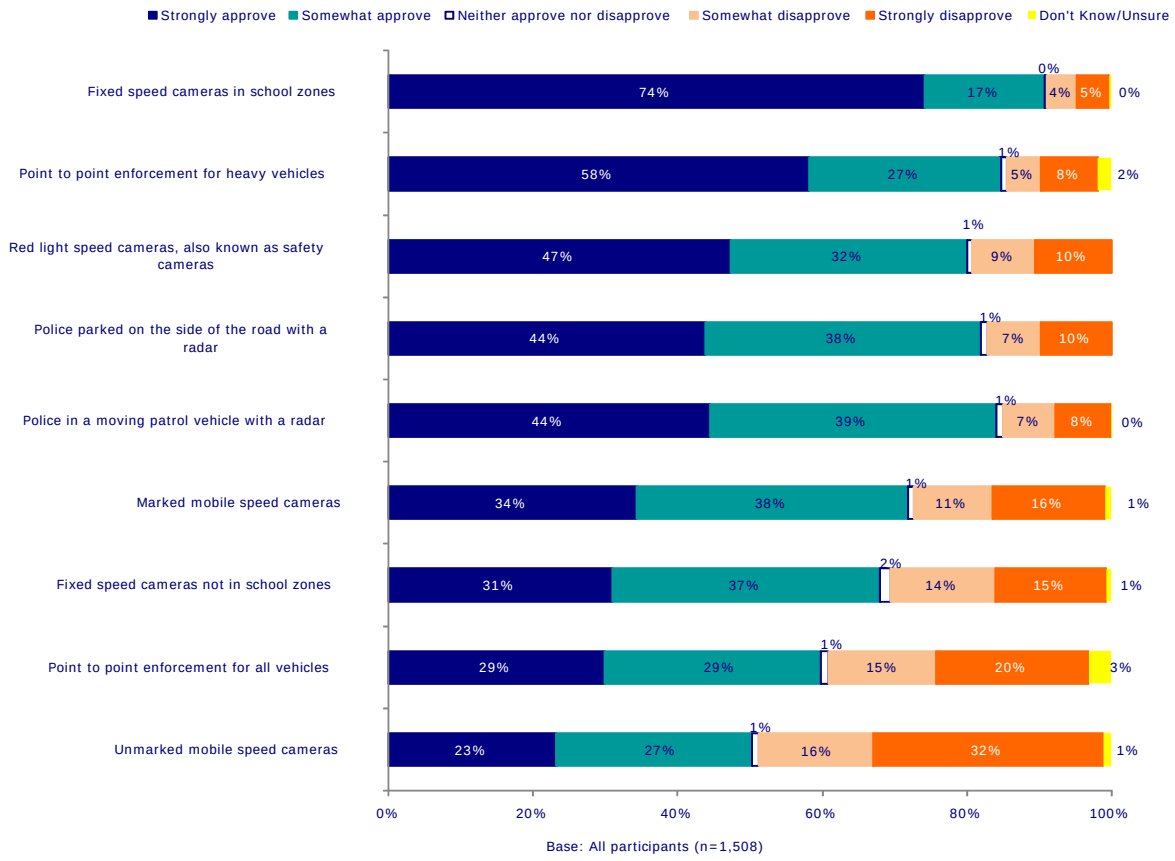
- Through road user-specific deterrence – this involves the safety improvement that arises when a road user has been penalised for speeding and reduces their speed to avoid further penalties.

- Through changes in community norms – this involves the safety improvement that results from an increasing view that speeding is socially unacceptable and that speed enforcement is therefore necessary.

2.2. Community perception of speed camera enforcement

The NSW Centre for Road Safety (CRS) regularly monitors community attitudes to road safety issues in order to identify and address the needs and concerns of customers and develop effective road safety initiatives.

In October 2009, the CRS conducted a comprehensive survey of 1,500 NSW drivers' attitudes to speeding. Based on this research, the CRS presented a paper at the 2009 Australasian Road Safety Research, Policing and Education Conference that clearly explained driver attitudes toward speeding and speed enforcement issues. This research found that while speeding was recognised as the most significant factor in the road toll, there was still a large number of drivers who continue to speed (Walker et al, 2009). A follow-up research survey of the same scope was conducted in March-April 2011, which identified that there was a high level of support for existing speed enforcement practices in NSW, including mobile speed cameras, as well as practices in other jurisdictions such as the use of red-light speed cameras and point to point enforcement (RTA, 2011). The figure below demonstrates that there is more community support for marked mobile speed cameras than for fixed speed cameras not in school zones.



Opinion of safety initiatives used in NSW and other jurisdictions, March-April 2011.

Regarding the primary focus of mobile speed cameras, participants were asked about the extent to which they agreed or disagreed with two statements – that "marked mobile speed cameras are mainly about revenue raising" and that "the primary focus of marked mobile speed cameras is increasing road safety". These statements were read out to participants in a randomised order and within a battery of statements.

A majority of participants agreed at least "somewhat" with both statements, however, participants were more likely to agree that "marked mobile speed cameras are mainly about revenue raising" (60% agreeing and 35% disagreeing) than agree that "the primary focus of marked mobile speed cameras is increasing road safety" (54% agreeing and 44% disagreeing). These results highlight that while there is a level of support for mobile speed cameras and an acknowledgement that these cameras are installed for road safety, the perception that mobile speed cameras are mainly there to raise revenue is still strong within the community.

2.3. Performance of Current Interim NSW Mobile Speed Camera Program

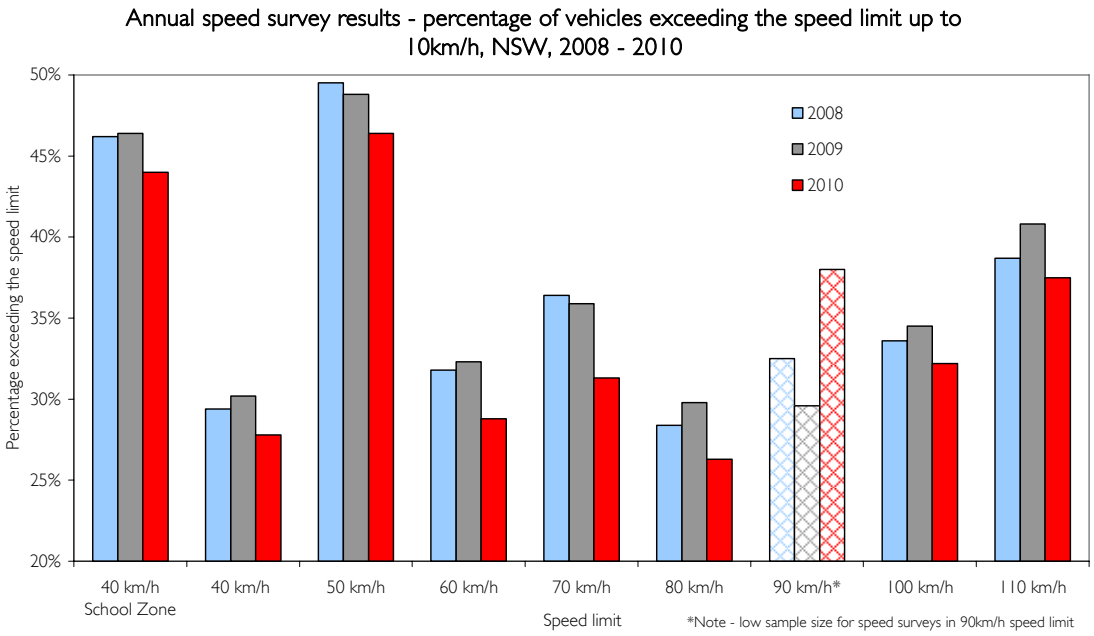
Analysis to date of the current NSW mobile speed camera program suggests that the program has been effective in producing reductions in driver speed across the NSW road network, as well as reductions in identified speed related fatalities and fatalities overall.

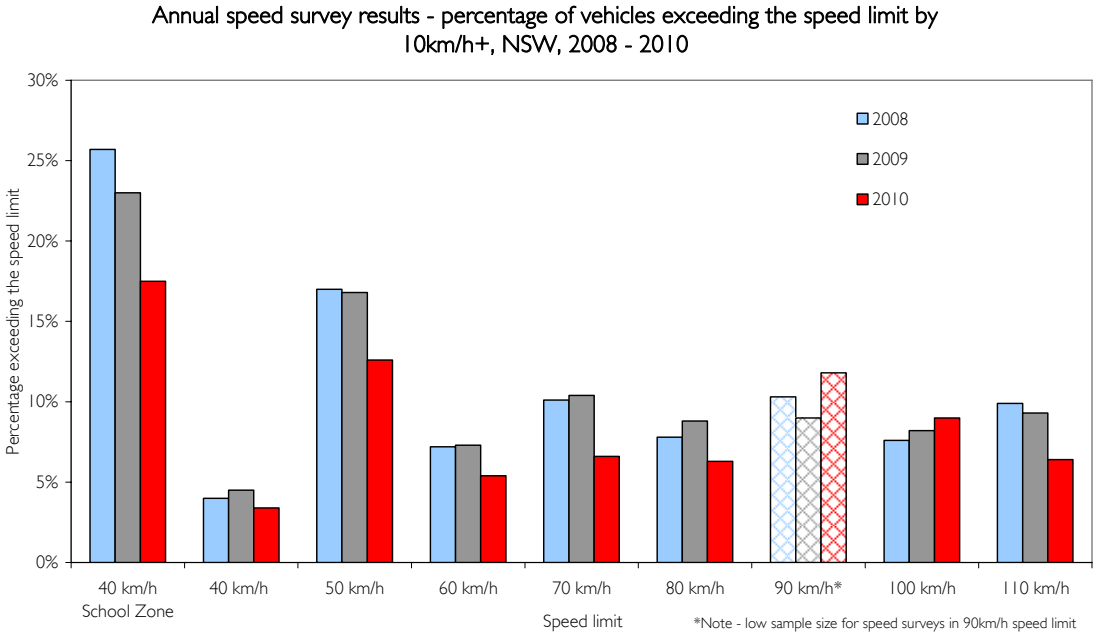
The table and figures below present a descriptive analysis of recent speed surveys by each speed limit, including 2010 findings. Last year 32-50% of vehicles were detected speeding and 5-12% of vehicles were speeding by 10km/h or more in 60-110km/h speed limits. Importantly, findings from 2008 to 2010 also demonstrate a slight upward trend in the proportion of vehicles exceeding the speed limit from 2008 to 2009 when the road toll increased and mobile speed cameras ceased operation in NSW (which seems to have particularly affected high speed roads), and also an immediate impact of the reintroduction of the mobile speed camera program on vehicle speed. The annual speed surveys are conducted in August/September, which in 2010 coincided with the reintroduction of the mobile speed camera program. The results show a significant reduction the proportion of vehicles exceeding the speed limit and exceeding the limit by 10km/h or more across most speed limits. These reductions are most likely the result of the general deterrence effects of the program coming from the initial short public education campaign, media and word of mouth associated with the program. Also note that increased travel speeds in higher speed limits observed for 2009 coincide with an increase in fatalities on high speed rural roads. Increases in travel speeds for these higher speed limits have been addressed in 2010 with the re-introduction of mobile speed cameras, which is supported by these speed survey data.

Light vehicle mean speed, proportion of vehicles detected over the speed limit by speed limit and year, NSW speed surveys 2008-2010

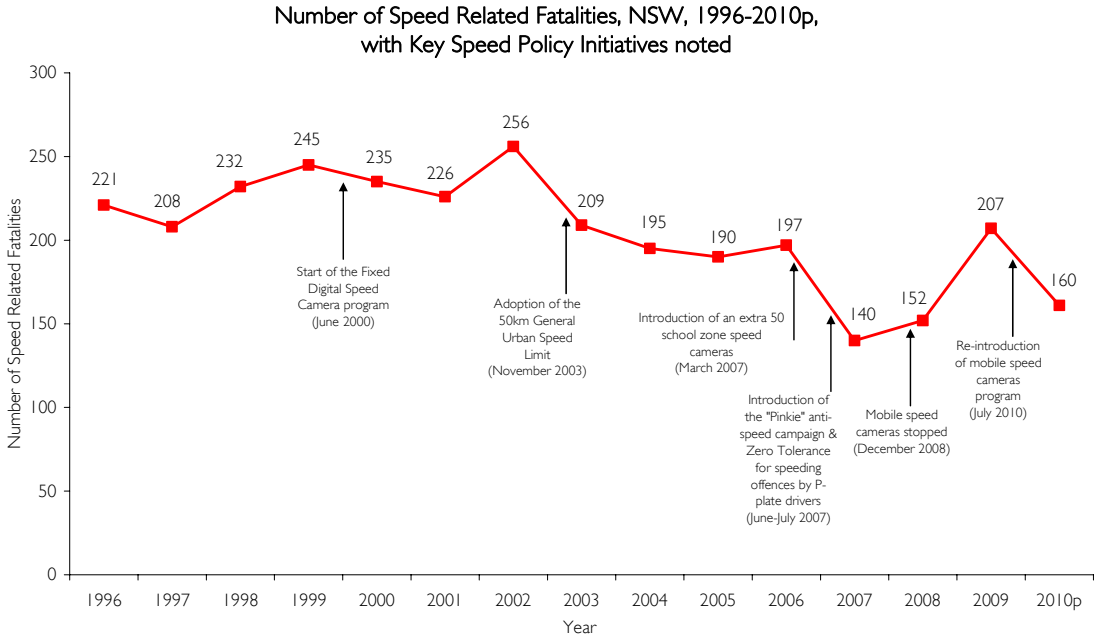
Posted Speed Limit	% Exceeding the Speed Limit				% Exceeding the Speed Limit +10km/h		
	2008	2009	2010		2008	2009	2010
40 km/h School Zone	71.9 %	69.4 %	61.5 %		25.7 %	23.0 %	17.5 %
40 km/h	33.4 %	34.7 %	31.2 %		4.0 %	4.5 %	3.4 %
50 km/h	66.5 %	65.6 %	59.0 %		17.0 %	16.8 %	12.6 %
60 km/h	39.0 %	39.6 %	34.2 %		7.2 %	7.3 %	5.4 %
70 km/h	46.5 %	46.3 %	37.9 %		10.1 %	10.4 %	6.6 %
80 km/h	36.2 %	38.6 %	32.6 %		7.8 %	8.8 %	6.3 %
90 km/h*	42.8 %	38.6 %	49.8 %		10.3 %	9.0 %	11.8 %
100 km/h	41.2 %	42.7 %	41.2 %		7.6 %	8.2 %	9.0 %
110 km/h	48.6 %	50.1 %	43.9 %		9.9 %	9.3 %	6.4 %

*Note small number of speed survey locations, resulting in large variation in results.





In addition to a general suppression of travel speed, the NSW mobile speed camera program has also resulted in reductions in crash outcomes. Broadly speaking, after a 36% annual increase in speed related fatalities in 2009, speed related fatalities dropped by 23% from 207 in 2009 to 160 in 2010 following the re-introduction of mobile speed cameras (based on provisional data, which is subject to change).

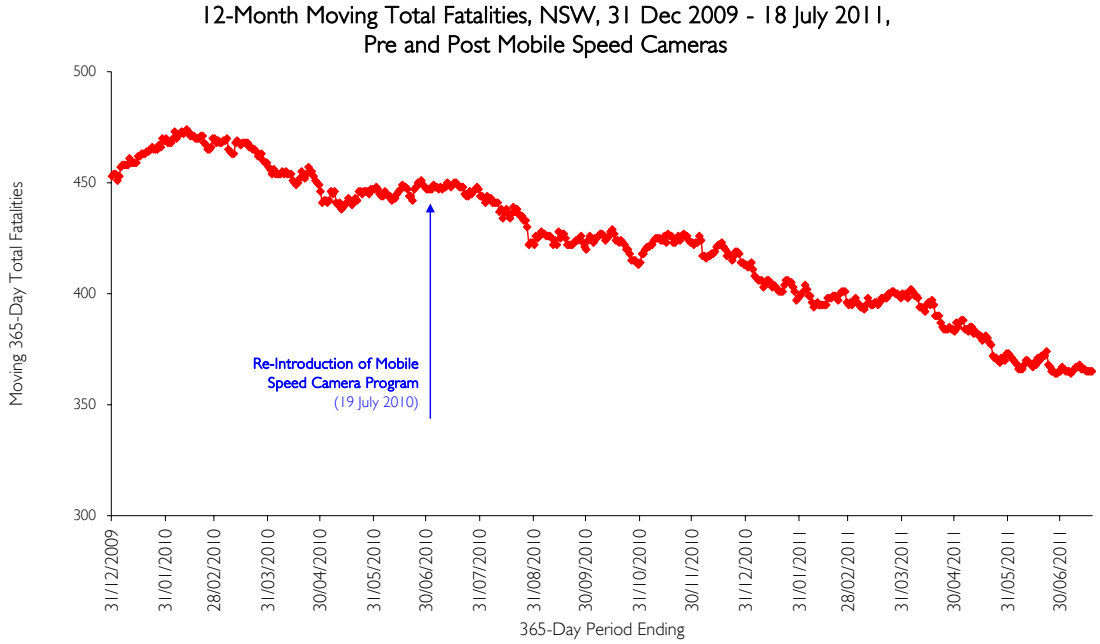


There has been a 19% statistically significant reduction ($p<0.001$) in fatalities throughout NSW since the re-introduction of mobile speed cameras (chi-square test of independence at 0.05 probability level).

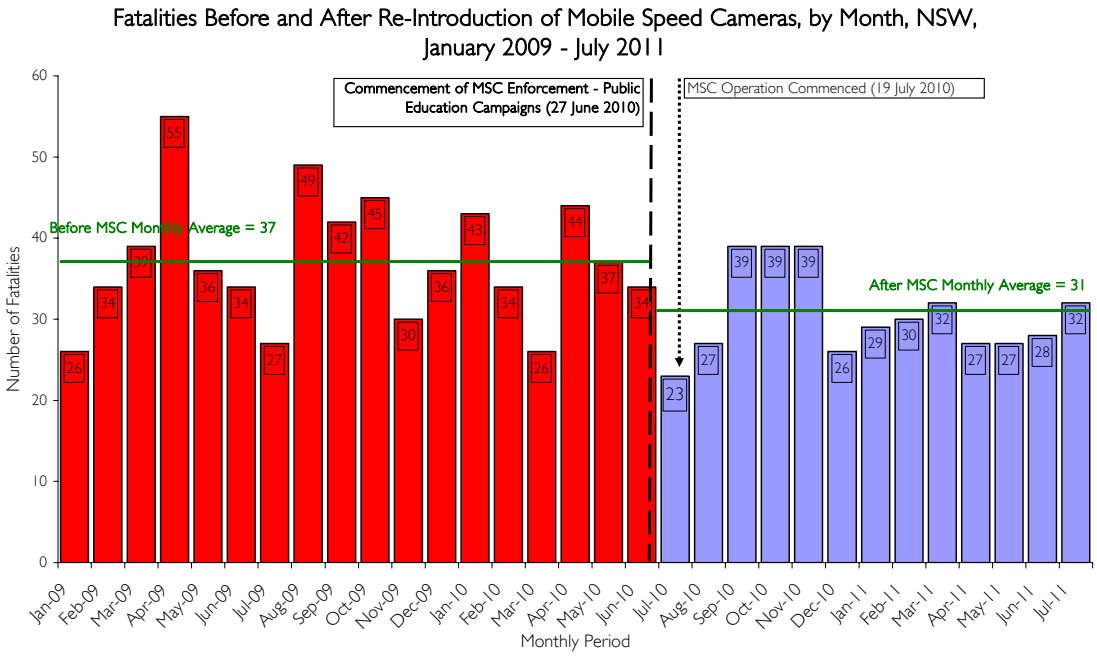
In the year before mobile speed cameras (19 July 2010 – 18 July 2011) there were 449 fatalities in NSW, whereas in the year after mobile speed cameras (19 July 2010 – 18 July 2011) there were

365 fatalities. This represents a saving of 84 lives, at an estimated community saving of around $490 million (based on willingness-to-pay methodology).

The graph below (based on moving totals, which smooth out short-term data fluctuations) highlights the consistent reduction in fatalities observed throughout NSW since mobile speed cameras recommenced.



The next graph presents the raw month fatality figures before and after mobile speed cameras, demonstrating that the commencement of public education campaigns for the NSW mobile speed camera program, coupled with the initial warning letter phase of the program, coincided with a drop in monthly fatalities. This initial effect appeared to have faded in September 2010; however, since this time there has been a downward trend in monthly fatalities moving into the period of actual mobile enforcement. Since the commencement of mobile speed camera operation, the average number of monthly fatalities has dropped to 31, compared to an average 37 fatalities per month prior to operation, a saving of six fatalities per month. Bolstering the current interim NSW mobile speed camera program can potentially drive the road toll down even further.



These data demonstrate that the road safety benefits of even the small-scale interim mobile speed camera program are being realised every day on NSW roads. The reduction in travel speeds observed in the annual speed surveys provide strong evidence that these crash reductions are due to the general deterrence provided by the interim mobile speed camera program.

Note that data for 2010 and 2011 are preliminary and subject to change.

2.4. Summary of the Parameters of Current Mobile Speed Camera Programs in Australian Jurisdictions

As noted earlier, mobile speed camera enforcement programs exist in all jurisdictions in Australia. However, the degree of enforcement visibility varies between jurisdictions. For example, in Queensland and Tasmania, the locations of mobile speed cameras are not published, to maximise the covert nature of operations and reinforce to drivers that they can be caught anywhere on the road network and at anytime, thus creating general deterrence.

In Queensland, the covert operation of mobile speed cameras is consistent with the greater focus placed on general deterrence across the road network. Recent changes in Queensland have involved a shift from overt to covert enforcement; while 70% of mobile speed camera vehicles in Queensland are marked and signposted by a small sign after the camera unit, the remaining 30% are unmarked and not signposted. In Victoria, recent media announcements and a letter from the Deputy Premier of Victoria have reiterated that mobile speed camera enforcement is primarily a road safety issue, and that a mix of overt and covert methods will be examined.

As outlined below, Victoria, South Australia and Tasmania have largely covert mobile speed camera enforcement programs, Queensland and Western Australia use a mix of covert and overt, and the ACT and the Northern Territory have overt mobile speed camera enforcement.

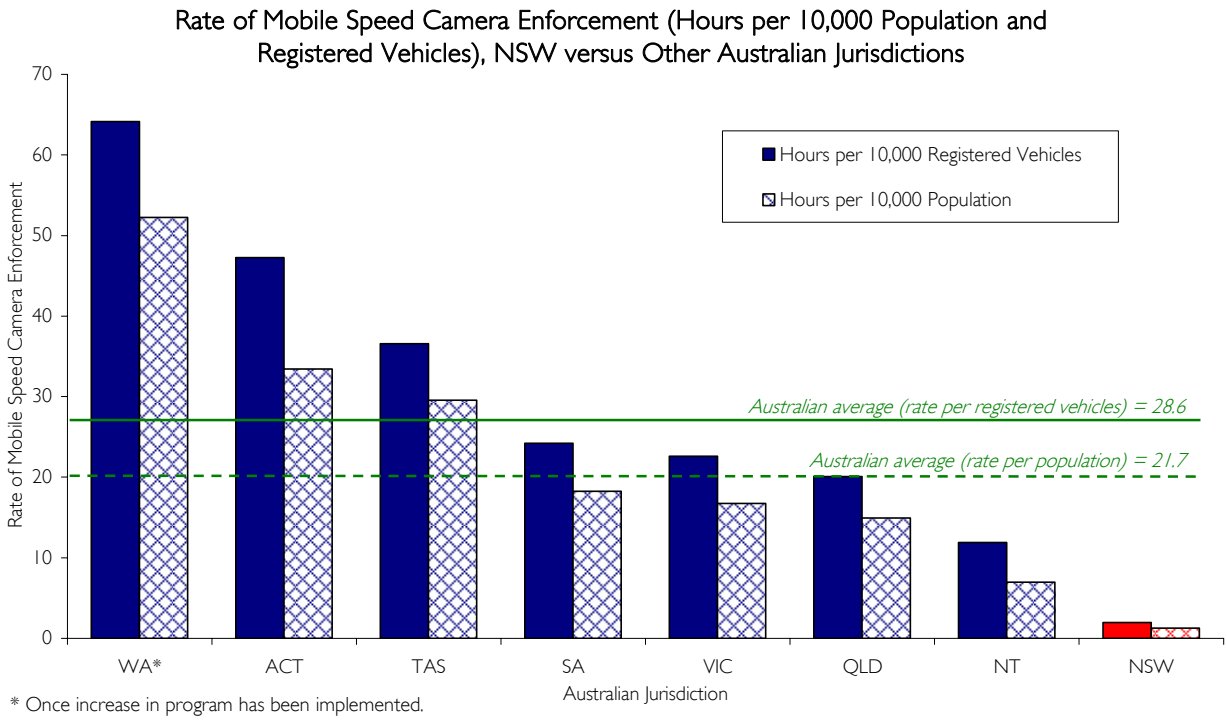
Mobile Speed Camera Enforcement Programs in Australian Jurisdictions

State	Mobile speed camera enforcement hours per month	Rate of enforcement (hours per 10,000 population)	Rate of enforcement (hours per 10,000 registered vehicles)	Overt or covert	Model of operation
VIC	9,300	16.8	22.6	Covert	Outsourced
QLD	6,740	14.9	20.1	70% overt, 30% covert	Police operated
WA	12,000*	52.3	64.2	Covert and overt	Police operated
SA	3,000	18.2	24.2	Covert	Police operated
TAS	1,500	29.5	36.6	Covert	Police operated
ACT	1,200	33.4	47.3	Overt	Operated by RMS equivalent
NT	160	7.0	11.9	Overt	Police operated
NSW	930	1.3	2.0	Overt	Outsourced

* Once increase in program has been implemented.

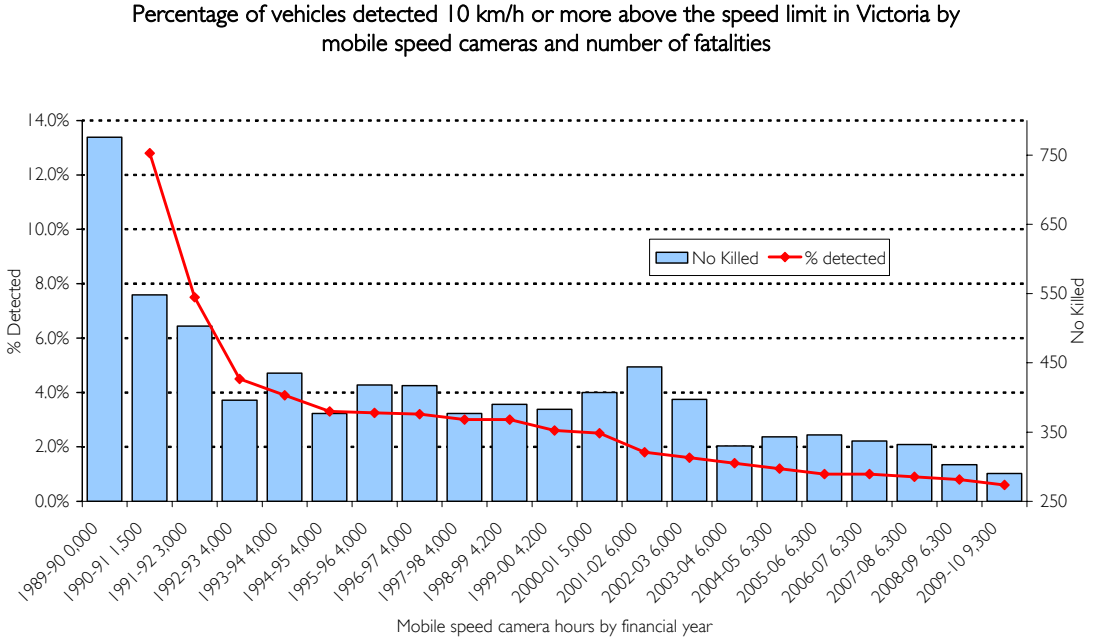
The number of mobile speed cameras (and enforcement hours per month) varies significantly between jurisdictions with Victoria currently having the largest program.

Western Australia has recently announced that their program would increase to a total of 57 mobile speed cameras and 12,000 enforcement hours per month. This significant commitment to mobile speed camera enforcement followed an extensive period of community consultation to develop a new road safety strategy for the state. The figure below compares mobile speed enforcement hours in each Australian jurisdiction, based on the population and number of registered vehicles in each jurisdiction. These data clearly demonstrate that, on both per registered vehicle and per population basis, NSW employs the smallest mobile speed enforcement program of all Australian jurisdictions, with both rates well below the overall Australian average.



Comparison of enforcement hours of mobile speed camera programs in Australia

The graph below details the proportion of vehicles passing mobile speed cameras that were detected speeding since the commencement of the Victorian mobile speed camera program in 1990, which operated in conjunction with a highly publicised education campaign. It shows that as the number of hours of enforcement has increased in Victoria, the rate of speeding by 10km/h or more above the speed limit decreased from around 12% to less than 1%. The graph also demonstrates that the decrease in speeding vehicles detected by mobile speed cameras has coincided with a steady drop in fatalities in Victoria since 1990.



Change in annual number of infringements from mobile speed cameras and total fatalities, Victoria, 1990-2009

This result clearly demonstrates that mobile speed cameras are effective in deterring drivers from speeding. This is because the unpredictability of the cameras leads to a reduction in speeding at all times, rather than just on the approach to a camera. As outlined earlier in this report, and as demonstrated above, this reduction in the proportion of vehicle speeding has resulted in significant reductions in casualty crash outcomes in Victoria.

2.4.1. Implications for Continued Mobile Speed Camera Enforcement in NSW

These findings demonstrate that NSW is behind every other Australian state on levels of mobile speed camera enforcement, especially on a per population basis. More importantly, the limited scope of mobile speed camera enforcement in NSW to date has compromised the road safety of all road users. In 2009, the year mobile speed cameras were not operating, the NSW road toll was significantly higher than the previous year. Conversely, states that had implemented significant mobile speed camera programs did not experience a significant increase in the road toll in the same year. For example, the Victorian Road Toll for 2009 was 290 deaths, 13 fewer deaths or 4% lower than in 2008, and the Western Australian Road Toll stood at 193, 16 fewer deaths or 8% lower than the same period in 2008.

Based on a per population basis, NSW would require 15,700 hours of enforcement per month in order to reach the average enforcement rate in Australian jurisdictions (around 22 hours per 10,000 population). Delivering a program of this size would significantly improve road safety, saving many lives and injuries, as well as many millions of dollars.

2.5. Benefit-Cost Ratios for NSW Mobile Speed Camera Enforcement

Over the first 12 months, the re-introduction of mobile speed cameras in NSW has resulted in a 19% reduction in fatalities, or a saving of 84 lives, at an estimated community saving of approximately $490 million (based on willingness-to-pay methodology). The budgeted cost for the current interim NSW mobile speed camera program is around $4 million per year, including costs for outsourcing the program as well as marketing and public education costs.

Evaluations have estimated a 32% reduction in fatal crashes as a result of the initial mobile speed camera program in Queensland (Newstead & Cameron, 2003) and 25% in Victoria (Cameron & Delaney, 2006). This program is roughly equivalent in enforcement hours per population to the proposed full roll out of the NSW mobile speed camera program. Applying an average 28% fatal crash reduction achieved by these programs, in NSW, this could be expected to result in a reduction of 103 fatal crashes (and, therefore, at least 103 fatalities) annually, equating to an estimated community saving of around $600 million (based on willingness-to-pay methodology). Given that the budgeted cost for the full roll out of the NSW mobile speed camera operations is around $28 million per year (including costs for outsourcing the program as well as marketing and public education costs), the BCR of the full overt NSW mobile speed camera program is estimated to be 21:1.

Note that these estimates does not consider mobile speed camera fines as revenue, and only consider crash and casualty savings. Also note that this estimate subsumes the benefits of the existing NSW mobile speed camera program, and should not be added to any estimated savings for the existing interim program.

3. Conclusions regarding speed enforcement in NSW

Speed enforcement helps to reduce speeding on our roads, and thus assists in reducing the risk of being involved in a crash and the severity of crash outcomes. Speed cameras are proven throughout the world, and different types of cameras have different purposes.

Mobile speed cameras are effective in reducing travel speed and casualty crash outcomes, both at specific camera locations and more broadly throughout the road network. This is because motorists are less able to predict when and where the enforcement will occur, and so are more likely to modify their behaviour across the whole road network, rather than just at locations where they know enforcement is likely to be present.

This has already been observed during the initial months of operation from the small scale re-introduced *overt* mobile speed camera program in NSW. However with the size of the NSW road network there is a risk to these initial gains if the NSW program continues at this low level and a best practice approach would be to increase mobile speed camera enforcement hours so they are in line with per capita rates in other Australian jurisdictions.

The positive effects of mobile speed cameras on the safety of all road users have been consistently supported by findings from numerous research studies throughout the world, and documented in international and national recommendations for best practice principles regarding effective speed management

Employing evidence for an average 28% reduction in fatal crashes as a result of the initial mobile speed camera programs in Victoria and Queensland, the BCR associated with the proposed full-scale NSW mobile speed camera operations (equivalent to Queensland in terms of enforcement hours per population), would be around 21:1 (based on an estimated additional 103 lives saved).

A mobile speed camera program that is increased to a size similar to other Australian jurisdictions on a per capita basis is recommended to ensure continued positive effects from mobile speed enforcement are realised in NSW. Delivering a program of this size would significantly improve road safety, saving many lives and injuries, as well as many millions of dollars.

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