Increasing the effectiveness of mobile speed cameras on rural roads in Victoria based on crash reductions from operations in Queensland

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The original text of this paper was included in MUARC's submission to the Inquiry Into the Increase in Victoria's Road Toll during 2019 conducted by the Economy and Infrastructure Committee of the Parliament of Victoria. MUARC's submission was published on the Committee's website and is protected by parliamentary privilege. The paper has been peer-reviewed by three independent experts in the field and some clarifications were added.

Key Findings

- Mobile speed cameras operating on rural roads in Victoria could be more effective in reducing serious crashes if operations reflected experience in Queensland.
- The Victorian Government's decision to increase mobile speed camera hours by 75% is an opportunity to increase rural sites and randomly schedule camera visits. This has been found to be an important attribute of mobile speed cameras in Queensland.
- The operations at the new rural sites could be expected to save 22.5 fatal crashes and 172 serious injury crashes per year in Victoria.
- Savings in social costs of crashes would exceed 45 times the cost of camera operations.

Abstract

Mobile speed cameras on Victoria's rural roads are not as effective as they could be due to the site selection criteria, the limited number of sites, and the visibility and predictability of their enforcement operations. Queensland's overt mobile speed cameras achieve substantial crash reductions up to 4 km from rural camera sites due to site selection based only on crash history and randomised scheduling of operations to those sites. New sites in Victoria should be selected as in Queensland and camera visits should be randomly-scheduled. The Victorian Government's announcement to increase mobile speed camera hours by 75% should take the form of at least 75% increase of rural sites. The new sites should be selected on the basis of a serious crash history within 2.5 km. Mobile speed cameras operated at these new rural sites could be expected to save 22.5 fatal crashes and 172 serious injury crashes per year.

Keywords

Speed camera, mobile, rural, covert, overt, random

Background

Automated speed enforcement in Victoria takes the form of camera-based units at fixed locations or movable camera units covering many locations for short shifts. The fixed cameras are either:

- Fixed spot-speed cameras on freeways measuring speeds at the spot,
- Point-to-point (P2P) cameras at each end of a freeway section, measuring average-speeds over the section, or
- Red-light/speed cameras at signalised intersections measuring spot-speeds on an approach road as well as red-light running offences.

The movable cameras are either:

- Mobile speed cameras (MSC) measuring spot-speeds at each road location they are moved to for a period typically of 2-3 hours, or

- Mobile P2P camera units measuring average-speeds over each pre-defined road section for a shift period yet to be defined [mobile P2P cameras are being trialled in some Australian States but have yet to be introduced].

Research has found that the fixed camera systems have very limited range of effect on speeds and crashes around the locations operated, except in the case of fixed P2P camera operations where the effect is over the whole freeway section (Gains, Nordstrom, Heydecker and Shrewsbury 2005; ARRB 2005; Newstead, Diamantopoulou, Cameron and Candappa 2017).

In the case of mobile spot-speed cameras, the effect on speeds and crashes can extend well beyond the locations operated (Cameron and Delaney 2006, 2008; Wilson, Willis, Hendrikz, Le Brocque and Bellamy 2010). This is because, in Victoria, MSCs are operated covertly from unmarked standard vehicles without signage on the approaches and are relatively unpredictable, especially in urban areas. Other Australian States (e.g. Queensland and Western Australia) have achieved broad effects of their relatively-overt MSCs by operating them at many more sites than Victoria and randomly-scheduling site visits to increase unpredictability.

Mobile speed cameras (MSC) on rural roads in Victoria

Sites for operation of mobile speed cameras in Victoria are chosen and operated according to both a set of site selection criteria based on a serious crash or speeding history or unsafe behaviour, and a set of physical field criteria, dictating the suitability of a site for siting and operation of a mobile camera unit.

The Victorian Auditor General's Office (VAGO 2011) conducted a review of the Victorian traffic camera program. They identified research evidence supporting the siting of mobile speed cameras using sites based only on physical criteria, but not necessarily on demonstrated crash or speed risk at the site as specified in the site selection criteria. This is because the primary purpose of the Victorian mobile camera program is to create a general, area-wide effect – the perception by drivers that the program could be in operation anywhere at any time so as to encourage universal compliance with speed limits. This is in contrast to the fixed speed camera program which is designed to deter speeding only in an area local to the camera. VAGO considered that there are factors that have led the mobile speed cameras in essence becoming an extension of the fixed camera program, especially on rural roads.

VAGO (2011) expressed a concern that use of narrow site selection criteria can limit the extent to which siting of mobile cameras has an area-wide effect, particularly if the number and spread of sites across the network is insufficient. It also noted that if there is a systematic pattern of deployment of mobile cameras, regular road users can identify this and adjust their behaviour according to their knowledge of where a camera is likely to be. As the perceived risk of detection falls, the deterrence effect of mobile cameras is also diminished. (The deterrence effect over a broad area relates to a speeding driver perceiving detection anywhere at any time.) It noted that siting of mobile camera operations based on physical criteria alone might reduce the likelihood of an identifiable pattern and therefore potentially heighten the level of area-wide effect. This approach would also increase the number of sites available for cameras which had been diminishing over time due to development of the surrounding environment, thus excluding sites based on the necessary physical criteria.

Trial of alternative operations and additional MSC sites

In response to a VAGO (2011) recommendation, Victoria Police conducted a trial of mobile speed camera deployments based only on the physical field criteria during 2014-2015. In three Police Divisions, the number of MSC sites was approximately doubled by choosing new sites without any constraint to needing a history of serious crashes or speeding in the vicinity. The total hours of operation of MSCs in each Division continued unchanged.

The analysis found about 5% reduction in casualty crashes in the lower speed limit zones (up to 60 km/h) of the trial Divisions (Cameron, Newstead and Budd 2019). There was no evidence of an effect on crashes on roads with higher speed limits, principally rural roads. It was concluded that there was no advantage in relaxing the site selection criteria (based on serious crash or speeding history) for MSC sites on higher speed limit roads in Victoria. However, nor is there a disadvantage in increasing the number of MSC sites on these roads and spreading the total hours of MSC operation over all sites in a Division (approximately halving the intensity per site). The "covert" MSCs may still be visible and obvious on typical higher speed limit roads in Victoria, but an increase in MSC sites leads to a broader coverage of the road system because the local effects of MSC operations multiply.

Experience with the operation of overt MSCs in Queensland indicates how the local effects of Victorian MSCs on rural roads can achieve a broader distance-halo of influence around MSC sites than current operations and maintain a longer-term local effect than that just during MSC presence at each site. The Queensland experience and research are outlined in the following section.

Local effects of Queensland's mobile speed cameras

Queensland MSCs are randomly scheduled to approved sites within the camera operator's Police District prior to each shift commencing, with the intention of reducing the predictability of camera placements. MSC sites are located after identifying an area with diameter of one kilometre (urban regions) or five kilometres (rural regions) in which at least two "speed camera criteria" crashes have occurred during a previous five-year period. "Speed camera criteria" crashes are defined as either:

- Speed-related crash (i.e. reported by Police as exceeding the speed limit, or excessive speed for the circumstances), or
- Serious casualty crash (i.e. resulting in death or hospitalisation) not at an intersection, or
- Either an "out of control" or "off path on curve" type of crash.

Newstead, Budd and Cameron (2017) and Cameron, Newstead and Budd (2017) estimated the local crash effects each program year from 2008 to 2015 (Table 1). The zones of influence considered in the analysis were up to 1 km from camera sites in urban areas and up to 4 km from sites on rural roads. In the period analysed, MSC operations grew from 5,640 to 8,980 hours per month at 3,134 active sites during 2015.

The crash effects of Queensland MSCs in rural areas are of greater interest to Victoria than urban areas because Victoria's covertly-operated MSCs are known to have strong general effects on urban crashes and their injury severity (Cameron, Cavallo and Gilbert 1992).

Table 1 shows the estimated crash reductions within 4 km of the rural MSC sites during 2008 to 2015. The rural MSC hours per month were reduced during 2014 and 2015 from the relatively high level during 2013. The reductions in serious casualty and all casualty crashes near rural MSC sites were also substantially lower during those years compared with reductions during 2013. The crash effects within 4 km during 2013 represent more typical effects, namely 41% reduction in fatal crashes, 30% reduction in serious casualty crashes and 27% reduction in all casualty crashes.

Transportability of Queensland experience to Victoria's rural MSCs

It is suggested that the effects of Queensland's MSC program on rural roads could be used to estimate that at new MSC sites on Victoria's rural roads if:

New sites were chosen by having at least two serious casualty crashes within 2.5 km during a recent five-year period as the principal criterion

MSC sessions are randomly scheduled to all new sites within each operator's area during each operator's shift

Each new site is visited and operated for at least 35 hours per site per year, the average intensity per site in Queensland during 2015.

With these MSC site selection, scheduling and visitation characteristics, it is expected that crashes would be reduced within 4 km of rural sites by the percentages shown in Table 1. It is acknowledged that there is a substantial difference in the sizes of the rural areas of Victoria and Queensland, but the transportability of the Queensland

Table 1: Estimated local effects measured at Queensland MSC sites in urban and rural areas within 1 km and 4 km analysis halos, respectively. Year, MSC hours per month, and percentage reduction in crashes (Newstead et al 2017; Cameron et al 2017)

Years	Hours per month		Fatal crashes		Serious casualty crashes		All casualty crashes	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
			0-1 km	0-4 km	0-1 km	0-4 km	0-1 km	0-4 km
2008	3999	1639	41.3%	22.4%	19.6%	28.7%	19.8%	23.3%
2009	4051	1550	51.3%	11.2%	24.1%	20.6%	26.3%	19.4%
2010	4458	1729	56.6%	23.8%	25.6%	21.0%	28.1%	15.9%
2011	4608	1651	49.4%	39.1%	26.0%	25.2%	29.4%	23.2%
2012	4911	1558	49.5%	31.6%	27.4%	25.0%	33.4%	25.4%
2013	6354	1749	70.3%	41.3%	29.3%	29.5%	32.0%	27.4%
2014	6849	1489	67.5%	42.3%	32.7%	17.6%	34.1%	14.7%
2015	7483	1497	61.0%	33.5%	32.8%	14.5%	33.3%	10.6%

experience seems reasonable if the operational characteristics of Queensland MSCs are maintained in Victoria.

Current MSC operations at existing sites in rural Victoria are expected to influence crashes at most 1 km from each site, in a similar way as a fixed speed camera at the site. This is because existing MSC sites have probably become well known, the presence of an MSC is predictable, and when present the "covert" MSC vehicle is probably visible from a substantial distance, allowing the driver to correct any speeding. It is not known whether the random scheduling of MSC sessions to existing sites would overcome their predictability and increase their effect halo. However, the existing rural sites are currently visited for more than 44 hours per site per year which exceeds the Queensland visitation rate.

Estimated crash effects of new rural MSC sites in Victoria

During December 2013, there were 1079 rural MSC sites and 910 urban sites in Victoria. These were increased by about 300 sites during the trial of alternative operations in 2014-2015, but it is understood that the number has returned to pre-2014 levels following the completion of the trial.

In May 2019, the Victorian Government announced plans to increase the operational hours of MSCs by 75%. On rural highways, this should take the form of an increase in MSC sites. If these new sites are selected, scheduled and visited by MSCs as in Queensland, then it could be expected that they would reduce crashes over 8 km sections centred on the sites (Cameron and Newstead 2018).

All 8 km sections of rural category A divided roads and A, B and C undivided roads in Victoria were ranked by their number of serious crashes during 2006-2015 (10 years). This provided a stable indicator of the relative crash problem on these sections. The 75% increase of the existing rural MSC sites, namely 810 new sites, was distributed over the four categories of rural roads in proportion to their length. The highest ranked 8 km sections within each road category were selected as potential new MSC sites near the centre of each section (subject to constraints due to physical field criteria).

Table 2 shows the estimated savings in crashes of each severity if MSCs were randomly scheduled to operate at each of these new sites for at least

Table 2: Crash savings per year, Human Capital cost savings, BCR and marginal BCR from 75% increase in new sites for randomly-scheduled overt mobile speed cameras (MSC). Also estimated effects of 10 new sections for mobile P2P cameras.

Rural road type	Length (km)	Enforce-ment type	Percent increase in sites*	New sites (or P2P sections)	Increase in hours per year	Fatal crashes saved per year	Serious injury crashes saved per year	Minor injury crashes saved per year	**Crash cost saving per year ($m)**	**Total additional cost ($m pa)**	**BCR** (Increase benefits/ increase costs)	Marginal BCR
Divided A Roads	418	Overt MSC	New site numbers distributed by road length	18	617	3.00	51.89	112.34	45.910	0.087	**524.97**	353.04
Undivided A Roads	2,606	Overt MSC		110	3,848	4.04	24.63	28.13	28.122	0.545	**51.58**	24.16
Undivided B Roads	3,907	Overt MSC		165	5,769	5.01	29.53	33.28	34.142	0.817	**41.77**	14.21
Undivided C Roads	12,252	Overt MSC		517	18,090	10.42	65.85	75.57	74.158	2.563	**28.93**	4.56
All Highways A-C Total	**19,183**	**Overt MSC**	**75%**	**810**	**28,324**	**22.48**	**171.90**	**249.32**	**182.332**	**4.013**	**45.43**	**16.78**
All Highways A-C	19,183	Mobile P2P cameras	New sections	10	350	1.91	15.10	14.49	15.664	0.431	**36.37**	28.45

* Increase from 1079 rural MSC sites operated for 48,091 hours per year during 2013 and essentially unchanged during 2014-2018

35 hours per year (e.g. 14 visits at 2.5 hours per visit). It is likely that there is a greater focus of the proposed new sites onto category B and C roads than existing MSC sites in Victoria. While these roads are more lightly trafficked than category A roads, they still cover a substantial proportion of serious crashes due to their length. In total, the 8 km sections cover 34% of the total length of each rural road category.

The estimated annual savings in crashes across the road sections influenced by MSC operations at the new sites are 22.5 fatal crashes, 172 serious injury crashes and 249 minor injury crashes. The benefit-cost ratio (BCR) of the social cost savings, based on Human Capital costs of crashes, compared with the costs of camera operations, would be 45. The marginal BCR of further increases in new sites would be nearly 17, indicating that more than the 75% increase in rural sites would be warranted.

Mobile P2P cameras

Table 2 also shows estimated crash savings if mobile point-to-point (P2P) [average-speed] cameras operated on rural highways, covering ten sections of category A-C roads, the number chosen only to illustrate effects (Cameron and Newstead 2018). Mobile P2P camera units are a new technology that makes use of two units parked at the terminals of a carefully-surveyed road length to measure the average speed in the same way as fixed P2P camera systems. Each unit could be either vehicle- or trailer-based. It is expected that each one-way section will need to be visited on average for 35 hours per year, as visited by the mobile MSCs in rural Queensland, to produce a long-term time-halo effect along each section in a similar way as the effect produced by a fixed P2P system operating continuously.

No mobile P2P cameras yet operate in Victoria. It is envisaged by the authors that in suitable rural road environments, long sections would be selected, longer than the halo of influence of each spot-speed MSC. Sections typically 20 km in length would be ranked by their serious crash rate per kilometre and the top ranked sections selected (Cameron and Newstead 2018).

In Table 2, the estimated effect of mobile P2P was analysed by initially considering the ten highest-ranked 20 km sections of rural roads. An allowance of $20,000 per annum was made for the establishment and maintenance of each surveyed road section. Two P2P mobile camera units would be required to enforce each mobile P2P hour, but the cost to process each average-speed offence was assumed to be the same as those detected by a spot-speed MSC. While expensive to operate, mobile P2P has the potential to cover long rural road sections, longer than can be covered by spot-speed MSCs, and achieve benefits well in excess of the costs.

Conclusions

- Mobile speed cameras on Victoria's rural roads are not as effective as they could be due to the site selection criteria, the limited number of sites, and the visibility and predictability of their enforcement operations.
- Queensland's overt mobile speed cameras achieve substantial crash reductions up to 4 km from rural camera sites due to site selection based only on crash history and randomised scheduling of operations to those sites.
- Victoria's mobile speed cameras could achieve crash reductions over 8 km sections of rural roads ranked highly by their serious crash history. New sites should be selected as in Queensland and camera visits should be randomly-scheduled to each site for shifts totalling at least 35 hours per year.
- The Victorian Government's announcement to increase mobile speed camera hours by 75% should take the form of at least 75% increase of rural sites. The new sites should be selected on the basis of a serious crash history within 2.5 km and should consider all category A, B and C rural roads.
- Mobile speed cameras operated at these new rural sites could be expected to save 22.5 fatal crashes and 172 serious injury crashes per year. Social cost savings would exceed 45 times the cost of camera operations.
- While still a new technology, mobile point-to-point camera units have the potential to enforce speeding over much longer rural road sections than the traditional spot-speed mobile cameras.

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