Road Safety Camera Commissioner

REPORT OF THE ROAD SAFETY CAMERA COMMISSIONER TO THE MINISTER FOR POLICE AND EMERGENCY SERVICES

Investigation into the reliability and accuracy of road safety cameras on EastLink

Release date: 15 July 2013

PURPOSE

1 The purpose of this investigation is to determine the reliability and accuracy of the road safety cameras installed along the EastLink highway.

BACKGROUND

2 The road safety cameras installed along EastLink were activated in September 2008. Since then, there has been a public perception that the cameras on EastLink are neither accurate nor reliable. The perception appears to be reinforced by media reports about the number of infringements issued by the road safety cameras on EastLink, specifically the cameras located at the Wellington Road Bridge.

3 Since my appointment as the Road Safety Camera Commissioner in February 2012, I have received over fifty individual complaints relating to the road safety cameras installed along EastLink. Most of the complaints were directed towards the cameras installed on the northbound carriageway at Wellington Road Bridge and the southbound carriageway at the Dandenong Bypass Bridge. I have not received any complaints regarding the cameras in the two tunnels, despite those cameras being the same type of system with identical hardware and software components as the other cameras installed on EastLink.

4 Due to the number of complaints I received concerning the cameras installed on EastLink, I undertook a full technical investigation into the reliability and accuracy of these road safety cameras, pursuant to my powers under section 10(e) of the *Road Safety Camera Commissioner Act 2011*.

ROAD SAFETY CAMERA SYSTEMS ON EASTLINK

5 The road safety camera systems are installed at the following six locations on EastLink:

a. Mullum Mullum Tunnel, Donvale
b. Melba Tunnel, Donvale
c. Wellington Road Bridge, Rowville, Southbound
d. Wellington Road Bridge, Rowville, Northbound
e. Dandenong Bypass Bridge, Keysborough, Southbound, and
f. Dandenong Bypass Bridge, Keysborough, Northbound.

6 A road safety camera system consists of two major components: the camera unit, also known as the primary speed calculation unit, and a set of in-road sensors, also known as the secondary speed calculation unit. There is one camera system installed in each lane, at each of the six locations.

7 The type of camera unit, or primary device, installed on EastLink is the Gatsometer Digital Radar Camera System-Parabolic (DRCS-P), which is prescribed for use in Victoria by the Road Safety (General) Regulations 2009. This type of device uses radar signals to detect the presence of a vehicle and to measure the speed of that vehicle. The speed measurement is carried out using the Doppler Effect. Appendix B contains a detailed explanation of how the Doppler Effect works.

8 All fixed road safety cameras in Victoria are equipped with a secondary speed calculation unit or secondary device that operates independently from the primary device. The secondary

devices used on EastLink are inductive loop sensors located at the point where the radar beam hits the road. Inductive loop sensors measure a change in magnetism corresponding to the metallic content of vehicles when they travel over them.

9 The two systems use different methods of measurement to ensure that the measurement is consistent. This means that all vehicles travelling on EastLink have their speed measured twice and both speed measurements must correlate. If the speed measurements produced by the primary and secondary devices do not correlate, the speed measurement is rejected.

10 Road safety cameras are required to be tested, sealed and used in accordance with the Road Safety (General) Regulations 2009. As a part of this process, the speed calculation unit is calibrated and certified annually by an independent Testing Officer to ensure that it accurately measures the speed of passing vehicles.

11 In addition to certification, both the primary and secondary devices are maintained on a monthly basis and tested quarterly by an independent contractor for the accuracy of their speed measurements and the repeatability of the speed measurement accuracy.

12 During the quarterly testing process, the cameras are:

a. Switched into a testing mode and no infringement notices can be issued. The speed limit is lowered to enable testing to be conducted within the legal speed limits.

b. An independently calibrated speed measurement device is set up at the point of measurement of the primary device.

c. The speed measurements made by the device are compared to the speed measurements made by both the primary and secondary devices over a period of several hours.

d. The independent testing authority drives past the cameras with a vehicle equipped with an independently calibrated speedometer and speed display board.

e. The speed displayed when the camera captures an image of the vehicle is compared to the speed measurements made by the primary and secondary systems and the independent speed measurement device.

f. All measurements made by the four independent systems must correlate for the camera system to pass the testing requirements.

SCOPE OF INVESTIGATION

13 The scope of this investigation is limited to determining the reliability and accuracy of the speed measurements recorded by the road safety camera systems on EastLink between 1 July 2011 and 30 June 2012. This investigation did not include an examination of the procedures relating to the manual processing of images captured by the cameras, nor the processes surrounding the issuing of traffic infringement notices as these processes have no relevance to the technical operation of the cameras.

14 In this report, the phrase "vehicles detected speeding" refers to the number of vehicles that were detected exceeding the speed limit by the road safety camera system. It does not mean the number of infringement notices issued by Victoria Police.

15 Between 1 July 2011 and 30 June 2012, 60,169,400 speed measurements were recorded by the road safety camera systems installed on EastLink. The reliability and accuracy of these speed measurements were examined by the following means:

a. The certification, testing and maintenance reports in relation to the road safety camera systems were examined, and

b. All the speed measurements made by the primary and secondary speed calculation units were compared to ensure that the primary device measured vehicle speeds accurately.

16 In order to determine whether the speed measurement data from both the primary and secondary devices correlated, the records were compared using an automated computer algorithm. This algorithm compared over 60 million speed measurements taken by both devices to determine whether they were reliable and accurate over the period of the investigation.

17 The investigation also looked at driver behaviour on EastLink. Speed measurement data was analysed across the six camera sites to determine whether there were any behavioural trends displayed by motorists over the relevant period that could offer an insight into the number of infringements being issued by Victoria Police for speeding on EastLink. In addition to this, a study was conducted to examine driver behaviour at and approaching the Wellington Road Bridge.

RESULTS OF INVESTIGATION

GENERAL RESULTS AND OBSERVATIONS

18 As a result of this investigation, I am satisfied that the road safety camera systems on EastLink accurately and reliably measure the speed of vehicles. The annual certification reports showed the cameras complied with the legislative and regulatory requirements of the Road Safety (General) Regulations 2009. In addition to the requirements of the Regulations, the cameras were also maintained to the specifications of the manufacturer and the quarterly testing requirements of the Department of Justice.

19 In my role as the Road Safety Camera Commissioner, I have personally witnessed these thorough and robust testing methods used by the independent testing authorities at the Wellington Road Bridge cameras. Using four different methods to measure the speed of a vehicle and ensuring that they all correlate gives me the highest degree of confidence in the accuracy and reliability of the road safety cameras on EastLink.

20 I am also satisfied that all vehicles detected speeding were processed by the camera systems correctly and that only those vehicles where the primary speed measurement was corroborated by the secondary device were sent to Victoria Police for further processing. Detections not verified by the secondary speed measurement process were automatically rejected by the road safety camera system.

21 I am confident that the secondary device within the camera system is an effective safeguard against anomalies that can affect the accuracy and reliability of speed detections. Examples of vehicles for which an anomaly is detected are articulated vehicles, open trailers and vehicles with rear ends that include a horizontal protrusion, which can cause the vehicle's speed to be measured twice. These occurrences are anticipated in the design of the camera system by the manufacturer. The camera system is designed to immediately reject the second measurement made by the primary device of each vehicle, as they will not have a corresponding speed measurement from the secondary device.

22 During the 2011 to 2012 financial year, the camera at second lane of the northbound carriageway of Wellington Road Bridge was found to be non-compliant as the result of a

quarterly test. This camera should have been deactivated, however, the camera at lane one was inadvertently deactivated. When this error was discovered, 717 infringements issued by the lane two camera between 13 July 2011 and 14 August 2011 were withdrawn by Victoria Police. As I stressed in my annual report, this incident resulted solely from human error. A summary of my investigation into this matter can be found in my Annual Report for 2011-2012.

23 Other than the above issue caused by human error, there is no evidence that any speeding infringements issued by the EastLink cameras were incorrect.

DRIVER BEHAVIOUR ON EASTLINK

24 The results of this investigation show that over 99.5 per cent of vehicles passing the road safety cameras on EastLink between 1 July 2011 and 30 June 2012 complied with the speed limit. This indicates that the overwhelming majority of motorists travel within the speed limit.

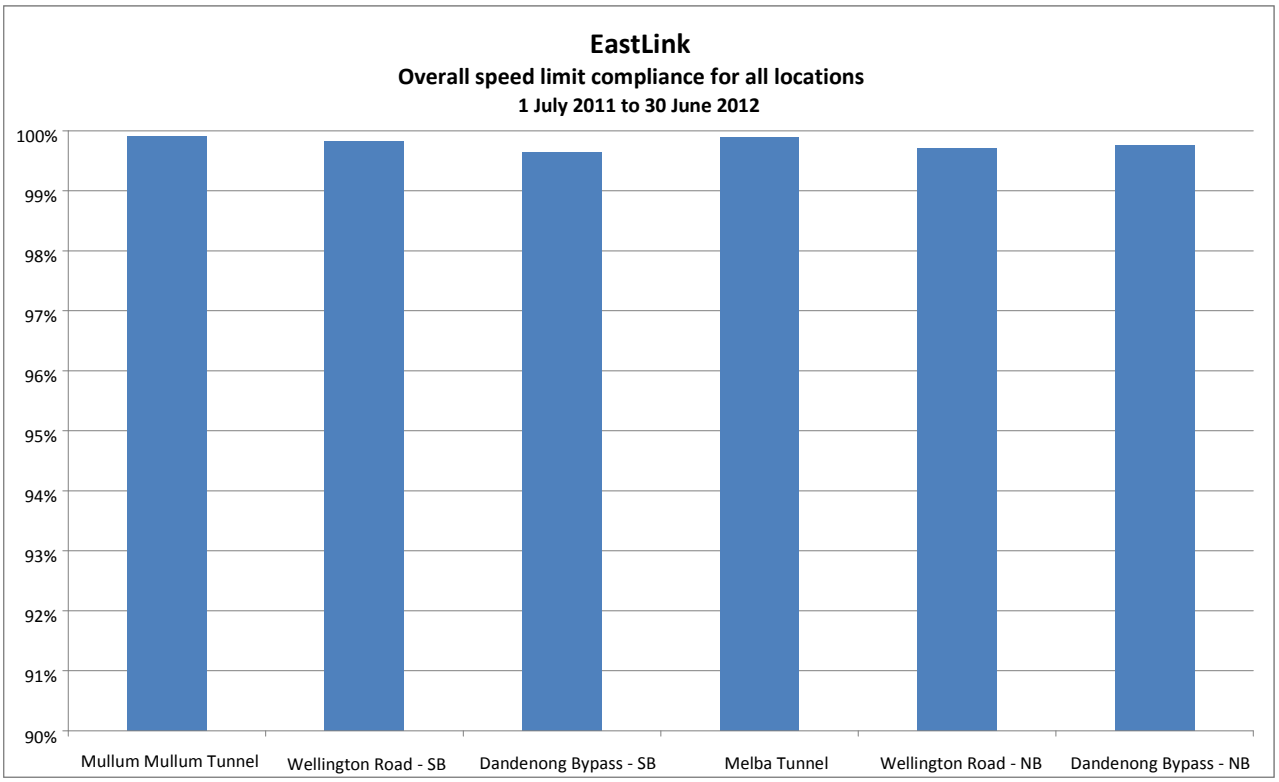

Figure 1 – Speed limit compliance on EastLink between 1 July 2011 and 30 June 2012

25 The two camera sites located in the tunnels recorded the lowest number of speeding vehicles. Of the total number of vehicles detected speeding on EastLink, only 8 per cent of vehicles were recorded speeding in each of the tunnels. The relatively low level of detections suggests that motorists viewed driving in tunnels as inherently more risky due to the more enclosed environment. It also suggests that motorists were more willing to comply when speed limits are lowered during busy periods or roadworks and maintenance activities in the tunnels.

26 Conversely, 25 percent of the total number of vehicles detected speeding were detected travelling northbound at the Wellington Road Bridge and 26 percent were detected travelling southbound at the Dandenong Bypass Bridge. It is reasonable to assume that the higher number of complaints regarding these sites is a reflection of the relatively higher number of speed detections at these sites.

Camera location	Number of vehicles detected speeding	Percentage of total
Mullum Mullum Tunnel	9,778	8%
Melba Tunnel	10,517	8%
Wellington Road Bridge – Northbound	31,736	25%
Wellington Road Bridge – Southbound	22,174	17%
Dandenong Bypass Bridge – Northbound	21,069	16%
Dandenong Bypass Bridge - Southbound	33,066	26%
TOTAL	**128,340**	**100%**

27 The results of this investigation also showed that 52 percent of speeding vehicles were detected in the outside lane (Lane 3) at all six sites. In principle, the outside lane is the overtaking lane, it generally has less traffic and therefore can support a higher average speed. This is a reasonable explanation why the majority of speeding vehicles are detected in these lanes.

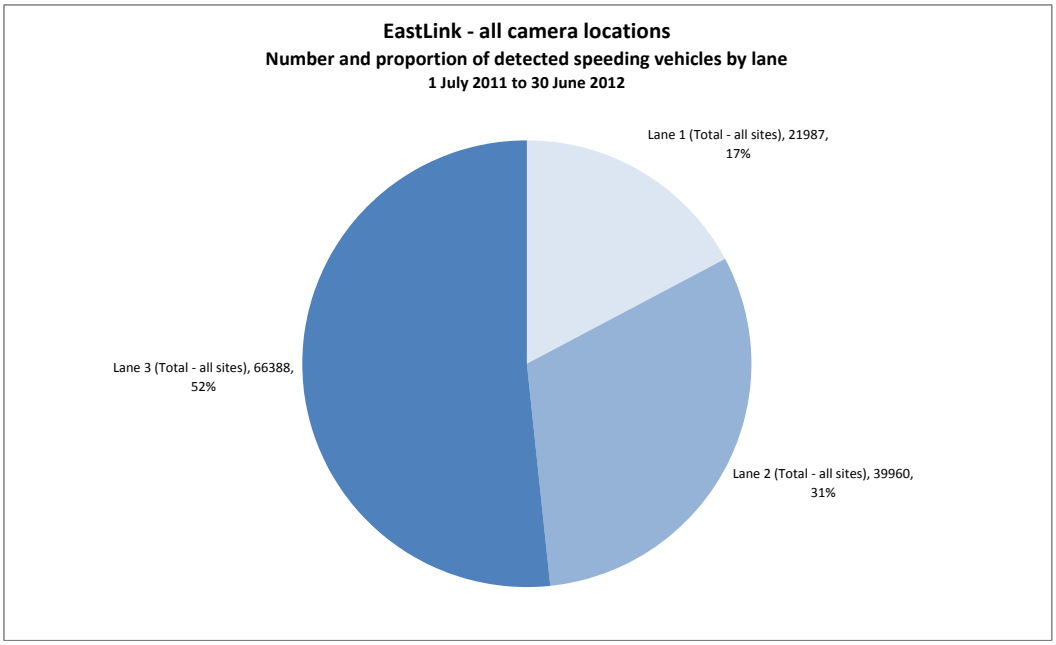

Figure 2 – Number of vehicles detected speeding on EastLink by lane between 1 July 2011 and 30 June 2012

28 At most of the camera sites, the highest number of vehicles detected speeding were in the afternoon peak hour period and the early evening (Figures A1 to A6 in Appendix A). Only two locations did not follow this trend. These were the Mullum Mullum Tunnel and the southbound camera site on the Dandenong Bypass Bridge.

DRIVER BEHAVIOUR AT WELLINGTON ROAD BRIDGE

29 As part of this investigation, my office also carried out an experiment to test the urban myth that many motorists believe that the road safety cameras are installed in the tolling gantries located 700 metres prior to the Wellington Road Bridge, rather than on the Wellington Road Bridge itself. The purpose of this experiment was to determine whether motorists were slowing down for the tolling gantries and then speeding up as they passed under the actual location of the road safety cameras at the Wellington Road Bridge.

30 Between 29 April 2013 and 26 May 2013, independently calibrated traffic and speed monitoring devices were temporarily installed to measure the average speed of motorists at two locations on the approach to the road safety camera installation on the northbound carriageway of EastLink at the Wellington Road Bridge. These temporary devices were located:

a. 700 metres south of the Wellington Road Bridge, just after the tolling gantry, and

b. 450 metres south of the Wellington Road Bridge, just before the exit sign gantry.

31 The speed data collected by these two independent devices was compared to the speed data collected by the road safety cameras installed at the Wellington Road Bridge. During this period, each of the three devices collected speed data from over one million vehicles.

32 Speed measurements from the three devices showed that drivers decreased their average speed by 0.1km/h between the first and second temporary devices and by 1.6km/h between the second temporary device and the fixed camera. Given that the speeds of over one million vehicles were analysed, this is a significant change in driver behaviour.

33 More significantly however, this experiment showed that 8,885 vehicles were detected exceeding the speed limit by 10km/h or more at the first temporary device located 700 metres before the Wellington Road Bridge. As vehicles passed under the cameras located at the Wellington Road Bridge, the number of vehicles exceeding the speed limit by more than 10km/h fell to only 706.

34 The results of this experiment suggest that motorists are aware that the road safety camera systems are actually installed under the Wellington Road Bridge and not on the tolling gantries. The change in average speed shows that the majority of drivers are slowing down as they travel under the Wellington Road Bridge. In my mind, the urban myth is busted!

CONCLUSIONS

35 In my investigation of all six cameras on EastLink, I found that all six camera locations were functioning correctly and that:

a. all the cameras were calibrated, certified, sealed and used in accordance with the Road Safety (General) Regulations 2009,

b. the cameras were maintained and tested to the manufacturer's specifications and requirements of the Department of Justice,

c. all road safety cameras installed along the EastLink highway were operating reliably and accurately, and,

d. it follows that I am satisfied that all infringements issued by cameras on EastLink are valid.

36 In the driver behaviour analysis experiment carried out at the Wellington Road Bridge, it is clear that motorists are aware of the location of the road safety camera installation and decelerate as they approach the camera installation. This diminished effect of the road safety camera system in promoting safer driving practices is of concern to me.

CONSULTATION

37 This report was prepared in consultation with the Department of Justice and SGS Australia Pty Ltd

APPENDIX A

TABLES AND CHARTS OF STATISTICAL ANALYSIS

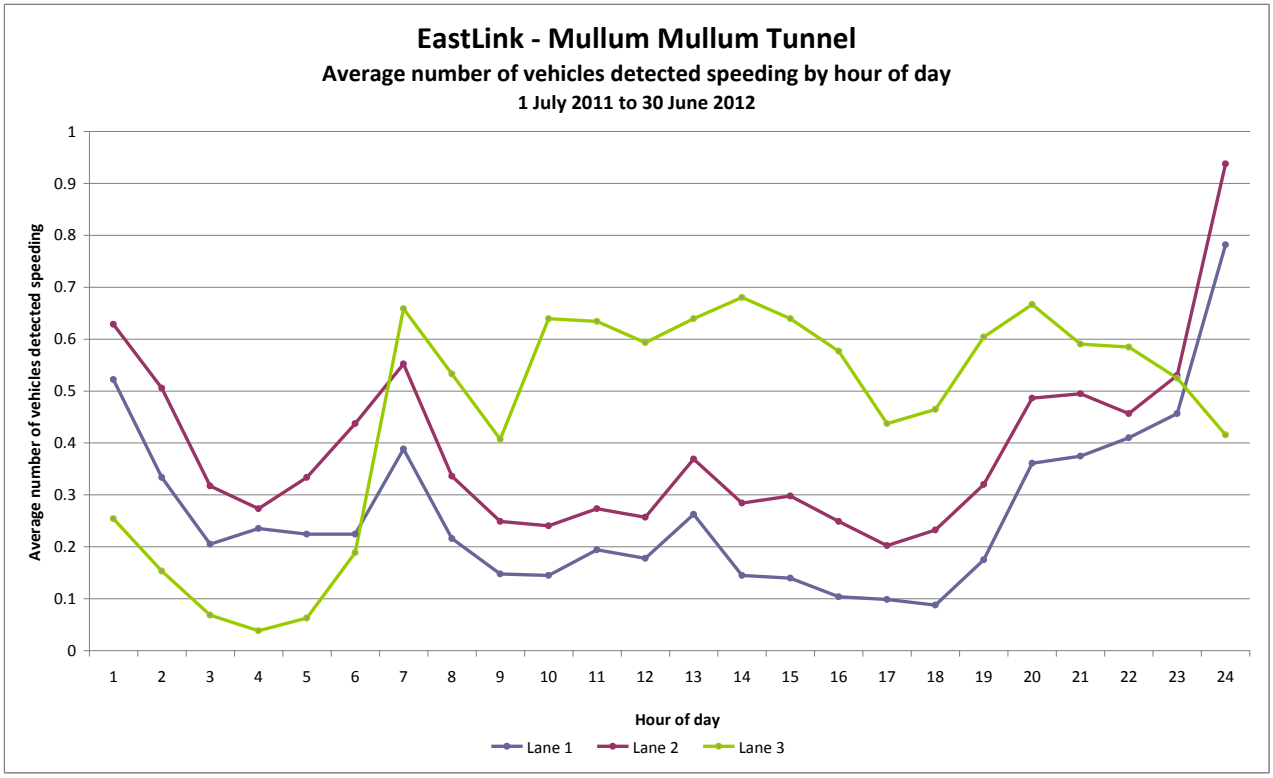

Figure A1 – Average number of vehicles detected speeding in Mullum Mullum Tunnel per hour of the day

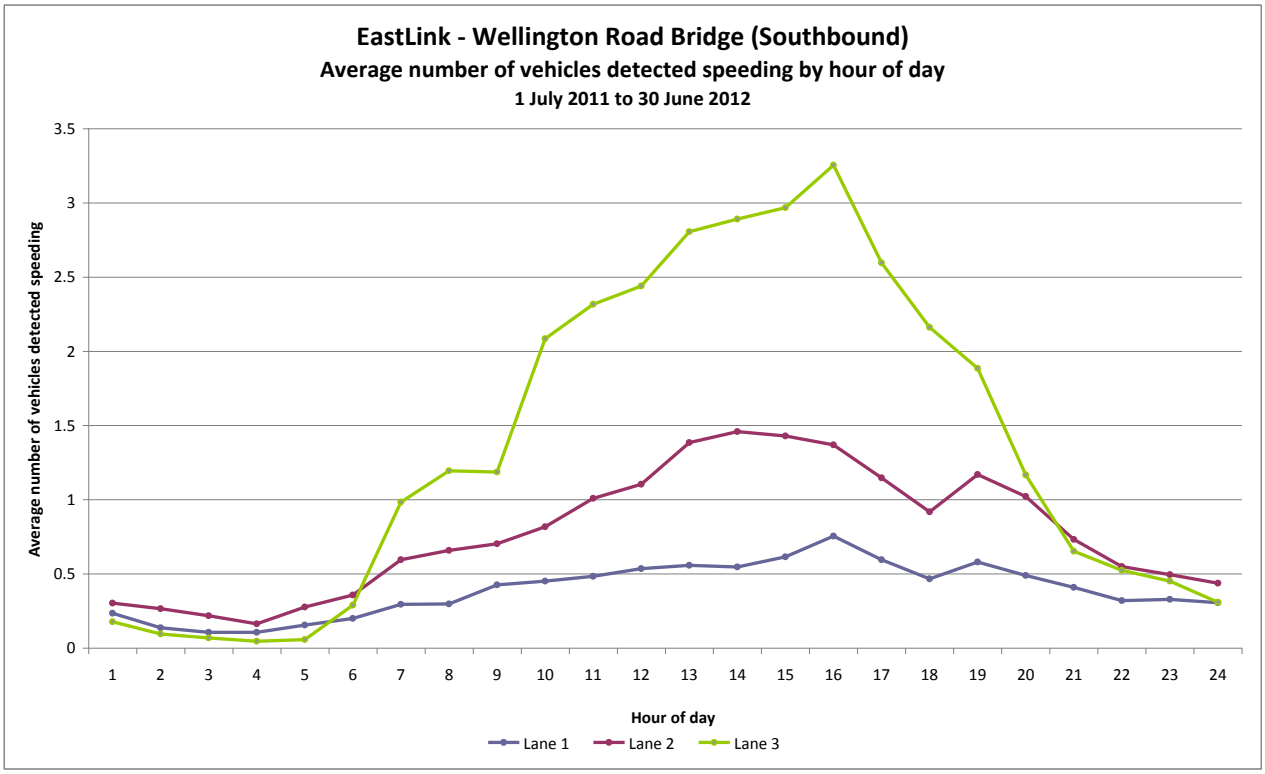

Figure A2 – Average number of vehicles detected speeding at Wellington Road Bridge travelling south per hour of the day

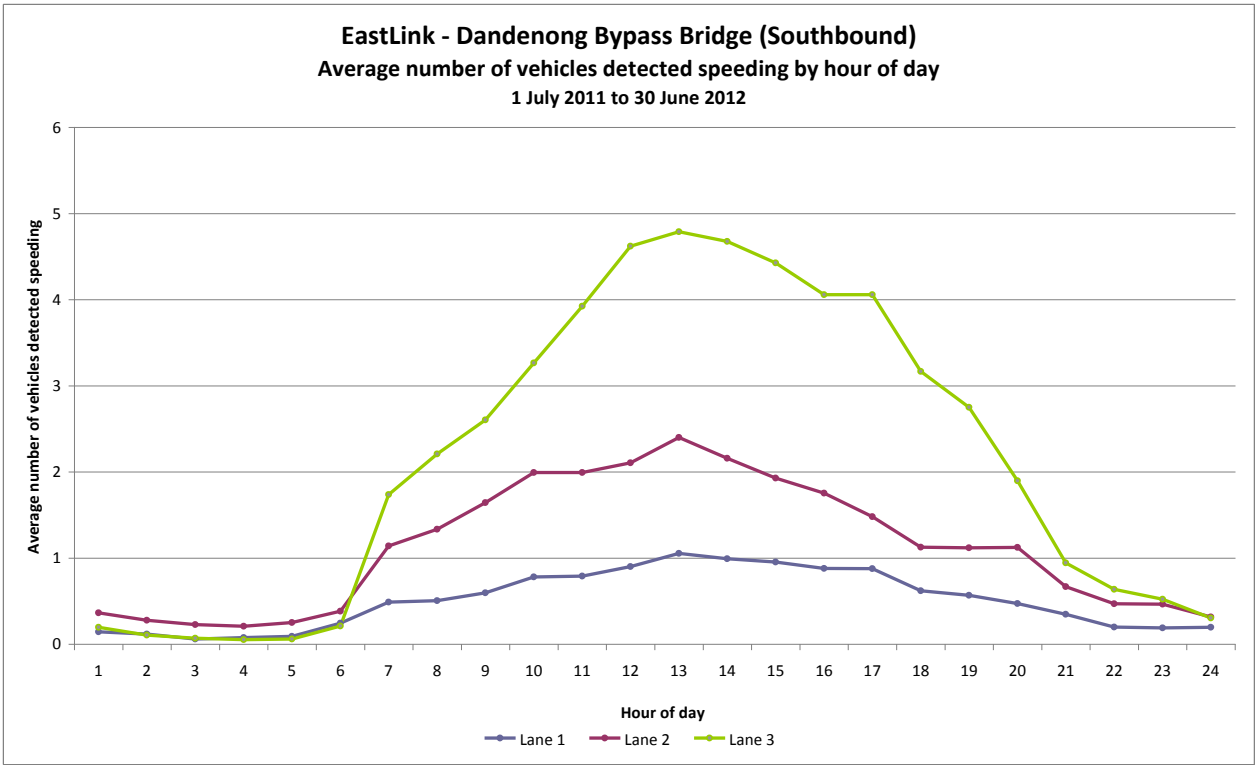

Figure A3 – Average number of vehicles detected speeding at Dandenong Bypass Bridge travelling south per hour of the day

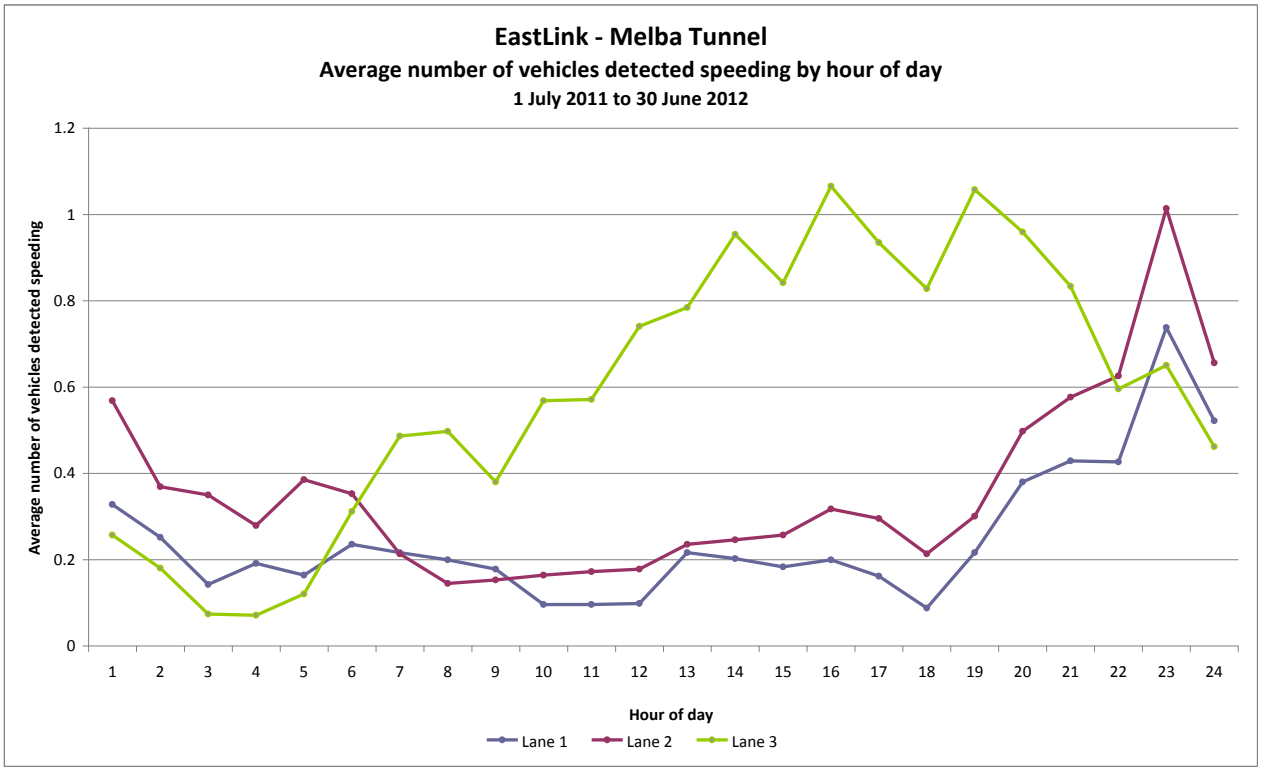

Figure A4 – Average number of vehicles detected speeding in the Melba Tunnel per hour of the day

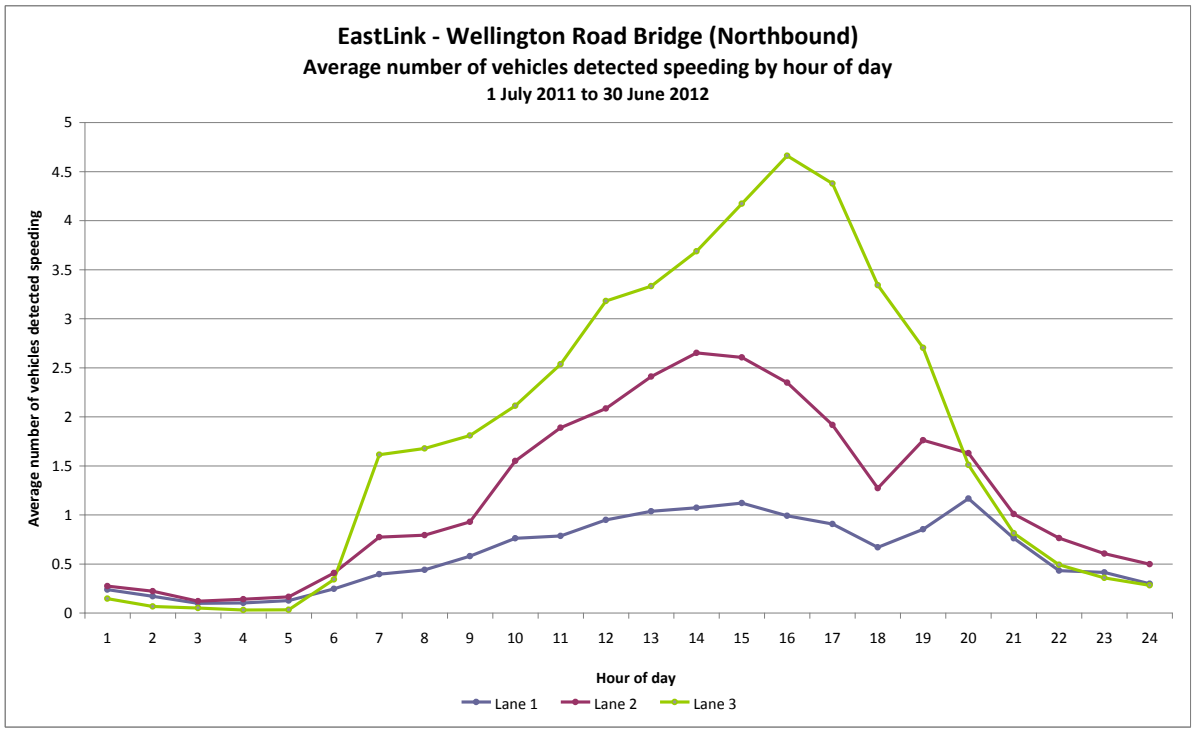

Figure A5 – Average number of vehicles detected speeding at Wellington Road Bridge travelling north per hour of the day

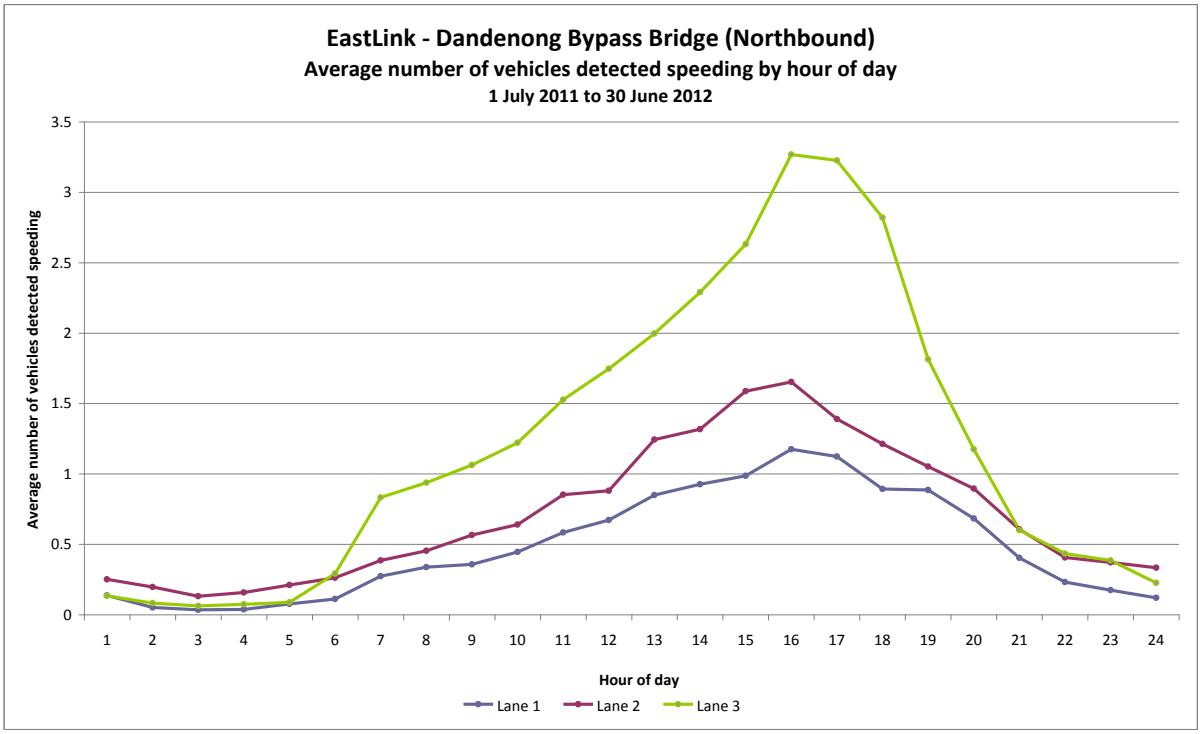

Figure A6 – Average number of vehicles detected speeding at Dandenong Bypass Bridge travelling north per hour of the day

APPENDIX B

THE DOPPLER EFFECT

The Doppler Effect is an everyday phenomenon and affects all types of waves, including sound and electromagnetic radiation, such as light or radar. The effect relates to changing frequencies of emitted or reflected sound or light by moving objects from the point of view of an observer. The road safety camera measures the speed of a vehicles by utilising the Doppler Effect to measure the change of frequency of the reflected radar signal from a passing vehicle.

For example, when an ambulance is travelling towards a observer, the pitch or the frequency of the siren's sound is higher. When it begins to move away from the observer, the pitch of the siren becomes lower. By measuring the change in pitch of the sound, it is possible to work out the speed of the ambulance using the Doppler Effect equation.

The general Doppler Effect equation is shown below:

$$f_{received} = \left(\frac{c + v_{observer}}{c + v_{source}} \right) f_{emitted}$$

Doppler Effect variables

Variable	Definition
$f_{received}$	Frequency of returned signal
$f_{emitted}$	Frequency of the emitted signal
$v_{observer}$	The speed of the observer – in this case, it is zero metres per second as the camera is fixed
v_{source}	The speed of the vehicle being measured
c	The speed of light - 299,792,458 metres per second