Average Speed Safety Cameras

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ABSTRACT

In 2009, the NSW government enacted legislation to enable the detection and subsequent penalising of drivers of heavy vehicles speeding over a distance as opposed to instantaneous (fixed point) detection. To achieve the requirements of the legislation and to present evidence at court to inform participants of the nature of the site, various surveys need to be undertaken. Such surveys need to be of varying accuracy. This paper presents the method of determination and certification of the Shortest Practicable Distance (SPD), the methods used to detect vehicles and the various surveys needed to provide supporting information. The legislation requires that the distance so determined must be accurate to 0.01 kilometres, i.e. 10 metres. Various methods were considered to achieve this accuracy in a timely and accurate manner. In considering any method of measurement, the method of detection of a vehicle at the terminals of the SPD length is useful to understand.

KEYWORDS: *Average speed camera, surveying, shortest practicable distance*.

1 INTRODUCTION

The Road Transport Legislation Amendment Act (Traffic Offence Detection) Act 2009 (No. 50) has being introduced in NSW to prosecute drivers that exceed the legal "average speed limit" within a designated Point-to-Point (P2P) Speed Enforcement Zone. Each P2P length will have a measured "Shortest Practicable Distance" (SPD). The SPD is that distance between each detection point which is the shortest possible path that a vehicle can legally travel along the road, i.e. crossing over broken lane/centre lines.

The terminals of the P2P length will be within a detection area linked to a detection sensor (e.g. loops, radar 'video'). The sensors will detect each vehicle, identify it and record the registration numbers. Any offending vehicles will then be infringed.

2 LEGISLATION

The Road Transport (Safety and Traffic Management) Act 1999 No. 20 was amended with the inclusion of section 43A. The legislation specifies that only heavy vehicles are to be infringed and outlines the method for calculating the average speed for single or multiple speed zones. There are also further infringements that can occur within a P2P zone. A P2P zone is defined in the Act as being within approximately 300 metres of the cameras. Such an infringement is attempting to avoid detection, e.g. crossing to other side of road or driving around the site.

43A Average speed of heavy vehicle is evidence of actual speed in certain circumstances

The pertinent clauses that impact the type of survey are:

(a) *the average speed of the heavy vehicle* calculated in accordance with this section is admissible and *is prima facie evidence of the actual speed at which a driver of the vehicle drove the vehicle on a road between the detection points*, and

(b) *the heavy vehicle and any of its drivers are*, for the purposes of calculating the vehicle's average speed and any average speed limit, *taken to have travelled between the detection points by means of the shortest practicable distance between those points regardless of the actual route taken by any of the drivers between the points*.

(4) **How average speed is to be calculated**

The average speed of a heavy vehicle between detection points is to be calculated in accordance with the following formula (and expressed in kilometres per hour rounded down to the next whole number):

$$\frac{D_T \times 3600}{T} \tag{1}$$

where D_T is the total shortest practicable distance (expressed in kilometres and rounded down to 2 decimal places) that could have been travelled by the vehicle on a road between the detection points. T is the journey time (expressed in seconds) of the vehicle between the detection points.

(5) **How average speed limit is to be calculated**

The average speed limit for a driver of a heavy vehicle on a road between detection points in circumstances where more than one speed limit applied to the driver between those points is to be calculated in accordance with the following formula (and expressed in kilometres per hour rounded up to the next whole number):

$$\frac{D_T}{\frac{D_1}{S_1} + \frac{D_2}{S_2} + \ldots \frac{D_n}{S_n}} \tag{2}$$

where D_T is the total shortest practicable distance (expressed in kilometres and rounded down to 2 decimal places) that could be travelled by the vehicle on a road between the detection points. S_1, S_2 … S_n are each of the speed limits (expressed in kilometres per hour) that would have applied to a driver of the vehicle if the vehicle were travelling along the shortest practicable distance D_T on a road between the detection points. D_1, D_2 … D_n are each part of the total shortest practicable distance D_T between the detection points (expressed in kilometres and rounded down to 2 decimal places) for the different speed limits S_1, S_2 … S_n that would have applied to a driver of the vehicle between the detection points.

3 DETERMINING THE SPD

When considering how to measure each P2P length, it was recognised that the road surface (not the horizontal) distance will be that travelled by a vehicle. The distances involved for the 22 P2P lengths vary from 6 to 70 km. They traverse varied terrain from very hilly to very flat and straight to very windy.

Normal methods of measuring were considered for the task of measuring the SPD but were found to be extremely costly and dangerous for the personnel. Therefore, the method that Roads & Maritime Services (RMS) adopted to measure the SPD is to use the GIPSICAM (Global-Inertial Positioning Systems Image Capture for Asset Mapping) van.

This paper will not go into the intricacies of GIPSICAM. Suffice to say that it captures images (jpegs) as it travels the road. It is equipped with two GNSS receivers, inertial systems, odometers, computers and cameras; and software for processing the raw data and images collected by the vehicle. The images are able to be geo-referenced. GIPSICAM is calibrated on an established test site within two months prior to and after a SPD survey. The baseline has been measured and certified by a registered land surveyor using GNSS equipment, total station and 100-metre band all calibrated to Australian standards.

During a SPD survey, GIPSICAM has a daily calibration procedure and runs the length three times in both directions. From the data extracted, the surface distance can be obtained and spot coordinates obtained (Figure 1).

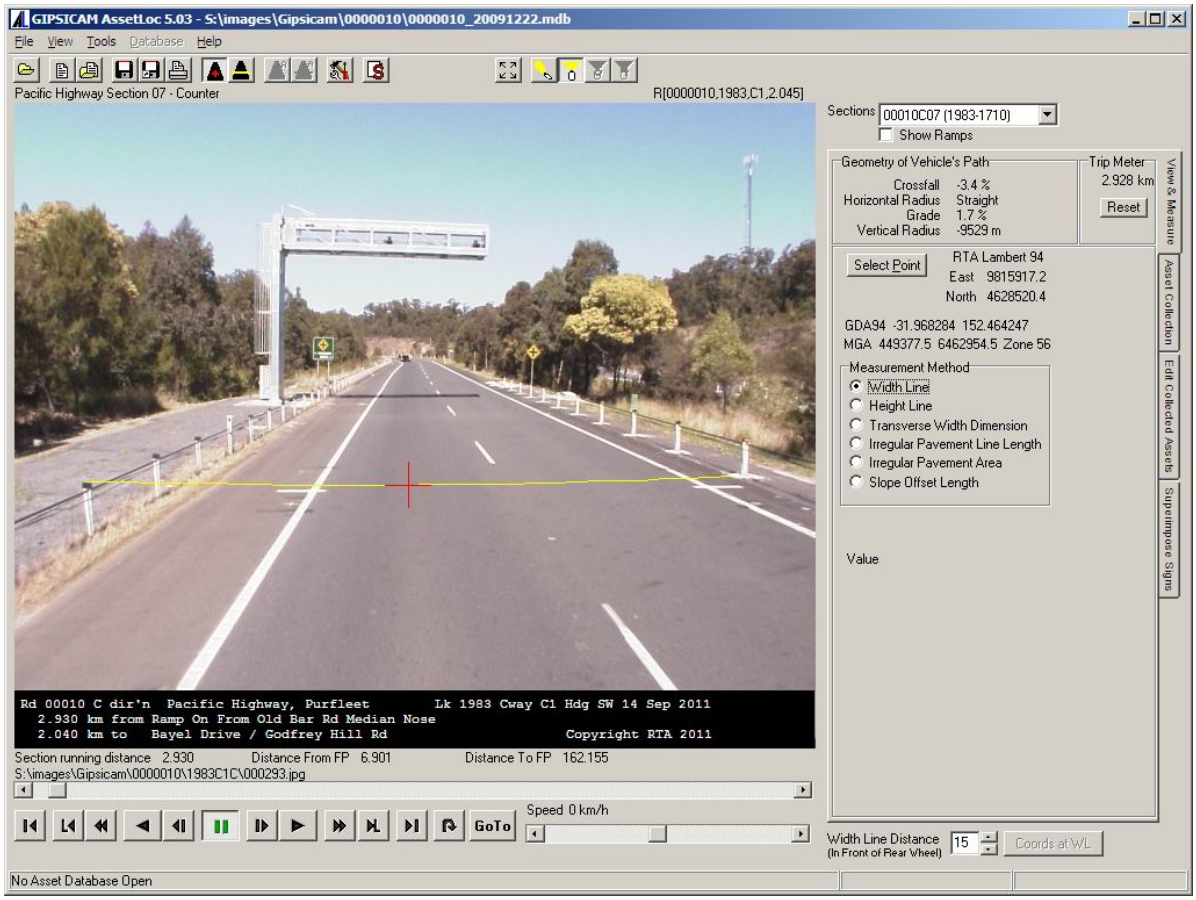

Figure 1: GIPSICAM image showing cursor position.

The SPD is to be taken as the distance of the shortest travel path of a vehicle. This can be determined on screen by the operator, less all possible distance and positioning measurement errors to ensure that there is no possible path length shorter than that determination. It can be seen from Figure 2 that the deflection in the vehicle path is not the same as the road curve deflection, and may be zero in some cases.

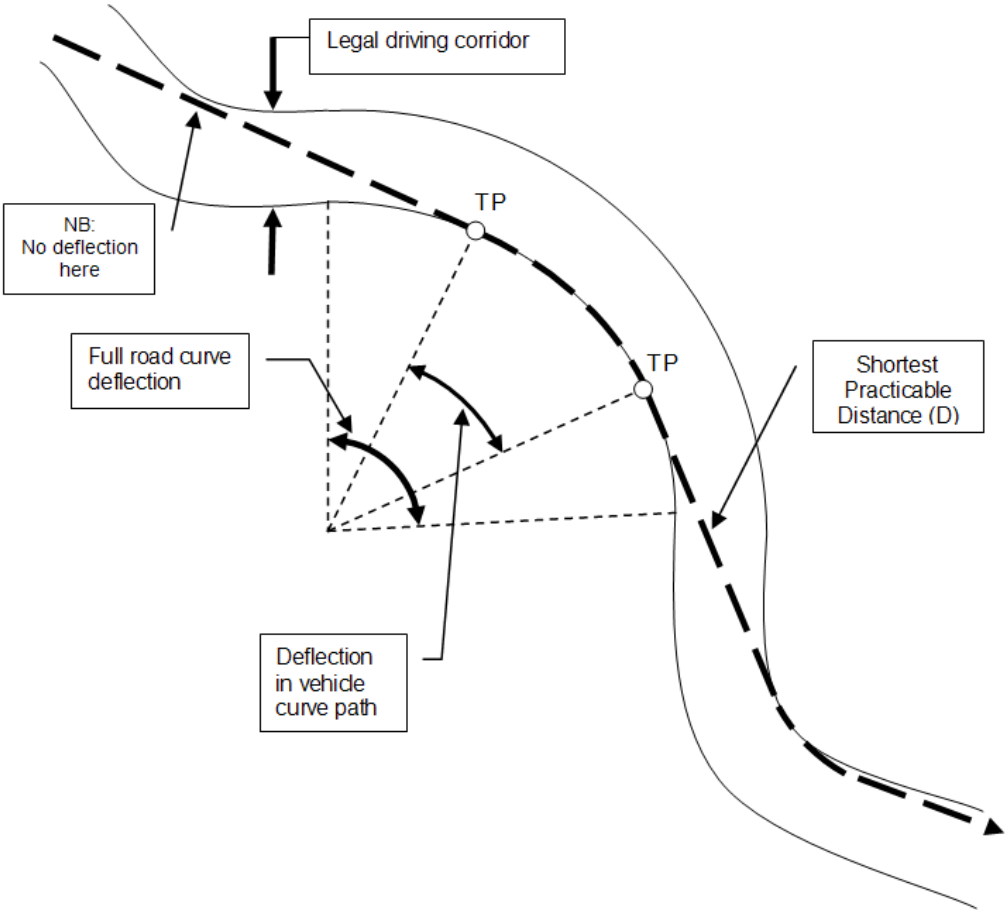

Figure 2: Deflection in the vehicle's path.

4 METHODS OF DETECTION

There are currently three methods that vehicles are detected entering and exiting these lengths. These are discussed in this section.

4.1 Inroad Sensors

This type of detection is used for fixed digital speed cameras, traffic lights, etc. The type used to date in this program is known as Loop-Loop as there are two loops a set distance apart (Figure 3). These are able to perceive the magnetic signature of a vehicle twice. The second time is to confirm that it is the same vehicle.

Figure 3: Inroad sensor loops seen in the road.

4.2 'Video' Technology

'Video' technology uses infrared cameras to detect 'hot' pixels on a vehicle – in particular the number plate. A number of images are taken in a short period of time (sub-second), compared and the clearest image adopted as the vehicle being detected. Figure 4 shows the corners of the footprint of each of four infrared cameras at this site. The detection point for the purposes of certifying the SPD is taken as the last moment that a vehicle enters the length and the first moment that a vehicle leaves the length. This is to ensure that the driver is not disadvantaged.

Figure 4: Corners of the footprint of each of four infrared cameras at this site.

4.3 Radar

To date radar is not in use on any site in NSW. That will change when a length south of Sydney comes online. Radar is self explanatory. The difficult part is determining where the point of detection will be so as to certify the SPD. The point of detection is affected by the speed of the vehicle.

5 OTHER SURVEYS

5.1 Location

A location sketch (A4 size) is prepared of the overall length to show its geographic location (Figure 5). Importantly, on this sketch the locations of all regulatory speed signs are shown, including the signs immediately before and after the length. This is to establish, at court, exactly what and where each speed sign showed the speed limit. This is to avoid the argument that the driver was unaware of the limit, especially if there are multiple speed zones.

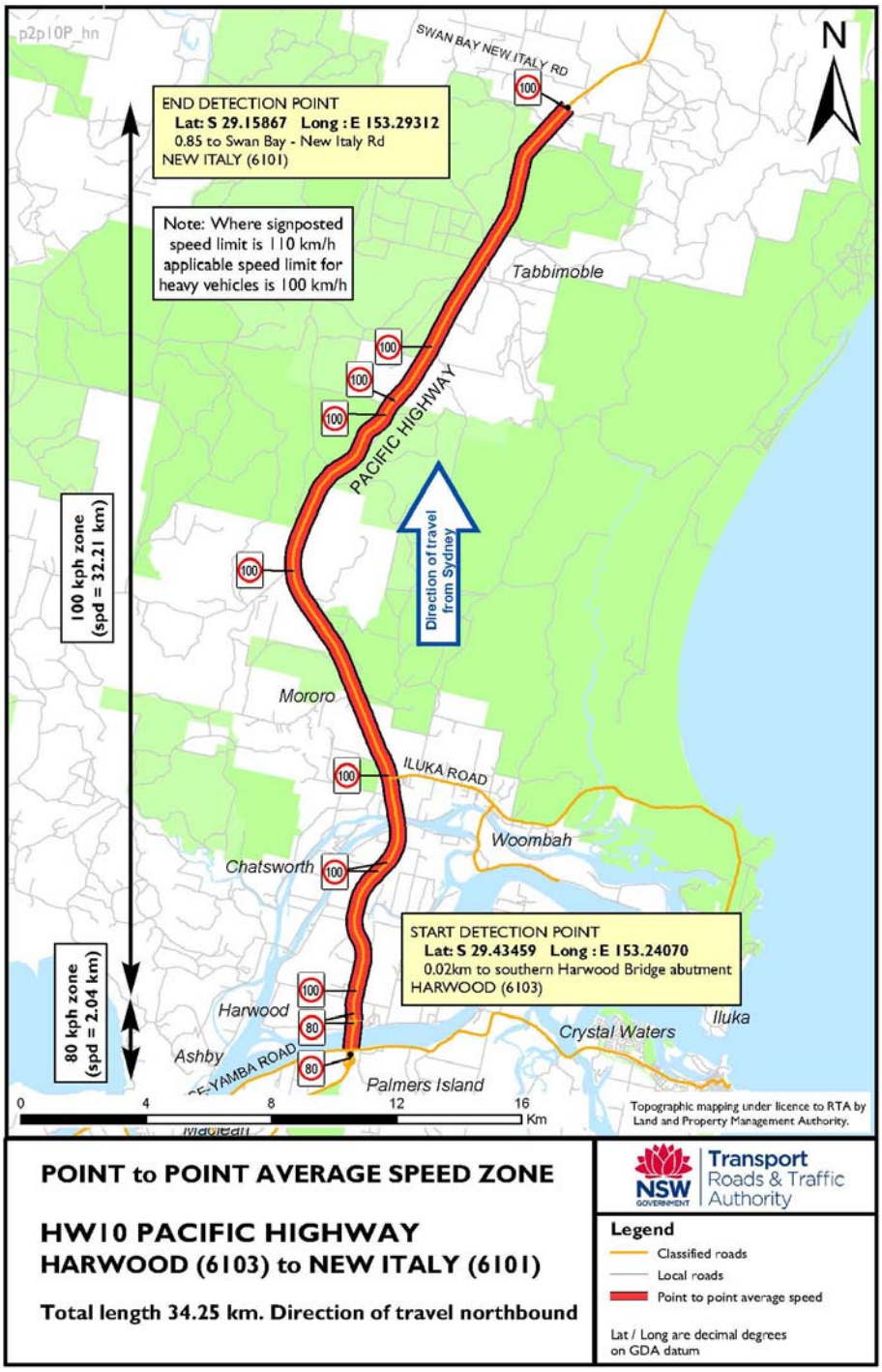

Figure 5: Location sketch showing the overall length of the Harwood to New Italy site (Pacific Highway).

5.2 Detail Survey

Warning signs are placed about 150 metres either side of the detection area. It is between these signs that vehicles can be infringed for other matters, e.g. avoidance or wilful damage. Therefore, a detail survey is prepared of the site that includes these signs and is generally fence-to-fence wide (Figure 6). The purpose of this plan is to present an image of the site for those that do not visit it, e.g. the court.

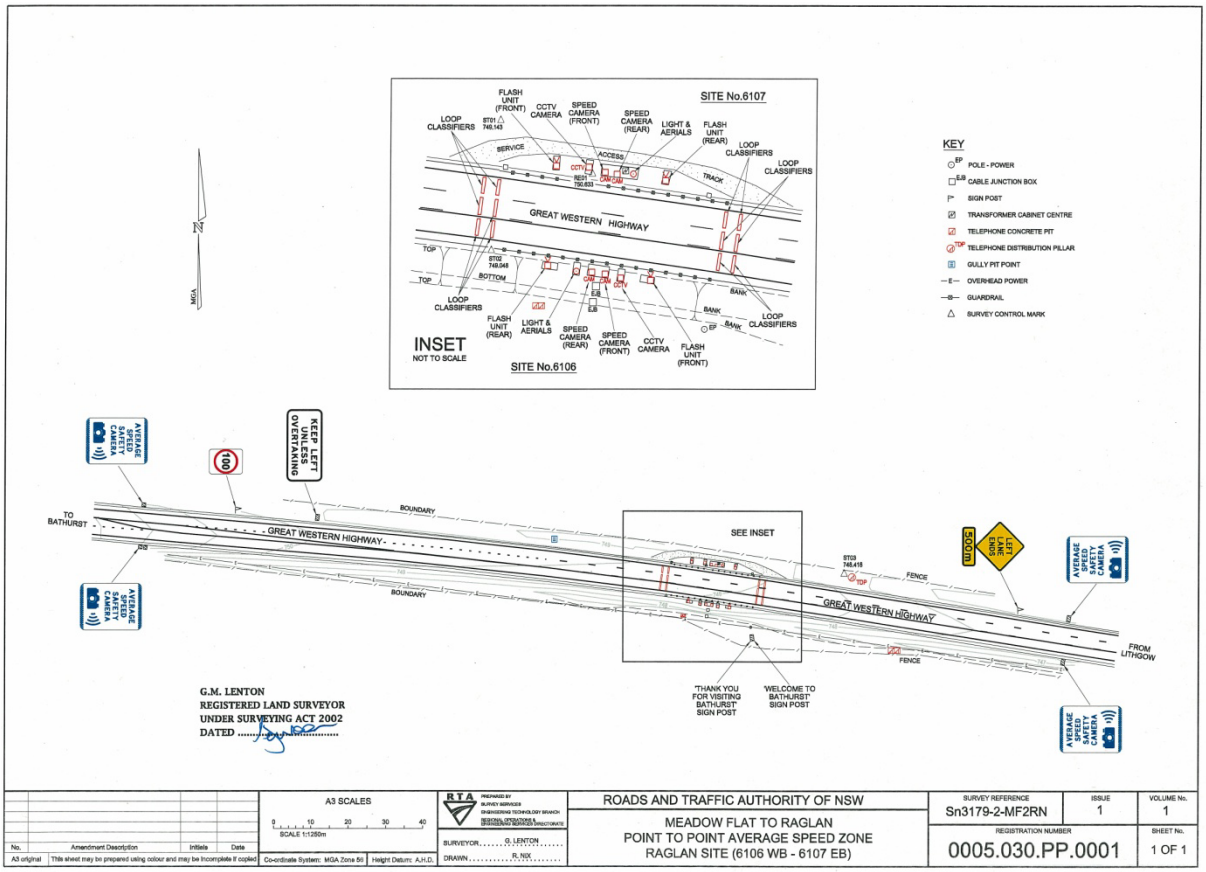

Figure 6: Detail survey plan for the Raglan site (Great Western Highway).

6 CONCLUDING REMARKS

The survey branch of Roads & Maritime Services was presented with the task of establishing a process of surveying and documenting the requirements of new legislation. This paper has described the survey work involved.