Background Paper 4

Traffic Speed

VICTORIA State Government | Department of Transport

Contents

Other elements of the project can be found at: https://www.vicroads.vic.gov.au/safety-and-road-rules/vehicle-safety/construction-trucks-and-community-safety

Any photos, figures or illustrations where a source is not provided should be assumed to be produced by the combined authors and organisations acknowledged below.

Produced in 2020 as part of the Construction Truck and Vulnerable Road User project, Department of Transport, Victoria. The first iteration of the main document was commissioned by Melbourne Metro Rail Authority (now Rail Projects Victoria) and developed by the Aurecon Jacobs Mott MacDonald joint venture.

Department of Transport, 1 Spring Street Melbourne Victoria 3000

1. Introduction

This paper forms one of a series of background papers relating to issues around the safety and provision for pedestrians and cyclists at roadworks. It provides additional details and information for use by practitioners.

Speed is a critical factor in crash severity and there are specific issues around pedestrian and cycle safety around roadworks that should be considered.

This document was developed to support the “Safety Essentials: Accommodating Pedestrians and Bicycle Riders at Temporary Road Works” summary document. This project was undertaken for the Construction Truck and Vulnerable Road Safety project.

2. Background

AS 1742.3 Manual of uniform traffic control devices – Traffic control devices for works on roads (2019) prescribes that the use of temporary speed zones at works on roads are to be adopted for workplace safety and traffic safety. The standard further acknowledges that the speed limit applied to an area should not exceed the maximum safe speed of travel depending on pedestrian activity, however, does not provide further direction on what speeds should be adopted under what circumstances.

Research shows that when average travelling speeds are reduced, fatal crashes reduce at a rate up to four times the reduction in average travelling speed (Cameron & Elvik, 2008), (Department of Transport and Main Roads, Data Analysis Unit, 2015). There are other studies indicating that a reduction in traffic speed reduces the risk of injury and fatalities amongst VRUs. Figure 1 provides statistics on the chance of pedestrians surviving when being hit by vehicles at different speeds, indicating that an increase in speed decreased the survival chance of pedestrians.

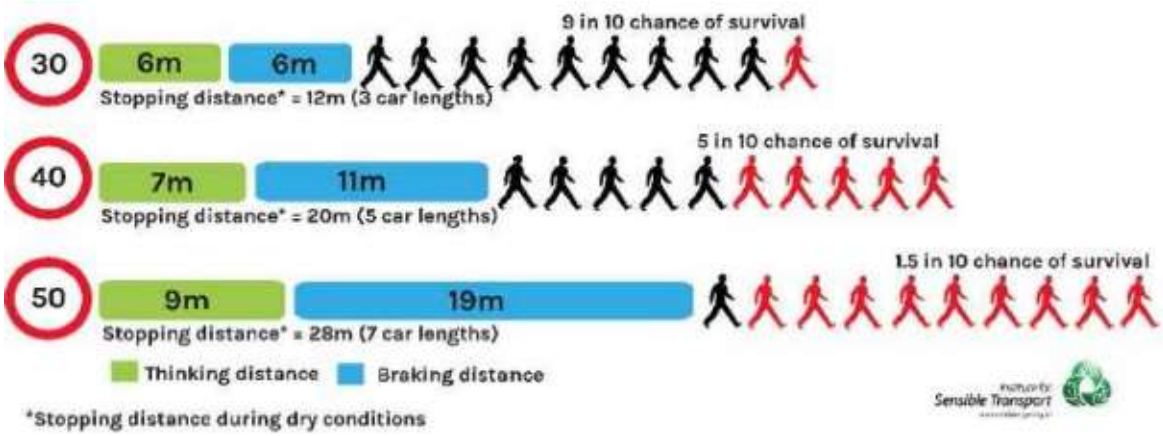

FIGURE 1: CAR STOPPING DISTANCE PEDESTRIAN SURVIVAL STATISTICS[1]

The safety of VRUs when selecting speeds around construction sites should be a prime consideration, especially in dense urban surrounds where VRU activity is likely to be high. For example, the gazetted speed within Melbourne’s CBD is 40 km/h which may not be appropriate around construction sites where construction traffic and heavy pedestrian and cycle movements are to co-exist.

The following provides a multi-pronged approach for the selection of safe vehicle speeds around construction sites and associated signage for implementation. In addition to providing selection criteria, the chapter summarises the findings of a speed case study carried out as part of the Metro

[1] Yarra Ranges Council, Integrated Transport Strategy, 2020-2040

Tunnel Project in Melbourne. The study monitors the success of an implemented speed reduction around a construction site that requires cyclists and vehicles to merge into a shared road space.

This document was developed to support the “Safety Essentials: Accommodating Pedestrians and Bicycle Riders at Temporary Road Works” summary document. This project was undertaken for the Construction Truck and Vulnerable Road Safety project.

3. Speed Selection Criteria

As noted, VRU safety should be a key factor when determining suitable vehicle speeds around construction sites. A suitable relationship between vehicle speeds and VRU protection needs to be established. Protection of the vulnerable road user group can be obtained through appropriate speed limit implementation or the provision of separation, which in turn can be spatial (separation by distance) or physical (separation by object). The most appropriate protection through speed and / or the provision of separation for VRUs should be assessed on a site by site basis. The following should be considered and assessed when selecting temporary vehicle speeds around construction sites, to ensure safe and practicable operation:

- Volumes of cyclists, pedestrians and vehicles as well as modal priority in the area;
- Construction traffic volumes and manoeuvres;
- Roadway width and clearance between vehicles and cyclist envelope
- Alignment of road

Where speeds are reduced, appropriate measures need to be in place to ensure compliance to the altered limit. Figure 2 provides a suggested selection criteria process to ensure appropriate speeds for both pedestrians and cyclists.

Cyclists that share the road space with vehicles are particularly at risk owing to their proximity to moving traffic, as well as the size of heavy vehicle blind spots, where cyclists can find themselves in positions where drivers are unable to see them.

The following table provides recommended temporary vehicle speeds depending on the cyclist infrastructure. Where permanent vehicle speeds are to be maintained, appropriate, separated cycle infrastructure should be considered.

Description	Temporary Vehicle Speed	Other Requirements	Suitable Application
On-road, shared (no designated cycle lanes)	20 km/h (or lower)	• Streets that carry < 3000 vehicles per day • Monitoring of speed behaviour • Suitable signs highlighting bicycle presence and priority, and potential presence in the centre of lanes • Potential traffic calming measures where speeds are reduced 20km/h or more than under permanent conditions	• Where off-road bicycle facilities are not practicable • Where roads have permanent narrow widths or are constrained around construction sites
On-road bicycle lane	30 km/h (or lower)	• Streets that carry < 3000 vehicles Monitoring of speed behaviour • Potential traffic calming measures where speeds are reduced by20km/h or more compared to the permanent conditions	• Where off-road bicycle facilities are not practicable

Protected bicycle lane	30 km/h - 50 km/h	• Cycle lanes, both midblock and at intersections, are required to frequently be maintained, as cyclists are not able to deviate easily from their path if obstructions are in the way	• Where parking is prevalent • Raised separation can be provided to physically prevent vehicular access to the bicycle lane and provide clearance for the opening of car doors.
Fully separated path to vehicles; off-road	50 km/h or higher	• Adequate separation to cyclists • Signs indicating where users should ride	• Where construction vehicles volumes are high and • Where vehicle volumes are high • Where speed reduction is not preferred

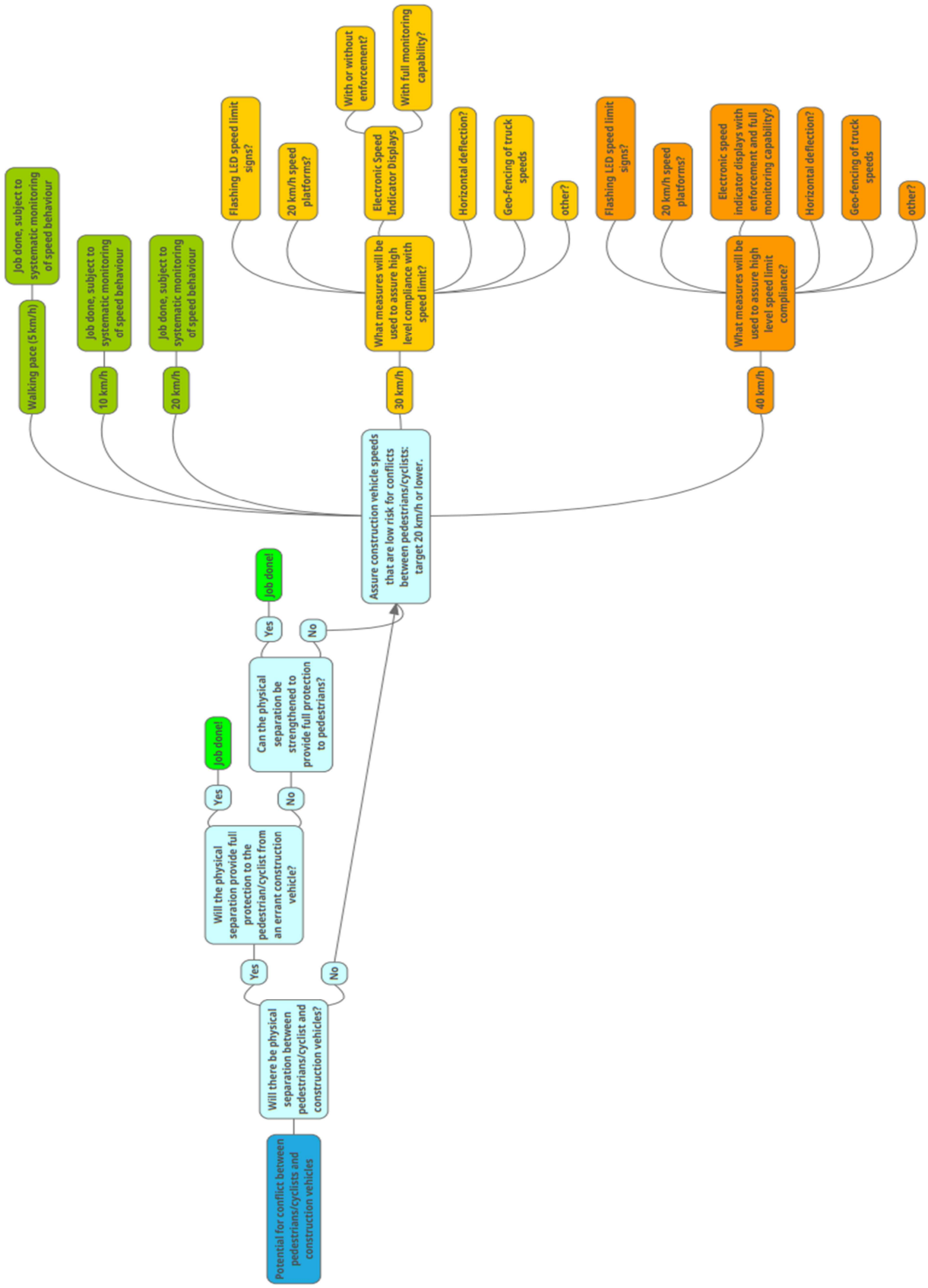

FIGURE 2: SPEED SELECTION CRITERIA[2]

[2] Corben Consulting

3. Speed Signage

3.1 Cyclist Signs

Cyclists that share the road space with vehicles are particularly at risk owing to their proximity to moving traffic, as well as the size of heavy vehicle blind spots, where cyclists can find themselves in positions where drivers are unable to see them. Consideration should be given to speed differentials particularly when cycles are forced to share a traffic lane, or a narrower lane, from the existing condition. When any cycle lane is closed, and cyclists forced to merge this differential can put cyclists at severe risk. This particualty the case on 70-90 kph arterial roads which have marked on road bike and parking lanes. Closing these lanes can force cyclists to merge unsafely with high speed traffic and speed reduction measures are required.

Where cyclists are to share the road space with vehicles, appropriate signs indicating their presence should be provided, especially if the treatment differs from permanent measures. Figure 3 and Figure 4 provide suggested signs.

FIGURE 3: BICYCLE PRIORITY ROUTE SIGNING

FIGURE 4: 'WATCH FOR CYCLISTS'

3.2 'Reduce Speed' Sign

AS 1742.3 (2019) makes no provision for the use of temporary REDUCE SPEED signs at road worksites. However, Main Roads Western Australia (2015) states in their variations to AS 1742.3 (2019) that from experience it has been found beneficial to erect REDUCE SPEED signs where the approach speed of traffic is high and vehicles must slow down.

FIGURE 5: REDUCE SPEED SIGN

Reducing vehicle speed around worksites, provides drivers more time to react if pedestrian and cyclists veer into their path of travel, which is more likely to occur around construction sites, where their infrastructure is temporarily altered.

The use of the G9-9 signs "REDUCE SPEED", specified in the Australian Standards as under permanent conditions is recommended for temporary roadworks. Details of the sign are in AS 1742.1 (2014).

The sign should be positioned so that the reason for the reduction in speed is apparent and the signs are simultaneously visible to approaching drivers. REDUCE SPEED signs used for works on roads must always be used in conjunction with all other advance warning devices and signs. They must not be used in place of any other required warning signs.

3.3 'Dwell on Red' Sign

In areas of high pedestrian use around construction sites, particularly at night, traffic lights can be changed to rest on red permanently and only switch to green when a vehicle is in the vicinity. This measure helps ensure traffic speeds are low on approach to the lights. It is suggested that this is a good measure where there are high volumes of trucks operating 24 hours per day.

3.4 Case Study: Lloyd Street

As part of the Metro Tunnel Project, the Principal contractor carried out work underneath the Lloyd Street rail bridge, located in Kensington, north-west of the Melbourne CBD.

The road configuration under the bridge prior to the works comprises of one traffic lane, a designated on-road cycle lane and footpath in each direction, with a bridge footing and median strip separating the two directions. The posted speed limit on Lloyd Street is 40km/h, with an advisory turning speed of 20km/h for vehicles travelling northbound as they turn under the bridge

The work carried out by the Principal contractor required the temporary closure of the existing southbound lane under the bridge. As a result, the northbound traffic lane was widened with the removal of the median and the on-road cycle lane to accommodate for the southbound traffic lane. The pedestrian footpath in the northbound direction remained in place. During the works, advance signs were placed well outside of the construction area to inform users that the on-road cycle lane on Lloyd St, in particular under the bridge was closed with cyclists diverted away from Lloyd St at Arden St to the north and at Dynon Rd to the south. However, for cyclists who continued to use Lloyd St despite its closure, they would need to merge into the traffic lane on the approach to the bridge. This was implemented through placement of signs and the use of 'sharrow' pavement markings. The speed along Lloyd St in the vicinity of the site was reduced from 40 km/h to 20 km/h on the approach and through the site in both directions

The work was deemed an appropriate site to trial, measure and analyse the effectiveness of implementing speed reduction adjacent to a construction site used by both vehicles and cyclists. Surveys were carried out prior and during the works measuring vehicle and cyclist volumes and their speed on the approach and under the bridge in both directions.

The data was collected by setting up Automatic Traffic Count (ATC) Data loggers at three locations around the proposed works between the 8th and 14th of September 2018 (i.e. prior to the works) and between 14th and 20th December 2018 (i.e. during the works) as per Figure 5 78. The three locations are:

- Location 1: Lloyd Street, 40 m west of Redcliffe Street (2 loggers)
- Location 2: Lloyd under the bridge on the north side (2 loggers)
- Location 3: Lloyd Street, 120 m south of Arden Street (2 loggers)

It is noted that during the works, cyclists and vehicles share the traffic lane at Locations 1 and 2 but not at Location 3.

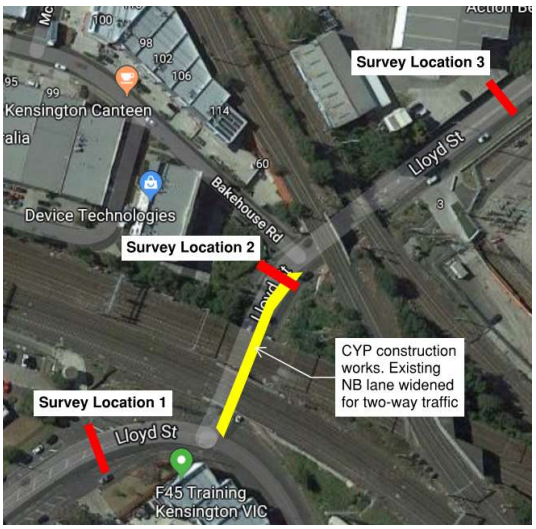

FIGURE 6: SITE SURVEY LOCATIONS

Case Study Speed Results

The following figures provide a summary of the survey results taken prior and during the construction works at the three locations. Figure 7 to Figure 9 provide the mean vehicle speeds (dashed line) and mean cycle speeds (solid line) from the surveyed days in the northbound (blue) and southbound (red) direction during permanent conditions (i.e. prior to the works in September 2018). Chart 2 shows the

mean vehicle and cyclist speeds during the construction works in December 2018 while Chart 1 provides a comparison of the average speeds across the two survey periods.

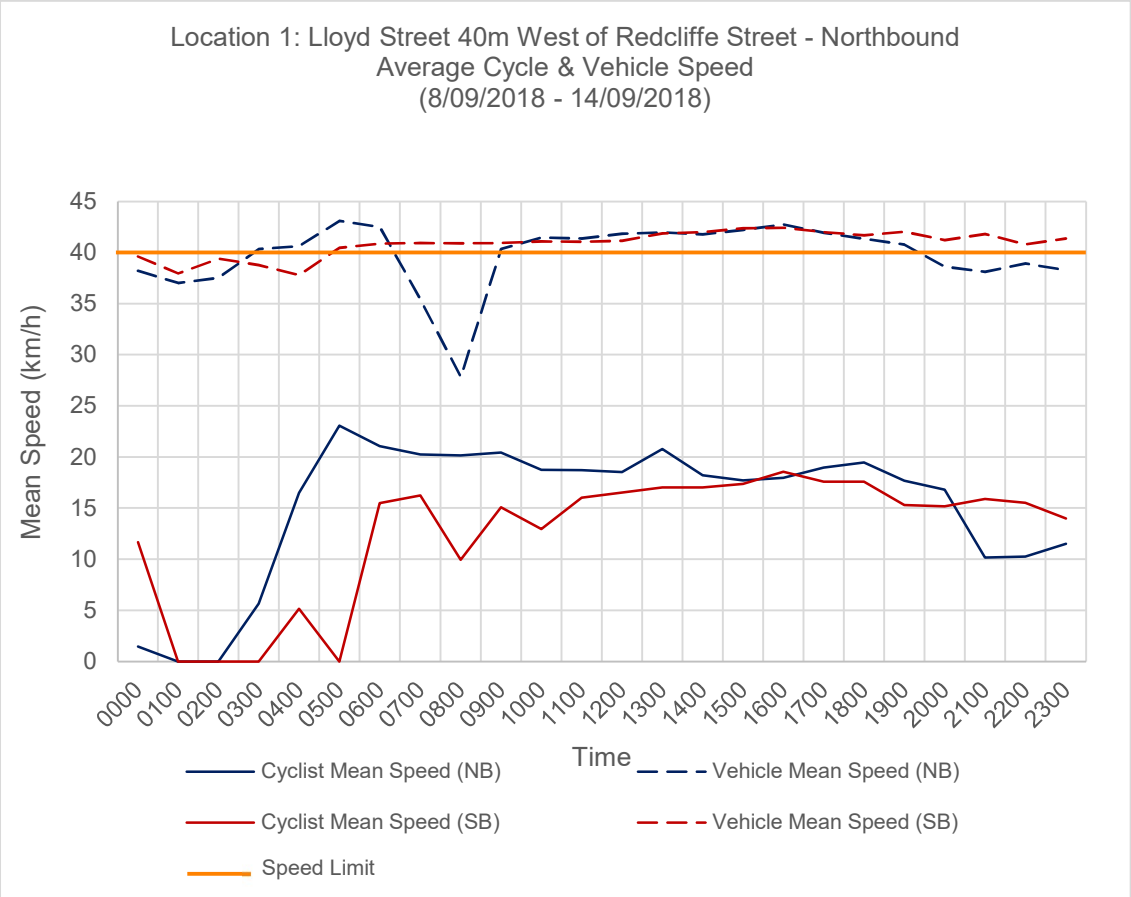

FIGURE 7: LOCATION 1 CYCLIST AND VEHICLE MEAN SPEED – PERMANENT OPERATION

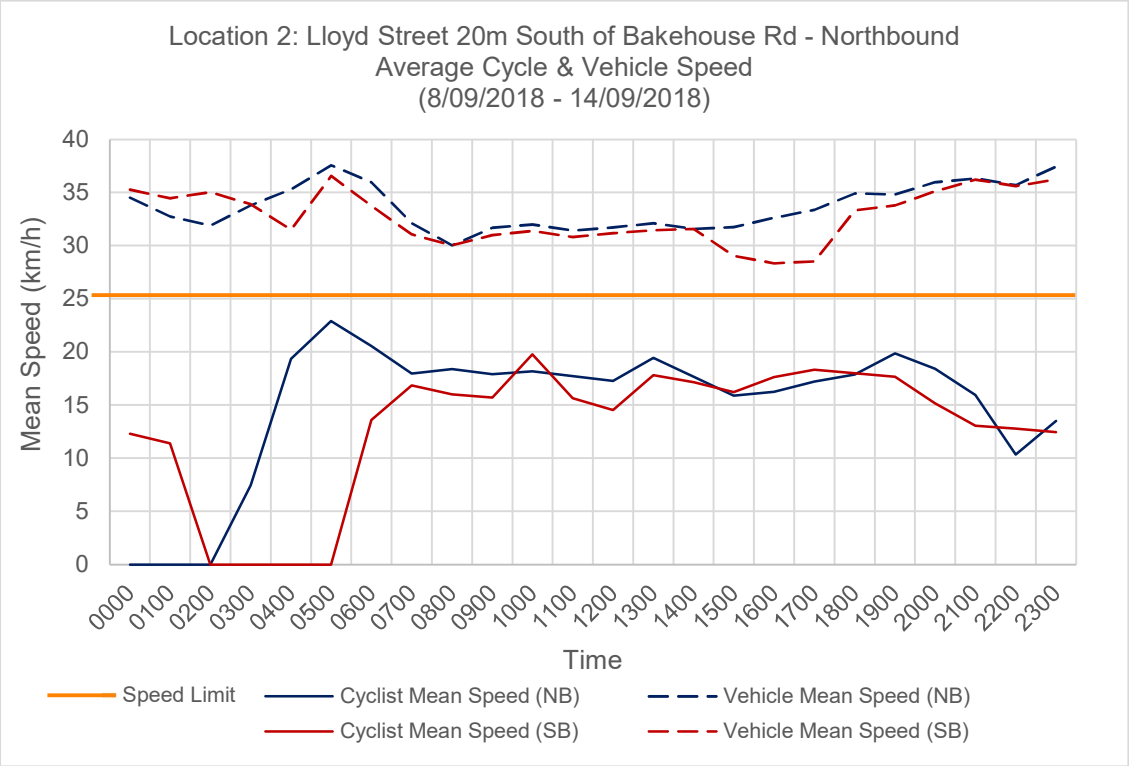

FIGURE 8: LOCATION 2 CYCLIST AND VEHICLE MEAN SPEED – PERMANENT OPERATION

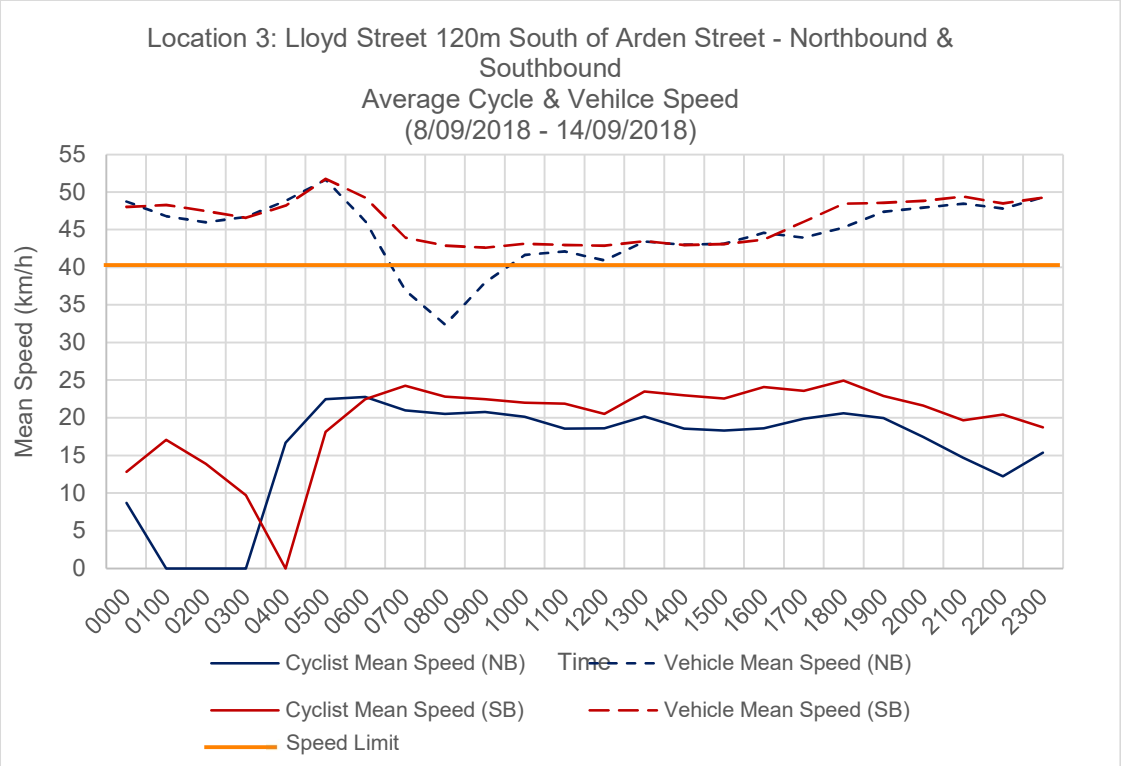

FIGURE 9: LOCATION 3 CYCLIST AND VEHICLE MEAN SPEED – PERMANENT OPERATION

In the permanent operation, the survey results show that vehicles on average are:

- travelling at the speed limit at Location 1 (on the approach to, or departure from, turning under the rail bridge);

- travelling below the posted speed limit at Location 2 (under the rail bridge), and;
- travelling above the posted speed limit at Location 3 (on a straight alignment at a slight grade).

Cyclists' speeds are on average between 15-km/h and 20 km/h at Locations 1 and 2, and between 20 km/h and 25 km/h at Location 3.

These speeds generally mirror the alignment and design of the road. It is likely the motorists and cyclists are ignoring the posted speed but driving and cycling in a way that feels safe.

Case Study Results Discussion

As Chart 1 shows, there was not a significant difference in the cycle or vehicle speeds between the prior and during works assessment. Chart 1 below shows diagrammatically how cycle speeds tended to increase when works were occurring, and vehicle speeds decreased.

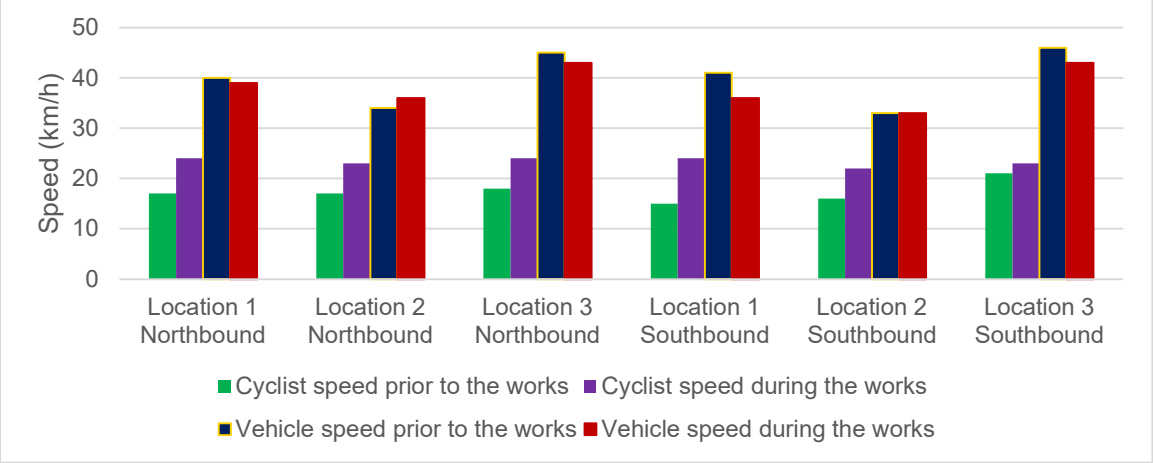

CHART 1: AVERAGE SPPED COMPARISONS PRIOR AND DURING WORKS

Chart 2 further narrows this down to just the data collected during the works and comparing this to the speed limit. The lower the speed limit, the more likely the average motorist, or even cyclist, will exceed the limit. As per the data collected prior to the works, these speeds also mirror the design of the road. The increase in cyclist speeds may be attributed to the decrease in motorist speeds, as the cyclists feel safer.

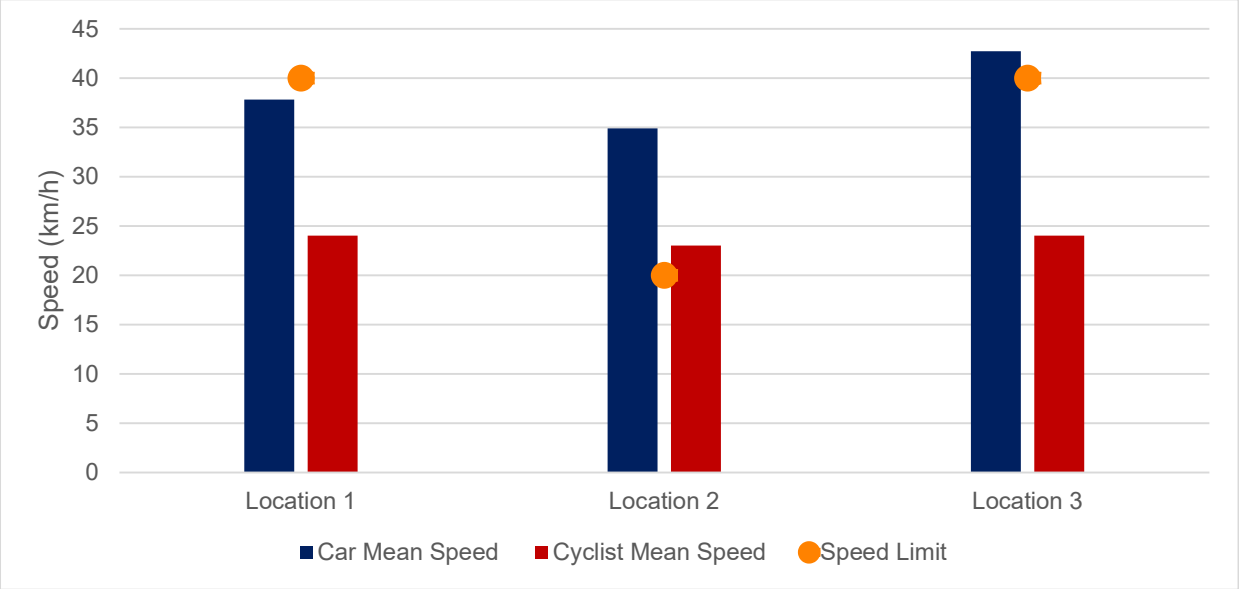

CHART 2: VEHICLE AND CYCLIST SPEED DURING WORKS

To further examine the speed profile, the following charts (Chart 3- Chart 8) log all the vehicle and cyclist speed recorded at each of the three locations.

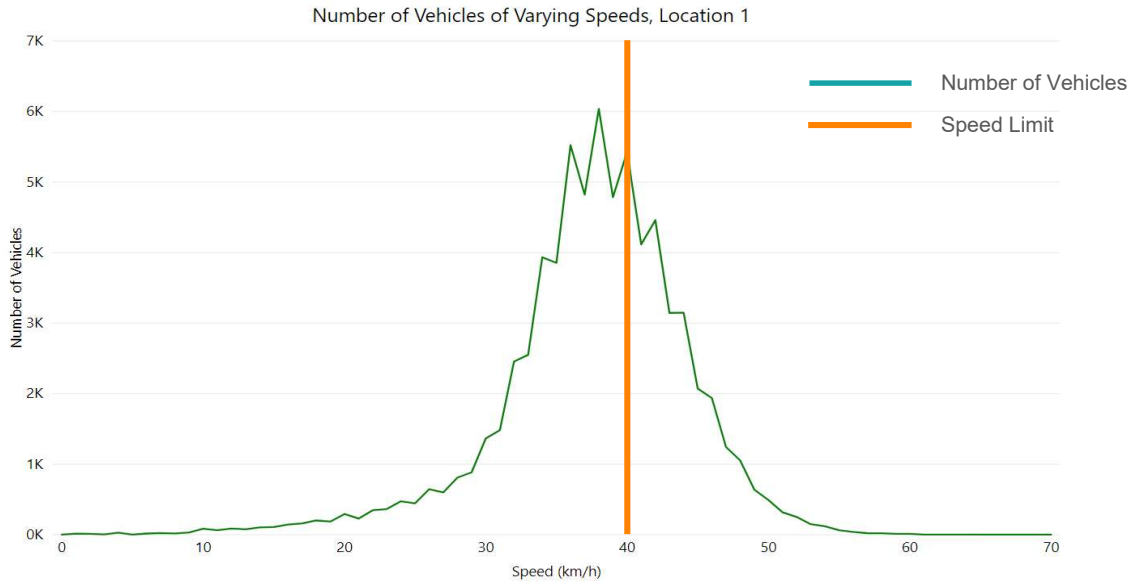

CHART 3: COLLECTED VEHICLE SPEEDS, LOCATION 1, 14TH – 20TH DECEMBER 2018

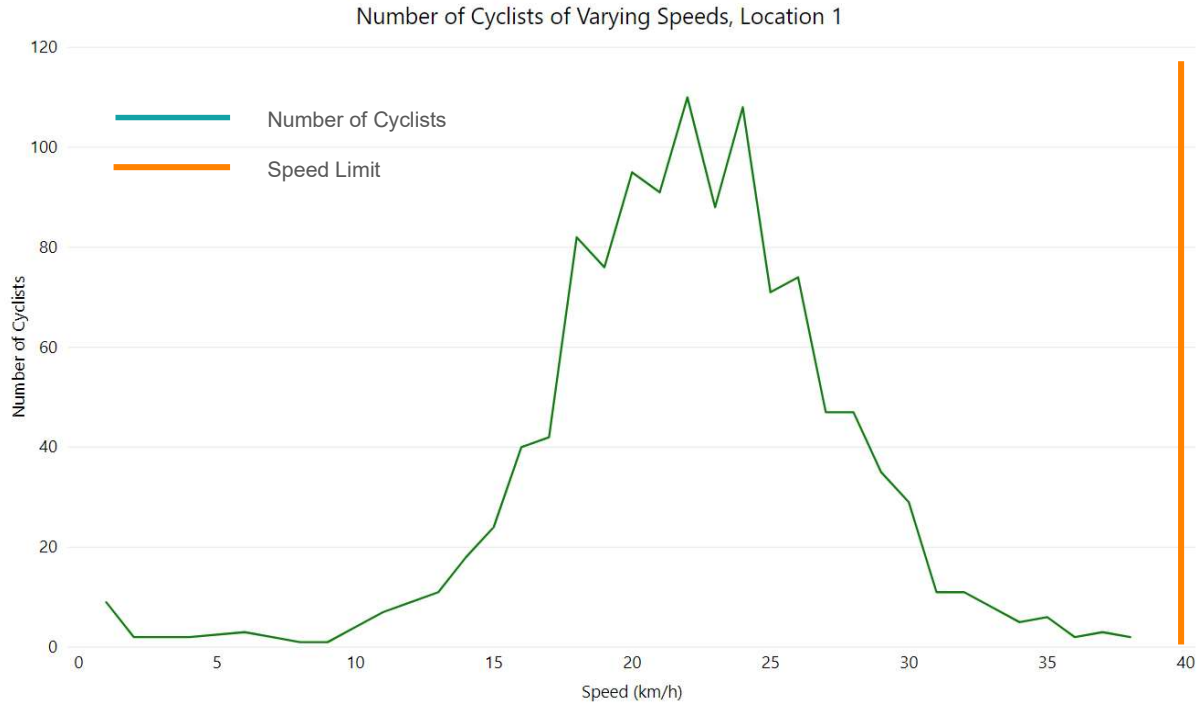

CHART 4: COLLECTED CYCLIST SPEEDS, LOCATION 1, 14TH – 20TH DECEMBER 2018

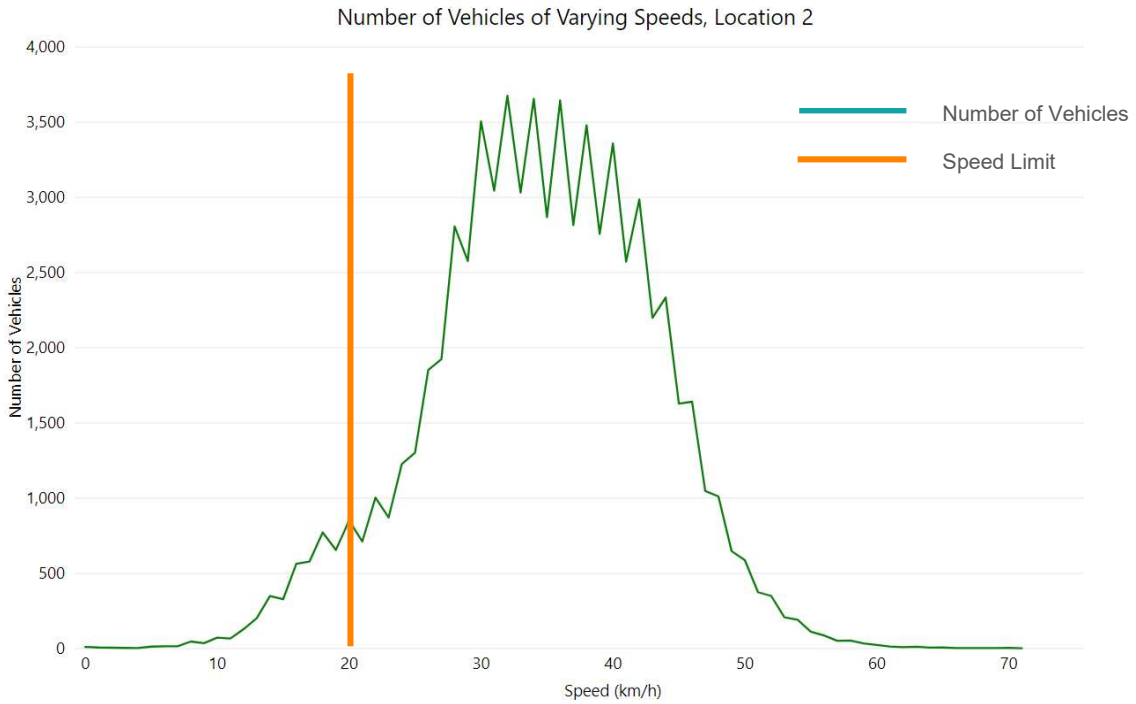

CHART 5: COLLECTED VEHICLE SPEEDS, LOCATION 2, 14TH – 20TH DECEMBER 2018

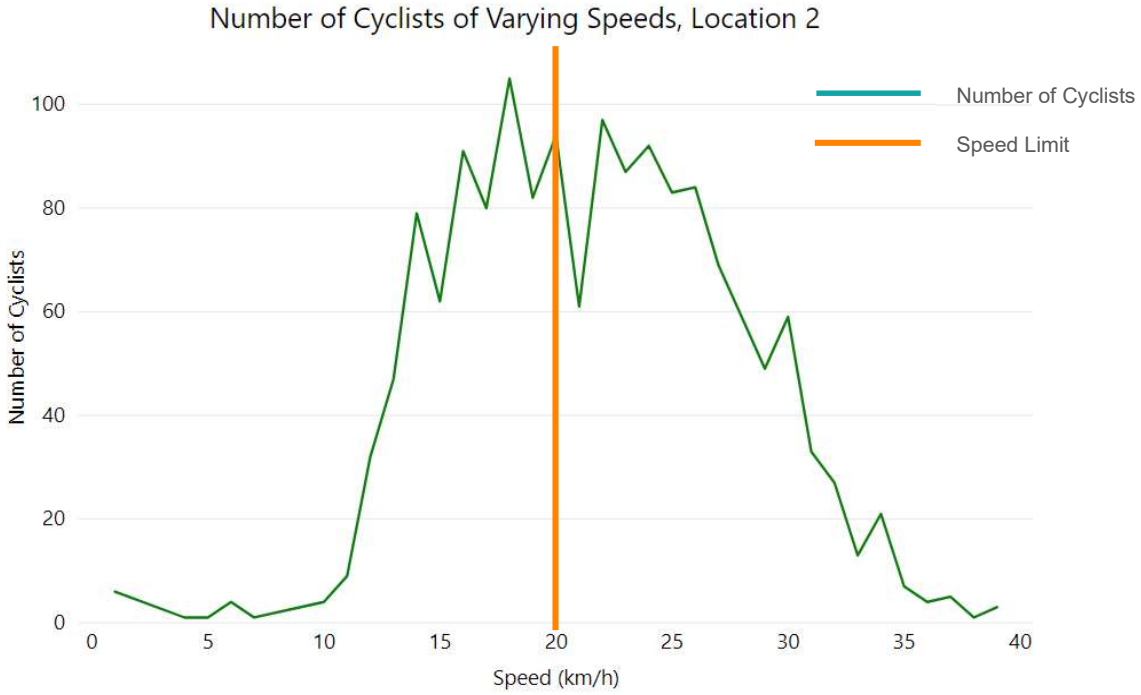

CHART 6: COLLECTED CYCLIST SPEEDS, LOCATION 2, 14TH – 20TH DECEMBER 2018

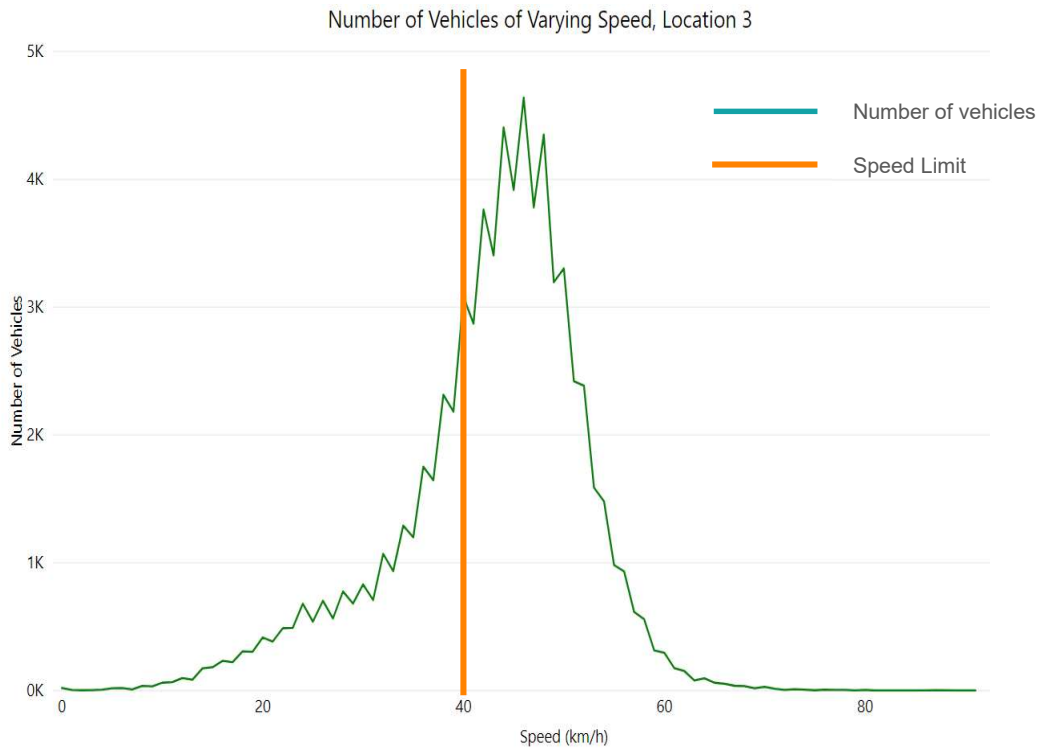

CHART 7: COLLECTED VEHICLE SPEEDS, LOCATION 3, 14TH – 20TH DECEMBER 2018

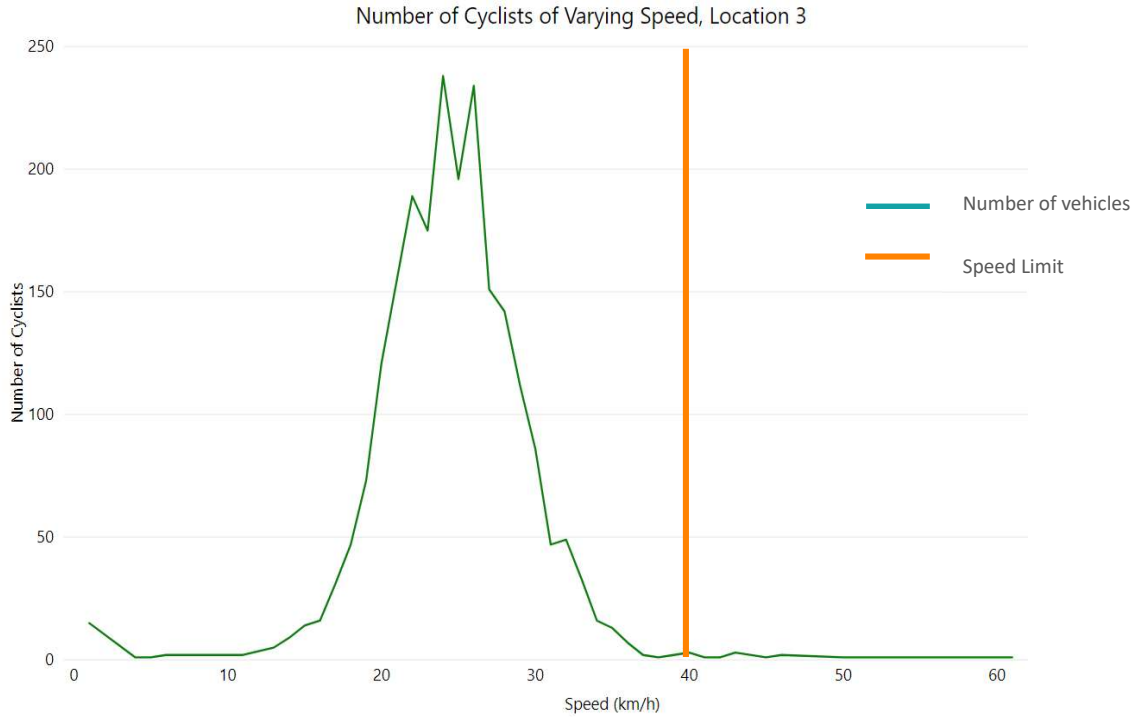

CHART 8: COLLECTED CYCLIST SPEEDS, LOCATION 3, 14TH – 20TH DECEMBER 2018

Case Study Conclusion

The analysis shows that lowering the speed limit along Lloyd St had minimal effect in reducing vehicle speed. The signs did little to slow vehicles to the proposed speed limit as they travel along adjacent to the construction site. In fact, of the three surveyed locations, the only location with an increased vehicle travel speed was the one with the proposed 20km/h speed reduction.

Why did cyclists' speed increase?

Results also show that cyclists were travelling at a higher speed across this area compared to the permanent operation. One of the key changes to the road condition is the introduction of the shared traffic lane adjacent to the works. While cyclists get to travel in front or behind vehicles in the shared traffic lane, however they may also feel pressured to increase their speed if vehicle speeds are not reduced to a perceived level comfortable to the cyclist. Cyclist speed was higher within the shared traffic lane compared to if they were riding in the dedicated bicycle lane adjacent to the traffic lane.

Based on this case study, the use of speed sign (an Administrative control under the risk hierarchy) and introduction of the shared traffic lane environment were insufficient to reduce vehicle speed through this area. Whilst cyclists were diverted outside the site onto the associated cyclist detour routes and notwithstanding other potential factors that may contribute to this outcome (e.g. visibility of the signs, congestion levels, driver behaviour, etc), however the recommendation is that traffic management plans for construction sites should show how vehicles will be slowed, in addition to speed limit signage, to protect vulnerable road users.

Construction sites should consider:

- Adequately separate cyclists from the traffic flow,
- Narrow the traffic lane width to slow vehicle travel speeds further, whether by construction barriers or by temporary kerb and channel,
- Provide alternative traffic calming or speed devices in the road that requires slower speeds e.g. rumble strips

This additional separation from the construction site would also provide improved safety for both pedestrians and onsite workers as the vehicle flow is likely to be further away and travelling slower than without changes.

4. Conclusion

This document has explored a number of issues relating to speed and the safety of pedestrian and cyclists around roadworks. Speed is very important when it comes to the severity of crashes, particularly for vulnerable users. Speed reduction should not just be about of road workers but all those in the area of the works. Even where works do not require traffic lane closures practitioners should consider how both pedestrians and cyclists navigate around footpath and cycle lane closures and if reduced speed limits are required for this to occur safely.

5. References

Yarra Ranges Council, Integrated Transport Strategy, 2020-2040

Australian Standards AS 1742.3 (2019) Traffic Control for Works on Roads

Nilsson's Power Model connecting speed and road trauma: Does it apply on urban roads, Cameron & Elvik, 2008

Department of Transport and Main Roads, Data Analysis Unit, 2015).

Traffic Management for Works on Roads: Code of Practice, Main Roads Western Australia (2015)

Australian Standards AS 1742.1 (2014) General Introduction and Index of Signs