

Before a Commissioner
Appointed by the Christchurch City
Council

Under the Resource Management Act 1991

In the matter of a resource consent application for a free standing digital
billboard at 235 Manchester Street (RMA/2020/1877)

Statement of Evidence of Andrew David Carr

15 February 2022

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Introduction

- 1 My name is Andrew (“Andy”) David Carr.
- 2 I am a Chartered Professional Engineer and an International Professional Engineer (New Zealand section of the register). I hold a Masters degree in Transport Engineering and Operations and a Masters degree in Business Administration.
- 3 I served on the national committee of the Resource Management Law Association between 2013-14 and 2015-17, and I am a past Chair of the Canterbury branch of the organisation. I am also a Chartered Member of Engineering New Zealand (formerly the Institution of Professional Engineers New Zealand), and an Associate Member of the New Zealand Planning Institute.
- 4 I have more than 32 years’ experience in traffic engineering, over which time I have been responsible for investigating and evaluating the traffic and transportation impacts of a wide range of land use developments, both in New Zealand and the United Kingdom.
- 5 I am presently a director of Carriageway Consulting Limited, a specialist traffic engineering and transport planning consultancy which I founded in early 2014. My role primarily involves undertaking and reviewing traffic analyses for both resource consent applications and proposed plan changes for a variety of different development types, for both local authorities and private organisations. I have previously been a Hearings Commissioner and acted in that role for Greater Wellington Regional Council, Ashburton District Council, Waimakariri District Council and Christchurch City Council.
- 6 Prior to forming Carriageway Consulting Limited I was employed by traffic engineering consultancies where I had senior roles in developing the business, undertaking technical work and supervising project teams primarily within the South Island.
- 7 I have been involved in assessing the road safety effects of around 55 proposed digital billboard installations throughout New Zealand. My role has been as both a peer reviewer for the council receiving the application and also providing supporting reports for applicants. As a part of this work, I have reviewed in detail over 70 published research papers regarding digital billboards and I have also commissioned my own research in New Zealand, which I understand to be the first of its kind in the country.

Code of Conduct for Expert Witnesses

- 8 While this is not a hearing before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2014 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of evidence

- 9 My role in relation to Wilson Parking New Zealand's application for consent for signage at 235 Manchester Street, Christchurch has been to provide advice in relation to effects of the billboard upon road safety, including on and the safe operation of the nearby traffic signals. As part of my work I provided a review of these effects (**the Transportation Assessment**), dated 2 February 2021, which forms part of the AEE.
- 10 I largely adopt the findings of the Transportation Assessment for the purposes of this Statement of Evidence, and as such I have not repeated much of the report other than what is necessary as background information when responding to a particular matter. However I have taken the opportunity to ensure that the report is up-to-date, noting that it was prepared over a year ago. This forms the first section of my evidence.
- 11 I am aware that when considering whether to notify the application, Christchurch City Council requested a review of the Transportation Assessment from Mr Axel Downard-Wilke of consultants Viastrada Limited. Mr Downard-Wilke raised several matters (his memorandum dated 26 February 2021). I took the opportunity to speak with Mr Downard-Wilke during January 2022 in respect of the content of his February 2021 memorandum. During our conversation he confirmed that each of the matters raised remains 'live', and so a response to these forms the second section of my evidence.
- 12 The third section of my evidence is a response to the submitters that have raised traffic and transportation matters, with the final section being a response to the Council officers' reports.
- 13 As a resident of Christchurch and traveller along Manchester Street, I am very familiar with the site. However I visited the site specifically to assess matters relating to the proposed billboard in January 2021 and January 2022.

Executive Summary

- 14 I have reviewed the Transportation Assessment that I produced early in 2021, and which accompanied the application. I confirm that there have been no material changes to the prevailing environment from a transportation perspective and that the conclusions of the Transportation Assessment remain valid.
- 15 The report prepared by Mr Downard-Wilke for the notification decision, and the report he prepared for the s 42A report, are very similar. I have reviewed and responded to both.
- 16 It appears to be common ground between Mr Downard-Wilke and myself that there is no visual overlap between the proposed billboard and three of the four signals at the Manchester Street / Gloucester Street intersection. There is overlap only for the signal head on the southwestern corner of the intersection (which he refers to as Signal Pole 5), but this overlap does not arise in the southbound traffic lane for general traffic at the point where drivers need to decide whether to stop at the traffic signals or not.
- 17 Rather, the overlap only occurs in the kerbside lane and only over a distance of 26m. This lane is used by buses to travel straight ahead and for general drivers to turn left (and the latter equates to peak hour flows of just 20 vehicles). I have considered the effects of the proposed billboard on each of these movements and consider that these will be negligible. This is largely because I consider it highly likely that drivers will be looking towards the traffic signals that are directly in front of them, and paying less heed to Signal Pole 5 which is on the diametric opposite corner of the intersection.
- 18 Importantly, the main role of this particular traffic signal is not to advise drivers whether to stop or not, but to advise them when to restart after they have already stopped.
- 19 I have considered the matters of vertical overlap of the signals and of driver colour-blindness, but do not consider that either of these are particularly pertinent to the effects of the proposed billboard. I remain of the view that as a driver approaches, the billboard will appear to move (visually) in relation to the billboard such that a driver will be well aware that the two are different objects, and very unlikely to confuse the two.
- 20 While Mr Downard-Wilke has proposed some interesting theories about road safety effects, in my view they are not substantiated by any evidence. I have assessed locations where there are also visual overlaps between traffic signals and billboards in circumstances where volumes and traffic speeds are greater than in this location, but these do not show any adverse

road safety effect. I have similarly been unable to find evidence of a latent road safety issue arising due to driver colour-blindness.

- 21 The submissions received typically raise general matters of road safety, which I responded to in detail within the Transportation Assessment. One submitter highlighted a particular research study, but this found that it could not be conclusively answered whether digital billboards constituted a road safety hazard or not. There has been a considerable amount of research since this study was produced 10 years ago.
- 22 I have reviewed the traffic-related conditions of consent set out in Ms Collie's evidence and confirm that these provisions remain appropriate.
- 23 Overall then, I remain of the view that it is very unlikely that adverse safety-related effects will arise from the operation of the billboard, and I am able to support the proposed digital billboard from a traffic and transportation perspective.

Updates to Assessment of Transportation Assessment

- 24 As set out above, the Transportation Assessment was issued in February 2021 and I have therefore reviewed the contents to ensure that it remains up-to-date.
- 25 The roading environment in the immediate area has not changed over the past year. I confirm that the speed limit on the road remains at 30km/h.
- 26 In Section 2.2 of the report I noted that this part of Manchester Street carried 5,500 vehicles per day but this survey was carried out in 2017. However this remains the most recent all-day survey.
- 27 In July 2020, peak hour surveys were carried out on this section of Manchester Street, which showed:
- (a) Morning peak hour
 - (i) 215 vehicles northbound
 - (ii) 330 vehicles southbound
 - (iii) 545 vehicles (two-way)
 - (b) Evening peak hour
 - (i) 397 vehicles northbound
 - (ii) 320 vehicles southbound

(iii) 717 vehicles (two-way)

- 28 These peak hour volumes are broadly aligned with what would be expected from the daily volume. Peak hour volumes are typically 10% to 12.5% of the daily flow, suggesting 550 to 690 vehicles (two-way), as seen here. I therefore conclude that the traffic patterns remain as taken into account within the Transportation Assessment.
- 29 The report identified that four crashes had occurred on Manchester Street for a distance of 100m north and south of the proposed billboard location (that is, encompassing the intersections of Manchester Street with Gloucester Street and Worcester Street). In the same area, for the calendar year of 2021 plus the part-year of 2022, no further crashes have been recorded, indicating that this part of the roading network continues to operate safely.
- 30 Over the past year, I have been involved in a number of other applications for digital billboards, and as part of this I have sourced and reviewed additional research papers over and above those which I referenced within the report. However this research does not change the outcomes which I set out in my earlier report. To summarise this:
- (a) the evidence suggests that there are certain ways in which a digital billboard can be operated which leads to adverse road safety effects. These include video/animation and/or flashing effects, interacting with the driver, sequential images (where one image needs to be read in conjunction with a previous image), brightness, and having a very short dwell time.
 - (b) Within New Zealand however, those ways of operation are controlled for (that is, eliminated), through conditions of consent.
 - (c) As such, I have been unable to identify any adverse road safety effects that have arisen from the operational of digital billboards within New Zealand.
- 31 I therefore confirm that the conclusions of the Transportation Assessment remain valid, that in my view it is very unlikely that adverse safety-related effects will arise from the operation of the billboard, and the proposed digital billboard can be supported from a traffic and transportation perspective.
- 32 On review, I note that the Transportation Assessment referred to primary, secondary and tertiary signals, and it may not have been clear where these are located. Since this is an important aspect of my evidence, below I set out the specific technical names and locations for each of the traffic signals.

I have also identified Signal Pole 5, which is the subject of the concern raised by Mr Downard-Wilke.

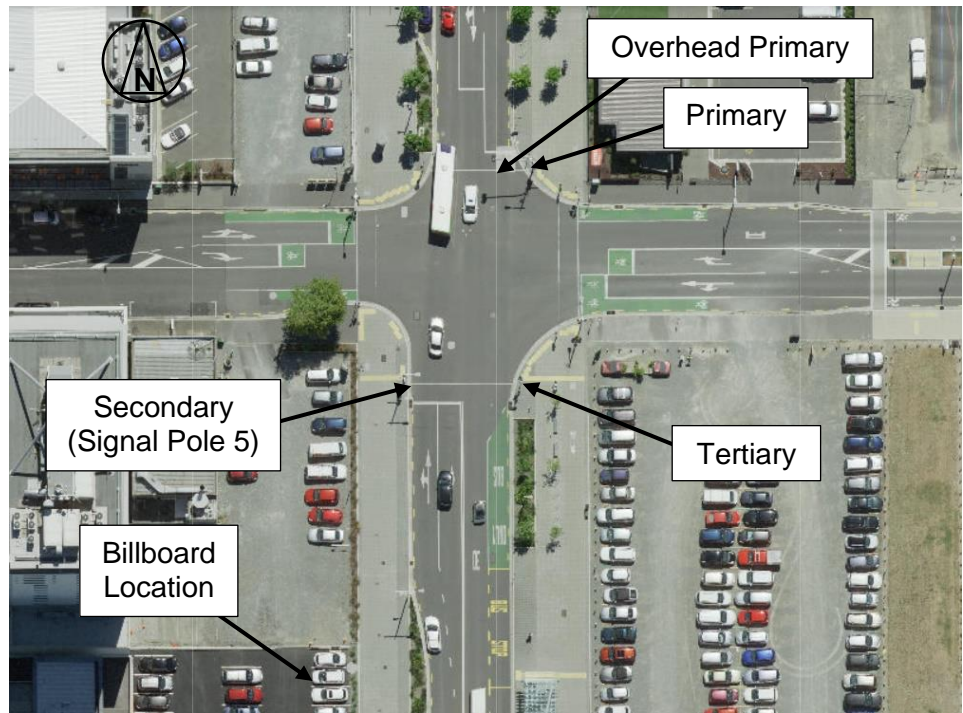


Figure 1: Names and Locations of Traffic Signals

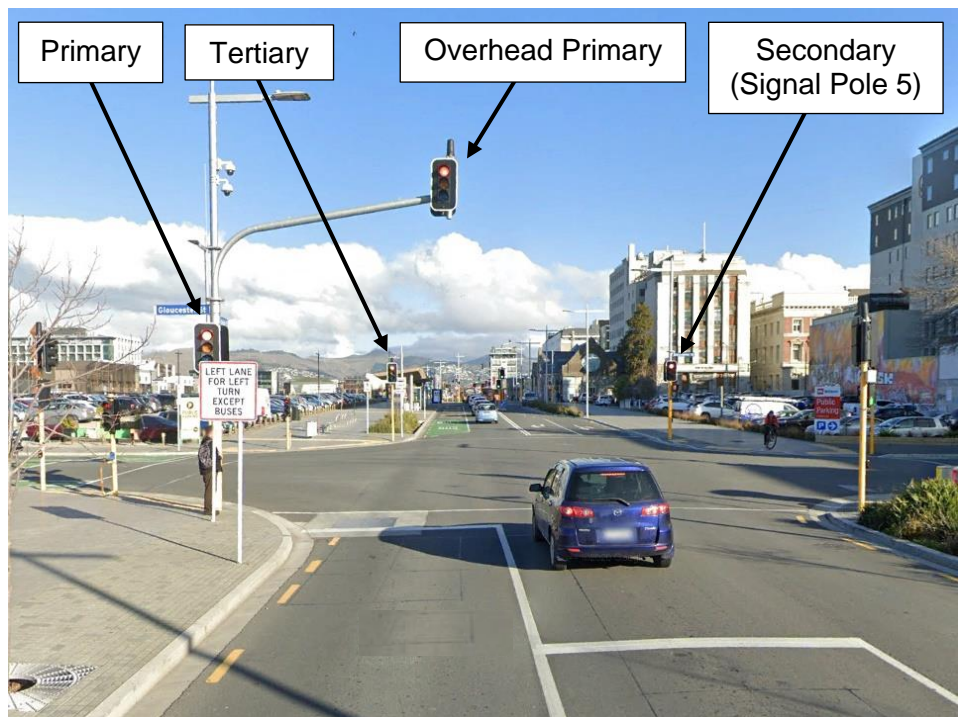


Figure 2: Names and Locations of Traffic Signals as seen by Southbound Drivers

Matters Raised in the Notification Memorandum

- 33 Within his February 2021 memorandum, Mr Downard-Wilke raised a number of matters relating to transportation and road safety. As I noted above, in my conversation with him in January 2022, he confirmed that each matter remained 'live' and so I have addressed each of these within this section for my evidence. For context, I have firstly summarised Mr Downard-Wilke's comments before responding.
- 34 Note that there is a degree of cross-over between the notification memorandum and Mr Downard-Wilke's subsequent report for the s 42A report. For clarity, this section of my evidence refers only to matters raised in the notification report.
- 35 The first matter raised (his sections 2.1.1 and 2.1.2) is whether a southbound driver will see a traffic signal lantern appearing to overlap with the billboard as they approach the Manchester Street / Gloucester Street intersection. Figure 9 of the Transportation Assessment shows that there is no visual overlap for three of the four signals whatsoever, and during our conversation, Mr Downard-Wilke confirmed that his concern related solely to the signal head on the southwestern corner of the intersection, which he refers to as Signal Pole 5.
- 36 The particular concern was twofold. The first matter (his paragraph 2.1.1) is that the Transportation Assessment assumed a typical vehicle speed of 40km/h (being the speed limit of 30km/h plus 10km/h) on Manchester Street, and used this to identify the Approach Sight Distance (**ASD**) for the traffic signals, being the distance at which drivers needed to be able to see the signals and judge whether to stop or not. However Mr Downard-Wilke considered that slower speeds of 35km/h or 30km/h might also regularly arise (his bullet points in paragraph 2.1.1) and sought an assessment at those speeds.
- 37 The second matter (his paragraph 2.1.6) was that while a detailed assessment of visual overlap was carried out in the horizontal plane view, a detailed assessment should also be carried out in the vertical plane, taking into account the different eye-heights of approaching drivers. The purpose of this was to see whether it changed the extent of visual overlap.
- 38 In respect of the latter, I have revisited the site to determine the heights of the lanterns. For Signal Pole 5 (the signal in contention) I find that these lie between 3.2m and 3.9m above ground level (being the bottom of the green lantern and the top of the red lantern respectively).

- 39 The billboard lies 39m south of the traffic signal. It will be 3m above ground level and be 6m in height.
- 40 Under the Austroads Guide to Road Design Part 3 ('Geometric Design'), the driver eye heights to be used in design are:
- (a) 1.1m for a passenger car
 - (b) 1.8m for a bus and
 - (c) 2.4m for a truck.
- 41 I have illustrated the approach used to assessing the vertical alignment and visual overlap in a graphic to the rear of my evidence in Annexure A. This is simply an example, as in practice the assessment is carried out using trigonometry to provide a more accurate value.
- 42 When considered in the vertical plane, the visual overlap of the signals commences at:
- (a) 14.1m from Signal Pole 5 for a passenger car
 - (b) 9.4m from Signal Pole 5 for a bus and
 - (c) 5.4m from Signal Pole 5 for a truck.
- 43 The vertical visual overlap then continues further north on Manchester Street (conceptually, this equates to the truck shown in Annexure A moving further left on the page).
- 44 Overall though, for there to be a visual overlap between the traffic signal and the billboard, there must be an overlap in both the vertical and the horizontal planes. As discussed above, the visual overlap in the vertical plane starts relatively close to Signal Pole 5 but at this point, Figure 5 of the Transportation Assessment shows that there is no overlap in the horizontal plane. Put another way, the signal lanterns will appear to be at the same height as the billboard to an approaching driver, but off to one side. There is therefore no overlap.
- 45 Slightly further north on Manchester Street, there is a visual overlap in the horizontal plane (as shown on Figure 5 of the Transportation Assessment) and also in the vertical plane.
- 46 However further north again, although there remains an overlap in the vertical plane, there is no overlap in the horizontal plane. So again, the

signal lanterns will appear to be at the same height as the billboard to an approaching driver, but off to one side.

- 47 In summary then, as a driver travels south on Manchester Street towards the signals, Signal Pole 5 and the digital billboard will appear to be the same height. Initially though, the billboard will appear to be on the right of Signal Pole 5. As the driver gets further south, the billboard will appear in the background of Signal Pole 5, and further south again, the billboard will appear on the left of Signal Pole 5.
- 48 Consequently I confirm that the full extent of visual overlap of the lanterns at Signal Pole 5 is shown on Figure 5 of the Transportation Assessment. The vertical alignment does not affect visual overlap in this particular instance.
- 49 Turning to the matter of ASD, Mr Downard-Wilke suggests several different parameters for use in the calculation. Within the Transportation Assessment, I calculated ASD of 40m, but taking the most conservative of Mr Downard-Wilke's parameters, he suggests 22m could be appropriate.
- 50 I am not aware that Mr Downard-Wilke has raised concerns with the accuracy of the visual overlap shown on Figure 9 of the Transportation Assessment, and have therefore taken this as my 'starting point' (although I discuss this further below). Using this, and taking into account the position of drivers on the road, the visual overlap for drivers in the kerbside bus lane arises at 14m to 40m from the 'stop' line and for drivers in the adjacent southbound general traffic lane arises at 0m to 15m from the 'stop' line.
- 51 Mr Downard-Wilke sets out that the ASD represents the last point at which a driver could be expected to stop if the signal changed from green to amber, and defines the area "*immediately prior*" to the ASD is a "*critical decision zone*" where a driver will decide whether to stop at the signals or to continue.
- 52 While not disagreeing with this, I highlight firstly that there is no visual overlap if his value of 22m ASD is used for the general traffic lane. Rather, the last point at which a driver can make the decision to stop is 22m from the stop-line, whereas the overlap only commences at 15m from the stop-line. The driver will have already made the decision about whether to stop before any overlap arises. Secondly, although there is visual overlap for vehicles in the kerbside lane, this occurs for only one traffic signal pole which is diametrically opposite to the position of the driver (and hence inconvenient to look towards), and there is no overlap on the remaining three poles. I discuss the subsequently, in my response to the s 42A report.

- 53 The Austroads Guide to Traffic Management Part 10 (*'Transport Control – Types of Devices'*) sets out the primary functions of each signal head. The primary and overhead primary lanterns have a principal function of *"warning approaching traffic of the state of the signals, and to stop traffic at the correct position"*. These are the signals on the northern side of the intersection, and there is no visual overlap on these signal heads.
- 54 Signal pole 5 (where there is visual overlap) is defined as a secondary signal and has a principal function of *"indicating to traffic that is stopped, the start of a running phase"*.
- 55 In other words, the visual overlap only arises at a signal which does not have a prime function of indicating to drivers whether to stop or not.
- 56 Mr Downard-Wilke discusses the roles of traffic signals in the s 42A report, and I therefore return to the topic later in this evidence.
- 57 I therefore remain of the view set out in the Transportation Assessment, that approaching drivers are highly unlikely to be looking towards that specific signal head but are far more likely to be looking to the signals that are closest to them as they approach. This view is reinforced by the Austroads Guide definitions, which sets out that those are the signals that are expected to be seen and evaluated by drivers as to whether to stop. From a practical perspective, as shown on Figure 7 of the Transportation Assessment (and Figure 2 above), these two signal heads are also visually far more prominent to an approaching driver.
- 58 I also note that because the billboard is 39m behind the signal head, even while there is visual overlap, the signal will visually appear to move across the billboard image as the driver approaches. This means that a driver is very unlikely to confuse the signal lantern as being part of the billboard. This is further reinforced by the traffic signal having a black backing board, which will visually isolate the signal lanterns from the billboard and further reduce the potential for confusion.
- 59 Finally, I consider it is also relevant whether in fact there is any evidence that overlapping of a signal head with a digital billboard gives rise to any adverse road safety effects. In the Transportation Assessment, I provided the example of the billboard at the George Bolt Memorial Drive, on the approach road into Auckland Airport. Mr Downard-Wilke queried whether there was a visual overlap in both the horizontal and vertical planes. In Annexure B to this report, I set out photographs taken at 55m from the stop-line of the adjacent intersection, showing the overlap of the primary signal

head with the billboard. To confirm, the primary signal head is one which is expected to inform drivers about whether to stop or not.

- 60 The photographs in Annexure B show that there is significant visual overlap of the primary signal head within the 'critical decision area'. This road has 20,000 southbound vehicles per day (nearly four times more than Manchester Street), and has a higher vehicle speed (meaning drivers have less time to react to, and avoid, any conflict). However no crashes have been recorded at this location due to drivers being distracted by advertising signs over the past ten years.
- 61 I therefore remain of the view that any visual overlap of the traffic signal will not give rise to adverse road safety effects.
- 62 Mr Downard-Wilke has highlighted the matter of drivers being red-green colour-blind, and therefore potentially being unable to differentiate between the colour of the traffic signals and the colours of the digital billboard (his paragraph 2.1.3).
- 63 In the first instance, Mr Downard-Wilke states that this risk occurs if the traffic signals change at exactly the same time as the billboard. This would occur extremely infrequently in my view, because the dwell time of the billboard is different to the signal timings, and so the two would not be in phase with one another. Moreover, such a change would also need to occur at the same time as a driver was within the critical decision zone, and the driver would need to be placing more emphasis on the secondary traffic signal, and disregarding the two primary signals (and the tertiary signal). This makes the scenario even less likely in my view.
- 64 Notwithstanding that, I have considered the matter of whether driver colour-blindness is a factor that should be taken into account. At the outset though, in my experience of assessing digital billboards, it is not an issue that has been raised previously. It is also the case that the wider traffic signage system in New Zealand relies on colour differentiation, and Waka Kotahi requires that "*drivers must instantly recognise traffic lights, indicator signs, hazard warning lights and stop lights*".
- 65 In reviewing research into this matter, I identified Cole BL. Colour blindness and driving. *Clinical and Experimental Optometry* 2016; 99, 484–487¹. Of particular interest is that colour-blind drivers identify problems in seeing

¹ <https://onlinelibrary.wiley.com/doi/full/10.1111/cxo.12396> accessed on 1 February 2021

brake lights and the colours of traffic signals (with 5-30% of drivers with colour-blindness making errors in naming colours). However people that are colour-blind are not prohibited from driving in New Zealand. Consequently, it would be reasonable therefore that with up 8% of males having this condition, and up to 30% of these having difficulties in naming colours, that there would be a high incidence of crashes where colour-blindness was cited as a contributing factor.

- 66 In order to assess this hypothesis, I carried out a search of the Waka Kotahi Crash Analysis System. I firstly found that there was no specific crash code for driver colour-blindness. Rather, there is simply a general code of “*defective vision*”, which I anticipate will cover a multitude of conditions. I then searched the entirety of New Zealand for the past ten years for crashes where ‘defective vision’ was noted as a factor. Between 2012 to 2021, there were 264 crashes recorded with this code, against a total number of 329,527 reported crashes. This equates to 0.08% of all reported crashes. By way of context there were 2,592 crashes where drivers were distracted by passengers in the vehicle, 3,493 crashes where a driver was dazzled, 3,774 crashes where drivers pressed the wrong pedal, and 14,540 crashes where drivers fell asleep.
- 67 In my view the number of crashes reported for vision-impaired drivers does not correspond to evidence of a significant adverse road safety effect arising from colour-blindness.
- 68 It could be argued that this is somewhat self-fulfilling in that there are few locations where billboards and traffic signals visually overlap, and hence there would naturally be no evidence of an effect. However, if the effect described by Mr Downard-Wilke was real and significant, I would expect that for those locations where there is a demonstrable overlap (the George Bolt Memorial Drive being just one example), then a higher crash rate would be present. This is not the case.
- 69 In fact, even if the crash records did not specifically record ‘defective vision’ as a factor, there should still be a higher incidence of crashes at locations where visual overlaps are present. Again, this is not seen.
- 70 I therefore do not agree with Mr Downard-Wilke that driver colour-blindness presents an inherent risk in this situation.
- 71 Within Section 4.2 of the Transportation Assessment, I discussed studies relating to crash rates around digital billboards, which showed no adverse road safety effect, as attached as Annexure A to that report. Mr Downard-Wilke raises questions as to whether any of these studied locations had the

billboard appearing as the background to traffic signals and within the critical decision zone. I have reviewed the locations of the 14 billboards identified and can confirm that at least four have a visual overlap with at least one traffic signal in the critical decision zone. However none of these showed any increase in crashes after the digital billboard was installed.

- 72 In conclusion, on reviewing his Notification Memorandum, in my view Mr Downard-Wilke has not presented any firm evidence to support his view of the proposed billboard potentially distracting drivers from observing the traffic signals. The matter of visual overlap for one signal head (Signal Pole 5) is mitigated by this being just one traffic signal head, which is used for advising drivers that have already stopped, when to restart. Conversely, there are two other signals (the primary signals) which have a main role of indicating to drivers whether to stop or not (and for completeness, a tertiary signal which also advises stopped drivers about when to start again) where there is no overlap.
- 73 If the value of ASD calculated by Mr Downard-Wilke is used (22m) then there is no visual overlap of Signal Pole 5 for southbound drivers in the general traffic lane within the critical decision zone.
- 74 The matter of assessment of visual overlapping in the vertical plane is of no practical relevance in this particular case, because the limiting factor is the horizontal overlap as evaluated in the Transportation Assessment. In other words, the effects arising from overlapping remain as previously assessed.
- 75 Even in the unlikely event that approaching drivers are only looking at this one signal head, it will appear to move across the face of the billboard, and so drivers will be easily able to differentiate that it is separate to the billboard. This is further reinforced by the traffic signal having a black backing board.
- 76 Finally, I have not been able to find any evidence of an adverse road safety effect arising when evaluating the matter of limited visual overlap of one traffic signal within the critical decision zone, even where traffic volumes and speeds are higher than at the application site. There is similarly no evidence of a latent road safety issue arising due to driver colour-blindness.

Matters raised by submitters

- 77 I have reviewed the submissions received on the application, and note that there are five that raise transportation matters. Each of these however raises the general matter of the billboard leading to adverse road safety effects through distracting drivers. I addressed this issue in considerable detail within the Transportation Assessment with reference to published

research, my own research, and evidence of crashes in New Zealand. To (heavily) summarise this, the manner in which digital billboards are operated in this country effectively eliminates those characteristics that are shown through research to result in adverse road safety effects. Therefore, subject to appropriate conditions of consent (as proposed), I do not consider that adverse road safety effects will arise from the proposal.

- 78 One submitter highlights concerns that cyclist and pedestrian priority in the area will be adversely affected. From a transportation perspective, I have not been able to identify any research that suggests pedestrians or cyclists are at increased risk of a collision in the vicinity of a digital billboard, but again, provided that suitable conditions of consent are put in place that control how the billboard operates, I do not consider that adverse road safety effects will arise.
- 79 One particular submitter raised road safety concerns and cited a specific study to underpin these. This is a 2013 article by Dukic at al² which used a sample of 41 drivers in Sweden to drive a route passing four electronic billboards during day and night conditions. My understanding of the context of the study is that the Swedish Transport Administration approved the installation of 12 digital billboards for a trial period with a view to assessing their effect on driving prior to determining whether digital billboards should be freely permitted, restricted or prohibited.
- 80 The conclusion of the paper was that “*electronic billboards have an effect on gaze behavior by attracting more and longer glances than regular traffic signs. Whether the electronic billboards attract too much attention and constitute a traffic safety hazard cannot be answered conclusively based on the present data*” (my emphasis). I note that the study was published in 2013, and subsequently far more data has become available from other studies as has the technology of digital billboards. The veracity of this study, as with any other research, needs to be considered with regard to the subsequent body of work in the same field.
- 81 That said, the study also made a number of other salient points:
- (a) Increased dwell time for an image will likely mean that drivers are less likely to look at the image, as it behaves more like a static billboard.

² Dukic, Tania & Ahlstrom, Christer & Patten, Christopher & Kettwich, Carmen & Kircher, Katja. (2013). Effects of Electronic Billboards on Driver Distraction. *Traffic injury prevention*. 14. 469-476. 10.1080/15389588.2012.731546.

The Dukic study used a 7-second dwell time, whereas a dwell time of 10 seconds (42% greater) is proposed in this case.

- (b) Fading between images is less distracting to drivers than fading to black before another image appears. This is the manner in which this billboard is proposed to operate³.
 - (c) The researchers noted *“As can be deduced ... a substantial number of drivers did not look at the electronic billboards at all, which is a strong indication that they actually can be ignored. We do not know whether drivers actively ignored the signs ... or whether drivers did not notice the signs at all.”*
 - (d) The researchers also noted that directional information was being given verbally to the participants by an experimenter within the car. Consequently drivers did not need to look at roadside directional signs as much, which may have decreased their gaze behaviour towards such signs, and thereby exacerbating the difference in gaze behaviour between digital billboards and static road signs.
- 82 Finally, the Dukic study took place on *“a three lane motorway with heavy traffic”* with vehicle speeds in excess of 50km/h. The roading environment was therefore considerably different to the environment of Manchester Street.
- 83 Of relevance to this application, I was aware of, and took into account, the Dukic study when preparing the Transportation Report.

Matters raised by CCC staff report

- 84 I have read the s 42A report prepared by Ms Brown, a Senior Planner at Christchurch City Council. With regard to traffic effects, Ms Brown relies on the reports of Mr Downard-Wilke, and so I have therefore responded to Mr Downard-Wilke’s report below. At the outset though, I note that Mr Downard-Wilke’s report for this hearing is largely an update of the earlier notification report.

³ In passing, Christchurch City Council has granted a large number of consents which allow the image to fade to black before the next image is displayed, disregarding this part of the research which clearly states this way of operation was found to distract drivers.

- 85 In his sections 3.1.1 to 3.1.2, Mr Downard-Wilke discusses ASD and the matter of whether there is a visual overlap of the secondary traffic signal. In my view, there is very little difference between his Figure 3 and my Figure 5 of the Transportation Assessment, and I note that Mr Downard-Wilke concludes that by his own calculations there is no overlap of Signal Pole 5 for traffic in the general southbound lane within the critical decision zone. As I set out in my paragraph 52 above, I agree with this conclusion. However he states (and I agree) that there is visual overlap for the kerbside traffic lane.
- 86 Given that Mr Downard-Wilke confirms that there is no visual overlap between Signal Pole 5 and the digital billboard for drivers in the southbound general traffic lane within the critical decision zone, this therefore meets his own criteria that “*it should be avoided to have an electronic billboard form the backdrop to any traffic signal display while a driver travels through a critical decision zone*” for this lane.
- 87 It is therefore unclear to me why Mr Downard-Wilke discusses the issue of the function of traffic signals (his paragraph 3.1.3). He states that in his view, drivers that are turning right at the intersection “*are most likely to look at Signal Pole 5*”. However he has already demonstrated that there is no visual overlap between Signal Pole 5 and the billboard for right-turning drivers within the critical decision zone. In my view then, this point is moot⁴.
- 88 In passing, Mr Downard-Wilke discusses the roles of various traffic signals in his section 3.1.3. Although the version of the Austroads Guide that he refers to was superseded two years ago, the broad concept of the table remains appropriate, and I generally agree with his comment that drivers may take their information from several different sources. However, his underlying assumption in this section appears to be that drivers would take their information only from Signal Pole 5, and simultaneously disregard

⁴ For completeness, I record that I disagree with the statement that right-turning drivers are “*most likely to look at Signal Pole 5*”. In essence, Mr Downard-Wilke is saying that drivers are most likely to look at one single traffic signal head that is located on the southern side of the intersection, while disregarding two other (primary) traffic signal heads that are located 30m closer to the approaching driver. Further, because the primary signal heads are closer to the approaching driver, they will appear larger and hence will be far more conspicuous. It is therefore not reasonable in my view to anticipate that drivers will only look solely towards Signal Pole 5 unless there is some compelling evidence for this. However I have not been able to identify any supporting information within Mr Downard-Wilke’s report.

information from the other three traffic signals. It also necessarily has to be the case that design guides and driver behaviours are well-aligned – put another way, if roads were designed in one way and drivers used them in another way, then this would inherently be unsafe and one or the other would need to change. As per my footnote below, the primary signals at any intersection will always appear larger and more conspicuous than secondary or tertiary signals.

- 89 I discuss parallax and colour blindness (Mr Downard-Wilke's section 3.1.4) in my paragraphs 58 and 62 to 70 above.
- 90 It is an agreed point between us that there is visual overlap for the left-turn movement (north to east) at the intersection. By way of context, the 2020 traffic count of the Council identifies that in the peak hours, fewer than 20 vehicles make this movement. In the non-peak hours, around 10 vehicles per hour undertake the turn. The matter therefore affects a very small number of drivers. However, bus drivers are permitted to travel straight-ahead from this lane.
- 91 If it is accepted (for the sake of argument) that Mr Downard-Wilke is correct in saying that drivers turning right will look solely towards Signal Pole 5 then this is presumably because it is the most convenient for them to look at since it lies in their natural direction of gaze. It therefore must be the case that the same principles apply to drivers turning left. For these drivers, the signal that is the most convenient is the tertiary signal head. However both myself and Mr Downard-Wilke agree that there is no visual overlap whatsoever between the tertiary traffic signal and the proposed billboard. There is therefore no reason to expect that left-turning drivers will become confused.
- 92 I have also considered the situation of bus drivers, who use the kerbside lane to travel straight ahead (south) on Manchester Street. Again though, I do not consider that drivers will be looking towards the signal on the diametric opposite corner of the intersection, but they will instead use the primary signal and tertiary signals, which are more directly in front of them. There is no visual overlap with those signals. Moreover, bus drivers are professional drivers and regular users of the route, who in my view will be unlikely to be influenced or confused by the presence of the billboard.
- 93 I have considered a situation where a southbound driver encounters another vehicle that is turning right, and decides to move into the kerbside lane to pass them. Under this scenario, the decision of the southbound driver would be made in a location where there would be no visual overlap with Signal Pole 5. Moreover, the southbound vehicle will be angled slightly

when making this passing movement, such that the tertiary signal will appear more directly in front of the driver and Signal Pole 5 will appear more to the driver's right. In my view this makes it even less likely that the southbound driver will be looking solely towards Signal Pole 5. Finally, in the event that the right-turning vehicle was high-sided, then Signal Pole 5 would not be visible anyway, being blocked by the vehicle bodywork.

- 94 Finally, I have considered the situation of a driver turning right that is stationary within the intersection and waiting to turn. Such a vehicle is shown on Figure 3 of Mr Downard-Wilke's report, and it can be seen that there is no visual overlap for that driver.
- 95 In short then, having reviewed Mr Downard-Wilke's report, it appears to be common ground between us that there is no visual overlap between for three of the four traffic signals. For the remaining signal (Signal Pole 5), Mr Downard-Wilke demonstrates that under his own parameters, there is no overlap for drivers in the general traffic lane within the critical decision zone. We also agree that there is visual overlap between Signal Pole 5 and the digital billboard for the kerbside traffic lane, but applying Mr Downard-Wilke's own methodology, it seems evident that drivers will not be looking towards Signal Pole 5 anyway but towards other lanterns.
- 96 Further, as I noted above, even if an overlap does arise within the critical decision zone, the question arises as to whether this gives rise to adverse road safety effects. In my paragraphs 59 to 61 above (and the Transportation Assessment), I have considered a number of locations where traffic conditions are less favourable than at the application site (such as sites with higher vehicle speeds and heavier volumes) but I have not been able to identify any adverse road safety effect from such an overlap. I note that Mr Downard-Wilke has similarly not been able to point to a particular example of where such a visual overlap has led to any incidence of crashes.
- 97 As a final point, I confirm that this application is for both a north-facing and a south-facing billboard. Mr Downard-Wilke has not raised any concerns in respect of the south-facing billboard and I therefore anticipate that he is of the view that no adverse traffic-related matters will arise from this billboard.

Proposed consent conditions

- 98 Section 5 of the Transportation Assessment set out a number of conditions of consent that I considered to be necessary to ensure that the digital billboards did not give rise to adverse effects. I have reviewed the traffic-

related conditions of consent set out in Ms Collie's evidence and confirm that these provisions remain appropriate.

Conclusion

- 99 I have reviewed the Transportation Assessment that I produced early in 2021, and which accompanied the application. I confirm that the report conclusions remain valid.
- 100 It appears to be common ground between Mr Downard-Wilke and myself that:
- (a) There is no visual overlap between the proposed billboard and three of the four signals at the Manchester Street / Gloucester Street intersection.
 - (b) There is overlap only for the signal head on the southwestern corner of the intersection (which Mr Downard-Wilke refers to as Signal Pole 5). However this overlap does not arise in the southbound traffic lane for general traffic at the point where drivers need to decide whether to stop at the traffic signals or not.
 - (c) The overlap only occurs in the kerbside lane and only over a distance of 26m. This therefore only can affect bus drivers traveling straight ahead and general drivers turning left. The latter equates to peak hour flows of just 20 vehicles.
- 101 I have considered the effects of the proposed billboard on each of the potential traffic movements and consider that these will be negligible. This is largely because I consider it highly likely that drivers will be looking towards the traffic signals that are directly in front of them, and paying less heed to Signal Pole 5 which is on the diametric opposite corner of the intersection.
- 102 I have not been able to find any evidence regarding the adverse road safety effects of driver colour-blindness, or of adverse safety outcomes in other locations where there is a visual overlap between traffic signals and digital billboard.
- 103 The submissions received typically raise general matters of road safety, which I responded to in detail within the Transportation Assessment. One submitter highlighted a particular research study, but this found that it could not be conclusively answered whether digital billboards constituted a road safety hazard or not. There has been a considerable amount of research since this study was produced 10 years ago.

104 I have reviewed the traffic-related conditions of consent set out in Ms Collie's evidence and confirm that these provisions remain appropriate.

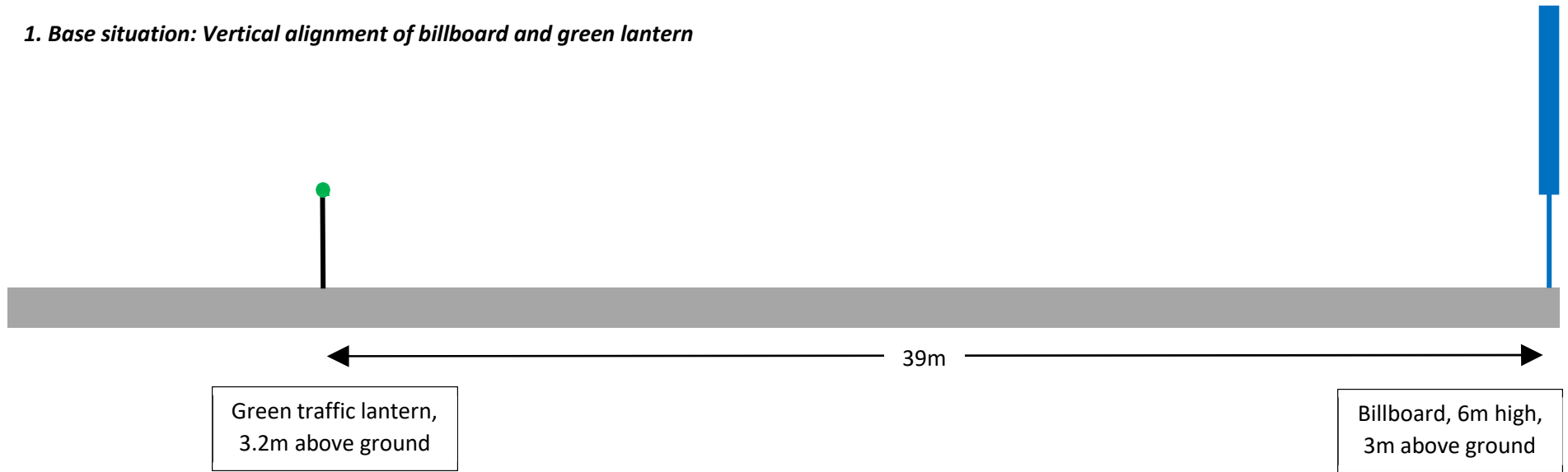
105 Overall then, I remain of the view that it is very unlikely that adverse safety-related effects will arise from the operation of the billboard, and I am able to support the proposed digital billboard from a traffic and transportation perspective.

Andy Carr

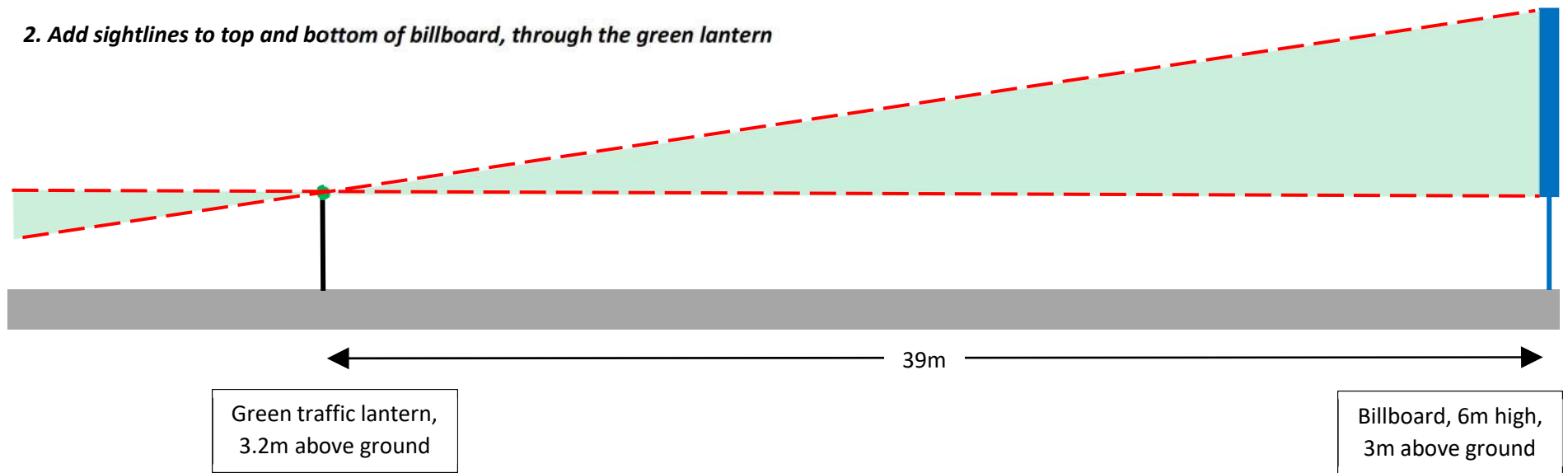
Dated this 15th day of February 2022

Annexure A: Example of Calculation of Overlap of Traffic Signals

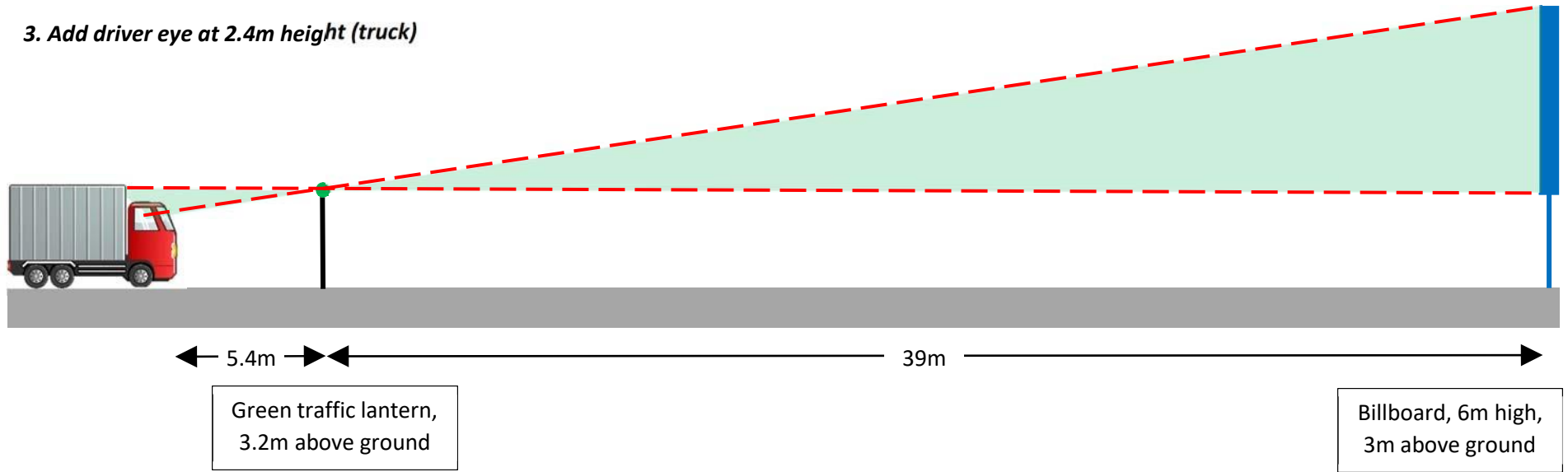
1. Base situation: Vertical alignment of billboard and green lantern



2. Add sightlines to top and bottom of billboard, through the green lantern



3. Add driver eye at 2.4m height (truck)



Annexure B: Photographs at George Bolt Memorial Drive Intersection

Photographs taken at 55m from stop-lines (being the ASD for a 2-second reaction time and 50km/h operating speed) and at 1.1m height to represent a car driver eye height. Images have been 'zoomed in' to show the overlap more clearly.



Photograph 1: Right Turn Lane (Overlap with Primary Signal Highlighted)



Photograph 2: Right Turn Lane (Overlap with Primary Signal Highlighted)



Photograph 3: Straight-Head Lane (Overlap with Primary Signal Highlighted)



Photograph 4: Straight-Head Lane (Overlap with Primary Signal Highlighted, Behind Temporary Signage)