CCL Ref: 14940-041024-collie3

4 October 2024

CARRIAGEWAY CONSULTING
A. PO Box 29623, Christchurch, 8540
P. 03 377 7010
E. office@carriageway.co.nz

Anita Collie
Town Planning Group Limited

By e-mail only: anita.collie@townplanning.co.nz

Dear Anita

Proposed Digital Billboard, 322 Queen Street: Proposed Reorientation

Based on recent discussions, we understand that it is now proposed to rotate the proposed billboard at 322 Queen Street anti-clockwise, such that it faces in a more south-westerly direction, construct a parapet, and increase the dwell time for images displayed. We understand that these amendments have been made primarily in order to address issues by NZTA in relation to:

- Traffic safety concerns, particularly associated with left-turn movements using the unsignalised slip lane on Lower Queen Street; and
- The 'dominance' of the proposed digital billboard within the wider environment.

This letter sets out the likely traffic-related effects of the amendments proposed. The letter augments the Transportation Assessment that we prepared which accompanied the resource consent application for the billboard (and so we have not repeated background information unless particularly relevant to the reorientation.)

Proposal

We show the proposed orientation of the billboard below.

Figure 1: Proposed Reorientation of the Digital Billboard (Extract from DCM Urban Drawing)

It can be seen that the billboard will face more towards Gladstone Road and to Queen Street than the previous proposal. We also understand that it is proposed that a parapet is constructed behind the proposed billboard as illustrated below:

Figure 2: Mock-Up of the Digital Billboard (Extract from DCM Urban Drawing) Showing Parapet

Views of Proposed Billboard

Introduction

The reorientation of the billboard will necessarily change the locations from which it can be viewed.

As with any digital screen, the viewing angle of digital billboards is commonly assessed as being within 70 degrees of the perpendicular. Some types of screens appear to be black/unlit when viewed at 70 degrees or more, but even where a billboard appears to be lit at these angles, the acute viewing angle means that any image simply appears as a patch of light within the observers' field of view rather than any word or image that could be read. We will provide a more detailed assessment in relation to these issues in the evidence to be filed in support of the application. In short, however, at a viewing angle of 20 degrees, a 7m wide billboard visually appears to be just 2.4m wide, as well as the furthest parts of the billboard appearing to be narrower (depending on the viewing distance).

Below we show a 20 degree viewing angle of the billboard in each direction along Queen Street and Lower Queen Street.

Figure 3: 20-Degree Viewing Angle of Proposed Digital Billboard (Extract from DCM Urban Drawing)

Lower Queen Street

It can be seen that the digital billboard could not be read by any drivers travelling in the left-turn slip lane.

There is a slight potential for drivers that are at the stop-lines of the approach in the 'straight ahead' lane to be able to read the billboard but the angle means that this would only be practical for drivers at the front of the queue, as at distances further back, the billboard is outside the 20-degree viewing angle.

In the Transportation Assessment, we noted that the previously-proposed billboard location created a visual overlap with the primary traffic signal on the Lower Queen Street approach. As can be seen from the graphic above, any visual overlap has been eliminated by the re-orientation.

There is the potential for drivers to be able to read an image when travelling in the right-turn traffic lane. This occurs at a distance of 21m (and closer) to the stop-line. As addressed in the Transportation Assessment, drivers require a certain minimum distance in which to perceive traffic signals, decide to stop, and then stop. This is referred to as the Approach Sight Distance (**ASD**). In this case, 21m aligns with an ASD for an operating speed of 25km/h. In other words, if drivers are approaching the traffic signals at a speed of more than 25km/h, they will have already passed their final decision point about whether to stop or not by the time that an image on the billboard becomes visible. If travelling at less than 25km/h then the image may become readable, but this slow speed suggests that drivers are already in the process of stopping at a red traffic signal, or are travelling in congested conditions in which their cues to stop are also provided via the actions of drivers around (and particularly ahead of) them.

We set out in the Transportation Assessment that we were able to support the billboard in its then-proposed location, and we remain of this opinion. However, the reorientation of the billboard will:

- Eliminated views from the left-turn slip lane;
- Reduces the extent of views from other traffic lanes on Lower Queen Street; and
- Eliminate the visual overlap associated with the primary traffic signal.

Accordingly, in our view the proposed position represents an improved location from a traffic safety perspective compared with that previously proposed.

Gladstone Road

The reorientated billboard will more directly face traffic approaching from Gladstone Road, but we do not consider that this will have any material effect from a traffic safety perspective.

The location continues to be elevated above the traffic signals, with the result that there is no visual overlap with any signal heads for these drivers. Rather, the billboard will appear to be towards the right of drivers, with the signals being towards their left.

Overall, we do not consider that the reorientation changes the perception of the billboard for drivers on Gladstone Road, and we remain able to support the billboard from a traffic safety perspective.

Queen Street

We have considered how drivers may be able to view the billboard from Queen Street. As can be seen from Figure 3 above, drivers potentially have views of the billboard, but these would occur at a distance of 21m from the stop-lines of the traffic signals. As noted above, this means that drivers will have already determined whether to stop or not at the traffic signals by this point.

Additionally, the NZTA Traffic Control Devices Manual Part 3 ('Advertising Signs') (**TCDM-3**) sets out a cone of vision for drivers, which widens as vehicle speeds diminish. The lowest speed addressed in TCDM-3 is 50km/h, but further research shows[1] that at 30km/h (noting that this is the posted speed limit of Queen Street), the cone of vision increases to 60 degrees on either side of the driver. In this case, this means that at 21m from the stop-line, the billboard image would become visible to drivers but it starts to move outside of their cone of vision at 11m from the stop-line.

The billboard would also appear to be well above the driver, given that the centreline of Queen Street is 13m from the billboard, and the billboard is 4.6m to 8.1m above ground level.

There is no overlap of any traffic signal heads.

On this basis, we do not consider that the reorientation of the billboard would give rise to any adverse traffic safety / management effects on the Queen Street approach. The speed limit of the road is low, the billboard is only visible for a distance of 10m and, even then, it would appear to be elevated well above the driver and, in our view, is unlikely to be looked towards.

[1] Sołowczuk, Alicja. (2021). Effect of Bulb-outs at Intersections on Speed Reduction and Visibility Conditions in Tempo–30 Zone. 10.9734/bpi/naer/v4/8595D.

Summary

On the basis of our assessment, we consider that no new adverse traffic-related effects are introduced by the reorientation of the billboard, while the reorientation further minimises any adverse effects on Lower Queen Street[2].

Effects of Parapet

We understand that the parapet is proposed in order to reduce the visual dominance of the billboard. Dominance is largely an urban design concept, as it relates to perception of the billboard within its setting, and we cannot comment on such matters.

Insofar as dominance may be seen to affect driver behaviour, it might be considered intuitive that if an object is 'dominant' then it means that it is looked at to a greater extent. However, we consider that this reflects a simplistic approach that needs to be carefully considered.

Firstly, driver behaviours are governed by a number of factors. In particular, there is research that shows that when driving environments become more complex, drivers simply 'tune out' extraneous information and focus on the driving task instead[3].

Secondly, there are numerous instances where public art has been installed near to roads and highways, often with the support of the relevant road controlling authority, and which (by the very nature of art) is expected to be gazed towards.

One example of which we are aware is 'Fanfare', one of New Zealand's largest public sculptures, described as a "*six-storey-high sphere (20 metres in diameter) covered in 1.5-metre steel pinwheel fans and can be illuminated in a spectrum of colours at night*"[4][5]. These pinwheels are polished stainless steel that create a flickering effect when turned by the wind, while the illumination varies in colour and intensity during hours of darkness. In our opinion, it could be argued to be highly dominant within the context of the roading environment.

[2] To reiterate, we considered that these effects were less than minor with the billboard in its original position.
[3] For example, Harasimczuk, J., Maliszewski, N. E., Olejniczak-Serowiec, A., & Tarnowski, A. (2021). *"Are longer advertising slogans more dangerous? The influence of the length of ad slogans on drivers' attention and motor behavior".* Current Psychology, 40(1), 429–441.
[4] https://www.scapepublicart.org.nz/artwork/fanfare/
[5] https://www.stuff.co.nz/the-press/news/north-west/10184382/Sculpture-coming-home-to-Northern-Motorway

Figure 4: 'Fanfare' as Viewed from State Highway 1 (Source: Google Streetview)

Fanfare is installed within 17m of the southbound traffic lanes next to State Highway 1 just north of Christchurch, and is within the legal highway reserve. However, it was installed with NZTA's approval[6] as it was not considered to compromise the safe and efficient operation of the highway.

Despite traffic volumes being in excess of 34,000 vehicles per day, and the posted speed limit of the highway being 100km/h, a review of the NZTA Crash Analysis System shows that no crashes have been reported within 300m of the sculpture in which distraction was recorded as a factor since its installation in 2015.

We give this example to demonstrate that the role of 'dominance' in matters of road safety needs to be considered judiciously.

Dwell Time

Introduction

NZTA has advised that in its view, the majority of drivers should only be able to see two changes of image at most. In practice, this would correspond to a driver seeing one change of image as they are first able to discern the image display, and then a second change occurring just before the image passes outside their field of vision.

There are a number of factors that are relevant to this but, in particular, we highlight:

- The size of the lettering. As letter height becomes larger, it can be seen from further away, meaning that for any given speed, there is a greater time between first seeing the image and passing the billboard. This suggests that a longer dwell time is needed to achieve NZTA's desired outcomes.
- The vehicle speed. As vehicles travel faster, there is less time between first seeing the image and passing the billboard. This suggests that the dwell time could be shorter while achieving NZTA's desired outcomes.

[6] https://www.scoop.co.nz/stories/AK1309/S00436/council-approves-location-for-fanfare-sculpture.htm

These two factors will vary frequently, even over the course of an hour. Under a scenario for an image with large text and a driver in congested conditions and travelling slowly, a long dwell time would be needed. However, if the image had smaller text and the driver was travelling more quickly, the dwell time could be shorter.

One relevant offsetting effect is that, at slow speeds, drivers have more time available to react to potential conflict and take avoiding action. In the event of a collision at slow speeds, there is also less likely to be an injury.

Distance over Which Images Could be Read

Ultimately, advertisers wish to ensure that their images are noticed. The United States Sign Council has a 'best practice' guide which sets out the lettering height needed to be visible to assist advertisers in this[7], and this sets out that lettering that is 1 inch in height (2.54cm) can be read at distances of 25 to 37 feet (7.6m to 11.3m), depending on the style of lettering used.

TCDM-3 sets out that within a 50km/h speed limit, the absolute minimum height of text on a billboard within a 50km/h speed limit area is 75mm. Applying the United States Sign Council approach indicates that this height of lettering means that the text would be legible at 22m to 33m away from the billboard, but no further. The minimum height of the primary message is expected to be 150mm under TCDM-3, meaning that under the United States Sign Council approach it would be visible at 44m to 66m away.

However, TCDM-3 also sets out that within a 50km/h speed limit, unobstructed views of billboards are expected at a distance of 80m. This distance is further away than the text would be legible, which may indicate a degree of conservatism in the TCDM-3 distances.

We have also considered another approach for assessing at which distance the image on a billboard might first be readable. A person with 20/20 (i.e., normal) vision in excellent lighting is able to read letters that subtend an angle of 5 minutes of arc[8]. This equates to 0.0833 degrees. We understand, though, that this assumes perfect lighting conditions at a 6m viewing distance (which is standardised for the purposes of assessing eyesight). However, this would be unlikely for the billboard, since luminance decreases as the viewer is further from the billboard.

Nevertheless, using this approach, the minimum 75mm letter height of TCDM-3 would be visible at 51m and at the minimum letter height for the primary message of 150mm, it could be read at 103m.

This then gives a range for reading images on the billboard of 66m to 103m, allowing for the minimum lettering size for the primary message under TCDM-3 and depending on which methodology is used (the United States Sign Council or the first-principles approach for typical eyesight). As noted above however:

- The 103m distance is based upon the image being seen under ideal conditions, which is unlikely. This suggests that the practical viewing distance would be shorter than this.
- Conversely, while TCDM-3 specifies the minimum height of the primary lettering, it does not specify a *maximum* height. If an image had larger lettering then it could be visible at greater distance than 103m.

On balance then, taking into account the 'unders and overs', we have adopted the upper limit of the range (103m) for the practical viewing distance of the billboard.

---

[7] https://usscfoundation.org/wp-content/uploads/2018/03/USSC-Guideline-Standards-for-On-Premise-Signs-2018.pdf

[8] https://en.wikipedia.org/wiki/Snellen_chart#:~:text=In%20the%20most%20familiar%20acuity,subtends%20one%20minute%20of%20arc

Calculation of Dwell Time

In March 2022, NZTA issued an addendum report to TCDM-3 addressing digital billboards. The addendum was withdrawn within a few months, but one part of this related to considering dwell times. This set out an equation by which the dwell time could be calculated with "*a maximum of 5% of drivers seeing one image change*", found though the following equation:

Dwell time (s) = distance (m) x 6 / posted speed limit (km/h)

In this case then, the equation shows that at the posted speed limit of 50km/h, and with text being legible at 103m, a dwell time of 12.4 seconds is appropriate.

We acknowledge that it could be argued that drivers may be travelling more slowly than this in practice. The withdrawn NZTA guide is specific in the use of the posted speed limit and not the actual operating speeds, but even if an operating speed of (say) 25km/h is used, then a dwell time of 24 seconds would be found through the calculation.

In this case, we understand that the Applicant has offered a condition of consent that the dwell time will be a minimum of 30 seconds. This is more than twice the duration that is found via the NZTA equation, and 25% more than the duration adopting a low operating speed, and therefore in our view it represents a conservative approach to the dwell time.

As a final note, we are unaware of any research that shows that 5% of drivers seeing one change of image represents a practical maximum prior to some sort of adverse effect arising, rather than (say) seeing two or three changes of image. There is certainly research that indicates extremely short dwell times give rise to extensive glances away from the roadway, but this is one reason why the typical approach in New Zealand is for each image to be displayed for a minimum of 8 seconds. This 8-second duration has not given rise to any adverse road safety effects.

Summary

Based on our analysis, we consider that the use of a 12-second dwell time can be supported, or a 24-second dwell time would be appropriate if lower vehicle speeds are assumed. The Applicant's proposal for a 30-second dwell time represents a conservative approach to addressing this matter, and will mean that fewer than 5% of drivers will see a change of image.

Summary

In summary, we consider that:

- No new adverse traffic-related effects are introduced by the reorientation of the billboard;
- The reorientation further minimises any potential adverse traffic effects on Lower Queen Street;
- The proposed parapet does not have any material effects on road safety; and
- A dwell time of 12 to 24 seconds can be supported, and so the increase in dwell time offered by the Applicant to 30 seconds is a highly conservative approach and means that less than 5% of drivers will see a change in image.

In conclusion, we consider that these proposed amendments introduce additional beneficial safety-related factors into the operation of the billboard, and further reduce any potential that it will give rise to adverse road safety effects. We therefore remain able to support the proposal from a transportation perspective.

Please do not hesitate to contact me if you require anything further.

Kind regards
Carriageway Consulting Limited

Andy Carr
Traffic Engineer | Director

Mobile 027 561 1967
Email andy.carr@carriageway.co.nz