Traffix Group

Traffic Engineering Assessment

Proposed Electronic Sign

4-6 Breakwater Road, Belmont

Prepared for
Regional Billboard Co Pty Ltd

July 2026

G38822R-01B

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AS/NZS ISO 45001-2018 Occupational Health & Safety Management Systems
AS/NZS ISO 14001 Environmental Management Systems
AS/NZS ISO 9001-2016 Quality Management Systems

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1. Introduction

Traffix Group has been engaged by Regional Billboard Co Pty Ltd to prepare a traffic engineering report for a proposed electronic sign at 4-6 Breakwater Road, Belmont.

This report provides a detailed traffic engineering assessment of the traffic safety and operation issues associated with the proposed sign.

2. Proposal

The proposal is for a single-sided electronic sign at 4-6 Breakwater Road, Belmont.

The sign will be pole mounted within the carpark and will be fully contained within the boundary of the site.

The sign will be located on the north-western corner of the Breakwater Road and Barwon Heads Road intersection. The sign will primarily face traffic travelling northbound on Barwon Heads Road and westbound on Breakwater Road.

The proposed sign will have dimensions of 8.08m wide by 2m high. The maximum height of the sign is 9.95m above ground and the underside of the digital sign is 7.95m above ground.

The sign face will operate with static advertising. Each image on the sign will have a dwell time of 30 seconds, with an instantaneous transition time. The application does not propose any animated images (i.e. moving images). The proposed site plan and elevation plans are provided at Figure 1 and Figure 2, respectively.

An in-vehicle view of the existing conditions at the site when travelling northbound on Barwon Heads Road and westbound on Breakwater Road, is presented at Figure 3 and Figure 4, respectively.

A copy of the application plans prepared by the applicant detailing the proposed sign are attached at Appendix A.

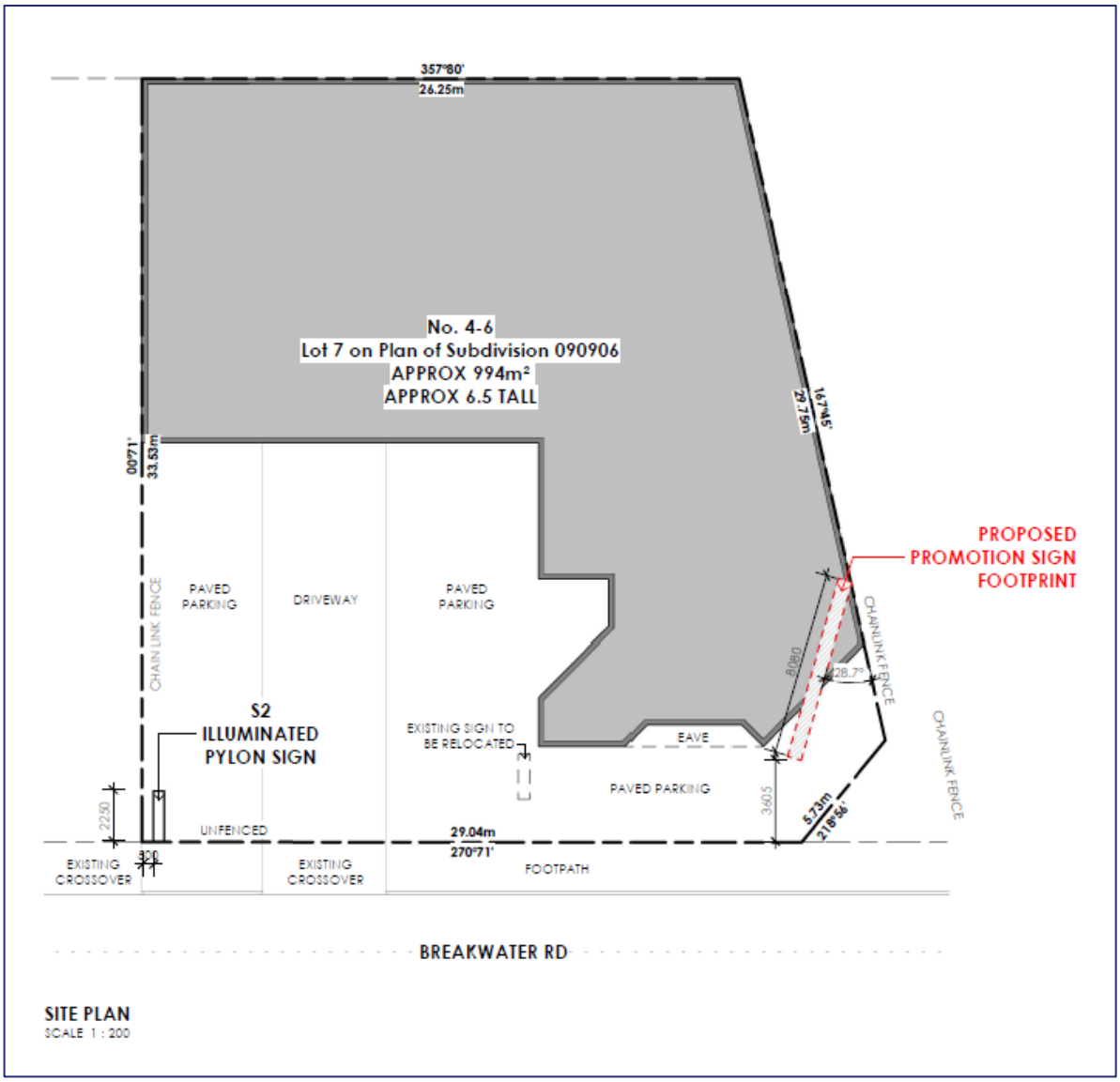


Figure 1: Site plan

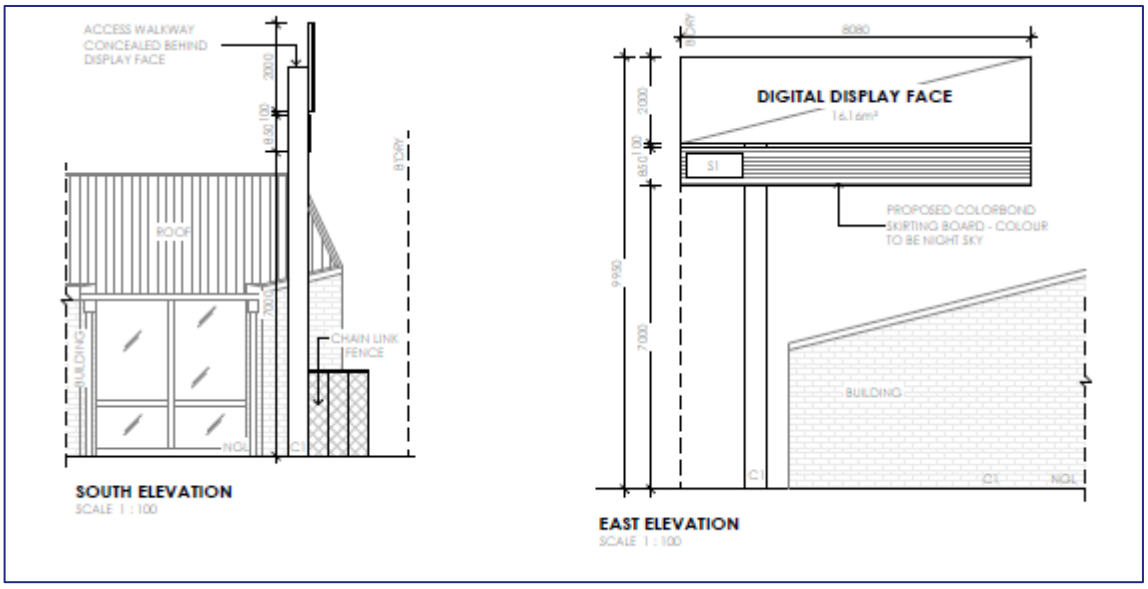


Figure 2: Proposed Elevation

Figure 3: In-vehicle view of the sign location – westbound on Breakwater Road

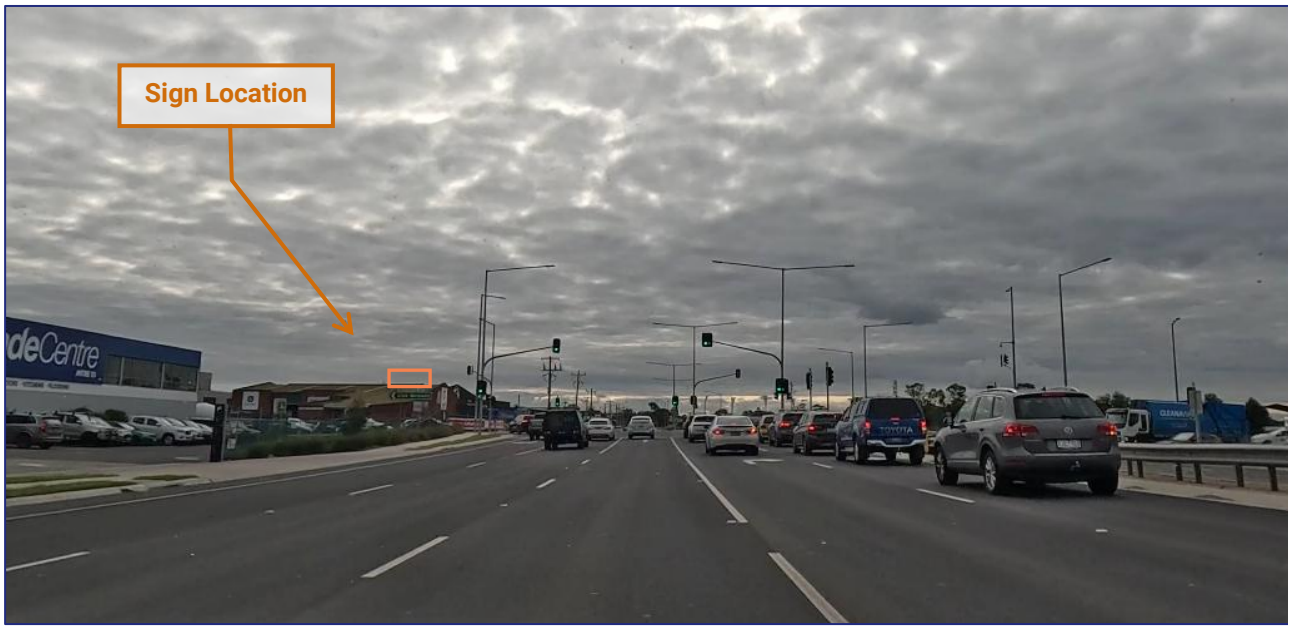


Figure 4: In-vehicle view of the sign location – northbound on Barwon Heads Road

3. Existing Conditions

3.1. Subject Site

The sign will be located on the north-wester corner of the Breakwater Road and Barwon Heads Road intersection in Belmont. The sign will be pole mounted within the carpark of site.

The sign will primarily face traffic travelling northbound on Barwon Heads Road and westbound on Breakwater Road.

A locality plan is presented at Figure 5.

Land use in the vicinity of the site is a mix of industrial and parkland, with residential uses in the wider area. A land use zoning map is provided at Figure 6.

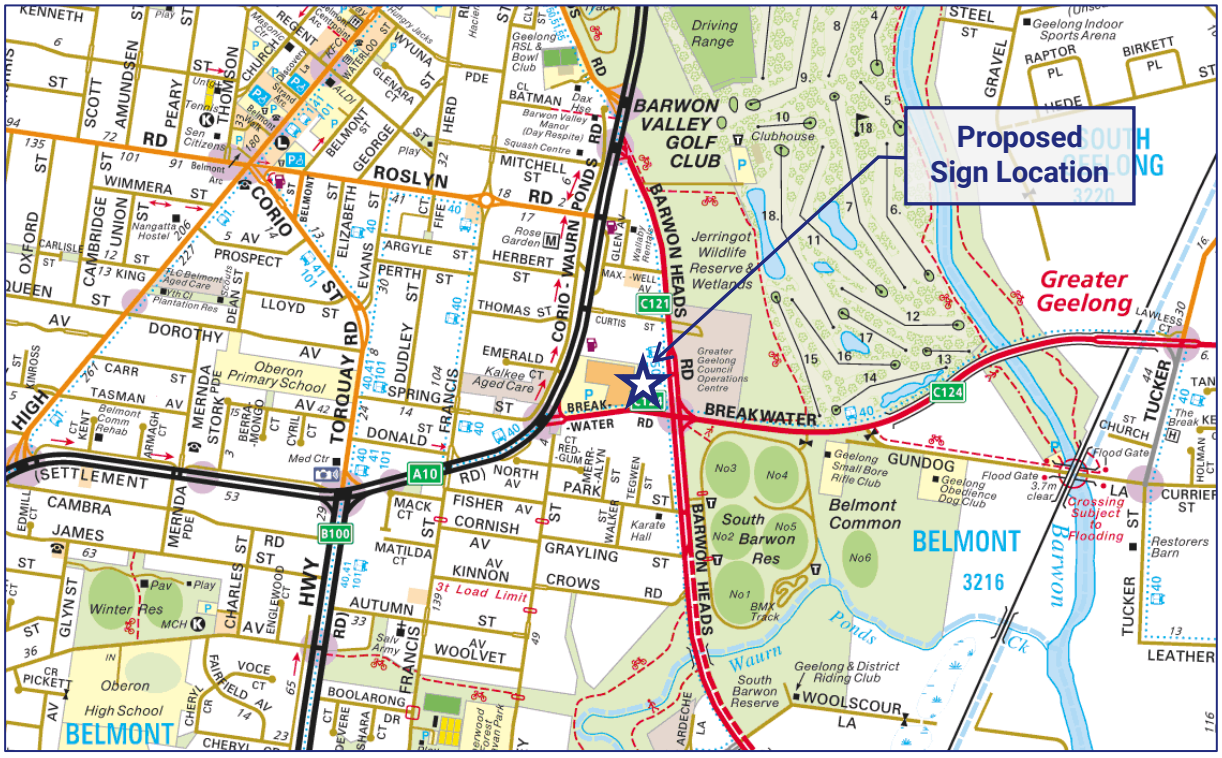


Figure 5: Locality plan (Source: Melway Publishing)

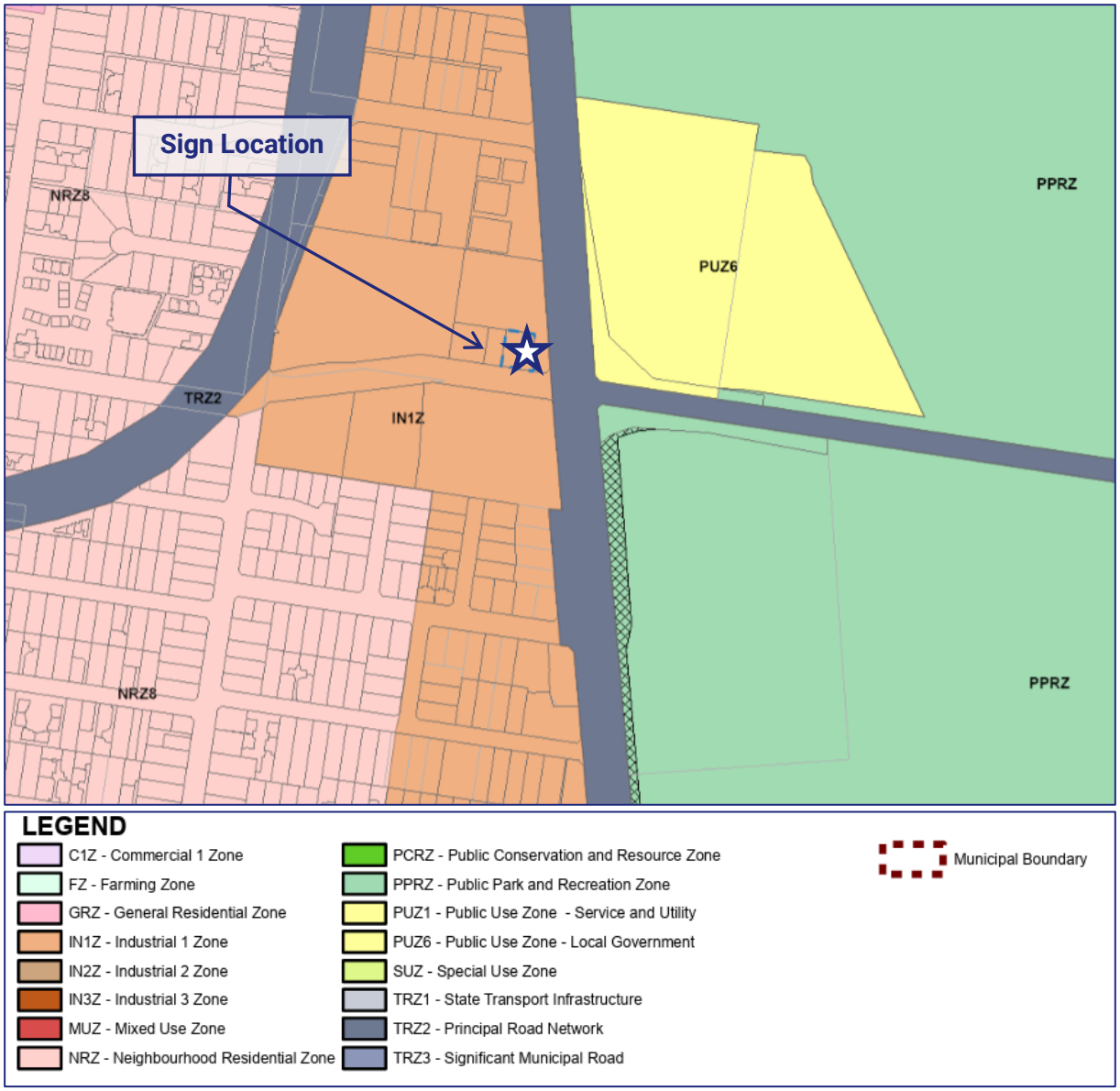


Figure 6: Land use zoning map (Source: Planning Schemes Online)

3.2. Road Network

Breakwater Road is a Department of Transport and Planning (DTP) declared Arterial Road, and Transport Zone 2 (TRZ2) under the Planning Scheme, which extends in an east-west direction in the vicinity of the site. To the west of the sign, Breakwater Road is a not a TRZ2, but remains a DTP managed road.

Breakwater Road typically has 2 traffic lanes in each direction (which increases to three lanes at the Barwon Heads Road intersection), separated in areas by a central line marked median.

At the intersection with Barwon Heads Road, two right turn lanes and two controlled left turn lanes are added in westbound direction. The right turn movement is fully controlled. In the eastbound direction a right turn lane is added with the movement fully controlled.

A posted speed limit of 60km/h applies to Breakwater Road in the vicinity of the site.

Barwon Heads Road is a Department of Transport and Planning (DTP) declared Arterial Road, and Transport Zone 2 (TRZ2) under the Planning Scheme, which extends in a north-south direction in the vicinity of the site.

Barwon Heads Road typically has three lanes in each direction, separated by a central median. At the intersection with Breakwater Road, two right turn lanes are added in northbound direction, and one right turn lane is added in the southbound direction.

A posted speed limit of 70km/h applies to Barwon Heads Road.

An aerial photograph illustrating the key road signage and available traffic lanes for the northbound approach on Barwon Heads Road and westbound approach on Breakwater Road is provided at Figure 7 and Figure 8, respectively.

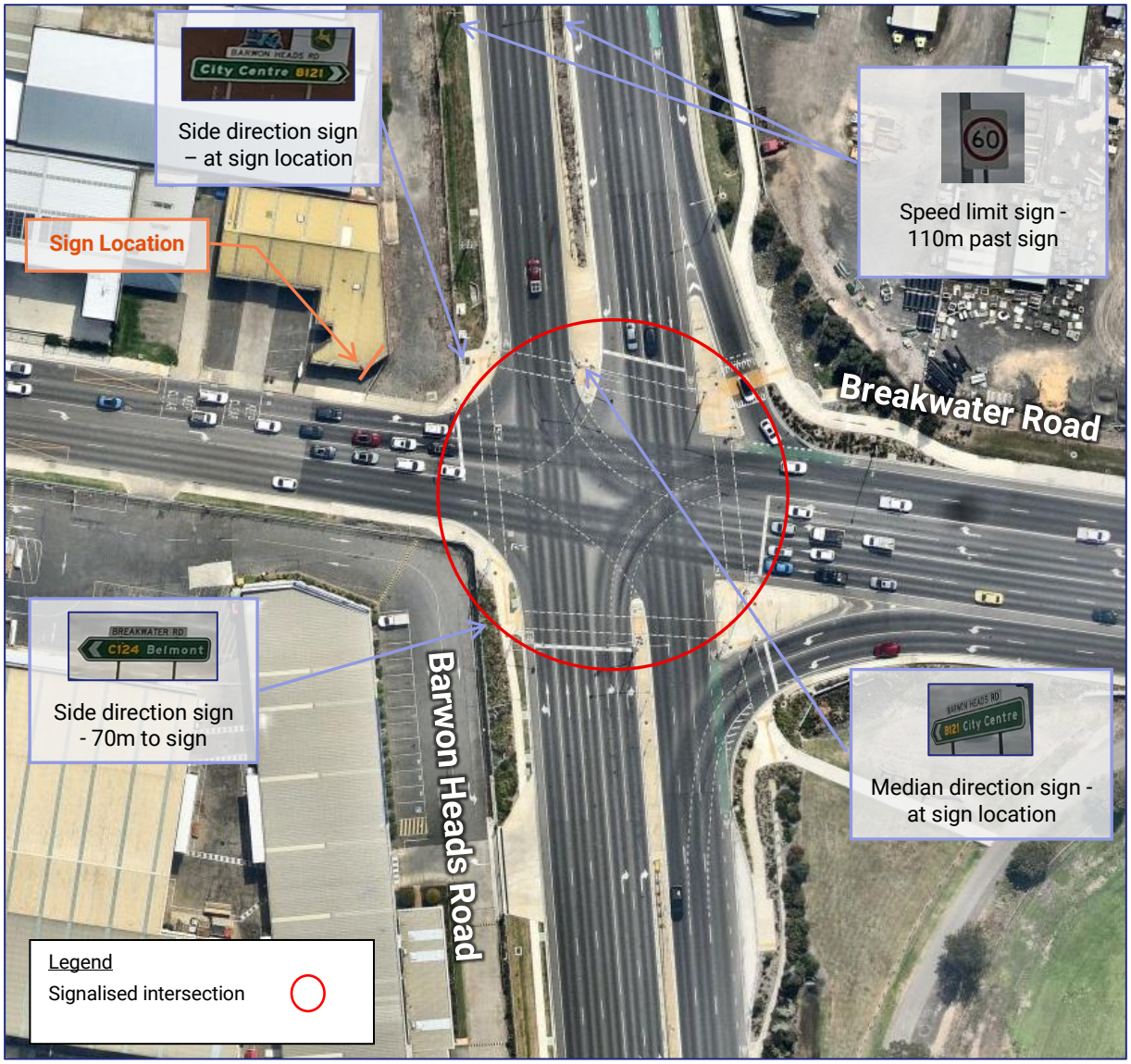


Figure 7: Aerial view of Northbound Road Network (Source: Nearmap)

Figure 8: Aerial view of Westbound Road Network (Source: Nearmap)

3.3. Road Safety Review

A review of the State Road Accident Records (CrashStats) has been undertaken in the vicinity of the site for the past 5 years of available data (01/10/2020 to 30/09/2024)[1]. The crash investigation area is shown in the figure below.

The review does not include crashes where the sign would not be visible to drivers (such as rear end crashes between southbound vehicles).

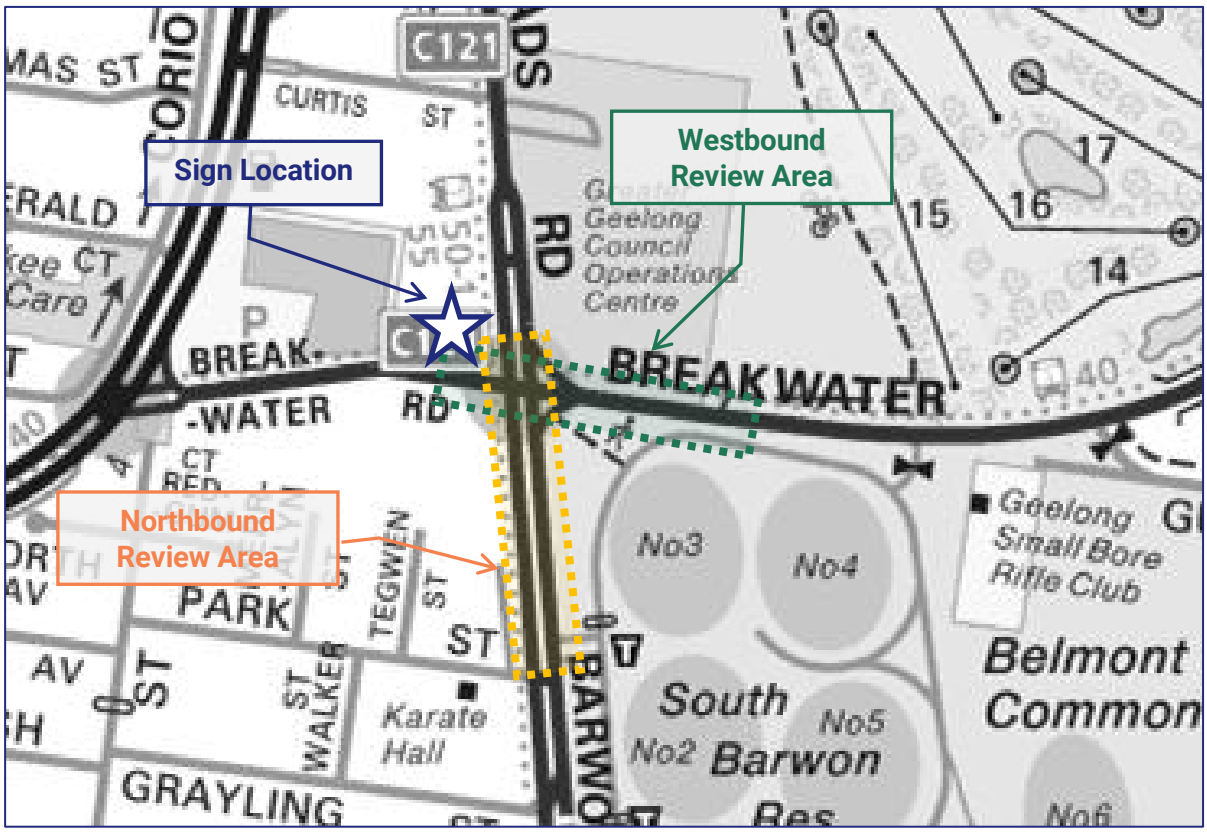


Figure 9: Road safety review area (Source: Melway Publishing)

[1] Casualty crash data is contained in the VicRoads' CrashStats Internet Database and includes all reported casualty crashes (i.e. injury crashes), which are classified into Fatal Injury, Serious Injury and Other Injury (i.e. minor injury) crashes. Property damage only or non-injury crashes are not included in the database

The crash review indicated that there were 12 casualty crashes on approach to the sign.

Of these crashes, 7 occurred at the Barwon Heads Road / Breakwater Road intersection, while the remaining crashes were spread across the review area. This number of crashes is partly the function of being the intersection of two busy arterial roads (i.e. higher exposure). Most crashes were of different types or on different approaches.

Between late 2021 and mid-2023, this intersection was upgraded with additional lanes and some movements became fully controlled. Accordingly, the relevance of the casualty crashes before mid-2023 is somewhat limited.

This includes one fatality in November 2021, which involved a southbound cyclist emerging from the footpath onto the carriageway, and being struck by a westbound truck. This occurred at the start of the intersection works. Part of the upgraded included formal on-road bicycle lanes through the intersection that were not present in 2021.

At the Barwon Heads Road / Breakwater Road intersection, the sign is well to drivers' side and outside their 20° cone of peripheral vision.

Based on the review above, this intersection does not exhibit a discernible casualty crash pattern of particular concern in relation to this sign.

4. Traffic Engineering Assessment

4.1. Road Safety Research

We have undertaken an extensive literature review to determine what road safety research is available regarding static and electronic billboards, including roadside signage and advertising, the relationship between advertising signs and accident statistics, the relationship between driver performance and billboards and billboard design recommendations.

The key conclusions from the current road safety research into static, electronic billboards are:

- Drivers have a 30 to 50% spare attention capacity, which they devote to objects not related to the driving task, including advertising or billboard signs. This means that during normal driving, most drivers have time to look at objects not related to the driving task (scenery, buildings, people, cars, etc.). Research also indicates that when a driver is overloaded with information, they shed part of the input demand to focus on what is important. For instance, if a driver is in busy traffic, they automatically pay more attention to the road environment at the expense of other tasks (looking at scenery, talking to passengers, listening to music, etc.).
- Traffic signs are not conspicuous to drivers until they are within approximately 10 degrees horizontally and 5 degrees vertically from the driver's line of sight. Research indicates that the further away from a vehicle an object is and the faster a vehicle is travelling, drivers have less ability to look at objects away from their travel path. The implication is that signs located above or to the side of vehicle travel paths can only be comfortably viewed at certain points and outside of these sight lines, drivers are unlikely to look at signs.
- Eyes-off-road durations greater than 2 seconds significantly increased individual near-crash/crash risk, whereas less than 2 seconds was comparable to normal driving. Outdoor advertising is intended to be a 'glance medium' with only short glances of only a second being required to read and interpret the message, which would not have a significant impact on road safety.
- There is no measurable difference between a driver's behaviour towards digital billboards compared to conventional billboards, comparison sites (landmarks, on-premises signs) and baseline sites (sites with no signs). This includes mean number of glances, glance direction, percentage eyes on road, lane and speed deviation.
- Multiple studies have found that no significant driver distraction effect could be ascertained for electronic billboards when compared to conventional billboards, and no effect on crashes could be determined as a result of installing electronic billboards in new sites or in sites where conventional billboards operated previously.
- New Zealand crash study data confirms advertising signs are not a statistically significant cause of road crashes. This data indicates that of the 11.8% of casualty crashes that involved 'attention diverted' as a contributing factor, only 0.3% identified 'advertising or signs' as a factor. That is, a factor in less than 0.04% of total casualty crashes.

The detailed findings from the road safety research are presented at Appendix B.

4.2. Traffix Group Review of Legibility Distances of Electronic Billboards

Traffix Group has conducted a video and GPS survey of electronic billboards around Melbourne to determine the distances that major promotion signs in the form of electronic billboards were legible from a passenger car. A total of 18 electronic billboards were observed in the survey.

The survey used a GPS device fitted to the vehicle to record the location where the advertising sign was first legible by the driver/passenger (i.e. readable and not just where it was visible) and the actual location of the advertising sign.

From a road safety perspective, the distance that an advertising sign is legible is more important than the distance that it is visible, as an illegible sign is unlikely to capture or hold the attention of passing observers. The distance at which a sign is visible, but not yet legible, is of little relevance to the assessment as it would have a similar affect to observing buildings, landmarks or other roadside features at a distance.

The distances that advertising signs were legible (i.e. could be read or understood if presented pictorially) are presented in Table 1.

It was found that the legibility of the advertising sign varied with regard to a number of factors including size, location, whether it was obscured by roadside objects and in particular, the image displayed on the advertising sign.

The clarity of the sign was the key variable in determining its legibility. For example, bright images and videos, in conjunction with a long sight distance made one large electronic billboard (with a width of approximately 27m) noticeable from a large distance (570m). A number of electronic billboards were not able to be seen until within a close proximity to the sign due to their location, however these billboards were clearly legible once they had come into the driver's cone of reading vision. Electronic billboards positioned away from the roadway or located in obscure positions were difficult to comprehend and could only be understood after close observation.

Table 1: Legibility distances of electronic billboard advertising signs

Distance Measure	Legibility Distance
Mean	217m
Median	205m
Minimum	98m
Maximum	570m
85th Percentile	282m

4.3. Assessment of Sign Legibility and Driving Task

The following section reviews the driving task approaching the proposed advertising sign along the following approaches:

- Barwon Heads Road, northbound.
- Breakwater Road, westbound.
- Barwon Heads Road, northbound, right turn at Breakwater Road.
- Barwon Heads Road, northbound, left turn at Breakwater Road.
- Breakwater Road, westbound, right turn at Barwon Heads Road.
- Breakwater Road, westbound, left turn at Barwon Roads Road.

This analysis uses a variety of aerial photographs and 'in-car' photographs. These photographs were taken as snapshots from a video camera mounted on the windscreen of a car at the driver's eye height and represent the locations at which the driver/passenger identified that the sign was first legible. The vehicle position on the road network was determined by GPS coordinates. The vehicle was fitted with a GPS device that tracks the vehicle and enables data points to be logged by the driver/passenger (by the press of a button), time stamped and correlated to the video data.

Video clips for each of the approaches to the sign can be accessed at the link below:

https://tinyurl.com/BreakwaterSign

The videos included are as follows:

- Video 1 –Barwon Heads Road, northbound
- Video 2 – Breakwater Road, westbound
- Video 3 – Barwon Heads Road, northbound, right turn at Breakwater Road
- Video 4 – Barwon Heads Road, northbound, left turn at Breakwater Road
- Video 5 – Breakwater Road, westbound, right turn at Barwon Heads Road
- Video 6 – Breakwater Road, westbound, left turn at Barwon Heads Road

Glossary of key terms and calculations:

- **10° cone of reading vision:** Traffic signs are not conspicuous to drivers until they are within approximately 10 degrees horizontally and 5 degrees vertically from the driver's line of sight. Research indicates that the further away from a vehicle an object is and the faster a vehicle is travelling, drivers have less ability to look at objects away from their travel path. The implication is that signs located above or to the side of vehicle travel paths can only be comfortably viewed at certain points and outside of these sight lines, drivers are unlikely to devote significant attention to a sign unless they have spare attention capacity.
- **20° cone of peripheral vision:** The sign is considered to fall outside of the driver's peripheral cone of vision once it moves outside of the driver's 20° cone of peripheral vision. Past this point drivers are unlikely to look at the sign as during free-flow traffic conditions the sign is rapidly moving past the vehicle.

- **Calculations:** Distances where signs fall outside of the driver's cones of vision were calculated based on the method detailed within the Austroads Guide to Traffic Management Part 10: Traffic Control and Communication Devices. These are provided at Appendix C.
  For side-mounted signs, the driver's cone of reading vision is considered to be 10° horizontally. The proposed sign falls outside of this cone of vision approximately 170m from the proposed sign location for northbound drivers, based on the centre of the carriageway being approximately 30m offset from the centre of the sign. The proposed sign falls outside the 10° cone of vision approximately 125m from the proposed sign location for westbound drivers, based on the centre of the carriageway being approximately 22m offset from the centre of the sign.
- **Visibility distance:** The visibility distance relates to when drivers can see the sign and does not necessarily mean that drivers can read the sign (see legibility distance below). Visibility distance does not necessarily mean the entire sign is visible as signs in urban environments are often only partially visible at first due to roadside obstructions (i.e. vegetation or nearby buildings) and drivers are unlikely to devote attention to the sign if more than half of the sign is obscured.
- **Legibility distance:** The legibility distance is the location where the face is readable. The legibility of the sign face is critical, as in our view drivers will not devote attention to the sign face if it is not within a legible distance. The distance that the proposed electronic billboard is likely to be legible is based on surveys conducted by our office of billboard signs (see Section 4.2) during field investigations. A legibility distance of 280m has been adopted for the proposed digital sign. This has been determined based on legibility distances recorded during surveys of similar sized signs conducted by our office of existing major promotion signs.

4.3.1. Barwon Heads Road, Northbound

Northbound drivers approach the advertising sign via Barwon Heads Road.

The relevant videos to be viewed in conjunction with reading this section are highlighted in **Green** below:

https://tinyurl.com/BreakwaterSign

The videos included are as follows:

- **Video 1 – Barwon Heads Road, northbound**
- Video 2 – Breakwater Road, westbound
- Video 3 – Barwon Heads Road, northbound, right turn at Breakwater Road
- Video 4 – Barwon Heads Road, northbound, left turn at Breakwater Road
- Video 5 – Breakwater Road, westbound, right turn at Barwon Heads Road
- Video 6 – Breakwater Road, westbound, left turn at Barwon Heads Road

An aerial photograph of this approach with the relevant signs and landmarks highlighted is provided at Figure 10.

- The sign is not visible
- The sign is first visible but not yet legible
- The sign is visible and legible
- The sign passes outside drivers' 10° horizontal cone of reading vision
- The sign passes outside drivers' 20° horizontal cone of peripheral vision

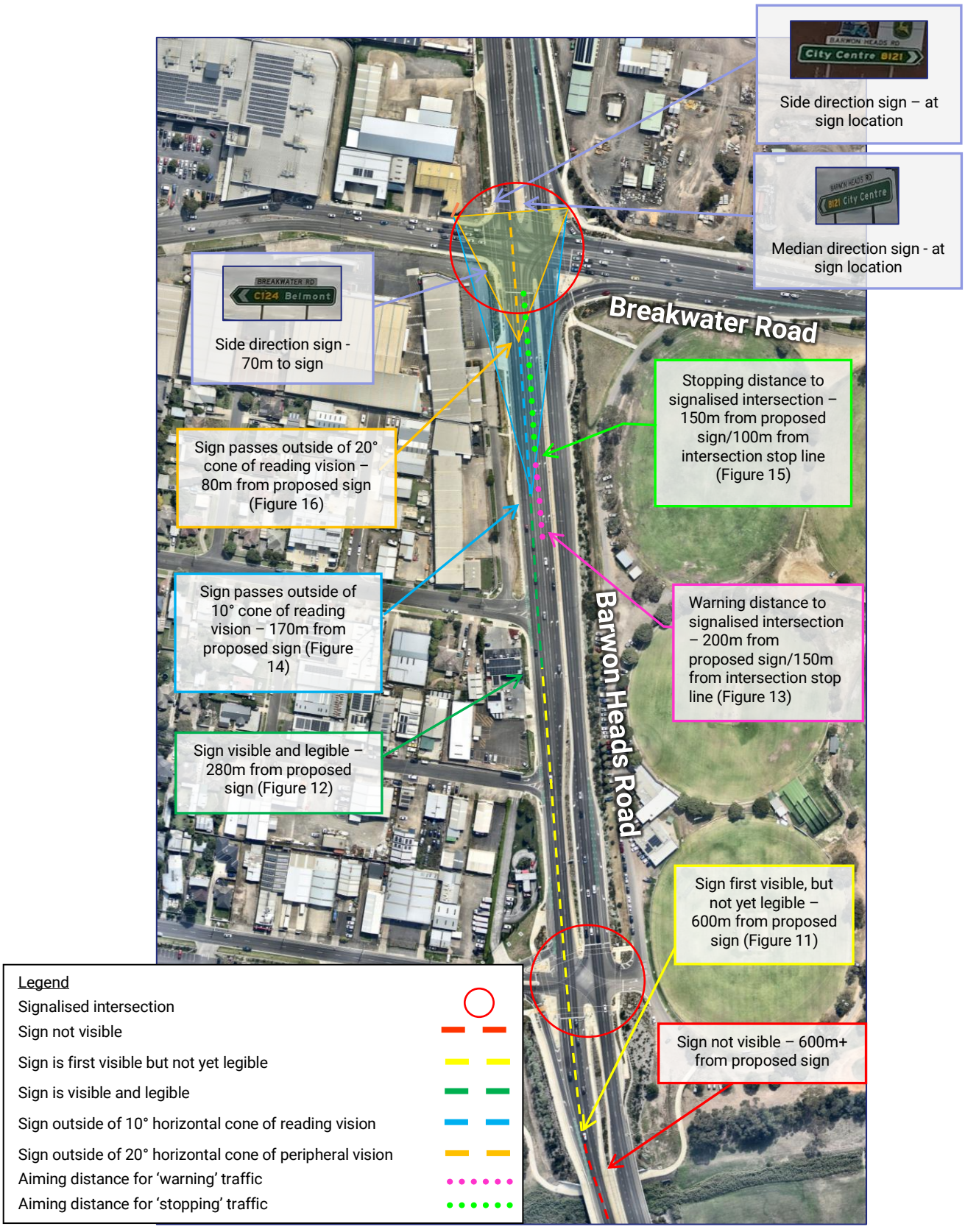


Figure 10: Aerial View of Northbound Road Network (Source: Nearmap)

Table 2: Review of northbound driving task on Barwon Heads Road

Review of Northbound Driving Task – Barwon Heads Road	
Sign Not Visible **Distance from Sign:** 600m+	
Visible? No. **Legible?** N/A.	**Sign within 10° cone of reading vision?** N/A. **Sign within 20° cone of peripheral vision?** N/A.
Discussion: The proposed sign is obstructed from drivers' view at a distance greater than 600m from its location by horizontal and vertical alignment of Barwon Heads Road. Accordingly, drivers will not view the sign before this point.	

Sign First Visible, Not Yet Legible **Distance from Sign:** 600m-280m	
Visible? Yes. **Legible?** No.	**Sign within 10° horizontal cone of reading vision?** Yes. **Sign within 20° horizontal cone of peripheral vision?** Yes.

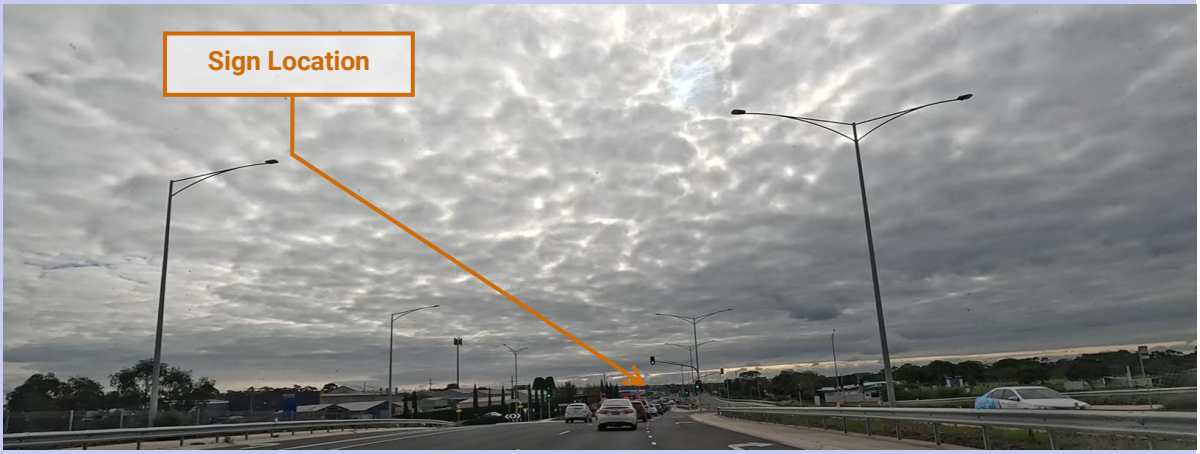


Figure 11: Northbound approach – sign first visible, not yet legible (approximately 600m to the sign)

Discussion:
The sign first enters drivers' view at approximately 600m to its location, as the road carriageway straightens up to face the sign location.

The sign is not yet legible (based on a legibility distance of 280m). Accordingly, we are satisfied that drivers' will be unlikely to pay attention to the sign within this section of road.

There is a signalised intersection with Crows Road located approximately 500m to the sign location, however at this point, the sign is far in the distance, and drivers will not be able to read the sign.

Additionally, drivers will have passed the warning and stopping distance to the intersection before the sign passes into view, and will therefore already be in the process of responding to the intersection before the sign is visible.

We are satisfied that the sign will not impact drivers' decision making in relation to this signalised intersection.

Sign First Visible, Not Yet Legible
Distance from Sign: 280m-170m

Visible? Yes. **Legible?** Yes.	**Sign within 10° horizontal cone of reading vision?** Yes. **Sign within 20° horizontal cone of peripheral vision?** Yes.

Figure 12: Northbound approach – sign first legible (approximately 280m to the sign)

Discussion:
The sign enters drivers' legible range to 280m to its location.

At this point, drivers may view the sign if they have the spare attention capacity to do so.

The *AustRoads Guide to Traffic Management Part 10: Traffic control and Communication Devices* specifies the following aiming distances for signal lanterns in a 70km/h speed zone:

- Warning distance – 150m
- Stopping distance – 100m

The warning distance to the signalised intersection with Breakwater Road occurs within this section of road, at 200m to the sign location.

The sign is well to the side of the intersection and does not background any of the traffic signals at the critical warning or stopping distances.

Accordingly, we are satisfied that the sign will not impact drivers' ability to respond to the signalised Breakwater Road intersection.

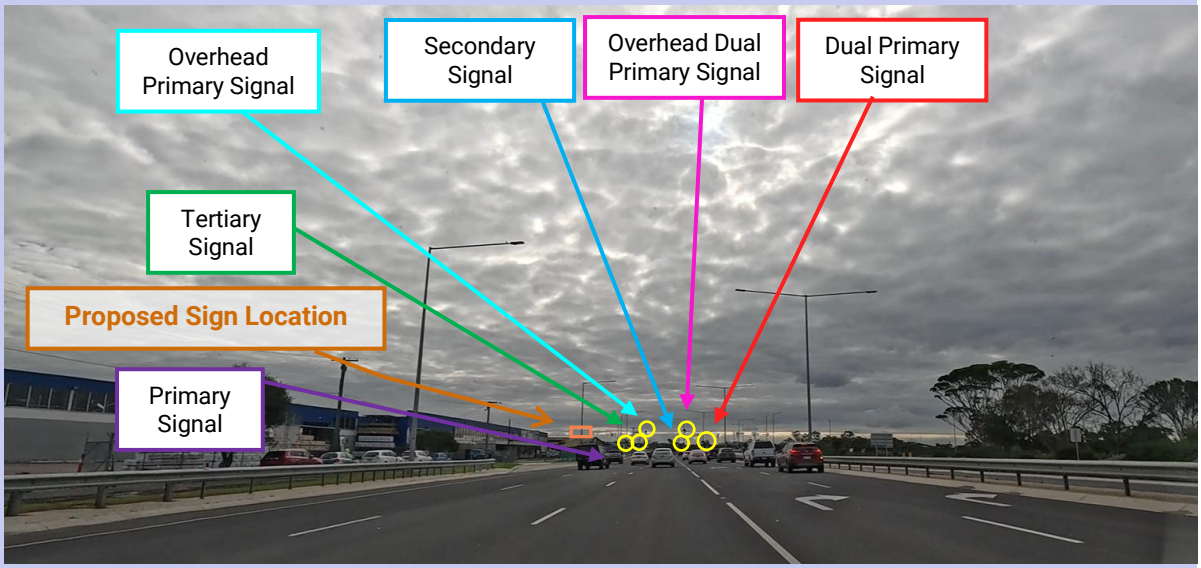


Figure 13: Northbound approach – warning distance Breakwater Road intersection (200m to sign /150m to stop line)

The sign is located outside of drivers' 10° horizontal cone of reading vision
Distance from Sign: 170m-80m

Visible? Yes. **Legible?** Yes.	**Sign within 10° cone of reading vision?** No. **Sign within 20° cone of peripheral vision?** Yes.

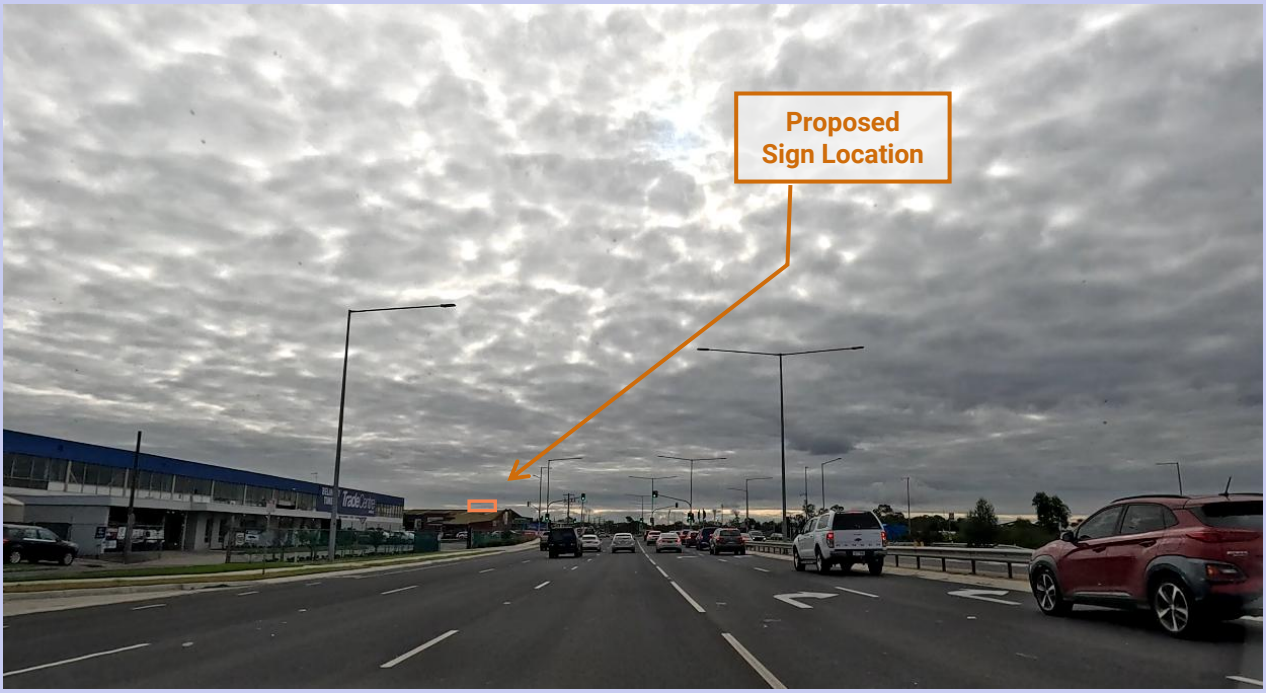


Figure 14: Northbound approach – sign passes outside drivers' 10° cone of reading vision (170m to sign)

Discussion:
The sign passes outside drivers' 10˚ cone of reading vision at approximately 170m to its proposed location. We are satisfied that drivers will be unlikely to pay attention to the sign from this point forward given it's offset from the driver.

Accordingly, we do not expect that drivers will pay attention to the sign when it does pass into their view.

The stopping distance to the signalised intersection with Breakwater Road occurs within this section of road (at 150m to the proposed sign location).

The sign is located well to the side of drivers at this point, and does not background any traffic lanterns associated with this upcoming intersection. We are satisfied that drivers are unlikely to view the sign at this point as they become aware of the upcoming intersection.

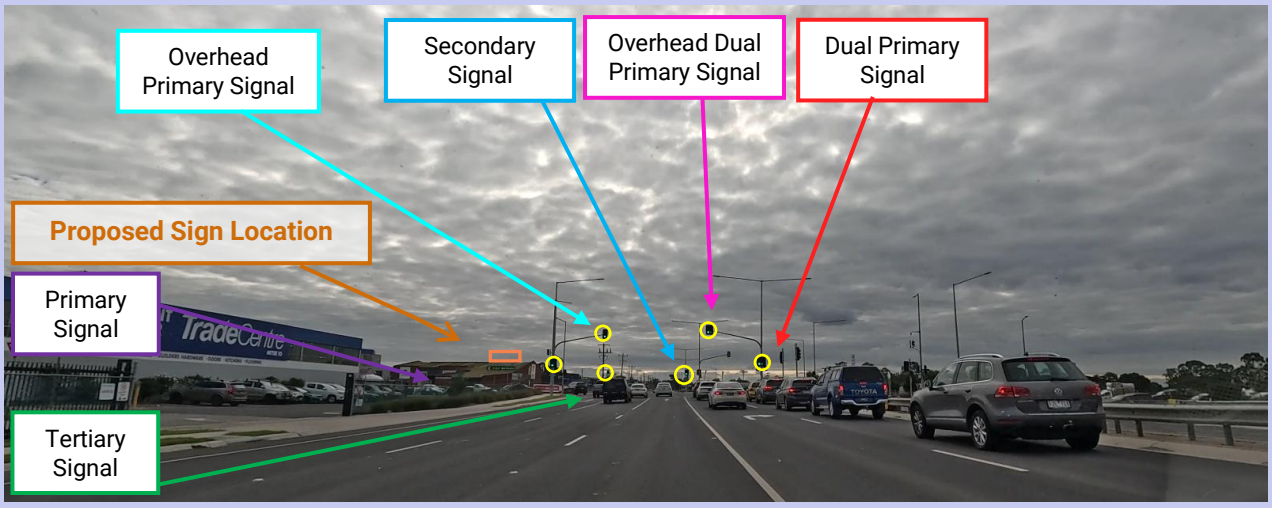


Figure 15: Northbound approach – stopping distance Breakwater Road intersection (150m to sign /100m to stop line)

The sign is passes outside of drivers' 20° cone of peripheral vision
Distance from Sign: 80m-0m

Visible? Yes. **Legible?** Yes.	**Sign within 10° cone of reading vision?** No. **Sign within 20° cone of peripheral vision?** No.

Figure 16: Northbound approach – sign passes outside drivers' 20˚ cone of peripheral vision (approximately 80m to the sign)

Discussion:
The sign will pass out of drivers' 20˚ cone of peripheral vision at approximately 80m to its proposed location.

Drivers are unlikely to view the proposed sign from this point onwards due to offset from the northbound carriageway and it is rapidly moving to the driver's left side. Drivers will also pass through the signalised intersection in this section of road.

The sign very briefly passes behind one traffic signal lanterns. We are satisfied that this is acceptable as:

- The backgrounding is brief.
- It is only of the 6 available traffic lanterns.
- The sign is not particularly large, and the signal lantern largely blocks it out as a result.
- It is past the point drivers have decided to stop or proceed through the intersection.

Based on the above, we are satisfied that the sign will not impact drivers' ability to react to or traverse this intersection.

Impact of image change of drivers along the northbound approach

On the approach to the sign, the distance that the sign will be both visible and legible (at a distance of 280m from the sign) and within the driver's 20° cone of peripheral vision (at a distance of 80m from the sign) is approximately 200m. The travel time for this section of the Barwon Heads Road is approximately 10.3 seconds when travelling at 70km/h in free-flowing traffic conditions. The percentage chance that a driver will observe an instantaneous transition between images along the approach to the sign during free-flowing conditions is approximately 34%.

Based on the above analysis, during free-flowing conditions, drivers would not have the opportunity to read more than 1-2 images. Outside of free-flow times drivers may observe more images, which is acceptable given that driver demand is negligible while the vehicle is stationary. Most drivers are only expected to observe one image change, this accords with the recommendations of the Austroads Research Report 2013[2] to minimise image changes.

Passengers would be free to look at the sign at any stage as they are not engaged in the driving task.

[2] Source: Austroads Research Report AP-R420-13, 2013, 'Impact of Roadside Advertising on Road Safety'.

4.3.2. Breakwater Road, Westbound

Westbound drivers primarily approach the advertising sign via Breakwater Road.

The relevant videos to be viewed in conjunction with reading this section are highlighted in **Green** below:

https://tinyurl.com/BreakwaterSign

The videos included are as follows:

- Video 1 – Barwon Heads Road, northbound
- **Video 2 – Breakwater Road, westbound**
- Video 3 – Barwon Heads Road, northbound, right turn at Breakwater Road
- Video 4 – Barwon Heads Road, northbound, left turn at Breakwater Road
- Video 5 – Breakwater Road, westbound, right turn at Barwon Heads Road
- Video 6 – Breakwater Road, westbound, left turn at Barwon Heads Road

An aerial photograph of this approach with the relevant signs and landmarks highlighted is provided at Figure 17.

- The sign is not visible due to roadside barriers and existing signage
- The sign is first visible but not yet legible
- The sign is visible and legible
- The sign passes outside drivers' 10° horizontal cone of reading vision
- The sign passes outside drivers' 20° horizontal cone of peripheral vision

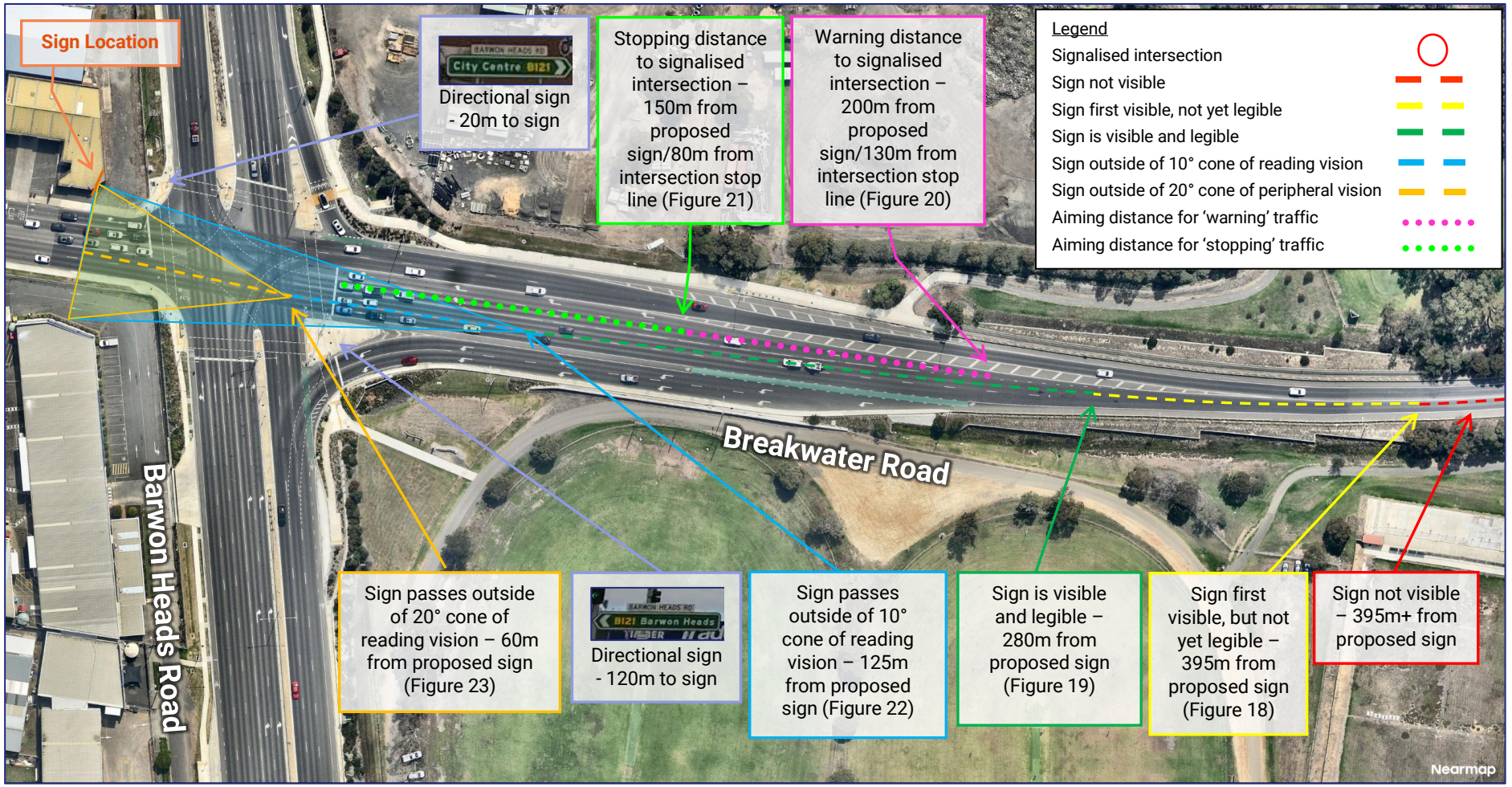


Figure 17: Aerial View of Westbound Road Network (Source: Nearmap)

Table 3: Review of westbound driving task on Breakwater Road

Review of Westbound Driving Task – Breakwater Road	
Sign Not Visible **Distance from Sign:** 395m+	
Visible? No. **Legible?** N/A.	**Sign within 10° cone of reading vision?** N/A. **Sign within 20° cone of peripheral vision?** N/A.
Discussion: The proposed sign is obstructed from drivers' view greater than 395m due to vegetation along the northern side of the carriageway. We are satisfied that drivers will not view the sign before this point.	

Sign First Visible, Not Yet Legible
Distance from Sign: 385m-280m

Visible? Yes. **Legible?** No.	**Sign within 10° horizontal cone of reading vision?** Yes. **Sign within 20° horizontal cone of peripheral vision?** Yes.

Figure 18: Westbound approach – sign first visible, not yet legible (approximately 395m to the sign)

Discussion:
The sign first enters drivers' view at approximately 395m to its location.

The sign is not yet legible (based on a legibility distance of 280m). Accordingly, we are satisfied that drivers' will be unlikely to pay attention to the sign within this section of road.

There are no critical driving tasks at this point other than maintaining a safe distance from the vehicle in front.

Sign Visible and Legible
Distance from Sign: 280m-125m

Visible? Yes. **Legible?** Yes.	**Sign within 10° cone of reading vision?** Yes. **Sign within 20° cone of peripheral vision?** Yes.

Figure 19: Westbound approach – sign is visible and legible (280m to sign)

Discussion:
The sign will first enter drivers' view at approximately 280m to its location, when it passes out from behind vegetation along the northern side of the Barwon Heads Road intersection.

The sign also enters drivers' legible range at this point.

The *AustRoads Guide to Traffic Management Part 10: Traffic control and Communication Devices* specifies the following aiming distances for signal lanterns in a 60km/h speed zone:

- Warning distance – 80m
- Stopping distance – 130m

The warning and stopping distance to the signalised intersection with Barwon Heads Road occurs within this section of road (at 200m and 150m to the proposed sign location, respectively).

The sign is located to drivers' right hand side and does not background any traffic lanterns along approach to the sign at these critical distances.

We are satisfied that drivers will be focusing on responding to the upcoming signals, being the primary driving task, and will only view the sign if they have the spare attention capacity to do so.

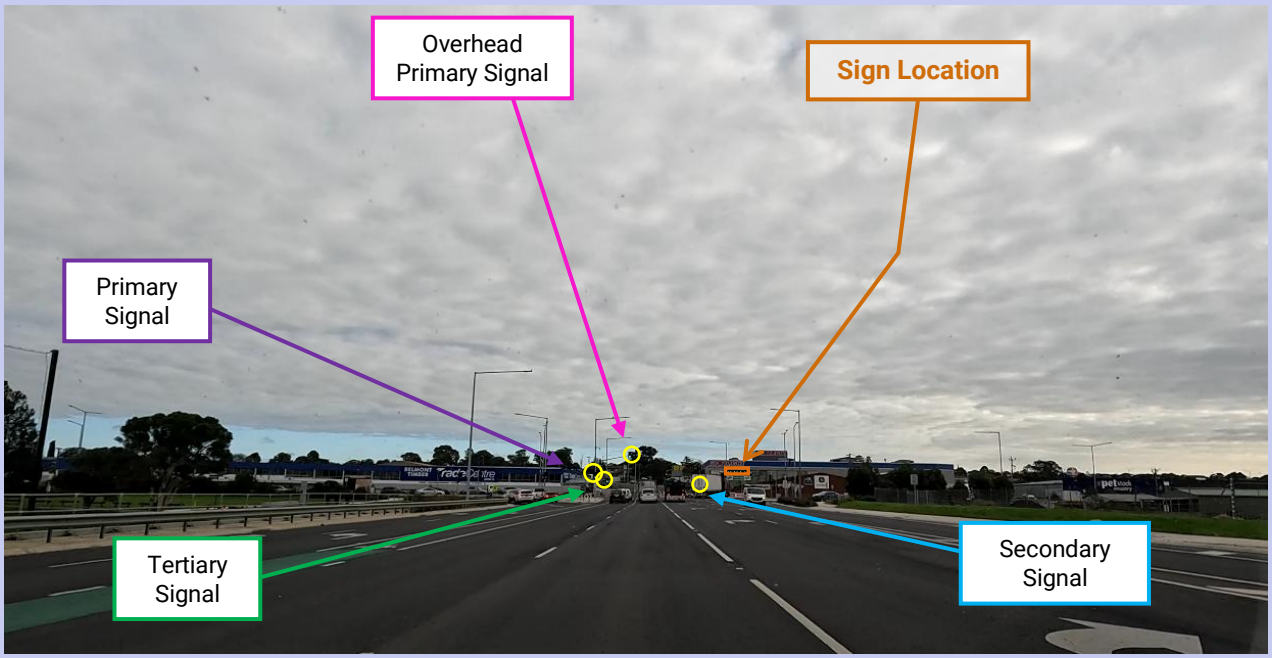


Figure 20: Westbound approach – warning distance to signalised intersection (200m to sign/ 130m to stop line)

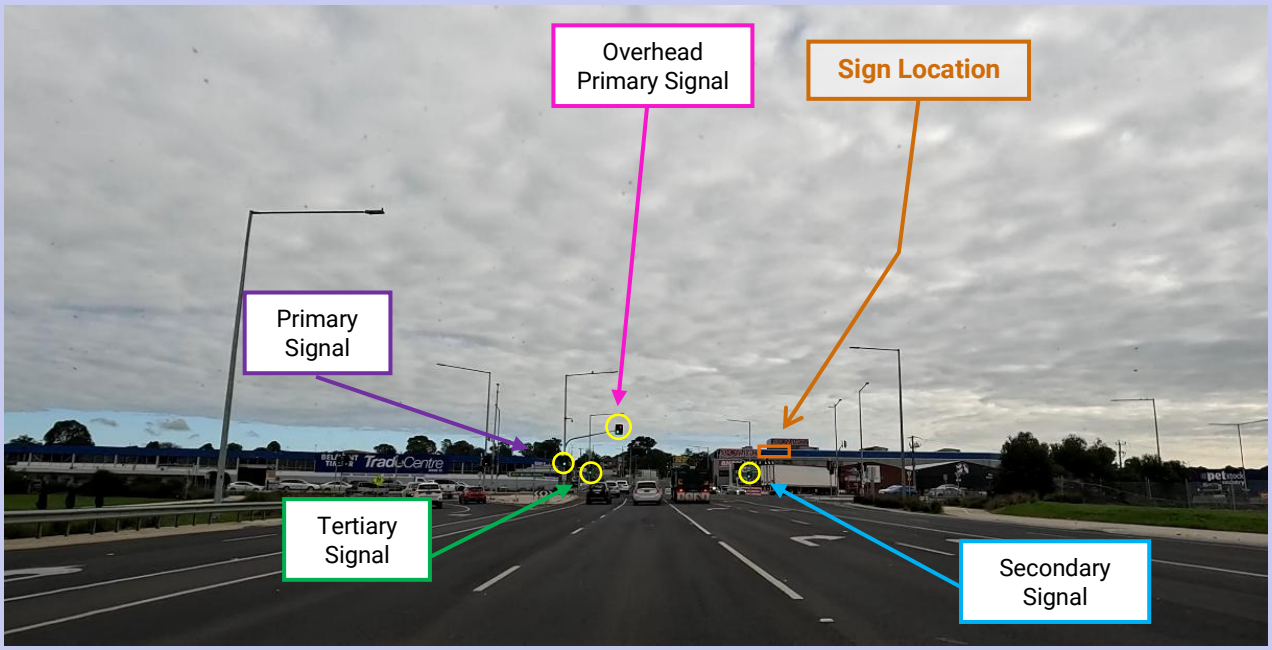


Figure 21: Westbound approach – stopping distance to signalised intersection (150m to sign/ 80m to stop line)

The sign passes outside drivers' 10˚ cone of reading vision
Distance from Sign: 125m-60m

Visible? Yes.
Legible? Yes.

Sign within 10° cone of reading vision? No.
Sign within 20° cone of peripheral vision? Yes.

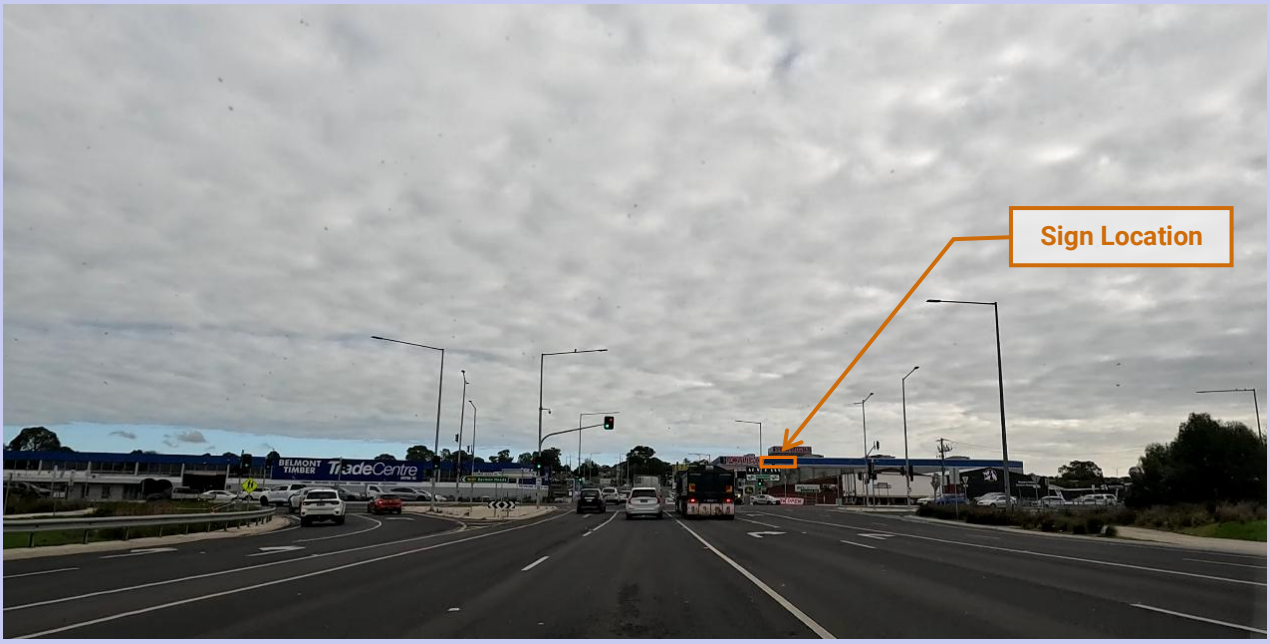


Figure 22: Westbound approach – sign passes outside drivers' 10˚ cone of reading vision (125m to sign)

Discussion:
The sign will pass outside drivers' 10˚ cone of reading vision at approximately 125m to the sign's location.

Drivers are unlikely to pay attention to the sign from this point onward.

We are satisfied that drivers will be focusing on responding to the upcoming signalised intersection with the Barwon Heads Road and that the sign will not impact drivers' ability to undertake this task.

The sign is passes outside of drivers' 20° cone of peripheral vision
Distance from Sign: 60m-0m

Visible? Yes. **Legible?** Yes.	**Sign within 10° cone of reading vision?** No. **Sign within 20° cone of peripheral vision?** No.

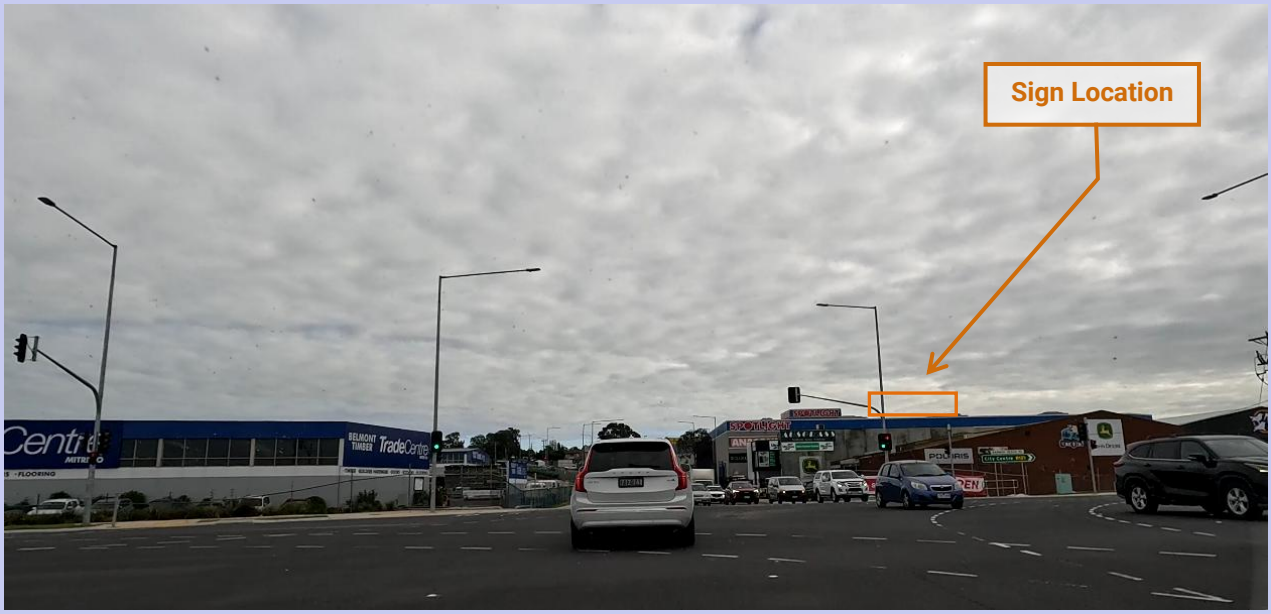


Figure 23: Westbound approach – sign passes outside drivers' 20˚ cone of peripheral vision (approximately 60m to the sign)

Discussion:
The sign will pass out of drivers' 20˚ cone of peripheral vision at approximately 60m to its proposed location.

The sign will be located to the far-right hand side of drivers and rapidly moving further out of view. Accordingly, we are satisfied that the drivers will not view the proposed sign from this point onwards.

Impact of image change of drivers along the Westbound approach

On the approach to the sign, the distance that the sign will be both visible and legible (at a distance of 280m from the sign) and within the driver's 20° cone of peripheral vision (at a distance of 60m from the sign) is approximately 220m. The travel time for this section of the Breakwater Road is approximately 13.2 seconds when travelling at 60km/h in free-flowing traffic conditions. The percentage chance that a driver will observe an instantaneous transition between images along the approach to the sign during free-flowing conditions is approximately 44%.

Based on the above analysis, during free-flowing conditions, drivers would not have the opportunity to read more than 1-2 images. Outside of free-flow times drivers may observe more images, which is acceptable given that driver demand is negligible while the vehicle is stationary. Most drivers are only expected to observe one image change, this accords with the recommendations of the Austroads Research Report 2013[3] to minimise image changes.

Passengers would be free to look at the sign at any stage as they are not engaged in the driving task.

[3] Source: Austroads Research Report AP-R420-13, 2013, 'Impact of Roadside Advertising on Road Safety'.

4.3.3. Other Movements

The proposed sign is visible and legible from several other locations as detailed below.

Barwon Heads Road, right turn at Breakwater Road, northbound

The approach for northbound vehicles performing a right turn at Breakwater Road is essentially the same as the standard northbound approach discussed in Section 4.3.1 up until the point of the turn.

There are two dedicated turning lanes, which begin approximately 360m to the sign location. At this point, the sign is visible but not yet legible. Drivers' view at this point is shown in Figure 24.

Figure 24: Northbound Approach – Entering Right Turn Lane (approx. 360m to sign)

As drivers approach the intersection with Breakwater Road, the sign passes well to drivers' right-hand side and out of view. Accordingly, we are satisfied that drivers will not view the sign as they traverse this intersection.

This intersection (including right turn lanes) is a standard layout intersection. The right turn movement is fully controlled, with right turn lanterns provided on the dual primary, dual primary overhead and secondary signals, and these signals are clear of the sign location when drivers are entering and travelling in the turn lane. This is demonstrated in the figure below.

Drivers may view the sign when stopped at the intersection. Looking around when stationary at traffic signals is normal driver behavior, and given the low driver demands at this time, we consider this acceptable. Once moving into the intersection, we are satisfied that drivers will be engaged in this task and no longer look at the sign.

Figure 25: Northbound Approach – Right turn from Barwon Heads Road to Breakwater Road (50m to sign location)

We are satisfied that the proposed sign will not impact northbound drivers performing a right turn at this location.

Barwon Heads Road, left turn at Breakwater Road, northbound

The approach for northbound vehicles performing a left turn onto Breakwater Road is essentially the same as the standard northbound approach discussed in Section 4.3.2 up until the point of the turn.

The pedestrian crossing across Breakwater Road is clearly visible on approach. Drivers will be aware of the presence of pedestrians as they approach the intersection. Pedestrian crossings are common and expected by the driver. Additionally, drivers will be looking in the direction of the pedestrian crossing point and then the direction of opposing traffic as they navigate the turn, both of which are not obstructed by the proposed sign.

Figure 26: Northbound Approach – Drivers view at left turn (50m to sign location)

We are satisfied that the proposed sign will not impact drivers performing a left turn.

Breakwater Road, right turn at Barwon Heads Road, westbound

The approach for westbound vehicles performing a right turn at Barwon Heads Road is essentially the same as the standard westbound approach discussed in Section 4.3.1 up until the point of the turn.

There are two dedicated turning lanes, which begin approximately 260m to the sign location. At this point, the sign is visible and legible. This is shown below in Figure 27.

Figure 27: Westbound Approach – Entering Right Turn Lane (approx. 260m to sign)

This intersection (including right turn lanes) is a standard layout intersection. The right turn movement is fully controlled, with right turn lanterns provided on the dual primary, dual primary overhead and secondary signals, and these signals are clear of the sign location when drivers are entering and travelling in the turn lane. This is demonstrated in the figure below.

As drivers approach the intersection with Breakwater Road, the sign passes well to drivers' right-hand side and out of view. Accordingly, we are satisfied that drivers will not view the sign as they traverse this intersection.

Drivers may view the sign when stopped at the intersection. Looking around when stationary at traffic signals is normal driver behavior, and given the low driver demands at this time, we consider this acceptable. Once moving into the intersection, we are satisfied that drivers will be engaged in this task and no longer look at the sign.

Figure 28: Westbound Approach – Right turn from Breakwater Road to Barwon Heads Road (70m to sign location)

We are satisfied that the proposed sign will not impact westbound drivers performing a right turn at this location.

Breakwater Road Left Turn at Barwon Heads Road, southbound

The approach for westbound vehicles performing a left turn onto Barwon Heads Road is essentially the same as the standard westbound approach discussed in Section 4.3.2 up until the point of the turn.

There are two controlled left turn lanes which begins approximately 250m to the sign location. At this point, being in the leftmost traffic lane, the proposed sign is out-of-view and will not be visible to drivers. This is shown in the Figure below.

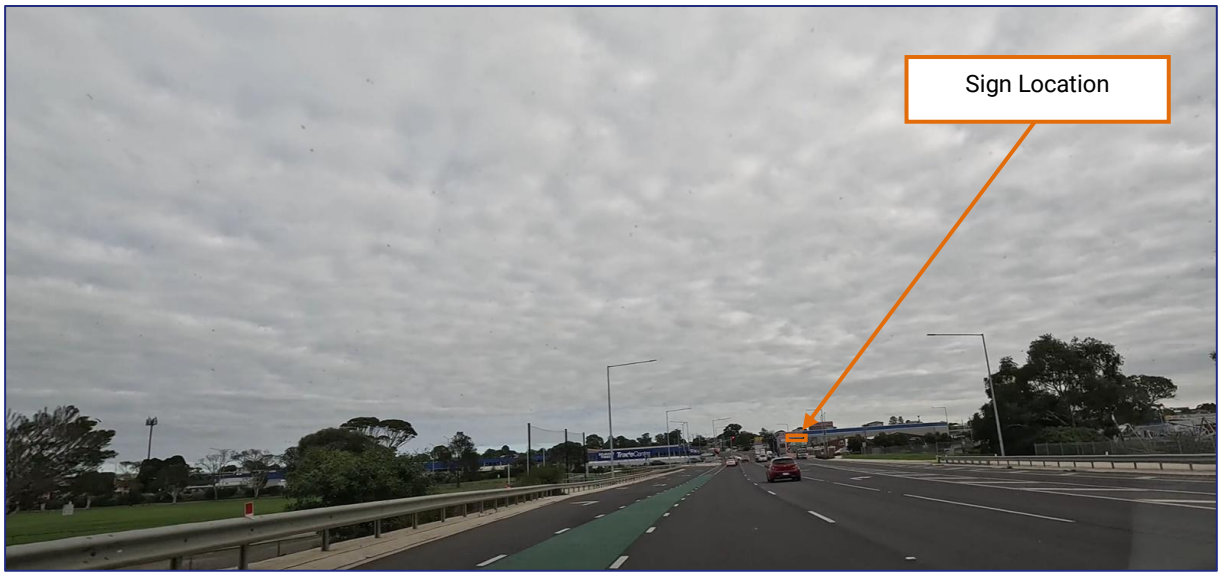


Figure 29: Westbound Approach – Entering Left Turn Slip Lane (approx. 250m to sign)

The pedestrian crossing point across these lanes is clearly visible on approach. Drivers will be aware of the presence of pedestrians as they approach the stopping line, given its proximity to the intersection and the signage for pedestrians on the approach to the stopping line. Pedestrian crossings across slip lanes are common and expected by the driver. Additionally, drivers will be looking in the direction of the pedestrian crossing point and then the direction of opposing traffic as they navigate the turn, both of which are not obstructed by the proposed sign.

Figure 30: Westbound Approach – Drivers' view at controlled left turn lanes

We are satisfied that the proposed sign will not impact drivers performing a left turn.

4.4. Requirements of the Planning Scheme

Clause 52.05-9 of the Planning Scheme includes specific conditions related to road safety in any permit issued for a major promotion sign. These are as follows:

- That the sign must not:
  - Dazzle or distract drivers due to its colouring.
  - Be able to be mistaken for a traffic signal because it has, for example, red circles, octagons, crosses or triangles.
  - Be able to be mistaken as an instruction to drivers.
- An expiry date which is 15 years from the date that the permit is issued unless otherwise specified in this clause. This does not apply to a permit for major promotion sign for a special event of temporary building shrouding.

4.4.1. Assessment Against Decision Guidelines

Clause 52.05-8 includes decision guidelines to assess whether a proposed promotion sign is a safety hazard. These criteria are also adopted in DTP's Ten Point Road Safety Checklist.

As decision guidelines for considering an application, Clause 52.05-8 states that the responsible authority must consider:

- The impact on road safety. A sign is a safety hazard if the sign:
  - Obstructs a driver's line of sight at an intersection, curve or point of egress from an adjacent property.
  - Obstructs a driver's view of a traffic control device, or is likely to create a confusing or dominating background which might reduce the clarity or effectiveness of a traffic control device.
  - Could dazzle or distract drivers due to its size, design or colouring, or it being illuminated, reflective, animated or flashing.
  - Is at a location where particular concentration is required, such as a high pedestrian volume intersection.
  - Is likely to be mistaken for a traffic control device, because it contains red, green or yellow lighting, or has red circles, octagons, crosses, triangles or arrows.
  - Requires close study from a moving or stationary vehicle in a location where the vehicle would be unprotected from passing traffic.
  - Invites drivers to turn where there is fast moving traffic or the sign is so close to the turning point that there is no time to signal and turn safely.
  - Is within 100 metres of a rural railway crossing.
  - Has insufficient clearance from vehicles on the carriageway.
  - Could mislead drivers or be mistaken as an instruction to drivers.

Table 4 summarises the responses to the decision guidelines. This assessment should be read in conjunction with Section 4.3.

Table 4: Review of Decision Guidelines

A sign is a safety hazard if the sign		Response
1.	Obstructs a driver's line of sight at an intersection, curve or point of egress from an adjacent property.	The sign is located to the side of the Breakwater Road and Barwon Heads Road carriageways, primarily facing northbound and westbound traffic. As the sign is not located along the carriageway (being well above and to the side of the road), clear sight lines are maintained along all approaches to the sign. *Therefore, the proposed sign will not obstruct a driver's line of sight at an intersection, curve or point of egress from an adjacent property.*
2.	Obstructs a driver's view of a traffic control device, or is likely to create a confusing or dominating background which might reduce the clarity or effectiveness of a traffic control device.	The sign is in an elevated position and will not obstruct or background a driver's line of sight to any key traffic control devices at key decision making points. Any backgrounding is fleeting and only occurs once drivers are already within the intersection. Clause 52.05-9 of the Planning Scheme imposes mandatory conditions on any planning permit that minimise the chance of an advertising sign being mistaken for a traffic control device. *Therefore, the proposed sign will not create a confusing or dominating background which might reduce the clarity or effectiveness of a traffic control device.*
3.	Could dazzle or distract drivers due to its size, design or colouring, or it being illuminated, reflective, animated or flashing.	The proposal is for an electronic sign. The electronic sign will not be reflective, animated or flashing, and only display static images. The electronic sign proposes a dwell time of at least 30 seconds per advertisement and an instantaneous transition time. The level of illumination, design, colour and content of the electronic billboard can appropriately be controlled by permit conditions. As discussed at Section 4.3, during free-flowing conditions it is expected that 34-44% of drivers will view an image change from either direction. This accords with the recommendations of the Austroads Research Report 2013 to minimise image changes. *We are satisfied that the design of the sign will not dazzle or distract drivers.*
4.	Is at a location where particular concentration is required, such as a high pedestrian volume intersection.	The concentration needs of drivers are discussed extensively in Section 4.2. <u>Northbound approach</u> For drivers travelling northbound along Barwon Heads Road, the sign enters the drivers view at approximately 600m to its location, at which point it will be visible but not legible. The main driving task along this approach is responding to the signalised intersection at Breakwater Road.

A sign is a safety hazard if the sign		Response
		The sign is well to the side of the intersection and does not background any of the traffic signals at the critical warning or stopping distances. Additionally, on the northbound approach, the sign is actually angled to the Barwon Heads Road carriageway, and is not particularly readable. Accordingly, we are satisfied that the sign will not impact drivers' ability to respond to the signalised Breakwater Road intersection. <u>Westbound approach</u> For drivers travelling westbound along Breakwater Road, the sign enters the drivers view at approximately 395m to its location. The main driving task along this approach is responding to the signalised intersection with Barwon Heads Road. The sign is located to drivers' right hand side and does not background any traffic lanterns along approach to the sign at these critical distances. We are satisfied that drivers will be focusing on responding to the upcoming signals, being the primary driving task, and will only view the sign if they have the spare attention capacity to do so. We are satisfied that the sign will not impact drivers' ability to respond to this intersection. *The proposed sign will not affect drivers' ability to concentrate in this location.*
5.	Is likely to be mistaken for a traffic control device, because it contains red, green or yellow lighting, or has red circles, octagons, crosses, triangles or arrows.	The control of lighting types, colours and shapes can be appropriately controlled by conditions, as required by Clause 52.05-9. *There is no reason to consider that the proposed sign will be mistaken for a traffic control device.*
6.	Requires close study from a moving or stationary vehicle in a location where the vehicle would be unprotected from passing traffic.	It is understood that the sign will not require close study from a moving or stationary vehicle as it will be used for general advertising only. *Therefore, the proposed sign will not require close study from a moving or stationary vehicle in a location where the vehicle would be unprotected from passing traffic.*

A sign is a safety hazard if the sign		Response
7.	Invites drivers to turn where there is fast moving traffic or the sign is so close to the turning point that there is no time to signal and turn safely.	The sign is to be used for general advertising only and will not specifically be advertising its location (i.e. not used for directional purposes). The advertising messages can appropriately be controlled by conditions set out by the road authority, which restricts certain types of images being used which may be mistaken as an instruction to drivers (i.e. misleading drivers to perform a certain type of movement along the approach, through the use for example of 'sound or motion' to activate the sign or interact with any of the road users). *Based on advice to Traffix Group, drivers will not be invited to turn at this location as it will only be used for general advertising.*
8.	Is within 100 metres of a rural railway crossing.	The sign is not located within 100m of an at-grade railway crossing. *Accordingly, this consideration is not applicable to this application.*
9.	Has insufficient clearance from vehicles on the carriageway.	The sign will be entirely contained within the site boundary and will not overhang any road carriageways. *The proposed sign will have sufficient clearance from vehicles on the carriageway.*
10.	Could mislead drivers or be mistaken as an instruction to drivers.	It is understood that the general advertising on the proposed sign will not mislead drivers or be mistaken as an instruction to drivers. The advertising messages can appropriately be controlled by conditions as required by Clause 52.05-9. *Based on advice to Traffix Group, the proposed sign will not mislead drivers or be mistaken as an instruction to drivers.*

Overall, we are satisfied that the proposed billboard does not pose a safety hazard to road users.

5. Conclusion

Having perused relevant documents and plans, undertaken a field visit, arranged for a video survey, undertaken a review of literature and undertaken a traffic engineering assessment, we are of the opinion that:

a) Traffic engineering and road safety research exists to demonstrate the following with respect to billboards:

   i) traffic signs are not conspicuous to drivers until they are within approximately 10 degrees horizontally and 5 degree vertically of the driver's line of sight,

   ii) drivers have a 30 to 50% spare attention capacity, which they devote to objects not related to the driving task, including advertising or billboard signs,

   iii) outdoor advertising is intended to be a 'glance medium' with only short glances being required to read and interpret the message, which would not have a significant impact on road safety,

   iv) eyes-off-road durations greater than 2 seconds significantly increased individual near-crash/crash risk, whereas less than 2 seconds was comparable to normal driving, and

   v) drivers have the ability to shed any unnecessary information when they have an information overload, to focus on what is judged to be more important.

b) The proposed electronic billboard will be located on the north-western corner of the Barwon Heads Road and Breakwater Road intersection and will be fully contained within the site boundary.

c) The sign is in an elevated position and will not obstruct a driver's line of sight to any key traffic control device or traffic sign along either carriageway at key decision making points.

d) The proposed dwell time of at least 30 seconds per image and instantaneous transition time are consistent with current practice.

e) During free-flowing conditions, drivers are unlikely to view more than one image change.

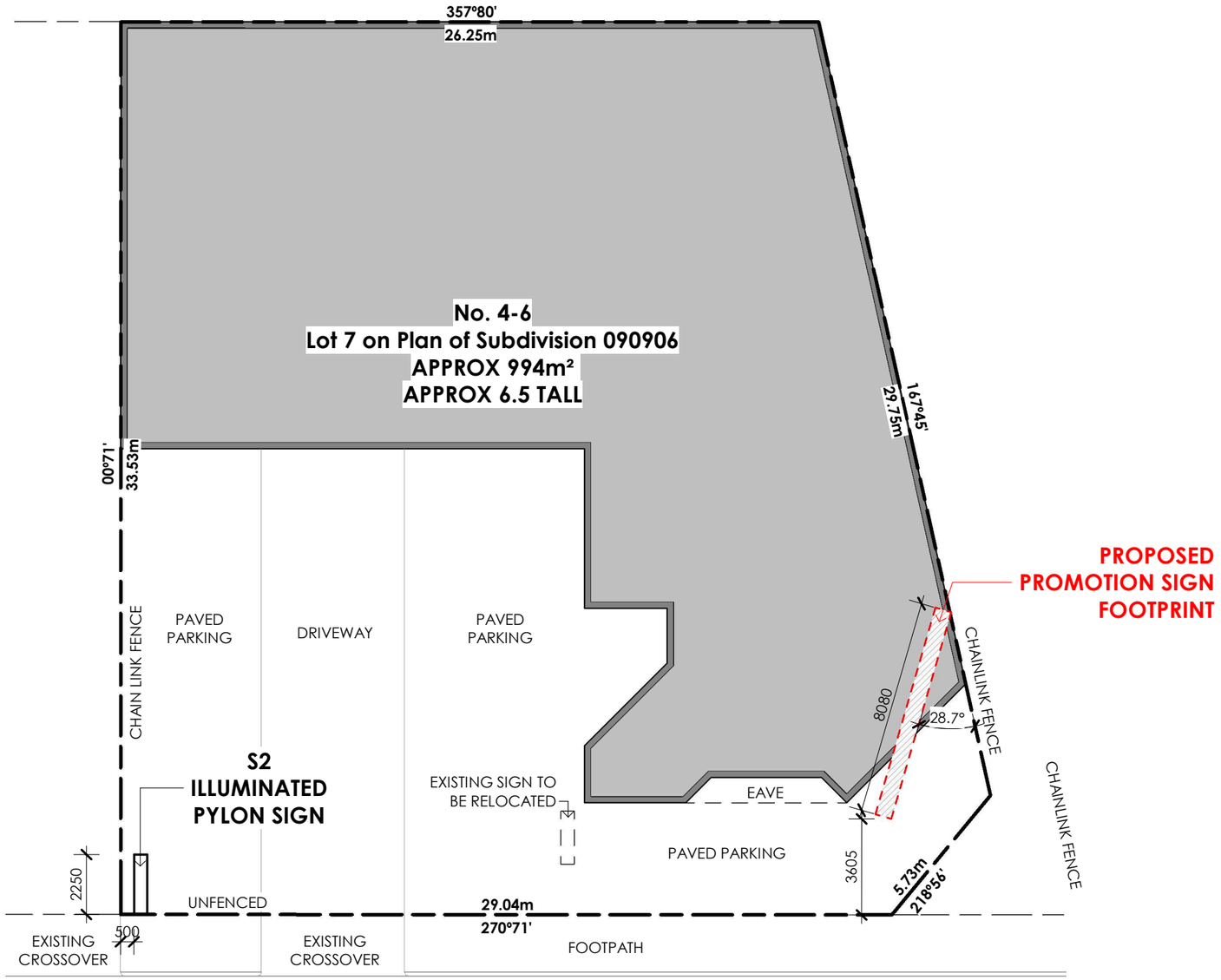
f) During times of traffic congestion and slower vehicle speeds, we are satisfied that drivers viewing additional images is acceptable given slower vehicle speeds and the lack of critical driving tasks within the vicinity of the proposed sign.

g) The proposed sign satisfies the decision guidelines set out in Clause 52.05-8 (and DTP's Ten Point Safety Checklist) assuming that appropriate controls are in place to govern the promotional material which can be displayed on the electronic billboard (for example using 'sound or motion' to activate the sign or interact with road users, along with advertisements which may contain of present time update information such as news or weather) to ensure that the advertisement displayed is not reflective, animated or flashing, and does not provide an instruction which could dazzle, distract or confuse motorists.

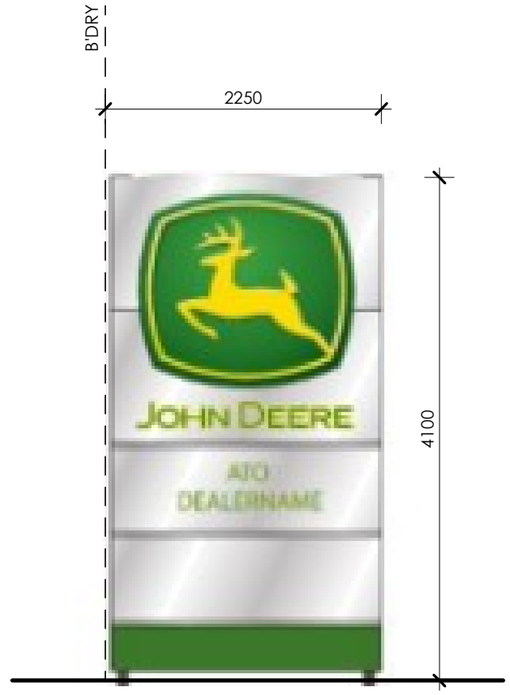
h) There are no traffic engineering reasons why a permit for a proposed electronic sign at 4-6 Breakwater Road, Belmont should not be granted.

Appendix A

Development Plans



SITE PLAN
SCALE 1 : 200



EXISTING PYLON SIGN TO BE RELOCATED. SIZE AND DESIGN TO REMAIN UNCHANGED.

THE PERMIT SEEKS FOR A NEW PERMIT TO BE GRANTED FOR THIS SIGN FOR AN ADDITIONAL 15 YEARS.

S2 - PYLON SIGN ELEVATION
SCALE 1 : 50

LEGEND

- PROPERTY BOUNDARY
- EXISTING BUILDINGS ONSITE
- PROPOSED MAJOR PROMOTION SIGN FOOTPRINT

ISSUE/AMMENDMENTS SCHEDULE

01 **26/05/2026**
TOWN PLANNING ISSUE

TOWN PLANNING

NOT FOR CONSTRUCTION

PROJECT
BELMONT - PROPOSED ILLUMINATED PYLON SIGN AND ELECTRONIC PROMOTION SIGN & ASSOCIATED WORKS

ADDRESS
4-6 BREAKWATER RD.
BELMONT, VIC 3216

NORTH POINT

DATE 26/05/2026
DRAWING NO. A02
DRAWN BY AP
PROJECT NO. 23-002
PAGE SIZE A3
ISSUE NO. 03

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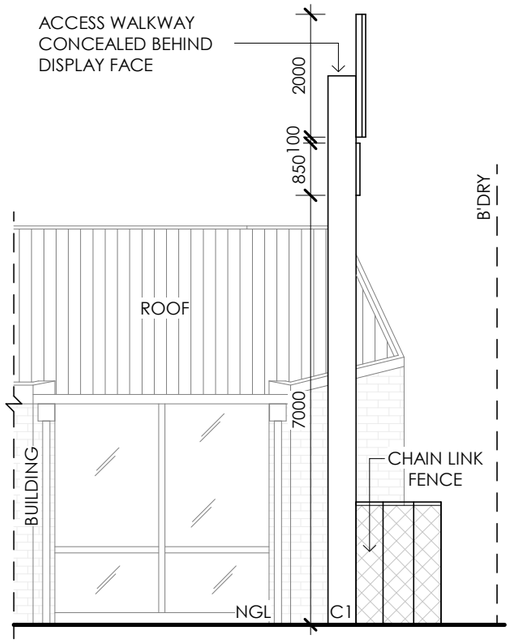
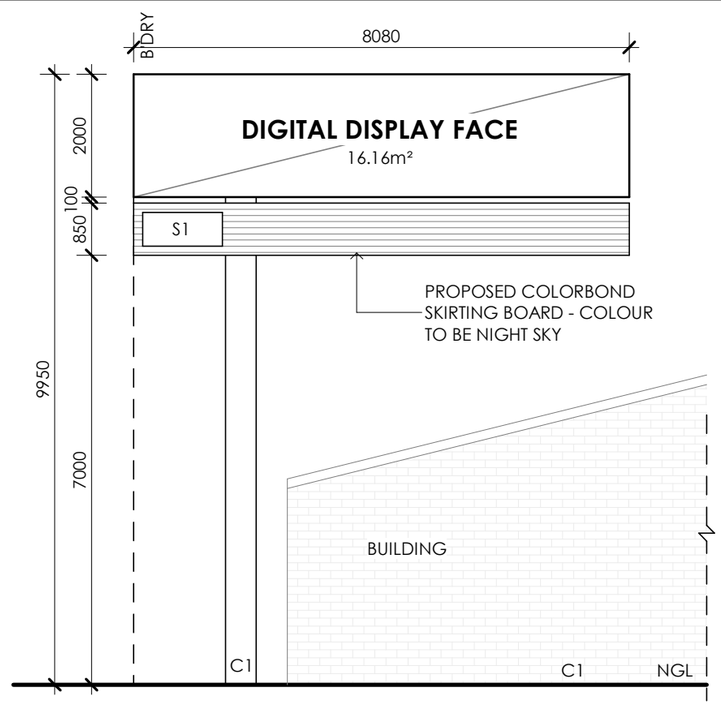
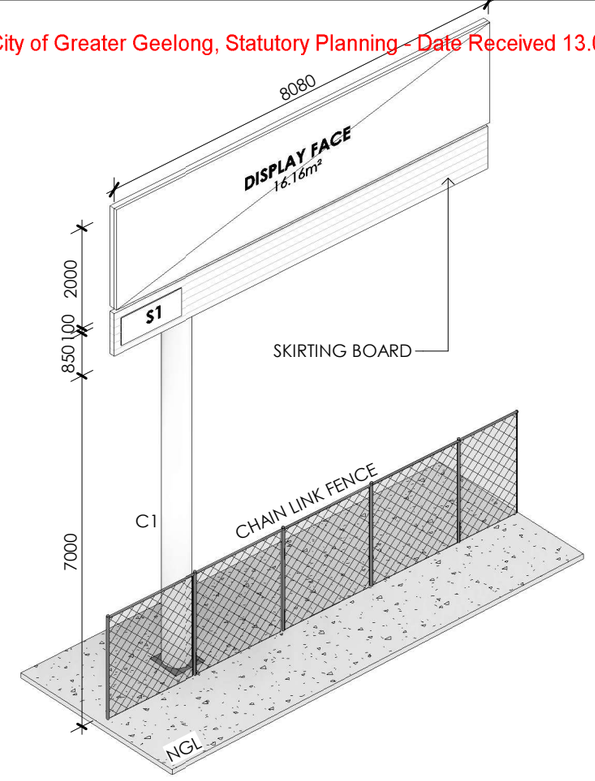


SOUTH ELEVATION
SCALE 1 : 100

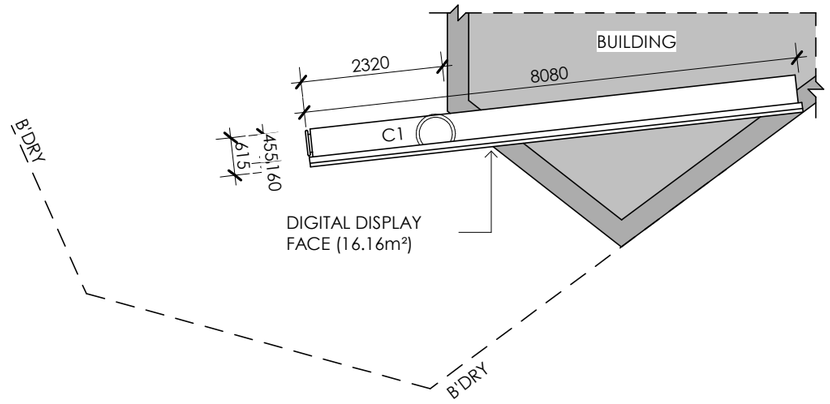


EAST ELEVATION
SCALE 1 : 100



PERSPECTIVE

S1 - SIGNAGE DETAIL
SCALE 1 : 20

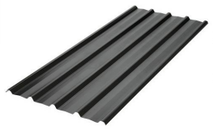


FLOOR PLAN
SCALE 1 : 100

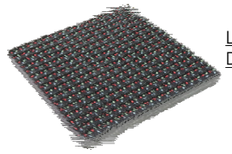
MATERIALS BOARD

C1
PROPOSED COLUMN - POWDERCOAT BLACK FINISH

BLACK PAINT
PROPOSED BLACK PAINT FINISH TO ALL FEATURES, TRIMS AND LIGHTING



SKIRTING BOARD
PROPOSED COLORBOND SKIRTING BOARD WITH NIGHT SKY FINISH



LED SCREEN DISPLAY

LEGEND

C1	PROPOSED COLUMN - POWDERCOAT BLACK FINISH
NGL	NATURAL GROUND LINE
S1	PERMANENT SIGN 1 - REFER TO DETAIL

ISSUE/AMMENDMENTS SCHEDULE

01 **26/05/2026**
TOWN PLANNING ISSUE

TOWN PLANNING
NOT FOR CONSTRUCTION

gawk

PROJECT
BELMONT - PROPOSED ILLUMINATED PYLON SIGN AND ELECTRONIC PROMOTION SIGN & ASSOCIATED WORKS

ADDRESS
4-6 BREAKWATER RD.
BELMONT, VIC 3216

NORTH POINT

DATE 26/05/2026
DRAWING NO. A03
DRAWN BY AP
PROJECT NO. 23-002
PAGE SIZE A3
ISSUE NO. 03

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Appendix B

Crash Analysis

Casualty Crash History

Table B1 details the locations of casualty crashes recorded over the 5 year period (1st October, 2020 to 30th September, 2025) for the northbound and westbound approach to the sign. Crashes were only included in the area in which the sign was visible, and not when it was obscured out of view.

Table B1: Casualty crash history (1st October, 2020 to 30th September, 2025)

Location	Date	Time	Sev erity	Type (DCA code)	Type of Accident	Sign Visible & Legible?
Northbound Approach						
Location 1 Barwon Heads Road, 5m south of Breakwater Road	Sunday 28/11/2021	13:30	OI	132	Right rear involving two northbound vehicles.	Sign visible but outside drivers 20° cone of peripheral vision
	Saturday 16/08/2025	14:00	OI	130	Rear end (vehicles in same lane) involving two northbound vehicles.	
Location 2 Barwon Heads Road / Breakwater Road intersection	Saturday 21/11/2020	06:45	SI	113	Right near (intersections only) involving a turning northbound and westbound vehicle.	
	Monday 22/11/2021	12:16	F	148 (RT) (B)	Vehicle off footpath strikes vehicle on carriageway involving a southbound cyclist and westbound truck.	
	Saturday 10/06/2023	07:28	SI	121	Right through involving a turning northbound vehicle and a southbound vehicle.	
	Friday 28/07/2023	12:10	SI	121	Right through involving a turning northbound vehicle and northbound vehicle (there is a possible data coding issue in the database as both vehicles could not be travelling north under a 121).	
	Monday 27/05/2024	12:00	OI	133	Lane side swipe (vehicles in parallel lanes) involving two north-westbound vehicles.	

Location	Date	Time	Sev erity	Type (DCA code)	Type of Accident	Sign Visible & Legible?
	Saturday 09/11/2024	10:06	OI	130	Rear end (vehicles in same lane) involving two north-westbound vehicles.	
	Sunday 22/06/2025	07:28	SI	110	Cross traffic (intersection only) involving a northbound and eastbound vehicle.	
Westbound Approach						
Location 3 Breakwater Road, 160m east of Barwon Heads Road	Thursday 23/06/2022	17:30	OI	130	Rear end (vehicles in same lane) involving two westbound vehicles.	Sign visible and legible
Location 4 Breakwater Road, 20m east of Barwon Heads Road	Monday 07/04/2025	15:22	OI	130	Rear end (vehicles in same lane) involving two westbound vehicles.	Sign visible but outside drivers' 10° cone of reading vision.
Location 5 Breakwater Road, 10m east of Barwon Heads Road	Saturday 27/02.2021	13:00	OI	140	U-turn involving two westbound vehicles.	

LEGEND:
OI: Other Injury SI: Serious Injury F: Fatality
(B): Bicyclist (M): Motorcyclist (P): Pedestrian
(C): Bus/Coach (RT): Rigid Truck (ST): Semi-trailer

The crash review indicated that there were 12 casualty crashes on approach to the sign.

Of these crashes, 7 occurred at the Barwon Heads Road / Breakwater Road intersection, while the remaining crashes were spread across the review area.

This includes one fatality, which involved a southbound cyclist emerging from the footpath onto the carriageway, and being struck by a westbound truck.

It is important to note that at the Barwon Heads Road / Breakwater Road intersection, the sign is well to drivers' side and outside their 20° cone of peripheral vision.

Accordingly, we are satisfied that drivers would be unlikely to view the sign at this point.

This number of crashes is partly the function of being the intersection of two busy arterial roads (i.e. higher exposure).

There were also 4 crashes that involved at least 1 vehicle failing to give way, however all movements are fully controlled and one of the parties has likely been travelling against a red

light. This pattern appears to be an existing enforcement issue with the intersection that should be monitored, rather than a geometric or design concern with the intersection.

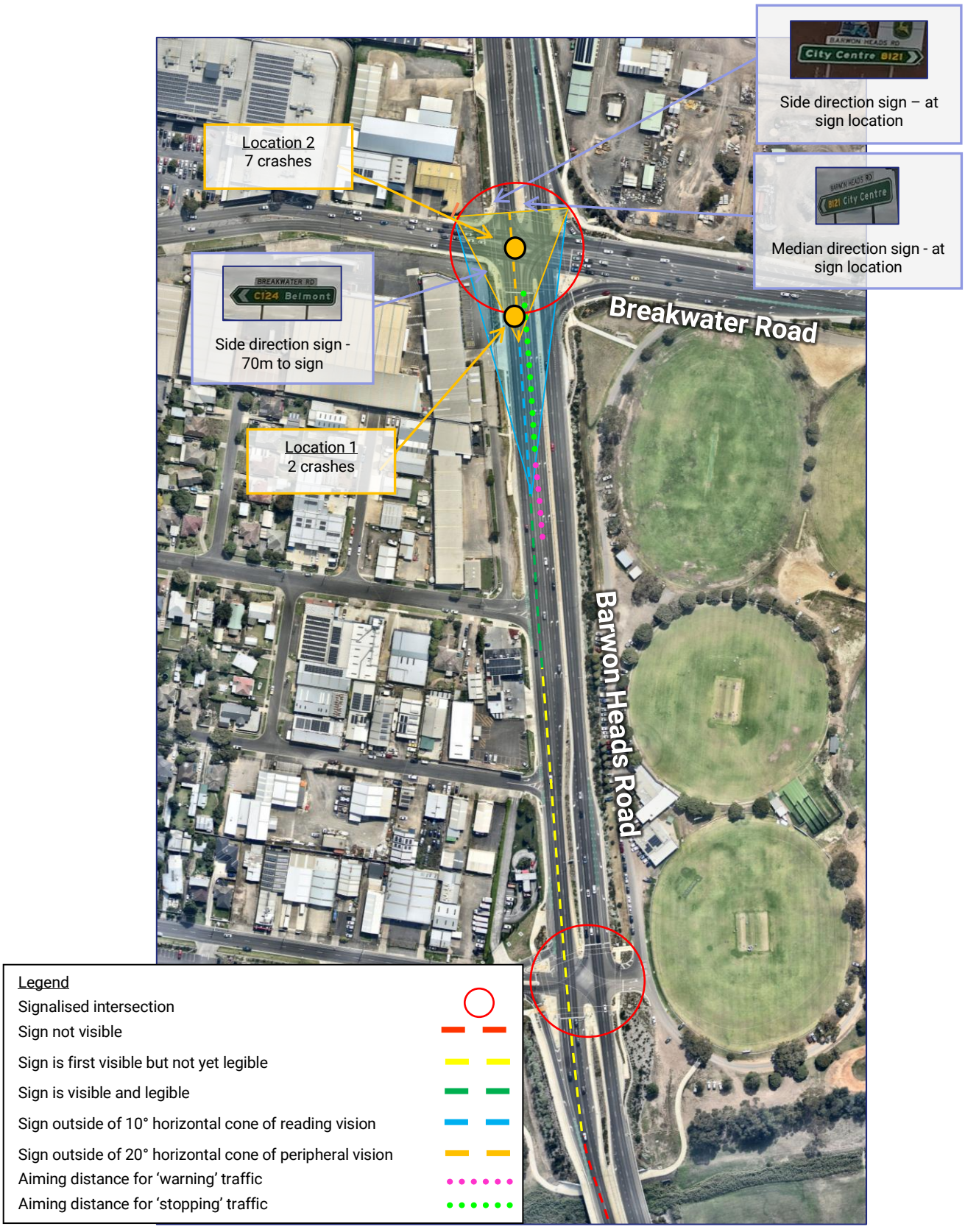

Figure B1: Crash location vs. sign visibility/legibility – Northbound approach (Source: Nearmap.com)

Figure B2: Crash location vs. sign visibility/legibility – Westbound approach (Source: Nearmap.com)

Appendix C

Road Safety Research

Technical References

The following statutory and technical references are relevant to this assessment:

- Clause 52.05-8 of the Planning Scheme.
- Austroads Research Report 2013, Impact of Roadside Advertising on Road Safety, Austroads, Sydney, NSW, AUS.
- Traffic Engineering and Management (2003) – Volume 2, Freeman, D. & Morgan, R., Institute of Transport Studies, Department of Civil Engineering, Monash University, Section 5.2.8 states that "once a sign falls outside of a line of vision 10 degrees either side or 5 degrees above the driver's straight ahead line of vision, it can no longer be read comfortably".
- Austroads Guide to Traffic Management Part 10: Traffic Control & Communication Devices (2009), which states "it is generally accepted that the normal range of lateral vision should be limited to 10° horizontally and 5° vertically" and "A sign location will generally be satisfactory if the sign is placed within the driver's comfortable field of vision (10° either side of centre in the horizontal plane and 5° upward in the vertical plane) and has adequate legibility distance".

The following considers the available road safety research on static electronic billboards. That is, digital billboards that display static images for a specified dwell time.

Roadside Signage and Advertising

Extensive research has been undertaken in relation to signage within the road environment, including studies which examine the characteristics of signs that attract a driver's attention and circumstances in which signs are processed as part of the overall driving task.

Key findings of studies relating to static signs that we consider to be of relevance are discussed below.

Research conducted by Hughes and Cole[4] and reported by the Australian Road Research Board in 1985 states "drivers have a 30% to 50% spare capacity which they devote to attending to objects not related to the driving task". The research continued to state that "Thus it seems likely that present traffic engineering practices within typical road environments are such that traffic control devices attract only 15% to 20% of the driver's "total" attention". The study found that if advertising signs were limited or removed from the road environment that drivers would still report (look at) other objects unrelated to the driving task.

A study by Cole[5] in 1972 found that the role of signage colour is that of identifying an object and conveying information as a colour code. By example, this means that green and white signage as typically installed on freeways, or blue and yellow signage on tollways would be recognised by motorists as conveying directional information based on its colour code.

[4] Source: Hughes, P. K. and Cole, B. L. 1985, 'What attracts attention when driving?' Ergonomics, Vol. 29, Issue. 3.
[5] Source: Cole, B. L. 1972, 'Visual aspects of road engineering', Proceedings 6th ARRB Conference, Vol. 6 (1).

This is further reinforced in the Austroads Guide to Traffic Management Part 10: Traffic Control & Communication Devices (2009), which states:

> *Except for the distinctive shape of some critical regulatory signs (e.g. octagonal stop signs) and warning signs (diamond shape), colour is the most important characteristic that enables early driver recognition of signs.*

For this reason, Clause 52.05-9 (Major promotion sign) requires that a permit issued for a 'major promotion sign' must include conditions that specify:

> *That the sign must not:*
>
> - Dazzle or distract drivers due to its colouring.
> - Be able to be mistaken for a traffic signal because it has, for example, red circles, octagons, crosses or triangles.
> - Be able to be mistaken as an instruction to drivers.

A review of previous studies by Jenkins found that for traffic control signs to be noticed, the important variables which determine conspicuity of the sign are its contrast with the immediate surroundings and the complexity of the background and that the placement of the sign needs to be within 10 degrees of the driver's line of sight. Various studies have found this to be particularly relevant for reading purposes. The relevant technical guidelines for road signs report that it is generally accepted that the normal range of lateral vision and the driver's comfortable field of vision should be limited to 10 degrees horizontally and 5 degrees vertically.[6]

Objects are also able to be detected in the peripheral vision field being 60 degrees above and 70 degrees below the line of sight, and 20 degrees left and right at a speed of 100km/h.[7]

Research also indicates that as drivers become overloaded with inputs to the driving task they shed part of the input demand to focus on that which is judged to be more important.

Drivers have an average reaction time to stimulus of around 2.5 seconds.[8,9] If the driver is provided with prior warning (such as advanced direction signs), the reaction time can be reduced.

Relationship between Advertising Signs and Accident Statistics

Extensive investigation has been undertaken by David Andreassen initially in 1984[10] and further in 2000[11] to examine the relationship between billboards and traffic crashes. Andreassen's 1984 investigations were based on crash studies from the USA and Perth in Australia, while the 2000 investigations reviewed material specifically in relation to billboards and almost exclusively in the Australian context.

[6] Source: Austroads Guide to Traffic Management Part 10: Traffic Control & Communication Devices (2009).
[7] Source: Ogden, K. 2003, Traffic Engineering and Management – Volume 1, Institute of Transport Studies, Department of Civil Engineering, Monash University, Section 2.1.10.
[8] Source: Garber, N.J. and Hoel, L.A. 2000, 'Traffic and Highway Engineering', p60.
[9] Source: Austroads Guide to Traffic Management Part 10: Traffic Control & Communication Devices (2009).
[10] Source: Andreassen, D. C. 1984, 'Traffic Accidents and Advertising Signs', Australian Road Research Board, Internal Report, AIR 000-213.
[11] Source: Andreassen, D. C. 2000, 'Billboards and traffic crashes'.

Andreassen's 2000 report confirmed that:

- No significant driver distraction effect could be ascertained for billboard signs.
- No effect on crashes could be determined as a result of installing billboards.

Most of the research on the issue of driver distraction and advertising signs in more recent times (including advances in updating decision guidelines for advertising signs) has been focused on the emergence of digital technology and the use of electronic billboards that enable advertising displays to change frequently and potentially contain motion.[12]

A study conducted by the Ministry of Transport in New Zealand for 2012 identified the factors contributing to road crashes for the 2012 calendar year that resulted in someone being killed or injured.[13] The report identified that approximately two-thirds of crashes are reported to the New Zealand Transport Agency (NZTA) and a subsequent Traffic Crash Report (TCR) is completed by a police officer. The reports are then examined and coded into the Crash Analysis System (CAS).

A study conducted by the Ministry of Transport in New Zealand for 2012 identified the factors contributing to road crashes for the 2012 calendar year that resulted in someone being killed or injured. The report identified that approximately two-thirds of crashes are reported to the New Zealand Transport Agency (NZTA) and a subsequent Traffic Crash Report (TCR) is completed by a police officer. The reports are then examined and coded into the Crash Analysis System (CAS).

The relevance of the New Zealand data is that the police accident reports include a detailed list of contributing factors, which is not available in similar reporting of casualty road crashes by Australian road agencies.

The New Zealand study identified that approximately 11.8% of casualty crashes involved 'attention diverted' as a contributing factor to the crash (noting that each crash report may involve several factors coded against each road user involved in the crash).

As shown in the Table below, of the reported casualty crashes identified as involving 'attention diverted' as one of the contributing factors, the main source of driver distraction is due to internal sources of distraction (47.4%), such as fellow passengers, reaching for the glove box and cell phones.

Of those crashes that included external sources of distraction as a factor (35.8%), the primary conflict factors were other traffic, scenery/persons outside the vehicle and drivers becoming dazzled.

Importantly, only 0.3% of casualty crashes identified as involving 'attention diverted' as one of the contributing factors identified 'advertising or signs' as a contributing factor.

The remaining reported casualty crashes (16.7%) identified as involving 'attention diverted' as one of the contributing factors lacked sufficient information to categorise further.

[12] Source: Austroads Research Report AP-R420-13, 2013, 'Impact of Roadside Advertising on Road Safety'.
[13] Source: Financial, Economic and Statistical Analysis, Ministry of Transport, 2012, 'Yearly Report 2013 - Motor Vehicle Crashes in New Zealand 2012. New Zealand: Ministry of Transport'.

Table C1: Factors Contributing to Crashes for 'Attention Diverted By' as a Vehicle Conflict Factor (Financial, Economic and Statistical Analysis, Ministry of Transport, 2012)

Attention Diverted by:	Number of Casualty Crashes involving this Contributing Factor	Percentage of Attention Diverted Crashes involving this Contributing Factor (%)
Contributing Vehicle Conflict Factors		
External Sources	**405**	**35.8%**
- Scenery or persons outside vehicle	120	10.6%
- Other traffic	165	14.6%
- Advertising or signs	3	0.3%
- Driver dazzled	117	10.4%
Internal Sources	**536**	**47.4%**
- Passengers	125	11.1%
- Animal or insect in vehicle	25	2.2%
- Trying to find intersection/house no.	39	3.5%
- Emotionally upset	92	8.1%
- Cigarette, radio, glove box etc.	184	16.3%
- Cell phone	59	5.2%
- Navigation devices	11	1%
- CB Radio/non-cell comms devices	1	0.1%
Other	**189**	**16.7%**
Total	**1130**	**100%**

The above data confirms advertising signs are not a statistically significant cause of road crashes in the New Zealand study. This data indicates that of the 11.8% of casualty crashes that involved 'attention diverted' as a contributing factor, only 0.3% identified 'advertising or signs' as a factor. That is, a factor in less than 0.04% of total casualty crashes.

Importantly, the study also identified that casualty crashes involving 'attention diverted' factors (from internal or external causes) are significantly fewer in number when compared to other major contributing factors such as speeding relative to the roadway conditions, driving under the influence of alcohol or drugs and losing control of the vehicle.

These findings confirm the conclusions from the AustRoads Research Report, which concludes:

> *Some of the riskiest kinds of inattentive driving that contributed to crashes and near crashes in the Klauer et al. (2006) study originated from either drowsiness or in-vehicle distractions. Importantly, looking at an external object exhibited the second highest significant odds ratio of all distractions, (reaching for a moving object produced the highest significant odds ratio) with a driver 3.7 times more likely to have a crash or near crash when looking at an external object. However this kind of distraction accounted for less than 1% of all crashes and near crashes in the study. Thus while looking at an external object appears to be quite risky behaviour when it is engaged in, it is not a frequent cause of crashes overall.*

Relationship between Driver Performance and Billboards

Overseas research

A study was undertaken by Virginia Tech Transportation Institute in 2003[14,15] to determine whether there is any change in driver behaviour in the presence or absence of billboards. The study involved detailed observation of participant's driving behaviour along a selected route with billboards, comparison sites with logo signs, on-premises signs, etc. and baseline sites with no visual elements. The factors observed included driver's eye glance, vehicle speed and lane deviation.

The study report concludes as follows:

> *The presence of billboards does not cause a change in driver behaviour in terms of visual behaviour, speed maintenance, or lane keeping. A rigorous examination of individual billboards that could be considered to be the most visually attention-getting demonstrated no relationship between glance location and billboard location. Driving performance measures in the presence of these specific billboards generally showed less speed variation and lane deviation. Thus, neither visual behaviour nor driving behaviour changes, even in the presence of the most visually attention-getting billboards.*

A study was undertaken by Virginia Tech Transportation Institute in 2007[16,17] to evaluate driving performance in the presence of conventional billboards, as well as digital billboards. The study involved conducting a naturalistic study with 36 drivers who were tasked with driving a 50-mile route which contained a number of types of billboards and comparison sites. The drivers were not informed of the true purpose of the experiment and a number of key indicators such as eye glance performance, speed maintenance and lane keeping were measured.

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[14] Source: Lee, S.E., Olsen, E.C.B and DeHart, M.C. 2003, 'Driving Performance in the Presence and Absence of Billboards'.

[15] It is noted that this study included 3 electronic billboards, which equated to approximately 10% of the sampled billboards. This study discusses that due to the few number of electronic billboards studied along the driving route, no conclusions regarding driver behaviour in the presence of this type of billboard can be drawn.

[16] Source: Lee, S.E., McElheny, M.J. and Gibbons, R. 2007, 'Driver Performance and Digital Billboard: Final Report Prepared for Foundation for Outdoor Advertising Research and Education'.

[17] It is noted that this study included 44 sites in total, comprising 15 conventional billboards, 12 comparison sites (including on-premises signs – some with digital elements, logo placards, landmark buildings and murals), 12 baseline sites (sites with no signs) and 5 digital billboards.

The following results were found:

- The mean number of glances (to any location) during an event was 5.73 for conventional billboards, which was comparable to comparison sites (i.e. landmarks, on-premises signs) (5.75), baseline sites (i.e. sites with no signs) (5.48) and for digital billboards (5.46).
- The glance duration (seconds) in the direction of events was 0.73 seconds for conventional billboards, which was comparable to comparison sites (0.87 seconds), baseline sites (0.63 seconds) and digital billboards (0.92 seconds).
- Percent eyes-on-road was found to be 74.1% for conventional billboards, 76.7% for baseline, 70.1% for comparison sites and 75.5% for digital billboards. Conventional billboards were found to be similar to baseline sites and digital billboards.
- Lane deviation from the centreline was found to be similar between conventional billboards (19.17 inches) and digital billboards (20 inches), while comparison sites (17.66 inches) and baseline sites (17.28 inches) were also similar to each other.
- Speed deviation was found to be similar between conventional billboards (0.72 MPH) and digital billboards (0.71 MPH), while comparison sites (0.66 MPH) and baseline sites (0.65 MPH) were also similar to each other.

Crundall et al in 2006[18] found that street level advertisements attracted more attention than raised advertisements when drivers were instructed to look for hazards. Crundall et al suggests that this is because street level advertisements fall within the normal window within which drivers habitually scan for hazards and that advertisements within this window are inappropriately capturing attention.

Klauer et al in 2006[19] found that "Total eyes-off-road durations of greater than 2 seconds significantly increased individual near-crash/crash risk whereas eye-glance durations for less than 2 seconds did not significantly increase crash risk relative to normal, baseline driving." Klauer et al also goes on to say that "if the task is simple and requires a short glance, the risk is only elevated slightly, if at all". It is also likely that movement or changes in luminance will involuntarily capture attention and that particularly salient emotional and engaging material will recruit attention to the detriment of driver performance.

Australian Research

A study was undertaken by the Monash University Accident Research Centre (MUARC) in 2015[20,21] to examine how static advertising billboards affect drivers' situation awareness and driving in a freeway environment. The study involved 19 drivers who were tasked with driving an instrumented vehicle around a 38km urban test route in Melbourne comprising a number of static roadside billboards. Drivers provided continuous verbal protocols throughout the

[18] Source: Crundall, C., Van Loon, E. and Underwood, G., 2006, 'Attraction and distraction of attention with roadside advertisements', Accident Research Unit, School of Psychology, University of Nottingham, Nottingham, UK.
[19] Source: Klauer, S.G., Dingus, T.A., Neale, V.L., Sudweeks, J.D. and Ramsey, D.J., 2006, 'The impact of driver inattention on near-cash/crash risk: An analysis using the 100-car Naturalistic Driving Study data', report DOT HS 810 594.
[20] Source: Young, K.L., Stephens, A.N., Logan, D.B. and Lenné, M.G., Monash University Accident Research Centre (MUARC), 2015, An on-road study of the effect of roadside advertising on driving performance and situation awareness, 4th International Driver Distraction and Inattention Conference, Sydney, New South Wales, Australia.
[21] This study analyses only the freeway section of the drive. This section included two static billboards: one located on the left side of the freeway (roadside) and one mounted on an overhead bridge (overpass).

drive. The factors observed included verbal protocol analysis, longitudinal control, lateral control and driver situation awareness.

The study discusses its results as follows:

> *Overall, the results indicate that the billboards did not overly distract drivers to the extent that their driving performance or observed behaviour diminished significantly.*
>
> *Drivers did mention the billboards as part of their verbal protocols; however, there was a strong trend for drivers to mention the billboards only when driving demand was low, such as when travelling on the freeway in medium density free-flowing traffic.*

The study continues on to report the following key findings:

> *Drivers directing relatively less attention towards billboards in higher workload driving conditions (at least on the freeway) may be due to unconscious attentional narrowing as a result of increased driving demand. However, it may also point to a form of driver self-regulation, whereby drivers are capable of adapting their visual and cognitive attention in relation to billboards, paying more attention to them when driving is less demanding and paying less attention when demand increases, such as when performing a manoeuvre (in this case exiting the freeway). This explanation is in line with a number of research studies that have examined the impact of static and electronic billboards on driver behaviour and attention and found that billboard-related distraction appears to be regulated by drivers across different road environments and levels of driving demand (see review by Decker et al., 2015)[22].*

This is further reinforced by Decker et al. (2015) which stated:

> *Billboards did not appear to affect the overall percentage of time spent glancing at the forward roadway, and drivers seemed able to self-regulate their attention to billboards when they realized that the demands of the driving task had increased; for example, to attend to lead vehicles or to view navigation-related, regulatory, or warning signs. Furthermore, drivers tended to make several short, consecutive glances to billboards rather than fewer, longer glances. The mean length of these glances probably do not suggest a traffic safety concern, especially because drivers may be able to attend to the forward roadway using peripheral vision even while glancing at a billboard. However, billboards may pose a considerable risk when PRTs (perception reaction time) near 0.75 s are required or when the driving task suddenly and unexpectedly becomes more difficult after a period of relatively low complexity.*

This study confirms that outdoor advertising is intended to be a 'glance medium', with only short glances required to read and interpret messages, which would not have a significant impact on road safety.

[22] Decker, J.S., Stannard, S.J., McManus, B., Wittig, S.M.O., Sisiopiku, V.P. and Stavrinos, D., 2015, The Impact of Billboards on Driver Visual Behavior: A Systematic Literature Review, Traffic Injury Prevention 2015.

An on-road study reported by Samsa[23,24] involving 29 participants was undertaken in 2015 to compare drivers' eye fixations and driving performance when advertising signs (static billboards, digital billboards and on-premise signs) were present. Participants were fitted with tracking glasses and drove an instrumented vehicle along a 14.6km route in Brisbane.

The study discusses its findings as follows:

> *Number of fixations and dwell times towards advertising signs were measured, along with lateral deviation and vehicle headway. The study found the average fixation durations for all signage types were well below 0.75 s, considered to be the minimum perception-reaction time to an unexpected event. There were no significant differences in average vehicle headway between the three signage types.*
>
> *The findings show that digital billboards do not draw drivers' attention away from the road for dangerously long periods of time compared to the other signage types, and drivers maintained a safe average vehicle headway in the presence of these signs. Whilst average SDLP (average standard deviation of lane position) increased in the presence of billboards generally, digital billboards were not solely responsible for this result.*

As can be seen in the table below, the average and median fixations were well below the minimum perception-reaction time to an unexpected event (0.75 seconds).

Table C2: Fixation characteristics by signage type

Sign type	Average fixation (s)	Median (s)
Static billboard	0.225	0.165
Digital billboard	0.207	0.165
On-premise	0.199	0.165

Relationship between Static Digital Billboards and Accident Statistics

A study was undertaken by Tantala and Tantala in 2010 on the relationship between digital billboards and traffic safety in the Greater Reading Area in Berks County, Pennsylvania, USA and reported on by the Outdoor Media Association (OMA) *2010 Discussion Paper: Digital Billboard and Road Safety: An Analysis of Current Policy and Research Findings*[25]. Tantala and Tantala's 2010 investigations examined eight years of traffic and crash data for roads near 26 digital billboards in the area, with most of the billboards containing static images (text and graphics) with a message dwell time (the length of time for which an image is displayed) of either 8 or 10 seconds, except for a six month period in 2006 when a number of the digital billboards contained message dwell times of 6 seconds. The overall conclusion of the study was that the digital billboards had no statistically significant relationship with the occurrence of accidents and the results were consistent for 8 and 10 second dwell times. Further to their

[23] Source: Samsa, C., Samsa Consulting, 2015, 'Digital billboards 'down under'. Are they distracting to drivers and can industry and regulators work together for a successful road safety outcome?', 4th International Driver Distraction and Inattention Conference, Sydney, New South Wales, Australia.
[24] It is noted that a total of 21 static billboards and a large number of on-premise signs were located within the analysed road segments for comparison with the 4 digital billboards within the review area.
[25] Source: Outdoor Media Association 2010, Discussion paper: Digital billboard and road safety: an analysis of current policy and research findings, OMA, Sydney, NSW, AUS.

findings, the total number of accidents after the conversion of the signs to digital billboards was approximately equivalent to what would have been statistically expected without the introduction of digital technology.

A second study was undertaken by Tantala and Tantala in 2010 on the relationship between digital billboards and traffic safety in Albuquerque, New Mexico, USA and was reported on by the Outdoor Media Association (OMA) *2010 Discussion Paper: Digital Billboard and Road Safety: An Analysis of Current Policy and Research Findings*[26]. The investigations examined traffic and crash data for a seven-year period for local roads near 17 existing digital billboards which had been converted from traditional PVC billboards between 2006 and 2007 and displayed a static image with a message dwell time of 8 seconds. The analysis found that the 17 digital billboards have no statistically significant relationship with crashes, with crash rates near five digital billboards decreasing by 0.3% within 0.6 miles over an average six year period. Crash rates had not increased following the conversion of the signs to digital billboards.

A study by Wachtel in 2009[27] reviewed the findings of 43 studies conducted between 1984 and 2008 on the possible road safety impacts of both traditional and digital billboards. The conclusions drawn from this study as reported within the OMA discussion paper[28] included that no definitive conclusions can be made about the presence or strength of adverse road safety impacts from digital billboards and that although some studies found a relationship between outdoor advertising signs and deterioration in driving performance, other studies found no such relationship. Wachtel also provided some guidelines for digital billboards, including that the interval between successive displays should essentially be zero and that digital signs should be prohibited near locations where drivers must make critical decisions.

Static Electronic Billboard Design Recommendations

Austroads Research Report 2013, Impact of Roadside Advertising on Road Safety, Austroads[29], was conducted with the aims to:

- Review the extant literature on the distraction risk associated with roadside advertising.
- Document and review the existing guidelines across road agencies so that inconsistencies and gaps could be identified.
- Inform guiding principles and make guidance recommendations that can be used to create guidelines and harmonise guidelines across road agencies.

The Austroads guidance recommendations for static electronic billboards developed in this report are detailed in the table below.

[26] Source: Outdoor Media Association 2010, Discussion paper: Digital billboard and road safety: an analysis of current policy and research findings, OMA, Sydney, NSW, AUS.
[27] Source: Wachtel, J., 2009, 'Research for AASHTO Standing Committee on Highways task 256: safety impacts of the emerging digital display technology for outdoor advertising signs, National Cooperative Highway Research Program, Washington, DC, USA.
[28] Source: Outdoor Media Association 2010, Discussion paper: Digital billboard and road safety: an analysis of current policy and research findings, OMA, Sydney, NSW, AUS.
[29] Source: Austroads Research Report 2013, Impact of Roadside Advertising on Road Safety, Austroads, Sydney, NSW, AUS.

Table C3: Austroads Research Report: Impact of Roadside Advertising on Road Safety (2013) - Digital Billboard Recommendations

Criteria	Recommendations
Movement	Roadside advertising should not contain movement, changes in luminance or any effects that create the illusion of movement.
Flashing lights	Roadside advertising should not contain flashing, blinking, revolving, pulsating or intermittent lights.
Dwell time	No specific measure is provided other than that the goal is to limit the number of message changes that drivers are exposed to.
Transition time	Messages should change instantaneously.
Message sequencing	Sequencing of messages should be prohibited.
Colour	Advertising devices should not be coloured like an official traffic sign or signal.
Information content/ meaning	Advertising devices should not imitate traffic control devices or give instructions to traffic. They should not contain extreme emotional material.
Luminance levels	Luminance levels should not exceed those of static signs in typical ambient light conditions.
Dimensions	Not to be shaped like an official traffic sign or device.
Longitudinal placement	Should not be located in such a way that they might interfere with the effectiveness of traffic control devices.
Lateral placement	Should not be placed so that drivers must divert their gaze from the forward roadway.
Vertical placement	Should be elevated above the height of vehicles, but not so high that they draw the gaze away from the forward roadway.
Orientation	Advertising devices should be orientated to facilitate legibility from the maximum legibility distance and across the full approach distance.
Sight distance	The sight distance must correspond to the required legibility distance so that drivers have enough time to comprehend the message on approach.

The Outdoor Media Association (OMA) 2010 Discussion Paper: Digital Billboard and Road Safety: An Analysis of Current Policy and Research Findings[30] has also provided recommendations in the following areas as detailed in the table below.

[30] Source: Outdoor Media Association 2010, Discussion paper: Digital billboard and road safety: an analysis of current policy and research findings, OMA, Sydney, NSW, AUS.

Table C4: OMA 2010 Discussion Paper digital billboard recommendations

Criteria	Recommendations
Dwell time	Each message shall remain fixed for a maximum 8 seconds, with 5-7 seconds being the recommended dwell time depending on the sign's location.
Transition time	The transition time between messages shall be no longer than 1 second.
Message sequencing	No message sequencing is to be permitted.
Colour	Advertisements should not be dominated by the colours red, yellow or green in combination if it is located near traffic signals.
Luminance levels	The light emitted shall not exceed certain thresholds and must have automatic dimming capabilities.

The OMA 2010 discussion paper also reported that in London, UK, the UK Outdoor Advertising Association developed a code that stated that digital roadside billboards should not change more frequently than every 5 seconds unless consent is granted.

The paper also indicates that the Federal Highway Administration, USA provides guidance on digital billboards to ensure national consistency is achieved. Recommendations include a dwell time between 4 and 10 seconds (with 8 seconds being recommended) and a transition time of between 1 and 2 seconds. It was also recommended that message brightness should automatically respond to changing light levels.

Appendix D

Austroads Standards

Austroads Standards

It is important to understand how the sign is viewed.

The Austroads Guide to Traffic Management Part 10: Traffic Control and Communication Devices includes a method for determining the legibility distance required of a traffic sign. This is represented diagrammatically at Figure D1 below.

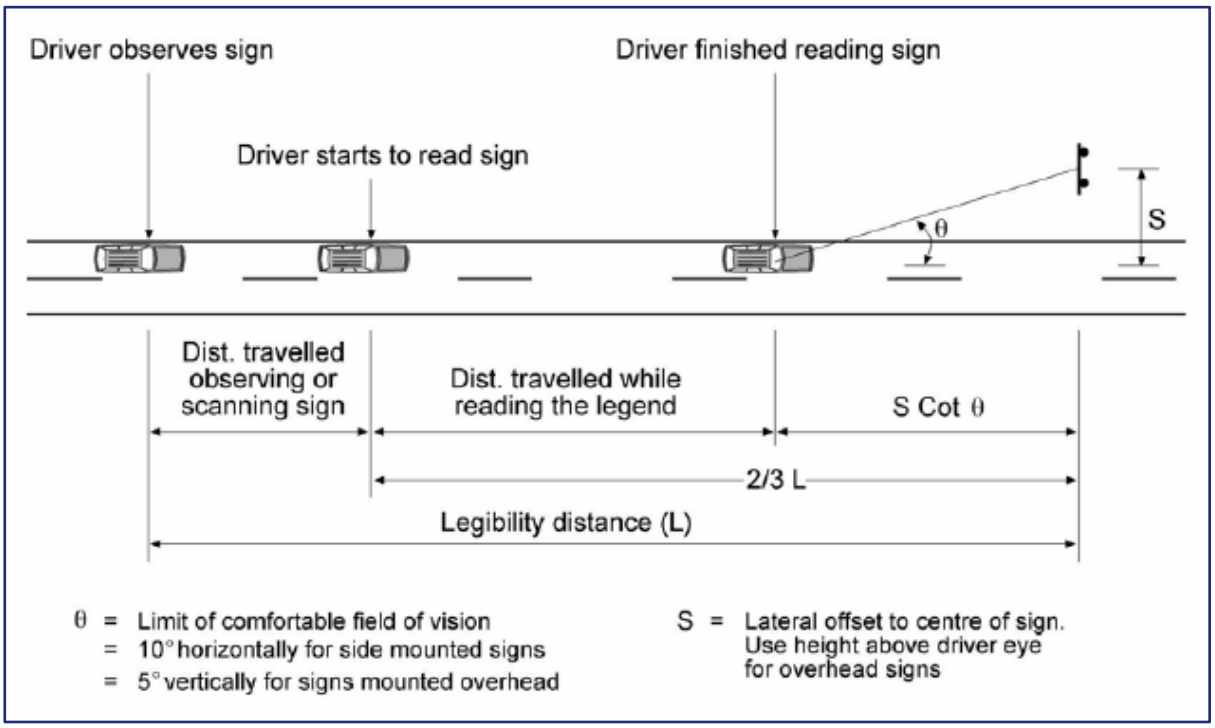

Figure D1: Austroads Guide to Traffic Management Part 10: Traffic Control and Communication Devices – Figure 4.3

This method of calculating the sign reading task breaks up the legibility distance into 3 parts, namely:

- the distance travelled while observing or scanning the sign,
- the distance travelled while reading the sign, and
- the distance in close proximity to the site where the sign is no longer in the driver's cone of vision and is no longer being read by the driver.

The Austroads Guide states that the time taken to read a sign containing up to 5 words is calculated by:

Equation 1:

T = 0.25N seconds

Where N is the number words in the sign

The legibility distance required for a side-mounted road sign can be calculated using the following equation provided in the Austroads Guide:

Equation 2:

L = 0.105NV + 8.55S

Where L is the legibility required

N is the number of words (for 2 to 5 words)

V is travel speed of vehicles approaching the sign in km/h

S is the lateral or vertical displacement of the centre of the sign from the centre of the traffic lane, or above the driver eye height, for side or overhead mounted signs respectively.