

## MEMO

**TO:** Timothy Brosnan, JCDecaux  
Marieka van den Bergh, Urbis

**FROM:** WSP Planning and Mobility

**SUBJECT:** Booragoon Digital Advertising Sign

**OUR REF:** PS109672-PAM-MEM-001 RevB

**DATE:** 11 August 2021

## INTRODUCTION

This Memorandum sets out the findings and recommendations of a traffic engineering review of a proposed digital advertising sign to be installed at the north-eastern corner of the Marmion Street and Andrea Lane traffic signal controlled intersection in Booragoon. The proposal is part of the re-development of the adjacent shopping centre, Garden City.

It is understood that the sign is approximately 8.3 wide and 2.2m high and is proposed to be mounted approximately 3.5m above ground level, within the land boundary of the shopping centre, not obstructing or installed above any footpaths.

The Memorandum follows a request to identify any potential road safety or operational concerns associated with the proposed advertising sign given the City of Melville's signage policy that requires signs to be located such that traffic/pedestrian safety is not compromised and/or will not cause driver distraction or otherwise impact on road safety. This is relevant given that the nature of digital advertising signs results in changing images/messages which may cause a distraction to road users.

In WA, there is limited guidance on the process for undertaking such assessment. Main Roads WA do have a document "*Policy and Application Guidelines for Advertising Signs Within and Beyond State Road Reserves*". This document is typically intended for the use of advertising signs adjacent to/observed from state roads. Whilst it can be applicable in other locations, in this instance it has been deemed to not be appropriate given that the signage is not aimed at a state road. As such, a more traditional traffic engineering / road safety review has been carried out, albeit taking into account the concept and philosophy underpinning the Main Roads WA document..

## IMPACT UNDERSTANDING AND ASSUMPTIONS

Given the proposed position and placement of the advertising sign, it is assumed that its impact will primarily be related to pedestrians/cyclists heading east towards the intersection whilst crossing over Andrea Lane, as well as to eastbound traffic on Marmion Street.

For the purpose of this review, there is deemed to be limited impact on westbound or southbound traffic movements at the intersection given the sign is difficult to observe from the

westbound carriageway of Marmion Street and/or Andrea Lane except for by stationary vehicles waiting at the intersection.

## CRASH HISTORY

A review of relevant crash data for the five year period between 2016 to 2020 has been carried at the intersection as well on the approach and exit to the intersection for the eastbound approach as discussed prior, as summarised below.

Crashes downstream (beyond the sign when travelling eastbound) of the intersection have been included given the potential for drivers to be distracted/thinking about the message that has been observed at the proposed site when approaching the next conflict area.

It should be noted that the Marmion Street/Andrea Lane intersection was changed in mid-2017 from a priority controlled Give Way controlled T-intersection to a signalised intersection. As such, only limited relevant crash data is available for the intersection in its current form.

It should also be noted that following the proposed redevelopment of the shopping centre, current traffic volumes may change/increase, which in turn, may result in changes to crash numbers/patterns and risk exposure.

- At the Andrea Lane/Marmion Street intersection (post the installation of the traffic signals in 2017): rear end crash x 1 (1 involving a medical severity crash) involving eastbound vehicles turning left into Andrea Lane (plus a southbound rear-end collision on Andrea Lane). In addition, a rear-end collision occurred on the Andrea Lane approach whilst a further crash involved a vehicle from the east turning right across westbound traffic, although it is unclear if this was pre or post the traffic signals being installed. This location will be directly exposed to the proposed sign.
- To the east of the Andrea Lane intersection prior to the next Garden City access: mid-block sideswipe crash x 1 (approx. 80m east of Andrea Lane) – eastbound movement involving drivers changing lane. The proposed sign will not be visible from this location.
- At Garden City Access South access (to the east of Andrea Lane): three crashes involving a vehicle from the east turning right across westbound traffic, one crash involving an eastbound vehicle on Marmion Street colliding with vehicle from the side road (medical severity) plus one crash involving a westbound vehicle on Marmion Street colliding with vehicle from the side road. The proposed sign will not be visible from this location.
- At the Davy Street traffic signal controlled intersection: five crashes involved eastbound rear end crash (three of which were medical severity crashes); plus two crashes involving an eastbound vehicle on Marmion Street colliding with vehicle from the side road. The proposed sign may be visible from this location (see site visit commentary).

## SITE VISIT FINDINGS

The site visit noted the following potential safety concerns:

- The proposed electronic advertising billboard has the potential to camouflage (backdrop) the primary signal lanterns (i.e. the traffic light on the left at the stop line) for eastbound traffic if the image behind the signal lantern is the same colour as the colour shown at the traffic signal. Given the height of the advertising sign, this is particularly the case when viewed from close to the intersection, particularly for traffic in the left turn lane and/or middle lane.

- Limited visibility to the dual primary signal head in the median (i.e. the traffic light on the right hand side for eastbound traffic at the stop line), which acts as an additional signal for traffic in the centre and right hand lane due to it currently being blocked by trees.

The combination of the two elements together (one of which is an existing issue) means that approaching eastbound drivers may be unaware of either set of primary signal heads, and may only observe the downstream secondary and tertiary signal heads (located after the stop line), resulting in drivers being unaware of the need to stop or prepare to stop. The tree obscuring issue could be rectified, and whilst not an outcome of the proposal, is an issue to be raised as the currently visible signal head visibility may be compromised.

In addition to the above:

- The proposed billboard is likely to camouflage (as a backdrop) the flashing yellow light on the signal post closest to the billboard for the pedestrian/cycle crossing movement (west to east) over Andrea Lane to warn left turning drivers that pedestrians/cyclists may still be crossing once the green pedestrian symbol has dropped out and replaced by the flashing red pedestrian symbol (noting that the flashing yellow in the median is unlikely to be affected). The flashing yellow light operates after the red left turn arrow has dropped out for turning vehicles.
- A similar issue may also occur with the pedestrian crossing symbol that is located on the signal post closest to the billboard for the west to east pedestrian/cycle crossing movement over Andrea Lane.

The above is a risk, particularly for eastbound cyclists given the shared path on the northern side of Marmion Street and higher speed of cyclists using the facility having less chance of slowing down and/or swerving to avoid a collision if a vehicle makes the left turn. This however is partly dependent upon the location/height of the pedestrian/cyclists relative to the flashing yellow lights/pedestrian symbols and the advertising board behind them.

Whilst the potential for safety concerns were identified for eastbound vehicles at the Davy Street intersection based on the existing crash data (see earlier comments), the view of the downstream Andrea Lane intersection/signal heads and associated proposed advertising billboard is typically blocked by trees on the northern side of Marmion Street. As such, this is not currently an issue (noting that it may however be somewhat visible and hence potentially a distraction for eastbound drivers from the right-hand Marmion Street traffic lane). Whilst currently less of a safety issue than the previously identified camouflaging issues, the above may become a factor if the tree canopies get pruned/cut back, making the advertising sign more visible from a distance further away.

The proximity of the downstream signals at the Garden City access and the potential for vehicles to queue back to the Andrea Lane intersection in peak periods may also pose a risk in terms of rear-end eastbound collisions occurring involving drivers looking at the advertising sign located to the left and above a driver's typical cone of vision whilst legally heading eastbound not being aware of stationary vehicles ahead).

As part of the site visit, it was noted that a large traditional billboard currently exists at the north western corner of the Marmion Street/Andrea Lane intersection. In addition, a small lit/electronic type of advertising sign exists at the norther eastern corner of the Marmion Street/Davy Street intersection along with a larger traditional style of billboard behind it.

## RECOMMENDATIONS

Based on the above potential issues, it is recommended that consideration be given to either undertake, or at least offer to undertake as part of the Development Application approval process, a formal, independent road safety audit of the proposed digital advertising sign, either at the design stage or post construction which may identify the need for appropriate mitigation measures to reduce ‘important’ potential risks – where the importance is defined in the Audit by the potential to kill or seriously injure road users as a result of the proposed signage. These may include:

- Set dwell times for images.
- Sign luminance levels.
- Advertising image primary colours.

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JCDecaux

LIGHTING IMPACT ASSESSMENT

OUTDOOR SIGNAGE AT MARMION STREET, WESTFIELD BOORAGOON, WA

6th August 2021  
Ref: 1096.100

## Lighting Impact Assessment Outdoor Signage at Marmion St, Westfield Booragoon WA

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06/08/21	REV A	For Information	IT	RS

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## 1. INTRODUCTION

Electrolight have been appointed by JCDecaux to undertake a Lighting Impact Assessment on the proposed digital signage to be installed at Marmion St, Westfield Booragoon, Western Australia. The objective of the assessment is to report on compliance with AS4282-2019 Control of the Obtrusive Effects of Outdoor Lighting and the Western Australia Main Roads “Policy and Application Guidelines for Advertising Signs”.

## 2. DEFINITIONS

### 2.1 Illuminance

The physical measure of illumination is illuminance. It is the luminous flux arriving at a surface divided by the area of the illuminated surface. Unit: lux (lx); 1 lx = 1 lm/m<sup>2</sup>.

(a) Horizontal illuminance (E<sub>h</sub>) The value of illuminance on a designated horizontal plane

(b) Vertical illuminance (E<sub>v</sub>) The value of illuminance on a designated vertical plane

Where the vertical illuminance is considered in the situation of potentially obtrusive light at a property boundary it is referred to as environmental vertical illuminance (E<sub>ve</sub>).

### 2.2 Luminance

The physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaire or reflecting material such as the road surface) when viewed from a specified direction. SI Unit: candela per square metre (cd/m<sup>2</sup>) – also referred to as “nits”.

### 2.3 Luminous Intensity

The concentration of luminous flux emitted in a specified direction. Unit: candela (cd).

### 2.4 Obtrusive Light

Spill Light which, because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information.

### 2.5 Threshold Increment

The measure of disability glare expressed as the percentage increase in contrast required between a standard object and its background (the carriageway) for it to be seen equally as well with the source of glare present as with it absent, derived in the specified manner. This metric is directly related to Veiling Luminance.

NOTE: The required value is a maximum for compliance of the lighting scheme.

### 2.6 AGI32 Light Simulation Software

AGI32 (by U.S. company Lighting Analysts) is an industry standard lighting simulation software package that can accurately model and predict the amount of light reaching a designated surface or workplane. AGI32 has been independently tested against the International Commission On Illumination (CIE) benchmark, CIE 171:2006, Test Cases to Assess the Accuracy of Lighting Computer Programs.

### 2.7 Upward Light Ratio (ULR)

The ratio between the luminous flux emitted above the horizontal plane to the total flux emitted by a light source. The ULR is used as a measure to limit direct spill light to the sky.

### 3. SITE DESCRIPTION AND SCOPE

The proposed digital signage is located at Marmion St, Westfield Booragoon WA, and faces the eastbound direction of Marmion St. The total active display (illuminated) area of the proposed digital signage is 18.26m<sup>2</sup>. The digital signage is to be in 24 hour operation. Refer Appendix A for proposed signage location plan and elevations.

The proposed digital signage is illuminated using LEDs installed within the front face. The brightness of the LEDs shall be controlled to provide upper and lower thresholds as required as well as automatically via a local light sensor to adjust to ambient lighting conditions.

For the purpose of this report the proposed specification of digital signage is as outlined in Appendix B. The signage includes baffles which mitigate upward waste light, resulting in an Upward Light Ratio (ULR) of not more than 50%. Alternative digital sign manufacturers may be used for this installation as long as they have equivalent lighting and performance characteristics and are commissioned as described in this report.

### 4. DESIGN GUIDELINES AND STANDARDS

The Lighting Impact Assessment will review the proposed signage against the follow Criteria, Design Guidelines and Standards.

- Western Australia Main Roads “Policy and Application Guidelines for Advertising Signs” Document (October 2020). (Refer Appendix C)
- AS 4282-2019 Control of the Obtrusive Effects of Outdoor Lighting.



## 5. LUMINANCE ASSESSMENT

The maximum permissible night time luminance of the signage is determined by the existing lighting environment of its surroundings. AS4282 outlines maximum average luminances for different Environmental Zones as shown in Table 1 below:

TABLE 1 - MAXIMUM NIGHT TIME AVERAGE LUMINANCE FOR SIGNAGE		
Environmental Zone	Description	Max Average Luminance (cd/m2)
A4	High district brightness e.g. Town and city centres, commercial areas, and residential areas abutting commercial areas	300
A3	Medium district brightness e.g. suburban areas in towns and cities	250
A2	Low district brightness e.g. sparsely inhabited rural and semi-rural areas	150
A1	Dark e.g. relatively uninhabited rural areas. No Road Lighting	0.1
A0	Intrinsically Dark e.g. Major Optical Observatories. No Road Lighting	0.1

Note: Where the signage is viewed against a predominantly dark background (e.g. night sky) then the maximum applicable environmental zone is A2

Based on an assessment of the surrounding environment, the proposed signage is located within Environmental Zone A4 under AS4282 therefore the maximum night time luminance of the signage is 350 cd/m2.

In addition, Appendix B of the Western Australia Main Roads “Policy and Application Guidelines for Advertising Signs” document outlines the maximum allowable day time, dawn/dusk and night time luminances of electronic signs to exhibit consistent apparent brightness in all lighting conditions (refer to Appendix C). The Guidelines require a maximum luminance limit of 6000cd/m2 during the day, 600cd/m2 at Dawn/Dusk and 300 cd/m2 during night time operation.

Table 2 outlines the maximum luminance levels to comply with AS4282 and the Western Australia Main Roads “Policy Application Guidelines for Advertising Signs” for the various lighting conditions listed below:

TABLE 2 - LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2) #	Compliant
Day Time	6000	✓
Dawn/Dusk	600	✓
Night time	300	✓

# The signage is to be dimmed on site to ensure the maximum luminance nominated above is not exceeded.

Appendix B of the Western Australia Main Roads “Policy and Application Guidelines for Advertising Signs” Document also requires that the signage be initially commissioned to half the recommended maximum luminances (as shown in Table 3 below). The sign luminances shall be gradually increased over time to an appropriate level as agreed with Main Roads.

TABLE 3 - INITIAL LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2)	Compliant
Day Time Luminance	3000	✓
Dawn/Dusk	300	✓
Night Time	150	✓

The operator of the screen must not exceed the maximum dimming levels above to comply with the Western Australia Main Roads “Policy and Application Guidelines for Advertising Signs” Document. To maintain constant visibility of the signage, the dimming value may increase to the maximum level at certain times of the day (such as in direct sunlight). This is to compensate for high levels of light striking the front the face of the sign, which would otherwise dull the image and make it difficult to view.

## 6. AS4282 ASSESSMENT

The proposed signage has been assessed against AS 4282-2019 Control of the Obtrusive Effects of Outdoor Lighting as outlined in Section 4.

AS4282 provides limits for different obtrusive factors associated with dark hours (night time) operation of outdoor lighting systems. Two sets of limiting values for spill light are given based on whether the lighting is operating before a curfew (known as “pre-curfew” operation) or operating after a curfew (known as post-curfew or curfewed operation). Pre-curfew spill lighting limits are higher than post-curfew values, on the understanding that spill light is more obtrusive late at night when residents are trying to sleep. Under AS4282, the post-curfew period is taken to be between 11pm and 6am daily. As it is intended that the digital signage be illuminated all night, the assessment will review the proposed signage under the more stringent post-curfew limits.

### Illuminance Assessment

The AS4282 assessment includes a review of nearby residential dwellings and calculation of the amount of illuminance (measured in Lux) that the properties are likely to receive from the signage during night time operation.

The acceptable level of illuminance will in part be determined by the night time lighting environment around the dwellings. AS4282 categorises the night time environment into different zones with maximum lighting limits as shown in Table 4 below:

TABLE 4 - MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS			
Environmental Zone	Max Vertical Illuminance (lx)		Description
	Pre-curfew	Post-curfew	
A0	0	0	Intrinsically Dark e.g. Major Optical Observatories. No Road Lighting
A1	2	0.1	Dark e.g. relatively uninhabited rural areas. No Road Lighting
A2	5	1	Low district brightness e.g. sparsely inhabited rural and semi-rural areas
A3	10	2	Medium district brightness e.g. suburban areas in towns and cities
A4	25	5	High district brightness e.g. Town and city centres, commercial areas, and residential areas abutting commercial areas

Based on an assessment of the surrounding areas, the nearest dwellings with potential views to the signage are at the following locations:

Address	Zone
547 A Marmion Street	A4
551 Marmion Street	A4
553 Marmion Street	A4
555 Marmion Street	A4
557 Marmion Street	A4
559 Marmion Street	A4
16 Colleran Way	A4

As such, the dwellings above will form the focus of the illuminance assessment.

The proposed signage (and surrounding environment) was modelled in lighting calculation program AGI32 to determine the effect (if any) of the light spill from the proposed signage. Photometric data for the screen was provided by the signage manufacturer\*, with luminances corresponding to the max night time limit outlined in Section 5. Appendix D shows the lighting model and the results of the calculations.

It should be noted that some of the houses are shielded by mature vegetation which effectively obstructs the spill light of the signage. However calculations were undertaken assuming there was no vegetation present as outlined in AS4282.

It can be seen from the lighting model that the maximum illuminance to dwellings is 1.5 lux, which complies with the maximum limit of 5 lux for Zone A4 as outlined in Table 3.

#### Threshold Increment Assessment

The Threshold Increment was calculated for the eastbound and westbound traffic on Marmion Street. The calculation grids were located at 1.5m above ground level for general traffic approaches, with an approach viewing distance of between 10 m to 200 m from the sign. The calculation results show that the Threshold Increment does not exceed 13.2% for any traffic approach (the allowable maximum under the standard is 20%).

#### Luminous Intensity

The luminous intensity limits nominated in the standard are not applicable for internally illuminated signage.

#### Additional Requirements:

The signage operator must ensure that the average luminance difference between successive images does not exceed 30% to ensure compliance with AS4282. The dwell time shall be 10 seconds or greater.

#### Summary:

It can therefore be seen that the proposed digital signage complies with all relevant requirements of AS 4282-2019 Control of the Obtrusive Effects of Outdoor Lighting.

\* Electrolight takes no responsibility for the accuracy of 3rd party provided photometric data.

## 7. SUMMARY

- When commissioned to the maximum dimming levels below, the illuminated signage will comply with the Western Australia Main Roads “Policy and Application Guidelines for Advertising Signs” Document and AS4282-2019 Control of the Obtrusive Effects of Outdoor Lighting.

LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2) #	Compliant
Day Time	6000	✓
Dawn/Dusk	600	✓
Night time	300	✓

- The signage shall be initially commissioned to half the recommended maximum luminances (as shown in the table below). The luminance shall be gradually increased over time to an appropriate level as agreed with Main Roads.

INITIAL LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2)	Compliant
Day Time Luminance	3000	✓
Dawn/Dusk	300	✓
Night Time	150	✓

- The signage operator must ensure that the average luminance difference between successive images does not exceed 30% to ensure compliance with AS4282. The dwell time shall be 10 seconds or greater.
- The proposed signage has been found to comply with all relevant requirements of AS4282-2019 Control of the Obtrusive Effects of Outdoor Lighting.
- In complying with the above requirements, the proposed signage should not result in unacceptable glare nor should it adversely impact the safety of pedestrians, residents or vehicular traffic. Additionally, the proposed signage should not cause any reduction in visual amenity to nearby residences or accommodation.

## 8. DESIGN CERTIFICATION

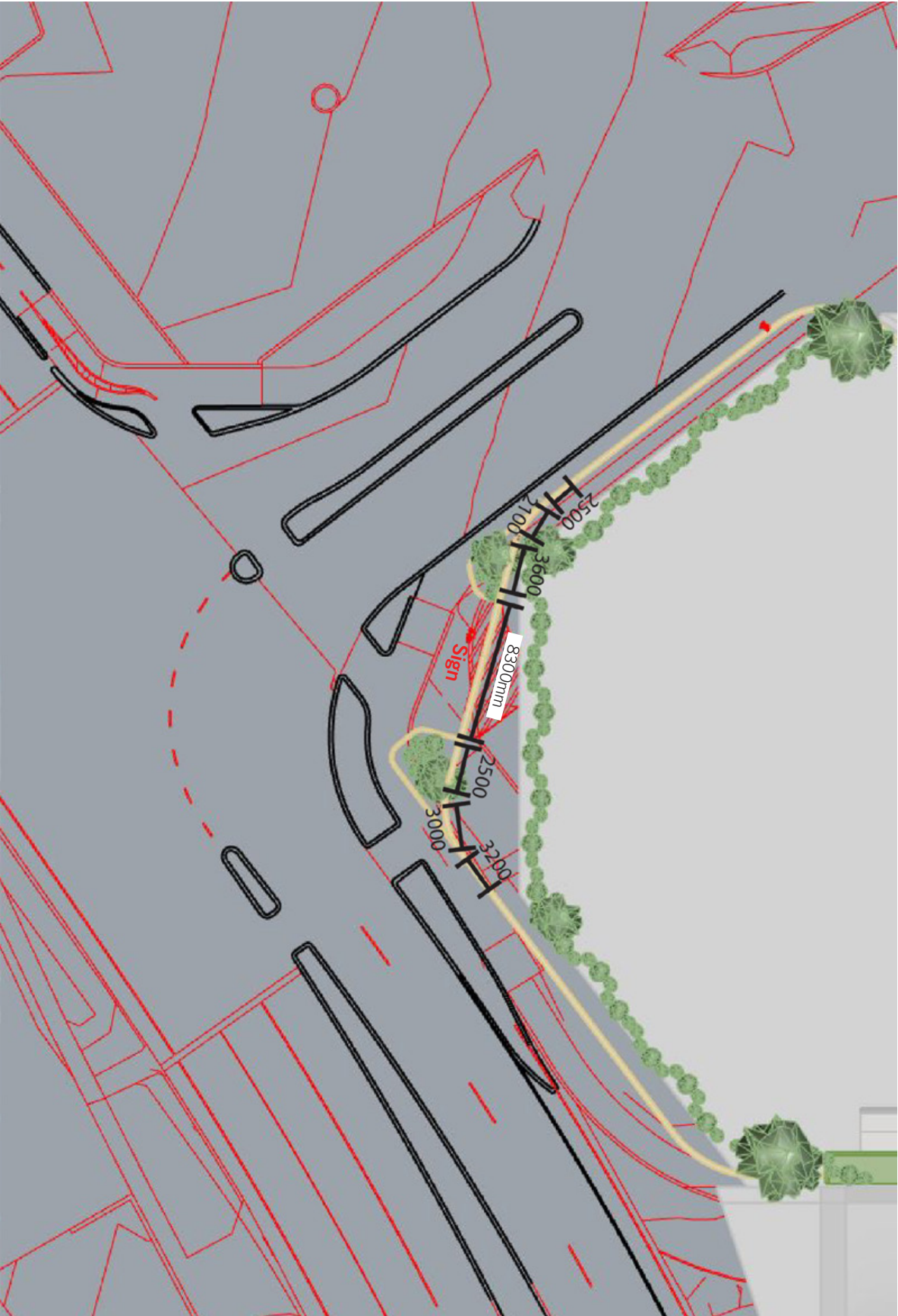
The proposed digital sign to be installed at Marmion St, Westfield Booragoon WA, if commissioned according to this report, will comply with the following criteria, guidelines and standards:

- Western Australia Main Roads “Policy and Application Guidelines for Advertising Signs” Document (October 2020) - Appendix B luminance and illuminance of electronic advertising signs.
- AS 4282-2019 Control of the Obtrusive Effects of Outdoor Lighting.

A handwritten signature in black ink, appearing to read 'Ryan Shamier', with a long horizontal stroke extending to the right.

Ryan Shamier MIES  
Senior Lighting Designer  
Electrolight Sydney  
06/08/2021

APPENDIX A  
SIGNAGE LOCATION PLAN





## SIGNAGE ELEVATION





APPENDIX B

DIGITAL SIGNAGE SPECIFICATION

Big Screen Video

Specs: Outdoor 8mm SMD

Product Specifications	
Catalogue no.	BSV-YATR-8
Physical Pitch	8mm, physical
Pixel Density	15,625 pixel/m2
Pixel Configuration	SMD LED
Module Dimensions (WxH )	256mm x 128mm
Module Resolution (WxH )	32 x 16 pixels
Cabinet Material	Steel
Viewing Angle	H 140 Deg. / V 140 Deg.
Best Viewing Distance	8+m
Maintenance	Rear access
Protection Degree	IP65 front; IP54 rear
Panel Net Weight	approx. 58kg/sqm

Product Specifications	
Gray Scale	16-bit Color Processing Depth
Refresh Rate	3840+ Hz
Display Control	Synchronous control
Power Supply	220V, 50Hz
Operation Temp.	-20° ~60°
Display Dimming	Auto/Manual, 8~256 Levels
Signal Transfer	Text, image, graphics animations, video
Power Consumption (Max./Avg.)	0.6kw/sqm; 0.2kw/sqm
Lifetime	100,000hrs
Luminance	7000 nits

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p.4

## APPENDIX C

### DIGITAL SIGNAGE SPECIFICATION

#### Luminance and Illumination of Electronic Advertising Signs

##### Safety and amenity

It is important that electronic billboards exhibit consistent apparent brightness in all lighting conditions, by maintaining a consistent ratio between the ambient light (illuminance) and light emitted by the billboard (luminance).

This allows the billboard to be easily read and reduces the time taken for a motorist to view the billboard content. Signs brighter than the ambient conditions may cause greater distraction and risk to drivers due to:

- Averting a motorists attention from important traffic devices / instructions.
- Temporary visual impairment where the difference in sign luminance and ambient light is disparate.

Due to the fast rate of change in ambient light during dusk and dawn periods, particular attention needs to be given to the luminance levels that are output during these periods to ensure that a consistent apparent brightness is maintained.

Any change to brightness levels should be applied during a message transition, not while an image is being displayed. This removes the risk that a motorist will be distracted by changing sign brightness.

##### Maximum Luminance

The following values are suggested *maximum* values for the varying ambient lighting conditions. The final luminance levels are to be determined based on the site specific requirements, including the orientation of the sign and shading around the sign.

- Daytime - 6000 cd/m<sup>2</sup>
- Dawn/Dusk - 600 cd/m<sup>2</sup>
- Night - 300 cd/m<sup>2</sup>

##### Commissioning Levels

It is required that when a new device is being commissioned, the initial luminance values be set to half the recommended maximum values outlined above, and gradually increased to an appropriate level as agreed to by Main Roads WA.

If required, the owner/operator of the billboard is responsible for shielding the electronic billboard to ensure that it does not cause a nuisance to surrounding properties.

APPENDIX D

OBTRUSIVE LIGHTING AND THRESHOLD INCREMENT CALCULATIONS

Calculation Summary			
Label	CalcType	Units	Max
16 Colleran Way Ill Seg1	Obtrusive - Ill	Lux	0.4
16 Colleran Way Ill Seg2	Obtrusive - Ill	Lux	0.1
547 A Marmion St Ill Seg1	Obtrusive - Ill	Lux	0.0
547 A Marmion St Ill Seg2	Obtrusive - Ill	Lux	0.3
547 A Marmion St Ill Seg3	Obtrusive - Ill	Lux	0.1
547 A Marmion St Ill Seg4	Obtrusive - Ill	Lux	0.0
547 A Marmion St Ill Seg5	Obtrusive - Ill	Lux	0.1
547 A Marmion St Ill Seg6	Obtrusive - Ill	Lux	0.3
547 A Marmion St Ill Seg7	Obtrusive - Ill	Lux	0.0
547 A Marmion St Ill Seg8	Obtrusive - Ill	Lux	0.3
551 Marmion St Ill Seg1	Obtrusive - Ill	Lux	0.9
551 Marmion St Ill Seg2	Obtrusive - Ill	Lux	0.0
551 Marmion St Ill Seg3	Obtrusive - Ill	Lux	1.3
551 Marmion St Ill Seg4	Obtrusive - Ill	Lux	0.8
553 Marmion St Ill Seg1	Obtrusive - Ill	Lux	0.2
553 Marmion St Ill Seg2	Obtrusive - Ill	Lux	1.5
555 Marmion St Ill Seg1	Obtrusive - Ill	Lux	0.2
555 Marmion St Ill Seg2	Obtrusive - Ill	Lux	1.4
557 Marmion St Ill Seg1	Obtrusive - Ill	Lux	0.2
557 Marmion St Ill Seg2	Obtrusive - Ill	Lux	0.2
559 Marmion St Ill Seg1	Obtrusive - Ill	Lux	0.0
559 Marmion St Ill Seg2	Obtrusive - Ill	Lux	0.0
559 Marmion St Ill Seg3	Obtrusive - Ill	Lux	0.0
559 Marmion St Ill Seg4	Obtrusive - Ill	Lux	0.0
559 Marmion St Ill Seg5	Obtrusive - Ill	Lux	0.0
559 Marmion St Ill Seg6	Obtrusive - Ill	Lux	0.0





APPENDIX D

OBTRUSIVE LIGHTING AND THRESHOLD INCREMENT CALCULATIONS

Calculation Summary			
Label	CalcType	Units	Max
Marmion St East Bound	Obtrusive - TI	%	1.5
Marmion St East Bound to center	Obtrusive - TI	%	13.2
Marmion St East Bound from center	Obtrusive - TI	%	0.1
Marmion St West Bound	Obtrusive - TI	%	0.0
Marmion St West Bound to center	Obtrusive - TI	%	0.2



## APPENDIX D

### OBTRUSIVE LIGHTING AND THRESHOLD INCREMENT CALCULATIONS

#### **Obtrusive Light - Compliance Report**

AS/NZS 4282:2019, A4 - High District Brightness, Non-Curfew L1  
Filename: 1096.100 Booragoon  
6/08/2021 11:16:38 AM

#### **Illuminance**

Maximum Allowable Value: 25 Lux

Calculations Tested (26):

Calculation Label	Test Results	Max. Illum.
547 A Marmion St_III_Seg1	PASS	0.0
547 A Marmion St_III_Seg2	PASS	0.3
547 A Marmion St_III_Seg3	PASS	0.1
547 A Marmion St_III_Seg4	PASS	0.0
547 A Marmion St_III_Seg5	PASS	0.1
547 A Marmion St_III_Seg6	PASS	0.3
547 A Marmion St_III_Seg7	PASS	0.0
547 A Marmion St_III_Seg8	PASS	0.3
551 Marmion St_III_Seg1	PASS	0.9
551 Marmion St_III_Seg2	PASS	0.0
551 Marmion St_III_Seg3	PASS	1.3
551 Marmion St_III_Seg4	PASS	0.8
553 Marmion St_III_Seg1	PASS	0.2
553 Marmion St_III_Seg2	PASS	1.5
555 Marmion St_III_Seg1	PASS	0.2
555 Marmion St_III_Seg2	PASS	1.4
557 Marmion St_III_Seg1	PASS	0.2
557 Marmion St_III_Seg2	PASS	0.2
559 Marmion St_III_Seg1	PASS	0.0
559 Marmion St_III_Seg2	PASS	0.0
559 Marmion St_III_Seg3	PASS	0.0
559 Marmion St_III_Seg4	PASS	0.0
559 Marmion St_III_Seg5	PASS	0.0
559 Marmion St_III_Seg6	PASS	0.0
16 Colleran Way_III_Seg1	PASS	0.4
16 Colleran Way_III_Seg2	PASS	0.1

#### **Threshold Increment (TI)**

Maximum Allowable Value: 20 %

Calculations Tested (5):

Calculation Label	Adaptation Luminance	Test Results
Marmion St East Bound	5	PASS
Marmion St East Bound to center	5	PASS
Marmion St West Bound	5	PASS
Marmion St West Bound to center	5	PASS
Marmion St Eat Bound from center	5	PASS