Transport for NSW
Ref: 3724.3

LIGHTING IMPACT ASSESSMENT
EXTERNALLY ILLUMINATED SIGNAGE AT
M4 NEAR BRABHAM DR, EASTERN CREEK NSW

DATE	REV	COMMENT	PREPARED BY	CHECKED BY
05/12/24	REV B	For Information	CB	RS

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CONTENTS

1. INTRODUCTION

Electrolight have been appointed by the Transport for NSW to undertake a Lighting Impact Assessment on the existing signage floodlighting at M4 Near Brabham Dr, Eastern Creek NSW (**existing signage lighting**). The objective of the assessment is to report on compliance with the State Environmental Planning Policy (Industry and Employment) 2021, NSW Transport Corridor Outdoor Advertising and Signage Guidelines, and AS/NZS 4282:2023 Control of the Obtrusive Effects of Outdoor Lighting.

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/m2.

(a) Horizontal illuminance (Eh) The value of illuminance on a designated horizontal plane
(b) Vertical illuminance (Ev) 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 can be referred to as environmental vertical illuminance (Eve).

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/m2) – also referred to as "nits".

2.3 Luminous Intensity

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

2.4 Dynamic content

Where the luminous image, pattern, colour or direction of light changes over an interval of less than 60 seconds.

Note: Definition source is AS4282.

2.5 Obtrusive Light

Spill light which, because of quantitative or directional attributes, gives rise to annoyance, discomfort, distraction, or a reduction in ability to see essential information such as transport signals.

Note: Obtrusive light includes the impact on humans and environmental receivers.

2.6 Threshold Increment

The measure of disability glare expressed as the percentage increase in luminance contrast threshold required between an object and its background for it to be seen equally well with a source of glare present.

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

2.7 Environmentally Sensitive Area (ESA)

Area of ecological value including, bushland, waterways and marine and coastal areas.

Note: Definition source is AS4282.

2.8 AGI32 Light Simulation Software

AGI32 (by U.S. company Lighting Analysts/Revalize) 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.

2.9 Upward Light Ratio Luminaire (ULR_L)

The ratio of the luminous flux of a luminaire that is emitted, at and above the horizontal, divided by the total luminaire flux when the luminaire is mounted in its designed position, and excluding reflected light from surfaces or obstructions.

Note: Definition source is AS4282.

2.10 Environmental Receiver

Any identified living species (plants, animals and other organisms) and their locations indicated, that may be impacted by the proposed lighting system.

Note: Definition source is AS4282.

3. SITE DESCRIPTION AND SCOPE

The existing pylon-mounted signage is located along the M4 Western Motorway near Brabham Drive. The signage is oriented towards the inbound direction of traffic on the M4. The total advertising display area is 44.92 m2. Refer to Appendix A for the signage location plan and elevations.

The signage is illuminated using four 120W "TigerLED Megaflood" LED floodlights mounted on bracket arms located 0.25m above and 2.1m out from the sign face. Refer Appendix B for further luminaire specification details. The luminaires are aimed towards the signage face at 15 degrees below horizontal^. The existing signage lighting operates all night and is switched off during the day. The existing signage lighting is dimmable via a simple control device. In order to ensure compliance with this report, the existing signage lighting shall be dimmed to ensure that the maximum luminance level outlined in Section 5 is not exceeded.

Environmental impact assessments, including the management of artificial light for the protection of specific entities protected by environmental legislation, is beyond the scope of this assessment.

^In order to comply with this report, the floodlights are to be aimed towards the signage face at 15 degrees below the horizontal.

4. DESIGN GUIDELINES AND STANDARDS

The Lighting Impact Assessment will review the existing signage lighting against the following Criteria, Design Guidelines and Standards.

- State Environmental Planning Policy (Industry and Employment) 2021 (**SEPP Industry and Employment**)
- Transport Corridor Outdoor Advertising & Signage Guidelines 2017 (**Transport Guidelines**)
- AS/NZS 4282:2023 Control of the Obtrusive Effects of Outdoor Lighting (**AS4282**)

5. LUMINANCE ASSESSMENT

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

TABLE 1 - AS4282 MAXIMUM AVERAGE NIGHT TIME LUMINANCE FOR SIGNAGE		
	Description	Max Average Luminance (cd/m2)
A4	High district brightness e.g. Town and city centres and other commercial areas, residential areas abutting commercial areas, industrial and Port areas and Transport Interchanges	350
A3	Medium district brightness e.g. Suburban areas in towns and cities, generally roadways with streetlighting through suburban, rural or semi-rural areas	250
A2	Low district brightness e.g. Sparsely inhabited rural and semi-rural areas, generally roadways without streetlighting through suburban, rural or semi-rural areas other than intersections	150
A1	Dark e.g. Relatively uninhabited rural areas (including terrestrial, marine, aquatic and coastal areas), generally roadways without streetlighting through rural areas	50
A0	Intrinsically Dark e.g. UNESCO Starlight Reserve, IDA: Dark Sky Parks, Reserves or Sanctuaries, major optical observatories, other accreditations for dark sky places for example astrotourism, heritage value, astronomical importance, wildlife/ecosystem protection, lighting for safe access may be required	0.1

Based on an assessment of the surrounding environment, the existing signage is located within Environmental Zone A2 under AS4282, therefore, the maximum night time luminance is 150 cd/m2.

AS4282 does not include limits for daytime operation of illuminated signage. However, the Transport Guidelines outlines maximum permissible luminance limits for various lighting conditions, including daytime. Under the Transport Guidelines, the existing signage is classified as being within a Zone 4 area, which is described as an area with generally low levels of offstreet ambient lighting e.g. most rural areas, or areas that have residential properties nearby. The maximum luminance limits of illuminated signage within Zone 4 with an area greater than 10m2 are: 400cd/m2 for daytime and 100cd/m2 for night time (night time values are taken to be 1/4 the daytime brightness as outlined in the previous revision of the Transport Guidelines).

Table 2 below outlines the maximum luminance levels to comply with AS4282 and the Transport Guidelines for the various lighting conditions listed below:

TABLE 2 - LUMINANCE LEVELS FOR EXTERNALLY ILLUMINATED ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2)	Compliant
Day	N/A (OFF)	✓
Night Time	100	✓

The luminance of the existing signage was calculated using lighting software AGI32. Photometric data for the luminaires was provided by the manufacturer,* and was used for calculation purposes. The luminaires were dimmed in the model to ensure a maximum night time luminance of 100cd/m2 was not exceeded, as per Table 3 below. The existing signage lighting therefore complies with the luminance limits outlined in AS4282 and the Transport Guidelines when comissioned to the levels shown in Table 3. For further lighting requirements, refer to Section 6.

TABLE 3 - MAX LUMINANCE LEVELS FOR EXTERNALLY ILLUMINATED ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2)	Compliant
Day	N/A (OFF)	✓
Night Time	100	✓

*Electrolight takes no responsibility for the accuracy of third party provided photometric data.

6. AS4282 ASSESSMENT

The existing signage lighting has been assessed against the lighting criteria and requirements outlined in AS4282.

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 the signage operates all night, it will be assessed against the more stringent post-curfew limits.

Spill light to any adjacent Environmentally Sensitive Areas are also assessed against the more stringent post-curfew limits, as outlined in Clause 3.2.1 of AS4282.

Illuminance Assessment

The AS4282 assessment includes a review of nearby residential accommodation and Environmentally Sensitive Areas and calculation of the amount of vertical illuminance (measured in Lux) that they are likely to receive from the signage during night time operation.

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

TABLE 4 - AS4282 MAXIMUM VALUES OF VERTICAL ILLUMINANCE

	Max Vertical Illuminance (lx)		Description
	Pre-curfew	Post-curfew	
A4	25	5	High district brightness e.g. Town and city centres and other commercial areas, residential areas abutting commercial areas, industrial and Port areas and Transport Interchanges
A3	10	2	Medium district brightness e.g. Suburban areas in towns and cities, generally roadways with streetlighting through suburban, rural or semi-rural areas
A2	5	1	Low district brightness e.g. Sparsely inhabited rural and semi-rural areas, generally roadways without streetlighting through suburban, rural or semi-rural areas other than intersections
A1	2	0.1	Dark e.g. Relatively uninhabited rural areas (including terrestrial, marine, aquatic and coastal areas), generally roadways without streetlighting through rural areas
A0	0	0	Intrinsically Dark e.g. UNESCO Starlight Reserve, IDA: Dark Sky Parks, Reserves or Sanctuaries, major optical observatories, other accreditations for dark sky places for example astrotourism, heritage value, astronomical importance, wildlife/ecosystem protection, lighting for safe access may be required

Residential Dwellings

Based on an assessment of the surrounding area, the nearest habitable windows with potential views to the signage are located at the following location/s:

Address	Zone
1 Peter Brock Dr (Alpha Hotel Eastern Creek)	A4

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

The existing signage lighting (and surrounding environment) was modeled in lighting calculation program AGI32 to determine the effect (if any) of the spill from the signage lighting. Photometric data for the luminaires was provided by the manufacturer*. The results of the calculations are shown in Appendix C.

Under AS4282, the maximum allowable illuminance to accommodation in Zone A4 is 5 lux (as outlined in Table 5). It can be seen from the lighting model that the maximum illuminance to accommodation in Zone A4 is 0.07 lux at 1 Peter Brock Dr.

The existing signage lighting therefore complies with the relevant illuminance limits for nearby residential accommodation.

Environmentally Sensitive Areas

No Environmentally Sensitive Areas were identified in the vicinity of the signage. The limits in AS4282 therefore do no apply.

Threshold Increment Assessment

The Threshold Increment was also calculated for the inbound and outbound traffic approaches on Western Highway (M4). The calculation grids were located at 1.5m above ground level, with a viewing distance of between 10m to 200m from the signage and a windscreen cutoff angle of 20 degrees (as outlined in AS1158). The calculation results show that the Threshold Increment does not exceed 15.36% for any traffic approach (the allowable maximum under the standard is 20%).

*Electrolight takes no responsibility for the accuracy of third party provided photometric data.

Upward Waste Light Assesment

In order to reduce light pollution and associated environmental impacts, AS4282 includes requirements that limit upward waste light into the night sky from signage. AS4282 states that externally illuminated signage shall have an Upward Waste Light Ratio (ULR_L) of not more than 0.01. The ULR_L of the existing signage is not more than 0.004. The signage therefore complies with this requirement.

Luminous Intensity

AS4282 nominates Luminous Intensity limits where a light source (such as a floodlight) can be directly viewed from a residential accommodation or Environmentally Sensitive Area, shown in Table 5 below:

TABLE 5 - MAXIMUM LUMINOUS INTENSITIES PER LUMINAIRE FOR EXTERNALLY ILLUMINATED SIGNAGE

	Non-Curfew L1 luminous intensity (cd)	Non-Curfew L2 luminous intensity (cd)	Curfew luminous intensity (cd)
A0	As close to 0 as possible, without impacting safety	As close to 0 as possible, without impacting safety	0
A1	2500	5000	500
A2	7500	12500	1000
A3	12500	25000	2500
A4	25000	50000	2500

It can be seen from the lighting model that the maximum luminous intensity to dwellings in Zone A4 is 1108 cd. The existing signage lighting therefore complies with the maximum Zone A4 AS4282 luminous intensity limit of 2500 cd for curfew operation.

AS4282 Assessment Summary

It can therefore be seen that the existing signage lighting complies with all relevant requirements of AS4282.

7. SEPP ASSESSMENT

Table 6 below outlines the illumination assessment criteria from the SEPP Industry and Employment Schedule 5 - Clause 7 Illumination. While the SEPP only applies to sites located on classified roads, this assessment references the guidelines for all sites as a best practice document in New South Wales. In addition to the criteria, responses have been included demonstrating that the existing signage is in compliance.

TABLE 6 - ILLUMINATION ASSESSMENT CRITERIA		
Assessment Criteria	Response	Compliant?
Would illumination result in unacceptable glare?	The existing signage complies with the Threshold Increment limits of AS4282, demonstrating that the illumination will not cause unacceptable glare.	✓
Would illumination affect safety for pedestrians, vehicles or aircraft?	The existing signage complies with the Threshold Increment limits of AS4282, demonstrating that the illumination will not cause unacceptable glare. The small size of the signage and its relatively low intensity limits the risk to pedestrians, vehicles or aircraft.	✓
Would illumination detract from the amenity of any residence or other form of accommodation?	The existing signage, when installed according to this report, complies with the illuminance (spill lighting) limits of AS4282, demonstrating that the illumination will not detract form the amenity of any residence or other form of accommodation	✓
Can the intensity of the illumination be adjusted, if necessary?	The existing signage is dimmable and can be adjusted if necessary.	✓
Is the illumination subject to a curfew?	The existing advertising signage, when installed according to this report, complies with the limits required during curfewed operation under AS4282 (nominally between the hours of 11pm and 6am). This means that a curfew is not required.	N/A

8. SUMMARY

- The existing signage lighting at M4 Near Brabham Dr, Eastern Creek NSW, shall be comissioned on site to not exceed the following maximum luminances:

LUMINANCE LEVELS FOR EXTERNALLY ILLUMINATED ADVERTISEMENTS		
Lighting Condition	Max Permissible Luminance (cd/m2)	Compliant
Day	N/A (OFF)	✓
Night Time	100	✓

- The existing signage lighting shall be aimed towards the signage face at 15 degrees below the horizontal in order to comply with the requirements outlined in this assessment.
- The existing signage lighting has been found to comply with all relevant requirements of AS4282, the Transport Guidelines and SEPP Industry and Employment.
- In complying with the above requirements, the existing signage lighting shall not result in unacceptable glare nor shall it adversely impact the safety of pedestrians, residents or vehicular traffic. Additionally, the existing signage lighting shall not cause any unacceptable amenity impacts to nearby residential accommodation or environmental receivers.

8. DESIGN CERTIFICATION

The existing signage lighting at M4 Near Brabham Dr, Eastern Creek NSW, if commissioned according to this report, complies with the following criteria, guidelines and standards:

- State Environmental Planning Policy (Industry and Employment) 2021
- Transport Corridor Outdoor Advertising & Signage Guidelines 2017
- AS/NZS 4282:2023 Control of the Obtrusive Effects of Outdoor Lighting

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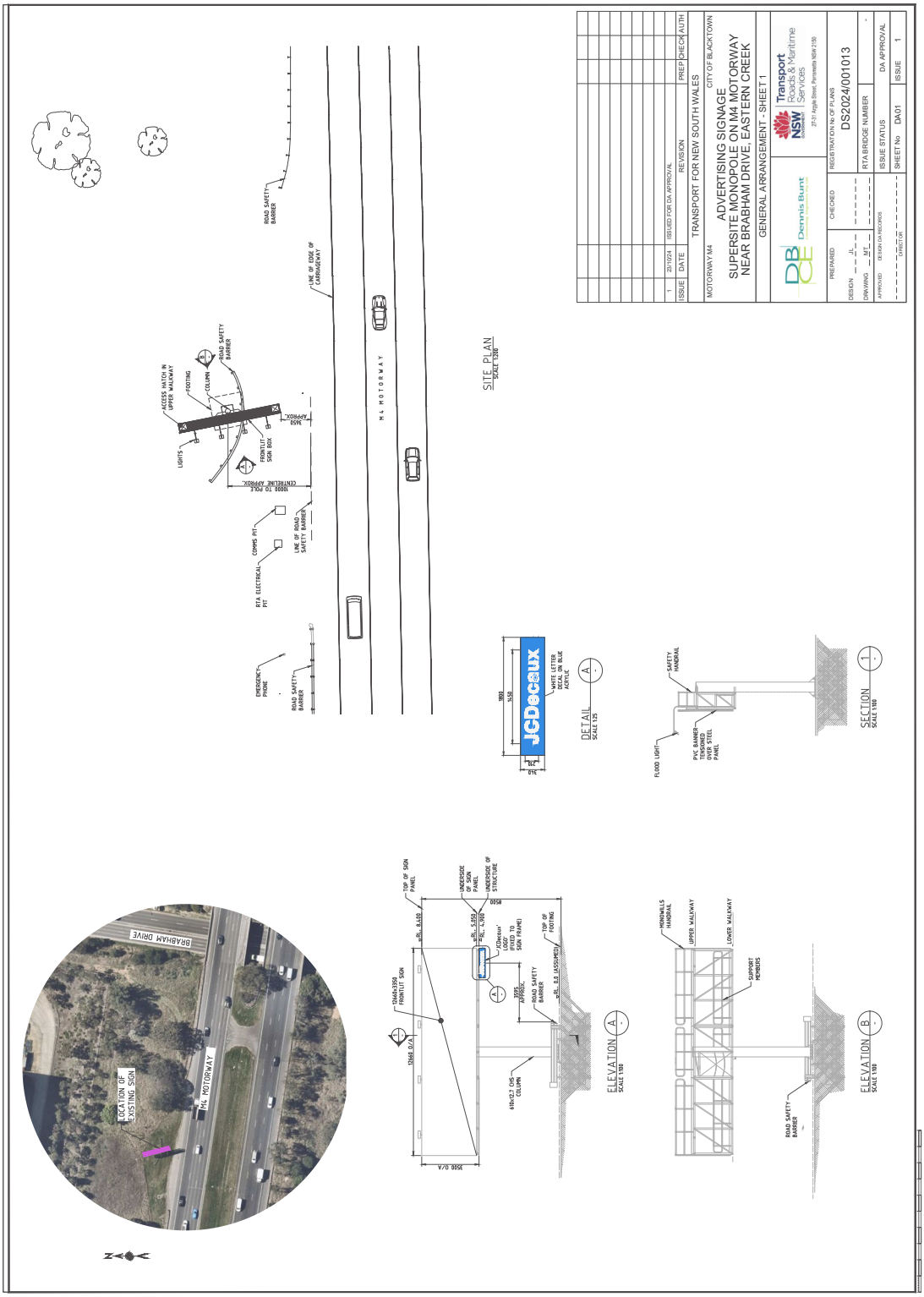
APPENDIX A
EXISTING SIGNAGE LOCATION AND ELEVATIONS



APPENDIX A

EXISTING SIGNAGE LOCATION AND ELEVATIONS

APPENDIX B

EXISTING LUMINAIRE SPECIFICATION

tigerlight | HIGH-PERFORMANCE INDUSTRIAL LIGHTING

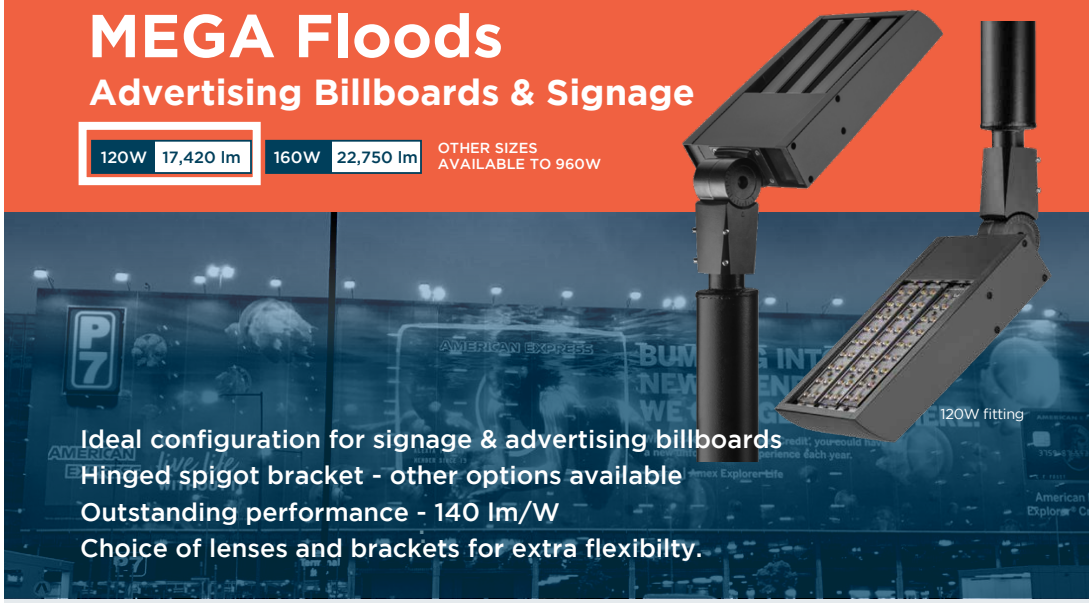
MEGA FLOOD

LED FLOOD / AREA LIGHT

MEGA Floods

Advertising Billboards & Signage

120W 17,420 lm | 160W 22,750 lm | OTHER SIZES AVAILABLE TO 960W



Ideal configuration for signage & advertising billboards
Hinged spigot bracket - other options available
Outstanding performance - 140 lm/W
Choice of lenses and brackets for extra flexibilty.

~140 LUMENS PER WATT	T3M LENSES & OPTIONS	IP67 RATING	IK10 RATING	MOUNTING OPTIONS	5000K CCT RA >70 CRI	5 YEAR WARRANTY

HIGH-PERFORMANCE COMPONENTS IN MODULAR DESIGN

High performance floods for extra heavy duty
High output 17,420 lm from 120W @ 140 lm/W
Open modular design for optimum heat managment. Operating temps of -40 to +50°C
Rated IP67 and IK10. Polycarbonate lenses.

PURPOSE-BUILT TO SUIT APPLICATION

T3M area lenses are standard specification with 11 options available on special order
Hinged bracket allows better uniformity of light
Bright, natural white 5000K light.

APPLICATIONS

- Hinged bracket is ideal for illuminating advertising billboards and signage on buildings
- Also useful specification for other pole-mounted carparks, street and tennis court lighting, where tilting is important.

Tigerlight High-performance industrial lighting

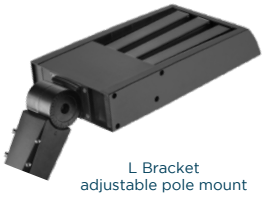
MEGA FLOODS Billboards & signage

APPENDIX B
EXISTING LUMINAIRE SPECIFICATION

tigerlight | HIGH-PERFORMANCE INDUSTRIAL LIGHTING

MEGA FLOOD by tigerlight

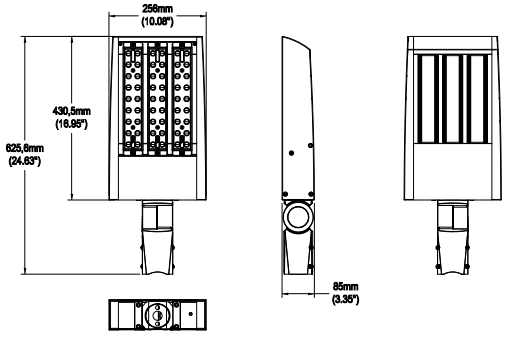
BRACKET OPTIONS



L Bracket
adjustable pole mount

Wall/pole bracket
for mountings without spigots

DIMENSIONS



	120W	160W
MODULES	3x40W	4x40W
WEIGHT	8.0kg	9.5kg
DIMENSIONS	625x256x85mm	625x310x85mm

Also available:

40W 80W 200W 240W 280W 320W

DELIVERY OF MADE-TO-ORDER ITEMS

Please allow up to 6-8 weeks for special order items and where sufficient components may not be available locally.

TECHNICAL PARAMETERS

Power consumption	120W 160W
Input voltage options	100-277VAC or 415VAC
Input current	700mA
Power factor	≥0.9 at full load
Surge protection	Imax 20kA
LED chips	High performance ~140+ lm/W
Driver / Dimming	Meanwell HLG Series / Dimmable 1-10VDC; DALI
Effficacy	~140lm/W
Colour temperature	5000°K (options for Amber, 4000°K, 6000°K)
CRI	RA >70
Light distribution	IESNA Types III, IV, V options
Light spill control	Built-in optical spill control

IP Rating / IK Rating	IP67 / IK10
Composition - lenses	Polycarbonate - no glass
Composition - housing	Aluminium with polyester coating (>100 microns)
Working temperature	-40 to 50 °C
Service life	>50,000 hours
Warranty	5 years
Weight	8.0kg 9.5kg
Dimensions (inc bracket)	625x256x85mm 625x310x85mm
Product codes	
120W	FLC120L (L-Bracket)
160W	FLC160L

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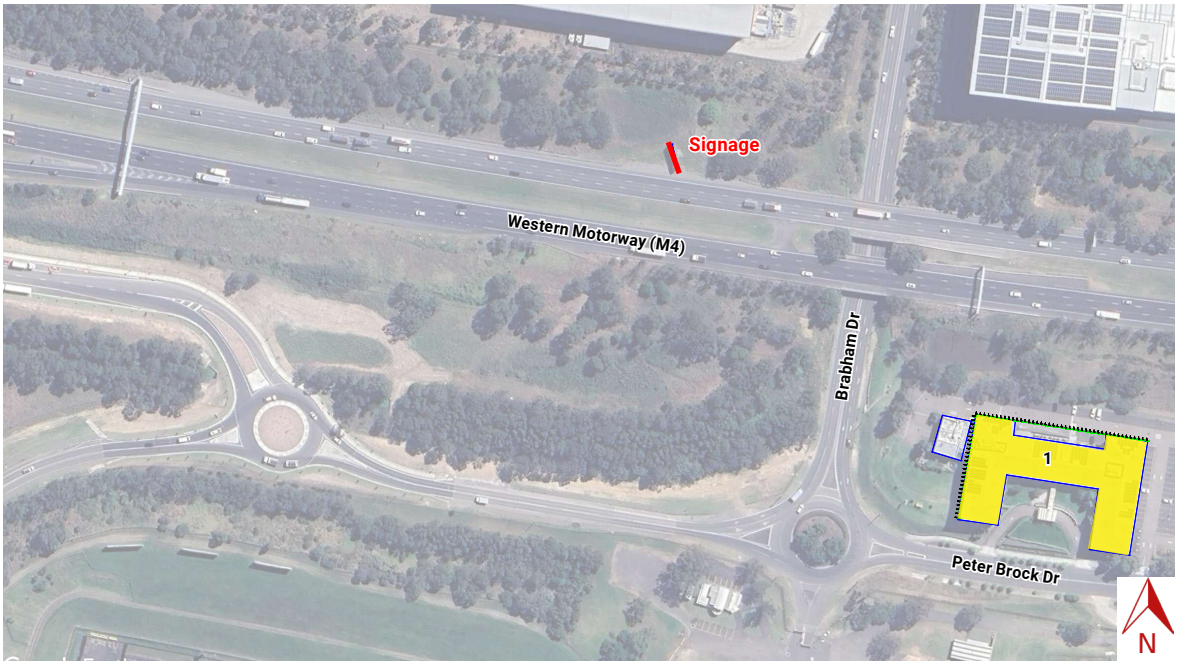
APPENDIX C
OBTRUSIVE LIGHTING CALCULATIONS

Environmental Zone Legend:

- A0
- A1
- A2
- A3
- A4
- Property within 100m of signage



OBTRUSIVE LIGHTING CALCULATIONS - DIRECT CONTRIBUTION FROM FLOODLIGHTS*

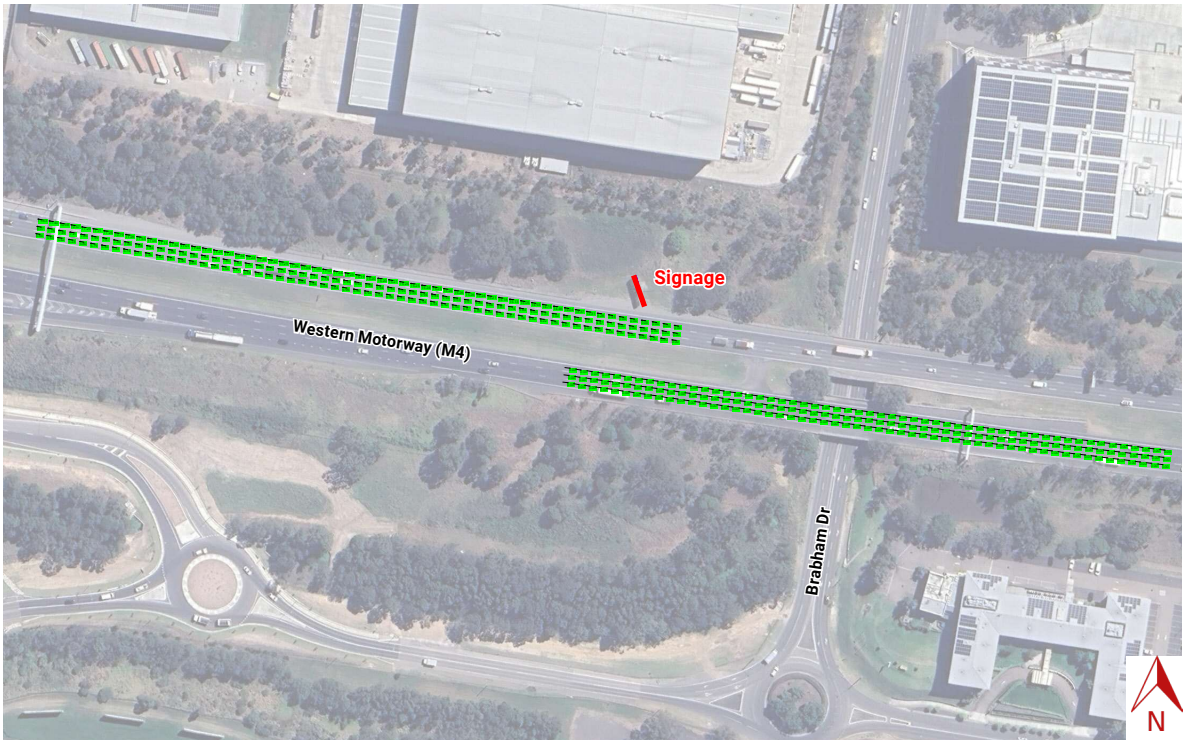
Calculation Summary			
Project: A4			
Label	CalcType	Units	Max
1 Peter Brock Dr_Cd_Seg1	Obtrusive - Cd	N.A.	1108
1 Peter Brock Dr_Cd_Seg2	Obtrusive - Cd	N.A.	346
1 Peter Brock Dr_Ill_Seg1	Obtrusive - Ill	Lux	0.06
1 Peter Brock Dr_Ill_Seg2	Obtrusive - Ill	Lux	0.02

OBTRUSIVE LIGHTING CALCULATIONS - REFLECTED CONTRIBUTION FROM FLOODLIGHT OFF SIGNAGE SURFACE*

Calculation Summary			
Project: A4 Obtrusive			
Label	CalcType	Units	Max
1 Peter Brock Dr_Ill_Seg1	Obtrusive - Ill	Lux	0.01
1 Peter Brock Dr_Ill_Seg2	Obtrusive - Ill	Lux	0.01

* The total illuminance shown in the report is a sum of the direct light from the floodlight and the indirect light reflected from the signage surface.

APPENDIX C
THRESHOLD INCREMENT CALCULATIONS



THRESHOLD INCREMENT CALCULATIONS - DIRECT CONTRIBUTION FROM FLOODLIGHTS*

Calculation Summary			
Project: TI			
Label	CalcType	Units	Max
Western Motorway (M4) Inbound	Obtrusive - TI	%	0.10
Western Motorway (M4) Outbound	Obtrusive - TI	%	2.35

THRESHOLD INCREMENT CALCULATIONS - REFLECTED CONTRIBUTION FROM FLOODLIGHT OFF SIGNAGE SURFACE*

Calculation Summary			
Project: TI			
Label	CalcType	Units	Max
Western Motorway (M4) Inbound	Obtrusive - TI	%	15.26
Western Motorway (M4) Outbound	Obtrusive - TI	%	0.00

* The total Threshold Increment shown in the report is a sum of the glare from the direct light from the floodlight and the indirect light reflected from the signage surface.

APPENDIX C
OBTRUSIVE AND THRESHOLD INCREMENT CALCULATIONS - Direct Contribution from Floodlights

Obtrusive Light - Compliance Report

AS/NZS 4282:2023, A4 - High District Brightness, Curfew
Filename: 3724.3 Eastern Creek - Direct calc for screen ave and lum intensity - Rev A
3/12/2024 12:17:44 PM

Illuminance

Maximum Allowable Value: 5 Lux

Calculations Tested (2):

Calculation Label	Test Results	Max. Illum.
1 Peter Brock Dr_Ill_Seg1	**PASS**	0.06
1 Peter Brock Dr_Ill_Seg2	**PASS**	0.02

Luminous Intensity (Cd) At Vertical Planes

Maximum Allowable Value: 2500 Cd

Calculations Tested (2):

Calculation Label	Test Results
1 Peter Brock Dr_Cd_Seg1	**PASS**
1 Peter Brock Dr_Cd_Seg2	**PASS**

Threshold Increment (TI)

Maximum Allowable Value: 20 %

Calculations Tested (2):

Calculation Label	Adaptation Luminance	Test Results
Western Motorway (M4) Inbound	0.25	**PASS**
Western Motorway (M4) Outbound	0.25	**PASS**

Upward Waste Light Ratio (UWLR)

Maximum Allowable Value: 1.0 %

Calculated UWLR: 0.4 %
Test Results: **PASS**

APPENDIX C
OBTRUSIVE AND THRESHOLD INCREMENT CALCULATIONS - Reflected Contribution from Floodlights off Signage Surface

Obtrusive Light - Compliance Report

AS/NZS 4282:2023, A4 - High District Brightness, Curfew
Filename: 3724.3 Eastern Creek - obtrusive full radiosity calc - Rev A
3/12/2024 12:20:49 PM

Illuminance

Maximum Allowable Value: 5 Lux

Calculations Tested (2):

Calculation Label	Test Results	Max. Illum.
1 Peter Brock Dr_Ill_Seg1	**PASS**	0.01
1 Peter Brock Dr_Ill_Seg2	**PASS**	0.01

Obtrusive Light - Compliance Report

AS/NZS 4282:2023, A3 - Medium District Brightness, Curfew
Filename: 3724.3 Eastern Creek - TI Direct calc with screen sim - Rev A
2/12/2024 1:41:21 PM

Threshold Increment (TI)

Maximum Allowable Value: 20 %

Calculations Tested (2):

Calculation Label	Adaptation Luminance	Test Results
Western Motorway (M4) Inbound	0.25	**PASS**
Western Motorway (M4) Outbound	0.25	**PASS**