

Digital Place Solutions

LIGHTING IMPACT ASSESSMENT -
OUTDOOR SIGNAGE AT WINDSOR ROAD, BAULKHAM HILLS, NSW (INBOUND)

20th October 2022
Ref: 3214.8

Lighting Impact Assessment
Outdoor Signage at Windsor Road, Baulkham Hills, NSW
(Inbound)

Electrolight Australia Pty Ltd
ABN: 44 600 067 392

info@electrolight.com
www.electrolight.com

4/414 Bourke St
Surry Hills, NSW 2010
T + 612 9267 4777

| DATE | REV | COMMENT | PREPARED BY | CHECKED BY |
|----------|-------|-----------------|-------------|------------|
| 20/10/22 | REV B | For Information | NL | RS |

CONTENTS

| | |
|-------------------------------------|----|
| 1. INTRODUCTION | 3 |
| 2. DEFINITIONS | 3 |
| 2.1 Illuminance | 3 |
| 2.2 Luminance | 3 |
| 2.3 Luminous Intensity | 3 |
| 2.4 Obtrusive Light | 3 |
| 2.5 Threshold Increment | 3 |
| 2.6 AGI32 Light Simulation Software | 3 |
| 2.7 Upward Light Ratio (ULR) | 4 |
| 3. SITE DESCRIPTION AND SCOPE | 4 |
| 4. DESIGN GUIDELINES AND STANDARDS | 4 |
| 5. LUMINANCE ASSESSMENT | 5 |
| 6. AS4282 ASSESSMENT | 6 |
| 7. SUMMARY | 8 |
| 8. DESIGN CERTIFICATION | 9 |
| APPENDIX A | 10 |
| APPENDIX B | 11 |
| APPENDIX C | 12 |
| APPENDIX D | 14 |

1. INTRODUCTION

Electrolight have been appointed by Digital Place Solutions to undertake a Lighting Impact Assessment on the proposed digital signage to be installed on the Windsor Road Overpass above M2 Motorway, Baulkham Hills, NSW (Inbound). 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 AS4282-2019 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 (E_h) The value of illuminance on a designated horizontal plane

(b) Vertical illuminance (E_v) 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_{ve}).

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 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 on the Windsor Road Overpass above M2 Motorway, Baulkham Hills, NSW. The signage is oriented towards the inbound direction of traffic on the M2 Motorway. The total active display (illuminated) area of the proposed digital signage is 39.94 m². The digital signage is to be in 24 hour operation. Refer to 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 manufacturer of the digital signage is noted as Daktronics model type DVX-2200N-10MN-8000-WJ with performance parameters as outlined in Appendix B. The signage includes baffles which mitigate upward waste light, resulting in an Upward Light Ratio (ULR) of less 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 digital signage against the following Criteria, Design Guidelines and Standards.

- State Environmental Planning Policy (Industry and Employment) 2021 (Refer Appendix C)
- Transport Corridor Outdoor Advertising & Signage Guidelines 2017
- 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 | 350 |
| 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 digital signage is located within Environmental Zone A3 under AS4282, therefore the maximum night time luminance is 250 cd/m2.

AS4282 does not include limits for daytime operation of illuminated signage. However, the Transport Corridor Outdoor Advertising & Signage Guidelines outlines maximum permissible luminance limits for various lighting conditions, including daytime. Under the Guidelines, the proposed signage is classified as being within Zone 4, which is described as an area with generally low levels of off-street ambient lighting e.g. most rural areas, or areas that have residential properties located nearby. The maximum night time luminance of a digital signage within Zone 4 is 200 cd/m2.

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

| TABLE 2 - LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS | | |
|---|-------------------------------------|-----------|
| Lighting Condition | Max Permissible Luminance (cd/m2) # | Compliant |
| Full Sun on face of Signage | No Limit | ✓ |
| Day Time Luminance (typical sunny day) | 6000 | ✓ |
| Morning and Evening Twilight and Overcast Weather | 500 | ✓ |
| Night Time | 90* | ✓ |

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

* The maximum permissible luminance allowable under AS4282 and the Transport Corridor Outdoor Advertising & Signage Guidelines is actually 200 cd/m2. The lower luminance limit shown above is to ensure compliance with other criteria of AS4282 and any additional lighting requirements as described in this report.

The proposed digital signage has a maximum brightness (luminance) of 8000 cd/m2. The screen shall be commissioned on site to yield a maximum screen luminance of 8000 cd/m2 when full sun strikes the face of the sign (maximum brightness), 6000 cd/m2 during normal daytime operation, 500 cd/m2 during twilight and inclement weather and 90 cd/m2 during night time.

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 the signage operates all night, the signage will be assessed against 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 3 below:

| TABLE 3 - 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 | Address | Zone |
|---------------------|------|--------------------------|------|
| 2 Goodin Road | A3 | 2-10a Livingstone Avenue | A3 |
| 3 Horwood Avenue | A3 | 12-20 Livingstone Avenue | A3 |
| 2-8 Junction Road | A3 | 1a Murrills Crescent | A3 |
| 12-28 Junction Road | A3 | | |

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 signage. Photometric data for the screen was provided by the screen manufacturer*, with the maximum luminance corresponding to the 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 and/or barriers which effectively obstructs the spill light of the signage. However calculations were undertaken assuming that there were no barriers or vegetation present.

It can be seen from the lighting model that the maximum illuminance to dwellings in Zone A3 is 0.4 lux at 2-8 Junction Road. The illuminance level above complies with the maximum AS4282 limit of 2 lux as outlined in Table 3.

Threshold Increment Assessment

The Threshold Increment was also calculated for the traffic approach on M2 Motorway (Inbound). The calculation grids were located at 1.5 m above ground level for general traffic approaches, with an approach viewing distance of between 5 m to 200 m from the sign. The calculation results show that the Threshold Increment does not exceed 18.8% 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 AS4282-2019 Control of the Obtrusive Effects of Outdoor Lighting.

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

7. SUMMARY

- The proposed signage to be installed on the Windsor Road Overpass above M2 Motorway, Baulkham Hills, NSW (Inbound), shall be commissioned on site to yield the following maximum luminances:

| LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS | | |
|--|-----------------------------------|-----------|
| Lighting Condition | Max Permissible Luminance (cd/m2) | Compliant |
| Full Sun on face of Signage | No Limit | ✓ |
| Day Time Luminance (typical sunny day) | 6000 | ✓ |
| Morning and Evening Twilight and Overcast Weather | 500 | ✓ |
| Night Time | 90 | ✓ |

- 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 signage should not cause any reduction in visual amenity to nearby residences or accommodation.

8. DESIGN CERTIFICATION

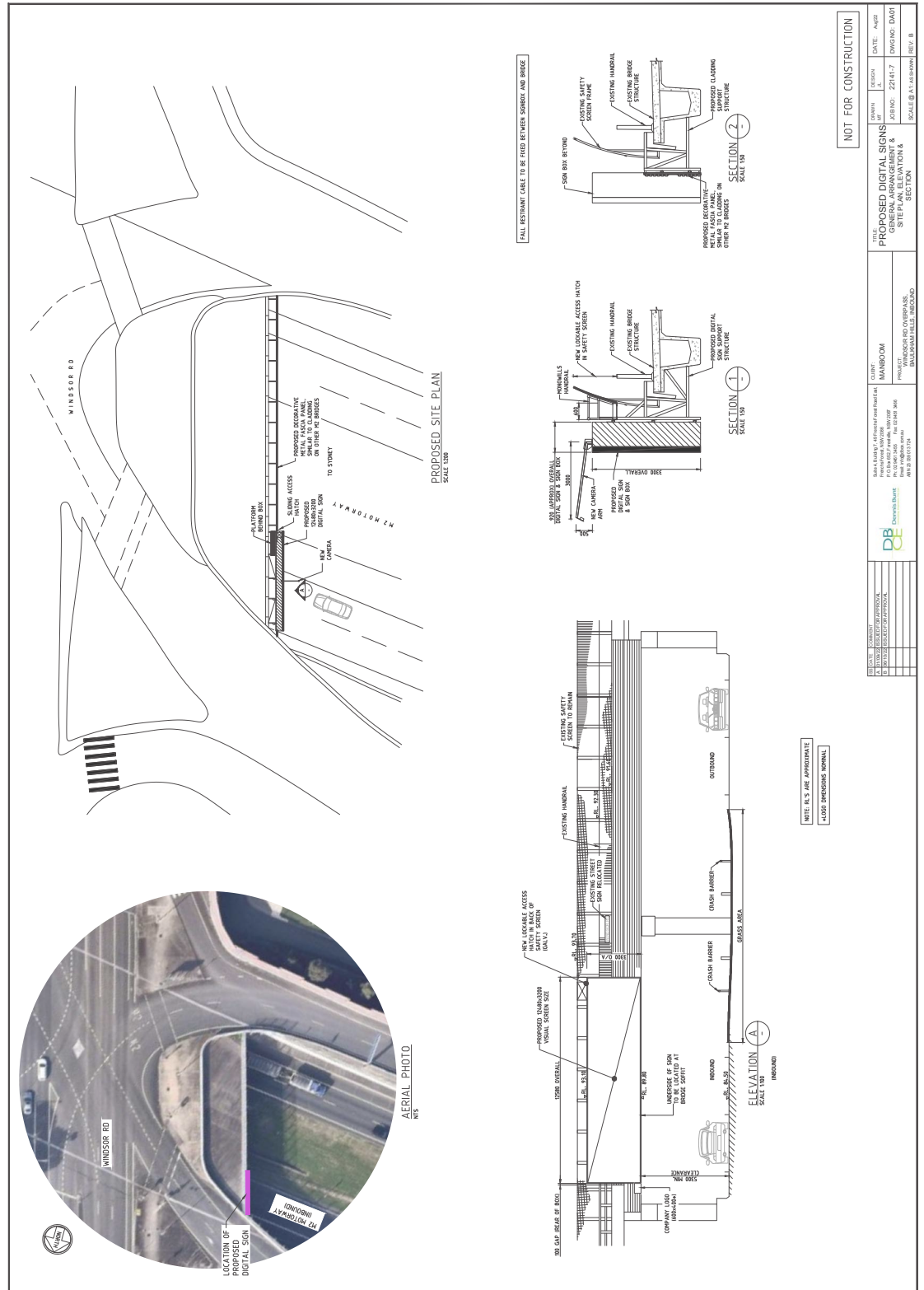
The proposed digital signage to be installed on the Windsor Road Overpass above M2 Motorway, Baulkham Hills, NSW (Inbound), if commissioned according to this report, complies with the following criteria, guidelines and standards:

- State Environmental Planning Policy (Industry and Employment) 2021 (Refer Appendix C)
- Transport Corridor Outdoor Advertising & Signage Guidelines 2017
- AS 4282-2019 Control of the Obtrusive Effects of Outdoor Lighting



Ryan Shamier
Senior Lighting Designer
Electrolight Sydney
20/10/22

SIGNAGE LOCATION PLAN AND ELEVATIONS



APPENDIX B

DIGITAL SIGNAGE SPECIFICATION

| DAKTRONICS PRODUCT SPECIFICATION | |
|--|--|
| SERIES SPECIFICATION | |
| DVX-2200N-10MN-8000-WJ | |
| Pixel Configuration | RGB 3-in-1 SMD |
| Line and Column Spacing | 0.394 inches - 10 millimeters |
| Module Configuration - Pixels (Rx/C) | 32 x 32 pixels |
| Module Dimensions (HxW) | 12.598 x 12.598 inches - 320 x 320 mm |
| Maximum Power per Module | 65.35 Watts |
| Average Power per Module | 16.34 Watts |
| Display Weight per Module | 10.2 pounds - 4.63 kilograms |
| Processing | 22 bit Distributed |
| Color Capacity | 281 Trillion Colors |
| Dimming | 256 levels |
| Color Temperature | 3,000°-10,000° kelvin (adjustable) |
| Calibration | pixel to pixel |
| LED Refresh Rate | 3840 hertz |
| LED Lifetime | 100,000 hrs |
| Brightness - Typical Nits | 8000 nits (cd/sm) |
| Horizontal Viewing Angle | 160° |
| Vertical Viewing Angle (Up/Down) | +60/-70° |
| Contrast Ratio | 1200:1 |
| Service Access | Front or Rear |
| Cabinet Depth | 3.937 inches - 100 millimeters |
| Cabinet Construction | Die-Cast Aluminum |
| Ingress Protection Rating | IP-66 Rated |
| Working Temperature Rating | -40° to 122° F - -40° to 50° C |
| Ventilation | None |
| Data Transmission to Display | Direct: Fiberoptic Cable Remote: Internet/Network (IP) |
| Note 1: Consistent with Daktronics policy of continuing product improvement, specifications shown on this document are subject to change without notice. | |
| Note 2: See contract specific drawings for customized product weights | |

APPENDIX C

State Environmental Planning Policy (Industry and Employment) 2021

Schedule 5 Assessment criteria

(Clauses 8, 13 and 17)

1. Character of the area

- Is the proposal compatible with the existing or desired future character of the area or locality in which it is proposed to be located?
- Is the proposal consistent with a particular theme for outdoor advertising in the area or locality?

2. Special areas

- Does the proposal detract from the amenity or visual quality of any environmentally sensitive areas, heritage areas, natural or other conservation areas, open space areas, waterways, rural landscapes or residential areas?

3. Views and vistas

- Does the proposal obscure or compromise important views?
- Does the proposal dominate the skyline and reduce the quality of vistas?
- Does the proposal respect the viewing rights of other advertisers?
-

4. Streetscape, setting or landscape

- Is the scale, proportion and form of the proposal appropriate for the streetscape, setting or landscape?
- Does the proposal contribute to the visual interest of the streetscape, setting or landscape?
- Does the proposal reduce clutter by rationalising and simplifying existing advertising?
- Does the proposal screen unsightliness?
- Does the proposal protrude above buildings, structures or tree canopies in the area or locality?
- Does the proposal require ongoing vegetation management?

5. Site and building

- Is the proposal compatible with the scale, proportion and other characteristics of the site or building, or both, on which the proposed signage is to be located?
- Does the proposal respect important features of the site or building, or both?
- Does the proposal show innovation and imagination in its relationship to the site or building, or both?

6. Associated devices and logos with advertisements and advertising structures

- Have any safety devices, platforms, lighting devices or logos been designed as an integral part of the signage or structure on which it is to be displayed?

7. Illumination

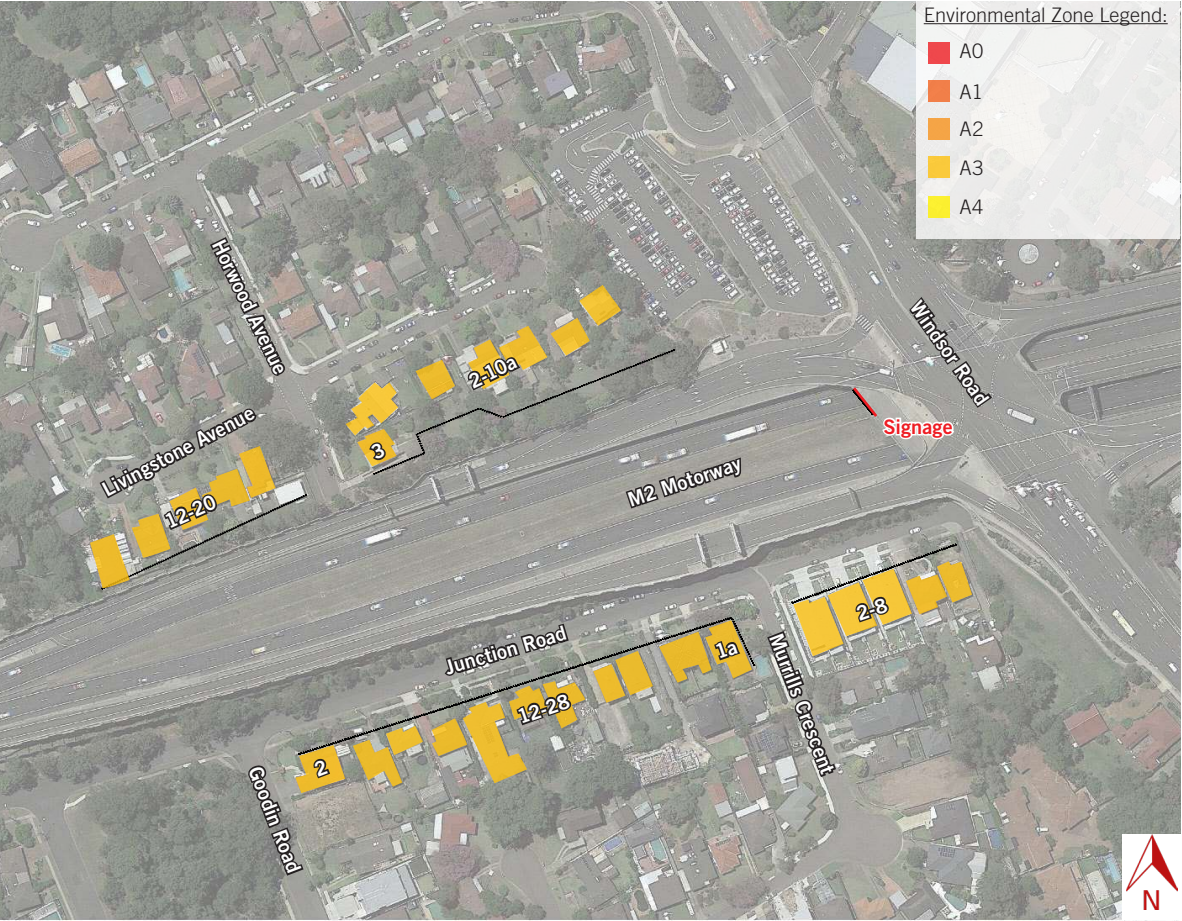
- Would illumination result in unacceptable glare?
- Would illumination affect safety for pedestrians, vehicles or aircraft?
- Would illumination detract from the amenity of any residence or other form of accommodation?
- Can the intensity of the illumination be adjusted, if necessary?
- Is the illumination subject to a curfew?

8. Safety

- Would the proposal reduce the safety for any public road?
- Would the proposal reduce the safety for pedestrians or bicyclists?
- Would the proposal reduce the safety for pedestrians, particularly children, by obscuring sightlines from public areas?

APPENDIX D OBTRUSIVE LIGHTING CALCULATIONS

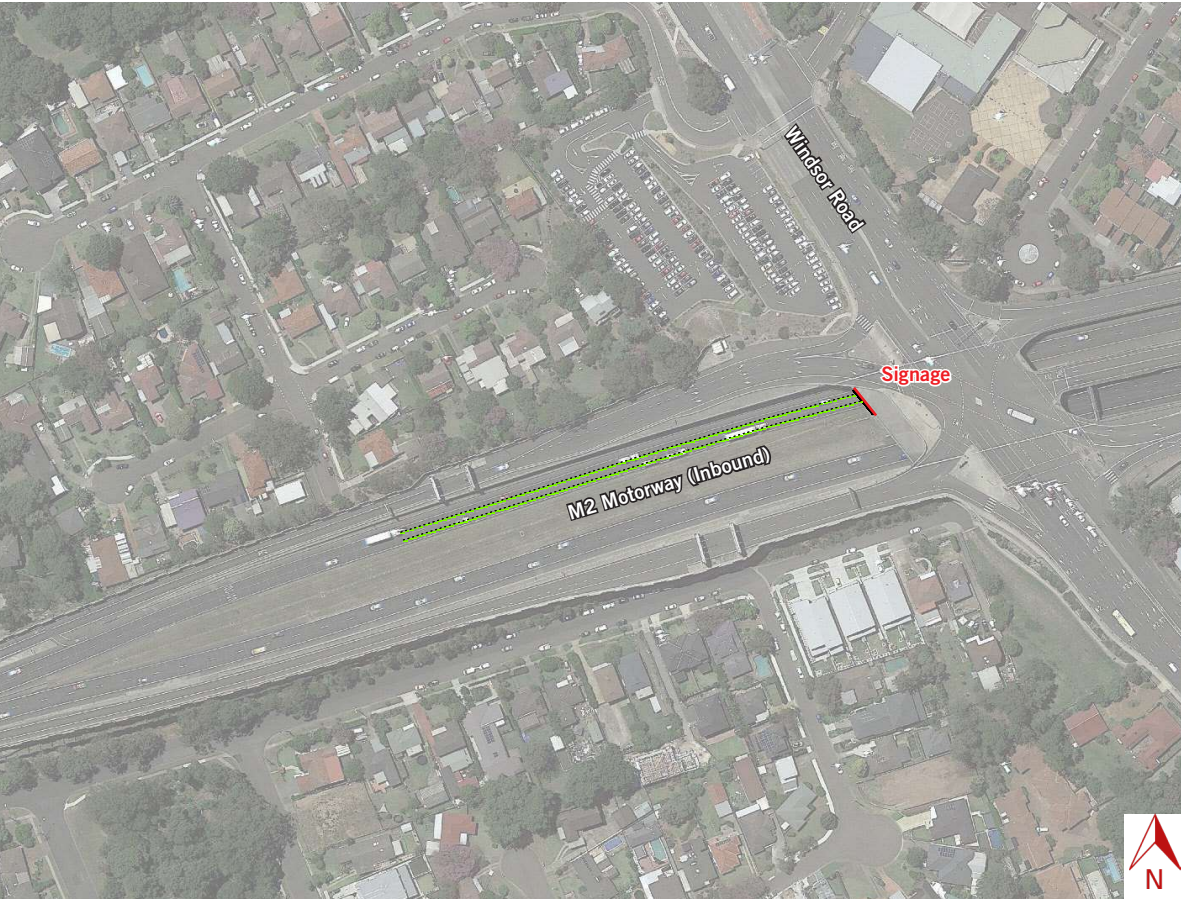
| Project: Obtrusive | | | |
|-----------------------------------|-----------------|-------|-----|
| Label | CalcType | Units | Max |
| 12-20 Livingstone Avenue_Ill_Seg1 | Obtrusive - Ill | Lux | 0.0 |
| 12-28 Junction Road Ill Seg1 | Obtrusive - Ill | Lux | 0.2 |
| 1a Murrills Cres Ill Seg1 | Obtrusive - Ill | Lux | 0.3 |
| 1a Murrills Cres Ill Seg2 | Obtrusive - Ill | Lux | 0.2 |
| 2 Goodin Road Ill Seg1 | Obtrusive - Ill | Lux | 0.0 |
| 2-10a Livingstone Avenue_Ill_Seg1 | Obtrusive - Ill | Lux | 0.0 |
| 2-10a Livingstone Avenue_Ill_Seg2 | Obtrusive - Ill | Lux | 0.0 |
| 2-10a Livingstone Avenue_Ill_Seg3 | Obtrusive - Ill | Lux | 0.2 |
| 2-8 Junction Road Ill Seg1 | Obtrusive - Ill | Lux | 0.4 |
| 3 Horwood Avenue Ill Seg1 | Obtrusive - Ill | Lux | 0.0 |
| 3 Horwood Avenue Ill Seg2 | Obtrusive - Ill | Lux | 0.1 |



APPENDIX D

THRESHOLD INCREMENT CALCULATIONS

| Calculation Summary | | | |
|-----------------------|----------------|-------|-------|
| Project: Ti | | | |
| Label | CalcType | Units | Max |
| M2 Motorway (Inbound) | Obtrusive - TI | % | 18.80 |



APPENDIX D

OBTRUSIVE LIGHTING AND THRESHOLD INCREMENT CALCULATIONS

Obtrusive Light - Compliance Report

AS/NZS 4282:2019, A3 - Medium District Brightness, Curfew
Filename: 3214.8 Windsor Road Baulkham Hills Inbound rev B
20/10/2022 4:44:53 PM

Illuminance

Maximum Allowable Value: 2 Lux

Calculations Tested (11):

| Calculation Label | Test Results | Max. Illum. |
|-----------------------------------|--------------|-------------|
| 2-10a Livingstone Avenue_Ill_Seg1 | PASS | 0.0 |
| 2-10a Livingstone Avenue_Ill_Seg2 | PASS | 0.0 |
| 2-10a Livingstone Avenue_Ill_Seg3 | PASS | 0.2 |
| 3 Horwood Avenue_Ill_Seg1 | PASS | 0.0 |
| 3 Horwood Avenue_Ill_Seg2 | PASS | 0.1 |
| 12-20 Livingstone Avenue_Ill_Seg1 | PASS | 0.0 |
| 2-8 Junction Road_Ill_Seg1 | PASS | 0.4 |
| 12-28 Junction Road_Ill_Seg1 | PASS | 0.2 |
| 1a Murrills Cres_Ill_Seg1 | PASS | 0.3 |
| 1a Murrills Cres_Ill_Seg2 | PASS | 0.2 |
| 2 Goodin Road_Ill_Seg1 | PASS | 0.0 |

Threshold Increment (TI)

Maximum Allowable Value: 20 %

Calculations Tested (1):

| Calculation Label | Adaptation Luminance | Test Results |
|-----------------------|----------------------|--------------|
| M2 Motorway (Inbound) | 1 | PASS |