Source: *MM Atelier Architects*

Port Macquarie Leisure & Entertainment Precinct

Light Spill Assessment Report

Project Reference: **Application 10.2018.1111.1**

September 2020

Prepared for: **Planet Warriewood Pty Ltd**

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2	C Rowsell	K Goodsell	24/09/2020
3	C Rowsell	K Goodsell	28/09/2020

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1 Introduction

1.1 Location

Proposed development of a new Leisure & Entertainment Precinct by Planet Warriewood Pty Ltd, situated on the corner of Warlters Street and Park Street (LOT: 22 DP: 1220661), Port Macquarie, NSW, 2444. The proposal envisages a new state of the art entertainment precinct with the following uses in a four-storey commercial building:

- 9 x Cinemas, restaurant and function room and managers residence
- Gymnasium
- Fun Fair including indoor bowling facility
- Food and Drink Premises, including two ground level drive through premises
- Retail tenancies
- Basement Carpark and delivering 160 car spaces and 12 motorbike spaces

1.2 Report Intent

Stowe Australia have been engaged by MM Atelier Architects to provide a Light Spill Assessment Report to provide additional information to assist in analysing the effects this may have with the proximity to existing residential areas and how these can be mitigated.

1.3 Assessment Approach

The assessment of light spill involves three separate actions.

- Measurement of existing environment conditions with respect to light spill,
- Calculation of potential light spill from the proposed lighting design,
- Assessment of the likely impact and identifying mitigation measure as or if necessary.

The impact of lighting on people is controlled by ‘AS/NZS 4282-2019 - Control of the obtrusive effects of outdoor lighting’ (AS 4282).

Under AS 4282, public lighting as covered in the AS/NZS 1158 (road and public lighting) series of Standards is exempt from compliance with AS 4282. There are no relevant guidelines or standards in relation to impacts on fauna.

2 Lighting Requirements

2.1 Local Environmental Plan

Schedule 2 Exempt development of the Port Macquarie-Hastings Local Environmental Plan 2011-84 includes the following references associated with external lighting, with emphasis on item 2:

Lighting (external)

(1) Must not be for the lighting of tennis courts or sports grounds.

(2) Constructed and maintained so that light spill is contained within site and in accordance with AS 4282–1997, Control of the obtrusive effects of outdoor lighting.

(3) Construction and maintenance of lighting at or in vicinity of air transport facilities if consistent with Manual of Standards (MOS)—Part 139—Aerodromes published by the Civil Aviation Safety Authority (established under the Civil Aviation Act 1988 of the Commonwealth).

2.2 Understanding and Interpreting Lux *(lx)* Values

Lux readings are directly proportional to the energy per square meter that is absorbed per second. Human perception of light levels is not so straightforward. Human perception of light is complicated because our eyes are constantly adjusting, and other biological processes are affecting our perception. However, we can think of this perception from a simplified perspective by creating several ranges of interest with known upper and lower thresholds.

The following example data set represents rough thresholds for common lighting conditions, and the corresponding lighting step. Here, each lighting step represents a change in lighting environment.

Lighting condition	From (lux)	To (lux)	Mean value (lux)	Lighting step
Pitch Black	0	10	5	1
Very Dark	11	50	30	2
Dark Indoors	51	200	125	3
Dim Indoors	201	400	300	4
Normal Indoors	401	1000	700	5
Bright Indoors	1001	5000	3000	6
Dim Outdoors	5001	10,000	7500	7
Cloudy Outdoors	10,001	30,000	20,000	8
Direct Sunlight	30,001	100,000	65,000	9

Table 1: *Understanding and Interpreting Lux Values.* ***Source****: Windows Development Centre (2018).*

2.3 Obtrusive Effects of Outdoor Lighting Technical Parameters

AS 4282 provides for two different sets of light limiting values dependent on the levels of light already in the area. One, with higher values, is for application outside the curfew period set by local government and the other, with lower values, is for application during the curfew period. Curfew period should be considered as being between 11pm and 6am (unless dawn comes before) unless identified otherwise.

The less restrictive values are based on dark activity taking place whilst giving passive recipients of spill light relief from it being excessively obtrusive. Limiting values are established on the use of conventional lighting technology, but with good design and installation practice being employed through selection of appropriate lighting levels (wattage), luminaire types and aiming practices.

The lower limit for application during the curfew period need not apply where it can be demonstrated to the satisfaction of the authority (i.e. Local Government / Council) that there will be no adverse effects on residents, i.e. no nearby residential development, either existing or planned.

The calculation plane for determining assessment conformance and illuminance in a vertical plane *(Ev)* is generally at the building line of the potentially affected dwelling(s). Building line is that which contains windows to habitable rooms but does not include balconies and is either the face of an existing building or the setback required by the planning authority for the construction of a new dwelling. Where is there an existing building less than 10m from the relevant boundary, the calculation plane shall be at the face of the building, however where the building is greater than 10m from the relevant boundary, the calculation plane shall be 10m from all relevant boundaries.

2.4 Environmental Zones

Zones	Description	Examples
A0	Intrinsically Dark	Major optical observatories. No road lighting – unless specifically required by the road controlling authority
A1	Dark	Relatively uninhabited rural areas No road lighting – unless specifically required by the road controlling authority
A2	Low district brightness	Sparsely inhabited rural and semi-rural areas
A3	Medium district brightness	Suburban areas in towns and cities
A4	High district brightness	Town and city centre and other commercial areas Residential areas abutting commercial areas
TV	High district brightness	Vicinity of major sport stadium during TV broadcasts
V	Residences near traffic routes	Refer AS/NZS 1158.1.1
R1	Residences near local roads with significant setbacks	Refer AS/NZS 1158.3.1
R2	Residences near local roads	Refer AS/NZS 1158.3.1
R3	Residences near a roundabout or local area traffic management device	Refer AS/NZS 1158.3.1
RX	Residences near a pedestrian crossing	Refer AS/NZS 1158.4

Notes: *Recreational areas are not considered commercial.*
Source: *AS 4282:2019 – Table 3.1*

2.5 Maximum Values of Light Technical Parameters

Zones	Vertical illuminance levels (*Ev*) lx		Threshold increment (*TI*)		Sky glow
	Non-curfew	Curfew	%	Default adaption level (*Lad*)	Upward light ratio
A0	Note 1	0	N/A	N/A	0
A1	2	0.1	N/A	N/A	0
A2	5	1	20%	0.2	0.01
A3	10	2	20%	1	0.02
A4	25	5	20%	5	0.03
TV	See Table 3.4	N/A	20%	10	0.08
V	N/A	4	Note 2	Note 2	Note 2
R1	N/A	1	20%	0.1	Note 3
R2	N/A	2	20%	0.1	Note 3
R3	N/A	4	20%	0.1	Note 3
RX	N/A	4	20%	5	Note 4

Notes: 1. For A0, *Ev* shall be as close to zero as practicable without impacting safety considerations.
2. Refer to AS/NZS 1158.1.1
3. Refer to AS/NZS 1158.3.1
4. Refer to AS/NZS 1158.4
5. N/A means 'Not Applicable'
6. For an internally illuminated sign in an A2 zone, Lad equal to or less than 0.25 cd/m²

Source: *AS 4282:2019 – Table 3.2*

Based on Item 2.4 and 2.5 (tables 3.1 and 3.2 respectively), the Environmental Zone would be considered to be A3 to A4, as well as being R3 to RX given the traffic signals and pedestrian crossing at the corner of Park Street and Warlters Street, and as such the illuminance values for non-curfew and curfew hours are to be applied to contain and minimise any light spill from the proposed development.

2.6 Maximum Average Luminance of Surfaces (cd/m²)

Application Conditions	Environmental zones				
	A0	A1	A2	A3	A4
See Clause 3.3.5.4	0.1	0.1	150	250	350

Note: Clause 3.3.5.4 – *Signs, facades and artwork with dynamic content* refers to where the graphical content can change (i.e. digital signage), noting dwell time of the image shall be 10 seconds or more.

Source: *AS 4282:2019 – Table 3.5*

2.7 Existing nearby development considerations

The proposed development is situated across from residential properties on the southern side of Warlters Street, and adjacent to the Kmart Marina Shopping Complex (opened 23rd March 2017) which hosts a wide range of food and drink premises and retail tenancies.

A condition of the Kmart Marina Shopping Complex development to mitigate public nuisance of external signage and lighting included:

F7 (F196) Illumination of all illuminated signage which can be visible in any way from nearby residential properties is to be fitted with a timer switch to dim illumination by 50% for operating hours past 11pm. Illuminated signage shall be switched off when the retail tenancies are not in operation.

Figure 1: *Kmart Marina Shopping Centre Complex, Warlters Street.* ***Source****: Stowe Australia.*

At present, the Kmart Marina Shopping Complex external lighting is automated to turn on all external carpark lighting and signage at 5:00PM AEST (6:00PM AEDT) and off at 11:00PM via the Building Management System (BMS). Noting however that this does not include any security lighting, which given the necessity is on 24 hours 7 days a week.

3 Environment

3.1 Existing Conditions

The surrounding environment includes many different areas associated with human activity, such as commercial areas to the north-west (Settlement City Shopping Centre, Panthers, Baypark Plaza, McDonalds, Kmart Marina Shopping Centre, Sails Resort), the Marina and public boat ramp to the north, Westport Park and Westport Club to the east, and residential areas to the south.

Figure 2: *Overview of area and neighbouring commercial sites, proposed site outlined in red.* ***Source****: Six Maps.*

Figure 3: *Overview of area and neighbouring commercial sites, proposed site outlined in red.* ***Source****: Google Maps.*

3.2 Survey Results

On Monday 21st September 2020, existing night-time conditions were recorded by taking a lux reading at selected locations as shown on figure 2 below, and the general view of existing conditions at those locations recorded by photograph of impacts of existing lighting around the proposed development site.

To obtain accurate results, this required new moon conditions or moon phases and times when the moon had either already *set* or *not yet risen*. Results were recorded between 9:15PM and 10:45PM during *'night'* conditions. Conditions were heavily overcast at the time results were recorded, and the moon was not visible during the times of survey as was noted to set at 10:01PM.

Figure 4: *Moon Rise & Set for date of survey results (21 September 2020).* ***Source****: timeanddate.com*

Figure 5: *Location of lighting observation and measurement points (i.e. X1, etc.).* ***Source****: Google Earth.*

Table 3

Position	GPS co-ordinates	Ev (lx)	Comments
X1	-31.4299391, 152.8990327	0.3	Boundary of Kmart and Proposed Development. Kmart eastern carpark entry/exit to Warlters Street.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking west along Warlters Street.
			Night-time location photo. Looking west along Warlters Street. Photo shows trees along carpark containing some light spill from public roadway.

Table 4

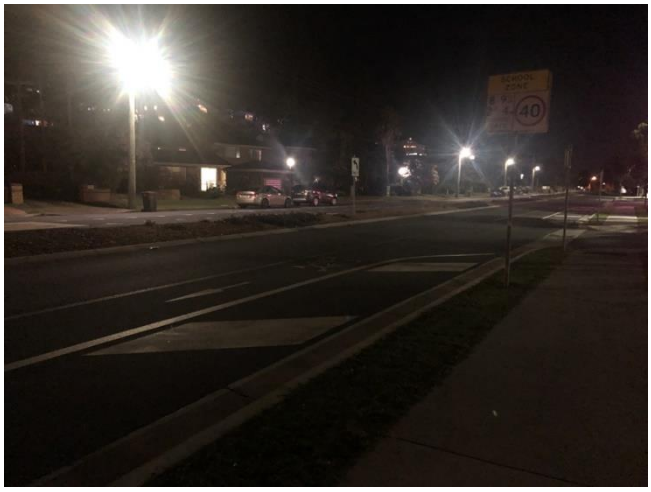
Position	GPS co-ordinates	Ev (lx)	Comments
X2	31.4298901, 152.8991446	0.2	Warlters Street, in vicinity of proposed Tenancy 15 Drive Thru Exit.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking west along Warlters Street.
			Night-time location photo. Looking west along Warlters Street. Photo showing light spill from existing roadway streetlights on southern side of road.

Table 5

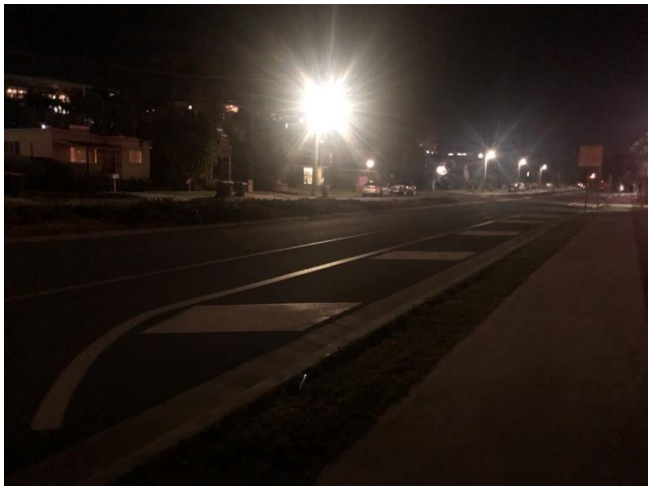
Position	GPS co-ordinates	Ev (lx)	Comments
X3	-31.4298901, 152.8991446	0.3	Warlters Street, in vicinity of proposed Basement Exit.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking west along Warlters Street.
			Night-time location photo. Looking west along Warlters Street.

Table 6

Position	GPS co-ordinates	Ev (lx)	Comments
X4	-31.4298901, 152.8991446	0.2	Warlters Street, in vicinity of proposed Tenancy 11.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking west along Warlters Street.
			Night-time location photo. Looking west along Warlters Street. Light spill from traffic signals (Red at time of photo).

Table 7

Position	GPS co-ordinates	Ev (lx)	Comments
X5	-31.4298901, 152.8991446	0.4	Warlters Street, in vicinity of proposed Tenancy 10 and stairway.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking west along Warlters Street.
			Night-time location photo. Looking west along Warlters Street. Light spill from traffic signals (Red at time of photo). Photo showing light spill from existing roadway streetlights at intersection of Park Street and Warlters Street (behind in photo).

Table 8

Position	GPS co-ordinates	Ev (lx)	Comments
X6	-31.4298901, 152.8991446	4.6	Warlters Street, traffic signals pedestrian cross.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south from intersection of Park Street and Warlters Street.
			Night-time location photo. Looking south from intersection of Park Street and Warlters Street. Photo showing light spill onto residential units from existing roadway streetlights at intersection of Park Street and Warlters Street (shadow of existing tree on proposed development site). With tree removed and proposed development, the new building may block some light spill from the northern streetlight and prevent some associated light spill onto existing residential units.

Table 9

Position	GPS co-ordinates	Ev (lx)	Comments
X7	-31.4298901, 152.8991446	17.4	Park Street, near traffic signals. Existing public roadway streetlight in vicinity.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south along Park Street (northbound lanes).
			Night-time location photo. Looking south along Park Street (northbound lanes).

Table 10

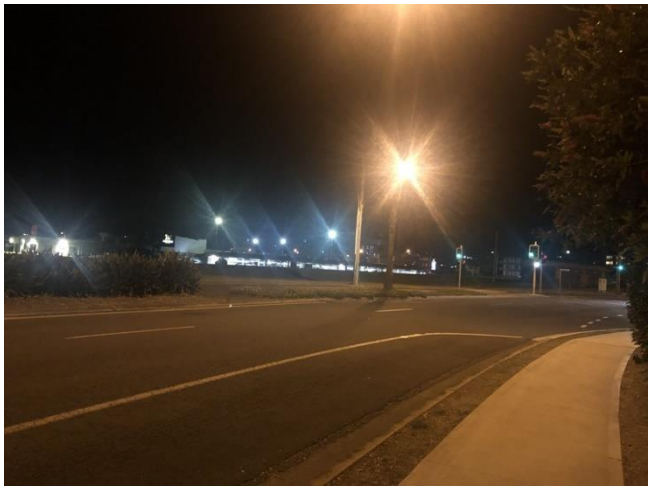
Position	GPS co-ordinates	Ev (lx)	Comments
X8	-31.4298901, 152.8991446	6.9	Park Street.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south along Park Street (northbound lanes).
			Night-time location photo. Looking south along Park Street (northbound lanes).

Table 11

Position	GPS co-ordinates	Ev (lx)	Comments
X9	-31.4298901, 152.8991446	27.0	Park Street, below public roadway streetlight.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south-east along Park Street (northbound lanes).
			Night-time location photo. Looking south-east along Park Street (northbound lanes).

Table 12

Position	GPS co-ordinates	Ev (lx)	Comments
X10	-31.4298901, 152.8991446	7.6	Park Street.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south-east along Park Street (northbound lanes).
			Night-time location photo. Looking south-east along Park Street (northbound lanes).

Table 13

Position	GPS co-ordinates	Ev (lx)	Comments
X11	-31.4298901, 152.8991446	6.2	Park Street.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south-east along Park Street (northbound lanes).
			Night-time location photo. Looking south-east along Park Street (northbound lanes).

Table 14

Position	GPS co-ordinates	Ev (lx)	Comments
X12	-31.4298901, 152.8991446	17.6	Park Street, opposite boat ramp area and carpark entry/exit. Existing roadway streetlight in the vicinity.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south-east along Park Street (northbound lanes).
			Night-time location photo. Looking south-east along Park Street (northbound lanes).

Table 15

Position	GPS co-ordinates	Ev (lx)	Comments
X13	-31.4298901, 152.8991446	17.6	Boundary of Kmart and Proposed Development. Park Street. Existing roadway streetlight in the vicinity.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south-east along Park Street (northbound lanes).
			Night-time location photo. Looking south-east along Park Street (northbound lanes).

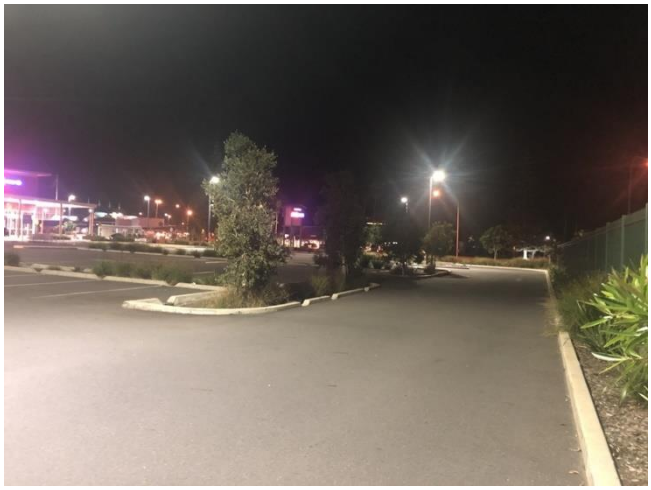
Table 16

Position	GPS co-ordinates	Ev (lx)	Comments
X14	-31.4298901, 152.8991446	36.0	Boundary of Kmart and Proposed Development. Kmart carpark, near existing carpark streetlight.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking north in Kmart Shopping Centre eastern carpark.
			Night-time location photo. Looking north in Kmart Shopping Centre eastern carpark.

Table 17

Position	GPS co-ordinates	Ev (lx)	Comments
X15	-31.4298901, 152.8991446	2.2	Boundary of Kmart and Proposed Development. Kmart carpark.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking north in Kmart Shopping Centre eastern carpark.
			Night-time location photo. Looking north in Kmart Shopping Centre eastern carpark.

Table 18

Position	GPS co-ordinates	Ev (lx)	Comments
X16	-31.4298901, 152.8991446	61.2	Boundary of Kmart and Proposed Development. Kmart carpark, near existing carpark streetlight.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking north in Kmart Shopping Centre eastern carpark.
			Night-time location photo. Looking north in Kmart Shopping Centre eastern carpark.

3.3 Existing lighting from adjacent areas

The surrounding area at present currently has a high volume of public roadway streetlighting. These streetlights along these roads are Essential Energy assets and are made up of a variety of high-pressure sodium, fluorescent and LED light in road lighting luminaries.

Lighting from the Kmart Marina Shopping Centre complex has been mostly contained within the complex's boundary, utilising a combination of LED pole lights and downward wall lights mostly to illuminate public areas to comply with safety and security requirements associated with these public spaces. Downward lighting focuses on the area requiring to be illuminated and minimises nuisance associated with glare.

Figure 6: *Day - Kmart Marina Shopping Centre Complex, Warlters Street.* ***Source****: Stowe Australia.*

Figure 7: *Night - Kmart Marina Shopping Centre Complex, Warlters Street.* ***Source****: Stowe Australia.*

Table 19

Position	GPS co-ordinates	Ev (lx)	Comments
E1	-31.4297133, 152.8972297	9.1	Outside 30 Warlters Street. Opposite Kmart boundary with St Joseph's Primary School.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking west along Warlters Street.
			Night-time location photo. Looking west along Warlters Street. No external lighting on Kmart building opposite this location.

Table 20

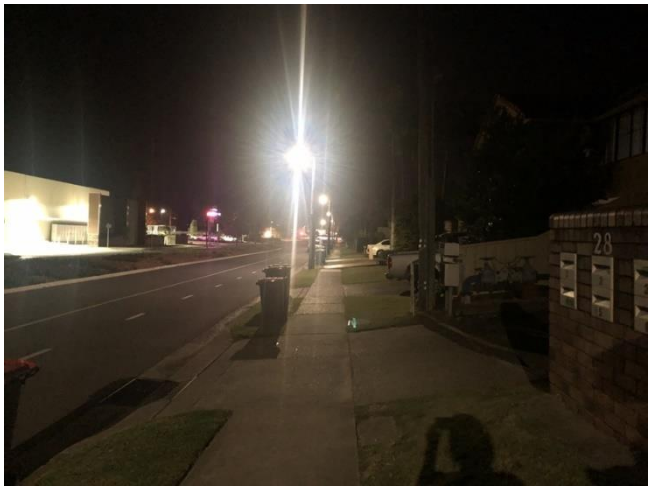
Position	GPS co-ordinates	Ev (lx)	Comments
E2	-31.4297133, 152.8972297	1.6	Outside 28 Warlters Street.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street.

Table 21

Position	GPS co-ordinates	Ev (lx)	Comments
E3	-31.4298139, 152.8975036	2.9	Outside 26 Warlters Street.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street.

Table 22

Position	GPS co-ordinates	Ev (lx)	Comments
E4	-31.4298139, 152.8975036	2.2	Outside 24 Warlters Street. Opposite Kmart Loading Dock.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street. Whilst loading dock has some downward facing wall lights, this appears not to contribute to light spill on southern side of Warlters Street.

Table 23

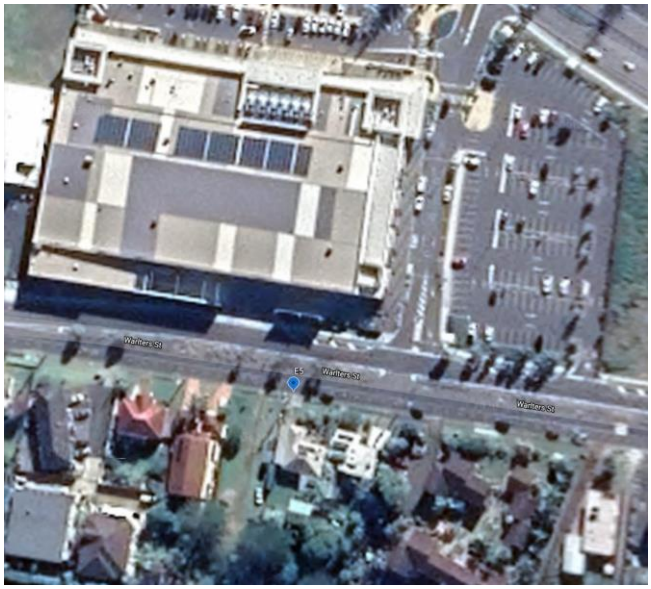
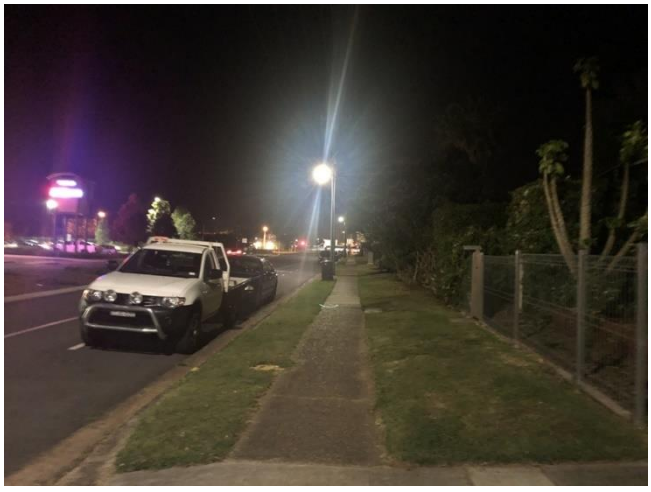
Position	GPS co-ordinates	Ev (lx)	Comments
E5	-31.4298278, 152.8977939	11.4	Outside 20 Warlters Street. Existing public roadway streetlight in vicinity.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street.

Table 24

Position	GPS co-ordinates	Ev (lx)	Comments
E6	-31.4298278, 152.8977939	3.4	Outside 18 Warlters Street.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street. In proximity to existing roadway streetlight. Whilst loading dock on opposite side of road has some downward facing wall lights, this appears not to contribute to light spill on southern side of Warlters Street.

Table 25

Position	GPS co-ordinates	Ev (lx)	Comments
E7	-31.4299191, 152.8982536	3.4	Outside 14-16 Warlters Street. Opposite Entry/Exit to Shopping Centre carpark.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street. Building signage and carpark lighting on opposite side of road, appears not to contribute to light spill on southern side of Warlters Street and is consistent with existing roadway streetlighting measurements.

Table 26

Position	GPS co-ordinates	Ev (lx)	Comments
E8	-31.429976, 152.8986312	1.1	Outside 14-16 Warlters Street. Opposite Shopping Centre carpark.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street. Carpark lighting on opposite side of road, appears not to contribute to light spill on southern side of Warlters Street and is consistent with existing roadway streetlighting measurements.

Table 27

Position	GPS co-ordinates	Ev (lx)	Comments
E9	-31.4300253, 152.8989614	5.2	Outside 8 Warlters Street. Opposite Entry/Exit to Shopping Centre carpark.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street. Glare from existing roadway streetlighting behind in photo appears to have contributed to a slightly higher measurement due to glare from School Zone signage.

Table 28

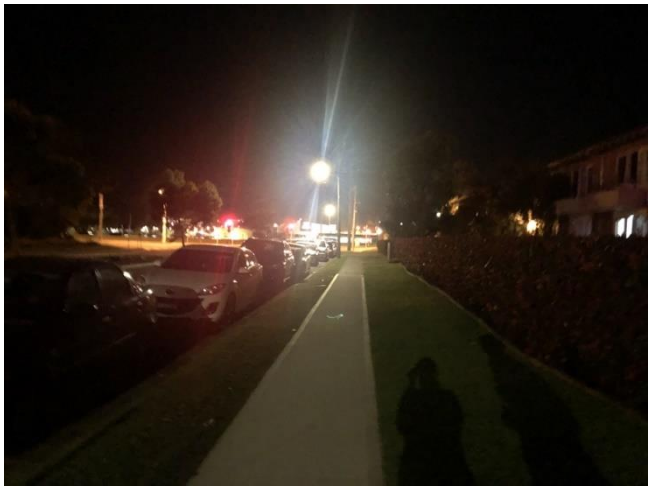
Position	GPS co-ordinates	Ev (lx)	Comments
E10	-31.4300784, 152.8991982	0.4	Warlters Street. Outside 21-29 Park Street units. Opposite proposed Tenancy 15 Drive Thru Exit.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street. No street lighting in vicinity of measurement location.

Table 29

Position	GPS co-ordinates	Ev (lx)	Comments
E11	-31.4300784, 152.8991982	0.2	Warlters Street. Outside 21-29 Park Street units. Opposite proposed Loading Dock Exit.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street.

Table 30

Position	GPS co-ordinates	Ev (lx)	Comments
E12	-31.4300784, 152.8991982	0.4	Warlters Street. Outside 21-29 Park Street units. Opposite proposed Loading Dock Exit.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street.

Table 31

Position	GPS co-ordinates	Ev (lx)	Comments
E13	-31.4301286, 152.899484	4.8	Warlters Street. Outside 21-29 Park Street units. Opposite proposed Tenancy 11.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street. Existing roadway streetlight in vicinity of measurement.

Table 32

Position	GPS co-ordinates	Ev (lx)	Comments
E14	-31.4301396, 152.8996146	1.0	Warlters Street. Outside 21-29 Park Street units. Opposite proposed Tenancy 10.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking east along Warlters Street.
			Night-time location photo. Looking east along Warlters Street.

Table 33

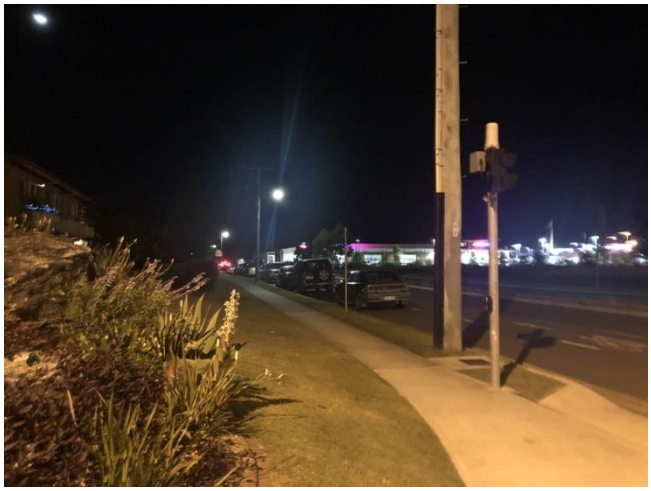
Position	GPS co-ordinates	Ev (lx)	Comments
E15	-31.4301396, 152.8996146	26.8	Corner of Park Street and Warlters Street. At traffic signals and pedestrian crossing.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking west along Warlters Street.
			Night-time location photo. Looking west along Warlters Street. Photo showing light spill onto residential units from existing roadway streetlights at intersection of Park Street and Warlters Street.

Table 34

Position	GPS co-ordinates	Ev (lx)	Comments
E16	-31.4304118, 152.899776	26.7	Corner of Park Street and Warlters Street. At traffic signals and pedestrian crossing.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south along Park Street.
			Night-time location photo. Looking south along Park Street. Photo showing light spill onto residential units from existing roadway streetlights at intersection of Park Street and Warlters Street. Carnival at Westport Park (December/January) would also contribute light spill from associated flood and spotlights of amusements.

Table 35

Position	GPS co-ordinates	Ev (lx)	Comments
E17	-31.4304118, 152.899776	21.6	Park Street, opposite Westport Park. Outside 21-29 Park Street units.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south along Park Street.
			Night-time location photo. Looking south along Park Street. Photo showing light spill onto residential units from existing roadway streetlights at intersection of Park Street and Warlters Street. Carnival at Westport Park (December/January) would also contribute light spill from associated flood and spotlights of amusements.

Table 36

Position	GPS co-ordinates	Ev (lx)	Comments
E18	-31.4304118, 152.899776	9.0	Park Street, opposite Westport Park. Outside 21-29 Park Street units.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south along Park Street.
			Night-time location photo. Looking south along Park Street. Photo showing light spill onto residential units from existing roadway streetlights at intersection of Park Street and Warlters Street. Carnival at Westport Park (December/January) would also contribute light spill from associated flood and spotlights of amusements.

Table 37

Position	GPS co-ordinates	Ev (lx)	Comments
E19	-31.4285354, 152.8980816	40.2	Park Street, opposite Marina Complex. Existing roadway streetlight in vicinity.
			Map location (symbol denotes location of results)
			Daytime location photo. Looking south-east along Park Street.
			Night-time location photo. Looking south-east along Park Street. Photo and measurement taken at location of existing roadway street lighting. Some light spill evident from tenancy lighting placement.

3.4 Other sources of light

Vehicles

The surrounding environment includes many different areas associated with human activity, vehicles such as cars and small commercial trucks arriving and departing will use headlights at night, however assumed that these are most likely to be on low-beam, and vehicular movements higher throughout the day, and minimal of a night.

Deliveries and associated contractor vehicle movements are assumed to also be mostly during the day during tenancy operating hours, with minimal impact of a night, evening, and early morning.

Road Lighting

Light spill from road lighting may generally be exempt from consideration under AS 4282 (road and public lighting falls under AS/NZS 1158 series) however notwithstanding that exemption, additional calculations in the vertical plane at sample sections along Park Street and Warlters Street indicate maximum values ranging from 1.6 to 27.0 lux, with an outlier of 40.2 at the tenancy on Park Street.

Figure 8: *Night – Example of Street Light Spill onto building (Buller Street).* ***Source****: Stowe Australia.*

Moonlight

The vertical illuminance from a full moon is likely to be in the range 0.25 to 0.35 lux depending on time of the year and position of the moon relative to Earth and the Sun.

4 Proposed lighting arrangement

4.1 Potential effects of outdoor lighting

In the design and installation of an outdoor lighting system, consideration has been given to the potential effects of the lighting on occupants of surrounding properties and on transport users in the vicinity of the installation. These effects include the following:

i. Changes to the amenity of an area due to the intrusion of spill light into otherwise dark areas, both outdoors and indoors, and to the direct view of bright luminaires.

ii. A reduction in the ability of transport system users to see essential details of the route ahead, including signalling systems, due to glare from bright luminaires.

iii. Changes to night sky viewing conditions due to a general luminous glow, i.e. skyglow, caused by the scattering of light in the atmosphere.

People will have a range of reactions to the installation of outdoor lighting; responses may vary from positive acceptance to outright rejection. The degree of response will depend, in part, on the nature of surrounding developments, past experiences, novelty of the installation, and frequency and times of operation.

4.2 Building and tenancy internal lighting

Internal lighting is subject to architectural arrangements and furniture layouts of the relevant tenancies. Downlights with the appropriate beam angle are suggested to be utilised within the tenancies with consideration to ensure that light spill out of the external windows and doorways are minimised.

Figure 9 and 10: *Example of current lighting arrangements on Horton Street, showing spill lighting onto pathway at night from internal tenancy lighting.* ***Source****: Stowe Australia.*

A mixture of LED lights including downlights and flat panels are suggested for incorporation to the design, consistent with a majority of new service commercial centres, to enhance the visibility of products inside and to meet the requirements associated with pedestrian and public lighting.

LED Light fittings are generally readily accessible and are low energy consuming, which in turn assist with reducing power consumption and energy costs for the centre.

4.3 Awning and public lighting

Wall lights that direct lighting downwards is suggested to be utilised on external walls of the building, as light fittings cannot be fixed to the underside of awnings due to their proposed construction type.

Figure 11: *Extract from Architectural Photomontage of tenancies along Warlters Street, demonstrating proposed awning type.* ***Source****: MM Atelier Architects.*

Appropriately selected downward wall lights will aid in avoiding nuisance glare to neighbouring residence and traffic, as well as maintaining appropriate lighting for public safety, and security of the building and neighbourhood.

Figure 12 and 13: *Example of downward wall lights appropriately selected to minimise light spill at newly constructed Sovereign Place Shopping Centre, noting footpath light spill evident from existing roadway street lighting.* ***Source****: Stowe Australia.*

Subject to final lighting and architectural designs, several downward facing LED light fitting types can be utilised with different beam and angle options, to ensure they appear aesthetically pleasing and provide optimal illumination and uniformity for outdoor designs, with consideration to light spill.

*(**Right:** example downward wall light fittings used in Figure 12 and 13)*

4.4 Signage and display lighting

Illuminated signage is one of the most popular advertising solutions, working day and night to draw attention and deliver maximum impact. LED technology has advanced the ways in which signs can be illuminated, generally ranging from lightboxes, 3D fabricated letters and most recently LED message boards.

It is expected that tenancies will have signage above their respective tenancies (as indicated on preliminary architectural drawings), in way of a lightbox. These are most common and are already utilised in tenancies across the area.

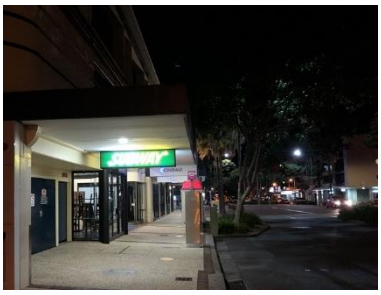


Figure 14, 15, 16: *Example Light Boxes utilised outside tenancies for advertisement.* ***Source****: Stowe Australia.*

Figure 17: *Extract from Architectural Photomontage of tenancies along Warlters Street, demonstrating proposed signage.*
Source*: MM Atelier Architects.*

Figure 18: *Extract from Architectural Photomontage – North-East Elevation, Park Street.* ***Source****: MM Atelier Architects.*

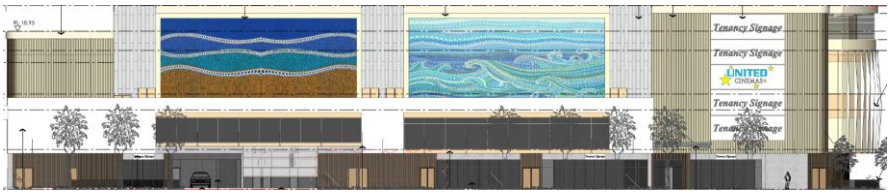


Figure 19: *Extract from Architectural Photomontage – Southern Elevation, Warlters Street.* ***Source****: MM Atelier Architects.*

Figure 20: *Extract from Architectural Photomontage – Western Elevation, Kmart Carpark.* ***Source****: MM Atelier Architects.*

The 'United Cinemas' proposed signage, 'Tenancy Signage' and Artwork on all elevations is expected to be illuminated, either by way of upward or downward lighting or lightboxes. The illumination of such advertisement signage must not cause light spillage into nearby residential properties. Consideration of advertising signage should also be given for safety in design, and access to signage in the event such advertisements are to be repaired or replaced.

The following criteria apply to *non-digital illuminated signs* whether internally illuminated or lit from the exterior:

a) Advertisements must comply with the luminance requirements in **Table 38**.

b) For night-time use, the sign (whether internally illuminated or lit from its exterior) must not cast a shadow on areas that were previously lit and that have a special lighting requirement, e.g. pedestrian crossings.

c) The light sources for illuminated signs must focus solely on the sign and:

   i. be shielded so that glare does not extend beyond the sign

   ii. except for back lit neon signs, have no light source visible to passing motorists with a light output greater than that of a 15W fluorescent/LED bulb.

d) The level of reflectance of an advertisement, and its content, is not to exceed the 'Minimum coefficients of Luminous intensity per unit area for Class 2A Material', as set out in Australian Standard AS/NZS 1906.1:2007. Flashing illuminated advertisements will not be approved

Requirements for *digital signs* differ between areas and agencies, however Table 39 below references the luminance levels permissible for digital advertisements.

Figure 21: *Example digital advertisements sign (Buller Street) with nearby residential properties.*

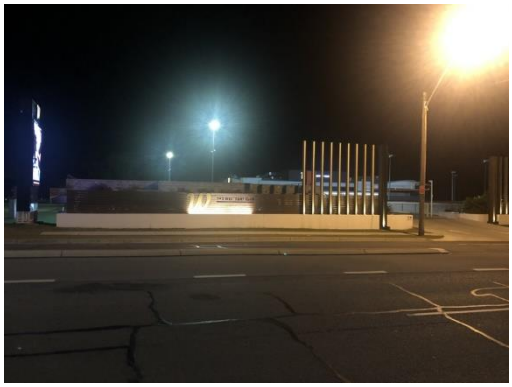


Figure 22: *Example up lighting of signage (Buller Street) with nearby residential properties. Utilising LED strip lighting.*

Figure 23: *Example up lighting of building signage and facade (Park Street). Utilising LED flood lights.*

Figure 24: *Example up lighting of building signage and facade (Sovereign Hills). Using LED Asymmetric ground up lighting.*

4.5 Table 38 – Maximum allowance daytime luminance of illuminated advertisements (not digital signs)

Illuminated Area (sqm)	Zone 1 (cd/sqm)	Zone 2 (cd/sqm)	Zone 3 (cd/sqm)	Zone 4 (cd/sqm)	Zone 5 (cd/sqm)
up to 0.5	No Limit	2900	2000	1000	No Limit
0.5 to 2.0	No Limit	2300	1600	800	No Limit
2.0 to 5.0	No Limit	2000	1200	600	No Limit
5.0 to 10.0	No Limit	1500	1000	600	No Limit
Over 10.0	No Limit	1200	800	400	No Limit

- ***Luminance*** *means the objective brightness of a surface as measured by a photometer, expressed in candelas per square meter.*
- ***Zone 1*** *covers areas with generally very high of-street ambient lighting, e.g. display centres like Kings Cross in Sydney, and Central Business District locations. This would normally be expected to include land zoned B8 Metropolitan Centre and may include land zoned B3 Commercial Core or B4 Mixed Use but does not exclude other land use zones.*
- ***Zone 2*** *covers areas with generally high of-street ambient lighting e.g. some major shopping/commercial centres with a significant number of off-street illuminated advertising devices and lights. This could be expected to include land zoned B3 Commercial Core or B4 Mixed Use but does not exclude other land use zones.*
- ***Zone 3*** *covers areas with generally medium of-street ambient lighting e.g. small to medium shopping/commercial centres. This would normally be expected to include land zoned B1 Neighbourhood Centre and B2 Local Centre but does not exclude other land use zones.*
- ***Zone 4*** *covers areas with generally low levels of off-street ambient lighting e.g. most rural areas, or areas that have residential properties nearby. This would normally be expected to include most RU Rural land use zones apart from the RU5 Village zone but does not exclude other land use zones.*

Source: *NSW Government. (2017). Transport Corridor Outdoor Advertising and Signage Guidelines. Table 5.*

Note: Lit surfaces of externally illuminated signs, building facades and artworks shall be no greater than the limits in Tables 3.2 and 3.5 of AS 4282 *(statement from Clause 3.3.5.1 – Signs, facades, and artworks)*

4.6 Table 39 – Luminance levels for digital advertisements

Lighting Condition	Zone 1 (cd/sqm)	Zone 2 and 3 (cd/sqm)	Zone 4 (cd/sqm)
Full sun on face of signage	No Limit	No Limit	No Limit
Daytime luminance	No Limit	6000	6000
Morning and evening, twilight, and inclement weather	700	700	500
Night-time	350	350	200

Note: *Levels differ as digital signs will appear brighter when light levels in the area are low. Unless provided above, luminance levels should otherwise comply with the recommended values of AS4282 Control of the Obtrusive Effects of Outdoor Lighting.*

Source: *NSW Government. (2017). Transport Corridor Outdoor Advertising and Signage Guidelines. Table 6.*

5 Mitigation and Discussion

5.1 Light spill calculated values

To place this in perspective by using a natural benchmark, that is moonlight, the calculated values for light spill from the proposed development site design, to residential buildings along the southern side of Warlters Street, taking into consideration implementation of mitigating barriers such as fixed items (fencing, plants and trees) and direction of light fitting and their illuminance, are proposed an order of magnitude below that expected from a full moon, that is less than 0.1 lux (lx) or equivalent to the light from the moon only days after or before new moon. Noting that existing roadway street lighting is higher than these aforementioned measurements in some instances.

5.2 Individual Luminaires

Where there arises an issue with the 'brightness' of a specific luminaire directly towards a particular observer location and the luminaire is already of the appropriate asymmetric distribution, the only other option is to fit a bespoke shield to that luminaire, to stop light spilling backwards towards residential properties. Additional proposed recommendation that suitable vegetation at an appropriate height be installed between the footpath and roadway, as well as within the median strip along Warlters Street, which would eliminate some of the spill shown on the light design. At the time of recording measurements and photos, it is evident that vegetation has been planted along the front boundary of neighbouring residential properties along Warlters Street, assuming to mitigate light spill from existing features of the area including street and vehicle lighting.

5.3 Avoiding over design

The potential sensitivity of the general environment would commend that the lighting design meet required Standards and safe work practice without excessively exceeding the minimum requirements of that criteria. We consider the current lighting design parameters around the building and footpath areas would need to meet classification P7 *for areas primarily for pedestrian use (e.g. city, own, suburban centres, malls, open arcades, town centres, civic centres* (medium night time vehicle movements, medium risk of crime, and medium need to enhance prestige) in accordance with Australian Standard AS/NZS 1158.

5.4 Reduction in Lighting after hours

The intent would be to limit the number of lights required to be illuminated after hours, and limit to security lighting only via use of time clocks after operating hours have ceased, with the exception of carpark and footpath areas requiring to be illuminated. Limiting lights would minimise the light spill and assist achieving the required values during curfew times per AS 4282.

Suggestion to adopt the condition imposed to the Kmart Marina Shopping Complex development to mitigate public nuisance of external signage and lighting:
F7 (F196) Illumination of all illuminated signage which can be visible in any way from nearby residential properties is to be fitted with a timer switch to dim illumination by 50% for operating hours past 11pm. Illuminated signage shall be switched off when the retail tenancies are not in operation.

5.5 Vehicle headlights

Vehicles accessing and leaving the entertainment precinct (including loading dock and drive thru roads) directly face the southern boundary residential properties, with the misuse of high beam headlights of issue also. Whilst no such barrier currently exists for the existing Kmart complex carpark entry and exits, if required suitable vegetation at an appropriate height is suggested within the median strip along Warlters Street opposite these exits to limit headlights and inadvertent light entering the neighbouring residential properties.

6 Conclusion

The intent of this report provides a benchmark of current lighting conditions around the proposed development site, and offers additional information to assist in analysing the effects lighting may have with the proximity to existing residential areas around the proposed development and how these effects can be mitigated.

The intended lighting associated with the proposed development is expected to generally comply or exceed compliance with the relevant objectives and requirements as outlined within this report. The type of lighting proposed and most commonly used now and into the future (LED Lighting) is the most energy efficient for the application and with effective controls can be selected to suit any requirements.

The information tabled in the report also references similar developments with neighbouring residential areas, with similar or greater lighting outputs than that anticipated of this development. A preliminary concept lighting design which would be part of the electrical consultation during the construction process of the development would contain any direct light spill effectively and accurately, taking into consideration the neighbour residential areas as noted in this report. Additional mitigation measures if applicable could easily be implemented to shield any specific luminaire should an issue arise.

For some residential locations within proximity to the proposed development site, there will be noticeable change in regards to additional lighting that is currently not present on the vacant site, however is expected to not see any additional lighting spill into neighbouring residential properties, as this would be mitigated in a number of ways (effective lighting and architectural design, limiting over design, landscaping, shielding, limiting illumination during non-business hours, etc) as has been implemented and accepted on neighbouring developments and similar developments within the Port Macquarie-Hastings area.

With consideration that the measurements taken opposite the vacant proposed development lot were at the property boundary and not the 10m setback or face of building as defined in AS 4282, generally the measurements obtained at these points were less than the allowable permitted curfew illuminance levels defined in table 3.2, with the exception of those areas influenced by the roadway streetlighting which is permissible under AS 1158. It is then assumed that if calculations were taken at the 10m setback or face of building these values would be even lower and still within the permitted curfew values.

It should also be noted that some controls to neighbouring residential properties already exist in the way of vegetation barriers due to their proximity to high traffic areas and accompanying roads, in particular Park Street, to mitigate inadvertent light associated with vehicle movements, existing street lighting and events held at the nearby park generally throughout the year.

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