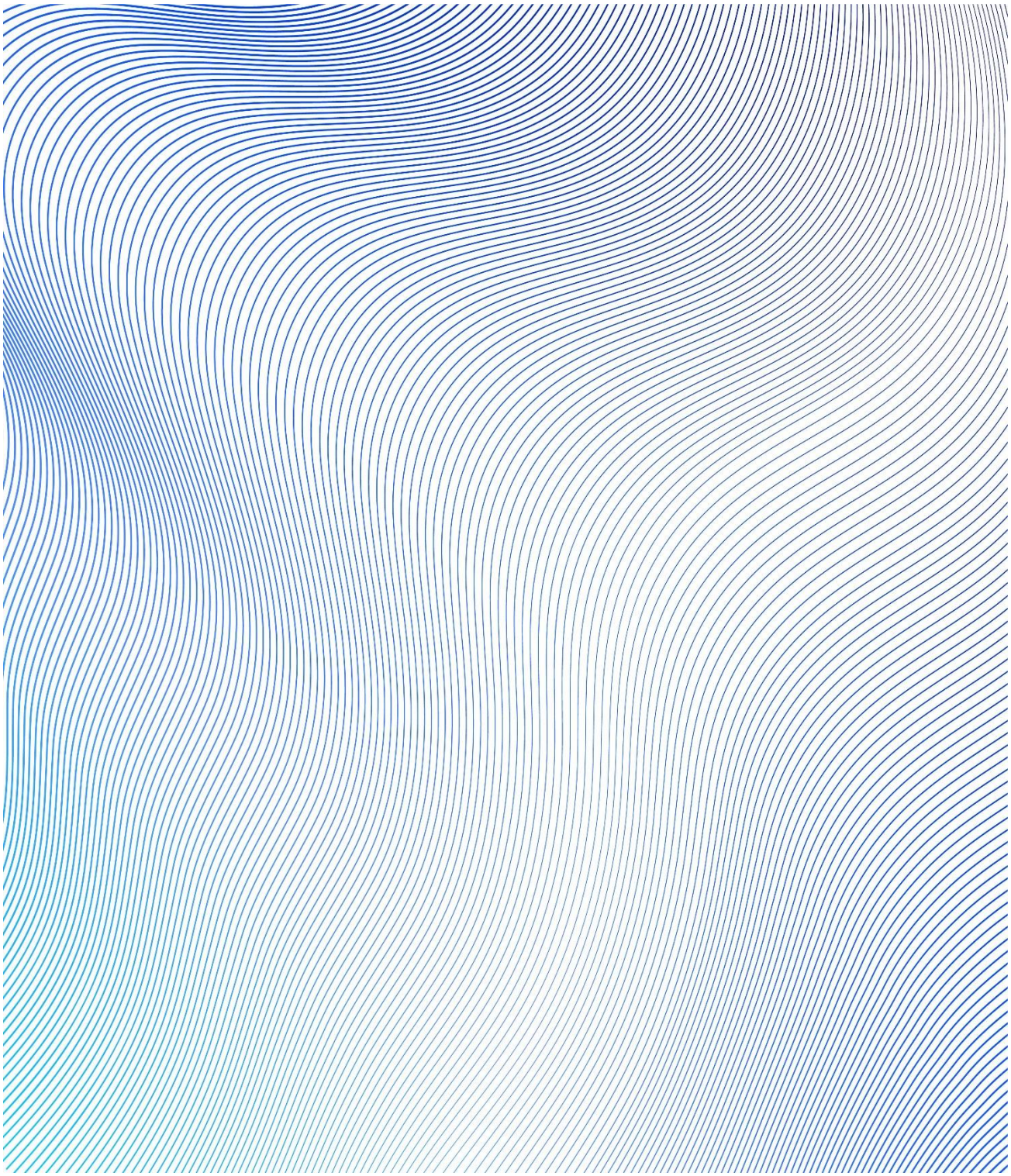
610101 – Botany Aquatic Centre

External Lighting Strategy Report

February 2024



Introba

610101.001 – External Lighting Strategy Report

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A	Preliminary	23/06/2023	AR	RH
B	For Submission	17/07/2023	AR	RH
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Executive Summary

This report addresses the key external lighting design considerations and parameters associated with the Botany Aquatic Centre at Botany.

This report supports the Development Application for the redevelopment of the Botany Aquatic Centre at Myrtle Street & Jasmine Street, Botany NSW 2019. The Botany Aquatic Centre includes an indoor / outdoor swimming pool facility, gymnastic facility, amenities, community space and with existing picnic area and carpark area.

Bayside Council is the proponent for the Development Application.

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1. Introduction

1.1 General

This Design Report, prepared by Introba supports Development Applications for the development of the Botany Aquatic Centre at Myrtle Street & Jasmine Street, Botany NSW 2019. The Botany Aquatic Centre is a new indoor / outdoor swimming pool facility, gymnastic facility, amenities, community space and with existing picnic area and carpark area. Bayside Council is the proponent for the DA.

The purpose of this report is to capture Introba's procedural-based assessment of a suitable external lighting strategy for the Botany Aquatic Centre development (Main building & surrounds, pool area, new grandstand, car parking, pedestrian and vehicular traffic areas complaint with relevant Australian Standards, National Construction Code and applicable guidelines.

A summary of scope, design criteria, design options considered (where applicable) is provided in our assessment along with recommendations on key design strategies or options to be adopted during design development.

1.2 Site Description

The subject site is located on the corner of Myrtle Street and Jasmine Street, Botany as highlighted in Figure 1. The site has been inspected and the existing external lighting has been assessed as at the end of its service life and not suitable for re-use in the proposed development.

The site has a primary frontage to Myrtle Street to the south and is bounded by Big picture Australia Pty Ltd to the north, Booralee park to the west, and railway line to the east.

The surrounding context of the site is predominately low and medium density residential, with a smaller business premises, shop-top housing located immediately to the south of the site across Myrtle Street, with Botany Public School located 1000m to the south-west.

Figure 1 Aerial View of the site

1.3 Overview Of Proposed Development

The Botany Aquatic Centre Development Application which seeks consent for the construction and use of the Botany Aquatic Centre, including:

- Demolition of existing buildings and structures within the site.
- Site preparation works, including termination or relocation of site services and infrastructure, tree removal and the erection of site protection fencing.
- Construction of the new Botany Aquatic Centre, including:
- An outdoor 50M competition pool.
- An indoor learn to swim pool.
- An indoor 25M lap pool.
- Adventure slides/major water play/splash pad.
- A new building including entrance, amenities, change rooms and kiosk.
- A new Grandstand.
- A local indoor health and fitness gym space.
- A multifunction room and program room.
- Car parking, including a combination of staff and visitor spaces, accessed via Jasmine Street and Lord Street.
- Public domain works within the site, including new landscaping and tree planting.

Full details of the proposed development are included in the Architectural Drawings prepared by Co-op Studio which accompany the Development Application.

2. Design Criteria

New external lighting will be provided around the main aquatic centre building, car parking, pedestrian and vehicular circulation areas of the facility to provide a safe and welcoming environment for users of the facility and the general public, with consideration given to:

- Safe movement of pedestrians, cyclists, and vehicles,
- Integration with the architectural design intent and to compliment the overall aesthetics of the building and surrounds,
- Minimisation of obtrusive light spill and glare to surrounding properties and the public domain,
- Minimise the impact of external lighting on wildlife,
- Security lighting,
- Application of the Crime Prevention through Environmental Design (CPTED) principles.

2.1 Standards and Guidelines

External lighting will be designed according to the following standards and guidelines:

Standards	
AS/NZS 1158.3.1:2020	Lighting for Roads and Public Spaces – Part 3.1: Pedestrian Area (Category P) Lighting – Performance and Design Requirements
AS/NZS 2560.1:2002	Lighting for Outdoor Sports
AS/NZS 2560.2.5:2007	Lighting for swimming pools and immediate surroundings
AS/NZS 4282:2019	Control of the Obtrusive Effects of Outdoor Lighting
NCC 2022	National Construction Code of Australia 2022
CIVIL AVIATION SAFETY REGULATIONS 1998	Aerodromes Part 139 – Manual of Standards 2019

3. Control of Obtrusive Effects of Outdoor Lighting

3.1 Environmental zone

While the site is located in the Sydney Metropolitan Area, to assist in achieving the design aesthetic and for the purposes of light spill management, the site has been assigned the following environmental zone (AS/NZS 4282 Table 3.1):

Zone	Description	Examples
A3	Medium District Brightness	Suburban Areas in Towns and Cities

The following maximum values of light technical parameters are applicable (AS/NZS4282 Table 3.2):

Zone	Vertical Illuminance levels (E_v) lx		Threshold Increment (*TI*)		Sky Glow
	Non-curfew	Curfew	%	Default Adoption Level (L_{ad})	Upward Light Ratio
A3	10	2	20%	1	0.02

The following maximum luminous intensities per luminaire are applicable (AS/NZS 4282 Table 3.3):

Zone	Luminous Intensity (*I*), cd		
	Non-curfew L1	Non-curfew L2	Curfew
A3	12500	25000	2500

3.2 Potential obtrusive effects

With regards to obtrusive lighting, the following aspects have been identified for consideration during design development: -

3.2.1 Adjacent Properties

Residential properties are located on the southern side of the Myrtle Street, opposite the proposed development. The light spill impact from the facility entrance and car park area is anticipated to be negligible and will be assessed at the property boundary in accordance with AS/NZS-4282 requirements. The approximate distance to the properties on the southern side of the aquatic centre is 50 metres.

3.2.2 Effects on Transport System Users

The design intent is to minimise the impact of the light spill on traffic travelling south bound along Myrtle Street and northwest bound along Lord Street. This shall be achieved by selection of appropriate light distribution optics and positioning of poles in such a manner to mitigate potential light spill onto adjacent traffic and road users.

3.2.3 Effects on Wildlife

The design intention is to minimise the effect of external lighting on the wildlife by considering and implementing below: -

- Minimise the intensity of lighting to the minimum required to comply with standards as far as practical.
- Minimise the intensity of lighting by switching to a reduced lighting design category when the facility is unoccupied or in use by maintenance staff only.
- Minimise the duration of light by turning off site lighting when not required for access or security purposes.

3.2.4 Effects on Astronomical Observations

The design intention is to minimise the impact of the light spill on observatory facilities.

Nearby observatories were identified from the Astronomical Society of Australia list of designated observatories (review 6/9/2019).

- Macquarie University – 30km
- Sydney Observatory – 14km
- Green Point Observatory – 22km
- Penrith Observatory – 55km

As the site is distant from above mentioned sites and the environmental category A3 for upward light ratio is minimal (0.02), it is not anticipated the development will have an impact on the observatories.

3.2.5 Effects on Runway

The design intention is to minimise the impact of the light spill on the nearby airport runways.

This shall be achieved by selection of appropriate light distribution optics and positioning of poles in such a manner to mitigate potential light spill onto the runway. The site is located in Zone-C of the 07-25 runway, the selection of light fitting should be limited to 150cd at 3 degrees above horizontal to restrict the light spill.

3.2.6 Obtrusive Lighting Prevention

As part of the detailed design process prior to construction of the development, a detailed study to demonstrate compliance with AS 4282 shall be undertaken. This shall take into account specific locations and specifications of all external lighting (including decorative building lighting) and the positioning of adjacent residences, roadways, and businesses. In order to control the obtrusive light spill from the development and the potential affects on sensitive viewers, the following measures shall be considered:

- Highly controlled optics to illuminate specific areas in place of wide angle ‘flood’ type luminaires that incorporate little control of the light distribution.
- Position luminaires away from boundaries or behind physical obstructions which will assist in controlling the spread of light.
- Provide backlight shields and glare reduction hoods as a last resort where other methods are not effective or applicable.

4. External Lighting Assesment

4.1 Area of Work Category

The proposed development has been assessed as comprising the area / activity types described within the below standards;

- AS/NZS 1158.3.1:2020
  - Table 2.2 – pedestrian / cycle activity
  - Table 2.5 – outdoor car parks
- AS/NZS 2560.1:2002
  - Outdoor sport general Principles
- AS/NZS 2560.2.5:2007
  - Table 1 – Swimming Pools

Please refer to Appendix A, which provides a summary of categories and subcategories for roads and public space type areas, and outdoor swimming pool with the applicable areas for the development highlighted.

Please refer to Appendix B for a plan view of the site, indicating the extents of the various lighting subcategories identified within this assessment.

4.2 Sub-Category Selection

The level of activity and fear of crime is considered in the sub-category selection to determine an applicable lighting subcategory, which determines the light technical parameters for the area.

4.2.1 Pedestrian/Cyclist Pathway and Outdoor carpark

Level of activity has been assessed as high in the sub-category selection.

For Fear of Crime, the selection criteria is considered medium level for the lighting subcategory determination.

Table 2.2 and 2.5 subcategory definitions as per AS/NZS 1158.3.1 is provided below.

TABLE 2.2

LIGHTING SUBCATEGORIES FOR PEDESTRIAN AND CYCLIST PATHS

1	2	3	4	5
Type of pathway		Selection criteria[a,b,c]		Applicable lighting subcategory
General description	Basic operating characteristics	Pedestrian/ cycle activity	Fear of crime	
Pedestrian or cycle orientated pathway, e.g. footpaths, including those along local roads[d] and arterial roads[e], walkways, lanes, park paths, cyclist paths	Pedestrian and or cycle traffic only	N/A	High	PP1[c]
		High	Medium	PP2[c]
		Medium	Medium	PP3
		Medium	Low	PP4
		Low	Low	PP5

TABLE 2.5

LIGHTING SUBCATEGORIES FOR OUTDOOR CAR PARKS (INCLUDING ROOF-TOP CAR PARKS)

1	2	3	4
Type of area	Selection criteria[a,c]		
	Night time vehicle and/or pedestrian movements	Fear of crime	Applicable lighting subcategory[b]
Parking spaces, aisles and circulation roadways	High	High	PC1
	Medium	Medium	PC2
	Low	Low	PC3
Designated parking spaces specifically intended for people with disabilities	N/A	N/A	PCD
For any designated areas for pedestrians to cross	N/A	N/A	PCX

Summary of subcategory assessment is provided below: -

Category	Classification
Type of Road or Pathway	Pedestrian or cycle-oriented pathway
Basic Operation Characteristics	Pedestrian/cycle traffic only
Pedestrian/ Cycle Activity	Medium
Fear of Crime	Low
Applicable Lighting Subcategory	PP4

Table 2: Table 2.2 Assessment Summary – Pedestrian/Cyclist pathway

Category	Classification
Type of Area in Carpark	Parking spaces, aisles and circulation roadways
Night-time Vehicle and/or Pedestrian Movements	Low
Fear of Crime	Low
Applicable Lighting Subcategory	PC3

Table 3: Table 2.5 Assessment Summary – General Circulation

Category	Classification
Type of Area in Carpark	Designated parking spaces specifically intended for people with disabilities
Night-time Vehicle and/or Pedestrian Movements	N/A
Fear of Crime	N/A
Applicable Lighting Subcategory	PCD

Table 4: Table 2.5 Assessment Summary – Disabled Carpark

Category	Classification
Type of Area in Carpark	Any designated areas for pedestrian to cross
Night-time Vehicle and/or Pedestrian Movements	N/A
Fear of Crime	N/A
Applicable Lighting Subcategory	PCX

Table 5: Table 2.5 Assessment Summary – Pedestrian Crossing in Carpark

4.2.2 External Swimming Pool

General objectives of the lighting design:

a. Provision of illuminance levels appropriate to the visual requirements of the participants, officials and spectators, and to ensure safety.
b. Provision of an appropriate uniformity of illuminance over the total water area and the pool surrounds.
c. Control of glare and veiling reflections from luminaries and windows, within the range of normal viewing directions of participants and where applicable, of officials and spectators.
d. Control of stray light and glare beyond the boundaries of the pool complex.
e. Provision of colour rendering properties suitable for colour appearance of the people and the surroundings.
f. Addressing environmental considerations, including compliance with AS4282 – Control of obtrusive effect of outdoor lighting.
g. Selection of lighting equipment of appropriate type and locations as well as arrangement of such equipment in a manner that will facilitate all necessary maintenance during the lifetime of the installation.

The level of use is understood to be recreational, and the level of activity has been assessed as high in the sub-category selection. Table 1 subcategory definitions as per AS/NZS 2560.2.5:2007 is provided below.

TABLE 1

LIGHTING CRITERIA FOR SWIMMING POOLS

Level of use	Maintained average horizontal illuminance ($\bar{E}_{mh}$)[a] lux	Minimum horizontal uniformities[b]		Minimum colour rendering index
		(U_1)	(U_2)	($R_{a\,min}$)
Recreation or training	120	0.5	0.3	65
Club, interclub or district competition	240	0.6	0.4	65
International, national or state competition	600	0.7	0.5	65[c]

Summary of subcategory assessment is provided below: -

Category	Classification
Level of use in swimming pools	Recreation or training
Maintained Average horizontal illuminance *(lux)*	120
Minimum horizontal uniformities	0.5 *(U1)*
	0.3 *(U2)*
Minimum colour rendering index ***(R_a Min)***	65

Table 6: Table 1 Assessment Summary – Outdoor Swimming Pool

4.3 Light Technical Parameters (LTP) – Pedestrian/Cyclist pathway & Carpark

Computer aided lighting design to comply with Light Technical parameters set out in AS1158.3.1:2020 Table 3.4 and 3.7 for footpath and carpark sections respectively will be completed during development to ensure compliance is achieved.

Summary of Light Technical Parameters definition is provided below: -

LIGHT TECHNICAL PARAMETERS (LTP)

Parameter	Symbol
Average horizontal illuminance	$\bar{E}_h$
Point horizontal illuminance	E_{ph}
Illuminance uniformity Category P	U_{E2}
Point vertical illuminance	E_{pv}

Further assessment of Maintenance of Light Technical Parameters by considering two main aspects of Luminaire Dirt Depreciation Factor (LDD) of 0.9 provided by Table 3.2 and Luminaire Source Lumen Depreciation (LLD) of 0.8 which is standard across LED type light source is considered for the system overall Light Loss Factor (LLF).

LDD FACTORS

Environmental zone	LDD factor			
	Cleaning frequency			
	36 months	48 months	60 months	72 months
Rural	0.95	0.94	0.93	0.92
Urban	0.90	0.88	0.86	0.84

In accordance with section 3.5.5 of AS1158.3.1:2020, the overall LLF of 0.7 will be considered.

4.3.1 Pedestrians and cyclist path - LTP

The development will comply with Light Technical Parameters set in AS1158.3.1:2020 Table 3.4. Refer below for summary of design criteria to achieve in order to obtain compliance.

VALUES OF LIGHT TECHNICAL PARAMETERS FOR PATHWAYS AND CYCLIST PATHS

1	2	3	4	5
Lighting subcategory	Light technical parameters (LTP)			
	Average horizontal illuminance[a,b] $(\bar{E}_h)$ lx	Point horizontal illuminance[a,b,d] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})	Point vertical illuminance[a,b] (E_{Pv}) lx
PP1	10	2	5	1
PP2	7	1	5	0.3
PP3	3	0.5	5	0.1
PP4	1.5	0.25	5	0.05[e]
PP5	0.85	0.14	5	0.02[e]

[a] These values are maintained. See Clause 3.2 pertaining to lumen derating values for non-white light sources.

[b] Conformance is achieved by being greater than or equal to the applicable table value.

[c] Conformance is achieved by being less than or equal to the applicable table value.

[d] Conformance of 50% of E_{ph} shall also be demonstrated over an area of 5 m either side of the pathway—where a verge exists—or up to any structure/fence/property boundary that forms the edge of the pathway, unless deemed otherwise by the relevant authorities (see Clause 3.1.3.5).

[e] For luminaires with mounting heights of 1.5 m or less, the E_{Pv} values need not be applied.

4.3.2 Carpark - LTP

The development will comply with Light Technical Parameters set in Table 3.7. refer below for summary of design criteria to achieve in order to obtain compliance.

VALUES OF LIGHT TECHNICAL PARAMETERS FOR OUTDOOR CAR PARKS (INCLUDING ROOF-TOP CAR PARKS)

1	2	3	4	5
Lighting subcategory	Light technical parameters (LTP)			
	Average horizontal illuminance[a,b] $(\bar{E}_h)$ lx	Point horizontal illuminance[a,b] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})	Point vertical illuminance[a,b] (E_{Pv}) lx
PC1	14	3	8	3
PC2	7	1.5	8	1
PC3	3.5	0.7	8	—
PCD[d]	—	≥14 and ≥$(\bar{E}_h)$[d]	—	—
PCX[e]	21	5	8	—

[a] These values are maintained.

[b] Conformance is achieved by being greater than or equal to the applicable table value.

[c] Conformance is achieved by being less than or equal to the applicable table value.

[d] E_{Ph} shall be determined for each PCD area in the car park and, in each case, it shall be greater than the value stated and greater than the average for the overall car park.

[e] This level shall be used for any marked areas for pedestrians to cross.

4.4 Light Technical Parameters (LTP) – Swimming Pool

Computer aided lighting design to comply with Light Technical parameters set out in AS/NZS 2560.1:2002 for outdoor sport lighting and AS/NZS 2560.2.5:2007 Table 1 for swimming pool and immediate surroundings, the viewing requirements of participants, including officials and spectators.

Summary of Light Technical Parameters definition is provided below: -

TABLE 1

LIGHTING CRITERIA FOR SWIMMING POOLS

Level of use	Maintained average horizontal illuminance ($\bar{E}_{mh}$)[a] lux	Minimum horizontal uniformities[b]		Minimum colour rendering index
		(U_1)	(U_2)	($R_{a\,min}$)
Recreation or training	120	0.5	0.3	65
Club, interclub or district competition	240	0.6	0.4	65
International, national or state competition	600	0.7	0.5	65[c]

Further assessment of Maintenance of Light Technical Parameters by considering two main aspects of Luminaire Dirt Depreciation Factor (LDD) of 0.91 provided by AS/NZS 2560.1:2002 -Table 4.1 (considering cleaning interval of 24months, IP6X with low pollution category) and Luminaire Source Lumen Depreciation (LLD) of 0.8 which is standard across LED type light source is considered for the system overall Light Loss Factor (LLF).

TABLE 4.1

ESTIMATION OF LUMINAIRE DIRT DEPRECIATION FACTOR FOR OUTDOOR FLOODLIGHTING INSTALLATION

Cleaning interval	Ingress protection number of lamp housing								
	IP2X *			IP5X *			IP6X *		
	Pollution category			Pollution category			Pollution category		
months	High	Medium	Low	High	Medium	Low	High	Medium	Low
12	0.53	0.62	0.82	0.89	0.90	0.92	0.91	0.92	0.93
18	0.48	0.58	0.80	0.87	0.88	0.91	0.90	0.91	0.92
24	0.45	0.56	0.79	0.84	0.86	0.90	0.88	0.89	0.91
36	0.42	0.53	0.78	0.76	0.82	0.88	0.83	0.87	090

In accordance with section 4.6 of AS/NZS 2560.1:2002, the overall LLF of 0.8 will be considered.

4.5 Glare control – Swimming Pool

Swimming pool lighting design shall give careful consideration to visual requirements and comfort of swimmers and spectators. The most difficult problem associated with the lighting of swimming pools is the control of reflections from the water surface (veiling reflection).

As per AS/NZS 2560.2.5:2007 clause 8.2.1 the veiling reflections shall be avoided by below three factors:

- The percentage of incident light reflected from the surface of the water should be kept low.
- The percentage of incident light that penetrates the surface of the water should be kept high.

  he reflectance of the (underwater) pool lining should be relatively high, preferably above 0.7.

Swimming pool lighting therefore must be designed by qualified lighting designers to make sure that both glare control and lighting level recommendations of AS 2560.2.5:2007 are met.

Glare control measures to be used are:

- Find appropriate locations for the pole lights.
- Locate the pole lights to optimal locations i.e., away from normal line of sight.
- Install the pole lights at adequate heights and aim the lights to avoid glare.
- Select light fixture with good glare control.

4.6 Environmental matters

This section deals with complying with AS4282- Control of obtrusive effects of outdoor lighting as well as the daytime appearance of the installation.

Lighting designers use AGi32 Lighting Analyst Software to calculate compliance to AS4282 based on the parameters on the site plan and the final lighting design.

Requirements:

- Pre curfew time (before 11pm): the acceptable illuminance levels at the bedroom window of a house (or houses) cannot exceed 10 lux
- Post curfew time (after 11pm): the acceptable illuminance levels at the bedroom window of a house (or houses) cannot exceed 2 lux

When AS4282 compliance is calculated using AGI32 software the photometric data of the selected floodlights, height and aiming angles of the floodlights and the site conditions are loaded into the software. Compliance is demonstrated by calculations and compliance report issued.

5. Lighting Strategy

The facility will be used during normal business hours as well at night. The external lighting to the carpark and walkways will be adapted to suit with means of adjustable/programmable control to suit the site's operations. It is anticipated that the lighting system will operate from dusk till dawn.

The lighting system will utilise a combination of post-top, bollard, recessed location, façade mounted and pathway illumination type luminaires to achieve the design intent and comply with the relevant requirements.

Pole mounted luminaires shall be 5-8 metre high and shall have adjustable mounting brackets to properly aim the luminaires' light distribution (to be detailed during design development).

External pool lighting shall comprise pole mounted luminaires at approximately 14m height to align with AS2560 guidance.

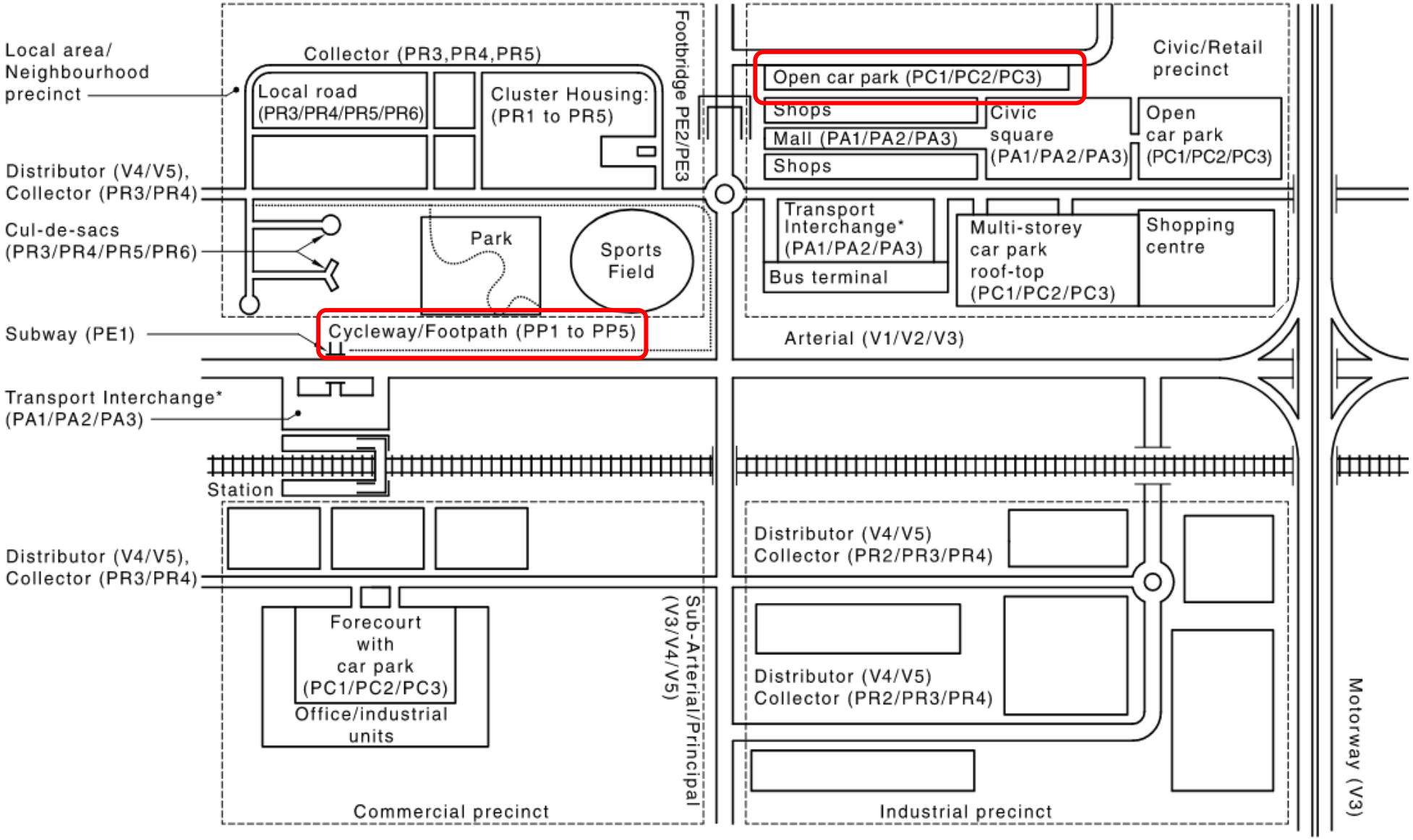
Luminaire selections shall generally incorporate the following: -

- High Impact Resistance - IK10
- High Ingress Protection Rating – IP66
- Light source to be LED
- Forward and side light distribution optics
- Colour Rendering Index of greater than 80
- Colour Temperature of 4000K
- Compatible with DALI Lighting Control System
- Low-cut-off, Aero screen style casing to minimise upward light spill

5.1 Switching and control

The site switching and control strategy will utilise a flexible DALI programmable control system that can be adjusted to meet changing requirements for community use. The main use of the site lighting will be from dusk and dawn to ensure safe community access and use and will be switched using a timeclock/photoelectric cell with manual override. Lighting provided for security purposes will operate between dusk and dawn.

Appendix A Outdoor Lighting Categories / Sub-Categories



Appendix B Area of Work Assessed Sub-categories