ALTERATIONS AND ADDITIONS TO THE GLADESVILLE BRIDGE MARINA

Light Spill Assessment

Prepared for:

Gladesville Bridge Marina Pty Ltd
380 Victoria Place
DRUMMOYNE NSW 2047

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Gladesville Bridge Marina Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18292-R02-v1.3	17 October 2019	Peter Hayman	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
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EXECUTIVE SUMMARY

SLR Consulting Australia has been engaged Gladesville Bridge Marina Pty Ltd to undertake a light survey and a light spill study for the proposed alterations and additions to the Gladesville Bridge Marina.

The Gladesville Bridge Marina includes a water-based structure and a land-based building, which is located at 380 Victoria Place, Drummoyne within the Canada Bay Local Government Area (LGA). The site is located on the southern foreshore of the Parramatta River, to the west of the Gladesville Bridge. The site is approximately 19,740m^2 in area, comprising an approximate 1,740m^2 land-based component and an approximate 18,000m^2 of lease area, which accommodates the water-based component.

The proposed development constitutes alterations and additions to the marina berth layout to provide overall storage for 130 vessels comprising 15 swing moorings and 115 floating berths. The works include:

- removal of 29 existing moorings and retention of 15 existing swing moorings;
- construction of 65 new floating berth spaces of varying sizes, that increases the number of floating berths from 50 to 115;
- cessation of slipway activities;
- demolition of the slipway rails and demolition of the internal office mezzanine structure within the covered slipway area; and
- provision of 8 new valet car parking spaces within the existing slipway area.

The design of marinas is covered in Australian Standard: AS 3962-2001. Section 6.5 of the standard states:

"Adequate lighting should be provided for safe pedestrian access to the berths, security of the vessels and shore facilities, and safe navigation within the marina area"

"All lighting should be designed and located to minimise glare for vessels navigating in the vicinity."

Base Case Scenario

A baseline survey was conducted to establish current night-time lighting levels.

- The light survey conducted on the 6th of June 2019 found that the average illuminance on the land area of the site is around 3 lux while the average value on the walkways that provide access to the berths was 15.7 lux.
- The baseline values measured at the site are lower than the reference values found in AS 1680.5:2012.

Future Planned Scenario

A three dimensional lighting simulation model of the site was developed using lighting fixtures of a type that have been designed for use around waterfronts. The model included the surrounding building and terrain along with the received plans for the proposed redevelopment.

The resulting light spill was modelled using the dedicated lighting software AGi32. This model only assessed additional light produced by the proposed alterations and additions.

EXECUTIVE SUMMARY

- The reference values found in AS 1680.5:2012 were used as a conservative estimate to produce the light model. The resulting illuminance levels of approximately 61 lux on the land based area and 28 lux on the walkways meet these minimum requirements.
- The resulting illuminance levels on the facades of surrounding buildings from the proposed alterations and additions were shown by the modelling to be low. The modelled values met the requirements of AS 4282-1997.
- Any light spill from proposed development on to the facades of surrounding buildings can be managed to avoid unacceptable impacts because (among other things) lighting can be designed, installed and operated to comply with AS4282.
- The proposed marina can be lit in accordance with AS 3962-2001 while also meeting the light spill requirements of AS 4282-1997.

SLR has provided a number of recommendations to manage potential light spill during the construction design phase of the proposal. As more detailed lighting design plans are generated and become available, the lighting model can be updated to reconfirm compliance with AS 4282-1997.

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1 Introduction

SLR Consulting Australia has been engaged Gladesville Bridge Marina Pty Ltd to undertake a light survey and a light spill study for the proposed alterations and additions to the Gladesville Bridge Marina. This will involve taking physical measurements on the current site and the production of a digital model of the proposed layout and surrounding area to check for any areas that may be adversely affected by the site lighting. This report will form part of the Environmental Impact Statement (EIS) for the project.

1.1 Site and Surrounds

The Gladesville Bridge Marina includes a water-based structure and a land-based building, which is located at 380 Victoria Place, Drummoyne within the Canada Bay Local Government Area (LGA). The site is located on the southern foreshore of the Parramatta River, to the west of the Gladesville Bridge.

The site is approximately 19,740m^2 in area, comprising an approximate 1,740m^2 land-based component and an approximate 18,000m^2 of lease area, which accommodates the water-based component.

Figure 1 Aerial Image of Site

Image: Nearmap (May 2019)

The Marina's current services are as follows:

- 50 floating berths; berth sizes range from 25' to 75.5' (7.6m to 23m)
- 44 swing moorings; swing moorings are available for boats, with the most popular lengths from 17' (5.2m) up to 50' (15m), although there is no limit in length
- Total capacity for 99 boats

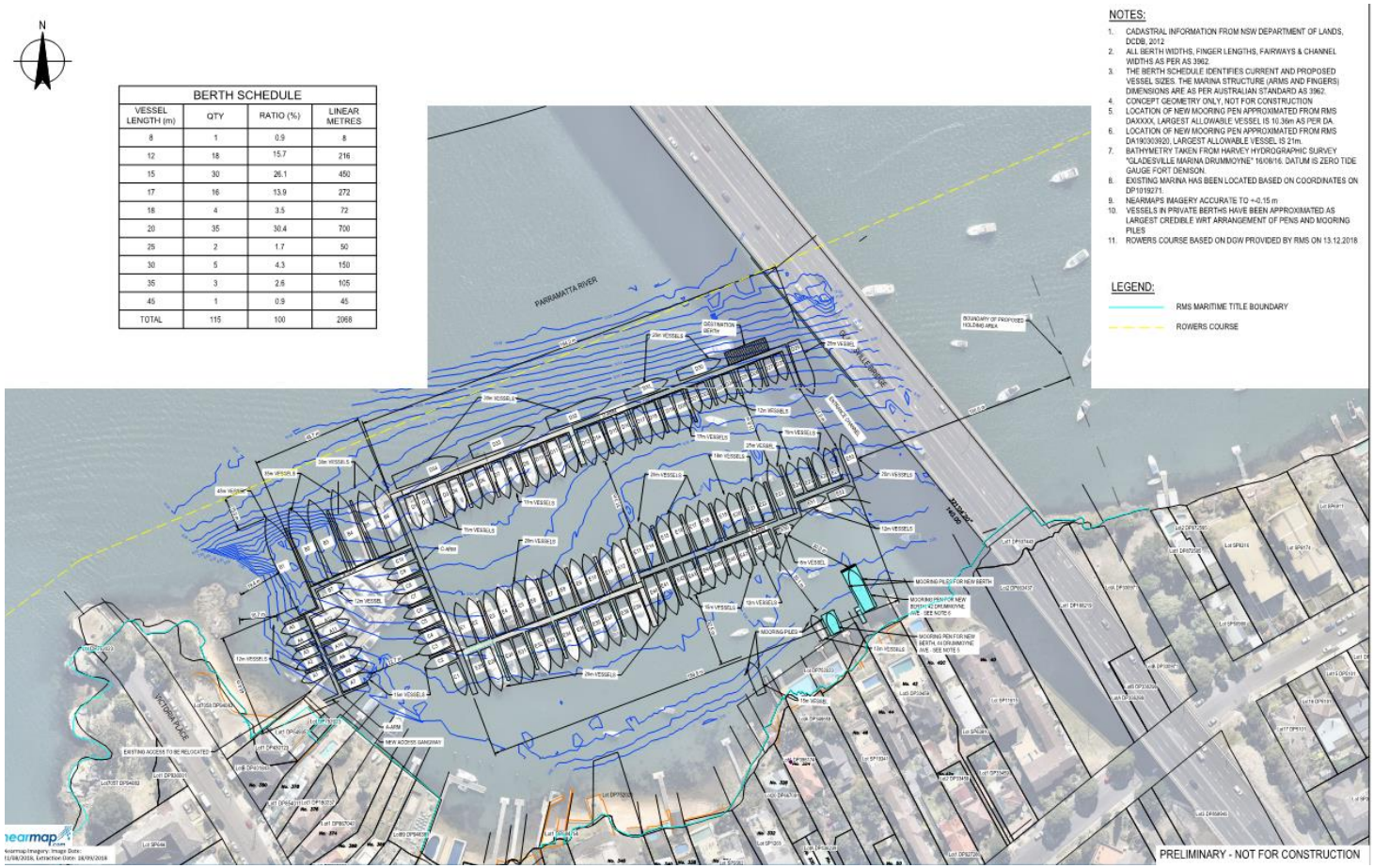
- Complimentary tender service available 7 days a week, transporting customers to and from the marina pontoons to their vessels on the swing moorings;
- Dinghies availability for after-hours use;
- Slipways – antifouling, boat surveys and painting. The slipway can accommodate vessels up to 60' (18m) LOA and 16' (5m) beam. Non-flybridge power vessels of up to 40' (13m) are able to be housed in our undercover slipway area for all weather painting and repairs
- Pump out facilities
- Food and beverage kiosk (currently machine based)
- Boat repairs
- Shipwright services
- Mechanical services
- Work berths
- New and used boat sales
- Charter operation (back-of-house).

The proposed development constitutes alterations and additions to the marina berth layout to provide overall storage for 130 vessels comprising 15 swing moorings and 115 floating berths. The works include:

- removal of 29 existing moorings and retention of 15 existing swing moorings;
- construction of 65 new floating berth spaces of varying sizes, that increases the number of floating berths from 50 to 115;
- cessation of slipway activities;
- demolition of the slipway rails and demolition of the internal office mezzanine structure within the covered slipway area; and
- provision of 8 new valet car parking spaces within the existing slipway area.

A plan of the proposal is shown in **Figure 2.** The green area shows the current extent of the marina.

Figure 2 Redevelopment Plan



2 Light Spill Background

2.1 Lighting Terminology

A description of the common terminology used for the lighting study, taken from *AS 4282-1997: Control of the Obtrusive Effects of Outdoor Lighting* is shown in **Table 1.**

Table 1 Lighting Terminology (Consistent with AS 4282-1997)

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, eg traffic lights.
Spill light	Light emitted by a lighting installation which falls outside the boundaries of the property on which the installation is sited.
Residential property	Land upon which a dwelling exists or may be developed, e.g.: land zoned for residential development.
Dwelling	A building in which people normally reside, especially during the hours of darkness, e.g. house, hotel, motel, hospital.
Illuminance	The luminous flux arriving at a surface divided by the area of the illuminated surface. Unit: lux(lx); 1 lx = 1 lm/m^2
Luminous intensity	The concentration of luminous flux emitted in a specific direction. The SI unit of luminous intensity is the candela (cd).
Luminous flux	The measure of the quantity of light. For a lamp or luminaire it normally refers to the total light emitted irrespective of the directions in which it is distributed. Unit: lumen (lm).
Luminaire	Apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except for the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary circuit auxiliaries together with the means for connecting them to the electrical supply.
Glare	Condition of vision in which there is a discomfort or a reduction in the ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrast in the field of vision (a) Disability Glare – Glare that impairs the visibility of objects without necessarily causing discomfort. (b) Discomfort Glare – Glare that causes discomfort without necessarily impairing the visibility of objects.
Curfew	Curfew hours refer to the time between 11:00 pm and 6:00 am when there are stricter requirements for light spill.

2.2 Light Spill Risks – Sensitive Receptors

The effect of light spill is addressed in Australian Standard: *AS 4282-1997 Control of the Obtrusive Effect of Outdoor Lighting*. When designing outdoor lighting the effects on the following four areas should be taken into account:

- Impacts on residents.
- Impacts on road users (eg motorists, cyclists, pedestrians).
- Impacts on transport signalling systems (eg air, rail, water).
- Impacts on areas where astronomical observations are made.

Due to the site's location in a suburban area with a major road nearby, there will already be a reasonable amount of night-time lighting. It is therefore unlikely that existing lighting will affect transport signalling systems or locations where astronomical observations are made. Nearby residents already have a view of the current marina and also have sight lines to the Gladesville Bridge which is the most noticeable night time light source in the area.

2.3 Lighting Design

The design of marinas is covered in Australian Standard: AS 3962-2001. Section 6.5 of the standard states:

"Adequate lighting should be provided for safe pedestrian access to the berths, security of the vessels and shore facilities, and safe navigation within the marina area.

All lighting should be designed and located to minimise glare for vessels navigating in the vicinity."

While no specific illuminance requirements are stated in AS 3692-2001 some guidance can be found AS 1680.5:2012 Interior and Workplace Lighting Part 5: Outdoor Lighting. Table 3.1 of the standard give a number of minimum illuminance requirements for various tasks and situations. The parts used for this study are summarised in Table 2.

Table 2 Recommended Light Technical Parameters for General Outdoor Areas

Description	Average Illuminance (Lux)	Minimum Illuminance (Lux)	Uniformity
Fabrication, manufacture or maintenance	80	10	5
Manual loading and unloading	40	5	5
Pedestrian access and general storage	20	2.5	7

While the detailed descriptions given in AS 1680.5:2012 do not exactly match the possible function of a marina they provide a basis to be able to assume an example lighting layout and gain an understanding of the possible light spill in the area.

2.4 Light Spill Requirements

The effect of light spill is addressed in Australian Standard AS 4282-1997 *Control of the Obtrusive Effect of Outdoor Lighting* (herein "AS 4282-1997"). The maximum recommended values of light technical parameters for the control of obtrusive lights are given in **Table 3**.

Table 3 Recommended Maximum Values of Light Technical Parameters (AS 4282-1997)

Light Technical Parameter	Time of Operation	Commercial Areas	Residential Areas	
			Light Surrounds	Dark Surrounds
Illuminance in Vertical Plane	Pre-curfew hours	**25 lx**	**10 lx**	10 lx
	Curfew hours	**4 lx**	**2 lx**	1 lx
Luminous Intensity emitted by luminaires (I)	Pre-curfew hours	7,500 cd* (for a medium to large area with Level 1 control)	100,000 cd (for a large area with Level 1 control)	100,000 cd (for a large area with Level 1 control)
	Curfew hours	2,500 cd	1,000 cd	500 cd
Threshold Increment (TI)	Limits apply at all times where users of transport systems are subjected to a reduction in the ability to see essential information	20% based on adaption luminance (L) of 10 cd/m^2		

* The SI unit of luminous intensity is the candela (cd)

The vertical illuminance limits for *curfew hours* apply in the plane of the windows of habitable rooms or dwellings on nearby residential properties. The vertical illuminance criteria for *pre-curfew hours* apply at the boundary of nearby residential properties in a vertical plane parallel to the boundary.

Values given are for the direct component of illuminance, ie no reflected light is taken into account.

- Limits for luminous intensity for curfew hours apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents, from positions where such views are likely to be maintained; and
- Limits for luminous intensity for pre-curfew hours apply to each luminaire in the principal plane, for all angles at and above the control direction.

As can be seen in **Table 3**, the applicable limits for adverse spill light depend on the time of operation for the lighting installation. Operation taking place during *pre-curfew hours* is less likely to give rise to complaints from adjacent residential properties, while a more restrictive limit would be applicable to *curfew hours*.

The analysis in this report has therefore been based on *curfew hour* requirements. The residential properties can be best classed as being in a residential area with "Light Surrounds" (refer **Table 3**).

Accordingly:

- Light spill from the proposed site onto the facades of the surrounding residential dwellings should be kept below 2 lux during curfew hours; and

- Light spill from the proposed site onto the facades of residential dwellings in the surrounding commercial areas should be kept below 4 lux during curfew hours.

2.5 Light Spill Effects

The adverse effects of light spill are due both to an increase in general illuminance that may cause annoyance and may disrupt sleeping patterns, and from the direct view of the light source that can cause glare issues.

The adverse effects of light spill from outdoor and exterior lighting are influenced by a number of factors:

- The topology of the area. Light spill is more likely to be perceived as obtrusive if the lighting installation is located above the observer. Lighting installations are usually directed towards the ground and an observer could hence have a direct view of the luminaire.
- The surrounding topography and existing installations. Hills, trees, buildings, fences and vegetation generally have a positive effect by shielding the observer from the light source.
- Pre-existing lighting in the area. Light from a particular light source is seen as less obtrusive if it is located in, or perceived in, an area where the lighting levels are already high, e.g. along roads and near built up areas. .
- The zoning of the area. A residential area is seen as more sensitive compared to commercial areas where high lighting levels are seen as more acceptable.
- Time of use. Clearly light will be seen as being more obtrusive during night and curfew hours. This is considered to be between 11:00 pm and 6:00 am by AS4282x.

Typical illuminance levels for a variety of circumstances are given in **Table 4** for comparison.

Table 4 Typical Illuminance Levels for Various Scenarios

Lighting Scenario	Horizontal Illuminance (lux)
Moonless overcast night	0.0001
Quarter Moon	0.01
Full Moon	0.1
Twilight	10
Indoor office	300
Overcast day	1,000
Indirect sunlight clear day	10,000-20,000
Direct sunlight	100,000-130,000

3 Light Survey

SLR undertook a baseline study assessment of the existing night-time illumination environment around the land and water based parts of the site.

3.1 Methodology

SLR used a calibrated Testo 545 Light Meters to conduct the site measurements. These meters was supplied and calibrated by Air-Met Scientific Pty Ltd.

Measurements of the existing night-time lighting condition at areas of interest were recorded on the site plans and survey.

Recordings were conducted on 6th of June 2019 from 5:30 pm onwards. The atmospheric conditions during testing were partly overcast. The illuminance provided by an overcast sky is 0.0001 lux and would therefore have had no impact on the survey results.

3.2 Lighting Layout

Along the marina walkways there were approximately 40 bollard style light posts (see Photo 1). These were set at 1-1.2 metres above the walkway and were unshielded. There were two post mounted area lights (see Photo 2) mounted at the gate to the walkways and at the corner of the northern walkway.

Photo 1 Bollard Style Lighting

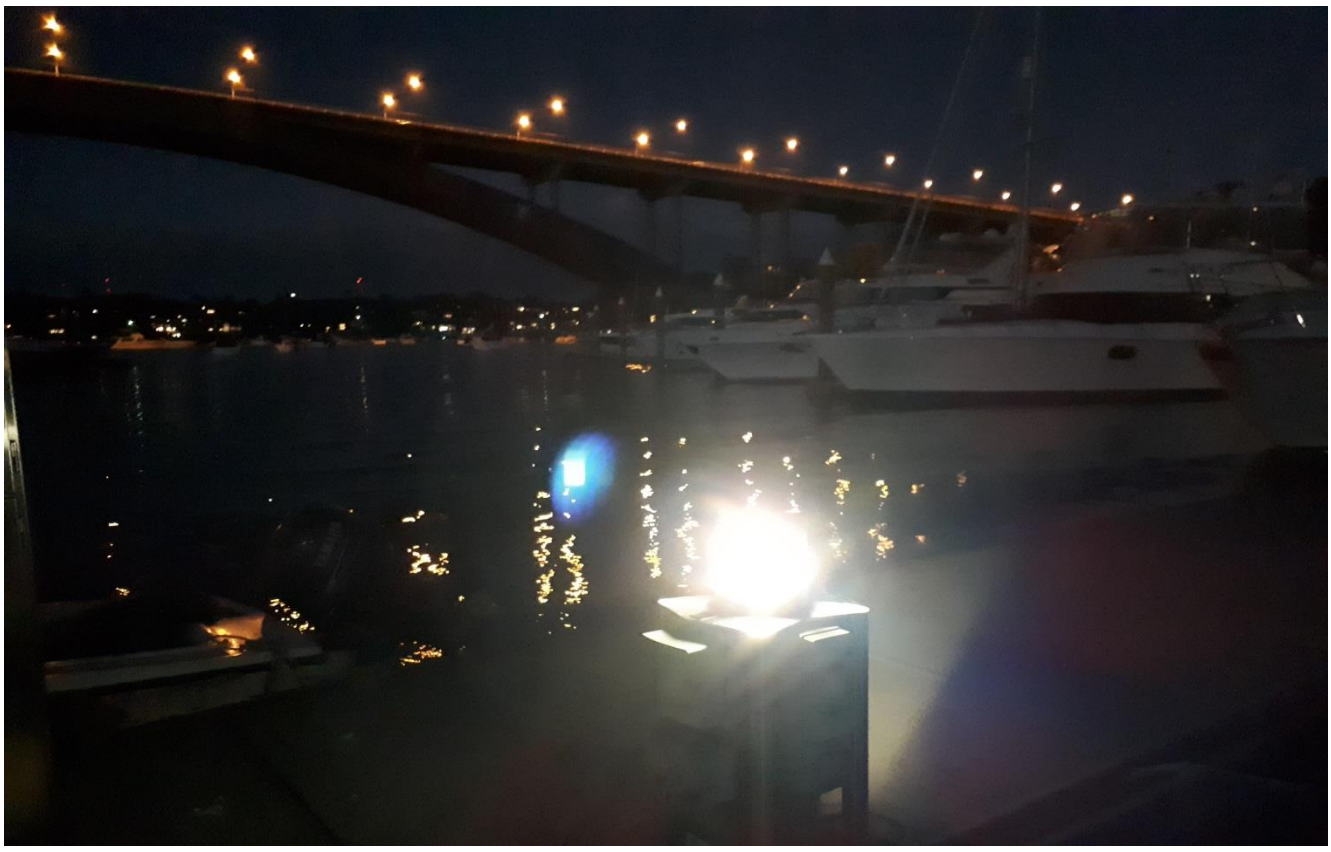
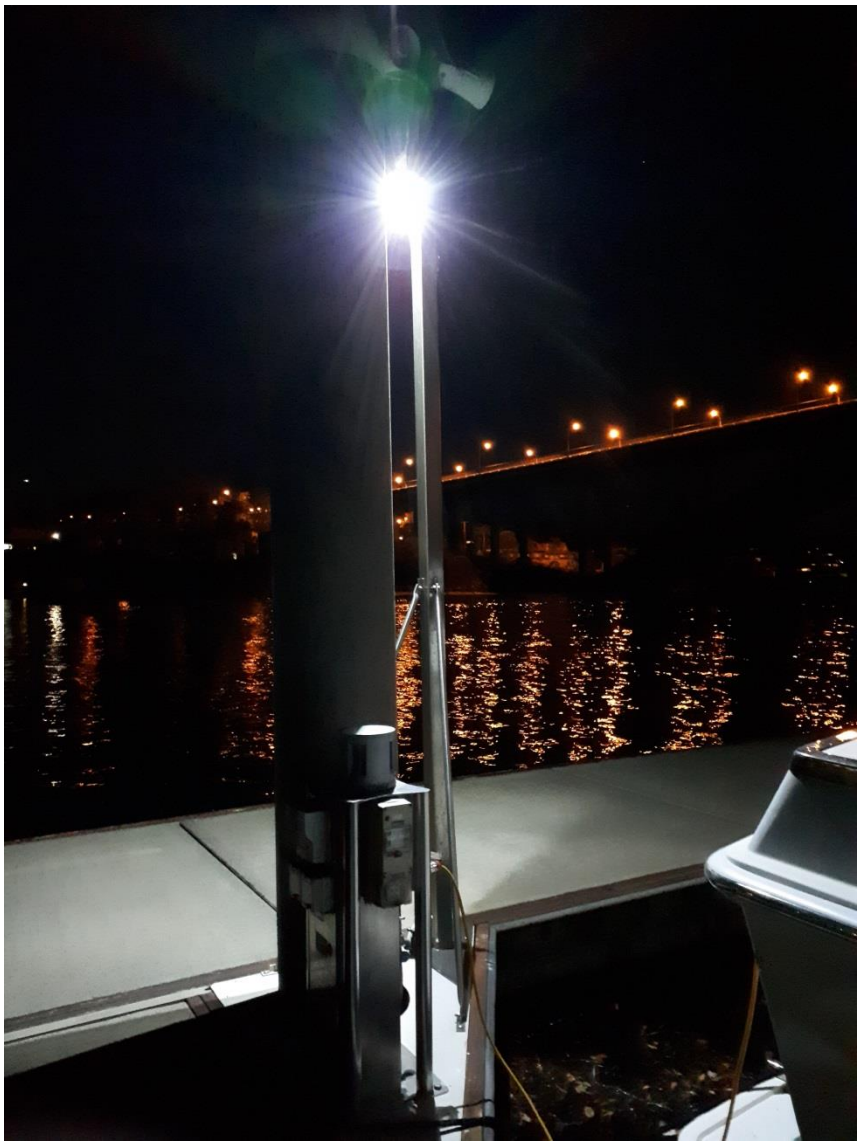


Photo 2 Pole Mounted Lighting



3.3 Site Illuminance

Measurement locations are shown in Figure 3. The measurement points/groupings were split as follows:

- Measurement points 1 to 5: "Land Area"
- Measurement points 6 to 30: "Walkways"

Figure 3 Measurement locations

The illuminance values are shown in the table below.

Table 5 Marina Illuminance

Location	Value	Location	Value	Location	Value	Location	Value
1	0-3	9	16-20	17	12-23	25	9-13
2	0-3	10	16-20	18	12-23	26	9-13
3	0-3	11	12-23	19	12-23	27	9-13
4	0-3	12	12-23	20	16	28	9-13
5	3	13	12-23	21	31	29	9-13
6	43	14	12-23	22	9-13	30	9-13
7	3	15	12-23	23	9-13	31	0-1
8	7	16	12-23	24	9-13		

The average illuminance on the land area (Location 1-5) is around 3 lux while the average value on the walkways (Location 6-30) was 15.7 lux. These results appear to be low when compared to AS 1680.5:2012

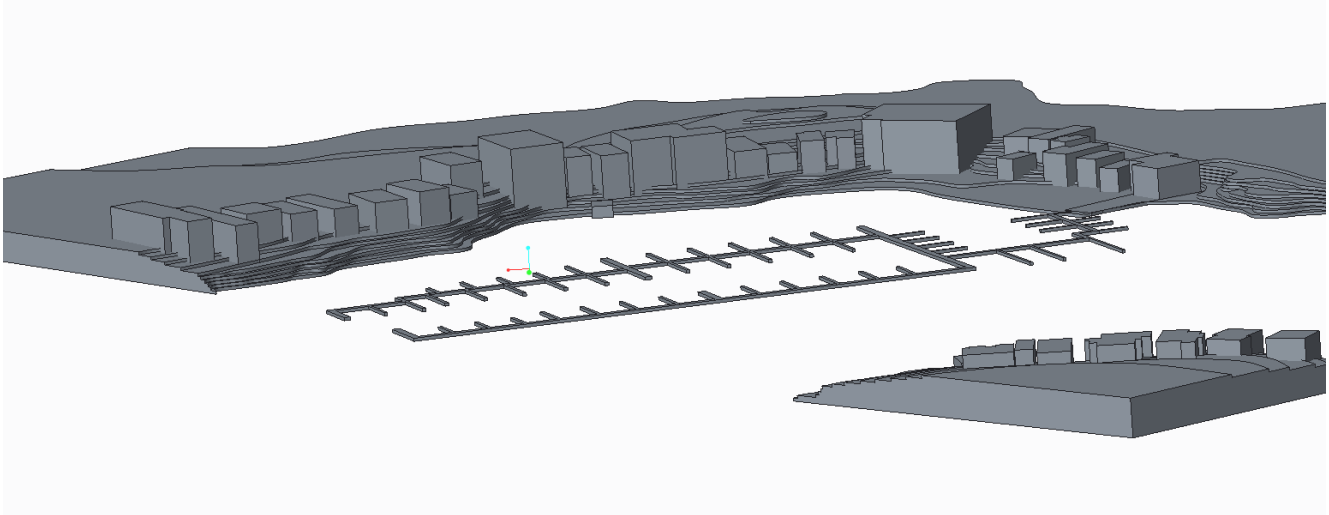
4 Light Spill Modelling for the Proposal

4.1 Geometry

A 3D digital geometry was generated for the site using the surrounding building and terrain along with the received plans for the proposed redevelopment (shown in **Figure 3** below). This was then imported into the light modelling program AGi32.

- luminaires and a ground plane were added;
- Trees were not included in the model to give a worst case scenario. For the same reason all lights were assumed to be switched "on" for the analysis;
- A concrete texture was used for buildings, grass texture was used for ground surfaces, again concrete was used for the walkways of the marina and blue was used for the water;
- A horizontal 1 m by 1 m calculation grid was used for all pedestrian areas such as the walkways to provide an indication of the area illuminance; and
- A vertical 1 m by 1 m grid was added to the facades of all nearby surrounding buildings to calculate the light spill at those facades.

Figure 4 Recreated 3D Geometry with Surrounds



4.2 Areas to be Illuminated

This section aims to identify areas of the site where new lighting will be needed as well as the minimum illumination required for those areas.

SLR added lighting to the following areas of the model:

- On water walkways;
- Land based areas such as the new carpark;

SLR used luminaires designed for use around water. Area lights were used for the land based areas and for major corners along the berth walkways. In between the area lights, bollard lights were used to light the walkways.

- LED area lighting was used for spaces such as the car park and other land based areas.
- The area lighting was positioned to face inwards towards the middle of the site to reduce the potential for light spill on to surrounding buildings.
- A mixture of area and bollard style lighting was used along the on water walkways.
- All lights used in the model were full cut-off luminaires with an upward waste light ratio of zero.

SLR will aim for an average illuminance between 20 and 40 lux. Maintenance is unlikely to be carried out at night time so the 80 lux requirement will not be used for the modelling exercise.

5 Results

5.1 Area Lighting

The initial goal of the modelling was to produce a lighting case that provided at least the minimum required illuminance to the main pedestrian areas. The lighting model produced the following results.

Table 6 Ground Illuminance from Lighting Model within the Planned Redevelopment

Area	Calculated Average Lux
Land Area	60.98
Walkways	27.69

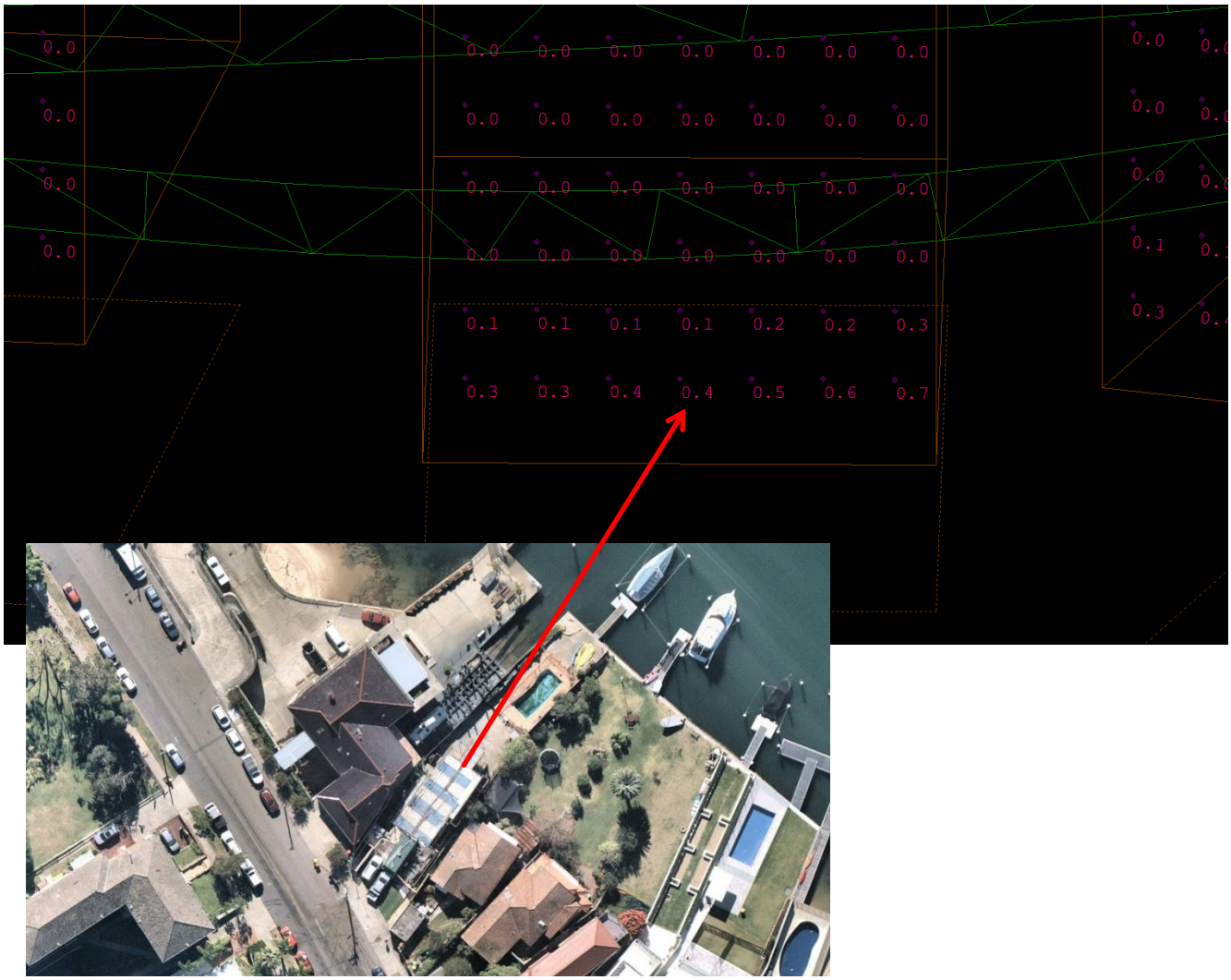
Comparing the model output with the recommended lux levels in **Table 2** and the measured values taken during the survey, the modelled future case has more light provided than necessary. This will provide a conservative case for assessing the light spill in the surrounding environment meaning any light spill found will not be as severe in real life.

5.2 Light Spill

As previously stated, calculation points were added to the facades of all surrounding buildings immediately facing the site. Some buildings on the north side of the Parramatta River have been included although due to their distance from the site there is unlikely to be any light spill on their facades.

The only façade shown by the modelling to receive any light spill is at 378 Victoria Place neighbouring the marina building. The peak illuminance on the façade facing the water is 0.7 lux which is below the requirements shown in AS 4282-1997.

Figure 5 Light Spill on 378 Victoria Place



6 Recommendations

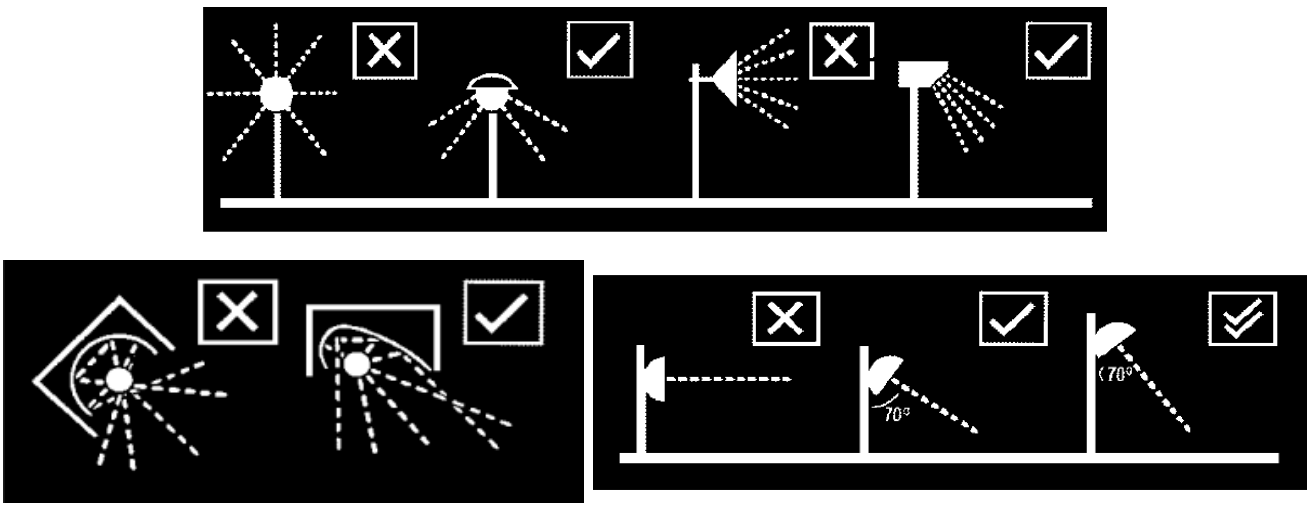
To ensure that any potential light spill from the proposal complies with the relevant requirements, the following recommendations are given:

6.1 General Mitigation

When designing outdoor light to minimise any adverse effect of the light installation, use the following general principles during the detailed lighting design phase as set out in *AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting*:

- Direct lights downward as much as possible;
- Use luminaires that are aimed to minimise light spill, e.g. full cut off luminaires where no light is emitted above the horizontal plane;
- Note that reducing spill light means that more of the light output is used to illuminate the area and a lower power output can be used. The energy consumption for the fitting can thus be reduced without decreasing the illuminance of the area. Refer **Figure 6**.
- Do not waste energy and increase light pollution by over-lighting;
- Keep glare to a minimum by keeping the main beam angle less than 70°. Refer **Figure 6;**
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit;
- Be aware of the location of any surrounding sensitive receptors and direct the site lighting away from these locations where feasible; and
- Where possible position site lighting as far away from site boundaries as practicable.

Figure 6 Luminaire Design Features that Minimise Light Spill



6.2 Site Specific Recommendations

- The proposed development will be designed to comply with AS 4282-1997 and AS 3962-2001.
- Use luminaires with a narrow beam to provide useful light on the walkways while minimising wasted light shining on the water
- Current lighting (e.g. bollard lighting) should be replaced with full cut-off luminaires (all luminaires used in the modelling exercise were full cut-off). This will mean no light will escape above the horizontal plane and light can be directed down to the walkways where it is needed allowing for energy savings
- Take advantage of smart placement and choice of lights to minimise light spill. Specifically lights on the land area should face away from the neighbouring building.
- Vegetation, fences and other obstacles were not included in the model, primarily due to the uncertainties involved in modelling landscaping which may be prone to seasonal changes in foliage density and varying growth height with the passage of time. They will however provide additional shielding in the real world case and further reduce light spill.
- From observations on the night of testing shown in **Photo 3** it would appear that the lights on the Gladesville Bridge have the biggest effect on the local environment in terms of lighting and are likely to be more noticeable than other lighting installations.

Photo 3 Gladesville Bridge

7 Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

SLR has also reviewed the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 and has the following light spill comments with regard to the additions and alterations to the marina:

- Part 2, Clause 13 (c) states the following:

  "decisions with respect to the development of land are to take account of the cumulative environmental impact of development within the catchment"

  The cumulative effect of the additional lighting will be an increased number of lighting fixtures. The current light modelling study covered a "Future Planned" scenario that included the surrounding building and terrain along with the received plans for the proposed redevelopment. The light spill modelling results indicate the following:

  - The light spill impact on the façade of nearby buildings is minimal and the predicted Lux level is well below the AS 4282-1997 requirements.
  - As previously stated it is likely that the most noticeable lighting in the area will be the road lights on the Galesville Bridge.
  - The proposed mitigation in **Section 6.1** and **Section 6.2** will further reduce light spill to observers on the land and water.

- Part 3, Clause 26 states the following:

  "development should minimise any adverse impacts on views and vistas" and "the cumulative impact of development on views should be minimised".

While the addition of extra lighting fixtures could be seen to have a modest impact, the proposed mitigation strategies in **Section 6.1** (general mitigation) and **Section 6.2** (site specific recommendations) will address light spill issues relevant to the proposed development.

The light spill modelling results indicate that the light spill on to the surround buildings will be minimal.

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