

# Lighting and Security Strategy

## Causeway Pedestrian & Cyclist Bridges Project

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## Control Page

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## 1. PURPOSE

The Causeway Pedestrian and Cyclist Bridges Project is an opportunity to deliver a landmark pedestrian and cyclist connection across the Swan River that responds to the unique cultural and historic significance of the area, integrates with existing landscape and urban design, and provides an attractive link for both tourists and the wider community.

The aim of this brief is to identify the functional and technical requirements for each of the areas in scope and provide lighting and security recommendations and address any missed opportunities with regards to the lighting and security for the whole of site. In brief the lighting strategy will need to address the safe use of the shared pedestrian and cyclist path, the architectural features of the bridges, including to illuminate pylons, navigational/aviation lighting requirements, lighting of paths at the foreshore areas and identify any potential limitations or considerations that the client may need to be made aware of. These will need to be met whilst considering safety of pedestrian/cyclists from the perspective of clear visibility and security, aesthetics and cultural sensitivity, minimal light pollution, and minimising impact to flora and fauna.

The lighting strategy will and should complement the security surveillance requirements needed.

## 2. BASIS OF DESIGN AND ORIGINAL PROPOSAL

### 2.1 Lighting

The proposed lighting aims to provide a fully integrated and sustainable design solution that caters for the varying needs of the users while achieving safe movement principles. The lighting has been designed in accordance with the following standards, documents, and requirements:

- 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 4282:2019 Control of the obtrusive effects of outdoor lighting
- Lighting to connecting elements at foreshore areas in accordance with City of Perth and Town of Victoria Park Local Government Area (LGA) requirements
- Main Roads Western Australia requirements to comply with AS1158.3.1 subcategory PP3 for bridges, land-based paths and foreshore walkways to be lit to subcategory PP4.

The lighting design considers the following:

- The operational, safety and security requirements of the bridge and connecting elements
- Provide lighting for safe pedestrian and cyclist movement to all areas through orientation and detection of potential hazards
- The maintenance, access, and replacement flexibility of the lighting systems
- Security lighting for general surveillance including CCTV
- Appropriate illumination levels in accordance with CPTED principles to reduce the real and perceived risk of crime by revealing potential threats through adequate illumination
- The integration of lighting within the wayfinding and signage strategy to enable intuitive orientation
- Integration of the lighting with the landscape, to enhance and align with the natural environment
- Minimise glare and visual discomfort to the public and surrounding environment
- Minimise obtrusive light effects to surrounding areas and light pollution to the environment



- Consideration of lighting in the surrounding public domain, to ensure local regulatory body guidelines and requirements are met.

Luminaires for the project are selected to yield a harmonious integration with the architecture such that the outcome is a seamless solution. Generally, the luminaires perform two main functions:

1. Public Safety Lighting
  - for safe movement and to discourage potential malicious behaviour
2. Thematic & Architectural Lighting
  - for placemaking and civic pride.
  - for intuitive way-finding
  - for potential integration with public art and events

### 2.1.1 Public Safety Lighting

The Public Safety Lighting comprises LED luminaires mounted on free-standing light poles or handrail integrated lighting for safe movement and the improved perception of safety.

Given the exposed nature of the bridge infrastructure and connecting elements, the selected luminaires are of robust design to withstand the local environmental conditions and minimize potential malicious damage.

All luminaires include high quality energy efficient LED light sources and are of marine-grade construction.

### 2.1.2 Thematic / Architectural Lighting Design Intent

The Thematic / Architectural Lighting is mainly for off-site appreciation of the bridge form and structure. The lighting design employs LED floodlights at the base of each pylon to illuminate each of the pylons and stay cables (optional).

### 2.1.3 Marine and Aviation Lighting

Provision has been allowed for both marine navigation and aviation obstruction lighting in the form of conduits and draw wires only.

## 2.2 CCTV

A CCTV server will be located at the western side of Point Fraser and be connected to nearby City of Perth (CoP) cabinet for integration into CoP CCTV network. This will facilitate connection to CoP City Watch equipment room where all cameras can be centrally monitored and recorded.

A total of 32 No PTZ cameras will be installed providing coverage along main footpath from western boundary of Point Fraser to eastern boundary of McCallum Park. Cameras will only be provided to cover the pause points, this will be achieved with a minimum of three (3) PTZ cameras at each pylon.

## 3. PROPOSED LIGHTING AND SECURITY STRATEGY

### 3.1 Clarification and Ratification

The original proposal has made several assumptions that need clarification and confirmation to proceed with design clarity. The main issues to be resolved are as follows:

- Shared path lighting adherence to Main Roads current standard
- Stakeholder requirements
- Extent of thematic/architectural lighting

- Aviation obstacle lighting
- CCTV requirements
- Sustainability

### 3.2 Stakeholder requirements

Stakeholders have been consulted to seek feedback on their requirements on the lighting and security aspect of the project. The below table is a summary of those requirements.

| Stakeholder  | Requirement  |
|--|--|
| Main Roads (MRWA)  | Shared Path Lighting to meet safety and security requirements of the bridge and connecting elements. Lighting strategy to consider maintenance provisions of bridge lighting.  |
| City of Perth (CoP)  | Point Fraser and Heirisson Island pathway and Interest Points lighting. General surveillance for crowd control along the path from Point Fraser to McCallum Park.  |
| Town of Victoria Park (ToVP)   | McCallum Park pathway and Interest Points lighting. Also, to maintain consistency of light pole design with City of Perth. Request to include conduits for future CCTV throughout McCallum Park.   |
| Department of Transport (DoT)  | <ul style="list-style-type: none"> <li>- Navigational Lighting.</li> <li>- Future provisions for pile caps lighting to be allowed.</li> <li>- Overall bridge lighting spill should not impact Maritime traffic.</li> </ul>   |
| Department of Biodiversity, Conservation, and Attractions (DBCA)   | <ul style="list-style-type: none"> <li>- Lighting designed to minimise light spill to the foreshore reserve and river such that fauna/wildlife are not affected.</li> <li>- Minimal lighting is preferred however amenable to special event and safety requirement.</li> </ul> |
| Elders Advisory Group  | <ul style="list-style-type: none"> <li>- Lighting strategy to consider Heritage interpretation of the pylons and of bridge’s interpretative elements.</li> <li>- Differentiation of patterns on digging stick will be interpreted through the lighting strategy.</li> </ul>    |
| Aviation Group (Civil Aviation Safety Authority, AirServices Australia, Perth Airport, Jandakot Airport, RAAF Pearce Air Base) | <ul style="list-style-type: none"> <li>- Obstacle lighting will be dependent on government guidelines and regulations.</li> </ul>  |

#### 3.2.1 Shared Path Lighting

Current Main Roads WA requirements for principal shared path (PSP) lighting would require a higher category of illumination than that proposed. The Main Roads WA requirement is to use the lighting subcategory PP2 of AS1158.3.1 for PSP lighting. However, Main Roads WA has clarified that this will be a shared path (as opposed to a PSP) and although lighting levels that meet subcategory PP2 would be ideal, subcategory PP3 would be acceptable subject to a risk assessment.

Assessment of volume of traffic, crowd control CCTV requirement and pedestrian safety risk as part of the initial studies with regard to Safety in Design and Risk assessments categorised the pedestrian/cyclist activity and fear of crime to be medium in both cases. Based on these criteria the applicable lighting subcategory is PP3 (Table 2.2 of AS1158.3.1). See basis of assessment below:

Pedestrian & Cyclist Activity – medium

This is based on:

- Main Roads BDC specifies the following traffic figures “approximately 1,400 cyclists and 1,900 pedestrians per day, with peak hour volumes of over 150 cyclists and 200 pedestrians”.

- Based on current volumes the design width would require a 2.5 m bike path and a 2 m footpath for a total width of 4.5 m. In accordance with the BDC, Civmec/ SWC/ WSP is providing 3.5 m for cyclists and 2.5 m for pedestrians, a total of 6.0 m. Max capacity for the bridge at peak hour would be 1600 pedestrians and 1100 cyclists based on ARGRD Part 6a, Clause 5.1.3. The maximum capacity of the facility will provide a very high level of service for the foreseeable future.

Fear of crime – medium

This is based on:

- CCTV monitored by the City of Perth will be included at the approach embankments and at the pylons on the bridge, this will deter criminal activity.
- The bridges will be elevated and in the open reducing the risk perception of crime.
- The path provides a connection from the Town of Victoria Park to the City and will have a medium level of activity. Consequently, path users will not feel isolated.

Further justification:

- PP2 lighting sub category conflicts with other stakeholder requirements such as:
  - DBCA requirements for light spill into the river.
  - OGA requirements for cultural and architectural design intent of the bridge would suffer from the use of light poles.
- As detailed above the width of the path has significant capacity for more users. Reduced likelihood of conflict between path users.
- Furthermore, unlike traditional Main Roads PSP which have pedestrians & cyclist on the same path, this is a segregated path. Also the design is to incorporate measures to reduce cyclist speed throughout the bridge & particularly at potential conflict points such as the pause points. This poses a lower risk to traditional PSPs.
- The Elizabeth Quay Bridge is currently lit to PP3 and connects the shared path along the river.

**TABLE 2.2**  
**LIGHTING SUBCATEGORIES FOR PEDESTRIAN AND CYCLIST PATHS**

| 1   | 2                                    | 3                                   | 4             | 5                               |
|---|--------------------------------------|-------------------------------------|---------------|---------------------------------|
| Type of pathway   |                                      | Selection criteria <sup>a,b,c</sup> |               | 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 <sup>d</sup> and arterial roads <sup>e</sup> , walkways, lanes, park paths, cyclist paths | Pedestrian and or cycle traffic only | N/A                                 | High          | PP1 <sup>c</sup>                |
|   |                                      | High                                | Medium        | PP2 <sup>c</sup>                |
|   |                                      | Medium                              | Medium        | PP3                             |
|   |                                      | Medium                              | Low           | PP4                             |
|   |                                      | Low                                 | Low           | PP5                             |

**TABLE 3.4**  
**VALUES OF LIGHT TECHNICAL PARAMETERS FOR PATHWAYS AND CYCLIST PATHS**

| 1                    | 2   | 3  | 4  | 5  |
|----------------------|---|--|--|--|
| Lighting subcategory | Light technical parameters (LTP)                                    |  |  |  |
|                      | Average horizontal illuminance <sup>a,b</sup> ( $\bar{E}_h$ )<br>lx | Point horizontal illuminance <sup>a,b,d</sup> ( $E_{ph}$ )<br>lx | Illuminance (horizontal) uniformity <sup>c</sup> Cat. P ( $U_{E2}$ ) | Point vertical illuminance <sup>a,b</sup> ( $E_{pv}$ )<br>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 <sup>c</sup>  |
| PP5                  | 0.85  | 0.14   | 5  | 0.02 <sup>c</sup>  |

3.2.1.1 Bridge Lighting: Handrail lights on either side of the bridge (deck) path will provide the illuminance requirements to PP3. Figure 1 below is a reference image of luminaires recessed to handrails providing lighting for safe movement to cyclist and pedestrian crossing the bridge.

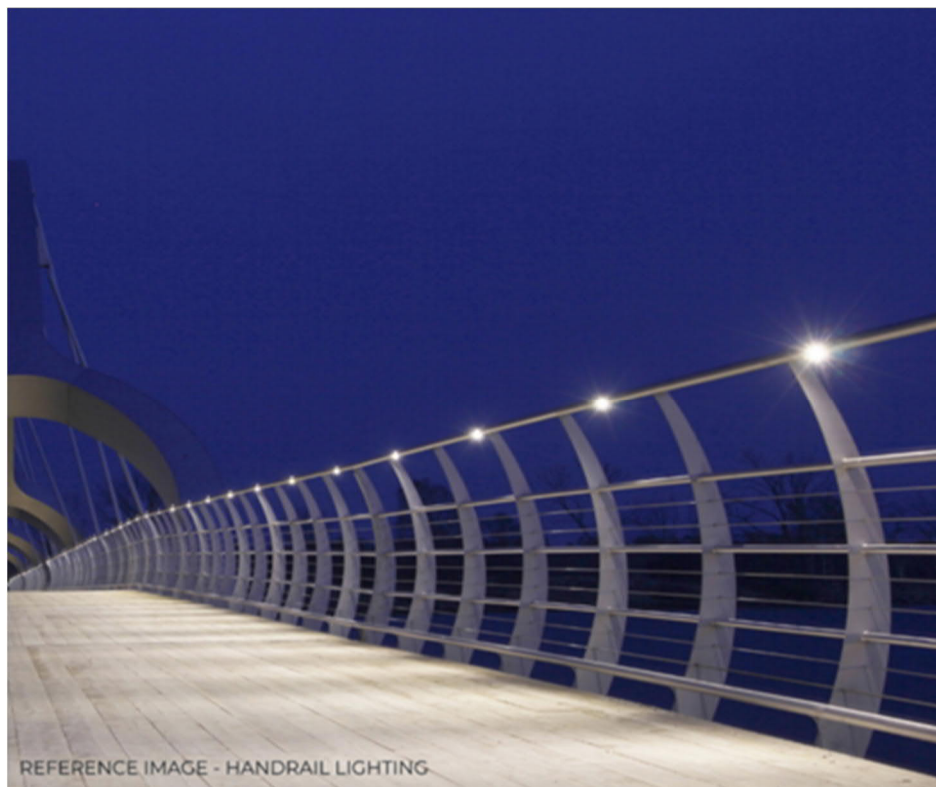


Figure 1: Reference image - Handrail lighting

Bridge deck calculation performed using design software AGI32.V20, confirms the handrail lighting complies to subcategory PP3 (Table 2.2 of AS1158.3.1). Figure 2 below is the calculation report generated from the design software. Design procedure performed in AGI32 are formulated from Clause 4.6 (Pathways for pedestrians or cyclists) of AS/NZS 1158.3.1. Results and compliance for Lighting subcategory PP3 are verified from table 3.4 of AS/NZS 1158.3.1.

| LABEL               | UNITS | AVERAGE | MAXIMUM | MINIMUM | UNIFORMITY |
|---------------------|-------|---------|---------|---------|------------|
| Eh Bridge Deck      | Lux   | 11.03   | 15.9    | 1.3     | 1.44       |
| Ev Bridge Deck - V1 | Lux   | N/A     | 0.9     | 0.4     | N/A        |
| Ev Bridge Deck - V2 | Lux   | N/A     | 0.9     | 0.4     | N/A        |

Figure 2: Calculation Summary

Horizontal Illuminance calculation: Minimum point horizontal illuminance = 1.3 lux > 0.5 lux required by AS/NZS 1158.3.1 Category PP3.

Horizontal Illuminance calculation: Illuminance (horizontal) uniformity =  $E_{max} / E_{avg} = 1.44 < 5$  required by AS/NZS 1158.3.1 Category PP3.

Vertical Illuminance calculation: Minimum point vertical illuminance = 0.4 lux > 0.1 lux required by AS/NZS 1158.3.1 Category PP3.

Bridge deck calculation render – Perspective view is shown in Figure 3 below.

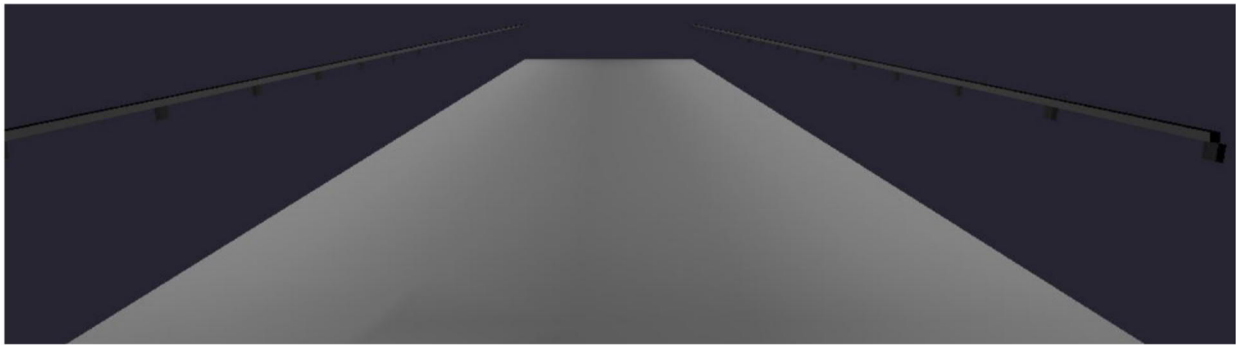


Figure 3: Bridge deck calculation render – Perspective view

Bridge deck horizontal illumination calculation is shown in figure 4 and the vertical illumination calculation are shown in figure 5 below.

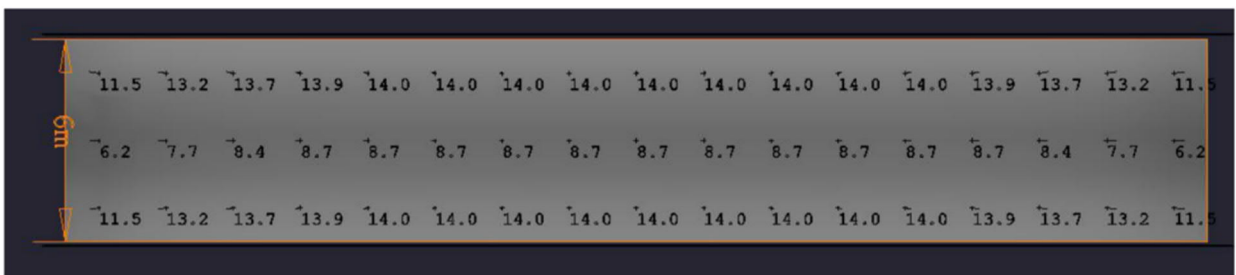


Figure 4: Horizontal Illumination calculation-  $E_h$  (Bridge deck floor)

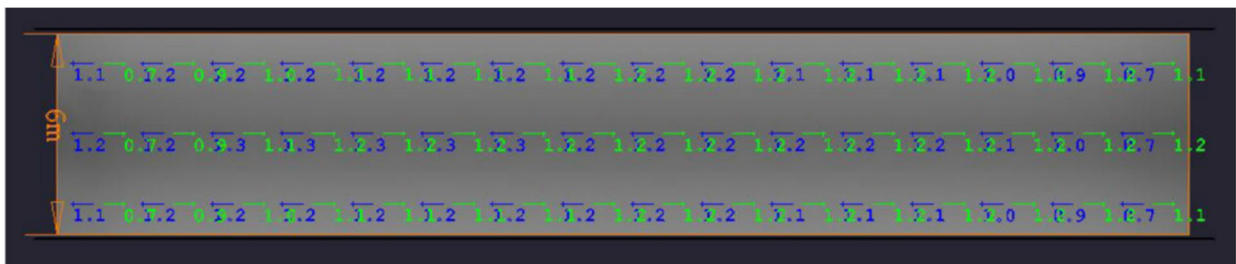


Figure 5: Vertical Illumination calculation-  $E_{pv}$  (Bridge deck floor)

Connecting elements to the path, points of interest, points of conflict and landscape lighting will be lit by pole lights conforming to City of Perth and Town of Victoria Park guidelines and complying to subcategory PP3. For land-based paths and foreshore walkways will be lit to subcategory PP4.

The shared pathways on Point Fraser, Heirisson Island and McCallum Park will be lit in accordance with AS1158.1.1 sub-category PP3. To achieve compliance, Pole mounted luminaires on 5m high posts will be used. Picnic and barbecue areas and conflict points will also be lit with high level lighting. Reference image of the pole mounted luminaires is shown in figure 6.





Figure 6: Reference Image - Pole mounted Luminaires

To consider the natural environment the foreshore walkways will be lit in accordance with AS1158.3.1 sub-category PP4.

Any areas identified where lights may (or might in future) impact fauna will be protected by using light shields and low illuminance light levels, with particular consideration to reducing short wavelength blue light.

All of these lights will be controlled by a local photoelectric cell and time clocks.

### 3.2.2 Thematic / Architectural Feature Lighting

The Point Fraser bridge consists of a single pylon shaped to replicate a boomerang. The McCallum Park bridge consists of two pylons replicating digging sticks. These features are to be lit to a standard that will be sympathetic to the cultural aspects. The stay cables, pylons and bridge structure will be lit to showcase the architectural features.

**Pylons:** All three pylons will be lit from their base by projector lights. These lights will showcase their features as well as supplement the obstacle lighting requirements. High output uplighters will illuminate the feature pylons. Narrow beam RGBW projectors installed at the bottom of each pylon gradiently graze the symbolic architectural elements that strongly represent the indigenous culture. With an intelligent lighting control system in place, the fixtures will be addressed via DMX and/or DALI drivers, a variety of pre-set schemes may be selected to suit events and seasonal festivities as required. Figure 7 below is reference image of the pylon lighting design intent. The pylon will also be equipped with Obtrusive Lights to comply with the relevant standards.



Figure 7: Reference image - Up lighting to Pylon

Stay Cables: The stay cables will be accented with narrow beam RGBW projectors installed to the bottom of each cable at location accessible for maintenance. The fixtures will be programmed via an intelligent lighting control system in conjunction with other colour changing luminaires so pre-set schemes can be created. Figure 8 is the reference image for design intent of stay cable lighting.



Figure 8: Reference image - Stay cable lighting design intent



Bridge structure: The underside of the bridge deck will not be lit to minimise light spill into the river and impacts on maritime traffic.

Special interest points in the parks will be lit to showcase artwork and/or features with in-ground floodlighting. Uplight to selected trees to highlight natural landscape elements. Linear lighting will be installed to underside of seat to provide low level lighting and create ambiance to key spaces. Design intent of seat lighting is shown in figure 9.



*Figure 9: Underside Seat lighting - Design Intent*

Figure 10 below is the overall lighting sketch render of the Causeway Pedestrian & Cyclist Bridges and figure 11 is the lighting sketch render of the thematic lighting. Look & feel of higher lighting level to active interest points are included in the Appendix 1.



*Figure 10: Causeway Pedestrian & cyclist bridges lighting sketch render*



Figure 11: Thematic Lighting sketch Render

### 3.2.3 Navigation / Aviation Lighting

Provision for future navigational lighting will be provided.

Swan River foreshore events where low flying aircraft are present, deem aviation obstacle lighting a requirement. Civil Aviation Safety Authority (CASA) guidelines indicate that the level of lighting will fall in the following category:

- When the top of the obstacle is less than 45 m above the level of the surrounding ground or the elevation of the tops of nearby buildings (when the obstacle is surrounded by buildings), the top lights are to be low intensity steady red obstacle lights. Additional low level intensity lights are to be provided at lower levels to indicate the full height and/or extent of the structure. These additional lights are to be spaced as equally as possible, between the top lights and ground level or the level of tops of nearby buildings, as appropriate. The spacing between the lights is not to exceed 45m.
- Where the installation of normal obstacle lighting is deemed impracticable or undesirable for aesthetic or other reasons, floodlighting of obstacles may be an acceptable alternative. However, floodlighting is not to be used unless with the concurrence of the relevant CASA office. Further, in general, floodlighting is not suitable if: the structure is skeletal as a substantially solid surface or cladding with satisfactory reflectance properties are required.

Low intensity steady red obstacle lights will be installed either at the top of the pylons or within 1.5 m of the top. The arrangement and number of lights will be such that the pylons are individually visible from every angle of azimuth. The arrangement of lights on the cables will be midway between the deck and the top of the pylon and spaced appropriately to indicate the extent of the obstacle.

### 3.2.4 Security Lighting for CCTV cameras

Some CCTV cameras can provide images in low light conditions, but generally CCTV requires support from lighting to provide footage that can be of value for monitoring, investigations, or provision of evidence. Considerations for lighting to support CCTV should include:

- Consideration for even/continuous lighting levels that do not create shadows or dark spots to ensure clarity of footage.
- Ensuring that lighting does not create glare for the cameras (thereby obscuring or flaring images).

- Consideration for lighting that provides good colour rendition (Colour rendering refers to the ability of the light source to accurately reflect the colour of objects.).

Some authorities develop their own lighting guidelines that exceed the levels listed in Australian Standards. The following table provides a comparison of lighting levels listed in Australian Standards with guidelines developed by the Government of Western Australia’s Public Transport Authority (PTA), and the ACT Crime Prevention and Urban Design Resource Manual issued by the Australian Capital Territory Government.

| Area   | AS/NZS 1158.3.1:2005 Lighting for Roads and Public Spaces | PTA Lighting Guideline | *ACT Resource Manual |
|--|---|------------------------|----------------------|
| Pathways – highest (eg for high risk crime areas) average horizontal illuminance (P1)  | 7 lux   | 7 lux                  | 7 – 20 lux           |
| Public activity areas – highest (eg for high risk crime areas) average horizontal illuminance (P6)   | 21 lux  | 21 – 150 lux           | 20 – 150 lux         |
| Connecting elements (eg. steps, stairways, footbridges, subways) – highest (eg for high risk crime areas) average horizontal illuminance (P10) | 35 lux  | 40 – 150 lux           | 35 – 150 lux         |
| Outdoor car parks – highest (eg for high risk crime areas) average horizontal illuminance (P11a)   | 14 lux  | 14 lux                 | 14 – 50 lux          |

City of Perth have indicated that CCTV/surveillance will be required at the entrances to the main pedestrian/cyclist path and at points of conflict, with light levels meeting or exceeding subcategory PP3. The level of surveillance will be to meet general crowd monitoring during major foreshore events.

PTZ cameras are to be mounted along the park pathways utilising the light poles where appropriate. The pause points on the bridge adjacent to the pylons will be monitored by cameras mounted on the pylon structure.

The cameras will be controlled remotely with the head end equipment located in the existing City of Perth cabinet at Point Fraser. The cameras will be connected via fibre optic cable from this cabinet along the path through to McCallum Park. Each camera pole will have two general purpose outlets for use by the cameras.

The CCTV will monitor the shared paths only from Point Fraser, Heirisson Island and on the bridge. It will be monitored and maintained by City of Perth.

**3.2.5 Sustainability**

LED lighting will be used for whole of site to reduce whole of life costs and provide more efficient energy solutions .

**4. CONCLUSION**

Lighting illuminance levels for the whole of the shared path will be predominantly meeting the subcategory of PP3. The foreshore paths will be lit to meet subcategory PP4.

Bridge pathway lighting will be ONLY via handrail lights and meet subcategory PP3.

All other connecting elements and park lights will be pole mounted.

Architectural bridge structure lighting will be deck based using projector lights upwards.

Obstacle lights will be mounted at the top of the pylons and midway on the suspension cables.

Surveillance via CCTV will be with cameras pole mounted along the path and mounted on the pylons near the pause points.

## **5. LIMITATIONS**

Lighting for aesthetic and decorative lighting is based on a minimalist, and sympathetic approach. Additional lighting such as under seat lights, event lighting, and any signalling/hazard lighting will be considered as being required either as low key and/or on demand basis.

Maintenance of the obstacle lights is assumed to be with an elevated work platform that has the required reach when located at the pause points.



## Appendix 1













## Appendix 2

# CLA-PS131735- Lighting Power and Security Risk Assessment

| Activity details        |                         | Sign-off                                |               |                   |
|-------------------------|-------------------------|---|---------------|-------------------|
| Project/activity<br>CLA | Project no.<br>PS131735 | Prepared by<br>Shabib Mehdi/ Mel Moreno | Sign<br>SM/MM | Date<br>25/7/2022 |
|                         |                         | Authorised by<br>C Pinto                | Sign<br>CP    | Date<br>26/7/2022 |

| Location/address  | Site contact | Date prepared |
|---|--------------|---------------|
| <b>Scope of works</b><br>Design of Pathway Lighting including Power supply and Security for the project site. |              |               |

| Desktop risk assessment |   |                |          |                     |          |          |                             |   |   |   |                                  |
|-------------------------|---|----------------|----------|---------------------|----------|----------|-----------------------------|---|---|---|----------------------------------|
|                         |   | Almost certain | Likely   | Moderate likelihood | Unlikely | Rare     | Consequence ratings defined |   | Reputation & Trust  | Financial   |                                  |
|                         |   |                |          |                     |          |          | Health and safety           | Environment   |   |   |                                  |
| CONSEQUENCES            | 5 | Critical       | Critical | High                | High     | Moderate | 5                           | Death, multiple major injuries, or significant irreversible disability.                         | Intense local impact with medium term effects and/or major potential for irreversible widespread impacts. | Abortive designs leading to time and budget overrun                     | Litigation and Major cost impact |
|                         | 4 | Critical       | High     | High                | Moderate | Low      | 4                           | Major injury or worker injury resulting in 4 or more days of incapacitation or hospitalization. | Major local impact with short term effects and/or moderate potential for widespread impacts.              | Missed project opportunities resulting in poor heritage design outcomes | Major cost impact                |
|                         | 3 | High           | High     | Moderate            | Low      | Low      | 3                           | Injuries resulting in 1-3 days incapacitation or hospitalization.                               | Moderate impact with medium term effects and/or low potential for widespread medium-term impacts.         | Public/community complaints   | Medium cost impact               |
|                         | 2 | High           | Moderate | Low                 | Low      | Low      | 2                           | Medical treatment beyond first aid.   | Minor local impact with short term effects or minor widespread impacts.                                   | Stakeholder criteria not met  | Minor cost impact                |
|                         | 1 | Moderate       | Low      | Low                 | Low      | Low      | 1                           | First aid, or an event with negligible safety impact.   | Minor impact with negligible effects.   | Feature not visible   | None or minor cost impact        |

| Task/activity   | Project Risk  | Resulting In  | Consequence category   | Potential hazard/impact   | Initial risk |          |          | Controls to be implemented<br><i>(prioritise elimination of risk so far as is reasonably practicable over substitution, engineering, administration &amp; PPE)</i>                                 | Residual risk |          |      | Person responsible for implementing controls |
|-----------------|---|---|--|---|--------------|----------|----------|--|---------------|----------|------|--|
|                 |   |   |  |   | Cons.        | Prob.    | Risk     |  | Cons.         | Prob.    | Risk |  |
| <b>LIGHTING</b> |   |   |  |   |              |          |          |  |               |          |      |  |
|                 | <ul style="list-style-type: none"> <li>Unable to achieve MRWA compliance to their shared path requirements with HANDRAIL Lights ONLY</li> </ul> | <ul style="list-style-type: none"> <li>Poor pathway visibility and glare.</li> </ul>  | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul>    | <ul style="list-style-type: none"> <li>Reduced safety of pedestrians and cyclists</li> </ul>                                  | 3            | Moderate | Moderate | <ul style="list-style-type: none"> <li>Investigate other solutions, higher intensity lights, lights on poles.</li> </ul>   | 1             | Unlikely | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Unable to achieve MRWA compliance to their shared path requirements with HANDRAIL Lights ONLY</li> </ul> | <ul style="list-style-type: none"> <li>Litigation</li> </ul>  | <ul style="list-style-type: none"> <li>Financial</li> </ul>              | <ul style="list-style-type: none"> <li>Additional cost due to reworks</li> </ul>  | 3            | Moderate | Moderate | <ul style="list-style-type: none"> <li>Investigate other solutions, higher intensity lights, lights on poles.</li> </ul>   | 1             | Unlikely | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Lighting glare with HANDRAIL Lights ONLY</li> </ul>  | <ul style="list-style-type: none"> <li>Complaints, falls, visibility issues</li> </ul>  | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul>    | <ul style="list-style-type: none"> <li>Reduced safety of pedestrians and cyclists</li> </ul>                                  | 1            | Moderate | Low      | <ul style="list-style-type: none"> <li>Investigate suitable mounting arrangements</li> </ul>   | 1             | Rare     | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Pollution - light spill</li> </ul>   | <ul style="list-style-type: none"> <li>Public/community complaints, reputational damage</li> </ul>  | <ul style="list-style-type: none"> <li>Reputation &amp; Trust</li> </ul> | <ul style="list-style-type: none"> <li>Loss of client's trust</li> </ul>  | 3            | Moderate | Moderate | <ul style="list-style-type: none"> <li>Undertake lighting study</li> </ul>   | 1             | Unlikely | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Lighting impact with Fauna</li> </ul>  | <ul style="list-style-type: none"> <li>Distress of fauna, Disturbance to nesting fauna.</li> <li>Breach of regulatory requirements</li> </ul> | <ul style="list-style-type: none"> <li>Environment</li> </ul>            | <ul style="list-style-type: none"> <li>Colour output of luminaire containing too much short wavelength blue light.</li> </ul> | 3            | Unlikely | Low      | <ul style="list-style-type: none"> <li>Design luminaires with minimal spill off bridge. Choose suitable colour of luminaire, but must be balanced with aesthetics for feature lighting.</li> </ul> | 1             | Rare     | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Use of light poles</li> </ul>  | <ul style="list-style-type: none"> <li>Stakeholder criteria not met</li> </ul>  | <ul style="list-style-type: none"> <li>Reputation &amp; Trust</li> </ul> | <ul style="list-style-type: none"> <li>Aesthetics, wind loading issues</li> </ul>   | 2            | Moderate | Low      | <ul style="list-style-type: none"> <li>Obtain stakeholder agreement</li> </ul>   | 1             | Rare     | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Vandal damage to light pole</li> </ul>   | <ul style="list-style-type: none"> <li>Infrastructure damage</li> </ul>   | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul>    | <ul style="list-style-type: none"> <li>Aesthetics</li> </ul>  | 1            | Likely   | Low      | <ul style="list-style-type: none"> <li>Consider vandal proof solutions</li> </ul>  | 1             | Unlikely | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Possibility of electrocution due to metal handrails (wet weather conditions)</li> </ul>                  | <ul style="list-style-type: none"> <li>Health hazards for pedestrians and cyclists.</li> </ul>  | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul>    | <ul style="list-style-type: none"> <li>Safety of pedestrians and cyclists</li> </ul>  | 4            | Unlikely | High     | <ul style="list-style-type: none"> <li>Adequate design with consideration to weather conditions and IP rating.</li> </ul>  | 1             | Rare     | Low  |  |

| Task/activity   | Project Risk   | Resulting In   | Consequence category  | Potential hazard/impact  | Initial risk |          |      | Controls to be implemented<br><i>(prioritise elimination of risk so far as is reasonably practicable over substitution, engineering, administration &amp; PPE)</i> | Residual risk |          |      | Person responsible for implementing controls |
|-----------------|--|--|---|--|--------------|----------|------|--|---------------|----------|------|--|
|                 |  |  |   |  | Cons.        | Prob.    | Risk |  | Cons.         | Prob.    | Risk |  |
|                 | <ul style="list-style-type: none"> <li>Pile cap lighting</li> </ul>  | <ul style="list-style-type: none"> <li>Damage to river vessels with potential for fuel spill. Damage to new structures.</li> </ul>                       | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul> | <ul style="list-style-type: none"> <li>Vessel collision with the structure</li> </ul>                                  | 4            | Moderate | High | <ul style="list-style-type: none"> <li>Adequate design.</li> </ul>   | 1             | Unlikely | Low  |  |
| <b>SECURITY</b> |  |  |   |  |              |          |      |  |               |          |      |  |
|                 | <ul style="list-style-type: none"> <li>Lack of Surveillance (No cameras)</li> </ul>  | <ul style="list-style-type: none"> <li>Personal injury</li> <li>Fatality/ Multiple fatalities</li> <li>Plant/ property/ Infrastructure damage</li> </ul> | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul> | <ul style="list-style-type: none"> <li>Fear of crime</li> </ul>  | 4            | Likely   | High | <ul style="list-style-type: none"> <li>Inclusion of surveillance cameras</li> </ul>  | 2             | Unlikely | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Minimal Surveillance (Inadequate number of cameras)</li> </ul>                      | <ul style="list-style-type: none"> <li>Conflict between pedestrians, cyclists and other bridge users</li> </ul>  | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul> | <ul style="list-style-type: none"> <li>Poor resolution of pedestrian transport modes</li> <li>Fear of crime</li> </ul> | 4            | Likely   | High | <ul style="list-style-type: none"> <li>Adequate design.</li> </ul>   | 2             | Unlikely | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Lack of appropriate lighting for personal sense of safety</li> </ul>                | <ul style="list-style-type: none"> <li>Personal injury</li> <li>Fatality/ Multiple fatalities</li> <li>Plant/ property/ Infrastructure damage</li> </ul> | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul> | <ul style="list-style-type: none"> <li>Fear of crime</li> </ul>  | 3            | Likely   | High | <ul style="list-style-type: none"> <li>Adequate design.</li> </ul>   | 1             | Rare     | Low  |  |
|                 | <ul style="list-style-type: none"> <li>Lack of appropriate lighting for CCTV image capture (Facial recognition)</li> </ul> | <ul style="list-style-type: none"> <li>Personal injury</li> <li>Plant/ property/ Infrastructure damage</li> </ul>  | <ul style="list-style-type: none"> <li>Health &amp; Safety</li> </ul> | <ul style="list-style-type: none"> <li>Lack of surveillance</li> </ul>   | 3            | Likely   | High | <ul style="list-style-type: none"> <li>Adequate design.</li> </ul>   | 1             | Rare     | Low  |  |

## Appendix 2

# LIGHTING STRATEGY

# Causeway Pedestrian and Cyclist Bridge

PERTH, WA

Thematic Lighting  
15% Concept Design







\_\_\_\_\_

We acknowledge the traditional owners  
of the lands where our projects take  
place, throughout Australia, and their  
continuing connection to culture,  
community, land, sea and sky.  
We pay our respect to Elders past,  
present and future.

\_\_\_\_\_



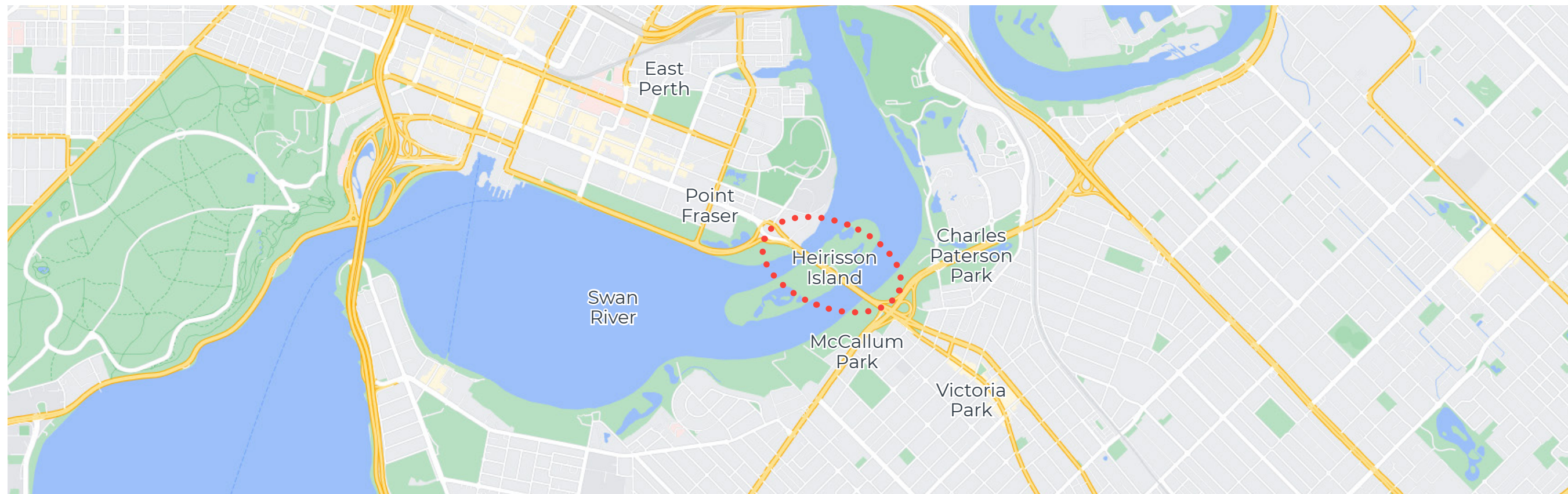
## Introduction

The Causeway Bridge is a new Pedestrian and Cyclist bridge to be constructed over the Swan River, stretching from Victoria Park to the city via Heirisson Island, on the Country of the Whadjuk Noongar people.

The iconic cable-stayed bridge will be built downstream of the heritage-listed Causeway Bridge, where currently more than 1,400 cyclists and 1,900 pedestrians use the two-metre wide Causeway path each day.

The new bridge will be six-metres wide and will provide a safer connection for people walking and riding from the Perth CBD to Victoria Park and beyond. There will be dedicated rest points along the bridges - which are being built for path users, not vehicles.

The project is located between East Perth and Victoria Park, within the local government authority of the City of Perth and the Town of Victoria Park.



### BENEFITS & KEY CONSIDERATIONS

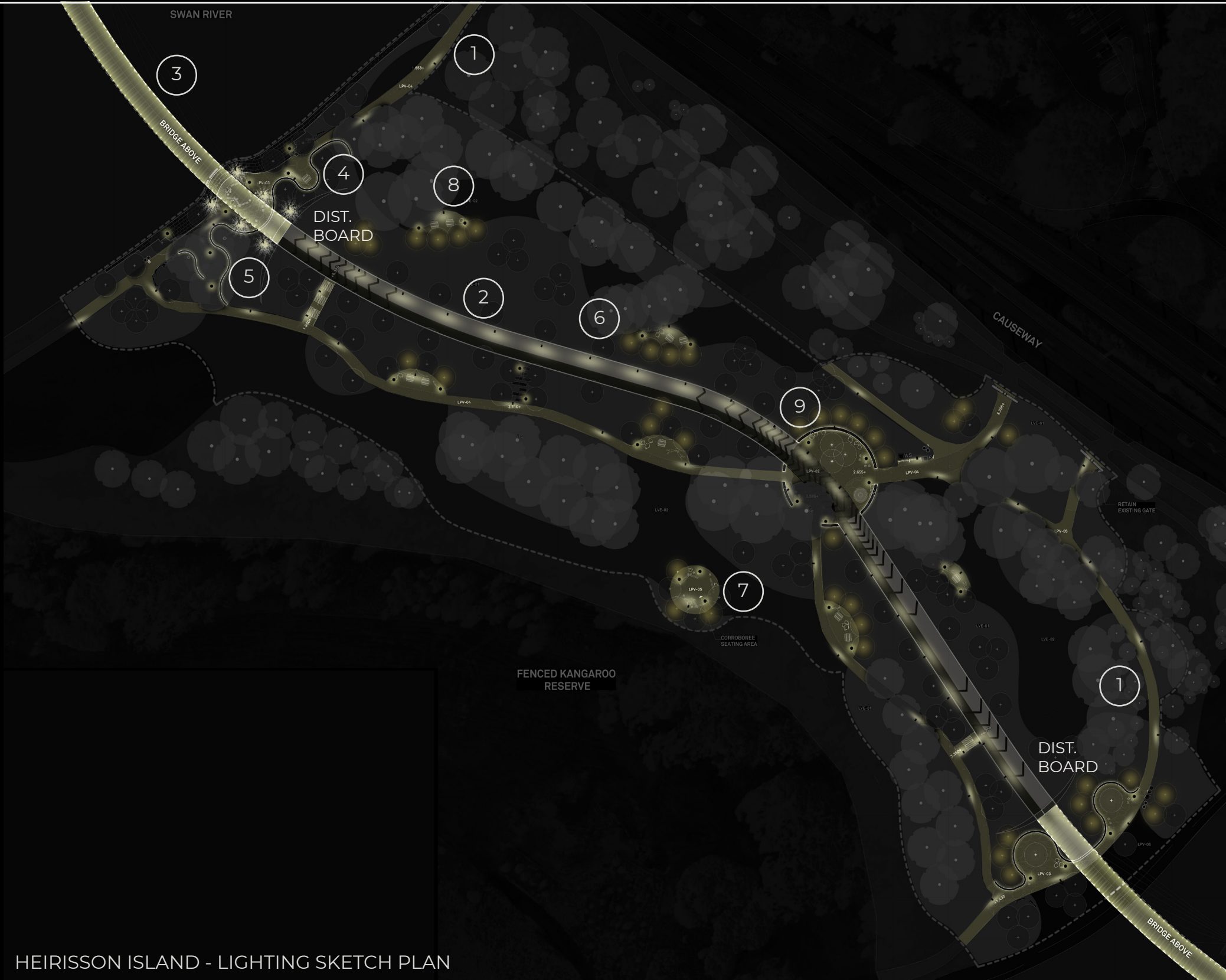
- Recognition of the significant Aboriginal heritage at Heirisson Island and the Swan River
- Provision of new bike riding and pedestrian facilities between Perth CBD and Victoria Park
- The new infrastructure will encourage more people to consider walking and riding as a transport option in the area
- Improved safety, connectivity and amenity for path users
- Intent to minimise the impact on the surrounding environment



## 2. OVERALL STRATEGY







HEIRISSON ISLAND - LIGHTING SKETCH PLAN

1. Pathway lit with pole mounted luminaires to comply with AS1158 sub-category PP4
2. Pathway lit with pole mounted luminaires to comply with AS1158 sub-category PP3
3. Bridge deck lit with handrail luminaires to comply with AS1158 sub-category PP3
4. Linear lighting to concrete seats for additional low level lighting to architectural elements
5. LED lighting installed underneath bridge in key areas for anti social behaviour lighting
6. Uplight to selected trees to highlight natural landscape elements
7. Accent lighting to sculptures and interest points
8. High level lighting to picnic and barbecue areas
9. Pole mounted luminaires to conflict points
10. Thematic lighting to bridge cables
11. Thematic lighting to pylon
12. Obstruction light on top of pylon



REFERENCE IMAGE - PARK POLE TOP & BOLLARD LIGHTING



### 3. AMENITY LIGHTING







3.1 // The shared pathways on Point Fraser, Hairisson Island and McCallum Park will be lit in accordance with AS1158.1.1 sub-category PP3.

To achieve compliance, Pole Top luminaires on 5m high posts will be used.

Picnic and barbecue areas and conflict points will also be lit with high level lighting.

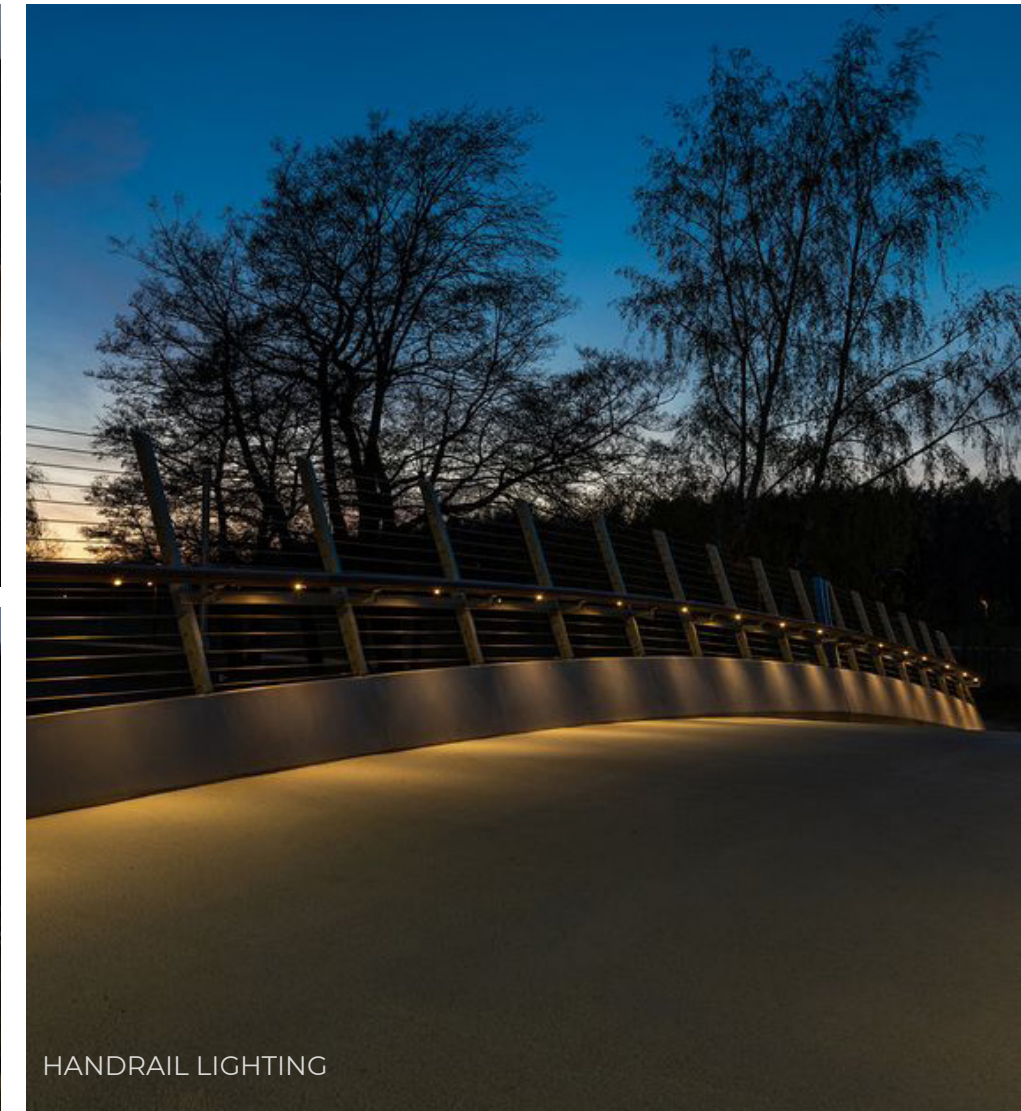
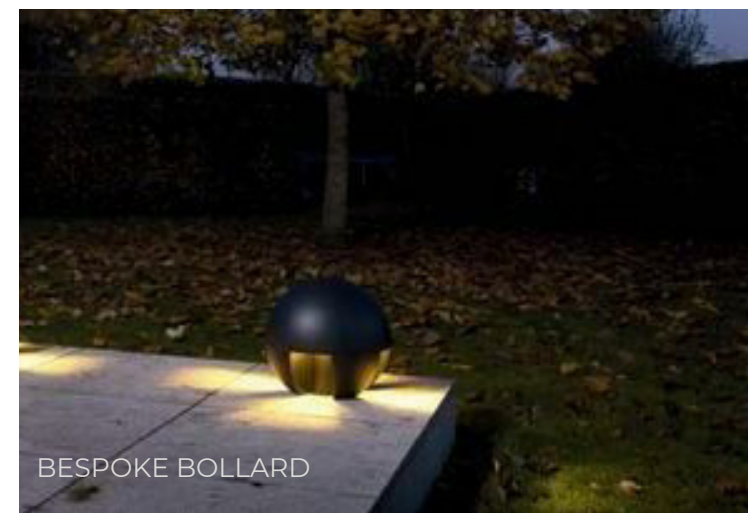
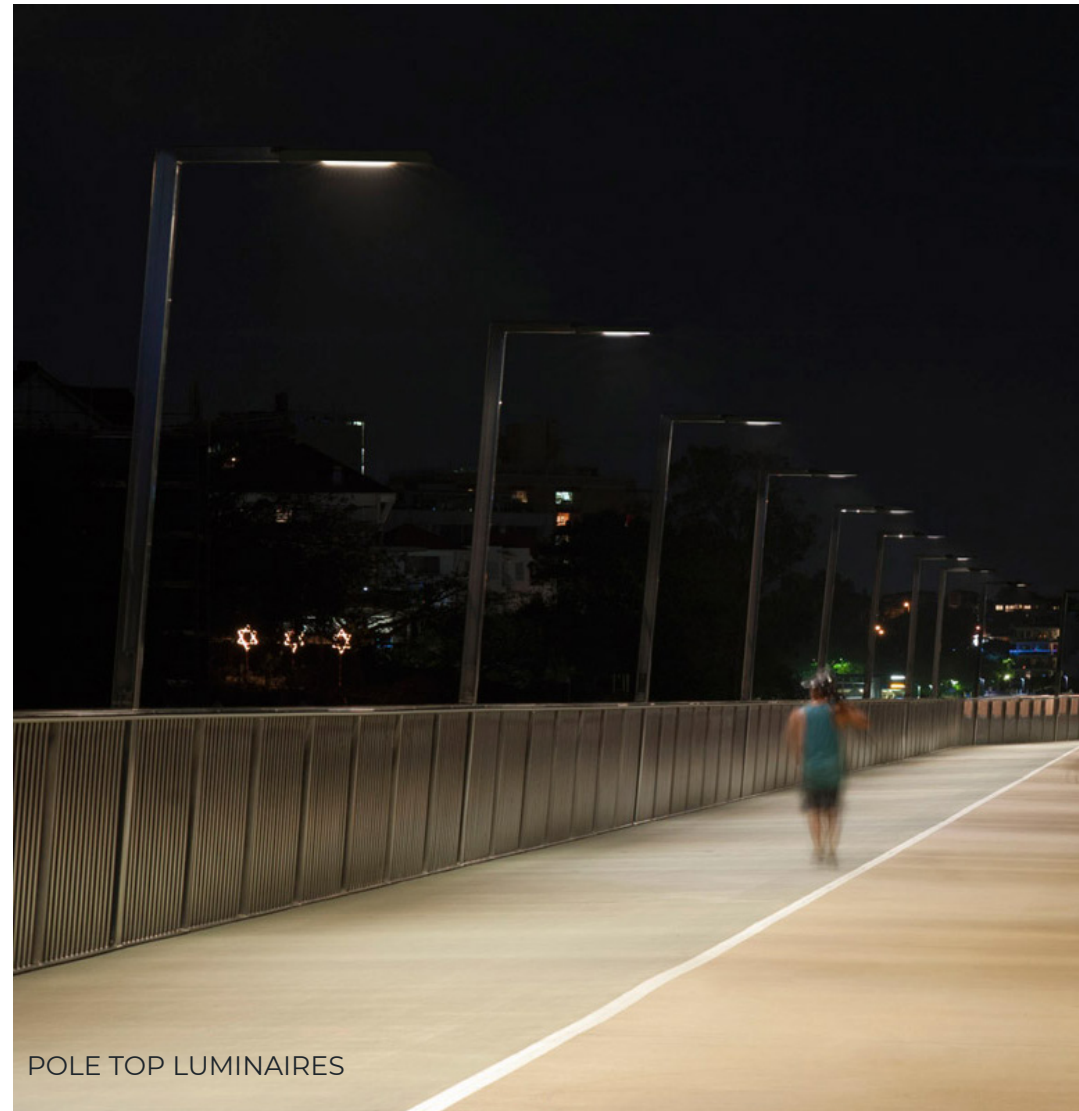
PHILIPS  
LUMA GEN2 47W 3000K  
MOUNTED ON 5m HIGH  
ALUMINIUM POLE WITH  
NEMA RECEPTACLE  
LUMINAIRE ON GRADE  
S60



REFERENCE IMAGE - POLE TOP LUMINAIRES



## Look & Feel



\* REFERENCE IMAGES ARE INDICATIVE AND FOR CONCEPT PURPOSES ONLY



# 4. THEMATIC LIGHTING







REFERENCE IMAGE - UPLIGHTING TO MASTS



4.1 // High output uplighters will illuminate the feature masts. Narrow beam RGBW projectors installed at the bottom of each mast gradually graze the symbolic architectural elements that strongly represent the indigenous culture.

With an intelligent lighting control system in place, the fixtures will be addressed via DMX and/or DALI drivers, a variety of pre-set schemes may be selected to suit events and seasonal festivities as required.

PHILIPS COLOR KINETICS  
COLOR BLAST GEN4 /50W

The masts will also be equipped with Obtrusive Lights to comply with the relevant standards.



REFERENCE IMAGE - OBSTRUSIVE LIGHT



5. ARCHITECTURAL LIGHTING







4.2 // Linear lighting installed to underside of seat to provide low level lighting and create ambiance to key spaces.

LED RGBW  
PURELED  
FLEXTUBE  
3000K





## Look & Feel - Indigenous Artwork Lighting

