



PENRITH

Pedestrian Lighting Strategy

PENRITH
CITY COUNCIL

Prepared for
Penrith City Council

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Ironbark has been operating since 2005 and brings together a wealth of technical and financial analysis, maintenance and implementation experience in the areas of building energy and water efficiency, public lighting and data management. We pride ourselves on supporting our clients to achieve real action regarding the sustainable management of their operations.

Our Mission

The Ironbark mission is to achieve real action on sustainability for councils and their communities.

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1 EXECUTIVE SUMMARY

The Penrith City Council Pedestrian Lighting Strategy (the Strategy) has been developed in response to the Penrith Night Time Economy Strategy 2015 which identified the need to improve pedestrian light levels in the City Centre.

The role of the Strategy is to:

- promote pedestrian safety
- improve amenity
- assist with way finding
- minimise energy use, and
- enhance peoples' experience of the City Centre at night.

The Strategy also seeks to help Council achieve best practice management of its pedestrian lighting assets, including street lighting, pathway and open space lighting, and car park lighting.

The Strategy is divided into three key sections:

- Functional Lighting - Identifies the key issues and actions relating to lighting which provides the 'base' level of illumination to assist pedestrians to move about safely and comfortably.
- Creative Lighting - Introducing lighting which makes the City Centre attractive, reinforces a sense of place, is used to highlight certain spaces, and may act as a mode for creative and artistic expression.
- People Spaces - Identifies the key pedestrian precincts and provides guidance on the functional and/or creative lighting that should be considered.

The Strategy development process included a detailed audit of pedestrian light levels within the City Centre and peripheral residential areas, and thorough consultation with key staff.

The Strategy defines issues, identifies actions and helps set priorities for Penrith City Centre pedestrian lighting projects. The Strategy will be used as the basis for developing a detailed implementation plan which will outline a program of tasks to be completed and resources required to achieve compliance with functional lighting requirements, implement creative lighting solutions, and to bring Council up to best practice level of management of pedestrian lighting assets.

2 INTRODUCTION

This Pedestrian Lighting Strategy seeks to promote pedestrian safety, amenity and way finding; minimise energy use; and enhance peoples' experience of the Penrith City Centre at night. The Strategy addresses the functional role that pedestrian lighting plays, but is also based on the understanding that lighting of the public domain can reinforce a sense of place and be a mode for creative and artistic expression. This Strategy will contribute to the identity of the City Centre and its peripheral residential areas, and serve as a medium for promotion, attracting tourism and increasing night-time patronage of businesses.

2.1 Pedestrian Lighting Strategy Focus and Objectives

The Strategy has two key areas of focus:

Functional Lighting - provides a 'base' level of illumination, ensuring that pedestrians, cyclists and vehicles have a safe and comfortable visual environment at night. Functional lighting is required throughout the Penrith City Centre.

Creative Lighting - makes the Penrith City Centre attractive, reinforces a sense of place, and is a mode for creative and artistic expression. Creative lighting will be used to target or highlight specific locations, may be seasonal, dynamic or linked to specific events, and will provide contrast to functional lighting.

Council's approach to the provision of both functional and creative pedestrian lighting in the Penrith City Centre and peripheral residential areas also seeks to address the key objectives outlined below, and which are described further in Section 4:

- Design Directions
- Safety and Amenity
- People Attraction
- Sustainable and Smart Cities
- Maintenance



2.2 Pedestrian Lighting Strategy Scope

This Strategy provides direction for lighting pedestrian spaces in the Penrith City Centre and surrounds. The areas to which this Strategy applies are identified in Figure 1, and includes existing pedestrian areas as well as planned sites such as the proposed City Park and City Square on Station Street. Pedestrian areas are classified as one of the following:

City Centre Footpaths where pedestrian activity is highest in the Penrith City Centre.

Peripheral Residential Area Footpaths where City Centre workers and visitors may park vehicles before entering the Penrith City Centre area.

People Spaces where pedestrian activity is high (including park pathways, key connecting routes and car parks) or where people may be expected to meet and gather (including plazas and lanes).

The Strategy seeks to promote pedestrian safety, amenity, way finding and minimise energy use, while enhancing people’s experience of the Penrith City Centre at night. The Strategy defines issues, identifies actions and helps set priorities for Penrith City Centre pedestrian lighting projects.

The Strategy does not apply to the illumination of on-road spaces. However, it is acknowledged that there will be some overlap, whereby in practice public lighting provides illumination for both on-road and pedestrian areas.



Figure 1: Pedestrian areas within the scope of the Strategy

2.3 Pedestrian Lighting Strategy Structure

The Strategy is divided into three key sections:

Section 4 Functional Lighting - This section outlines key issues and actions relating to functional pedestrian lighting in the Penrith City Centre and its peripheral residential areas.

Section 5 Creative Lighting - This section defines creative lighting and the outlines the general principles that govern where and how it should be applied.

Section 6 People Spaces - Identifies the key pedestrian precincts and provides guidance on the functional and/or creative lighting that should be considered.

Section 2.1 outlines the key objectives that underpin the expected lighting outcome in each area. These objectives are then addressed in an exploration of key issues within Sections 4, 5 and 6. A concise description of each issue is provided, followed by relevant actions.

Although each pedestrian lighting issue can be read independently, key actions under different headings are often related. Some actions also follow a critical path, and may not be able to be completed until previous actions are completed. For this reason, the document should be applied and understood as a whole.



3 BACKGROUND

3.1 What is Pedestrian Lighting?

Pedestrian lighting caters for various types of public spaces, and involves many different lighting types. Figure 2 provides a summary of the main lighting types that Council either manages or pays for. These include:

- pathway/open space lighting which can include lighting of any elements within open space such as BBQ's, pergolas and features
- car park lighting where the car park is wholly council managed
- residential street lighting which is generally found on minor roads in residential areas
- main road lighting which is generally found on major arterial roads
- foreshore lighting (similar to pathway/open space lighting)



Figure 2: What is pedestrian lighting?

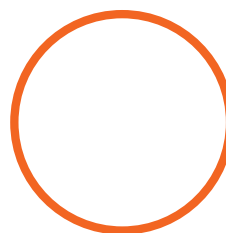
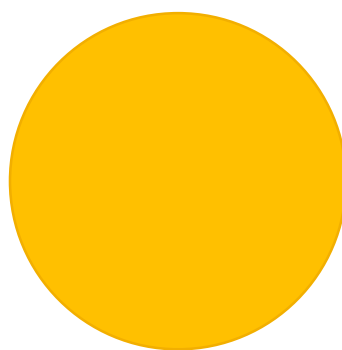
3.2 Responsibility for Pedestrian Lighting

There are three main management structures for pedestrian lighting infrastructure:

- **Council has full responsibility** - Councils are fully responsible for many outdoor pedestrian lighting assets (examples are for open space and around some wholly council managed buildings and car parks). Illustrated as the **BLUE** boxes in Figure 2.
- **Council has no responsibility** - Asset installation, operation and maintenance commonly the responsibility of private owners. Examples include under-awning, shop-front and building security lighting. Illustrated as the **GREEN** boxes in Figure 2.
- **Council shares responsibility with Distribution Network Service Provider (DNSP, i.e. Endeavour Energy)** - The DNSP is responsible for most maintenance and asset management decisions (for example, unmetered street lighting). Council is responsible for paying part or all costs, and can have responsibility for non-standard (decorative) lighting and shared responsibility for lighting levels. Illustrated as the **ORANGE** boxes in Figure 2.

The majority of the pedestrian lighting assets in the City Centre are street lights owned by Endeavour Energy, especially where peripheral residential areas are concerned. Endeavour Energy maintain ownership of the majority of poles and luminaires, and specify the range of luminaires and poles that can be installed at these locations.

Council is responsible for paying for the energy consumption and maintenance of these poles and luminaires.



In 2013 and 2014 the Western Sydney Regional Organisation of Councils (WSROC) and councils reviewed the ownership structure in preparation for a large-scale LED lighting changeover of Endeavour Energy's assets. During this process, it became clear that Endeavour Energy intended on retaining its assets. Council cannot acquire these assets without Endeavour's consent.

Within this Strategy a pragmatic approach to this issue has been considered. This approach is to focus on the outcomes and service levels Council wants to achieve, whilst balancing value for money and quality outcomes.

All of the actions and strategies within this document can be delivered under the current ownership model. If there are any changes to ownership and management responsibility then the actions may require reviewing.

Roads and Maritime Services (RMS) are another key stakeholder when it comes to pedestrian lighting along state roads in the Penrith City Centre and peripheral residential areas. In such instances, Endeavour Energy still maintain ownership of poles and luminaires, however energy and maintenance costs are shared between Council and RMS.

It should also be noted that while the primary purpose of a given public light may be to provide illumination for vehicles or cyclists, for example on footpaths along major roads, in practice this lighting may serve the dual purpose of also providing illumination for pedestrians, and therefore is considered within the scope of this Strategy.



3.3 Stakeholder Engagement

From December 2016 to May 2017 a series of stakeholder workshops were conducted with key Council stakeholders. Council stakeholders included representatives from the following Council departments/areas:

- Assets
- Community Safety
- Transport
- Sustainability
- Landscape
- Cultural Development
- Wayfinding
- Economic Development

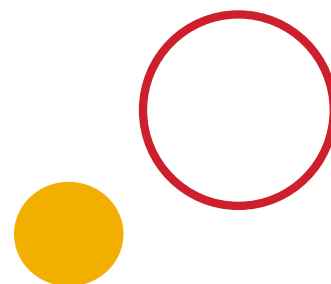
The purpose of the workshops was to identify the key issues and actions to be addressed by the Strategy, and to establish desired light levels for key pedestrian areas within the Penrith City Centre. Establishment of desired light levels was in part informed by the

results of a pedestrian lighting level audit conducted across sites in the City Centre in January 2017.

This Strategy incorporates the outcomes of the stakeholder consultations, with actions specifically designed to allow Council to address key issues identified.

While Council can exert significant influence on pedestrian lighting, it is also acknowledged that a wider range of stakeholders need to be consulted and collaborated with to achieve ideal outcomes. As such, Council will seek further consultation with the following external stakeholders:

- Endeavour Energy
- Local Police
- Penrith Valley Chamber of Commerce
- Endeavour Energy
- Roads and Maritime Services (RMS)
- Transport for NSW
- Penrith CBD Corporation



3.4 Strategic and Policy Context

This Strategy aligns with the objectives outlined in the following key Council plans, strategies and policies:

- Penrith Progression - A Plan for Action, 2015
- Penrith Night Time Economy Strategy, 2015
- Penrith City Centre Public Domain Masterplan, 2013
- Penrith City Council Wayfinding Strategy, 2014
- Penrith City Centre Car Parking Strategy, 2011
- Public Art and Place Making Policy, 2011

A number of other background documents were referred to in the development of this Strategy:

- Public Domain Lighting Policy, 2004
- Penrith CBD - Public Domain Technical Manual, 2013
- Penrith Civic Arts Precinct Technical Specification, 2015
- Pedestrian CBD Under Awning Lighting Report, 2016
- Triangle Park Lighting Design, 2016
- Penrith City Council Lighting Level Audit Report, 2017

Of particular importance is the Penrith City Council Lighting Level Audit Report commissioned by Council in 2017 to inform the development of this Strategy. The audit assessed pedestrian lighting levels within the City Centre and peripheral residential areas against both the Australian Standards¹ and Council's own target light levels for pedestrian lighting in the City Centre (established in consultation with key staff). Overall, pedestrian lighting levels were found to be at a relatively high standard with

¹ AS/NZS 1158.3 Pedestrian Area Lighting

most areas complying to at least minimum Australian Standards. However, some areas failed to meet Council’s desired light level targets. A high-level summary of the audit results is presented in Table 1.

Table 1: Audit findings according to Council’s light level targets.

| Audited Area (no. of sites) | Target Light Level | Results |
|---|---|--|
| Footpaths along City Centre Streets (27) | P2 level | Six footpaths fully comply with target. The remaining 21 footpaths included one or more segments with lighting levels that fell below the requirements of the P2 level target. |
| Footpaths along peripheral residential streets (20) | P3 level | No footpaths fully comply with target (though 12 of these included segments that met P3 level). |
| Pathways (5) | P1 to P3 level (site-specific) | One pathway complies with Council targets. Overall relatively good levels with four out of the five complying with at least the minimum subcategory of P5 level. |
| Public Spaces (5) | P8 level | Two comply with target. |
| Car Parks (8) | P11b level (standard car parking) P12 level (disabled car parking) | None comply with target. |

Community consultation conducted as part of the development of Council’s Night Time Economy Strategy highlighted a public perception that the City Centre does not have adequate public lighting, and that improvements to lighting of public spaces would assist with the development of the local night time economy. However, the results of the pedestrian light level audit (described above) indicated relatively high levels of compliance with Council’s desired light level targets for some key precincts (e.g. High Street). The apparent conflict between public perception and audit results may be a function of the inconsistent and ad-hoc provision of public lighting in some areas (e.g. a wide range of light types, colours, mounting heights etc.), rather than an accurate assessment of overall light levels. As a result, a key focus of this Strategy is the development of a consistent lighting style or aesthetic across the City Centre, in addition to achieving uniform minimum light levels.

4 FUNCTIONAL LIGHTING

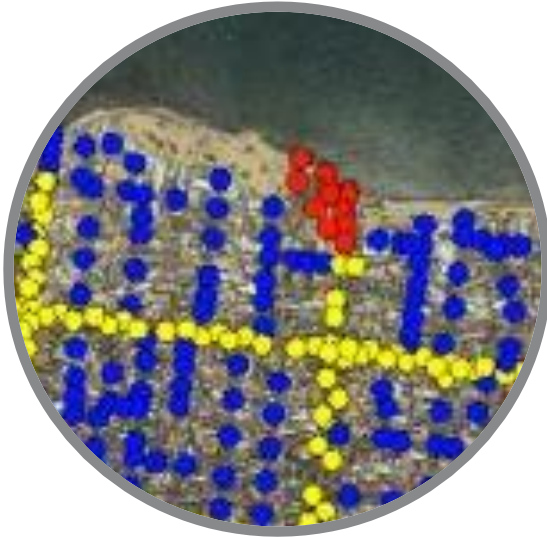
Functional Lighting provides a ‘base’ level of illumination ensuring that pedestrians, cyclists and vehicles have a safe and comfortable visual environment at night. Functional lighting is required within the Penrith City Centre and peripheral residential areas.



Outdoor public lighting of pedestrian areas is vital for ensuring the Penrith City Centre and its peripheral residential areas are accessible, safe and attractive for pedestrians. This is to be achieved by a ‘base’ level of functional lighting. The key purpose of this section of the Strategy is to define the functional lighting requirements for public pedestrian areas within the Penrith City Centre and peripheral residential streets, both in terms of illumination and technical specifications.

The use of functional lighting as specified in this Strategy will help Council achieve the objectives as outlined in Section 2.1.

4.1 Design Directions



The Design Directions objective is concerned with ensuring pedestrian lighting in the Penrith City Centre and its peripheral residential areas is consistent, attractive and balanced. Design Directions specify technical and performance requirements as well as some more general design principles that should be adhered to.

While these Design Directions should apply to all functional lighting, they should also be considered for creative lighting (refer to Section 5), although creative lighting solutions are likely to depart from these directions due to the specific requirements of certain sites (refer also to Section 6).

In general, functional lighting should enable people to navigate easily and comfortably through the Penrith City Centre and its peripheral residential areas. Functional lighting should provide a sense of completeness and continuity throughout the Penrith City Centre and peripheral residential areas, and should present public spaces as warm and inviting. Functional lighting hardware (luminaires and poles) should be selected to minimise capital and maintenance costs, and be a background element in the streetscape. Functional lighting should also consider people with vision impairment who require clear visual cues to navigate through public spaces.

Table 2 below outlines specific issues and associated design responses and actions relating to Design Directions.

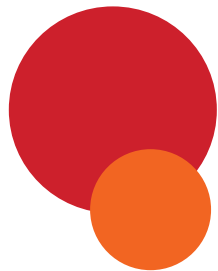


Table 2: Design Directions issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|--|---|
| 4.1.1 | Lighting levels to be appropriate for the space and consistent with the street hierarchy | <p>Lighting levels for pedestrians in the Penrith City Centre and peripheral residential areas shall be consistent and appropriate for the relevant space type, reflecting Council’s functional hierarchy of streets and public spaces.</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • Ensure pedestrian lighting achieves the relevant minimum light levels as specified in Section 4.1. |
| 4.1.2 | Lighting infrastructure to contribute to a coherent and consistent streetscape | <p>Functional pedestrian lighting infrastructure should be elegant and simple, and contribute to a coherent and consistent streetscape.</p> <p>Avoid the use of non-standard or decorative luminaires for functional lighting purposes.</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • For metered sites (Council-owned and maintained) develop a limited suite of standard luminaires and poles to be used for functional lighting of City Centre footpaths, Peripheral Residential footpaths, People Places and car parks. |
| 4.1.3 | Review of Public Domain Lighting Policy and Public Domain Technical Manual | <p>Review and update the existing Public Domain Lighting Policy and Public Domain Technical Manual to cater for updated standards and new technologies (e.g. LED lighting, smart lighting, smart poles etc.) and to align with relevant requirements specified in this Strategy (e.g. light level and control requirements).</p> |

| Ref | Issue | Design Response and Action(s) |
|-------|--------------------------------------|---|
| 4.1.4 | Smart technology opportunities | <p>Smart Lighting Infrastructure should be included in all metered pedestrian lighting installations. Council to also advocate to Endeavour Energy the use of smart technology in unmetered installations. Once advocacy successful, Council to select smart controls.</p> <p>Smart Lighting Infrastructure should at a minimum include the following:</p> <ul style="list-style-type: none"> • remote dimming • time switching • identification of maintenance requirements <p>Refer also to 4.4.7.</p> |
| 4.1.5 | Under-awning and shop-front lighting | <p>Retail streets (such as High Street) feature large amounts of shop frontage and under-awning space. Lighting of these features should contribute to a consistent, coherent and attractive streetscape.</p> <p>Consistent with actions identified in the Penrith City Night Time Economy Strategy, Council should develop and implement policies and programs to guide under-awning and shop-front lighting displays.</p> <p>Council has previously undertaken a study into the under-awning lighting on High Street. The report and its recommendations may form the basis of an under-awning lighting policy, however any policy should:</p> <ul style="list-style-type: none"> • include more detailed exploration of the challenges associated with private ownership of these lighting assets • ensure that any policy positions are consistent with those specified in this Strategy • review technical performance specifications to ensure they are consistent with best practice <p>Key action(s):</p> <ul style="list-style-type: none"> • Develop and implement Under-Awning Lighting Policy • Develop and implement Shopfront Display Lighting Program |

| Ref | Issue | Design Response and Action(s) |
|-------|-------------------------|---|
| 4.1.6 | Guidance and wayfinding | <p>Functional pedestrian lighting installations should align with and complement Council’s Wayfinding Strategy.</p> <p>To assist with navigation and wayfinding, feature lighting may also be used to highlight key landmarks. Landmarks should be chosen based on existing or desired pedestrian circulation patterns. Lighting of landmarks should be carefully designed and targeted to avoid excessive illumination, glare or light spill.</p> <p>Lighting of landmarks should be switched (at a time to be determined by Council).</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • Refer to Section 6. |



Lighting Levels and Controls

■ ■ ■ ■ ■ Lighting Levels and Controls for City Centre and Peripheral Residential Area Footpaths

Footpaths along streets and roads within the Penrith City Centre and Peripheral Residential Areas are identified and classified as per Figure 3.

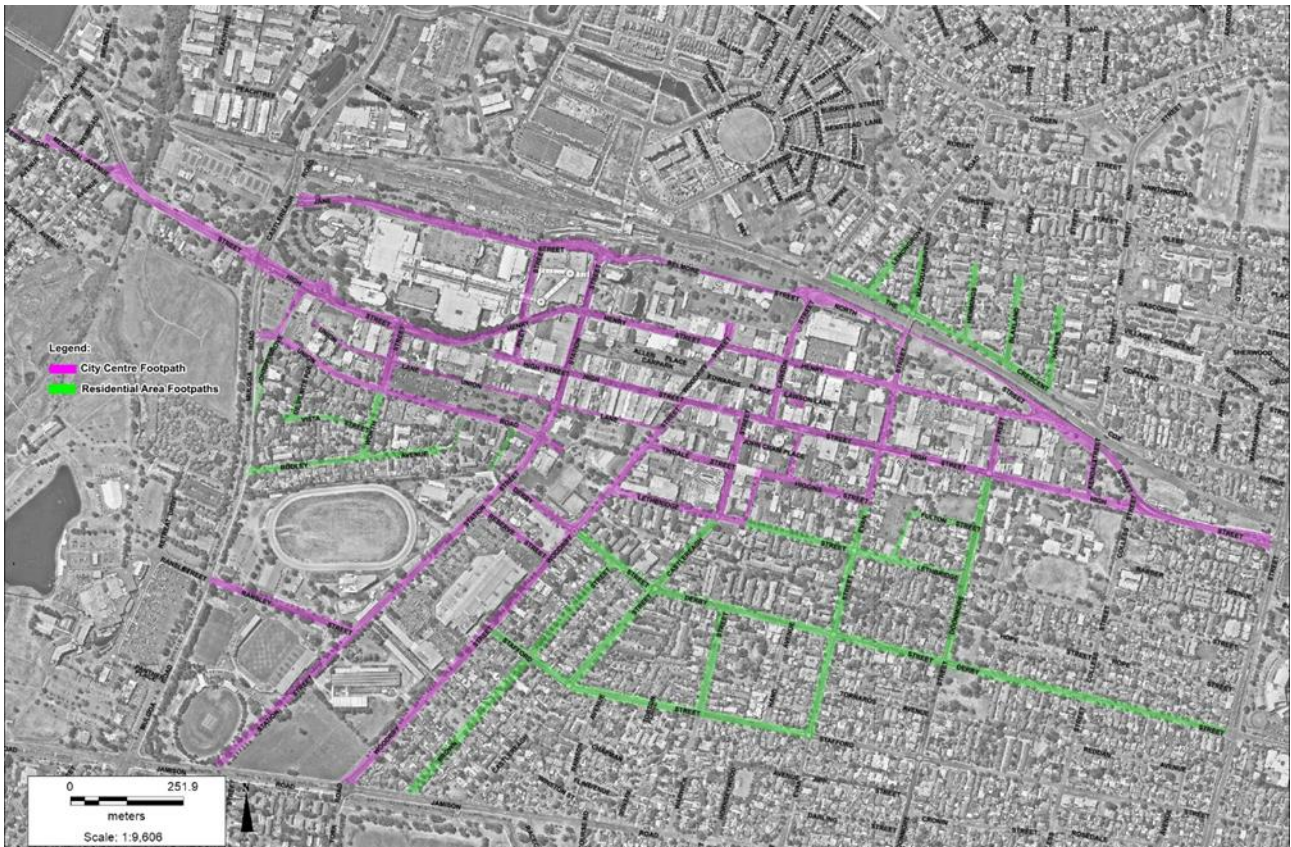


Figure 3: City Centre and peripheral residential area footpaths

The lighting levels specified in Table 3, as defined in AS/NZS 1158.3.1, are to be provided for each footpath type.

Table 3: Lighting levels for footpaths

| Footpath Type | Lighting Category |
|-----------------------------|---|
| City Centre | P2 level Monday to Thursday - dim to P3 level after 1am Friday to Sunday - do not dim |
| Peripheral Residential Area | P3 level Dim to P4 level after 11pm |

●●●●● Lighting Levels for People Spaces

People Spaces include transport interchanges, plazas, lanes, malls, parks and car parks. Lighting levels specified in Table 4, as defined in AS/NZS 1158.3.1, are to be provided for People Spaces.

Table 4: Lighting levels for People Spaces

| People Space Type | Lighting Category ² |
|---|--|
| Transport interchanges (e.g. Penrith Station Forecourt Plaza) | P6 level Do not dim |
| Plazas, squares, malls and lanes | P8 level Monday to Thursday - Dim to P2 after 1 am Friday to Sunday - do not dim Provide capacity to temporarily increase light levels for special events (e.g. markets, festivals) |
| Major pathways in parks | P2 level Dim to P3 after 1am |
| Minor pathways in parks | P3 level Dim to P4 after 1am |
| Standard car parking | P11c level Switch off outside hours of use of facility |
| Car parking for people with disabilities | P12 level Switch off outside hours of use of facility |
| Temporary car parking | Do not light |

² Dimming to be applied where dimming capability available.

Lighting Levels for Pedestrian Crossings and Kerb Extensions

Existing pedestrian crossings and kerb extensions in the City Centre include those identified in Figure 4.



Figure 4: City Centre pedestrian crossings and kerb extensions

Pedestrian Crossings

The lighting levels specified in Table 5, as defined in AS/NZS 1158.4, are to be provided for pedestrian crossings in the specified environment.

Table 5: Lighting levels for pedestrian crossings

| Pedestrian crossing environment | Lighting Category |
|--|-------------------|
| City Centre street with speed limit <= 60 km/h | PX1 Do not dim |
| City Centre street with speed limit <= 50 km/h | PX2 Do not dim |
| Peripheral Residential street | PX3 Do not dim |

Kerb Extensions

Kerb extensions (or ‘blisters’) such as those identified in Figure 4 shall be treated as ‘local area traffic management devices intended to slow traffic’ (other than a roundabout), and lighting provided in compliance with the requirements of AS/NZS 1158.3.1 (Cl 3.2.6.2).

Lighting Levels and Controls for Key Pedestrian Precincts

Some key pedestrian precincts will have specific functional lighting requirements that differ to the general requirements outlined in this section. Section 6 outlines additional requirements for existing key pedestrian precincts. For these and any other key pedestrian precincts identified or developed in the future, switching and/or dimming times are to be determined by Council on a case-by-case basis depending on an assessment of the particular use of the site.

Lighting and Controls for Other Locations and Applications

In addition to the lighting level and control requirements outlined above, Table 6 provides general guidance on the provision and control of lighting in other specific locations.

Table 6: Lighting and controls for other locations and applications in the City Centre and peripheral residential areas

| Location/Applications | Requirements |
|---|---|
| Lighting in parks | |
| Areas of high use (off-path) | Lights may be installed with timers in areas of high use. |
| Local/neighbourhood parks, linear and house front reserves | Lighting is not appropriate as there is little visitation in these reserves after dark. |
| Playgrounds | Lighting is not appropriate as playground activity is better suited to daylight hours. |
| Recreation areas including skate parks, basketball courts, BBQs | Do not light unless specifically intended for night time use. |
| Lighting for transport - walking, cycling, public transport and vehicles | |
| Transport nodes | Lights may be installed with timers linked to operating hours of public transport. |
| Bike paths | Lights may be installed with timers on popular commuter routes. |

| Location/Applications | Requirements |
|--|--|
| Laneways | Lights may be installed where the laneway provides a logical shortcut for pedestrians. |
| Lighting around buildings | |
| Building security lighting | Lights may be installed with timers directly linked to the operating hours of the building and/or on motion sensors. Motion sensors for all new security lighting installations. |
| General | |
| Uplighting/feature lighting of signs, trees, buildings, monuments, art | Lights may be installed with timers based on a needs assessment. Timers installed linked to operating hours of the associated site or building. Solar powered lights with minimal maintenance requirements are preferred. |
| Areas of High Vandalism | <p>Lights may be installed, subject to trial in the following order:</p> <ul style="list-style-type: none"> • turning lighting off to deter vandalism • using motion sensors • increase lighting in accordance with the <i>Crime Prevention through Environmental Design Guidelines</i> |

4.2 Safety and Amenity

The Safety and Amenity objective is concerned with providing pedestrian lighting that contributes to reducing people's perceptions and fear of crime, as well as aiming to increase people's enjoyment of public spaces. Such lighting may be a mixture of functional and creative lighting.

The issues of safety and amenity cannot be separated. People's perceptions of safety are influenced by factors such as visual comfort, way-finding, and the ease with which objects and places can be recognised. At night, the presence of artificial light affects these factors. Lighting determines our ability to negotiate the city at night and perform tasks comfortably, efficiently and safely.

People usually only become aware of lighting conditions when they are poor, dysfunctional or intrusive. However, the causes of bad lighting are complex, and often escape our attention. The amount of light is only one factor to be considered when illuminating an area for safety and amenity. Frequently, the distribution, direction and even the colour of light are more important variables. Impressions are also formed by comparison. Dimly lit areas appear darker if contrasted with patches of bright light. Therefore, it is helpful to take an holistic approach to lighting issues.

Table 7 below outlines specific issues and associated design responses and actions relating to Safety and Amenity.

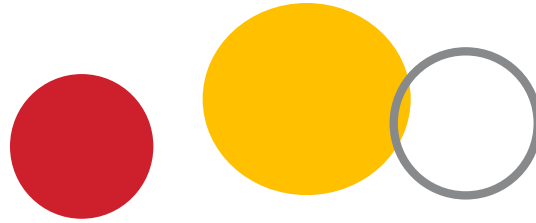


Table 7: Safety and Amenity issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|--|
| 4.2.1 | Glare and light spill | <ul style="list-style-type: none"> • Where relevant, new public lighting schemes shall be compliant with AS 4282 Control of Obtrusive Effects of Lighting. • LED lighting shall be used, given that light output from LEDs is directional and can be targeted exactly where it is needed. • Any design for new public lighting should aim to minimise upwards light spill from luminaires in accordance with AS 4282 and AS/NZS 1158.6. • Any designs for new off-street public lighting schemes should consider the use of full cut-off luminaires and site-specific photometrics (e.g. narrow beam lenses for pathways) to direct light where it is needed. • Any design for new public lighting should utilise luminaires that comply with the glare requirements of AS/NZS 1158. • Lighting should be dimmed or switched off outside of the hours where the site or road is to be utilised to avoid nuisance lighting for residents. |
| 4.2.2 | Colour temperature and colour rendering | <p>All functional lighting in areas that cater for outdoor evening dining should have colour temperature of 3000K (within the range outlined in AS/NZS 1158.6:2015).</p> <p>Functional lighting in all other areas should have colour temperature of 4000K (within the range outlined in AS/NZS 1158.6:2015). Colour temperatures in a given area should be consistent.</p> <p>Choice of colour temperature should be in conjunction with appropriate design to limit spill, nuisance lighting and reduce lighting levels outside of peak times.</p> <p>Pedestrian lighting shall have a colour rendering index (CRI) of not less than 80, to ensure the natural colour of objects and surfaces can be perceived.</p> |
| 4.2.3 | Crime Prevention Through Environmental Design | Lighting designs shall consider the Crime Prevention Through Environmental Design (CPTED) design principles on a case-by-case basis. |

| Ref | Issue | Design Response and Action(s) |
|-------|-----------------------|---|
| 4.2.4 | Lighting and CCTV | <ul style="list-style-type: none"> • Any new CCTV infrastructure should be selected based on its ability to perform at a wide range of lighting levels and colour temperatures. • Due to limitations in CCTV capabilities, the prioritisation of certain colour temperatures over others, as well as increased lighting levels, may be required in locations where high crime exists. • Ensure that dimming and switching does not conflict with CCTV needs. |
| 4.2.5 | Dimming and Switching | <p>Lighting is a tool to attract people to spaces. When Council does not want people to be in specific locations or to discourage visitations at certain times lighting should not be provided. The use of switching as well as dimming and lighting removals should be utilised.</p> <p>Refer also to Section 4.1.</p> |

4.3 People Attraction



The People Attraction objective is concerned with providing pedestrian lighting that brings more activity into the Penrith City Centre by drawing people in and enhancing their experience once they have arrived. People Attraction is of particular relevance to the Penrith City Centre and People Places, and of less importance for peripheral residential areas.

Creative lighting solutions can play a key role in attracting evening crowds, and as such, the creative lighting solutions outlined in Section 6 are a key element of addressing the objective of People Attraction. However, innovative and well-considered functional lighting can also enhance the attraction to particular public spaces.

Table 8 below outlines specific issues and associated design responses and actions relating to People Attraction.

Table 8: People Attraction issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|---|
| 4.3.1 | Clear connections between key precincts | <p>The pedestrian connections between key precincts should be clearly articulated to draw people along and encourage seamless movement from one area to another. Key connections include:</p> <ul style="list-style-type: none"> • From Riley Street into High Street • From Riley Street to the Civic Arts Precinct (via Henry and High Streets) • From the Civic Arts Precinct into High Street (via Triangle Park) • From High Street into Woodriff Street • From Memory Park into High Street and Woodriff Lane • From Penrith Train Station to key precincts including: <ul style="list-style-type: none"> ○ City Square ○ City Park ○ High Street Precinct ○ Penrith Stadium (refer also to Section 6.14) • From Judges Park through to Union Lane and Station Street (refer also to Section 6.11) • Laneway access from Belmore Street to Henry Street <p>A summary of these key connections is provided in Figure 5.</p> <p>From a functional lighting perspective, clear articulation of these connections shall be supported by ensuring footpaths are lit to minimum requirements (refer to Section 4.1), however higher light levels may be considered appropriate for the key connections outlined above.</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • Determine light level requirements for key connections. |

| Ref | Issue | Design Response and Action(s) |
|-------|---|--|
| 4.3.2 | Adapting functional light levels for specific night time events | <p>Functional pedestrian lighting should be adaptive, such that light levels can be temporarily increased for specific night time events (e.g. night markets, festivals, special events etc.), and returned to normal levels afterwards.</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • Refer to Section 4.4. |
| 4.3.3 | Infrastructure for temporary, event-based lighting in key public spaces | <p>Certain streets and public places are likely to host special events. For such locations, supplementary power outlets and ducts for video or computer cables should be included in the design of light poles. Provide underground services and discrete hookups within large open spaces.</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • Identify streets and public spaces likely to host special events. • Include supplementary power outlets and ducts for video or computer cables in the design of light poles. • Provide underground services and discrete hookups within large open spaces. |



Figure 5: Key pedestrian connections between precincts

4.4 Sustainable and Smart Cities

The Sustainable and Smart Cities objective is concerned with providing pedestrian lighting that minimises negative effects on the environment by maximising energy efficiency, and limiting resource use. It is also concerned with providing and ensuring compatibility with “Smart City” infrastructure, where this overlaps with the provision of pedestrian lighting.



Sustainable Cities

Public lighting is, in many cases, the single biggest energy user for local government. Therefore, the desire to reduce energy usage is a fundamental part of this Strategy.

Reducing the energy usage of public lighting can be as simple as replacing old inefficient lamp technologies such as mercury vapour with efficient LED technology. In such cases lighting levels are maintained with significant gains in energy efficiency. Sustainability becomes more complex when switching, dimming, zoning and light removal are involved. Whilst these actions address sustainability, they can be in conflict with other objectives such as safety and amenity. It is therefore vital to make decisions on switching, dimming, zoning and removal using a Strategy-wide perspective.

Table 9 below outlines specific issues and associated design responses and actions relating to Sustainable Cities.

Table 9: Sustainable Cities issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|--|--|
| 4.4.1 | Reducing energy usage associated with public lighting | <p>Key actions:</p> <ul style="list-style-type: none"> • Replace all existing public lighting with more efficient LED lamp technology • Consider the removal of existing public lighting where over-lighting exists or lighting is deemed inappropriate. • Ensure all new public lighting utilises the latest smart and energy efficiency technology • Ensure all new public lighting is designed to the most appropriate lighting level (see Section 4.1) to ensure over lighting does not occur. • Use timers, dimmers and motion sensors to switch public lighting off or turn it down when it is not needed. • Use smart city technology such as usage sensors and traffic counters to improve the appropriateness of switching and dimming times. |
| 4.4.2 | The desire to minimise energy use whilst seeking to ensure safety and amenity is catered for | <p>Key action(s):</p> <ul style="list-style-type: none"> • Ensure potential conflicts between reducing energy usage (via switching, dimming, zoning and removal) and safety/amenity are minimised by basing decisions on real-world data such as traffic counts, site usage patterns and public transport timetables. • Utilise smart city technology to create public lighting schemes that can adapt to changing usage patterns e.g. increase lighting levels via remote dimming technology during festivals. |
| 4.4.3 | Collect environmental data | <p>To assist with environmental reporting and progress towards targets, Council will collect environmental data (energy consumption, greenhouse gas emissions) for pedestrian lighting.</p> <p>Refer also to 4.5.3.</p> |

Smart Cities

The term ‘smart cities’ has emerged in recent years to describe the transformative effect modern technology is having on the way urban infrastructure is used, operated and managed.

As a concept, smart cities is inherently ambiguous owing both to the broad range of asset and infrastructure types within an urban environment and the seemingly endless ways in which technology can be integrated into the application, operation and management of assets and infrastructure. This ambiguity is leading many local governments in Australia to seek to better define what the concept of smart cities means for them.

For Penrith, pedestrian lighting has been identified as having the potential to be both directly enhanced by smart city technology as well as playing a central role in a broader smart city network.

The ability to control pedestrian lighting via remote switching, remote fault reporting and remote dimming are ways in which smart city technology can beneficially augment pedestrian lighting. In addition, the ubiquity, existing power supply and presence above ground level allows pedestrian lights and poles to act as the hubs and nodes of a smart cities network.

Smart City Infrastructure Options

When talking about pedestrian lighting within the context of smart city infrastructure there are two elements to consider.

- How smart city infrastructure can be used to augment pedestrian lighting; and
- How pedestrian lighting infrastructure can be used as a central element within a broader smart city network.

The first element is relatively simple in that it relates to controlling (switching, dimming, colour changing) and monitoring (faults reporting, energy usage) pedestrian lighting assets via a smart city network. For the purpose of this Strategy this capability should be designed into all new lights, both road lighting (owned by Council or Endeavour Energy).

The second element is more complex in that it relates to using pedestrian lighting infrastructure as the backbone of a smart city network as well as a key connection point (either physically or as a wireless node) for other smart city technologies such as sensors and input/output devices. Standard street lights connected to a smart grid system can assist in establishing a smart grid system in a given location and ensuring effective coverage. In addition, smart (or multifunction) poles can be located in certain areas to achieve specific smart city outcomes.

Smart poles are one of the more obvious solutions for leveraging pedestrian lighting infrastructure to create a smart city network. They are generally modular in design and easily adaptable to current and future smart city needs. This allows them to incorporate smart city technologies such as telecommunications, Wi-Fi, community messaging, parking management, data capture, surveillance, people counting, and electric vehicle car charging as well as traditional pole functions (signage and lighting) into a single uncluttered solution. Figure 6 below provides an example of a smart pole and possible features and functionality.

Smart poles also enable councils and others to consider more innovative business models to on-sell the location of the pole for advertising, to telecommunication carriers and others.

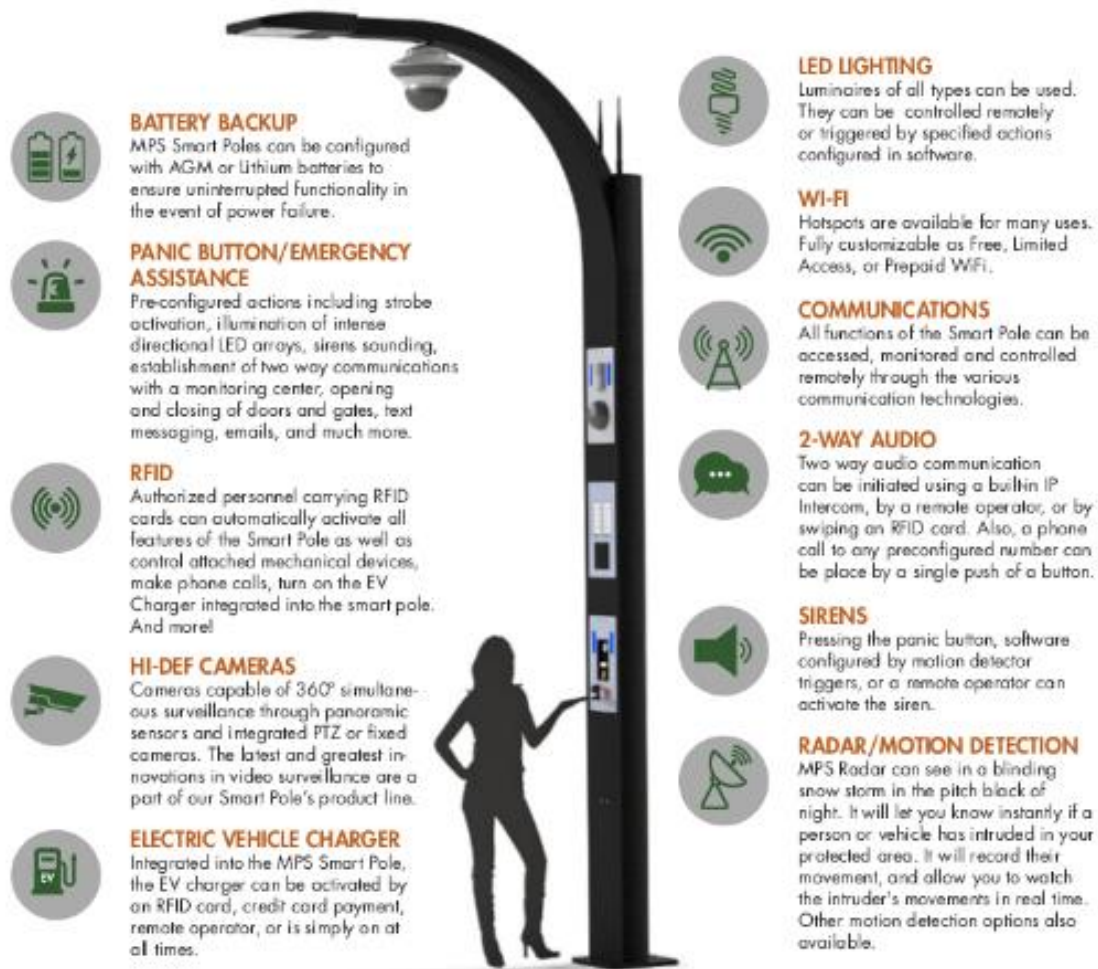


Figure 6: Examples of 'smart pole' features and functionality³

Table 10 below outlines specific issues and associated design responses and actions relating to Smart Cities.

³ Source: <http://www.mobileprosystems.com/products/smart-city-lighting-surveillance-public-safety-smart-pole/>

Table 10: Smart Cities issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|--|
| 4.4.4 | Planning for smart pedestrian lighting network | <p>Complete an Expression of Interest (EOI) process seeking smart lighting organisations for the installation and management of smart (modular) poles throughout the City Centre (in line with the objectives of this Strategy).</p> <p>EOI to cover:</p> <ul style="list-style-type: none"> • Use of smart (modular) poles and/or luminaires • Ability to leverage unmetered lighting assets • Smart lighting features (e.g. switching, dimming, colour temperature, fault reporting) • Consideration of other basic (signs, CCTV cameras) or smart cities (sensors, wi-fi, data repeaters) infrastructure to be attached to poles • Investigation of possible revenue opportunities |
| 4.4.5 | Implementation of metered smart pedestrian lighting network | <p>Deliver and maintain metered smart pedestrian lighting network (refer to 4.4.4).</p> <p>Note: modular smart poles are to be used on City Centre streets, and smart-enabled assets are to be installed on unmetered peripheral residential streets.</p> |
| 4.4.6 | Metered pedestrian lighting | <p>Incorporate Smart Lighting Infrastructure (e.g. switching, dimming, colour temperature, fault reporting) into all metered pedestrian lighting.</p> <p>To be achieved by specifying the use of luminaires with 7-pin NEMA PE cell base connected to variable control gear.</p> |
| 4.4.7 | Unmetered smart street lighting network | <p>Liaise with Endeavour Energy to:</p> <ul style="list-style-type: none"> • advocate for the future proofing of new unmetered street lighting via the use of smart-compatible PE Cell bases such as the 7-pin NEMA base connected to a dimmable control gear • determine minimum smart capabilities (e.g. switching, dimming, colour temperature) • establish governance arrangements (e.g. accessibility to data, ability to dim and relevant levels) |

4.5 Maintenance



The Maintenance objective is concerned with ensuring pedestrian lighting infrastructure is selected and operated in such a way as to minimise maintenance and on-going operating costs.

The maintenance of metered and unmetered public lighting assets is managed separately. The majority of street lighting is unmetered and managed by Endeavour Energy. Metered sites on the other hand are owned and maintained by Council.

The careful selection and design of lighting, as well as keeping the range of approved lighting infrastructure to a manageable portfolio, will help to reduce ongoing maintenance costs. The introduction of “smart lighting” capabilities (remote monitoring and management) also represents an opportunity for improved maintenance service delivery and subsequent improvements to amenity. In general, lighting schemes should be expected to have a minimum design life of 20 years.

Table 11 below outlines specific issues and associated design responses and actions relating to Maintenance.

Table 11: Maintenance issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|-------------------------------------|---|
| 4.5.1 | Quality of infrastructure | <p>Ensure that all metered lighting infrastructure used is designed for long life.</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • All luminaires shall comply with the technical requirements of AS/NZS 1158.6 • All poles shall comply with requirements of the Penrith CBD Public Domain Technical Manual |
| 4.5.2 | Remote monitoring of metered assets | <p>All metered pedestrian lighting installations should incorporate Smart Lighting Infrastructure.</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • Refer to 4.1.4 |

| Ref | Issue | Design Response and Action(s) |
|-------|-------------------------------|---|
| 4.5.3 | Maintaining asset information | <p>Council will collect and maintain information on all metered pedestrian lighting assets. At a minimum this information will include:</p> <ul style="list-style-type: none"> • for new installations, as-built drawings integrated into GIS systems • condition of poles, luminaires and cabling (collected at least every four years) • relevant safety information on assets as well as asset identification • lighting levels (and how they apply to specific installation from an electrical supply perspective) and time settings recommended in this Strategy (documented and followed) • Data will be maintained on GIS layers for easy review by relevant staff and users. <p>Key action(s):</p> <ul style="list-style-type: none"> • Collect and maintain information on metered assets and assess their condition <p>Refer also to 4.4.3.</p> |
| 4.5.4 | Proactive maintenance | <p>Council will:</p> <ul style="list-style-type: none"> • develop performance criteria and management plans for all metered public lighting installations • regularly monitor systems, clean and adjust luminaires <p>Key action(s):</p> <ul style="list-style-type: none"> • Introduce proactive maintenance programs |
| 4.5.5 | Lighting in trees | <p>Lighting attached to trees, including bud-lighting and other types of fixed lighting, should not be used given the risk of damage to the tree itself, and given such forms of lighting are maintenance intensive.</p> <p>Instead, where lighting of trees is desired, use pole-based lighting or lighting mounted on other infrastructure.</p> <p>Key action(s):</p> |

| Ref | Issue | Design Response and Action(s) |
|-------|--|---|
| | | <ul style="list-style-type: none"> • Avoid bud-lighting or other lighting fixed to trees |
| 4.5.6 | In-ground up-lighting in footpaths | <p>In-ground uplighting in footpaths is maintenance intensive and expensive to operate, as well as leading to increased glare and spill lighting.</p> <p>Key action(s):</p> <ul style="list-style-type: none"> • Avoid in-ground uplighting |
| 4.5.7 | Stakeholder liaison regarding unmetered street lighting assets | <p>Council will liaise with other key stakeholders involved in the operation, maintenance and funding of unmetered street lighting assets (Endeavour Energy and Roads and Maritime Services (RMS)) with a view to achieving improved maintenance outcomes and new technology approvals</p> <p>Key actions:</p> <ul style="list-style-type: none"> • Refer to 4.1.4 and 4.4.7 |

5 CREATIVE LIGHTING

As discussed in Section 2.1, creative lighting is used to make public places attractive, reinforces a sense of place, and is a mode for creative and artistic expression. Creative lighting will be used to target or highlight specific locations, may be seasonal, dynamic or linked to specific events, and will provide contrast to functional lighting.

Creative lighting should be applied as an overlay to functional lighting within the Penrith City Centre and peripheral residential pedestrian areas (refer to Figure 7) with the key objective of highlighting or emphasising particular spaces or features within the public realm.

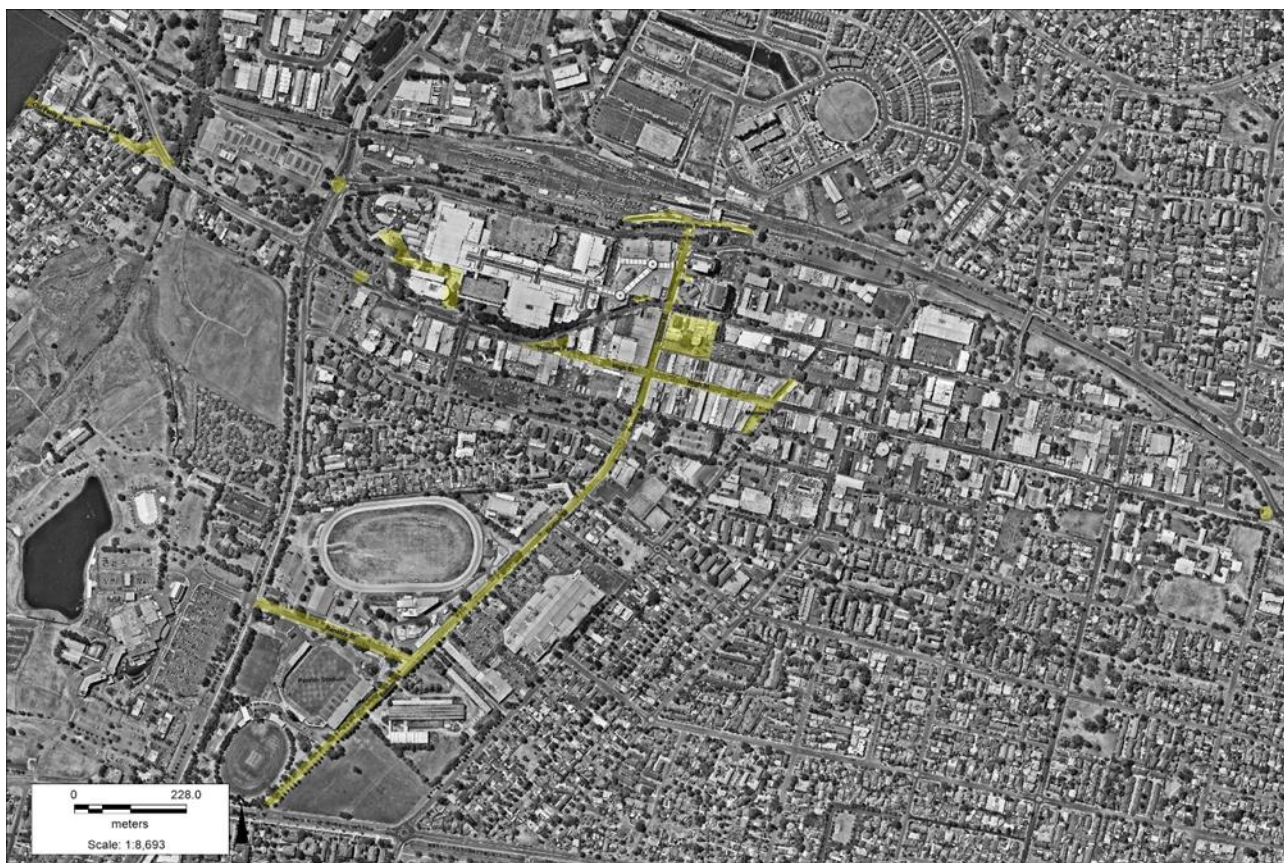


Figure 7: Key locations with creative lighting opportunities

Most of the Penrith City Centre and peripheral residential pedestrian areas should therefore be lit to 'functional' standards and serve as a backdrop for specific focal points where creative lighting is used to highlight features, spaces and draw people into and through spaces. Overuse of creative lighting should be avoided, so that the contrast and effect provided is not diluted. Overuse of creative lighting would also conflict with aiming to improve sustainability and limit lighting nuisance.

Section 6 describes key pedestrian precincts and provides guidance on creative lighting opportunities where they exist.

6 PEOPLE SPACES

Key pedestrian precincts include parks, squares and lanes, significant landmarks, gateways to the Penrith City Centre, and other locations where increased night time pedestrian activity is currently high or is desirable. Some sites represent creative lighting opportunities. Other sites have functional lighting requirements that differ from the basic requirements outlined in Section 4. For each precinct, key issues and actions are summarised, and site-specific functional or creative lighting requirements or recommendations are provided.



6.1 High Street and Mulgoa Road Intersection and Surrounds

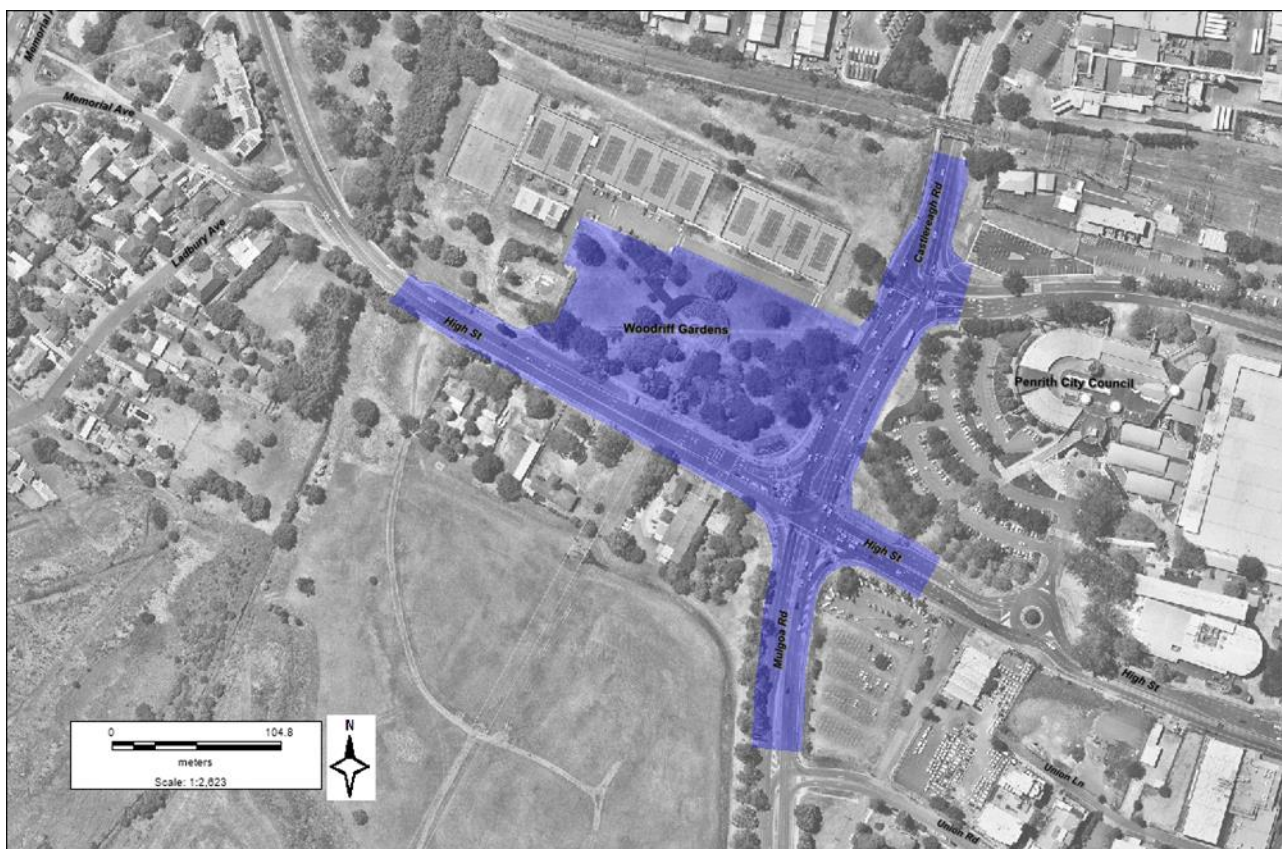


Figure 8: High Street and Mulgoa Road intersection and surrounds aerial overview

Site Overview

The High Street and Mulgoa Road intersection and the Mulgoa Road railway underpass are key gateways to the City Centre to the east as identified in Council’s Wayfinding Strategy. Most pedestrian movement through the intersection is concentrated along the shared pathways running east-west and north-south (refer to Figure 9), with the intersection forming a key part of the pedestrian connection from the City Centre to the Great River Walk precinct (refer to Section 6.13).

The intersection is under the management of RMS, with a major upgrade funded and currently undergoing a detailed design process with input from Council. The area covered by this upgrade roughly encompasses Mulgoa Road from John Tipping Grove Reserve to north of the railway underpass, and High Street from Peach Tree Creek to the Penrith City Council car park entrance. The upgrade is proposed to involve:

- Widening Mulgoa Road between High Street and Jane Street from 8 to at least 10 lanes
- Upgrading of all major road lighting
- Relocation of the “Penrith” garden bed to the northeastern corner of the intersection

- Installation of gate marker signage at various locations (refer to Figure 9)

Woodriff Gardens is located on the corner of High Street and Mulgoa Road adjacent to the Nepean District Tennis Association. The Gardens feature a network of internal pathways, with the Garden’s open spaces dominated by trees. The Gardens are generally not patronised after dark.

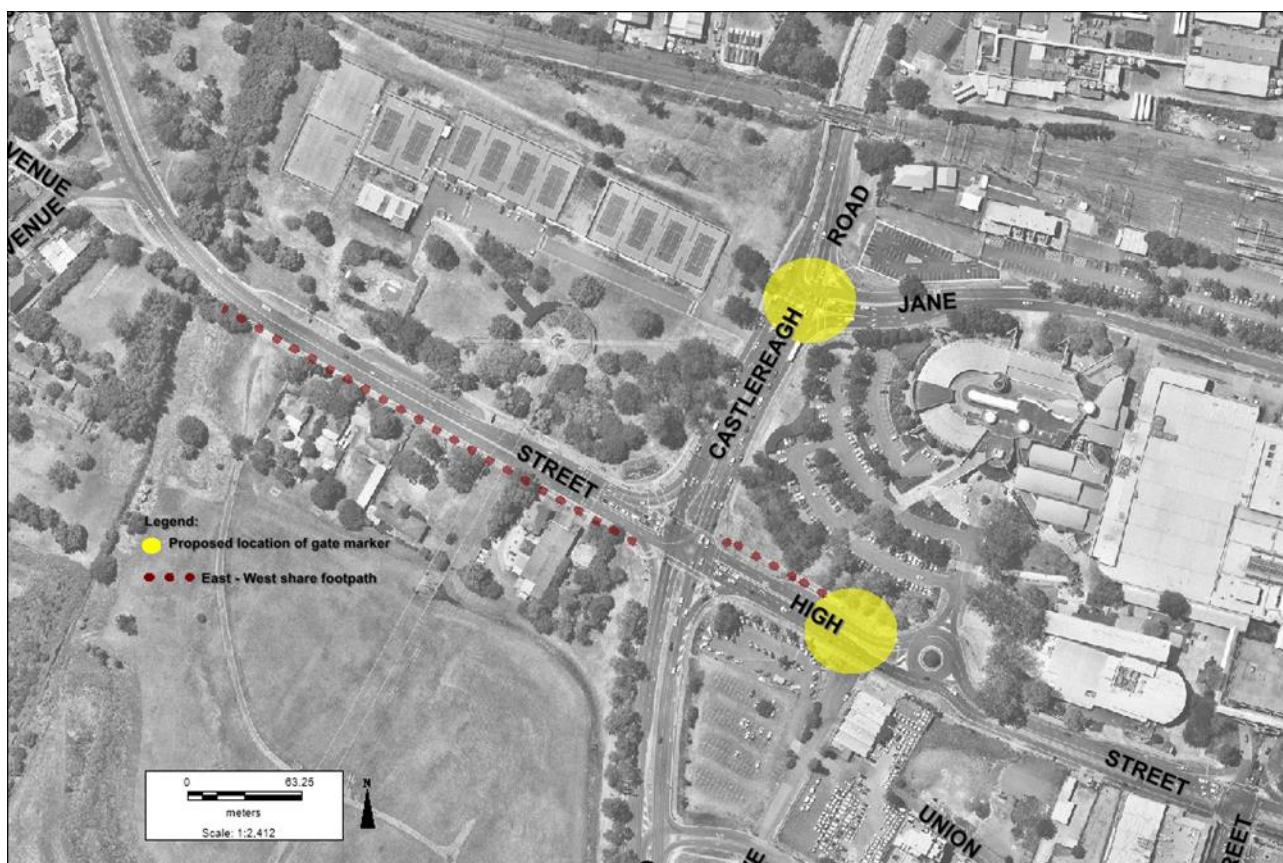


Figure 9: East-west shared pathway and proposed gate marker locations surrounding the High Street and Mulgoa Road intersection

Functional Lighting Overview

High Street and Mulgoa Road Intersection - Most east-west pedestrian movement through the intersection (connecting the City Centre to the Great River Walk precinct) is concentrated along the shared pathway, which is located immediately adjacent to the road carriageway. As such, functional pedestrian lighting is provided by the existing major road lighting.

It is expected that the RMS intersection upgrade will result in relatively high light levels, and therefore it is not anticipated there will be a need for additional functional pedestrian lighting to achieve the desired target (P2 level; refer to Section 4.1) once the upgrade is complete. However, should additional functional pedestrian lighting be deemed necessary in the future it should consider:

- Consistency and clear connection with the functional lighting theme used for the rest of the High Street to Great River Walk precinct (refer to 6.13)
- Limited space for trenching on some sections of the path (e.g. west of the intersection)

Woodriff Gardens - The internal pathways of the Gardens are serviced by varying degrees of spill lighting from the nearby major road lighting on High Street and Mulgoa Road and the nearby tennis courts (when in use), as well as some limited internal Garden lighting. Given the Gardens are not patronised after dark, provision of functional lighting of internal Garden pathways is not recommended.

Creative Lighting Overview

High Street and Mulgoa Road Intersection - There is currently no creative lighting associated with this site. Given the RMS upgrade is expected to result in relatively high light levels which would limit the impact of any creative lighting, in general such lighting is not recommended. However, illumination shall be provided for gate marker signage installed as per Council’s Wayfinding Strategy.

Woodriff Gardens - There is currently no creative lighting associated with this site, and creative lighting is not recommended given the space is not patronised after dark.

Table 12: High Street and Mulgoa Road intersection issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|--|---|
| 6.1.1 | Functional lighting of east-west shared pathway through High Street and Mulgoa Road intersection | <p>If RMS lighting upgrade does not achieve target functional light levels, additional functional lighting to consider:</p> <ul style="list-style-type: none"> • Consistency and clear connection with the functional lighting theme used for other sections of the High Street to Great River Walk connection (refer to 6.13) • Limited space for trenching on some sections of the path (e.g. west of the intersection) |
| 6.1.2 | Creative lighting of gate marker signage at High Street and Mulgoa Road intersection | <p>Install creative LED uplighting to illuminate gate markers.</p> <p>Creative lighting to switch off (at a time to be determined by Council).</p> |

6.2 Civic Arts Precinct

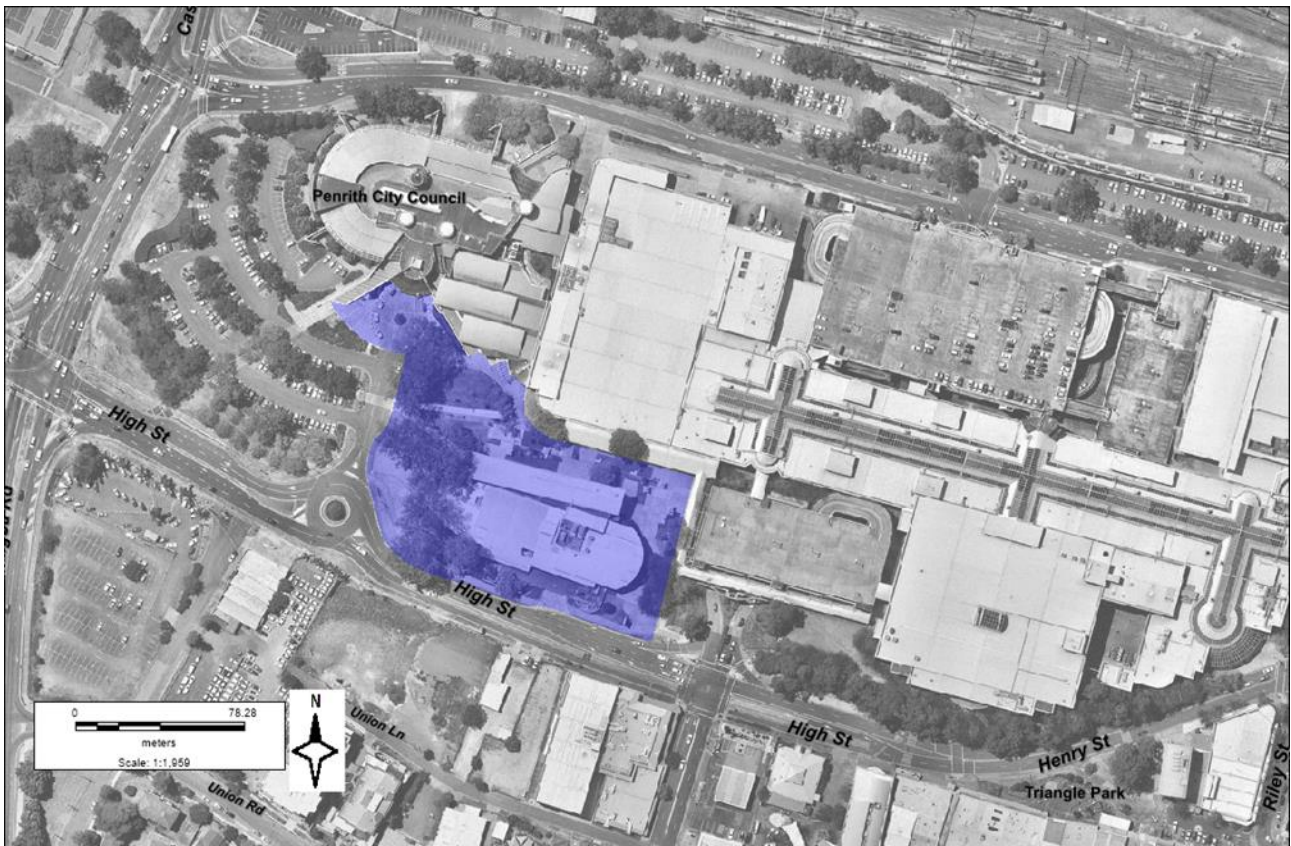


Figure 10: The Civic Arts Precinct aerial overview

Site Overview

The Civic Arts Precinct includes the Joan Sutherland Performing Arts Centre (the Joan) and the Mondo (the open space between the Joan, Westfield Penrith, Council Civic Centre and Penrith Library). The Mondo is a recently completed development which included re-landscaping of the area and new functional and creative lighting installed. This is a heavily used pedestrian precinct both during the day and after dark, and intended as a place where people can meet and gather. The Joan Sutherland Performing Arts Centre is one of Penrith's landmark buildings.

In terms of pedestrian movement, the following issues have been identified for the Precinct:

- The lack of any active frontage from the Joan onto High Street; and
- Ensuring clear connection to the Mondo and the Joan for pedestrians from:
 - the west (from High Street and the Council Civic Centre car park); and
 - the east (from High Street)

Functional Lighting Overview

Most of the Mondo's open space is adequately lit from a functional lighting perspective, however, some key pedestrian routes at the western end and northern edges of the space, and also the circulation roundabout adjacent to the Council Civic Centre entrance are underlit (as identified by audit; refer also to Section 3.4). Figure 11 identifies those pedestrian routes that have been assessed as underlit. Poles and luminaires used should be consistent in style/theme with those used elsewhere in the Mondo.

Creative Lighting Overview

The Mondo features various creative lighting elements (e.g. art panels embedded in seating, dimming capability) as well as facility to provide additional temporary creative lighting for special events. However, opportunity exists to use creative lighting to activate the western end of the Joan to more clearly signal the presence of the building to pedestrians approaching along High Street from the west (refer also to Figure 11).

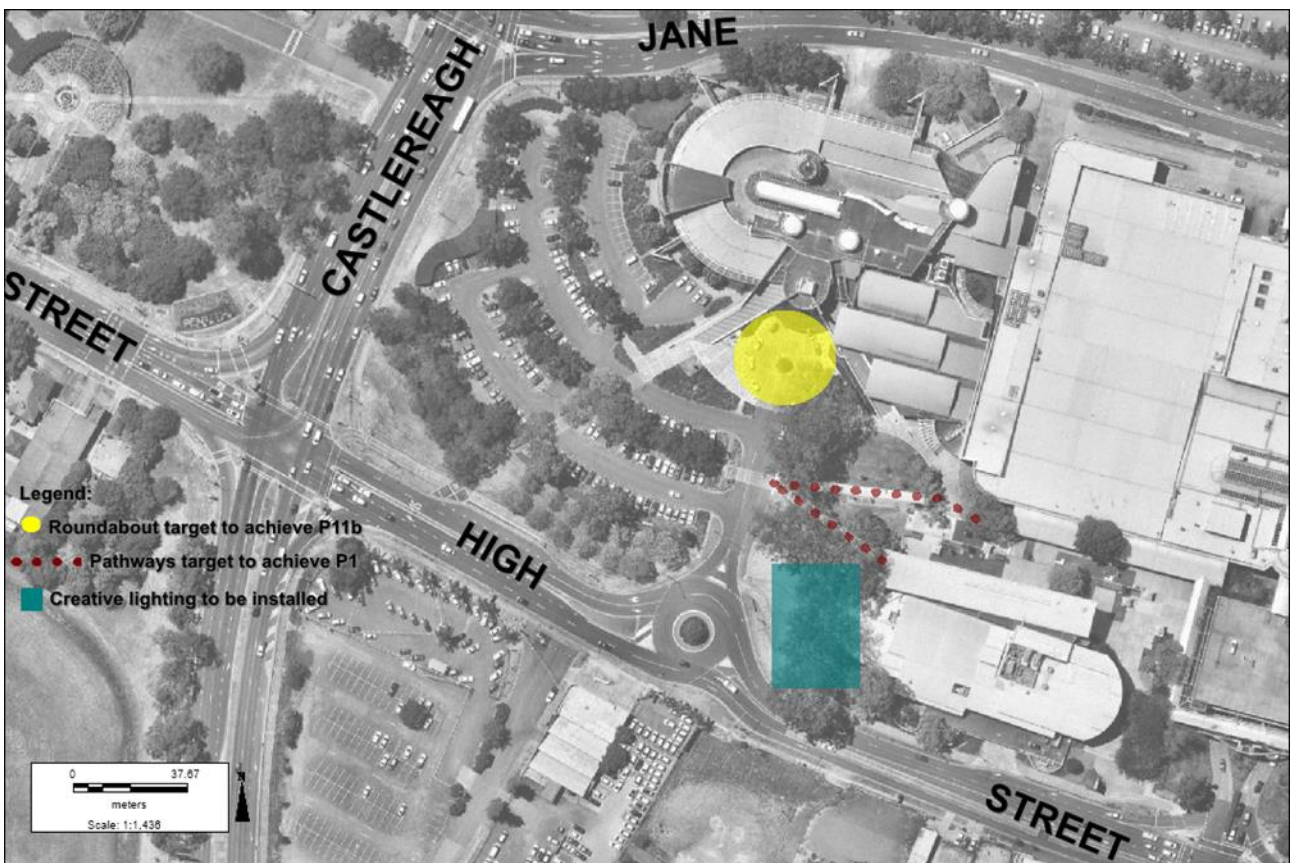


Figure 11: Location of proposed lighting upgrades/installations in Civic Arts Precinct

Table 13: Civic Arts Precinct issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|---|
| 6.2.1 | Connecting pathways at western end of Mondo underlit | Install upgraded lighting on connecting pathways on western and northern edge of the Mondo to achieve target P1 level. Dim to P3 level (at a time to be determined by Council). |
| 6.2.2 | Circulation roundabout adjacent to Council Civic Centre entrance underlit | Install upgraded lighting to P11b level. Dim to P11c level (at a time to be determined by Council). |
| 6.2.3 | Western façade of the Joan lacks presence at night | Install creative LED uplighting of trees (e.g. colour-changing RGB LED) to the west of the Joan. Install creative lighting on western façade of Joan to illuminate underside of building eaves and portico (e.g. colour-changing RGB LED with DALI control). Creative lighting to switch off (at a time to be determined by Council). |



6.3 Lawler Park



Figure 12: Lawler Park aerial overview

Site Overview

Lawler Park is located on the corner of High Street and the Great Western Highway adjacent to Kendall Street, with the High Street and Great Western Highway intersection a key gateway to the City Centre to the west as per Council's Wayfinding Strategy. The Park features a short internal pathway and areas of undercover seating, however the internal park space is generally not patronised after dark.

Functional Lighting Overview

The Park's internal pathway as well as footpaths around the perimeter of the Park are serviced by spill lighting from road lighting on High Street, the Great Western Highway and Kendall Street. Given the Park is not patronised after dark, provision of functional lighting of the internal Park space is not recommended.

Creative Lighting Overview

Given that the Park is not patronised after dark, and also is not part of a connecting route between key precincts, creative lighting is not recommended other than to

highlight gate marker signage that is installed as per Council’s Wayfinding Strategy (refer to Figure 13).



Figure 13: Proposed location of gate marker in Lawler Park

Table 14: Lawler Park issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|--|
| 6.3.1 | Creative lighting of gate marker signage in Lawler Park | Install creative uplighting at two gate markers. Creative lighting to switch off (at a time to be determined by Council). |

6.4 Woodruff Lane



Figure 14: Woodruff Lane aerial overview

Site Overview

Woodruff Lane is a key pedestrian connection between High Street and Memory Park to the south and the Allen Place and Edwards Place car parks to the north. At present, the Lane is predominantly used as a pedestrian thoroughfare connecting the Allen Place and Edwards Place car parks with High Street, however it has potential for activation to become a “night-time destination” in its own right, including outdoor eating and other attractions.

Functional Lighting Overview

The site is currently serviced by three (dual-head) light columns located down the centre of the Lane, with additional spill lighting emanating from awnings and shop frontages. In order to provide an environment supportive of outdoor dining and other activities, it is recommended that the existing pole-mounted functional lighting be removed and replaced by a sophisticated building-mounted catenary lighting system.

Creative Lighting Overview

The site currently features a simple catenary lighting set up. In order to support creation of a “night-time destination”, a more sophisticated building-mounted catenary lighting system should be used that can play the role of providing both functional light levels (see above) and also creative lighting during peak hours of night time activity (e.g. to be achieved by using DALI-controlled, colour-changing RGB LEDs). The upgraded catenary lighting may also support a curated lighting aspect.

Table 15: Woodriff Lane issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|---|
| 6.4.1 | Remove existing lighting assets (poles and catenary) and install upgraded catenary lighting system in Woodriff Lane | <p>Existing lighting (pole-mounted lighting and catenary lighting) to be removed and replaced with upgraded building-mounted catenary lighting system (e.g. colour-changing RGB LED with DALI control) which will serve as both functional and creative lighting at different times of the night. Provide functional lighting to P8 level.</p> <p>Dim as follows:</p> <ul style="list-style-type: none"> Monday to Thursday - dim to P2 (at a time to be determined by Council) Friday to Sunday - do not dim <p>Creative catenary lighting to be activated during hours of evening dining (specific timing to be determined by Council).</p> |



6.5 Memory Park



Figure 15: Memory Park aerial overview

Site Overview

Memory Park is located on the southwestern corner of the High Street and Woodriff Street intersection, at the eastern gateway to High Street. Pedestrian movement is predominantly concentrated along the western, eastern and northern (High Street) edges of the Park which serve as a key connection to High Street (refer to Figure 5 and 4.3.1). The internal Park area serves as a memorial and ceremonial space, with a key stakeholder being the RSL.

Future residential development is planned for the land immediately to the south of the Park which will likely see increased north-south pedestrian traffic through the Park via the western and eastern perimeters.

Functional Lighting Overview

The eastern and western perimeters of the Park are serviced by eleven vertical artistic light columns, which are intended to serve both a functional and creative lighting purpose, with dimming activated during memorial services. The western edge of the Park (including the privately-owned colonnade) is also serviced by varying levels of awning lighting and spill lighting from shop windows. The eastern and northern edges of

the Park are also serviced by spill lighting from the adjacent road lighting on Woodriff Street.

The overall combined result of the vertical light column, awning, shop-front and adjacent road lighting is to provide an inconsistent and patchy functional lighting effect, with the light columns also reported to be a significant source of glare. Replacement of the existing vertical artistic light columns is recommended. Functional lighting should provide a clear visual connection by minimising spacing and mounting height. Poles and luminaires used should be consistent in style with those used in other key precincts.

The eastern and western perimeters of the Park are the prime pedestrian routes through the Park and are currently underlit (as identified by audit; refer also to Section 3.4).



Figure 16: Location of proposed lighting upgrades/installations in Memory Park

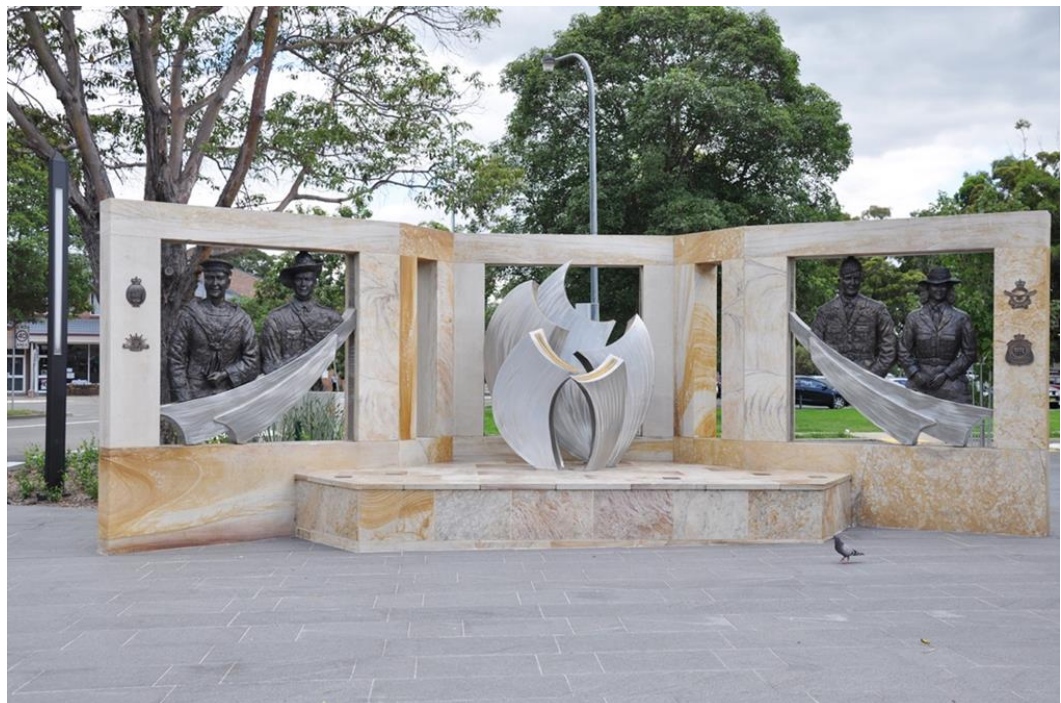
Creative Lighting Overview

The eleven artistic vertical light columns can be dimmed during memorial services. There is also a pole-mounted spot light that is used to light the flag pole.

Opportunity exists to highlight the Park as a gateway to High Street and to assist with drawing pedestrians from the south into High Street and Woodriff Mall by the use of creative uplighting of the palm trees at the northern end of the Park.

Table 16: Memory Park issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|--|
| 6.5.1 | Functional lighting of north-south pedestrian routes along western and eastern perimeters of Park | <p>Remove existing eleven artistic vertical light columns and replace with LED pole-mounted luminaires with DALI control. Light to P8 level (refer to Figure 16).</p> <p>Dim as follows:</p> <ul style="list-style-type: none"> • Monday to Thursday - dim to P2 level (at a time to be determined by Council) • Friday to Sunday - do not dim |
| 6.5.2 | Creative lighting to highlight gateway to High Street | <p>Install creative LED uplighting of palm trees at northern end of Park (e.g. colour-changing RGB LED with DALI control) (refer to Figure 16).</p> <p>Creative lighting to switch off (at a time to be determined by Council).</p> |



6.6 High Street Precinct (Triangle Park to Memory Park)



Figure 17: High Street Precinct aerial overview

Site Overview

The section of High Street from Triangle Park and Memory Park is the premier retail strip and heart of the City Centre and is one of the most heavily used pedestrian routes. High Street has the highest concentration of retail, restaurant, café and commercial businesses outside of Westfield. High Street also acts as a key pedestrian connection between several key precincts (refer to Figure 5 and 4.3.1).

Functional Lighting Overview

The section of High Street between Station Street and Woodriff Street is currently serviced by decorative (non-standard) pedestrian category (Category P) luminaires. The section of High Street from Station Street to Triangle Park is currently serviced by standard major road (Category V) luminaires. Both sections are also serviced by varying levels of under awning and shop-front lighting, all of which contributes to a perception that High Street is inconsistently and patchily lit, even though overall light levels have been confirmed to meet minimum requirements (as identified by audit; refer also to Section 3.4).

High Street is a logical location for “smart” poles with various smart city features installed. Functional lighting should also involve consistent lighting techniques along the length of the street to support a strong sense of identity for the space, and provide a clear visual connection by minimising spacing and mounting height. Poles and luminaires used should be consistent in style with those used in other key precincts.

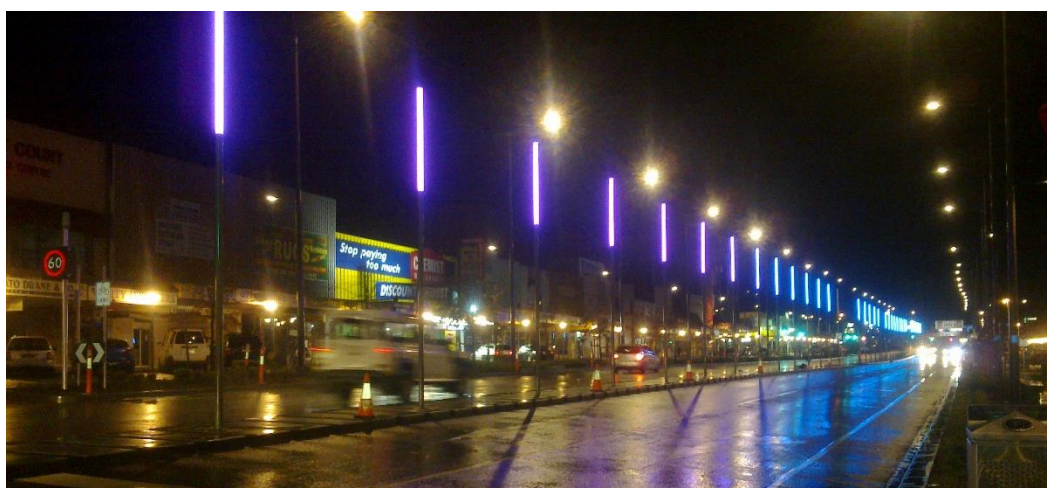
Creative Lighting Overview

The use of all-in-one modular smart poles (see Functional Lighting Overview above) will allow the installation of programmable colour-changing beacons to provide a creative lighting element.

Opportunity exists to complement the functional lighting along High Street through the creative uplighting of the trees on kerb extensions located at pedestrian crossing between Station Street and High Street (featuring mature trees).

Table 17: High Street Precinct issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|--|
| 6.6.1 | Functional lighting of footpaths along High Street | Removal of existing Category P and Category V functional lighting and installation of all-in-one modular smart poles with colour-changing RGB LED beacons. |
| 6.6.2 | Creative lighting to complement High Street functional lighting | Installation of creative LED uplighting of trees (e.g. colour-changing RGB LED) on footpath blisters at pedestrian crossings between Station Street and Woodriff Street. Uplighting to include DALI control. Creative lighting to switch off (at a time to be determined by Council). |



6.7 Triangle Park



Figure 18: Triangle Park aerial overview

Site Overview

Triangle Park is located at the western gateway to High Street, and is a key connecting element between the Civic Arts Precinct and High Street (refer to Figure 5 and 4.3.1). A detailed lighting design has been completed and funding confirmed, with the site to be developed in the near future.

Triangle Park is a logical location for “smart” poles with various smart city features installed. Any lighting upgrade should also include the capacity to dim and/or increase light levels at specific times or for special events (e.g. markets, festivals).

Functional Lighting Overview

The lighting design for the proposed development:

- Proposes LED in-ground uplighting, use of which is not recommended (refer to Section 4.5)
- Proposes principle pathways to be lit to P2 level, which would meet the minimum light levels specified by this Strategy for this type of space (refer to Section 4.1)

- Does not include provision for adaptive light levels (i.e. remotely dimming or increasing light levels at different times of the night, or for special events)
- Does not include provision of “smart” poles

Creative Lighting Overview

The lighting design for the proposed development includes a variety of creative lighting features including:

- LED projectors
- LED strip lighting
- LED in-ground uplighting
- LED spotlights

Table 18: Triangle Park issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|---|---|
| 6.7.1 | Triangle Park proposed lighting design: <ul style="list-style-type: none"> • Specifies the use of in-ground uplighting • Does not include provision for adaptive light level control • Does not specify the use of modular smart poles | Review existing design to consider: <ul style="list-style-type: none"> • Avoiding the use of in-ground uplights (replace with post top lighting) • Lighting pathways to P2 level (as per design), and dim to P3 level (at a time to be determined by Council). • Including capacity to remotely dim/increase light levels • Installation of modular smart poles |



6.8 City Park (Corner of Station Street and Henry Street)

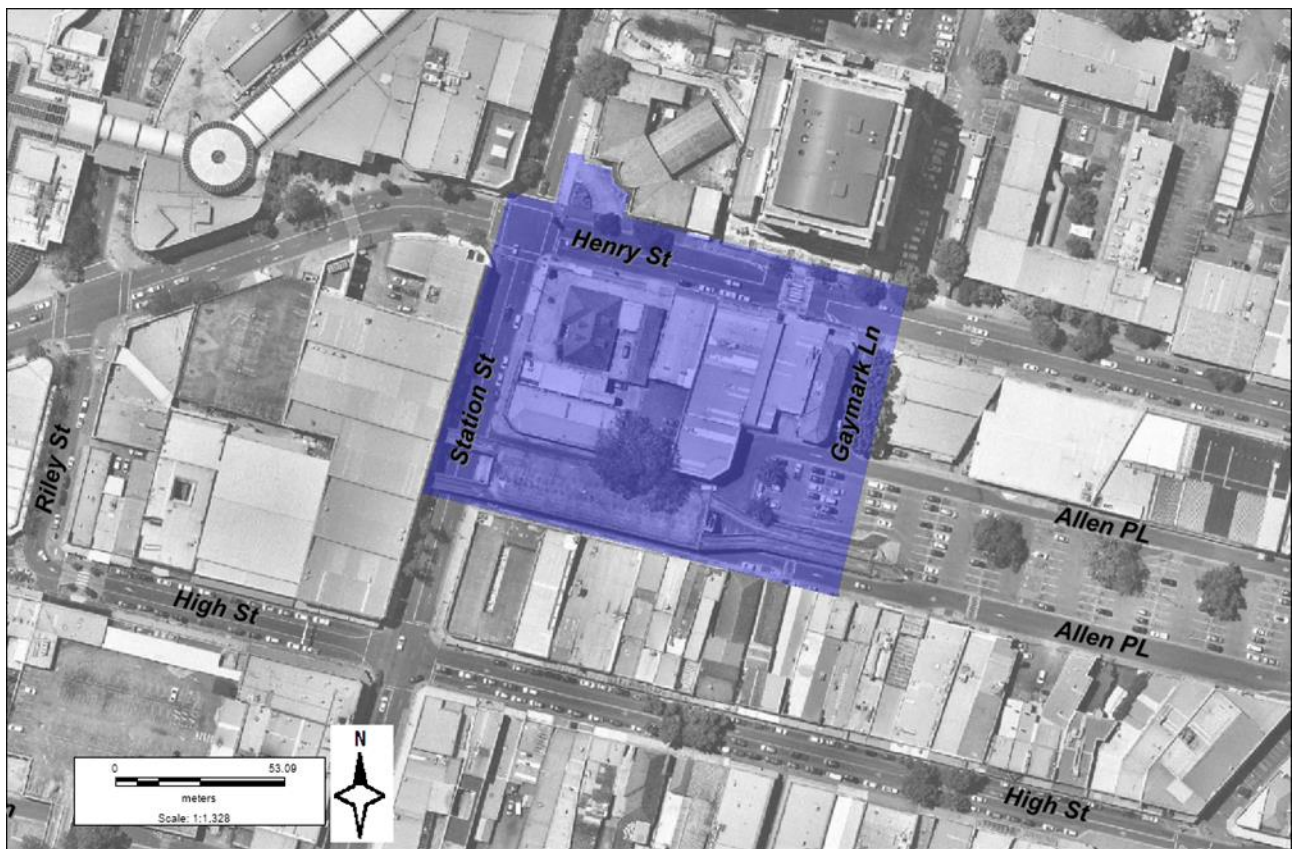


Figure 19: City Park aerial overview

Site Overview

This future City Park site will be located in the space between Station Street and Gaymark Lane, and Henry Street and Allen Place. It will be the principal open space within the City Centre, and act as a central meeting point for pedestrians as well as punctuating the pedestrian connection with other precincts such as High Street (refer to Figure 5 and 4.3.1). During special events, it is anticipated that the adjacent stretches of Station Street and Henry Street will be closed to traffic, and the public space temporarily extended to incorporate the former Council Chambers forecourt to the north. This site will undergo a detailed master-planning process which will determine the locations and requirements of the lighting and smart city infrastructure at the site.

Functional Lighting Overview

Lighting should cater for high-use pedestrian activity, outdoor dining and activity spaces. The City Park is also a logical location for “smart” poles with various smart city features installed. Any lighting upgrade should also include the capacity to dim and/or increase light levels at specific times or for special events (e.g. markets, festivals). A catenary lighting system that has the ability to provide both functional and creative lighting (e.g. colour changing) is recommended.

Creative Lighting Overview

As outlined above, the City Park presents a unique opportunity to implement an integrated catenary lighting system that provides both functional and creative lighting. Given the intended role of the site as the principal meeting and gathering space in the City Centre, it is the ideal location for additional artistic lighting features. Additional artistic lighting features should consider:

- Artistic lighting feature integrated into catenary lighting (see Functional Lighting Overview above)
- Under-seat and/or in-wall LED colour-changing strip lighting
- A bespoke light/art feature with the theme “Water and Light”



Table 19: City Park issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|--|---|
| 6.8.1 | Functional lighting of City Park | <p>Installation of a fully-programmable pole-mounted catenary lighting system (e.g. colour-changing RGB LED with DALI control) which will serve as both functional and creative lighting at different times of the night, as well as all-in-one modular smart poles with colour-changing RGB LED beacons along the Station Street interface.</p> <p>Provide functional lighting to P8 level.</p> <p>Dim as follows:</p> <ul style="list-style-type: none"> • Monday to Thursday - dim to P2 (at a time to be determined by Council) • Friday to Sunday - do not dim <p>Creative catenary lighting to be activated during hours of evening dining (specific timing to be determined by Council).</p> |
| 6.8.2 | Creative lighting to complement City Park catenary lighting system | <p>In addition to the catenary lighting system (which includes creative lighting capability) consider as part of master-planning process:</p> <ul style="list-style-type: none"> • Artistic lighting feature integrated into catenary lighting (see Functional Lighting Overview above) • Under-seat and/or in-wall LED colour-changing strip lighting • A bespoke light/art feature with the theme “Water and Light” |

6.9 City Square

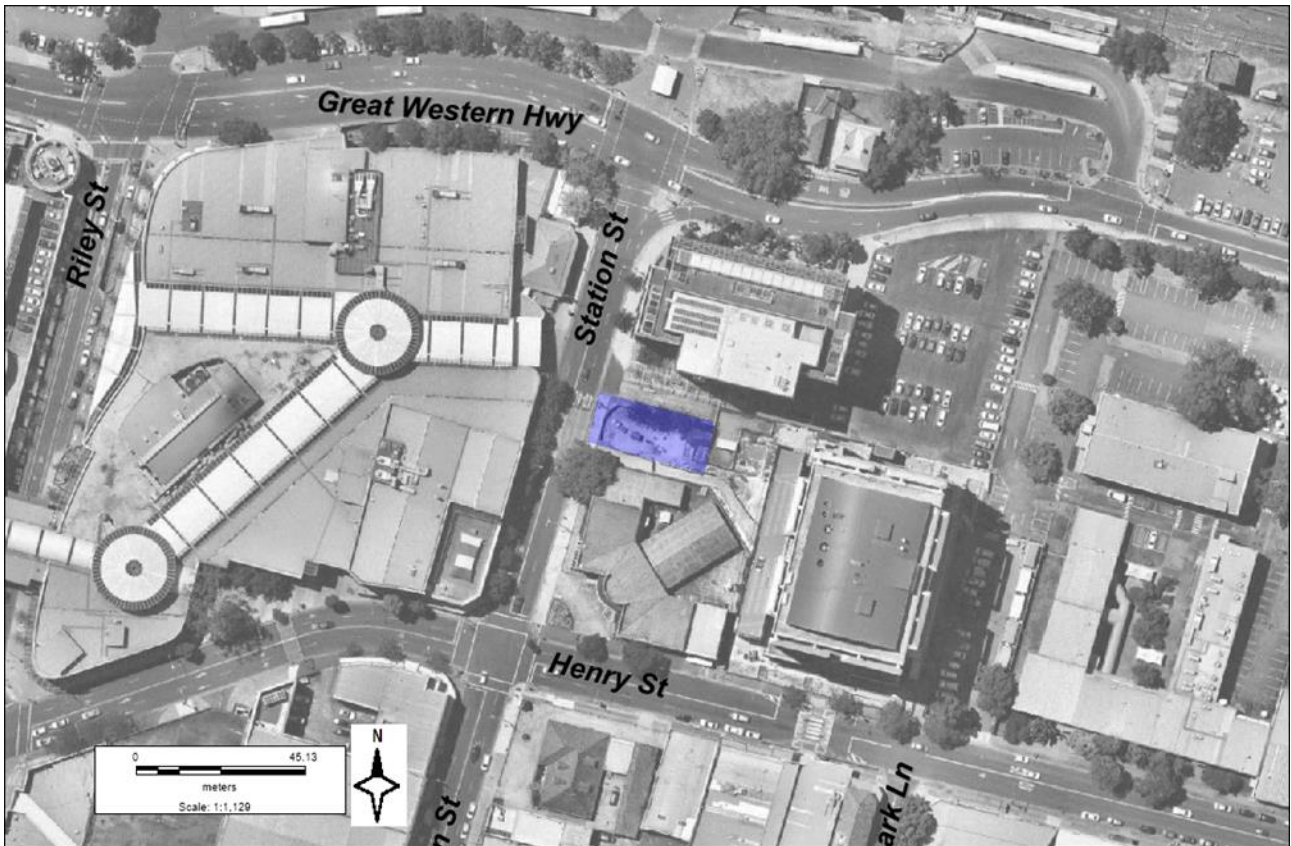


Figure 20: City Square and surrounds

Site Overview

This future City Square site is located on the eastern side of Station Street, north of the former Council Chambers. Similar to the future City Park to the south, it will act as a meeting point for pedestrians, and punctuate the pedestrian connection between Penrith Station and other key precincts to the south such as High Street (refer to Figure 5 and 4.3.1). This site will undergo a detailed master-planning process which will determine the locations and requirements of the lighting and smart city infrastructure at the site.

Functional Lighting Overview

Lighting should cater for high-use pedestrian activity and activity spaces. The City Square is also a logical location for “smart” poles with various smart city features installed. Any lighting upgrade should also include the capacity to dim and/or increase light levels at specific times or for special events (e.g. markets, festivals). A catenary lighting system that has the ability to provide both functional and creative lighting (e.g. colour changing) is recommended.

Creative Lighting Overview

As outlined above, the City Square presents a unique opportunity to implement an integrated catenary lighting system that provides both functional and creative lighting, consistent in theme and style with the nearby City Park. Given the smaller scale of the City Square however, additional creative lighting is not recommended.

Table 20: City Square issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|-------|------------------------------------|--|
| 6.9.1 | Functional lighting of City Square | <p>Installation of a fully-programmable pole-mounted catenary lighting system (e.g. colour-changing RGB LED with DALI control) which will serve as both functional and creative lighting at different times of the night, as well as all-in-one modular smart poles with colour-changing RGB LED beacons along the Station Street interface.</p> <p>Provide functional lighting to P8 level.</p> <p>Dim as follows:</p> <ul style="list-style-type: none"> Monday to Thursday - dim to P2 (at a time to be determined by Council) Friday to Sunday - do not dim <p>Creative catenary lighting to be activated during specific hours to be determined by Council.</p> |

6.10 Westfield Entrance Plaza (Henry Street, between Riley and Station Streets)

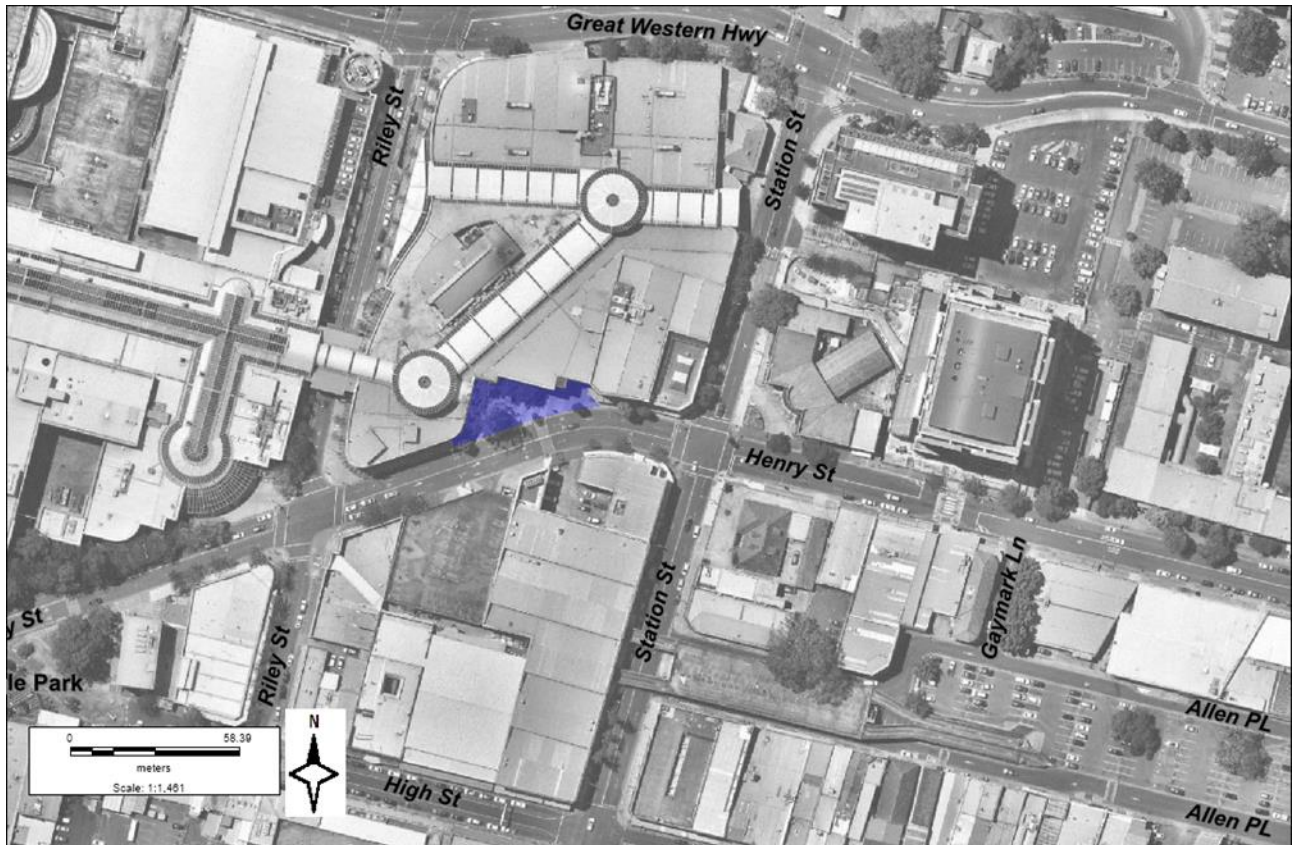


Figure 21: Westfield entrance plaza aerial overview

Site Overview

This small plaza is located outside the entrance to Westfield on Henry Street (between Riley and Station Streets) and forms part of the pedestrian connection between key precincts such as Station Street and the Civic Arts Precinct (refer to Figure 5 and 4.3.1) as well as marking an entrance point to Westfield Penrith.

Functional Lighting Overview

The site is currently serviced by spill lighting from the adjacent Westfield complex as well as nearby road lighting. Given that the site is not considered a key meeting or gathering point, but rather a space that pedestrians pass through en route to other nearby precincts (e.g. Station Street, High Street and the Civic Arts Precinct) the provision of functional lighting should be for the purposes of safe movement through the space. Functional lighting should provide a clear visual connection by minimising spacing and mounting height. Poles and luminaires used should be consistent in style with those used in other key precincts.

Creative Lighting Overview

As outlined above, given that the site is not considered a key meeting or gathering point, standalone creative lighting is not recommended. However, the use of all-in-one modular smart poles will allow the installation of programmable colour-changing beacons to provide a creative lighting element (if desired).

Table 21: Westfield Entrance Plaza issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|--------|---|---|
| 6.10.1 | Provision of functional lighting to support pedestrian movement through space to nearby key precincts | Installation of all-in-one modular smart poles with colour-changing beacons adjacent to Henry Street road reserve in alignment with preferred pedestrian route through space. |



6.11 Judges Park



Figure 22: Judges Park aerial overview

Site Overview

Judges Park is bordered by the PCYC Penrith, the Penrith Bowling and Recreation Club and the Penrith Senior Citizens Centre, and includes a heavily used public pathway stretching from Woodriff Street to Union Lane. While a large open space, it is typically used as a pedestrian thoroughfare and not as a place to meet and gather.

Functional Lighting Overview

The public pathway is currently serviced by varying levels of lighting emanating from dedicated pathway lighting and other sources of spill lighting. However, the existing light levels are considered inadequate (as identified by audit; refer also to Section 3.4) and should be increased to encourage use during likely periods of pedestrian activity.

Given that the site is not considered a key meeting or gathering point, but rather a space that pedestrians pass through en route to car parking (to the south) and other nearby precincts (e.g. Station Street) to the north, the provision of functional lighting should be for the purposes of safe movement through the space. Functional lighting should provide a clear visual connection by minimising spacing and mounting height.

Poles and luminaires used should be consistent in style with those used in other key precincts.

Creative Lighting Overview

As outlined above, given that the site is not considered a key meeting or gathering point, creative lighting is not recommended.

Table 22: Judges Park issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|--------|---|---|
| 6.11.1 | Provision of functional lighting to support pedestrian movement through space to nearby key precincts | <p>Remove existing light columns and replace with LED pole-mounted luminaires with DALI control.</p> <p>Light to P2 level.</p> <p>Dim as follows:</p> <ul style="list-style-type: none"> Monday to Thursday - dim to P4 level (at a time to be determined by Council) <p>Friday to Sunday - do not dim</p> |



6.12 Penrith Station Transit Plaza

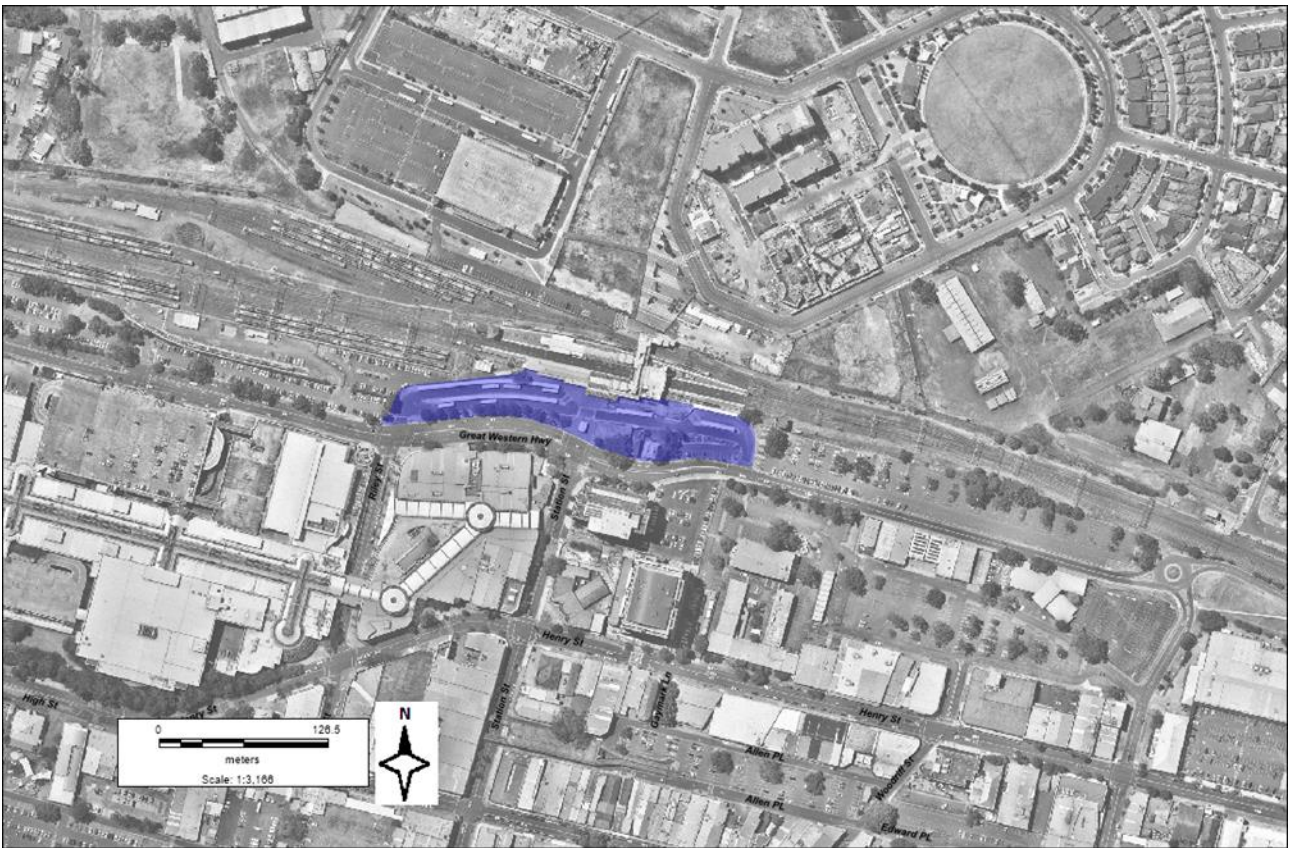


Figure 23: Penrith Station Plaza aerial overview

Site Overview

The Penrith Station Transit Plaza is one of the principle gateways to the City Centre. The space is managed by Transport for NSW, with some areas currently undergoing redevelopment, and other slated for future development. While Council has been invited to provide input into the design process, determination of the final design is at the sole determination of Transport for NSW. A major feature of the planned future works will be the construction of a pedestrian overpass connecting the Station to Station Street.

Functional Lighting Overview

The Transit Plaza space is currently serviced by dedicated plaza lighting as well as spill lighting from the nearby Belmore Street. However, the majority of this lighting will likely be upgraded during future development works.

Despite the limited control Council has over future design decisions, and given the status of the Station as one of the principal gateways to the City Centre, it is recommended that Council continue to engage with Transport for NSW with the objectives of:

- emphasising the Train Station as the key gateway to the City Centre

- achieving consistency with the public lighting theme used elsewhere in the City Centre (e.g. the installation of smart poles)

Given the frequency of public transport services and the limited time between last and first services each evening, any proposal to dim functional lighting is not recommended.

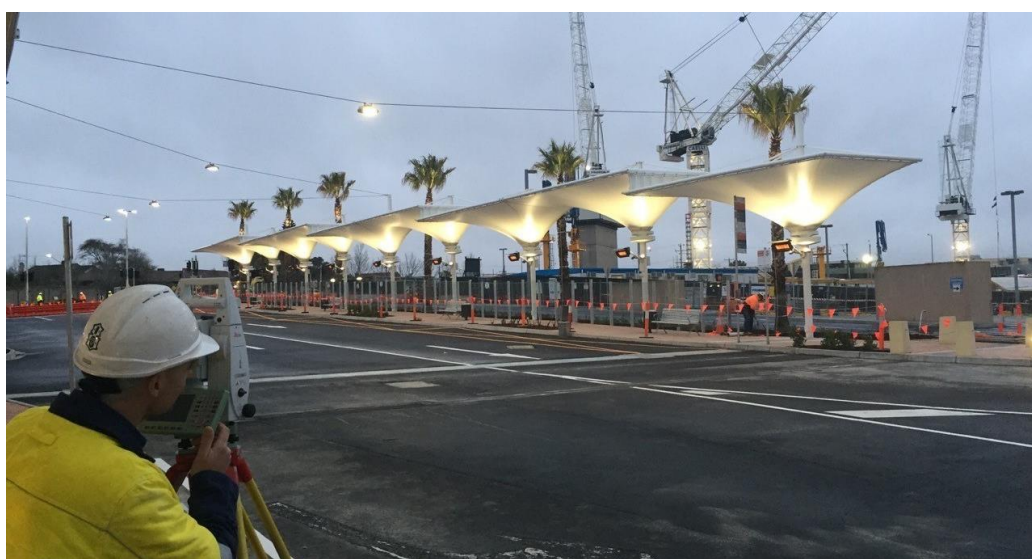
Creative Lighting Overview

In liaison with Transport for NSW, and in line with the objective of emphasising the Station as a gateway, Council may wish to consider advocating for creative lighting solutions such as:

- Special pole elements
- Coloured illuminated signage directed at pedestrians entering the City Centre from the train station

Table 23: Penrith Station Transit Plaza issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|--------|-------------------------------------|--|
| 6.12.1 | Consultation with Transport for NSW | Council to continue to liaise with Transport for NSW regarding any proposed changes to plaza lighting or layout, with the objective of emphasising the plaza as the key gateway to the City Centre and achieving consistency with lighting themes used elsewhere in the City Centre. |



6.13 High Street Connection to the Great River Walk

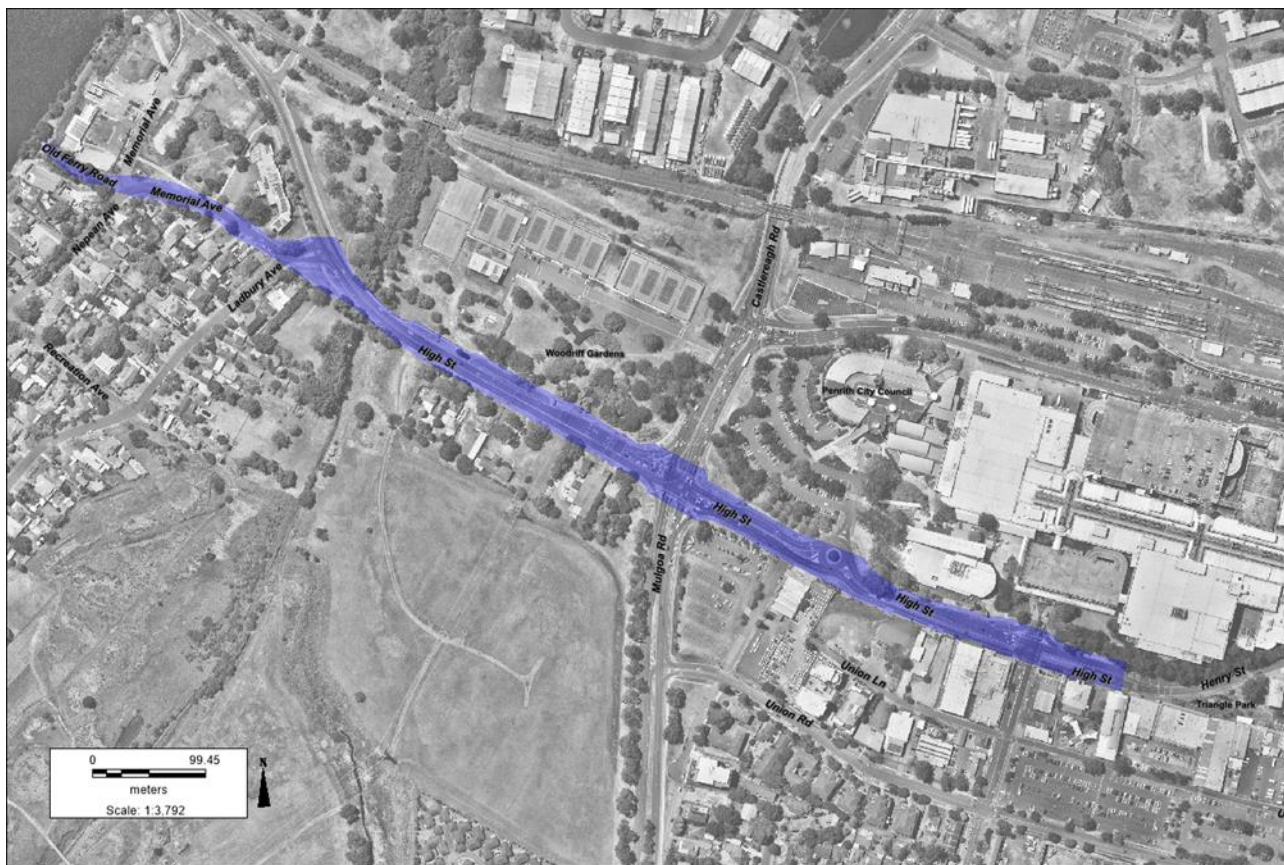


Figure 24: High Street to Great River Walk aerial overview

Site Overview

This pedestrian route runs along High Street from Triangle Park out of the City Centre to the Nepean River, and will eventually connect to the Great River Walk once works on the pedestrian footbridge are complete.

Functional Lighting Overview

The extension of High Street through to the Nepean River is serviced by variable pedestrian light levels, mostly provided by spill lighting from major road lighting servicing High Street. Current pedestrian light levels are considered inadequate (as identified by audit; refer also to Section 3.4) and should be increased in line with the route's classification as a City Centre street in this Strategy.

A large section of this route will be affected by the future RMS upgrade of the High Street and Mulgoa Road intersection (refer to Section 6.1), with road lighting expected to provide adequate pedestrian light levels, therefore the installation of any additional functional pedestrian lighting in this section should be considered carefully, and for the purposes of providing clear visual connection along the route. For other sections, in particular west of Peach Tree Creek, upgraded functional lighting is recommended.

Given that the route is not in itself a key meeting or gathering point, but rather a thoroughfare connecting to other precincts (e.g. High Street and the Great River Walk) the provision of functional lighting should be for the purposes of safe movement. Functional lighting should provide a clear visual connection by minimising spacing and mounting height. Poles and luminaires used should be consistent in style with those used in other key precincts.

Creative Lighting Overview

As outlined above, given that the site is not considered a key meeting or gathering point, standalone creative lighting is not recommended. However, the use of all-in-one modular smart poles will allow the installation of programmable colour-changing beacons to provide a creative lighting element (if desired).

Table 24: High Street connection to Great River Walk issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|--------|---|---|
| 6.13.1 | Functional lighting of footpaths along Memorial Avenue and Old Ferry Road (to west of Peach Tree Creek) | <p>Removal of existing Category P functional lighting along Memorial Avenue and Old Ferry Road and installation of all-in-one modular smart poles with colour-changing RGB LED beacons.</p> <p>Light to P2 level.</p> <p>Dim to P3 level (at a time to be determined by Council).</p> |



6.14 Station Street (from Train Station to Penrith Stadium)

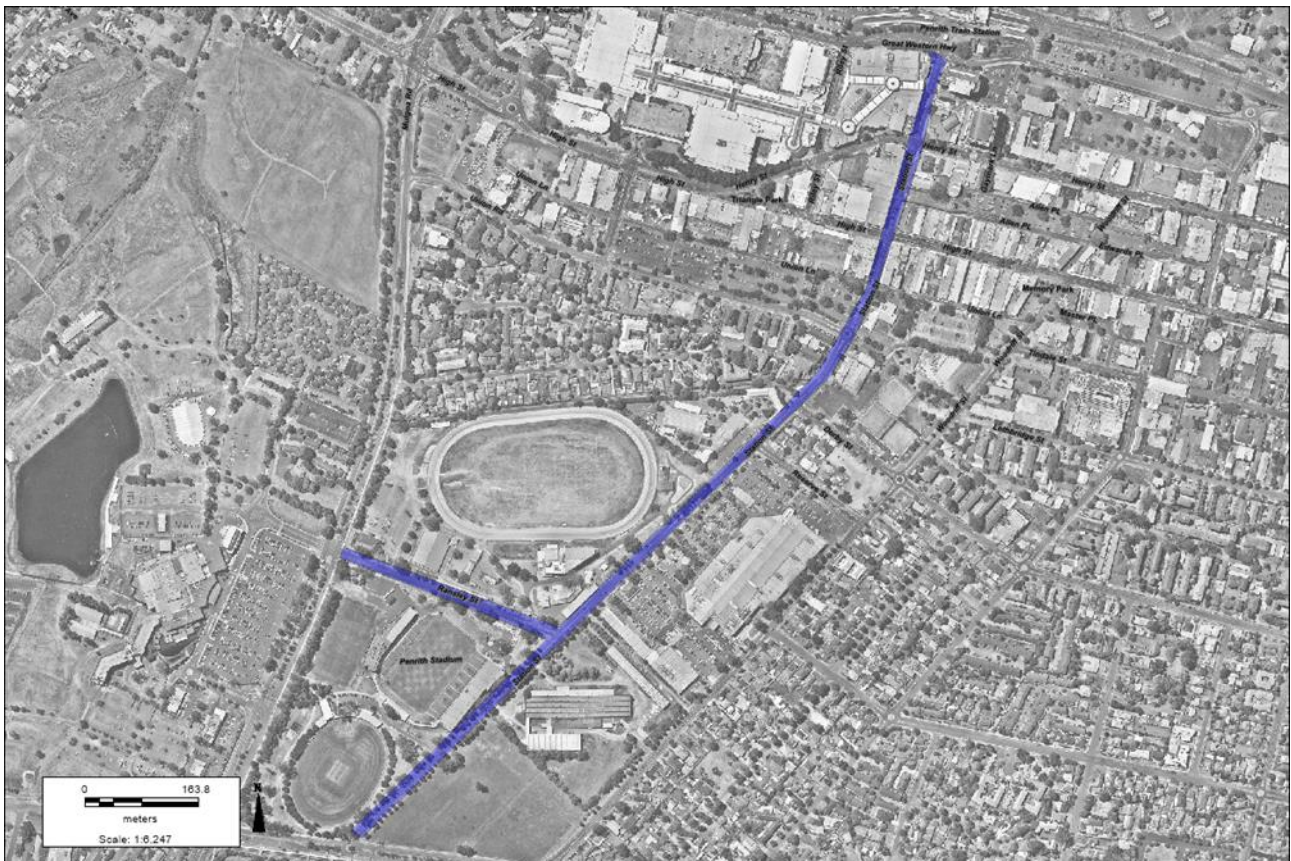


Figure 25: Penrith Station to Penrith Stadium aerial overview

Site Overview

This route is the principle pedestrian connection between the Penrith Train Station to Penrith Stadium, and includes Ransley Street which also serves as a key pedestrian gateway to the Stadium precinct.

Large-scale residential development is planned for the land between Station Street and Woodriff Street (north of Jamison Road), and the entrance to Station Street off Jamison Road is considered a gateway to the City Centre.

Functional Lighting Overview

The length of Station Street is serviced by highly variable pedestrian light levels, mostly provided by adjacent road lighting. Current pedestrian light levels are considered inadequate (as identified by audit; refer also to Section 3.4) and should be increased in line with the route's classification as a City Centre street in this Strategy.

Given that the route is not in itself a key meeting or gathering point, but rather a thoroughfare connecting to other precincts (e.g. the Train Station, High Street etc.) the provision of functional lighting should be for the purposes of safe movement. Functional

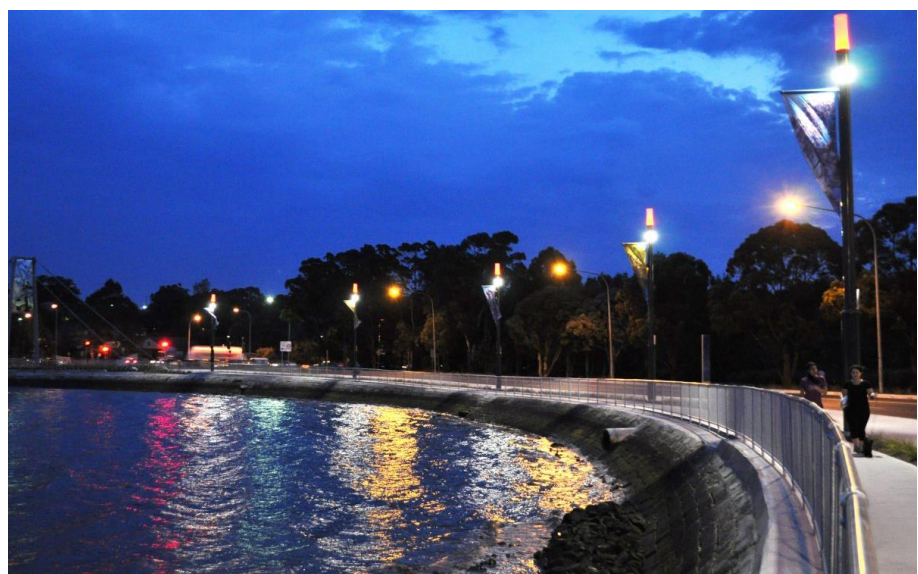
lighting should provide a clear visual connection by minimising spacing and mounting height. Poles and luminaires used should be consistent in style with those used in other key precincts.

Creative Lighting Overview

Given that this route connects the major public transport interchange in the City Centre with the Stadium, and experiences large volumes of pedestrian activity at those times when events are held at the stadium, creative lighting is recommended to identify the route, with the ability to be activated only during events (may be switched off or serve solely as functional lighting at other times).

Table 25: Station Street (from Train Station to Penrith Stadium) issues, design responses and actions

| Ref | Issue | Design Response and Action(s) |
|--------|--|--|
| 6.14.1 | Functional lighting of footpaths along Station Street and Ransley Street | <ul style="list-style-type: none"> • Removal of existing Category P functional lighting and installation of all-in-one modular smart poles with colour-changing RGB LED beacons. • Light to P2 level. • Dim to P3 level (at a time to be determined by Council). • Creative catenary lighting to be activated during specific hours to be determined by Council. |



7 GLOSSARY

| Term | Definition |
|-----------------------|--|
| Category P | Pedestrian category roads (sometimes referred to as “Cat P” or “minor” roads) |
| Category V | Vehicular category roads (sometimes referred to as “Cat V” or “major” roads) |
| Catenary lighting | Lighting suspended from a cable (or cables) typically secured to poles or building facades. |
| CCT | Correlated colour temperature describes the colour of a light source, and is measured in degrees Kelvin (K). Blue-white lamps have a high colour temperature (e.g. 4000K). Yellow lamps have a low colour temperature, (e.g. 2000K) |
| Colour Rendering | Colour rendering describes the degree to which natural colours can be perceived under different kinds of artificial light. It is measured on a colour rendering index (CRI). A CRI of 100 indicates that colours are depicted accurately. A CRI of less than 30 indicates colours are distorted and difficult to recognise. A CRI of 80 or above provides an acceptable standard for outdoor lighting. |
| Decorative | Refer to ‘non-standard’ |
| DNSP | Distribution Network Service Provider, also known as Energy Distribution Business (EDB) also known as distributors. |
| GHG | Greenhouse Gas |
| Lamp | The light bulb in a luminaire |
| LED | Light emitting diode |
| Luminaire | The lamp, fitting and control gear of the light |
| Non-standard lighting | Lighting that is typically not held in stock by DNSPs, sometimes also referred to as ‘decorative’. Typically found in URD areas. |
| RMS | Roads and Maritime Services |
| Standard lighting | Lighting that is typically held in stock by DNSPs, and is found on their list of products approved for use. |
| Street Lighting | Street lighting found in residential streets and main roads |
| URD | Underground Residential Developments |
| WSROC | Western Regional Organisation of Councils |