Guideline

Bicycle rider and pedestrian underpasses

May 2020

Queensland Government

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1 Introduction

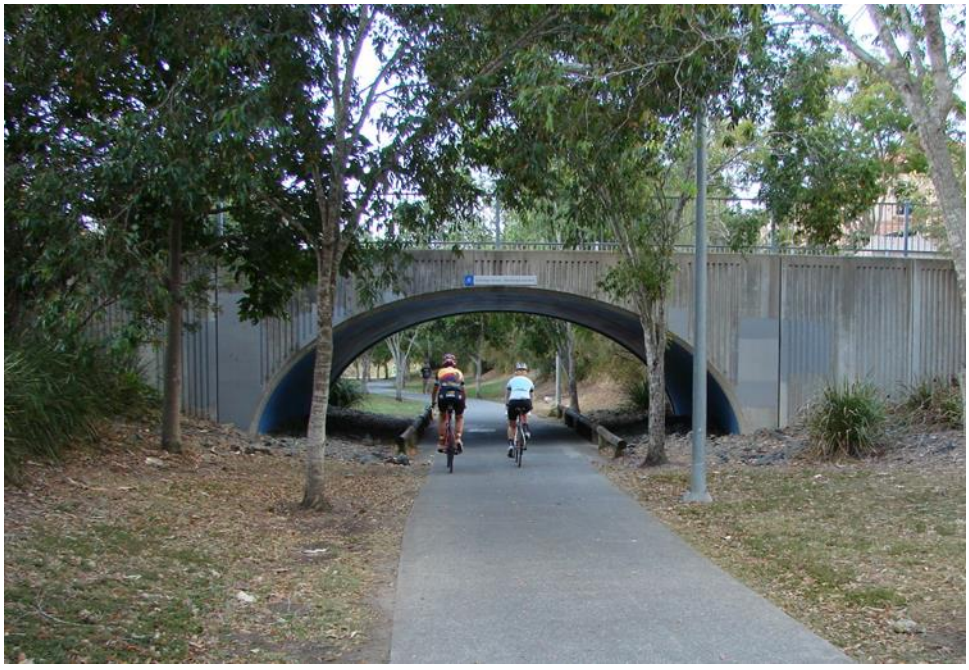
1.1 Background

The location of major transport corridors (highways, motorways, rail lines, busways, and so on) throughout Queensland suburbs can act as a barrier and sever community connectivity. Pedestrian and cyclist crossing are an important factor in providing access and connectivity to the surrounding community and adjoining land uses.

Pedestrian and cyclist road crossings (the definitions provided for the different crossings are from Austroads *Glossary of Terms*) are usually designed as either:

- at-grade crossings – crossing at the same level as a road (for further information on at-grade crossings, please refer to the: Austroads *Pedestrian Facility Selection Tool* and the Department of Transport and Main Roads *Raised priority crossings for pedestrian and cycle paths* guideline)
- overpass crossings – a grade separation where a pedestrian and/or cyclist path passes over a road (for further information on at-grade crossings, please refer to the Transport and Main Roads *Options for designers of pedestrian and cyclist bridges to achieve value-for-money* guideline), and
- underpass crossings (often referred to as subways) – a grade separation where a pedestrian and/or cyclist path passes under a road via a culvert or structure (for further information on underpass crossings, refer to this guideline).

Figure 1.1 – Example of a pedestrian and cyclist underpass (Uxbridge Street, Grange)



The objective of grade separation between pedestrian, cyclist and vehicle movements (including the use of underpasses) is to increase the safety of users by removing the potential conflict that can occur, contributing to Safe Systems outcomes.

Effectively planned and designed underpasses can support safe pedestrian and cyclist movements, provide a cost-effective crossing option to meet identified desire lines, reduce delays to traffic (that

would result from at-grade crossings) and provide network connectivity and improved permeability for communities; however, concerns about personal security and flood risk have resulted in this treatment being ruled out at concept stage of a project, when the issues can be addressed in the design stage of a project.

Perceptions of security

Historically, underpasses have been viewed as an undesirable crossing outcome due to the perceived security concerns associated with tunnels and crossings being out of sight, with this negative perception propagated by many publications.

This guideline suggests methods to mitigate personal security perception issues. The design guidance in Section 3 enhances useability of underpasses as a way to cross transport corridors.

Flood risk

As underpasses are located beneath a transport corridor and can be collocated with waterways, they can create low-lying ground levels that are susceptible to flooding during severe weather events which could close the underpass. The risk of flooding is not a deterrent to implementing an underpass as this risk can be treated and managed.

Underpasses prone to flooding can be managed via effective gradients (Section 3.5), path surface and maintenance (Section 3.6), drainage (Section 3.7) and warning signage (Section 3.10). Specific information on flood assessment and risk is identified in Section 3.7.

1.2 Purpose and scope

This guideline provides best practice information on the key attributes to be considered when planning and designing underpasses, and describes important design attributes that build on the Austroads guidance currently available. This document also includes case study observations from the application of underpasses throughout Queensland.

This guideline provides additional information to support Section 8.3 of the department's supplement to Austroads *Guide to Road Design*, the *Road Planning and Design Manual* (RPDM) *Edition 2 Volume 3* Part 6A and Volume 1 Part 6 Section 8.2 of the department's *Traffic and Road Use Management* (TRUM) manual. This guideline also provides additional information to support references to underpasses and grade separated crossings in Austroads *Guide to Road Design* (specifically Part 6A Section 8.3) and *Guide to Traffic Management* (specifically Part 6 Section 9.2.1).

Existing guidance provides limited specific details on improving safety and usability. There is a risk that, without this guideline, underpasses may be applied inappropriately or not considered at all in situations where they could be a cost-effective option and benefit to pedestrian and cyclist networks. The effective application of underpasses and the design attributes identified in this guideline can resolve perceived safety concerns and provide high-quality, cost-effective connections for pedestrians and cyclists.

This guideline outlines the design attributes and characteristics to be considered when planning underpasses to provide a suitable crossing treatment that enhances the network and supports a safe facility that is appropriate for pedestrians and cyclists.

1.3 Related documents

Table 1.3 – Summary of related documents

Title	Relevance
Australian and Australian/New Zealand Standards	
AS/NZS1158.3.1 *Lighting for roads and public spaces*. *Part 3.1 Pedestrian area (Category P) lighting – Performance and design requirements*	Identifies lighting standards for underpasses
AS1428.1 *Design for access and mobility Part 1 General requirements for access – new building work*	Identifies gradient standards for pathways
AS1742.9 *Manual of uniform traffic control devices Part 9 Bicycle facilities*	Identifies line marking standards for pathways used by bicycles
Austroads	
Guide to Road Design Part 1 Introduction to Road Design	Provides general design guidance and focus on the Safe System approach to planning and design
Guide to Road Design Part 4A Unsignalised and Signalised Intersections	Provides information on Safe Intersection Sight Distance
Guide to Road Design Part 5 Drainage – General and Hydrology Considerations	General guidance on drainage and flooding through dual use culverts
Guide to Road Design Part 5A: Drainage – Road Surface, Networks, Basins and Subsurface	General considerations on drainage and maintenance through underpasses
Guide to Road Design Part 6A: Paths for Walking and Cycling	Design considerations and criteria for paths
Guide to Road Design Part 6B: Roadside Environment	Design considerations in the roadside environment
Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings Management	Guidance, principles and attributes of grade separated crossings
Guide to Traffic Management Part 10: Transport Control – Types of Devices	Identifies principles and guidelines on wayfinding
Queensland Government agencies	
Queensland Police Service *Crime prevention through environmental design guidelines for Queensland Part A: Essential features of safer places*	Outlines the guidelines and principles for planning, designing and managing safe places in Queensland
Transport and Main Roads *Road Landscape Manual Edition 2*	Provides design guidance on landscaping at underpasses
Transport and Main Roads *Road Planning and Design Manual Edition 2 Volume 6*	Identifies the need for lighting in underpasses
Transport and Main Roads *Road Planning and Design Manual Edition 2 Volume 3 Part 6A*	Identifies the existing guidance on cyclist and pedestrian underpasses
Transport and Main Roads *Traffic and Road Use Management manual Volume 1 Part 6*	Identifies general information on pedestrian and cyclist crossings

2 Underpass attributes and application

This section will identify:

- the advantages and disadvantages of underpasses
- how the Safe System approach can be applied to underpasses
- Crime Prevention through Environmental Design (CPTED) considerations and how they apply to underpasses, and
- examples of commonly applied underpasses throughout Queensland mid-block connections and collocated crossing.

2.1 Advantages and disadvantages of underpasses

Some of the advantages of underpasses can include:

- improved pedestrian and cyclist travel times and travel time reliability by providing a direct route across the transport corridor without unnecessary deviations or delays
- reduced travel time delays (when compared to at-grade crossings) to pedestrians and cyclists (required to wait for vehicles to stop) as well as reduced travel time delays to vehicles (required to wait while pedestrians and cyclists cross)
- improved safety by reducing the potential for at-grade conflicts and incidents (crashes) between pedestrians, cyclists and vehicles
- reduced severing from community by providing a safe, direct and easy connection across the transport corridor
- increased network connectivity by providing direct connections between pedestrian and cyclist paths and networks
- potential to reduce project costs by removing the need for overhead structures, traffic signals and additional land requirements (for ramps and landings), and
- reduced user effort compared to overpasses (less vertical height change required).

Some of the disadvantages and issues with underpasses can include:

- a perceived reduction in personal security due to the design characteristics of the underpass – this could include attributes such as limited lighting, narrow height or width, reduced visibility, potential conflicts with other users or opportunities for crime
- flooding risk during periods of severe weather, resulting in closure of the underpass; however, demand for use of the facility is likely to decease significantly during these events
- water ponding along the path or dripping from the underpass ceiling due to limited drainage; this could include drainage systems not included in the underpass design, or gradients and crossfall not allowing water to flow
- uninviting environmental conditions due to irregular maintenance or cleaning; this could include a build-up of debris, dirt / cobwebs hanging from the ceiling or fixtures, or graffiti on each underpass surface, and

- increased opportunities for crime due to reduced visibility. This could include limited sightlines, landscaping which creates hiding spots, or absent passive surveillance from adjacent land uses or from the transport corridor.

Many of these disadvantages can be overcome by design practices discussed in Section 3.

2.2 Safe System approach

The Safe System approach is that crashes are likely to occur so the transport environment should be designed, managed and maintained to reduce the risk and consequences if a user makes a mistake. The Safe System approach is focused on four pillars that underpin the planning and design of transport corridors and their surrounding environments. These pillars involve providing safe roads, speeds, vehicles and road use.

For additional information on the Safe System approach, refer to Section 2.3 in Austroads' *Guide to Road Design Part 1: Introduction to Road Design* which identifies the ideal approach as removing conflicts between vehicles and vulnerable road users such as by providing an underpass as an alternative crossing of a transport corridor.

Table 2.2 describes how the Safe System pillars can be applied to underpasses to reduce risk to pedestrians and cyclists and create a safe travel environment.

Table 2.2 – Safe Systems principles applied to underpasses

Pillar	Application to underpasses
Safe roads	An underpass: • reduces conflict and potential crashes between motorised vehicles and pedestrians and cyclists • reduces the unpredictability of pedestrians or cyclists crossing in front of oncoming traffic • reduces the unpredictability of motorised vehicles continuing through the crossing when they are required to give way to pedestrians or cyclists • removes travel time delays for pedestrians, cyclists and vehicles when stopping to allow other users to cross or continue, and • reduces the potential for rear-end crashes by removing the need for vehicles to stop.
Safe speeds	• Pedestrians and cyclists are not sharing space with motorised vehicles travelling at significantly higher speeds. • An underpass supports a slower travel speed suitable for pedestrians and cyclists. • An underpass provides a consistent speed environment allowing pedestrians and cyclists a higher chance of visibility and reaction time to respond to movements.
Safe vehicles	Acceptable vehicles (bicycles) using the underpass are less likely to cause significant harm if conflicts occur between pedestrians and cyclists, based on the design visibility and approach of the underpass (refer to Section 3.4.2.2).
Safe road use	An underpass: • allows for pedestrians and cyclists to have appropriate travel behaviour and compliance with regulations and road rules, and • can be used by pedestrians and cyclist of all ages and abilities where at-grade crossings may be a hazard or not viable for children, elderly or people with a disability.

2.3 Crime Prevention through Environmental Design

CPTED is using the physical environment, built and/or natural, to improve safety and security through reduced incidences and opportunities for crime to occur, and to enhance the personal security of users through a space.

CPTED focuses on six key principles for the planning and designing of spaces for users and improving physical and perceived safety. These principles include improving surveillance, maintaining legibility of movement, defining territory, encouraging community ownership and legitimate users, improving management, and reducing vulnerability.

For additional information on CPTED, refer to the *Crime Prevention through Environmental Design Guidelines for Queensland Part A: Essential features of safer places* and the *Road Landscape Manual*.

Table 2.3 describes how the CPTED principles can be applied to underpasses to improve the personal and perceived safety of pedestrians and cyclists.

Table 2.3 – Crime Prevention through Environmental Design principles applied to underpasses

Principle	Application to underpasses
Surveillance	• Consider the surrounding environment to encourage passive surveillance of the underpass, or, if appropriate, install closed-circuit television (CCTV) to provide artificial surveillance. • Design the underpass to include adequate sightlines and space so users are visible and enables passers-by to identify them. • Remove unnecessary landscape or street furniture to increase visibility of the surrounding areas.
Legibility	• Design the underpass to have clear sightlines through the underpass, from the underpass entrance, mid-point and exit. • Consider wayfinding for location and directional signage to improve movement and user confidence.
Territoriality	• Provide sufficient space to support all users and encourage use. • Consider line markings and signage to advise on spaces for pedestrians and cyclists to reinforce defined boundaries.
Ownership	• Consider the use of local street art to decorate the underpass walls. • Encourage visibility and activity at or near the underpass through surrounding land uses. • Maintain a safe and clean environment free from debris, rubbish and graffiti.
Management	• Ensure adequate drainage to reduce water ponding or travel hazards. • Provide a regular asset management program to maintain the underpass and path.
Vulnerability	• Limit landscaping and street furniture that could be used as hiding places. • Ensure adequate natural and artificial light and remove concealed spaces. • Provide multiple entrance and exit paths to reduce path predictability and entrapment.

2.4 Common applications

This section contains examples of commonly-applied underpasses on the Queensland transport network. Refer to Section 3 for guidance on each design attribute.

Austroads' *Guide to Traffic Management Part 6: Intersections, Interchanges and crossings* identifies underpasses are generally applied at locations with high posted speed, high volumes of motorised and crossing traffic, multiple lanes and path continuity; and at those locations suitable for roads classified as freeway / motorway, primary arterial and secondary arterial. Generally, unless identified on a Local Cycle Network Plan or a Principal Cycle Network Plan, collector roads and local streets are not suitable for underpasses due to the lower volumes of traffic and road environment more supportive of pedestrians and cyclists.

Underpasses can be used in both greenfield and retrofit applications. Refer to Section 4 for a Queensland underpass retrofit case study.

2.4.1 Mid-block connections

A mid-block underpass refers to a pedestrian or cyclist connection across a transport corridor via a tunnel or culvert. Mid-block underpasses can be located at any location along the corridor; however, suitable planning should place underpasses on pedestrian and cyclist desire lines to key activity centres and land uses.

Figure 2.4.1 shows an example of a mid-block pedestrian underpass.

The design attributes to consider for mid-block underpasses include the provision of:

- adequate height, allowing space for cyclists to travel through without compromising their riding position
- sufficient width so users do not feel enclosed or trapped
- clear sightlines to and through the underpass so users can see other users and the conditions upon exiting
- appropriate and ample natural and artificial lighting so users are visible
- line marking and signage to distinguish between travel directions and orient users
- adequate drainage and gradients to allow water to clear and users to travel safely without obstacles or debris, and
- regular maintenance so users have a clear, safe and comfortable facility.

Figure 2.4.1 – Example of a mid-block underpass (Bicentennial Road, Boondall)

2.4.2 Collocated crossing

A collocated underpass uses an existing feature, such as a creek or waterway, to provide a crossing underneath a transport corridor, usually via additional cutbacks into the embankment to allow pedestrians and cyclists to travel adjacent to the natural feature. These underpasses are used to enhance recreational pathways and connect parks, centres and transport corridors.

Figure 2.4.2 shows an example of a collocated pedestrian underpass.

The design attributes to consider for collocated underpasses include the provision of:

- clear sightlines to and through the underpass so users can see other users and the conditions upon exiting
- appropriate and ample natural and artificial lighting so users are visible
- line marking and signage to distinguish between travel directions and orient users, and
- regular maintenance so users have a clear, safe and comfortable facility. This is particularly important for underpasses collocated with locations that flood and where debris can build up or block the path.

The proximity of the existing feature can allow for some design features to be modified such as:

- the underpass height – height may be constrained by the overhead structure; however, the minimum height for cyclists should be applied
- the underpass width – the existing feature tends to open up the underpass, giving users a sense of openness and less that of a constrained or enclosed environment, and
- the underpass drainage – particularly for underpasses collocated near waterways, drainage channels may not be required where the gradient of the path allows water to run-off into the waterway. Adequate design for debris is still required.

Figure 2.4.2 – Example of a collocated underpass (Sandgate Road and Kedron Brook, Nundah)

3 Design guidance

The design attributes to be considered in the planning and design of underpasses include:

- vertical clearance
- horizontal space
- underpass length
- sightlines and visibility
- gradients
- path surface
- drainage
- lighting
- landscaping, and
- wayfinding and signage.

The following section contains some examples of best practice and poor implementation of the design attributes listed and refers to the relevant guidelines or standards for additional specifications.

CPTED is a critical factor to the success of underpasses; however, it is not included in this guideline as a specific design attribute. The 10 design attributes listed have incorporated the principles and elements of CPTED into their design considerations. For specific guidance on CPTED, refer to the *Crime Prevention through Environmental Design Guidelines for Queensland Part A: Essential features of safer places* and the *Road Landscape Manual*.

3.1 Vertical clearance

Vertical clearance refers to the amount of space or height provided between the path and the ceiling of the underpass to allow pedestrians and cyclists to travel upright without striking the ceiling, having to slouch or bend, or requiring cyclists to dismount. Providing sufficient space improves the comfort of pedestrians and cyclists and the useability of the underpass.

3.1.1 Existing guidance

Sections 5.5.1, 5.5.2, 8.2.2, and 8.3.2 of Austroads' *Guide to Road Design Part 6A* identify a minimum vertical clearance of 2.5m through culverts and under bridges. Section 8.3.1 further identifies a preferred height to width ratio of 1:1.5.

Vertical clearance supports the CPTED principle of territoriality.

3.1.2 Queensland case studies

Table 3.1.2 provides observations from viewing vertical clearance at underpass sites.

For mid-block underpasses, those with a height over 2.5m tend to provide sufficient space to accommodate all users. Those underpasses with a height less than 2.4m encroach on the acceptable height, particularly for cyclists, yet the wider path tends to compensate for the shorter height and allows users to feel comfortable. If the height is less than 2.5m, a wider path can assist with usability.

For collocated underpasses, the additional width provided by the adjacent waterway opens up the underpass, so users feel comfortable using the facility even if the vertical clearance is lower than 2.5m.

For all underpasses with a height less than 2.5m, there is a risk cyclists who stand while riding could strike light fixtures. The minimum 2.5m height should be applied if width is sufficient (see Section 3.2); however, a desirable height of 2.7m or greater should be achieved where possible. The desirable height allows clearance between users and light fittings, signs and other equipment through the underpass.

For underpasses beneath a rail corridor, protective screening can protect users from debris or freight materials falling from passing carriages. For such locations, additional vertical clearance should be applied to allow for a freestanding screen.

Table 3.1.2 – Vertical clearance observations

Mid-block underpass observations	Collocated underpass observations
	
Gateway Motorway / Bracken Ridge Road, Bracken Ridge 2.4m height Below minimum vertical clearance	Coolnwynpin Creek / Old Cleveland Road, Capalaba 2.45m height Below minimum vertical clearance
	
Mount Lindesay Highway, Browns Plains 2.8m height Adequate height and clearance for all users	Kedron Brook Bikeway, Sandgate Road, Nundah 2.7m height Adequate height for all users

3.2 Horizontal space

Horizontal space refers to the amount of space provided between the sides of the underpass and the path, and the width of the path provided through the underpass. Providing sufficient space, particularly for two users to pass safely and comfortably reduces safety concerns and improves useability.

3.2.1 Existing guidance

The current standards and guidance for path width depends on the volume of pedestrians and cyclists using the path. Section 7.4.2 of Austroads' *Guide to Traffic Management Part 6* identifies the need for underpasses to have adequate width to be safe for use by pedestrians and cyclists.

The following documents outline the current standards and guidance:

- Section 5.1.4 of Austroads' *Guide to Road Design Part 6A* identifies a horizontal width between 2.5–3.5m for shared paths, and a clearance between the path and fixed object between 0.3–1.0m depending on the object's features.
- Section 5.1.4 of the RPDM Volume 3 Part 6A identifies the minimum standard for shared paths as 2.5m with the width increasing depending on the volume of pedestrians and cyclists.

Horizontal space supports the CPTED principles of territoriality and legibility.

3.2.2 Queensland case studies

Table 3.2.2 provides observations from viewing horizontal clearance at underpass sites.

For both mid-block and collocated underpasses, a width below 2.5m is observed as narrow and insufficient to support pedestrian and cyclist travel through the underpass.

A 2.5m path width provides the minimum path width for users through an underpass and can support safe movement; however, in a mid-block underpass, the adjacent walls may contribute to the perception of confinement. The provision of a wider path greater than 3.0m or additional verge / clearance between the path and objects (walls, fence or barriers) along the path can assist in creating a better travelling environment through the underpass.

For example, a total width of 6.0m through an underpass allows for a 3.5m wide shared path with 1.25m clearance each side between the path and underpass walls. This desired width provides sufficient space for users travelling in both directions to safely pass and improved visibility with users able to clearly see the path ahead, other users and the environment surrounding the underpass.

Table 3.2.2 – Horizontal clearance observations

Mid-block underpass observations	Collocated underpass observations
	
Cabbage Tree Creek / Linkwood Drive, Ferny Hills 2.0m wide Below minimum horizontal width	Cabbage Tree Creek / Woodhill Road, Bunya 2.0m wide path Below minimum horizontal width No clearance between the path and waterways
	
Uxbridge Street, Grange 2.5m wide path Clearance between path, barrier and underpass wall Adequate width and clearance for all users	Kedron Brook Bikeway / Shand Street, Enoggera 3.0m wide path and limited clearance between path and fence Adequate width for all users

3.3 Underpass length

Underpass length refers to the distance required to travel underneath the transport corridor. An underpass should use the most direct alignment under a transport corridor to ensure the quickest and shortest route possible. Aligning an underpass with the path skew can assist with sightlines. A longer underpass, without appropriate consideration, can result in safety concerns for users.

3.3.1 Existing guidance

There is no specific guidance available relating to the length of underpasses; however, Section 8.3.2 of Austroads' *Guide to Road Design Part 6A* identifies that a clear line of sight from one end to the other should be provided. This is further supported by Section 3.3.12.1 of the *Road Landscape Manual* which notes visibility through the underpass allows users to identify potential security risks.

Underpass length supports the CPTED principles of legibility and vulnerability.

3.3.2 Queensland case studies

Table 3.3.2(a) provides observations from viewing length at underpass sites.

The length of the underpass depends on the transport corridor it is traversing under and is difficult to standardise. The critical factor relating to the length is the ability to see through the underpass from one end to the other. This allows users to view and perceive any safety concerns or threats.

For scenarios where a longer underpass may be required, the length should not be a deterrent or justification to reject a potential underpass location. The length of an underpass can be managed sufficiently and compensated via appropriate lighting, surveillance mechanisms (casual surveillance and monitored surveillance cameras) and provide the local community with ownership of the space.

Refer to Section 3.4 for additional information on sightlines and visibility, Section 3.8 for lighting and Section 3.9 for landscaping and ownership.

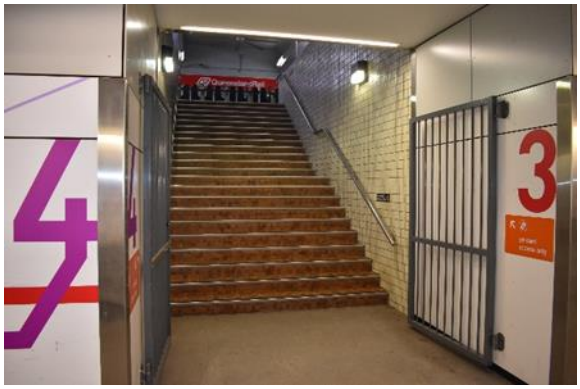
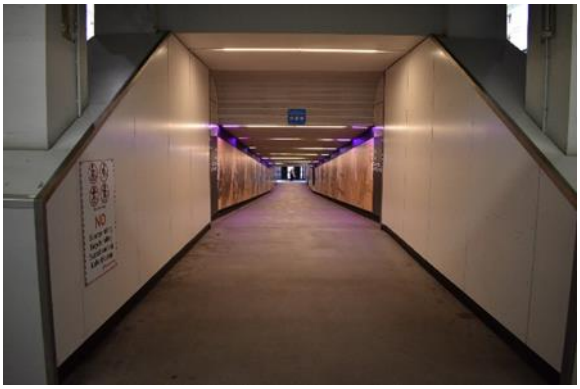
Table 3.3.2(a) – Underpass length observations

<table>
<tr><th>Mid-block underpass observations</th><th>Collocated underpass observations</th></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Gateway Motorway / Bracken Ridge Road, Bracken Ridge
64m in length
Stairs and level change obstruct view of the other side</td><td>Downfall Creek Bikeway / Sandgate Road, Toombul
74m in length
Utility box, curved path and road structure obstruct view of the other side</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Coronation Drive / Little Cribb Street (Bicentennial Bikeway), Milton
35m in length
Obstructed view through the underpass from the bikeway due to tight corner
Obstructed view through the underpass from Little Crib Street access due to Brisbane River fencing and directional signage</td></tr>
</table>

An example of an existing and popular long underpass is ANZAC Square, Brisbane where approximately 16,000 pedestrians use the underpass each weekday. The ANZAC Square underpass has the following characteristics:

- 207m in length from ANZAC Square to Central Station and Wickham Terrace car park
- a high level of artificial lighting creating a very light space; the light placement in the corners of the ceiling, coupled with a light finish to the ceiling and walls offers additional reflection
- a general width beneath the station platforms of 3.0m, increasing to 3.3m near ANZAC Square and reducing to 2.5m near the car park
- a general height of 2.35m reducing to 2.2m near ANZAC Square and the car park; the amount of lighting provided and the light surfaces colouring makes the space seem larger
- surveillance cameras located at regular intervals, maintained and monitored by Queensland Rail and Brisbane City Council
- restricting access to time periods when high volumes of users will be present (6.00am–8.30pm weekdays only) – the underpass is gated and locked outside this period
- limiting use to legitimate users accessing the rail station, CBD and car park, and restricting use of inappropriate users such as scooters and skateboards via signage
- walls covered in murals, pictures and historic information relating to the ANZACs, creating a sense of ownership within the space
- higher ceilings in most intersections between the underpass and station platform to allow greater visibility to the platform and oncoming pedestrians, and
- the sloping path means a user cannot see clearly from one end of the underpass to the other; however, the design ensure users can see a significant distance ahead and see other users.

Table 3.3.2(b) – ANZAC Square underpass observations

	
View from platform 5/6 to ANZAC Square Artificial lighting with light surfaces Local history and art create sense of place Surveillance cameras for additional security High visibility and sight distance	View from platform 5/6 to Wickham Terrace Artificial lighting on moderate surfaces Plain wall features reduces ownership / comfort Light globes not working creates dark spots High visibility and sight distances
	
View at underpass/platform 3/4 intersection Higher ceiling to provide extra visibility and sightlines up stairs	View from platform 1/2 to ANZAC Square Darker wall features and strip lighting reduces visibility and lightness of the underpass Wall features maintains local ownership

3.4 Sightlines and visibility

'Sightlines' refers to the ability for users to see clearly to, through and from the underpass and routes to travel. 'Visibility' refers to a user's ability to be seen and see other users in and surrounding the underpass. Improving sightlines and visibility increases the safety of users and reduces potential conflict. Sightlines and visibility are linked to the lighting design attribute outlined in Section 3.8.

3.4.1 Existing guidance

The current standards and guidance refer to providing sufficient visibility for users of the underpass and other users surrounding the underpass; for example, on adjacent roads or in land uses. The standards also refer to designing the facility with appropriate sightlines for users of the facility to see approaches, exits and through the underpass.

The following documents outline the general principles relating to sightlines and visibility:

- sections 2.6.1, 5.3, 5.7, and 8.32 of Austroads' *Guide to Road Design Part 6A* identifies the need to provide clear vision through the underpass and to allow visibility by avoiding tight corners approaching or exiting the underpass
- Section 8.4.2 of Austroads' *Guide to Traffic Management Part 6* identifies the need for entries and exits to have adequate sight distance, and
- Section 3.3.12.1 of the *Road Landscape Manual* outlines the provisions for sightlines and visibility throughout the facility with clear accessibility without blind corners.

Sightlines and visibility support the CPTED principles of surveillance, legibility and vulnerability.

3.4.2 Queensland case studies

Three elements relating to sightlines and visibilities were observed from viewing underpass sites. These include:

- internal visibility – the ability of users to be visible and see within and from the underpass
- underpass approach – the ability for users to view potential hazards prior to entering the underpass, and
- external visibility measures – the use of technical to provide additional surveillance and visibility of underpass users.

Internal visibility

Table 3.4.2(a) provides observations from viewing sightlines and visibility at underpass sites.

For both mid-block and collocated underpasses, sightlines and visibility can be obstructed if the geometry of the entry and exit have pronounced curves or grade differences. Designing straight pathways entering and exiting the underpass increases visibility and enhances user safety.

Convex mirrors can further enhance sightlines from within underpasses, allowing users greater visibility. For locations where a straight approach may not be possible, the placement of a convex mirror on the outside of the curve can enable users to view the approach and inside of the underpass.

Table 3.4.2(a) – Sightlines and visibility observations

<table>
<tr><th colspan="2">Mid-block underpass observations</th><th colspan="2">Collocated underpass observations</th></tr>
<tr><td colspan="2">  </td><td>  </td><td>  </td></tr>
<tr><td colspan="2">Uxbridge Street, Grange
Clear and unobstructed sightlines and visibility exiting the underpass</td><td colspan="2">Breakfast Creek / Kelvin Grove Road, Kelvin Grove
Clear view of approach and exit to underpass
Curve obstructs sightlines upon entry / exit</td></tr>
<tr><td>  </td><td>  </td><td colspan="2">  </td></tr>
<tr><td colspan="2">Gateway Motorway / Bracken Ridge Road, Bracken Ridge
Level difference obstructs sightlines and visibility to and from the underpass
Switchback ramp for cyclists is not visible from southern end and obscures approaching users</td><td colspan="2">Kedron Brook Bikeway / Burwood Road, Everton Park
Convex mirror improves visibility around the retaining wall and pathway curve
Mirror placement is high due to level difference in the approach to the underpass</td></tr>
</table>

Underpass approach

Approach to the underpass should be as long and straight as possible to allow users to identify hazards and respond accordingly.

Linked to internal visibility, the provision of straight and longer pathways leading to an underpass can improve user access and safety. Long and straight paths allow users to identify and perceive any potential hazards to their travel and provide enough time to adjust their travel or take appropriate action.

Relating to sightlines of users, the principle of Safe Intersection Sight Distances (SISD) can be applied to the pathway approach to an underpass. This is particularly relevant to cyclists who may be approaching at a higher speed and will require sufficient time and space to respond if a pedestrian or other cyclist is exiting from an underpass and the path curves. Providing a straight path leading to an underpass can improve sightlines and visibility for users and satisfy SISD. Refer to Section 3.3.2 of Austroads' *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* for additional information on how to measure SISD.

Figure 3.4.2(a) provides observations of an underpass with a curved path approach and a potential example of how modifying the approach alignment to be straighter and longer could improve sightlines and visibility.

Note the provision of longer pathways approaching the underpass will require site specific design and consideration of surrounding environmental factors.

Figure 3.4.2(b) provides observations of an underpass with a straight and long approach which allows for excellent sightlines and visibility for all users.

Figure 3.4.2(a) – Curved underpass approach (Kedron Brook Bikeway / Shand Street, Stafford)

Figure 3.4.2(b) – Straight underpass approach (Uxbridge Street, Grange)

External visibility measures

Additional visibility and security can be applied to underpasses via the implementation of security cameras and emergency call or duress points (panic buttons). Although these do not improve immediate visibility, they may assist in providing a deterrent for opportunistic crime as offenders can be recognised, as well as assist in improving a user's perception of safety by providing the ability to call for help if required. For surveillance cameras and emergency call points to be effective, they need to be monitored so that a response can be actioned when a user is experiencing a safety concern, and cameras need to be of a quality to allow for the identification of features of offenders.

Table 3.4.2(b) – Additional visibility systems

Security / CCTV cameras	Emergency call / duress points
	
Mount Lindesay Highway, Browns Plains Security camera at either end of the underpass to provide continual surveillance	Normanby Bikeway / College Road, Brisbane Emergency call button at the entry to the underpass

3.5 Gradients

'Gradients' refers to the slope of the path across (crossfall) and along (longitudinal) the path's cross-section. The slope of the path influences a user's ability to use the path comfortably, with a steep gradient restricting some users. Gradient is linked to the drainage design attribute in Section 3.7.

3.5.1 Existing guidance

The following documents outline the current standards and guidance:

- Australian Standard AS1428.1 and sections 5.6.1 and 8.3.2 of Austroads' *Guide to Road Design Part 6A* advise the crossfall of paths should not exceed 2.5% of 1 in 40; however, the preferred crossfall is 1.0%, and
- Section 8.3 of the RPDM Part 6A identifies the longitudinal gradient of an underpass should not be less than 0.3% in one direction.

Gradients support the CPTED principle of legibility.

3.5.2 Queensland case studies

Table 3.5.2 provides observations from viewing path gradients at underpass sites.

Gradient appears to be implemented very well in the case study sites observed with the pathways having slight gradients that are easy for pedestrians and cyclists to use.

The gradients implemented differ from mostly longitudinal in mid-block underpasses to mostly crossfall in collocated underpasses. This is likely to assist with drainage and using the adjacent natural features of the collocated underpass: refer to Section 3.7 for drainage.

Table 3.5.2 – Gradient case study observations

Mid-block underpass observations	Collocated underpass observations
	
Gateway Motorway / Bracken Ridge Road, Bracken Ridge Crest in the centre of the underpass and sloping crossfall gradients to the sides	Kedron Brook Bikeway / Burwood Road, Everton Park Longitudinal slope along the path Crossfall slope towards the waterway
	
Mount Lindesay Highway, Browns Plains Crest in the centre of the underpass and sloping longitudinal gradient to the exits	Cabbage Tree Creek / Woodhill Road, Bunya Crossfall sloping towards the waterway

3.6 Path surface

The following attributes and characteristics apply to the surface of pathways through an underpass and include line marking and maintenance of the path The surface and maintenance of the path influences a user's ability to travel safely and easily through the underpass. Appropriate and well-maintained surfaces influence the perception of safety of the facility by pedestrians and cyclists.

Line marking, particularly in locations where the preferred characteristics for horizontal clearance may not be achievable, can assist to define space and allow for opposing users to pass safely. As underpasses may be subject to flooding, slip resistance on the path surface is also an essential attribute.

3.6.1 Existing guidance

The following documents outline the current standards and guidance relating to the path surface:

- Section 2.10.2 of AS/NZS1158.3.1 recommends the walls of underpasses be finished in a light colour to facilitate interreflection of light within the underpass; this same guidance can be applied to the ceiling and path pavement, and
- Section 3.3 of Australian Standard AS1742.9 identifies that pavement markings should contrast well with the path colour.

The following documents outline the current standards and guidance relating to line marking:

- Section 3.3 of Australian Standard AS1742.9 notes a separation line may be used where sight distance is poor, in high volume locations where there is the potential for conflict – an edge line may be provided to assist in night time travel
- Section 5.5.2 of Austroads' *Guide to Road Design Part 6A* identifies that a centreline can be used on two-way paths where there is a minimal clearance between opposing flows, and
- Section 5.2 of the RPDM Part 6A identifies the need for adequate line marking where a path may narrow, such as the entry/exit of an underpass.

The following documents outline the current standards and guidance relating to path maintenance:

- Section 2.6.1 of Austroads' *Guide to Road Design Part 5* identifies that debris from any source should be cleaned as soon as possible.

Path surface supports the CPTED principles of territoriality, ownership and management.

3.6.2 Queensland case studies

Table 3.6.2 provides observations from viewing path surfaces at underpass sites. Path surface is considered the same for mid-block and collocated underpasses; therefore, there is no distinction between the sites identified following.

The use of pavement line markings, such as centrelines, can assist in separating opposing pedestrian and cyclist movement, particularly in underpasses where a wide horizontal clearance may be constrained. Line markings need to be visible to users and will become dull over time; therefore, remarking will need to be part of a maintenance program.

A smooth path surface provides a comfortable and attractive journey for users; however, the path requires a degree of roughness to provide traction. Paths that build up with debris can restrict movement and could present a slip hazard, particularly to cyclists travelling at a higher speed. The use of alternative or textured path surfaces can enhance useability.

Underpasses tend to collect debris, particularly after rain events; therefore, regular and scheduled maintenance is needed to maintain a safe path surface. The following elements should be considered as part of a regular asset management and maintenance program for each underpass:

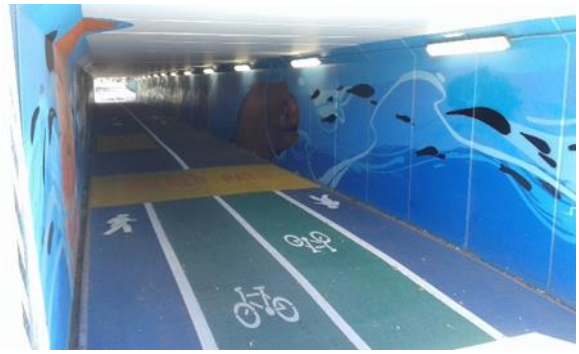
- regular cleaning including washing of walls and surfaces with additional cleaning required after significant rain events to remove built-up soil, silt and dirt
- regular maintenance on lighting, removal of graffiti, line marking, and pavement works
- maintenance of handrails specifically within flood-prone underpasses following flood events as handrails may capture debris or may incur damage from flood waters – multiple design options

are possible to allow for easy maintenance or replacement without requiring structural changes to the pavement of handrails

- regular audits of the condition of the underpass including pavements and walls, approach pathways and any associated infrastructure such as lighting, cameras or signage, and
- suitable access arrangements for machinery, if required, to clear debris from culverts or under bridges.

Having a contrast between the colour of the path and the underpass walls can support users with low vision and/or cognitive impairments. These users may have difficulty distinguishing between the different surfaces, placing them in an unsafe situation. Having a luminance contract of 30% between the colour of the path and the colour of the walls can provide a recognisable path to these users and improve their confidence in wayfinding.

Table 3.6.2 – Path surface observations

	
Bicentennial Bikeway / Land Street, Toowong Coloured pavement markings, line markings and symbols / directional arrows to delineate between pedestrians, cyclists and conflict areas Colour wall surfaces to increase reflection, local art and promote ownership of space	
	
Kedron Brook Bikeway, Sandgate Road, Nundah Centreline marking to separate opposing movements with edge line to provide clearance from fence and waterway Surface clear of debris and litter Alternative wall surface (rock) provided to deter graffiti and anti-social behaviour	Enoggera Creek Bikeway / Ashgrove Road, Newmarket Build-up of debris can create a slip hazard for cyclists

3.7 Drainage

As underpasses are generally located below a transport corridor and often collocated along waterway corridors, there is a critical need for appropriate drainage infrastructure to allow water to clear from pathways and allow users to travel without obstruction.

3.7.1 Existing guidance

The current standards and guidance refer to drainage, and the design of drainage systems for underpasses, being site specific and requiring input from experienced hydraulic engineers to ensure provisions are adequate and suitable for the level of water flow.

The following documents outline the current standards and guidance:

- Section 5.2.5 of Austroads' *Guide to Road Design Part 5A* identifies that drainage design must collect as much of the incoming flows as possible before the water enters the underpass
- sections 5.6.1 and 5.6.2 of Austroads' *Guide to Road Design Part 6A* identifies a preference for crowning of the pavement to allow for less accumulation of debris, and on sealed surfaces a crossfall of 2–4% should provide for the adequate disposal of surface water; paths should be further designed to ensure water does not pond on the surface or debris wash onto the path, and
- Section 8.3 of the RPDM Part 6A identifies the longitudinal gradient of an underpass should not be less than 0.3% in one direction to allow for longitudinal drainage.

Drainage supports the CPTED principle of management.

3.7.2 Queensland case studies

Table 3.7.2 provides observations from viewing drainage infrastructure at underpass sites. Drainage is considered the same for mid-block and collocated underpasses; therefore, there is no distinction between the sites identified following.

Collocated underpasses can improve drainage by considering crossfall and longitudinal gradients to support water flow from the path to an adjoining waterway. The case study sites visited implemented this approach with no visible signs of debris or water ponding; refer to Section 3.5.

The use of drainage grates in front of mid-block underpasses removed the flow of water from entering the underpass; however, for some case study sites, a build-up of debris was observed at the underpass entrance. Drainage channels and a path crossfall which allows water to flow from the path into the channel further improves the drainage ability of the underpass.

The drainage requirements of each underpass location will require a site-specific response. A suitably qualified and experienced drainage engineer will need to complete an investigation of the surrounding area and hydraulic profile to determine the specific needs of the underpass location. Potential drainage considerations could include:

- redirection of water runoff from overhead transport corridors and bridges away from the underpass to reduce water build-up within the underpass; this includes appropriate drainage provisions under the transport corridor pavement to remove water seeping through the underpass ceiling
- self-cleansing velocity provisions to allow water runoff to remove potential build-up of debris or litter
- provision of grates and channels to redirect surface water from entering the underpass, and
- porous pavement surfaces to allow for the absorption of pooled water or alternative pavement surfaces that allow water to evaporate.

Flood assessment

During project planning, an assessment should be completed that determines the amount of time a proposed underpass may be flooded as well as a risk assessment of potential flood intensity and frequency. This assessment should include a review of flood immunity tolerances, completed specifically for each site.

An underpass that is likely flooded and closed for small periods of time throughout the year is still a viable and cost-effective treatment for pedestrians and cyclists and such flooding is not a justifiable reason for rejecting a potential underpass location.

During severe weather events, pedestrian and cyclist volumes reduce on the network as alternative travel modes that provide protection from the elements are preferred. As a temporary measure during these periods, the provision of nearby at-grade crossings can maintain access across a transport corridor and cater for cyclists and pedestrians.

Table 3.7.2 – Drainage observations

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Mount Lindesay Highway, Greenbank
Drainage grate and drain in front of underpass to capture water flow prior to entering the underpass</td><td>Bloomfield Street, Cleveland
Drainage channel through the underpass and drain in front of underpass to capture water flow prior to entering the underpass
Drainage system likely ineffective due to debris build-up</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Coronation Drive / Little Cribb Street (Bicentennial Bikeway), Milton
Gradient towards Brisbane River and underpass entrance
Drainage grate at underpass entrance to capture water
Drainage channel through the underpass</td></tr>
</table>

3.8 Lighting

The lighting of underpasses, via natural and artificial methods, assists in the visibility of users through an underpass and allows for potential safety concerns to be identified clearly. Underpasses should use a mixture of artificial and natural lighting so the facilities are visible, particularly during darker periods of the day.

Refer to Section 3.4 for additional information on visibility.

3.8.1 Existing guidance

The following documents outline the current standards and guidance:

- Section 2.4 of AS/NZS 1158.3.1 identifies an underpass requires an applicable lighting subcategory of P10

- Section 2.10.2 of AS/NZS 1158.3.1 recommends the walls of underpasses be finished in a light colour to facilitate interreflection of light within the underpass
- Section 8.3.2 of Austroads' *Guide to Road Design Part 6A* identifies the need for vandal-proof lighting in underpasses
- Section 4.2.2 of Austroads' *Guide to Road Design Part 6B* identifies lighting of underpasses is essential with underpasses longer than 20m requiring lighting to operate both day and night, and
- Section 3.3.12.1 of the *Road Landscape Manual* suggests design responses should include adequate lighting, vandal resistant fixtures, and bold and bright finishes to promote natural illumination.

Lighting supports the CPTED principles of surveillance, legibility and vulnerability.

3.8.2 Queensland case studies

Table 3.8.2 provides observations from viewing lighting at underpass sites. Lighting is considered the same for mid-block and collocated underpasses; therefore, there is no distinction between the sites identified following.

A combination of natural and artificial lighting provides the maximum benefits to users through underpasses. Designers should be encouraged to include natural lighting where a transport corridor includes a median or such design that allows for natural lighting to filter through the road.

Artificial lighting assists with increasing visibility in the approach and through underpasses and should be included to enhance visibility and safety, particularly during the evening. The placement of lighting and the colouring of the ceiling, walls and path surface can further enhance and light the space. Lighting placed at the corner of the ceiling, with light finishes to surfaces, provides a brighter space within the underpass.

Locations that may require artificial lighting and wiring to connection could include additional support housing or an attached ceiling to hide wiring and lighting and provide protection of light fixtures from vandalism.

In implementing artificial lighting, providing a uniform lighting type and scale may maintain a consistent environment. This is particularly relevant to users with low vision and/or cognitive impairments who may have difficulty adjusting to different lighting designs, temperature and brightness. Anecdotally, the temperature of the lightbulbs used should be less than 5000 K(Degrees Kelvin) which represents the start of a typical daylight range of brightness.

Table 3.8.2 – Lighting study observations

	
Francis Road, Everton Hills No artificial lighting or gaps in the road median Creates a shaded and dark underpass that reduces visibility	Kedron Brook / north rail line, Clayfield Gaps in the rail tracks allow natural light to filter through to the underpass Artificial lighting on both approaches to improve lighting during darker periods
	
Kedron Brook / Dawson Parade, Arana Hills Artificial lighting provided through the underpass but not operational during the day Reduces visibility and provides a dark underpass Artificial lighting on approaches to improve sightlines and visibility	Gateway Motorway / Bracken Ridge Road, Bracken Ridge Medians between multiple lanes of travel or roads allows natural lighting to filter through the underpass Artificial lighting supplements the natural lighting and further lights the underpass

3.9 Landscaping

Landscaping commonly occurs at the entrance and exit of an underpass to assist with the natural aesthetics of the area; however, overgrown or large natural vegetation can create locations for concealment and potential safety concerns. Appropriate landscaping can enhance an area and improve user security if implemented correctly.

3.9.1 Existing guidance

The RPDM Part 6A and *Road Landscape Manual* provide general information relating to the placement of vegetation and landscaping surrounding underpasses. The key principles to implement in the design of landscaping at underpasses includes:

- ensure the placement of vegetation and landscaping does not create hiding places
- landscaping should not obscure sightlines and adjacent visibility of the underpass, and
- murals can discourage graffiti, assist with integrating local themes and aesthetics and encourage local community ownership of the space.

Landscaping supports the CPTED principles of surveillance, legibility, ownership and vulnerability.

3.9.2 Queensland case studies

Table 3.9.2 provides observations from viewing landscaping at underpass sites. Landscaping is considered the same for mid-block and collocated underpasses; therefore, there is no distinction between the sites identified following.

Retaining walls offset to the entry and exit of the underpass removes concealed and hidden locations while opening-up the access point to provide greater visibility for users.

Smaller and less dense vegetation tends to improve and soften the general appearance of the underpass access points; however, vegetation that is not maintained and large or bushy can lead to reduced visibility and concealed locations which are a safety concern. Appropriate types of vegetation should be chosen for landscaping that will not wash away and block drains or cause ponding in the underpass.

Offsetting and spacing large vegetation away from the path and underpass entrance can assist in providing shade as well as a natural environment. Vegetation surrounding the underpass needs to be maintained and not impede sightlines and visibility.

The finish on the underpass walls can assist to enhance the ownership of the space. Allowing the local community to provide murals, paintings or other local elements can provide a sense of ownership for the underpass and further enhance personal security. Underpass walls, whether painted or artist, should be light colours to further reflect lighting.

Table 3.9.2 – Landscaping observations

	
Bloomfield Street, Cleveland Thick and overgrown vegetation at the underpass entry Restricts visibility and creates concealed locations	Mount Lindesay Highway, Browns Plains Low ground cover shrubs near the underpass entry Offset retaining wall removes concealed locations for users exiting the underpass
	
Moreton Bay Cycleway, Bicentennial Road, Boondall Vegetation removed surrounding the underpass Offset retaining wall removes concealed locations for users exiting the underpass	Enoggera Creek Bikeway / Ashgrove Road, Newmarket Dense vegetation surrounding the underpass Creates conceal locations and perceived safety issues Reduces visibility for users

3.10 Wayfinding and signage

Signage, particularly wayfinding and advisory signage, can assist users with orientation of their surroundings and location, as well as advise of potential concerns such as temporary flooding. The use of signage at underpasses needs to enhance a user's experience.

3.10.1 Existing guidance

Austroads' *Guide to Traffic Management Part 10* identified the key principles and guidelines to consider when implementing wayfinding signage. These principles and guidelines, and their application to underpasses, is outlined in Table 3.10.1.

The following documents outline the current standards and guidance:

- Section 8.3.2 of Austroads' *Guide to Road Design Part 6A* identifies the need for warning signs advising users of potential hazards where adequate sight distance cannot be achieved or where there are right angle landings on the approach paths
- Section A.2 in Appendix A of Austroads' *Guide to Traffic Management Part 10* identifies the use of location signs to identify cross streets/roads, and
- Section 5.2 of the RPDM Part 6A identifies the need for warning signage where a path may narrow such as entering an underpass, and
- Flood warning traffic control (TC) signs (available from https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/TC-signs):
  - TC1831 PATH SUBJECT TO FLOODING INDICATORS SHOW DEPTH (suitable for collocated underpass locations where a path is adjacent a waterway), and
  - TC1019 UNDERPASS SUBJECT TO FLOODING (suitable for mid-block underpasses).

Wayfinding and signage supports the CPTED principle of legibility.

Table 3.10.1 – Principles and guidelines for wayfinding signage at underpasses

Principles and guidelines	Application to underpasses
Focus on the users: users need signage that is coherent and reliable	Provide signage that is relevant to pedestrians and cyclists using the underpass: for example, signs relating to flooding
Reduce clutter: have fewer but better-positioned signs in the streets	Consider the use of line markings instead of signs Design the underpass environment to be predictable so warning or advisory signs are not required
Disclose information progressively: the user should be given enough information to achieve the next stage of their journey, but not so much detail that they become confused	Provide simplified signs that are necessary, such as directional or location signs Provide warning signs for known or recurring hazards at the underpass such as flooding
Create connectivity: by linking one location to the next through signing, visitors can move freely and confidently from one place to another and from one transport mode to another	Provide locational signage for the adjoining transport corridor such as the street name or railway corridor Consider line markings to direct users to adjacent transport corridors
Be consistent: signage should carry consistent, predictable and reliable information	Signage at the underpass should reflect the same design and messaging that is used along the transport corridor
Use resources efficiently: work with other agencies to deliver and maintain improved signage	Implement signage only relevant to the underpass such as shared path

3.10.2 Queensland case studies

Table 3.10.2 provides observations from viewing signage at underpass sites. Wayfinding and signage are considered the same for mid-block and collocated underpasses; therefore, there is no distinction between the sites identified following.

Signage and wayfinding surrounding underpasses were observed as specific to each site. Caution, advisory and information signage should be implemented as required for each site to improve user travel and make the necessary decisions along their route.

Wayfinding signage should have a consistent design and similar messaging along the entire route so users are not confused and have certainty in travelling to their destination.

Signed alternative routes should be available for those users who choose not to travel through an underpass. This is particularly relevant to underpasses collocated with a waterway or other locations along a transport corridor that may be susceptible to flooding during severe weather events. Appropriately-signed routes can provide a safe alternative to crossing the transport corridor whilst maintaining connectivity of the path.

Table 3.10.2 – Wayfinding and signage observations

<table>
<tr>
<td>  </td>
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</tr>
<tr>
<td>Land Street / Coronation Drive (Bicentennial Bikeway), Toowong
Directional and location signage with additional information (distance to destinations)
Identification signage (map)
Advisory signage (speed limit)</td>
<td colspan="2">Breakfast Creek / Kelvin Grove Road, Kelvin Grove
Advisory signage</td>
</tr>
<tr>
<td>  </td>
<td colspan="2"> 
</td>
</tr>
<tr>
<td>Gateway Motorway / north rail line, Boondall
Caution and directional signage</td>
<td colspan="2">Bicentennial Road, Boondall
Location signage</td>
</tr>
</table>

4 Retrofit case study: Normanby Pedestrian and Cycle Link

4.1 Background

The implementation of the design attributes identified in Section 3 of this guideline can be applied to the planning and design of new transport infrastructure as well as retrofitting to existing transport infrastructure. The Normanby pedestrian and cycle link is an example of an underpass that has been retrofitted beneath existing transport corridors.

The Normanby pedestrian and cycle link completed a missing section in the Brisbane cycle network, providing a safe connection from development areas in north-west Brisbane such as the Kelvin Grove Urban Village, Victoria Park and Herston to the Brisbane CBD and southern Brisbane pathways. The link was the final section to be constructed in the Brisbane inner city network, and the first stage of the North Brisbane Bikeway, delivered by Transport and Main Roads.

Prior to 2007, pedestrians and cyclists had to navigate the 'Normanby Fiveways' via an at-grade intersection between College Road, Petrie Terrace, Countess Street, Kelvin Grove Road and Musgrave Road. The intersection required pedestrians to use multiple signalised legs to the crossing and on-road cyclists to negotiate with multiple lanes of traffic. This situation presented multiple safety issues and potential conflicts between pedestrians, cyclists and motorised vehicles.

Construction of the Normanby pedestrian and cycle link was completed in late 2007. The link included:

- a new wide off-road shared path between Roma Street Parklands and the existing Normanby bikeway north of College Road
- an underpass of College Road to avoid the at-grade intersection, and
- entry ramps either side of College Road to increase access and connectivity.

Table 4.1(a) provides before and after images highlighting the changes that occurred to the surrounding area with the implementation of the pedestrian and cycle link.

Table 4.1(b) provides images of the pedestrian and cycle link being constructed including the culvert being pushed through / under College Road.

Table 4.1(a) – Normanby pedestrian and cycle link: before and after

Pre-construction	Post construction
	
View looking north from Countess Street	View looking north from Countess Street

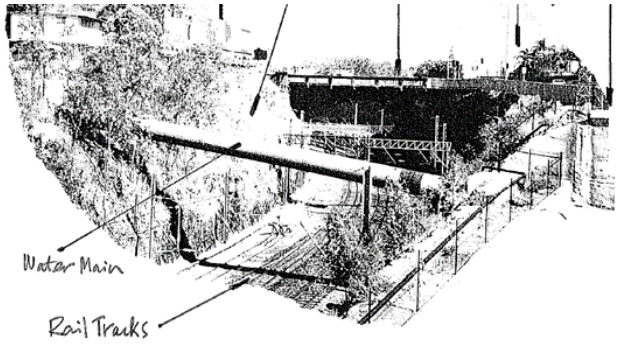
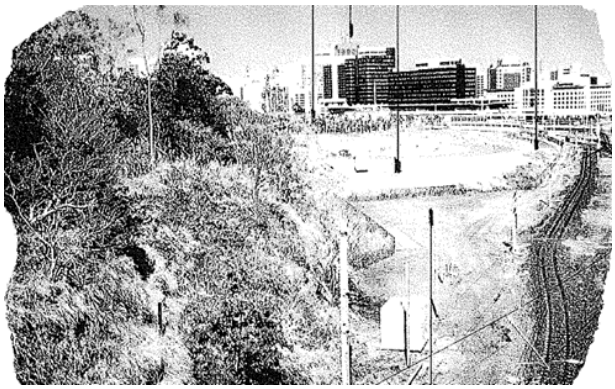
Pre-construction	Post construction
	
View looking south from Brisbane Girls Grammar School	View looking south from Normanby busway station
	
View looking south from College Road	View looking south from College Road

Table 4.1(b) – Normanby pedestrian and cycle link: construction

	
Excavation within the underpass	Jacking of the box culvert on the southern entry to the underpass
	
Construction on the southern entry to the underpass	Northern access ramps to the underpass and College Road

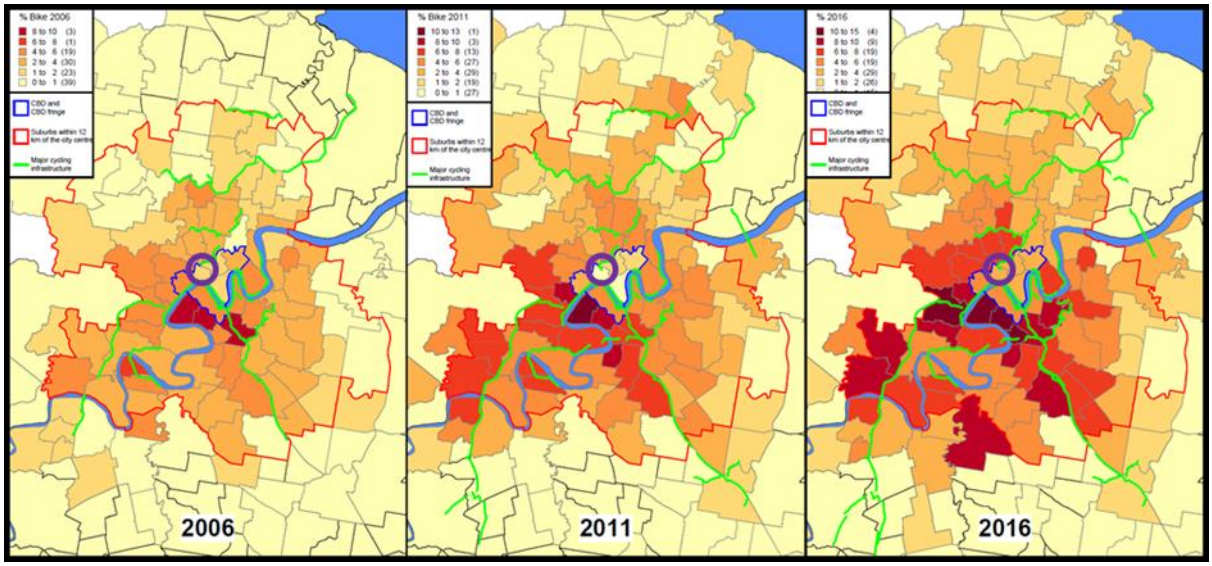
4.2 Pedestrian and cyclist usage

Upon opening, the link averaged approximately 440 cyclists and 230 pedestrians per day which has steadily increased to over 1200 cyclists and 450 pedestrians per day in 2019.

In 2011, intercept surveys of pedestrians and cyclists were conducted at the Normanby pedestrian and cyclist link to identify the influence of the underpass The survey results indicated the link had encouraged a mode shift, with users reporting that, without the link, they were previously using private vehicles (46%), public transport (36%) or taking alternative routes to walk (10%) or cycle (9%).

Figure 4.2 shows the change in bicycle mode share for journey to work data captured in the Australian Bureau of Statistics census at the location of the Normanby pedestrian and cycle link (purple circle). Cycle mode share in the northern suburbs of Brisbane has increased continually since 2006. The link has facilitated a change in travel patterns that can be attributed to the direct connection provided between the Brisbane CBD and northern suburbs, and the improvement in travel time, distance and safety by overcoming any need to navigate the at-grade crossing and multiple intersection legs.

Figure 4.2 – Change in bicycle mode share to the Brisbane CBD



(Source: TMR and ABS Census)

4.3 Design attributes

Table 4.3 identifies how each design attribute was addressed by the Normanby pedestrian and cycle link.

Table 4.3 – Normanby pedestrian and cycle link: design attributes

Vertical clearance and horizontal space • 2.5m high provides sufficient height for cyclists • 4.0m wide horizontal width provides for pedestrians and cyclists to pass each other • height and width feel comfortable for pedestrian and cyclist use
 

Underpass length

- visibility through the underpass
- can see through without obstruction

Sightlines and visibility

- curved approach to the underpass restricts total visibility beyond the immediate entry points, wide radius curve used to improve sightlines
- see-through fencing used to increase visibility of the adjacent rail corridor
- underpass visible to pedestrians on College Road
- inclusion of CCTV and emergency call button for additional external visibility and security
- sightlines restricted due to curves, solid centreline and additional pavement markings (messaging) added to define space and mitigate sightlines

Gradients

- flat grade throughout the underpass with slight slope towards the drainage channel - slope is very minor and does not affect travel
- pathway slopes at both approaches to the underpass

Path surface

- colour wall surfaces provided to increase reflection and local art (discourage graffiti / vandalism)
- centreline and directional line markings to separate opposing travel movements and define space

Drainage

- drainage grates located in across the entry of the underpass to capture waterflow and stop water from entering
- drainage channels provided along one side of the underpass

Lighting

- artificial lighting provided throughout the underpass and along the pathways leading to the underpass
- no hanging lighting fixtures removes potential conflicts for cyclists
- vandal-resistant fittings to protect lighting
- see-through fencing used to allow natural lighting onto the pathways approaching the underpass

Landscaping

- gardens with low ground shrubs on the southern approach to the underpass
- no landscaping on the northern approach
- underpass walls painted with 'heartbeat monitor' (local art works) on one wall

Wayfinding and signage

- directional signage provided at key intersections
- directional line marking provided to indicate direction of travel and separate opposing travel movements
- wayfinding / identification markers used in the pathway to advise distances and direction to key destinations, for example Roma Street Parklands

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