Technical Guideline

Raised priority crossings for pedestrians and cycle paths

January 2019

Queensland Government

Translating and interpreting assistance

The Queensland Government is committed to providing accessible services to Queenslanders from all cultural and linguistic backgrounds. If you have difficulty understanding this publication and need a translator, please call the Translating and Interpreting Service (TIS National) on 13 14 50 and ask them to telephone the Queensland Department of Transport and Main Roads on 13 74 68.

Feedback

Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

1 Introduction

1.1 Background

Where pathway users are given priority across a road using regulatory GIVE WAY or STOP signs and line marking, it is referred to as a priority crossing (refer to Figure 1.1). Where these facilities are constructed on a raised platform to increase visibility and reduce vehicle speeds, it is referred to as a raised priority crossing (example Figure 2.3).

Figure 1.1 – Example of a raised priority crossing for a shared pathway, Mooloolaba Qld

Raised priority crossings on shared pathways across local roads can support a *Safe Systems* approach to road safety, reduce level of traffic stress and improve level of service for all path users.

1.2 Purpose and scope

This Technical Guideline provides design guidance for raised priority crossings of shared pathways across local side roads, slip lanes and mid-blocks. It describes important design attributes identified in observational research into existing facilities (CDM Research 2015, 2016). Design attributes are generally consistent with current Austroads guidance in a *Safe Systems* philosophy to infrastructure planning (Austroads-SS 2018).

This Technical Guideline supplements Section 7.2.4 of Part 8 of the Austroads Guide to Traffic Management, Section 9.3 of Part 4 of the Austroads *Guide to Road Design* and Section 7.3.1 of Part 6A of the Austroads *Guide to Road Design*. Existing guidance identifies a limited number of situations where priority crossings are appropriate. There is a risk that, without this Technical Guideline, priority crossings may be applied inappropriately or underused in the network.

1.3 Related documents

This document should be read in conjunction with the guidelines described in Table 1.3 which provides further detail on design considerations.

Table 1.3 – Summary of related documents

Reference	Title
AGRD-4	Austroads *Guide to Road Design Part 4: Intersections and Crossings – General (2017)*
AGRD-4a	Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections (2017)*
AGRD-6	Austroads *Guide to Road Design Part 6: Roadside design, safety and barriers (2019)*
AGRD-6A	Austroads *Guide to Road Design Part 6A: Pedestrian and Cycle Paths (2017)*
AGRD-6B	Austroads *Guide to Road Design Part 6B: Roadside Environment (2015)*
AGTM-8	Austroads *Guide to Traffic Management Part 8: Local Area Traffic Management (2016)*
AS-1742.10	Standards Australia AS1742.10:2009 *Manual of uniform traffic control devices. Part 10: Pedestrian control and protection*
AS/NZS-1158.3	Standards Australia AS/NZS1158:2005 *Lighting for roads and public spaces* *Part 3.1: Pedestrian area (Category P) lighting - Performance and design requirements*
AS/NZS-1158.4	Standards Australia AS/NZS1158:2015 *Lighting for roads and public spaces Part 4: Lighting of pedestrian crossings (2015)*
Austroads-SS, 2018	*Towards Safe System Infrastructure: A compendium of current knowledge, Austroads (2018)*
Austroads-SSI, 2017	*Understanding and Improving Safe Systems Intersection Performance, Austroads (2017)*
MUTCD	Queensland *Manual of Uniform Traffic Control Devices* Part 13 Section 2.4.2.1.
RPDM-6A	Queensland Department of Transport and Main Roads *Road Planning and Design Manual Edition 2 Volume 3 Supplement to Austroads Guide to Road Design Part 6A: Pedestrian and Cyclist Paths (2015)*
RPDM-6B	Queensland Department of Transport and Main Roads *Road Planning and Design Manual Edition 2 Volume 3 Supplement to Austroads Guide to Road Design Part 6B: Roadside Environment (2015)*
TN128	Queensland Department of Transport and Main Roads Technical Guideline *TN128 Selection and Design of Cycle Tracks (2015)*
TRUM V1 P5	Queensland Department of Transport and Main Roads *Traffic and Road Use Management* manual *Volume 1 – (Supplement to) Guide to Traffic Management Part 5: Road Management (2014)*

References cited in this document are listed following.

- Austroads. 2015a. Level of Service Metrics (for Network Operations Planning). Sydney. NSW.
- CDM Research. 2018 "Evaluation of the Mann Street Cycleway, Cairns". Prepared for Queensland Department of Transport and Main Roads
- CDM Research. 2016 "Evaluation of the Mooloolaba to Minyama Separated Bikeway, Stages 1, 3 and 4a". Prepared for Queensland Department of Transport and Main Roads
- CDM Research. 2016b "Safety assessment of the Somerset Path Priority Crossing". Prepared for Queensland Department of Transport and Main Roads

- CDM Research. 2015 "Observational study of cyclist priority cycleway crossings". Prepared for Queensland Department of Transport and Main Roads
- Obrien Research. 2015 "Observational study of cyclist priority cycleway crossings". Prepared for Queensland Department of Transport and Main Roads

2 Design guidance

2.1 Types of priority crossings

Priority crossings may be considered at:

- intersections with side streets
- mid-blocks
- roundabouts
- slip lanes.

2.2 Advantages and disadvantages of raised priority crossings

Advantages of raised priority crossings are:

- providing a more direct route for cyclists and pedestrians, and providing a higher level of service that decreases cyclist travel time and effort required
- reducing vehicle speeds at the conflict point, which increases time available for perception-reaction
- improving safety by reducing both the likelihood and severity of crashes
- attracting riders away from higher risk on road routes (Munro, 2018)
- improved cycling participation as facility provides for riders of all ages and abilities
- improving the visibility of pedestrians, and people with a disability, to drivers
- removing kerb ramps which can be difficult to negotiate for some people with a mobility impairment
- providing an acceptable path cross-fall where a path crosses a side street on a gradient.

Disadvantages of raised priority crossings include:

- they may require modifications to drainage which can be expensive to retrofit
- can create issues with underbody clearances on bus routes if they are not designed appropriately

2.3 Evaluations of priority crossings in Australia

There is now a reasonably extensive record of real-world experience designing and operating cyclist priority crossings in Australia (CDM Research, 2015).

Observational studies conducted between 2015 and 2016 captured over 1000 interactions between bicycle riders and motor vehicles at priority crossings. Important findings from these studies are summarised following:

- motorists gave way to cyclists in between 94% and 99% of interactions, on four priority crossings examined in one study in 2015 (CDM Research, 2015)
- there was no evidence to suggest that the priority allocation of the crossing fundamentally affected the safety performance
- factors such as speed, visibility and setback of the crossing may be more important than priority in affecting safety.

The research described previously focused on crossings on side streets near intersections.

Two more priority crossings were evaluated by CDM Research in 2016 and 2018: Somerset Street in Brisbane (refer to Figure 2.3), and treated intersections on the Mann Street Cycleway in Cairns. The intersections also performed to a satisfactory level of safety and with a level of risk similar to other sign-controlled residential street intersections. Recommendations were made to optimise the performance of specific crossings by modifying site-specific attributes (CDM Research 2016a, 2016b, 2018).

Figure 2.3 – Somerset Street separated cycle track and footpath priority crossing, Brisbane

2.4 Safe System integration

The *Safe System* philosophy for road safety assumes that crashes will occur, and that the network should be managed in such a way that when they do, the consequences of harm will be minimised.

Cyclists are over-represented in crash data for priority controlled (GIVE WAY or STOP sign) intersections (Austroads-SS, 2018). *Safe System* recommends the application of risk management-based approaches to create safer cycling environments (Austroads-SS, 2018).

Table 2.4 describes how *Safe Systems* principles (AGRD-SS, 2018) can be applied to priority crossings to reduce risk to cyclists. Many of these risk management approaches will also apply to pedestrians.

Table 2.4 – Safe Systems principles applied to cycling facilities at priority crossings

Principle	Application to priority crossings
Functionality	Roads and pathways hierarchically defined in the network. Priority crossings provide the same priority as the parallel traffic lane and take priority over local side roads.
Homogeneity	Priority crossings can be designed to provide more homogenous speeds that give users more chance to see each other and respond to movements.
Predictability	Road user environment and road user behaviour that support road user expectations. This can be achieved by providing clear visual cues, line marking and signage to reinforce priority.
Forgiving-ness	To limit injuries to pedestrians and cyclists, vehicle speeds need to be reduced to under 30 km/h and desirably under 20 km/h at the crossing point where users may interact with vehicles (Austroads SS-2018).
State awareness	The ability of road users to assess their capability to undertake a task. Priority crossings put the responsibility on the licensed and most capable road users to give way. Conventional crossings rely on pedestrians and cyclists, some of whom may be young, or have vision or mobility impairments to take responsibility for crossing tasks.

2.5 Design attributes of priority crossings

Design attributes that contribute to safety of priority crossings are identified in Table 2.5. Research into priority crossing operation suggests that compromises can be made with regards to some attributes, but not all. The attributes in Table 2.5 are classified into levels of importance as follows:

- Essential – all listed attributes should be incorporated into all projects
- Important – attribute should be incorporated. A maximum of one of these attributes can be omitted, and only if all other attributes in the table are managed such that each attribute contributes to minimising risk to users.
- Highly desirable – attributes should be incorporated where possible. These attributes work together. If one attribute cannot be provided, it should be compensated for by increasing performance of other attributes.
- Supportive – these attributes support the risk management-based approach and should be used to support other measures.

Refer to Part 3 Construction Guidance for more information.

Table 2.5 – Attributes that improve safety performance of priority crossings

Importance	Attribute	Comments	Criteria	Guidance
Essential	Motorist speed at the crossing point	Speeds below 30 km/h (20 km/h ideal) strongly influence crash likelihood and severity. Low, equitable speeds increase response times and allow negotiation and communication between motorists and cyclists. Where existing speeds are high, crossings should be designed to reduce vehicle speeds when they approach the crossing	Maximum vehicle speed at crossing point	20 – 30 km/h
	Lighting	Lighting the crossing allows time for drivers to observe and react to pedestrians and some low-speed cyclists on the crossing. Lighting the approaches allows drivers to observe a cyclist and react before their paths cross, on the crossing facility. Lighting requirements are affected by vehicle speeds and surrounding land use	Luminaires on the crossing facility	If vehicle speeds at crossing point ≤ 20 km/h, apply AS/NZS 1158.3.1 Section 3.2.6.2. (Minimum lux on platform 3.5) For mid-block, apply AS/NZS 1158.4 on the crossing
			Pedestrian lighting on approaches to crossing	Apply AS/NZS 1158.3.1 category P3 for a minimum 10 m from the crossing on each approach. See Figure 3.2
	Regulatory signs and lines	Required to establish the priority rules to road users and approach of a raised platform.	Consistent with road regulations	GIVE WAY lines or STOP lines and line marking at vehicle approaches
Important	Raised crossing – platform height	Raising crossings is an effective way of reducing motorist speed, crash likelihood and severity. The platform height and grade influence its effectiveness. If a minimum height platform is used (for drainage purposes), a steeper ramp (1:6) is needed to achieve target vehicle speed. If flatter ramps are used (bus routes), other design features are needed to achieve target speeds.	Height of platform	Desirable: 100 mm–150 mm Acceptable 50 mm or greater
	Raised crossing – platform gradient		Gradient for intersection crossings Gradient for mid-block crossings	1:6 1:15*
	Kerb radius into side street	A tighter kerb radius encourages lower speeds. Consider using mountable aprons to encourage tighter turns for small vehicles, while being mountable for the design vehicle.	Radius of corner aprons	5 m for small vehicles

Importance	Attribute	Comments	Criteria	Guidance
	Coloured surfaces	Delineate the crossing location and reinforce the priority of path users. A consistent colour should be used on the pathway and the crossing that contrasts with the adjacent ramp surfaces. Note: green surfacing should not be used on shared path. For concrete platforms, a full depth pavement colour should be used as surface treatments affect slip resistance.	Crossing colour	Same as pathway or same as 2–5 m of pathway approaches and contrasting with road / ramp
	Visibility	Visibility contributes to good safety outcomes. It is desirable but not essential where other attributes (especially motorist and rider speeds) are achieved.	Unobstructed sight lines from drivers turning into side street to cyclists using path is desirable Approach sight distance to crossing must be available on the minor road approaches	
Highly desirable	Rider speed	Design speeds are ideally achieved by using suitable approach geometry. Speed should not be controlled by introducing hazards such as chicanes or bollards.	Bicycle speed range	15–25 km/h
	Set-back	A set-back allows a vehicle to store between the through traffic lane and the crossing. It mitigates against vehicles storing on the crossing and allows drivers to consider the crossing separately to the intersection. Optimum set-back is a compromise between having vehicle storage space and not diverging from desire lines or reducing sight lines. If set-back can't be achieved, sight lines should be good, and rider and motorist speed controlled to about 20 km/h.	Desirable set-back from traffic lane	5–7 m
			Where traffic volumes on side road 1000 vpd or less.	0–7 m set-back may be appropriate
Supportive	Motorist volumes	Volumes up to 5000 vpd appear to function adequately. Volumes appear unrelated to safety outcomes but affect motorist delay.	Vehicles per day	< 5000 vpd desirable but not essential
	Warning Signs	Can be used in advance of facilities where visibility of the crossing or the regulatory signs is obscured.	W3-2A (GIVE WAY sign ahead) TC2235 (To pedestrians and bicycles)	
	Intersection movements	Limiting movements at intersections can improve the ability of users to judge gaps between traffic	Remove left-out movements (more commonly associated with near misses in observational data than other movements) Install a centre median to reduce movements to left-in left-out	
	Crossing distance	Shorter crossing distances reduce exposure for path users, encourage lower speeds and reduce costs associated with platform construction.	Length of crossing (m)	5.5 m

*Gradients of 1:15 are acceptable on bus routes (Queensland *Manual of Uniform Traffic Control Devices* Part 13 Section 2.4.2.1). As a standalone treatment, they may be ineffective at reducing speeds to the acceptable range. If these ramp gradients are adopted, other design features such as tighter horizontal geometry need to be incorporated to achieve target design speeds.

2.6 Preferred solutions

This section contains examples of raised priority crossings with attributes from Table 2.5. Refer to Appendix 1 for drawings of structural elements. Refer to Section 4 for case studies of actual treatments.

2.6.1 Shared pathways at side roads

Raised priority crossings have been installed in a variety of settings in Queensland and Australia. These facilities have been evaluated and the important attributes listed in Table 2.5. Figures 2.6.1(a) and 2.6.1(b) provide examples of these facilities intersecting with and without parking. Common attributes of the examples include:

- raised priority crossing
- continuous coloured pavement on shared pathway across intersection, contrasting with platform colour
- tactile ground surface indicators
- regulatory signage and line marking
- aprons on intersection corners.

Figure 2.6.1(a) – Preferred arrangement of raised priority crossing at local side road

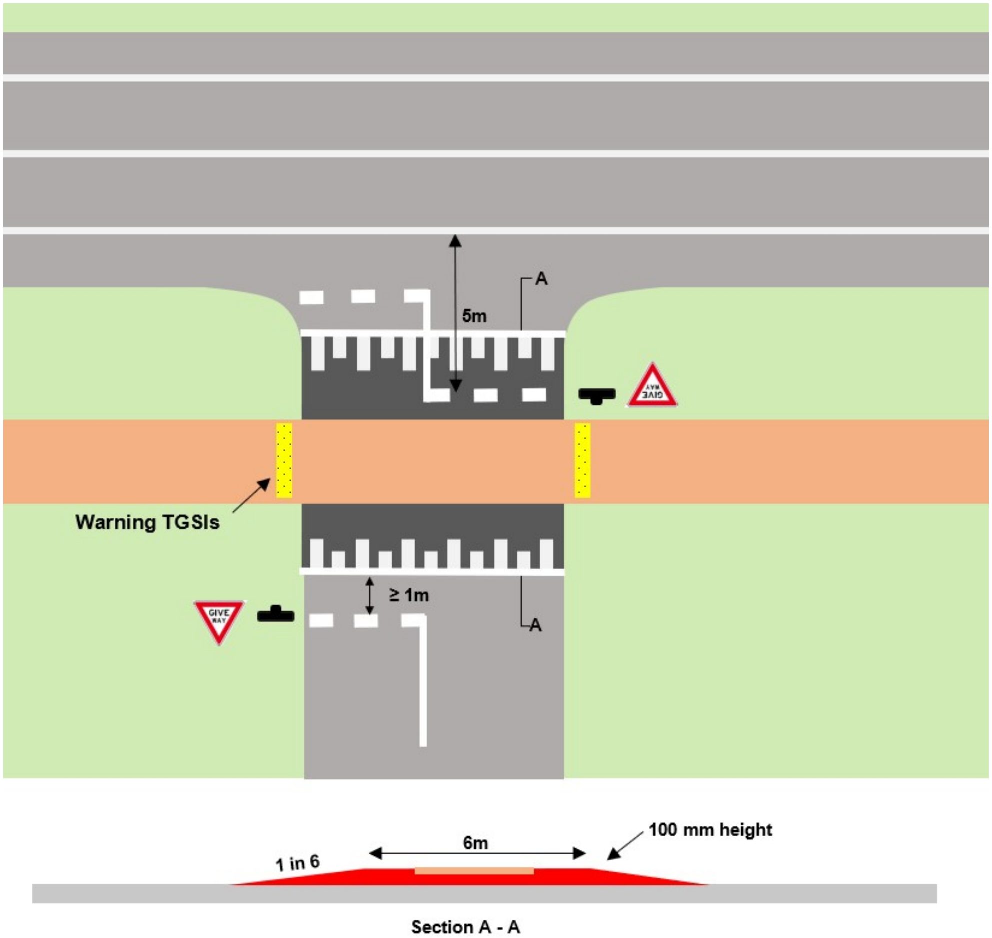
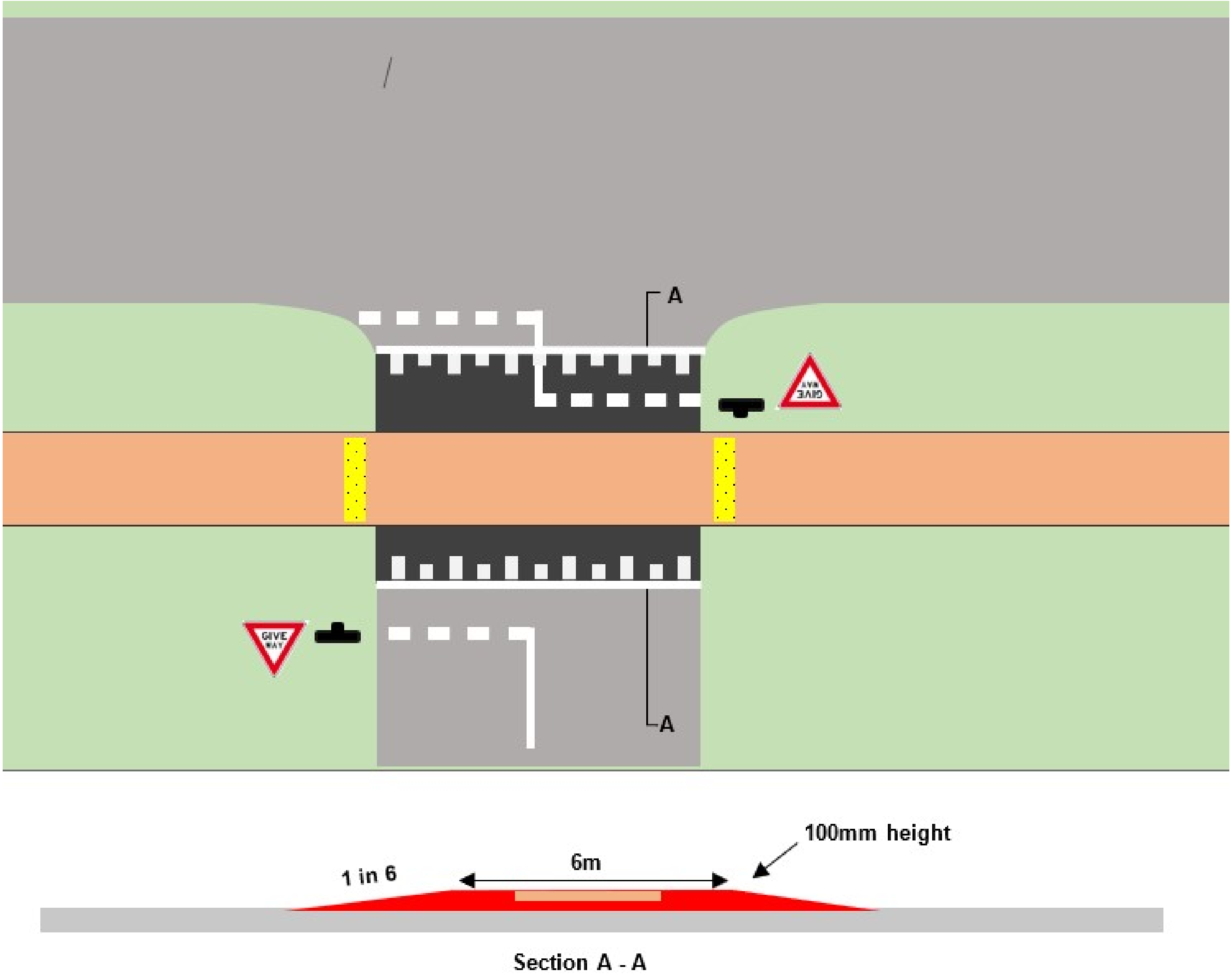


Figure 2.6.1(b) – Preferred arrangement of raised priority crossing at side road with < 1000 vpd



2.6.2 Mid-block crossings

Mid-block raised priority crossings are used to provide priority at the crossing point to higher order shared pathways over local roads. Figure 2.6.2(a) is an example of this treatment on Workshops Street in Ipswich.

Figure 2.6.2(a) – Example of mid-block priority crossing, Workshops St, Ipswich

Source: Nearmap 2018

Mid-block raised priority crossings are similar to raised pedestrian crossings. The key differences between the functions of these types of facilities are:

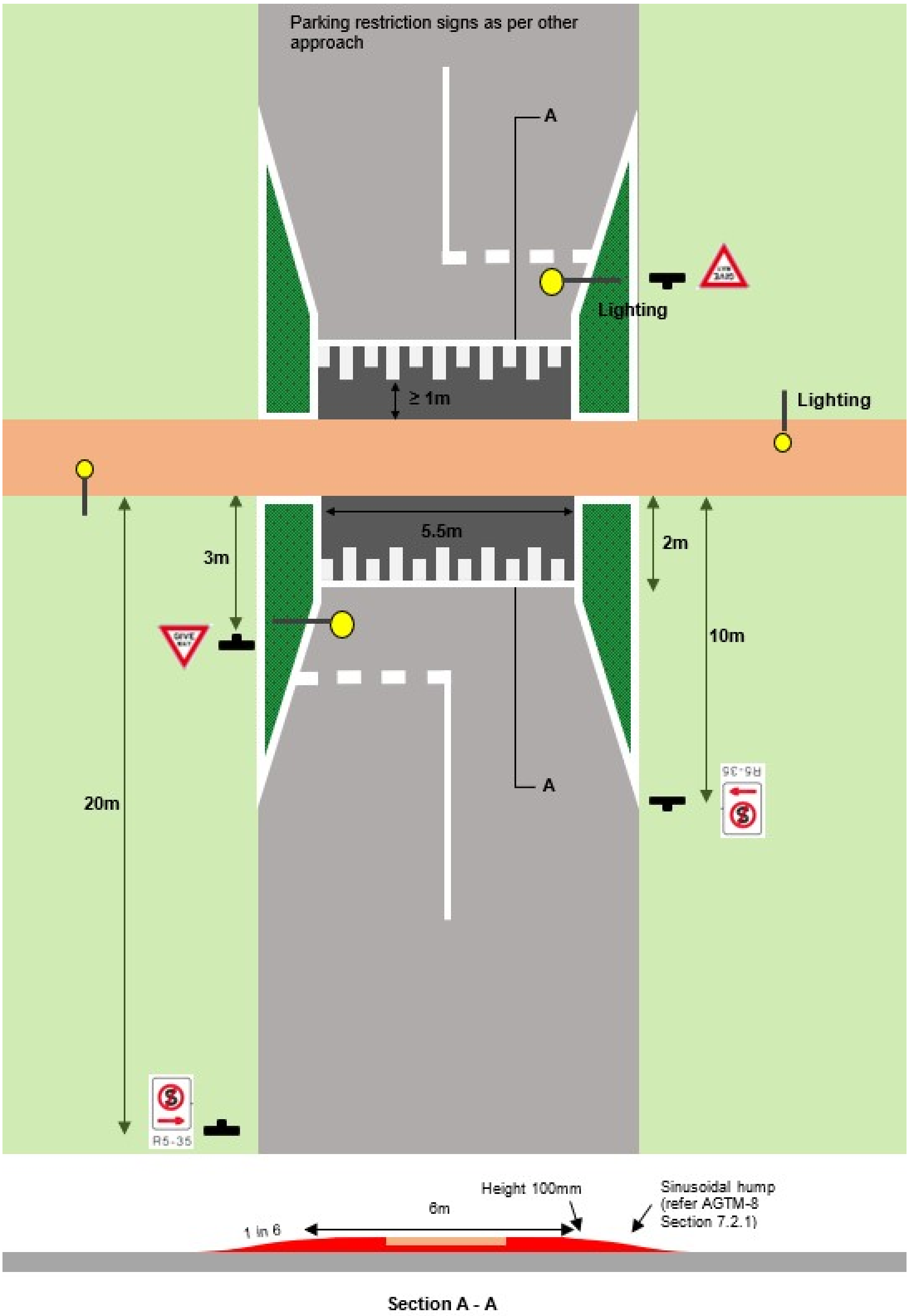
- pedestrian crossings allow cyclists to cross with priority after coming to a complete stop
- priority crossings allow cyclists to cross with priority without coming to a complete stop (after checking the road is clear)

Figure 2.6.2(b) shows an example of a mid-block raised priority crossing which features:

- a higher order pathway crossing a local road
- posted traffic speed limit is 50 km/h or less
- good sight distance between users approaching the crossing and vehicles
- approach sight distance to the crossing facility from road users and path users
- a raised platform with a sinusoidal approach ramp
- regulatory signage and line marking
- build-outs to narrow crossing distance
- lighting on the crossing and 10 m approaching the crossing.

Where mid-block pedestrian crossings are installed, the crossing treatment is entirely responsible for ensuring speeds are managed to a safe level where drivers can slow down to give way to approaching path users.

Figure 2.6.2(b) – Preferred arrangement of raised priority crossing mid-block



2.6.3 Slip lane crossings

Under Sections 81, 72(4) and 73(3) of the Queensland Road Rules, drivers must give way to pedestrians on slip lanes. Untreated slip lanes create uncertainty for path users and drivers as to who has right of way. Figure 2.6.3 (a) shows an example of an existing raised pedestrian crossing on a slip lane.

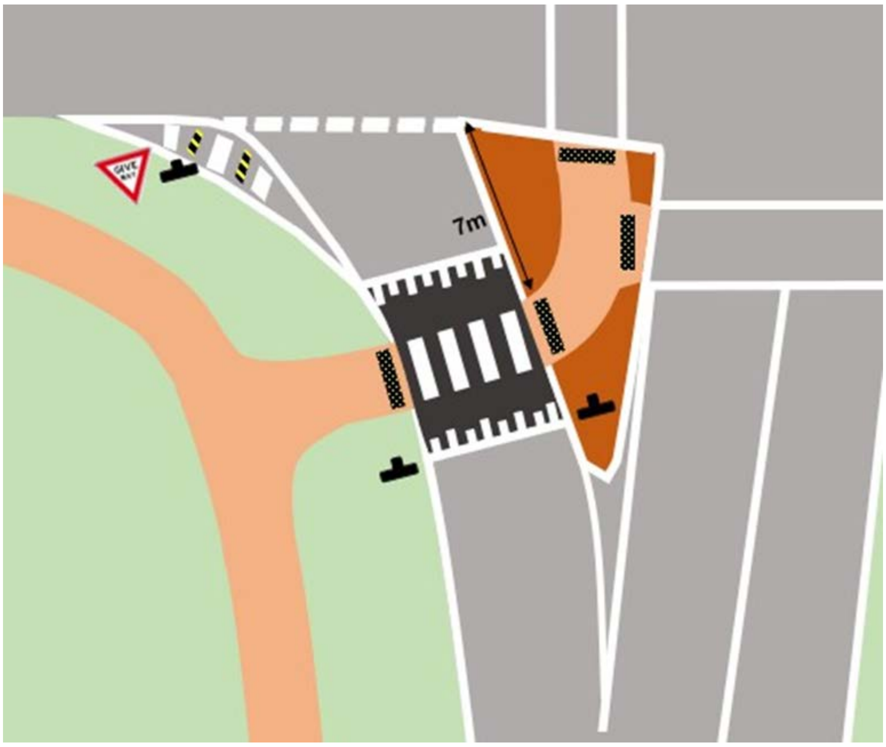
Figure 2.6.3(a) – Raised crossing treatment on slip lane, Entertainment Road, Oxenford, Qld

Key features of raised priority crossings on slip lanes are shown in Figure 2.6.3(b) and are listed following:

- a raised platform to reduce vehicle speeds and increase path user visibility (height and gradient varies between 1:6 and 1:15 depending on road user needs)
- provide a high entry approach angle to traffic that encourages lower vehicle speeds (aprons, line marking and raised reflective pavement markings or speed humps can be used for this)

pedestrian crossing signage and line marking as per AS1742.10 Figures 1 and 2.

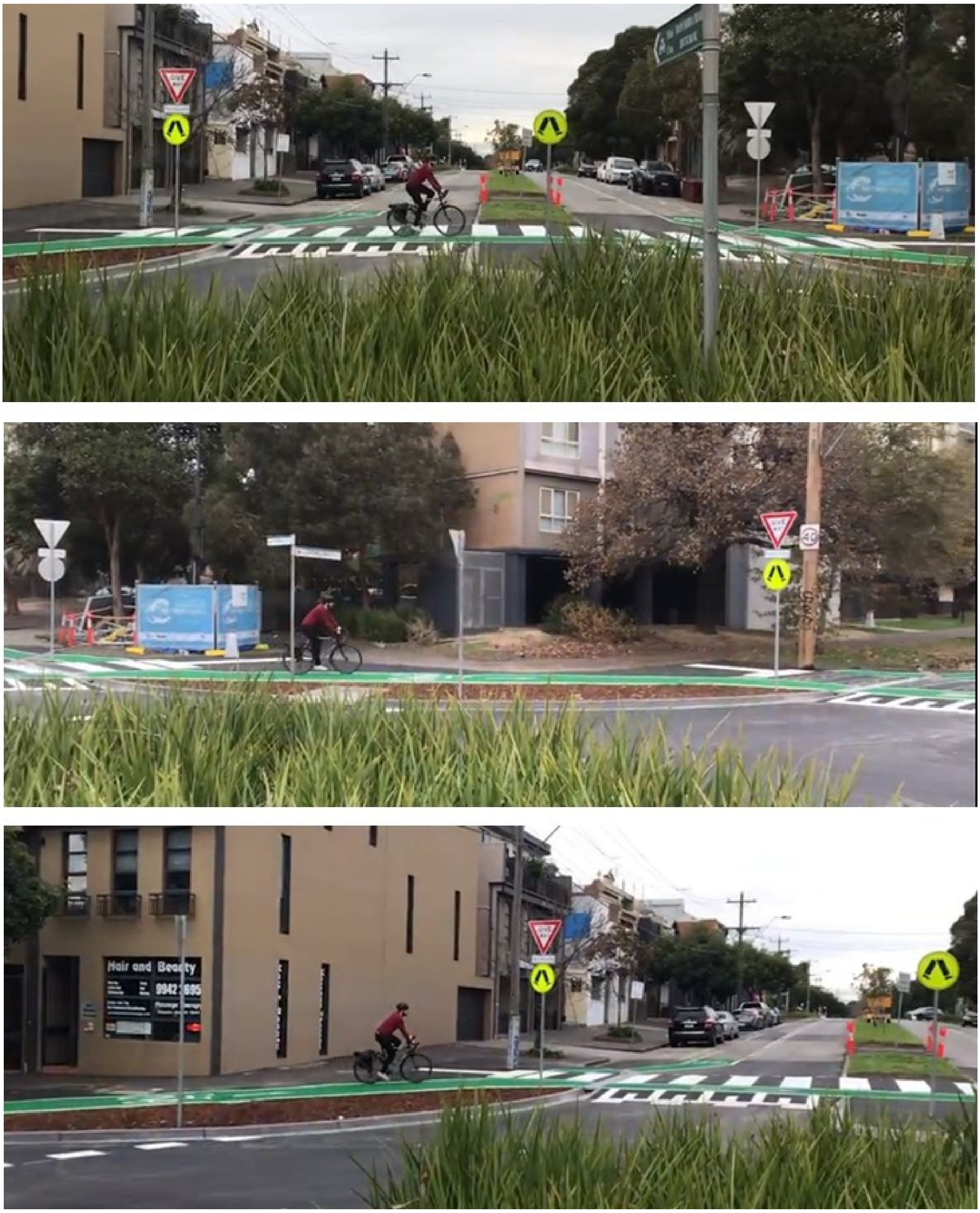
Figure 2.6.3(b) – Example arrangement of raised priority crossing on slip lane



2.6.4 Roundabout crossings

Raised priority crossings that provide priority to path users can be installed around roundabouts. Figure 2.6.4(a) shows an example from South Melbourne where raised pedestrian and cyclists crossings are provided. Guidance in TN128 for two-way cycle tracks on roundabouts should be referred to when raised crossings are being considered in the vicinity of roundabouts.

Figure 2.6.4(a) – Raised crossings at roundabout on Moray and Dorcas Street, South Melbourne

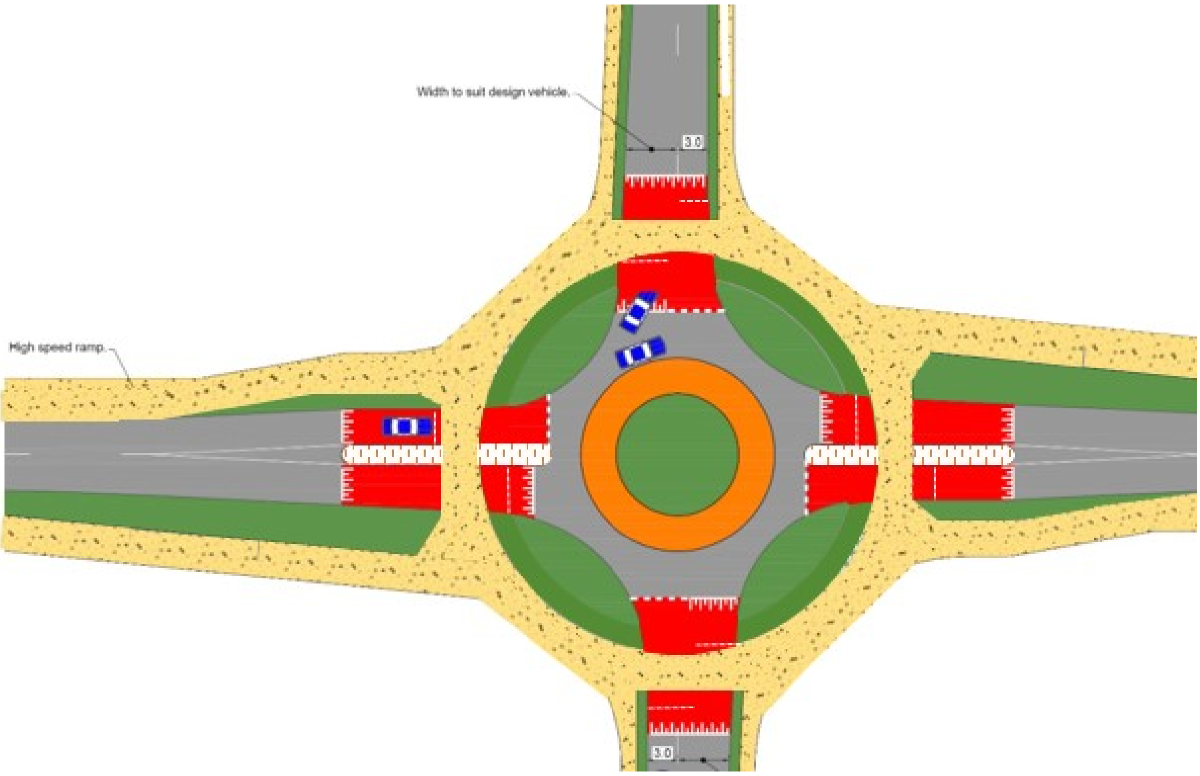


Source: Melbourne Bicycle Users Group

Figure 2.6.4(b) shows raised priority crossings on a four-way roundabout. Key features of this example include:

- radial roundabout design reduces vehicle speeds
- raised priority crossings on all legs, which balances vehicle approach speeds
- storage for vehicle provided between circulating area and crossings
- continuous coloured pavement on pathways contrasting with raised platforms
- GIVE WAY signage and line marking at platform approaches.

Figure 2.6.4(b) – Preferred arrangement priority crossings at roundabout



3 Construction guidance

3.1 Drainage

Drainage networks may be designed to accommodate minor events in pipe networks and roads for overland flow paths for more extreme events. Raised platforms can interrupt kerb flow paths and prevent water from draining away from the major road.

Options to address this issue include:

- upsizing pipes in the drainage system (expensive)
- incorporating box drains on the sides of platforms to retain drainage past the platform
- constructing minimum height platforms (50 mm) and modelling to confirm flow path.

Table 3.1 – Options to manage drainage at priority crossings

Treatment	Considerations	Examples
Box drains	• Opening needs to be sufficient size to reduce likelihood of blockages as has occurred in this example (North Street, North Ipswich) • Maintenance regime may be required • Providing the cover over the drainage pit access • Load-rated concrete infill utility trench covers may be an off-the-shelf solution for bridging the box drain	 *North Street, North Ipswich*  *The Esplanade, Rockhampton*
Reduce platform height	• Minimum platform height is 50 mm. This is below kerb height and may allow overland flow paths to be preserved • Ensure smooth transition from path to hump (1:20) • Ramp gradient 1:6 or steeper	 *Goonawarra Drive, Mooloolaba*
Upsizing pipe network	• May be an option where short sections of network can be upgraded to an appropriate discharge point	

3.2 Lighting

AS/NZS 1158.4 defines lighting categories and technical parameter ranges for pedestrian crossings on arterial, collector and local roads. The lighting parameter requirements are highest on arterial roads and reduce for collector and local roads. The standard requires a high level of lighting that may be impractical for priority crossings on local roads for the following reasons:

- providing flood lighting in residential areas can cause problems and complaints from nearby residents
- flood lighting at intersections can increase glare to other drivers and reduce visibility in some situations
- the standard of lighting assumes a 50–60 km/h speed environment and may provide minimal benefit in situations where traffic vehicle speeds have been managed to 20–30 km/h
- higher lighting standards are unlikely to be accommodated in minor upgrades to lighting systems and may have a significant effect on project costs
- the choice of whether to install supplementary lighting at a pedestrian crossing in compliance with AS/NZS 1158.4 rests with the applicable road authority. In many situations, priority crossings are providing treatments that reinforce existing pedestrian priority at intersections,

improve visibility and reduce vehicle speeds. Prescribing higher lighting standards may have the detrimental effect of reducing the number of appropriate sites for these facilities or increasing project costs, such that less facilities will be installed.

Consideration should be given to user needs, site characteristics, and the design attributes of the proposed crossing when selecting a relevant lighting standard to apply. It is recommended that the following standards are achieved for lighting priority crossings on local side roads:

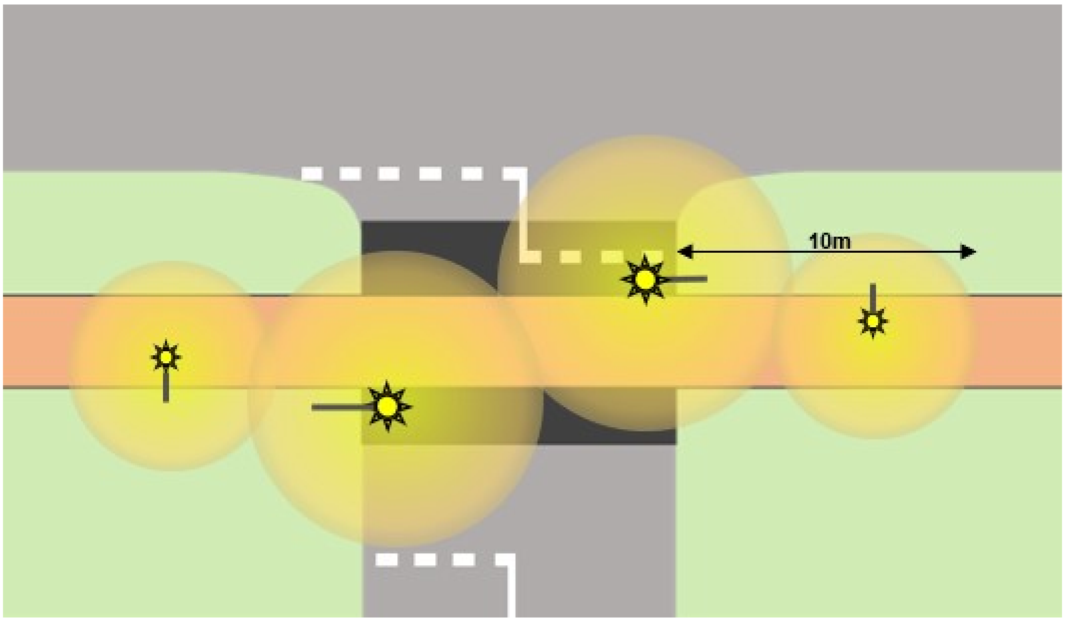
- AS/NZS 1158.3 Section 3.2.6.2 – this requires a minimum of 3.5 lux on the entire platform
- 10 m of lighting on the approaches to the crossing.

One interpretation of achieving 3.5 lux on the platform is to incorporate one major road luminance on the minor road.

Narrowing the crossing distance can create additional space to light the approaches to the crossing and minimise the amount of lighting required on the crossing.

Upgrading of existing lighting infrastructure to achieve compliance with this Technical Guideline should be modelled first before additional lighting treatments are considered.

Figure 3.2 – Example lighting layout at raised priority crossing on side street



3.3 Platform materials

Raised platforms can be constructed from concrete or asphalt. Standard drawings for these treatments are provided in Appendix 1.

Table 3.3 – Platform materials

Treatment	Advantages	Disadvantages	Examples
Concrete platforms	• Excellent design life (50 years approximately) • Precise gradients can be achieved • Tool joints / sharp change in grade can be achieved • Smoother top of platform • Plain or full depth coloured concrete can be used to provide contrast between pathway and platforms	• Expensive • Several separate pours are required and time consuming to set • Road usually needs to be done one side at a time (this doubles construction time) • Pavement surface treatments not suitable on concrete surfaces because slip resistance decreases with age	 *Brisbane Road, Mooloolaba*  *River Esplanade, Mooloolaba*
Asphalt platforms	• Cheaper • Shorter construction time • Able to provide a sinusoidal ramp more suitable for bus routes • Stamped treatments suitable for contrasting colours • Easily able to correct	• Less precision in controlling gradients • Reduced design life • Platform may not be as level	 *Benabrow Avenue, Bribie Island*  *Belford Road, Kew, Victoria*

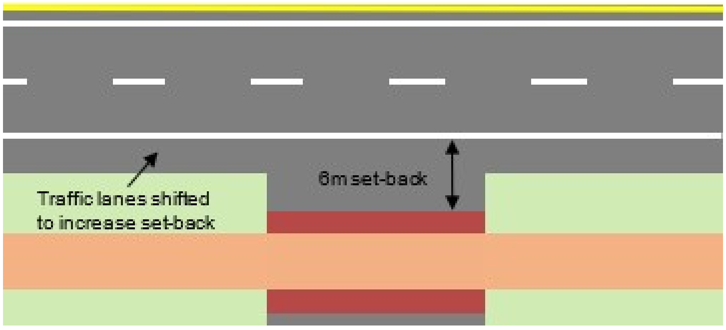
3.4 Set-back distance at side streets

Optimum set-back is a compromise between providing sufficient space for a vehicle to store without blocking the path, and not diverging too far from the desire line, or reducing sight lines. On lower-volume, lower-speed streets, it may not be necessary to provide a separate storage space for vehicles. On higher-volume, higher-speed streets, this becomes more important as it reduces likelihood of vehicles storing on the crossing and allows drivers to consider the pathway and road intersections separately.

The set-back should be measured from the edge of the closest traffic lane to the crossing. It is desirable to achieve sufficient set-back to store one motor vehicle (6 m).

The following treatments can be used to obtain sufficient space in constrained locations.

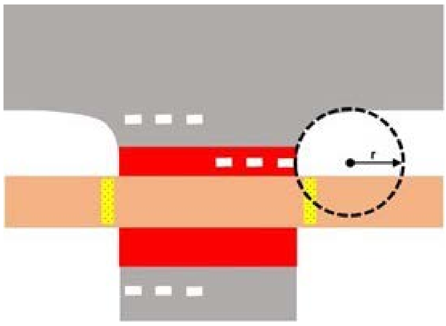
Table 3.4 – Making space to provide set-backs to priority crossings

Treatment	Considerations
Realign traffic lanes	• Realign traffic lanes further away from the intersection. • Provide parking only on the cycleway side of the road to assist in shifting traffic lanes further back. • Consider staggering parking so that it is provided on one side of the road at the approach to the intersection and on the alternative side at the departure. 
Narrow crossing distance	• Narrowing the crossing distance can free up road reserve to bend out the pathway at a suitable radius, and improve sight distance. Refer to Table 3.5 for treatments to provide appropriate turn radii. 

3.5 Horizontal geometry and kerb radii

Changes to horizontal geometry can encourage lower vehicle turning speeds and put drivers in a better position to look for path users by approaching the path head on. Table 3.5 provides examples.

Table 3.5 – Examples of treatments that affect horizontal geometry

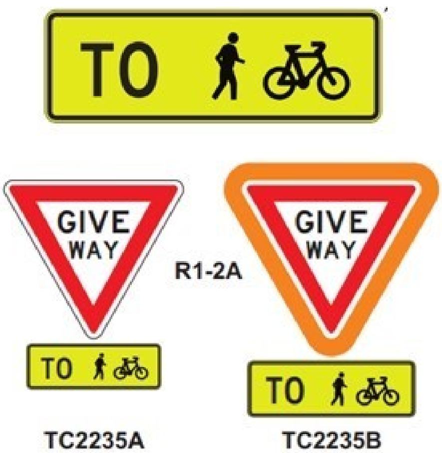
Treatment	Considerations	Examples
Aprons on kerbs	• Encourage passenger vehicles to follow a very tight kerb radius to promote lower vehicle speeds. • Design vehicles can mount the apron to make the corner. • Used widely in traffic calming and on roundabouts.	 Apron on a T intersection in Brisbane  *Source: Massachusetts Department of Transportation, 2006* Drawing of splitter island being mounted by design vehicle)
Aprons on slip lanes	• Encourage passenger vehicles to approach vehicle at high entry angle • Design vehicles can mount aprons • Used widely on roundabouts	 Safety bars and line marking define a high entry angle slip lane, Camp Mountain Road, Samford
Smaller kerb radius	• Tight kerb radii promote lower vehicle turn speeds and put vehicles front-on to crossing which improves visibility • Minimum kerb radii determined by design vehicle • Assume design vehicle can cross road centre line where a risk assessment confirms this is appropriate • More effective with aprons	 Distance r shows corner kerb radius

Treatment	Considerations	Examples
Blister islands	• Discourage all vehicles from crossing the centre line • Can reduce vehicle speeds, particularly for right-turning passenger vehicles, but can also result in the need for longer kerb radii, which can increase left-turn vehicle speeds	 Blister islands on raised priority crossing. Ammess Street, Melbourne.

3.6 *Reinforcing signs*

Reinforcing signage can be installed at approaches to priority crossings on either the local street or on the through-road approach, where sight distances are restricted or there is a need to reinforce the STOP / GIVE WAY signs and line marking. Signage options that can be considered are provided in Table 3.6.

Table 3.6 – Reinforcing signs suitable for use at approaches to priority crossings

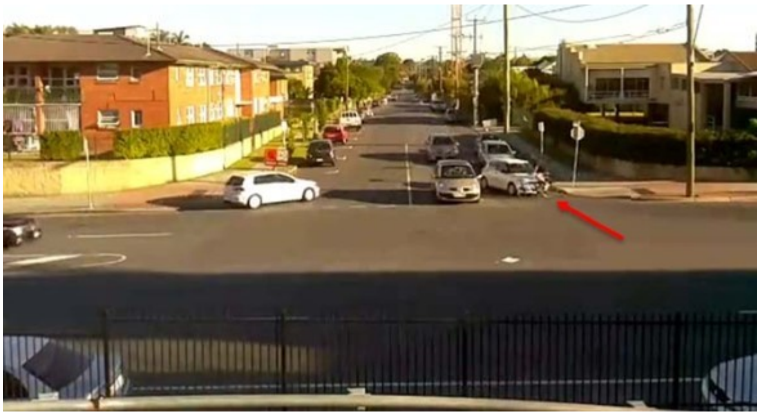
Reference	Image	For use
W3-2A		At approach to mid-block crossing where visibility of GIVE WAY regulatory sign is obstructed
TC-2235		To temporarily supplement GIVE WAY signs located on the approach to pedestrian / bicycle crossings

4 Case studies and examples

4.1 *Observational analysis of case studies*

This section summarises findings from observational studies of existing intersections. Video-based observational data were used to observe user interactions at existing shared path priority crossings, separated path priority crossings and one conventional crossing. A description of each crossing facility and a summary of key findings is presented following.

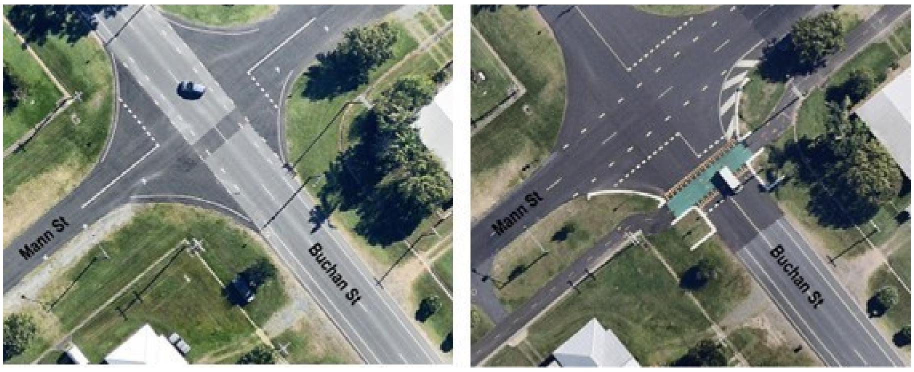
4.1.1 Conventional crossing, Carl Street at intersection with O'Keefe Street, Woolloongabba

Description	14 m wide crossing with kerb ramps either side
Design attributes	• Kerb ramps • Priority to motor vehicles
Design challenges	• Set-back 0 m • Excellent sight lines from major road, limited between vehicles approaching from Carl St and cyclists
Performance evaluation	• 259 interactions between riders and motorists at this location • 25% of interactions between riders and motorists required some form of adjustment, a small proportion of which were major, and one near collision • This crossing was considered the least safe, largely because of the level of confusion that sometimes arose between road users, motorist speeds and riders being masked from entering motorists by other motorists queuing to exit Carl St • Bicycle riders gave way to motorists in 72% of interactions
Photo	 *Conventional crossing, Carl Street at intersection with O'Keefe Street, Woolloongabba (photo)*
Plan view	 *Conventional crossing, Carl Street at intersection with O'Keefe Street, Woolloongabba (plan view)*

4.1.2 Somerset Street path priority crossing

Description	Separated bicycle and pedestrian path
Design attributes	• Raised, coloured platform, platform markings for raised pedestrian crossing, green bike path extending 30 m south and 10 m north, pedestrian path is continuous plain concrete • Steep ramp gradients (approximately 20%), effective at reducing vehicle speeds • Intersection built out and aprons installed to provide short 7.5 m crossing distance • Set-back 10 m from traffic lane with good sight lines • High cyclist volumes and low vehicle volumes • One street light over crossing
Design challenges	• Located on a bus route • Insufficient space to store a bus between crossing and major road • Four-way intersection with all movements allowed
Performance evaluation	• 80 interactions observed between motorists and path users (65 were cyclists) • In 87% of interactions the vehicle driver gave way to the pedestrian or cyclist • In the six cases where a motorist did not give way to a pedestrian, the vehicle was stopped or going slowly, and the pedestrian signalled for the motorist to go ahead • In three of the seven cases where a motorist did not give way to a rider, the rider stopped or signalled to the motorist to proceed ahead of the cyclist • The intersection appears to operate satisfactorily, the frequency of confusion, hesitation or near-collision conflict was low • The motor vehicle traffic volumes and speeds are generally low, such that the likelihood of interaction is low, the risk of conflict when an interaction does occur is low and speeds are sufficiently low that a collision is unlikely to result in serious injury (CMD Research, 2016)
Photos	 *Somerset Street path priority crossing (photos)*
Plan view	 *Somerset Street path priority crossing (plan view)*

4.1.3 Priority crossing on Mann Street and Buchan Street, Cairns

Description	One of nine raised priority crossings constructed on the 2.6 km Mann Street cycleway in Cairns, the crossing is located on one leg of a four-way intersection that was reprioritised as part of the project
Design attributes	• Raised platform, yellow piano key markings, green coloured surface on path • Crossing length between buildouts is 11 m • Set-back 10.5 m from traffic lane, sight lines very good
Design challenges	• Located on a four-way intersection that was reprioritised as part of the project • Intersection allows for all turn movements
Performance evaluation	• Crossing performs satisfactorily; risks presented to path users considered similar or better to what would be present if the crossing were not priority controlled • 169 interactions observed between path users and motorists: 56% involved bicycle riders and vehicles, vehicles gave way to bicycle riders in 85% of interactions • In 85% of interactions between bicycle riders and vehicles, a minor adjustment was made by one or both parties to avoid a collision: in 14% of interactions, a major adjustment was made, and one incident was classified as a near-collision – no collisions were observed • Elevated risk to cyclists, from drivers coming from the north; a raised platform for the entire intersection, or a retrofit incorporating speed cushions on the northern leg of the intersection at Buchan Street, would improve this issue
Photo	 *Priority crossing on Mann Street and Buchan Street, Cairns (photo)*
Plan view before and after	 *Priority crossing on Mann Street and Buchan Street, Cairns (plan view)*

4.1.4 Priority crossing, Brisbane Road, Mooloolaba

Description	The first priority crossing on the Sunshine Coast, located on the corner of Brisbane Road and Elanora Avenue in Mooloolaba – the route is used by recreational riders of varying levels of confidence, as well as utility and commuter cyclists
Design attributes	• Crossing set-back 7 m from vehicle lanes • Green treatments used on cycle track, extend 17 m and 13 m past edge of road • Coloured pavement on pedestrian section • Raised platforms designed to 1:15 • GIVE WAY signs and line marking installed at approaches • Side street access limited to left-in and left-out by centre median
Design challenges	• Low probability of cyclist and vehicle interacting (low vehicle and cyclist numbers) • Cultural context suggests that at least some path users are reluctant to 'claim' priority over motorists, side street on an arterial road • Ramp gradients are relatively flat (1:15)
Performance evaluation	• 143 interactions between riders and motorists at this location • No collisions or near-collisions were observed • In 75% of interactions, motorists gave way to path users consistent with design intent; drivers generally gave way to pedestrians unless pedestrians waved them through • Vehicle drivers did not give way to approximately 27% of bicycle riders • Minor adjustment by cyclists in 51% of interactions and major in 3% of interactions • The intersection appeared to perform satisfactorily from a safety standpoint because: – most road and path users are travelling slowly through the intersection, thereby allowing them to slow or stop as necessary and, should a collision occur, the consequence of a collision is unlikely to be severe – Elanora Avenue is a minor local street with low traffic volume, such that the likelihood of a path user encountering a motorist is 1 in 28
Photos	  *Priority crossing, Brisbane Road, Mooloolaba (photo)*

4.1.5 Tank Street at Kurilpa Bridge, Brisbane

Description	7.8 m driveway crossover at road grade with green coloured surface, Tank Street is one-way for motorists with a bi-directional cycleway connecting to Kurilpa Bridge – motorists entering from Tank St have priority over riders coming from Kurilpa Bridge
Design attributes	• Relatively steep driveway crossover ramp to reduce vehicle speed • Unknown cyclist and motor vehicle volumes • W6-9 warning sign for motorists turning left into car park
Design challenges	• Poor sight lines for motorists entering the car park • High cyclist speeds for cyclists approaching from the bridge
Performance evaluation	• Crossover performed satisfactorily; both motorists and bicycle riders travelling at low speeds consistent with an equitable and safe operating environment • 285 interactions between riders and motorists at this location • No collisions or near-collisions were observed • In 87% of interactions, no adjustment was made by the rider or driver • Only minor adjustments were recorded at this location • Motorists gave way to bicycles in over 95% of interactions • Footpath tends to protect cyclists from emerging motorists • Motorists tend to ignore painted buffer and line marking designed to encourage a wider angle into car park
Plan view and photo view	  *Tank Street at Kurilpa Bridge, Brisbane (plan view and photo view)*

4.1.6 Waterways Drive, Main Beach, Gold Coast

Description	Car park entry adjacent to four-lane undivided road (Waterways Drive), shared path is not set-back from road, crossing is at footpath grade with red coloured treatment on either side and ochre pavement, constructed in 2015
Design attributes	• Adjacent to four-lane road • Excellent sight lines • Set-back 2 m from traffic lane • Unknown cyclist and vehicle numbers • Painted splitter island
Design challenges	• Providing for long vehicles • Constrained setting restricted set-back to < 2 m

Performance evaluation	• Research captured 33 interactions between riders and motorists at this location • No collisions or near-collisions were observed • In 79% of interactions, no adjustment was made by the rider or driver • Where adjustments were made, they usually involved the rider veering around long vehicles • Motorists gave way to bicycles in over 97% of interactions • All interactions appeared safe
Photo	 *Waterways Drive, Main Beach, Gold Coast (photo)*
Plan view	 *Waterways Drive, Main Beach, Gold Coast (plan view)*

4.1.7 Priority crossing on Amess Street, Carlton North, Melbourne.

Description	Shared path with priority for path users over Amess St, installed adjacent to the four-way intersection of Park Street and Amess St, located in a suburb with high cycling numbers and good awareness of local facilities, constructed in 2012
Design attributes	• Raised platform, piano key markings, contrasting coloured surface extending approximately 5 m past edge of crossing, crossing length is 14 m • Excellent sight lines • Set-back 8.5 m from traffic lane • Approximately 2000 cyclists per day and 4000–5000 vpd • Splitter island on Amess St, 7 m corner radius

Design challenges	• Located on a bus route • Insufficient space to store a bus between crossing and major road • Four-way intersection with all movements allowed
Performance evaluation	• 381 interactions observed between riders and motorists • Vehicles gave way to bicycles in over 99% of interactions; where an interaction did occur, it involved only a minor adjustment to the course of travel by one party • Performed well, no indication that road users failed to understand priority • All interactions appeared safe
Photo	 *Priority crossing on Amess Street, Carlton North, Melbourne (photo)*
Plan view	 *Source: Victorian State Government* *Priority crossing on Amess Street, Carlton North, Melbourne (plan view)*

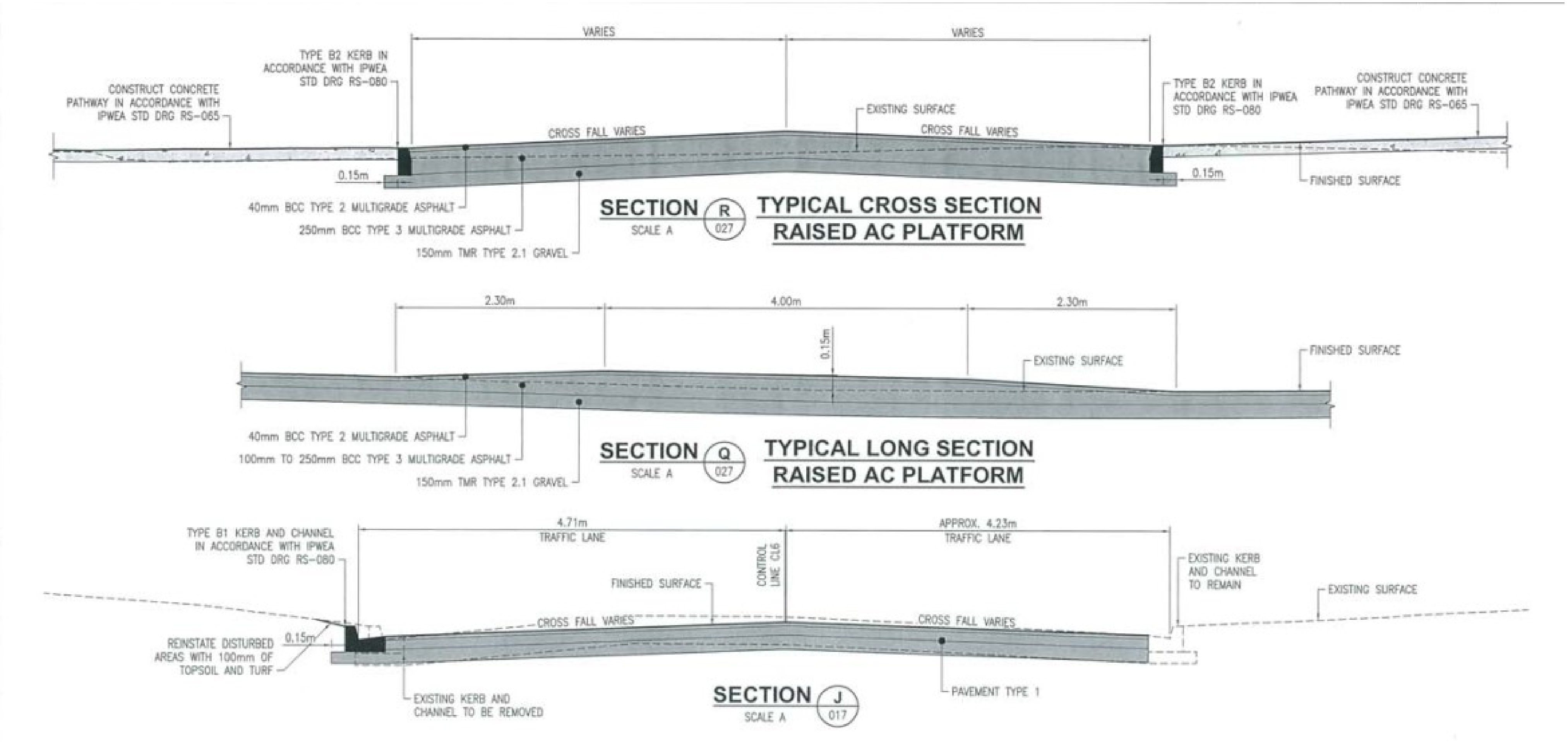
4.1.8 Devonshire Street, at Bourke Street, Sydney

Description	STOP sign-controlled cyclist crossing on a raised platform with an adjacent pedestrian crossing, crossing is 7.2 m wide on a 75 mm raised table
Design attributes	• Adjacent to two-lane road • Excellent sight lines • Set-back 6 m from traffic lane • Approximately 2000 cyclists per day and 4000 vpd • Corner radius 9 m
Design challenges	• Constrained location, limited set-back to 6 m • Restricted sight lines

Performance evaluation	• Observational research captured 336 interactions between riders and motorists at this location, and found that this intersection operates satisfactorily • Observations point to importance of having slow road user speeds to encourage safer negotiated crossings by motorists, bicycle riders and pedestrians • Significant decrease in cyclist crashes after the construction of the priority crossing • No collisions or near-collisions were observed • In 90% of interactions, no adjustment was made by the rider or driver • Motorists treated STOP signs as GIVE WAY controls • Motorists gave way to bicycles in over 94% of interactions • Tendency for motorists to encroach onto the zebra crossing • Critical safety case appears to be riders travelling against the adjacent traffic on Bourke St, emerging from behind a propped vehicle
Photo	  *Source: CDM Research* *Devonshire Street, at Bourke Street, Sydney (photo)*

Appendix 1 – Examples of detailed drawings

Asphalt platform cross section example



Source: Moreton Bay Regional Council

Concrete platform construction example