Queensland Guide to Traffic Management

Part 6: Intersections, Interchanges and Crossings Management (2020)

September 2025

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

About this document

Austroads' *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management* is concerned with traffic management at all types of intersections where road users must join or cross another stream of traffic.

This Part focuses on traffic management issues and treatments related to intersections, interchanges and crossings. It does not provide information on the geometric design of the treatment as this is provided in the Austroads *Guide to Road Design* (AGRD) Parts 4, 4A, 4B and 4C. Guidance on the management of road sections which are not part of the intersection or interchange is provided in the Austroads *Guide to Traffic Management* Part 5: *Link Management*.

Part 6 describes the appropriate use of, and design of, the various intersection types and the techniques that need to be applied if efficient and safe intersections are to be provided to the road user. All categories of road use – including cars, trucks, public transport, motorcycles, people riding bikes and people walking, including people who have disability or mobility difficulty, are addressed in the Guide.

How to use this document

The Department of Transport and Main Roads has agreed to adopt the standards published in Austroads *Guides* as part of national harmonisation. The department seeks to avoid duplicating information addressed in national guidance and has developed documents instead that provide Queensland-specific advice while following the structure established in Austroads *Guides*.

Queensland-specific advice includes practices which vary from national practice because of local environmental conditions (such as geography, soil types, climate); different funding practices; local research; local legislation requirements; and to expand instruction on particular issues.

As such, this Part of the *Queensland Guide to Traffic Management* (QGTM) takes precedence over the Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management* except where the Austroads *Guide* is accepted without changes.

This QGTM Part is designed to be read and applied together with Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management*. Readers must have access to the Austroads *Guide* to understand its application in Queensland.

This document:

- sets out how the Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management* applies in Queensland
- has precedence over the Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management* when applied in Queensland, and
- has the same section numbering and headings as the Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management*.

The following table summarises the relationship between the Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management* and this document:

Applicability	Meaning
Accepted	The Austroads *Guide* section is accepted.
Accepted, with amendments	Part or all of the Austroads *Guide* section has been accepted with additions, deletions or differences.
New	There is no equivalent section in the Austroads *Guide*.
Not accepted	The Austroads *Guide* section is not accepted and does not apply in Queensland.

Definitions

The following general amended definitions apply when reading the Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management*:

Reference to...	Means
AGTM Part 6	Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management*, as amended by this document; for example, a reference to AGTM Part 6 means the reader must refer to the Austroads *Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings Management*, and the *Queensland Guide to Traffic Management* Part 6: *Intersections, Interchanges and Crossings* (QGTM Part 6). Throughout AGTM Part 6, references are made to other Parts of the AGTM (for example, when reading AGTM Part 6, the reader may be referred to AGTM Part 3 for further information.) In such cases, the reader must refer to the equivalent Part within the QGTM first. Check the applicability of the equivalent QGTM Part before referring to the referenced AGTM Part. Similarly, references may be made to other Austroads Guides (for example, when reading AGTM Part 6, the reader may be referred to the *Guide to Road Safety* Part 3: *Speed Limits and Speed Management*. In such cases, the reader must refer to the equivalent Queensland Guide first where such exists. Check the applicability of the equivalent Queensland Guide before referring to the referenced Austroads Guide Part.
TRUM	The *Traffic and Road Use Management* manual preceded this *Queensland Guide to Traffic Management* and was withdrawn on publication of the corresponding QGTM.
Queensland MUTCD	Queensland *Manual of Uniform Traffic Control Devices*
TORUM	*Transport Operations (Road Use Management) Act 1995*

References

- www.legislation.qld.gov.au

Relationship table

Section	Title		Queensland application	Dept contact
1.	**Introduction**			
	1.1	Purpose	Accepted	
	1.2	Intended User	Accepted	
	1.3	How to Use	Accepted	
	1.4	Scope	Accepted	
	1.5	Out of Scope	Accepted	
	1.6	Notation on referencing errors, Austroads *Guide to Traffic Management* Part 6 2020	New	TPubs
2.	**Safety and Transport Management Objectives**			
	2.1	Safety Objectives	Accepted	
	2.2	Traffic Management Objectives	Accepted with amendments	WCI
3.	**Selection of Intersection Type**			
	3.1	General	Accepted	
	3.2	Types of Intersections		
	3.2.1	*Considerations*	Accepted	
	3.2.2	*Basic Turn Treatments (Type BA)*	Accepted	
	3.2.3	*Auxiliary Lane Turn Treatments (Type AU)*	Accepted	
	3.2.4	*Channelised Turn Treatments (Type CH)*	Accepted with amendments	WCI
	3.2.5	*Intersection Treatments – Rural Divided Roads*	Accepted	
	3.2.6	*Intersection Treatments – Urban Divided Roads*	Accepted	
	3.2.7	*Staggered T-intersections*	Accepted	
	3.2.8	*Seagull Treatments*	Accepted	
	3.2.9	*Wide Meridian Treatments*	Accepted	
	3.2.10	*Channelised Intersections with Right-turn Restrictions*	Accepted	
	3.2.11	*Left turn treatment selection*	New	WCI
	3.3	Intersection Selection		
	3.3.1	*Introduction*	Accepted	

Section	Title		Queensland application	Dept contact
	3.3.2	*Selection Process*	Accepted	
	3.3.3	*Assessment of Intersection Control Options*	Accepted with amendments	TEP
	3.3.4	*Intersection Type Selection – Key Traffic Management Considerations*	Accepted	
	3.3.5	*Determining the Need for Auxiliary Lanes*	Accepted	
	3.3.6	*Warrants for BA, AU and CH Turn Treatments*	Accepted with amendments	RD
	3.3.7	*Wide Meridian Treatment – Traffic Management Considerations*	Accepted	
	3.3.8	*Left turn treatment considerations*	New	WCI
	3.4	Road User Considerations	Accepted	
	3.4.1	*Pedestrians*	Accepted	
	3.4.2	*Cyclists*	Accepted	
	3.4.3	*Motorcyclists*	Accepted	
	3.4.4	*Trucks*	Accepted	
	3.4.5	*Public transport*	Accepted	
	3.5	Intersection Performance		
	3.5.1	*Safety*	Accepted	
	3.5.2	*Improving Traffic Flow Performance*	Accepted	
	3.5.3	*Environmental Considerations*	Accepted	
	3.5.4	*Road Lighting*	Accepted	
	3.6	Evaluation of Options	Accepted	
4.	**Roundabouts**			
	4.1	General	Accepted with amendments	TE
	4.2	Use of Roundabouts	Accepted	
	4.3	Performance		
	4.3.1	*Safety*	Accepted	
	4.3.2	*Traffic Performance*	Accepted	
	4.4	Road Space Allocation and Lane Management		

Section	Title		Queensland application	Dept contact
	4.4.1	*General*	Accepted with amendments	WCI
	4.4.2	*Cyclists*	Accepted with amendments	WCI
	4.4.3	*Motorcyclists*	Accepted	
	4.4.4	*Pedestrians*	Accepted with amendments	WCI
	4.5	Functional Design		
	4.5.1	*General*	Accepted	
	4.5.2	*Number of Legs*	Accepted	
	4.5.3	*Key Design Elements*	Accepted	
	4.5.4	*Entry Curvature and Deflection*	Accepted	
	4.5.5	*Wide streets and T-intersections*	Accepted	
	4.5.6	*Sight Distance*	Accepted	
	4.5.7	*Signs and Line Marking*	Accepted	
	4.5.8	*Landscaping and Road Furniture*	Accepted	
	4.5.9	*Lighting*	Accepted	
	4.6	Signalised Roundabouts		
	4.6.1	*General*	Accepted	
	4.6.2	*Metering in Advance of Roundabouts*	Accepted	
	4.6.3	*Signalisation at Junction of Roundabout Entry and Circulating Carriageway*	Accepted	
5.	**Signalised Intersections**			
	5.1	Introduction	Accepted	
	5.2	Functional Layout	Accepted	
	5.3	Road Space Allocation		
	5.3.1	*Introduction*	Accepted	
	5.3.2	*Urban Arterial Road Signalised Intersection Approaches*	Accepted with amendments	WCI
	5.3.3	*Local Road Approaches to Signalised Intersections*	Accepted	
	5.4	Lane Management	Accepted	

Section	Title		Queensland application	Dept contact
	5.5	Traffic Signal Operation	Accepted	
	5.6	Signs and Road Markings	Accepted	
	5.7	Road Lighting	Accepted	
6.	**Unsignalised Intersections**			
	6.1	Introduction	Accepted	
	6.2	Traffic Controls		
	6.2.1	*General*	Accepted	
	6.2.2	*Stop Signs and Give Way Signs*	Accepted	
	6.3	Intersection Capacity and Flow	Accepted	
	6.4	Traffic Control Devices	Accepted	
7.	**Road Interchanges**			
	7.1	Introduction	Accepted	
	7.1.1	*Terminology*	Accepted	
	7.2	Planning Considerations		
	7.2.1	*General*	Accepted	
	7.2.2	*Warrants*	Accepted	
	7.3	Route Considerations		
	7.3.1	*Spacing of Interchanges*	Accepted	
	7.3.2	*Consistency of Interchange Form*	Accepted	
	7.3.3	*Route Continuity and Consistency*	Accepted	
	7.4	Road Space Allocation and Lane Management		
	7.4.1	*General*	Accepted	
	7.4.2	*High-Occupancy Vehicle Lanes*	Accepted	
	7.4.3	*Integration of Public Transport*	Accepted	
	7.4.4	*Pedestrians and Cyclists*	Accepted	
	7.5	Interchange Forms		
	7.5.1	*General Categories*	Accepted	
	7.5.2	*System Interchanges*	Accepted	
	7.5.3	*Service Interchanges*	Accepted	
	7.5.4	*Characteristics of Service Interchange Types*	Accepted	

Section	Title		Queensland application	Dept contact
	7.5.5	*Interchange Selection Factors*	Accepted	
	7.6	Ramp Layouts		
	7.6.1	*General*	Accepted	
	7.6.2	*Speed Management for Ramps*	Accepted	
	7.6.3	*Lane Numbers*	Accepted	
	7.6.4	*Access Control*	Accepted	
	7.6.5	*Ramps on Two-lane, Two-way Freeways or Motorways*	Accepted	
	7.6.6	*Ramp Spacing*	Accepted	
	7.6.7	*Major Forks*	Accepted	
	7.6.8	*Branch Connections*	Accepted	
	7.7	Basic Lane Numbers and Lane Balance		
	7.7.1	*Basic Lane Numbers*	Accepted	
	7.7.2	*Lane Balance*	Accepted	
	7.8	Traffic Considerations		
	7.8.1	*General*	Accepted	
	7.8.2	*Traffic Data Requirements*	Accepted	
	7.8.3	*Operating Speeds*	Accepted	
	7.8.4	*Level of Service*	Accepted	
	7.9	Ramp Metering	Accepted	
	7.10	Signing, Marking and Lighting	Accepted	
8.	**Rail Crossings**			
	8.1	Levels of Protection	Accepted	
	8.2	Grade Separated Vehicle Crossings	Accepted	
	8.3	Rail Crossings At-grade	Accepted	
	8.3.1	*Passive Protection*	Accepted	
	8.3.2	*Active Protection*	Accepted	
	8.3.3	*Safety at Rural Rail Crossing*	Accepted	
	8.3.4	*Level Crossing Treatments*	Accepted	
	8.3.5	*Rail Level Crossings at or Near Road Intersections*	Accepted	
	8.4	Path Crossings of Railways	Accepted	

Section	Title		Queensland application	Dept contact
	8.4.1	*Path Crossings – Pedestrian*	Accepted	
	8.4.2	*Path Crossings – Shared*	Accepted	
	8.4.3	*Accessible Design*	Accepted	
	8.5	Lighting at Rail Crossings	Accepted	
	8.6	Selection of Treatment (ALCAM)	Accepted	
9.	**Pedestrian and Cyclist Crossings**			
	9.1	Introduction		
	9.1.1	*Types of Crossings*	Accepted	
	9.1.2	*Basics of Crossings*	Accepted with amendments	WCI
	9.2	Mid-block Crossings		
	9.2.1	*General Considerations for All Road Users*	Accepted with amendments	WCI
	9.2.2	*Bicycle Path Terminal Treatments at Road Crossings*	Accepted with amendments	WCI
	9.2.3	*Crossings at Signalised Facilities*	Accepted with amendments	WCI
	9.2.4	*Road Crossings by Off-road Bicycle Paths in Rural and Outer Urban Areas*	Accepted	
	9.2.5	*Road Crossings Used by Horse Riders*	Accepted	
	9.3	Bicycle Treatments at Intersections	Accepted with amendments	WCI
	9.3.1	*Unsignalised Intersections*	Accepted	
	9.3.2	*Signalised Intersections*	Accepted	
	9.4	Intersections of Paths with Paths	Accepted	
Appendices				
A	Signalised Intersection Guidance		Accepted	
B	Safe System Assessment Framework Summary		Accepted	
	B.1	Assessment Objectives	Accepted	
	B.2	Scale and Depth of Assessment	Accepted	
	B.3	Setting the Context	Accepted	
	B.4	Applying the 'Safe System Matrix'		

Section	Title		Queensland application	Dept contact
	B4.1	*Safe Roads and Roadsides and Speeds*	Accepted	
	B4.2	*Other Pillars*	Accepted	
C	Bicycle Path Terminal Treatments at Road Crossings Examples		New	WCI
Commentaries				
1	Relationship Between Vehicles Speeds and Likelihood of Severe Injury		Accepted	
2	Turn Treatment Research Findings		Accepted	
3	Research findings on Minor Road Stand-Up Lanes at Unsignalised Intersections		Accepted	
4	Additional Guidance on Service Lanes		Accepted	
5	Staggered T-intersections Research Findings		Accepted	
6	Unconventional and Innovative Intersection Designs		Accepted	
7	Considerations for Trucks at roundabouts		Accepted	
8	Considerations for Signals at Staggered T-Intersections		Accepted	
9	Warrants for Unsignalised Intersection Turn Treatments		Accepted	
	C9.1	Development of the Warrants	Accepted	
	C9.2	Application of the Warrants	Accepted	
10	Cyclist Types		Accepted	
11	Cycle Tracks		Accepted	
12	Additional Guidance on Site Characteristics for Roundabouts		Accepted	
13	Provision of Double Roundabouts		Accepted	
14	Research Findings on Cyclist Crashes at Roundabouts		Accepted	
15	Geometric Features of Roundabouts and Crashes		Accepted with amendments	WCI
16	Cyclist Paths at Roundabouts		Accepted	
17	The European Compact Radial Roundabout Design		Accepted with amendments	WCI
18	Lane Choice at Roundabouts		Accepted	
19	Additional Guidance on Signalising Roundabouts		Accepted	
20	Reducing Sight Distance on Intersection Approaches		Accepted	

Section	Title	Queensland application	Dept contact
21	Rural Intersection Active Warning System	Accepted	
22	Additional Guidance on Cyclist Paths at Interchanges	Accepted	
23	Additional Guidance on Ramp Types and Selection		
	C23.1 Left-turn Movements	Accepted	
	C23.1.1 Semi-direct Ramps	Accepted	
	C23.1.2 Outer Connectors	Accepted	
	C23.2 Right-turn Movements	Accepted	
	C23.2.1 Direct Ramps	Accepted	
	C23.2.2 Semi-direct Ramps	Accepted	
	C23.2.3 Loop Ramps	Accepted	
	C23.2.4 Diagonal Ramps	Accepted	
24	Provision of a Second Entry Ramp Lane	Accepted	
25	Closure of Railway Level Crossings	Accepted	
26	Linking of Intersection and Railway Signals	Accepted	

Departmental contacts:

- RD: Road Design, Hydraulics, Design & Spatial, Engineering and Technology, Transport and Main Roads email ET_HDS_RD_Design_Services@tmr.qld.gov.au
- TE: Traffic Engineering Technology & Systems, Engineering and Technology, Transport and Main Roads TrafficEngineering.Support@tmr.qld.gov.au.
- TEP: Traffic Engineering Practice, Traffic Engineering Technology & Systems, Engineering and Technology, Transport and Main Roads TrafficEngineering.Support@tmr.qld.gov.au.
- TPubs: Technical Publications & Systems email tmr.techdocs@tmr.qld.gov.au.
- WCI: Walking and Cycling Infrastructure (WCI), Engineering and Technology, Transport and Main Roads email Cycle&PedTech@tmr.qld.gov.au.

Contents

Tables

Figures

1 Introduction

1.6 *Notation* on referencing errors, Austroads Guide to Traffic Management Part 6 2020

New

The 2020 issue of Austroads *Guide to Traffic Management* Part 6 has referencing errors; for example, Section 4.6.2 *Metering in advance of roundabouts* paragraph 2 refers to Figure 3.9 to illustrate metered roundabouts, where the relevant figure is Figure 4.9 in the 2020 issue.

The Department of Transport and Main Roads has notified Austroads of this matter and been advised it will be corrected in a future issue of Austroads *Guide to Traffic Management* Part 6. Transport and Main Roads invites users of the Guide to contact Austroads for clarification as required in the interim.

The following Queensland exceptions to the Austroads Guide does not make further note of this matter. Users of the *Queensland Guide to Traffic Management* are invited to contact Transport and Main Roads Engineering and Technology via tmr.techdocs@tmr.qld.gov.au if clarification on referencing by this Guide is required.

2 Safety and Transport Management Objectives

2.2 Traffic Management Objectives

Difference

Table 2.1 *Objectives for intersections and crossings*, replace

> Maximise driver comfort.

with

> Maximise comfort for all users.

3 Selection of intersection type

3.2 Types of Intersections

3.2.4 Channelised Turn Treatments (Type CH)

Addition

Urban channelised (CH) turn treatments

CHL left-turn slip lanes should not be provided in urban areas. Where people walking and riding bikes are expected to cross a slip lane in an urban area, a wombat crossing or signalised crossing (preferably a two-aspect signal implemented as per Transport and Main Roads *Queensland Guide to Traffic Management* (QGTM) Part 9) shall be provided.

Left-in / left-out (LILO) turn treatments

A left-in /left-out turn treatment is preferred in urban areas, preferably incorporating raised priority crossings on side streets to promote accessibility and safe system outcomes while minimising intersection land requirements, Refer Transport and Main Roads guideline *Raised priority crossings for pedestrians and cycle paths.*

Refuges or channelization on side streets can increase swept path, property requirements and PUP impacts.

3.2.11 Left turn treatment selection

New

When selecting the appropriate treatment to accommodate the left-turn movement of vehicles at intersection, conflict with active transport movements needs to be considered. The following order of hierarchy should be followed when selecting an appropriate treatment, making sure site constraints are taken into consideration. The secondary list is the crossing control, in order of preference, that is recommended for the slip lane. When crossing a non-slip lane, the same treatment style related to the intersection is required for the crossing, which should be provided on all legs of the intersection:

Left turn treatment type:

A. Auxiliary left-turn only lane on approach to crossings at raised intersection.

B. Basic left-turn only lane on approach to crossings at raised intersection.

C. Auxiliary shared through and left-turn lane on approach to crossings at raised intersection.

D. High entry angle slip lane on approach to crossings at raised intersection^.

E. Non-high entry angle slip lane on approach to crossings at raised intersection^.

F. Auxiliary left-turn only lane on approach to crossings at intersection.

G. Basic left-turn only lane on approach to crossings at intersection.

H. Auxiliary shared through and left-turn lane on approach to crossings at intersection.

I. High entry angle slip lane on approach to crossings at intersection^.

J. Non-high entry angle slip lane on approach to crossings at intersection^.

^Crossing treatment type for slip lanes:

1. Raised pedestrian crossing (zebra controlled) – wombat crossing.
2. Raised priority crossing (give-way controlled) – numbat crossing.
3. Two-aspect traffic signals (as per QGTM Part 9)
4. Pedestrian crossing (zebra).
5. Unmarked*.

* Potential for disability discrimination claims. Only appropriate where no pedestrian desire lines exist and would not be expected to exist in the future.

Note: If motor vehicle movements other than left turns are permitted at the intersection and the movements interact with the crossing desire line (for example, right turns), then they should also be considered in selection of appropriate intersection form and crossing treatments.

3.3 Intersection selection

3.3.3 Assessment of Intersection Control Options

Addition

Table 3.5, add the following bullet point:

- Speed limit through the signalised intersection shall comply with the requirements of Section 7 of *Queensland Road Safety Technical User Volumes* (QRSTUV) – *Guide to Speed Management*.

3.3.6 Warrants for BA, AU and CH turn treatments

Addition

Warrants for BA, AU and CH turn treatments

Refer to Transport and Main Roads' *Road Planning and Design Manual 2nd Edition* Volume 3 Part 4A.

3.3.8 Left turn treatment considerations

New

Refer to Transport and Main Roads' *Road Planning and Design Manual 2nd Edition* Volume 3 Part 4.

4 Roundabouts

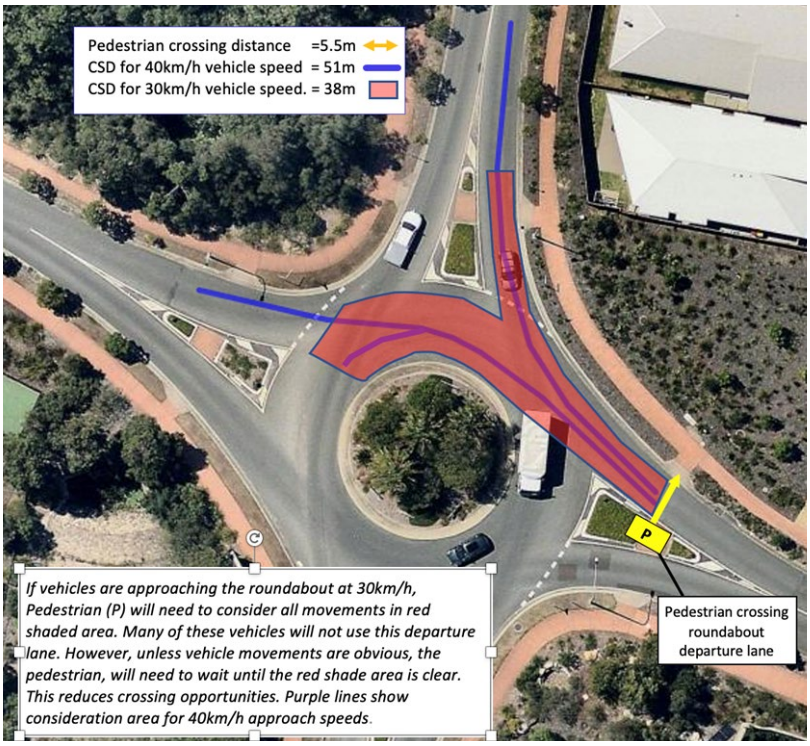
4.1 General

Addition

Roundabouts are likely to present significant obstacles to safe movements of people walking and riding bikes where any of the following conditions are met:

- vehicle speeds exceed 30 km/h on the roundabout or at crossing locations
- users find it difficult to predict a safe gap in traffic because of vehicle volumes, sight lines or geometry that requires them to consider vehicle movements from multiple directions (see Figure 4.1), and
- the roundabout has multiple circulating traffic lanes, and/or at least one multi-lane approach / departure.

Figure 4.1 – Area people walking need to consider when predicting a safe gap in traffic



These roundabout conditions affect all people walking and riding bikes but have a greater impact on more vulnerable users including children, older people and people with a disability or impairment. Specific problems for people walking and riding bikes at roundabouts include:

- children, older people and people with a disability require additional time to identify gaps in traffic and may also require a longer gap to accommodate longer crossing time
- people with vision impairments and walking cannot detect a safe gap because of background noise
- at exit lanes, users need to consider traffic approaching from several locations including the exit lane, entry lane / lanes and the circulatory carriageway: the higher workload makes gaps more difficult to establish and crashes more likely
- at multi-lane roundabouts, users must consider traffic approaching from multiple streams, and locations in complex and higher-speed environments, to avoid crashes that are likely to result in serious injuries or fatalities, and
- where vehicle speeds are higher than 30 km/h, crashes involving people walking or riding bikes and motor vehicles are likely to result in severe injuries.

Vehicle speeds and vehicle volumes are important variables affecting accessibility for people riding bikes and walking at roundabouts. Urban roundabouts should include ‘Primary’ or ‘Transformational’ Safe System treatments to reduce both the likelihood and consequences of crashes involving people walking and riding bikes and all other road users.

Critical impact speeds for crashes involving people walking and riding bikes are defined in Austroads' *Guide to Traffic Management* Part 13 as 20 km/h. Designing crossings to support maximum comfortable vehicle speeds of 30 km/h significantly reduces the likelihood of serious or fatal crashes to these users. It also provides a very high level of protection to vehicle occupants involved in adjacent direction crashes (30 km/h critical impact speed) and rear end crashes (55 km/h critical impact speed).

Preferred treatments at urban roundabouts

Urban roundabouts should be designed with single-lane approaches and departures, splitter islands and raised crossings that give priority to people walking and riding bikes on all approaches, unless higher-order crossings that remove conflicts altogether (grade separation) are provided. Crossings that give priority to people walking and riding bikes include a raised pedestrian (zebra) crossing ('wombat' crossing) with or without a separated cycle track.

These crossings facilitate movements of people walking and riding bikes and help to slow motorists to improve the overall safety performance of the roundabout and reduce risk associated with all crash types. Wombat crossings have evidence-based safety benefits for people walking and riding bikes. Roundabouts have evidence-based safety benefits for vehicle occupants. Combining both treatments allows risks to all users to be carefully managed at intersections.

Raised crossings that give priority to people walking and riding bikes should be provided on all approaches of roundabouts in urban areas, where all the following conditions are met:

- the upper 15 km/h pace speed at the raised crossing can be reduced to not exceed 30 km/h
- heavy vehicle volumes and type are appropriate for the site context, such as low to moderate heavy vehicle volumes
- the roundabout has a central island diameter up to 40 m
- the crossings are not expected to cause extensive queuing through multi-lane upstream intersections where the posted speed is greater than 50 km/h (see Austroads *Guide to Road Design* Part 4, Commentary 10), and
- there is likely to be some demand from people walking now or in the future

Examples of these roundabouts are provided in Sections 4.4-2 and 4.4-4 of the Department of Transport and Main Roads *Road Planning and Design Manual 2nd Edition* (RPDM) Part 4B provides further design guidance on crossings treatment design and location.

Locations where raised crossings that give priority to people walking or riding bikes may not be appropriate include:

- multi-lane roundabouts
- roundabouts with an upper 15 km/h pace that exceeds 60 km/h at crossing points
- larger roundabouts (central island diameter greater than 40 m)
- roundabouts with high heavy vehicle volumes, and
- road train routes.

If considering using raised crossings for these situations, they should be treated as a pilot project with the necessary documentation and mitigation strategies in place.

At these locations, the following alternative treatments for people walking or riding bikes should be provided:

- grade separated pedestrian and cyclist crossings
- signalised crossings on the roundabout
- replacement of the roundabout with traffic signals
- fully signalised the roundabout, and/or
- locating pedestrian crossings further away from the roundabout.

4.2 Road Space Allocation and Lane Management

4.4.1 General

Addition

Left-turn slip lanes or bypass lanes should be avoided in urban areas, refer to Section 3.2.11.

4.4.2 Cyclists

Difference

Replace Figures 4.5 and 4.6 in Austroads *Guide to Traffic Management* Part 6 with Figure 4.4.2.

Figure 4.4.2 – Visualisation

Source: Metro Tunnel (2018)

Replace section with:

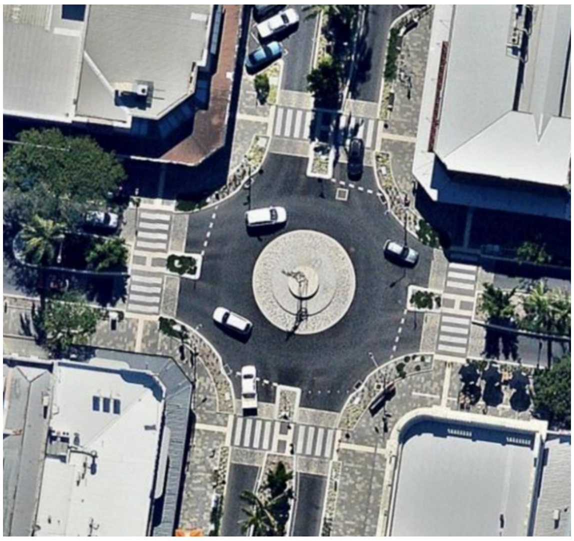
Refer to Transport and Main Roads Guideline *Providing for people walking and riding bikes at roundabouts* for further guidance.

4.4.4 Pedestrians

Difference

Replace Figure 4.7 in Austroads *Guide to Traffic Management* Part 6 with Figure 4.4.4.

Figure 4.4.4 – Example treatment at roundabout for people walking



Wood Street and Victoria Street, Mackay – installed 2015.

Replace section with:

Refer to Transport and Main Roads Guideline *Providing for people walking and riding bikes at roundabouts* for further guidance.

5 Signalised Intersections

5.3Road Space Allocation

5.3.2 Urban Arterial Road Signalised Intersection Approaches

Difference

Table 5.3 2nd paragraph, replace:

> At T-intersections and intersections at freeway / motorway ramp terminals (e.g. diamond interchanges), crossings are sometimes not provided across the continuing road on the right hand side of the T. This practice eliminates conflict between pedestrians and traffic turning right from the stem of the T and improve the efficiency of this movement. However, pedestrians crossing the major road to the right of the stem will have to make two road crossings instead of one, thereby reducing their level of service and expose them to risks on both crossings. The designer will need to consider whether these disbenefits exceed the benefits of not providing a crossing on all arms. If they are provided, some form of pedestrian protection must be considered.

with

> Signalised crossings shall be provided on all legs of signalised intersections. It is not illegal for pedestrians to cross on non-provided legs under Road Rule 232, it is safer to provide the signalised crossing.

Table 5.3 3rd paragraph, replace:

> The provision of pedestrian crossings across left-turn roadways should also be considered. Adequate stopping sight distance should be provided to pedestrians, particularly to crossings of left-turn slip lanes where speeds are higher than locations with small corner radii. At larger turn radii, drivers may tend to focus on the driving task and potentially conflicting traffic rather than pedestrians. Where significant pedestrian flows occur, turning speed may have to be controlled through road geometry.

with

> Left-turn slip lanes or bypass lanes should be avoided in urban areas, refer Section 3.2.11.

Table 5.3 4th paragraph, replace:

> Marked foot crossings should be located to minimise the potential for jaywalking.

with

> Crossings should be located as close to crossing desire lines as possible to maximise compliance.

Table 5.3 1st bullet point, replace:

- an adequate pedestrian storage area

with

- an adequate pedestrian storage area that protects people stored in the median from errant vehicles

Addition

Table 5.3 replace section with:

> Space required for turning lanes at intersections should be based on capacity analysis to determine the:

- number of lanes required for each movement
- length of lane necessary to accommodate safe deceleration at times of low demand, and sufficient storage clear of the through lanes during peak periods
- length of turn lane required to enable access to turn lanes and leading right-turn phases when through traffic is queued
- auxiliary left turn lanes may be required where path users are assigned priority on side streets
- Left-turn slip lanes or bypass lanes should be avoided in urban areas, refer Section 3.2.11.

9 Pedestrian and cyclist crossings

9.1 Introduction

9.1.2 Basics of Crossings

Addition

Multiple-threat risk

A multiple-threat type crash is defined as when a driver in one lane gives way to person crossing the street but the driver in the next lane does not.

Multiple-threat crashes generally require more than one general purpose traffic lane flowing in the same direction however this crash type may also occur on a single general purpose traffic lane where the lane width exceeds 4.6 m resulting in cars travelling side-by-side within the lane (refer to AGRD Part 3). Multiple-threat type crashes may occur even where drivers are not required to give way to people walking or riding bikes, such as where motor vehicle queuing extends across a path user crossing desire line and people filter through the motor vehicle queue to cross. Measures to reduce crossing exposure distance and control the multiple-threat risk should be considered even in non-priority crossing scenarios.

Pedestrian crossing facility selection

Inadequate crossing facilities for people walking and riding bikes in urban areas create a multitude of problems worsening safety, sustainability, social interaction and community health. Often, this can lead to repercussions such as discrimination claims and other liabilities. As these facilities provide for the most vulnerable road users such as children and people with a disability, it is essential that decision making is based on rational, defensible mechanisms for the implementation, replacement and upgrade of crossing facilities.

Existing crossing facilities that do not conform with all technical requirements should not be removed without careful consideration. The desire line will still exist, and removal of the crossing may result in people crossing at even more substandard locations. The feasibility of modifying other road environment factors should be reviewed before considering the removal of a priority pedestrian crossing. The review may consider factors such as reducing speed environment, reducing the number of approach lanes or upgrading the crossing to signals.

Pedestrian crossing facility selection method

In the interests of national harmonisation, the Australasian pedestrian crossing facility selection tool ('the tool') is the preferred method for assessing crossing facility type on a known desire line.

Care must be taken to understand tool limitations and background assumptions when interpreting the output. The tool is an aid and does not replace professional planning or engineering judgement.

The tool and user guide can be accessed through the Austroads website.

It is strongly recommended that the Australasian *Pedestrian Facility Selection Tool User Guide* ('the user guide') be read before using the tool. In-depth details on the development of the tool are contained in Austroads report AP-R472-15 *Development of the Australasian Pedestrian Facility Selection tool*.

Queensland-specific guidelines for using the Australasian pedestrian crossing facility selection tool

Tool limitations

The tool does not assess feasibility of pedestrian (zebra) crossings on slip lanes. Slip lanes should be avoided in urban areas, refer to Section 3.2.11. Slip lanes without pedestrian (zebra) crossings have been a source of disability discrimination claims from people with vision impairments. As such, pedestrian (zebra) crossings on slip lanes are feasible where approach speed conforms with the Queensland *Manual of Uniform Traffic Control Devices* (Queensland MUTCD) Part 10 and Approach Sight Distance (ASD) is achieved (refer to AGRD-4A) – no other warrants are necessary.

The tool does not assess feasibility of pedestrian (zebra) crossings at intersections. This can be a valid treatment at intersections when designed in accordance with Austroads *Guide to Road Design* Part 4 or Transport and Main Roads' Guideline *Selection and design of cycle tracks*. The facility needs to be flagged as mid-block in the tool to force an assessment.

The tool does not assess pedestrian (zebra) crossings on multi-lane roads; feasibility of shared zones (refer to Queensland MUTCD Part 4 and Austroads *Guide to Traffic Management* Part 8) or children's' crossings (refer to Transport and Main Roads' *Queensland Road Safety Technical User Volumes* (QRSTUV): *Guide to Schools*.

The tool does not include an assessment of health benefits in the Benefit Cost Ratio (BCR) calculation. By installing crossing facilities and making walking a competitive mode choice in urban environments, some health benefit may be realised. The Australian Transport Assessment and Planning Guidelines: M4 *Active Travel* provides guidance on the monetary value to the economy of the health benefits of active transport.

Using the tool in Queensland

1. Beginning the assessment

   It is strongly recommended all blank fields are filled out when using the tool. If the tool has been used previously, it is recommended that values are reset to the defaults. This is most easily done by clicking the 'Reset All' button in the save / load parameters section at the top right of the tool input form.

   Default values given in the tool should be accepted unless noted following or site-specific reasons justify modification of the defaults. The reasons for using modified values should be recorded in project documentation.

2. Site information

   Jurisdiction: should be set to Queensland.

3. Operational variables

   Volumes of people walking for sites without existing provisions or with inadequate provisions for people walking should allow for suppressed demand. The amount of suppressed demand is highly site-specific. Any assumptions regarding allowances for suppressed demand should be clearly noted in the project documentation. Suppressed demand should be considered where:

   a) people walking currently experience considerable difficulty crossing (LOS is D or worse)
   b) attractors or trip generators of people walking such as schools, shops or train stations are in close proximity to the proposed crossing point, or
   c) on-street parking is being rationalised and crossing desire lines are expected to focus due to more crossings from side streets.

   Where no current crossing facility exists, pedestrians crossing within 50 m of the proposed location should be included in the volume input of people walking. People riding bikes can legitimately use pedestrian crossings in Queensland and, if present, should be added to the non-sensitive volume of people walking. This requires site-specific judgement; as a road crossing connecting off-road paths will be used by bicycle riders. On-road riders may use pedestrian refuges to benefit from a protected right turn.

4. Crash information

   If there are no recorded crashes at the site, then select the crash 'Model' option.

   Years of crash history: Number of years for which crash history is known. Typically, 3 to 5 years, a longer crash history may be appropriate if the infrastructure has been unchanged during that time period.

   Number of injury crashes involving people walking: Crashes involving people walking within 50 m of the proposed crossing site are typically included.

   Crashes unrelated to crossing manoeuvres should not be counted, such as run off road crashes involving people walking on the footpath.

5. Model parameters

   Evaluation days per annum: 250 is appropriate for a rural road that has little weekend / public holiday traffic. For urban roads that are used continuously, adopt 365.25.

   Project lifetime: Depends on the likely useful life of the treatment, considering location and potential for growth. An assessment period of 5 years that results in a positive BCR may make a strong case for a short-term safety intervention. For longer assessment periods, whole-of-life maintenance costs may need to be considered in the construction cost estimate.

   Discount rate: The 7% default is appropriate. If sensitivity analysis is required, the Australian Transport Assessment and Planning (ATAP) Guidelines suggest using range between 4% and 10%.

6. Feasible facilities

   Construction cost: Should be an estimate to implement the crossing including all ancillary costs (for example, drainage, utility relocation, property acquisition, and so on). First pass option assessment costings do not need to be highly detailed. Once a facility is selected, the cost field should be revised with a detailed estimate for greater certainty in the BCR estimate.

Outputs

7. Facility assessment

   Any option with a BCR >1 does not automatically warrant the installation of a pedestrian facility. Likewise, the option with the greatest BCR may not be the most appropriate facility to implement at the site being assessed. A network operation plan (refer to Austroads *Guide to Traffic Management* Part 4) applicable to the site can guide which output factors should take precedence in facility evaluation and selection. Engineering code of ethics should be considered when judging if small vehicle delays should be traded off against safety in benefit-cost calculations.

   The options under consideration should be reviewed to ensure that:

   a) required sight distances are adequate
   b) adequate space is available to install a compliant facility (for example, the minimum refuge cut-through width is 2.4 m to ensure Tactile Ground Surface Indicators (TGSIs) are compliant), and
   c) effects of the crossing facility on the road network are acceptable; for example, queuing of vehicles onto a motorway should not be tolerated, however, minor queues in other situations may be appropriate and potentially assist crossing safety by reducing approach speed.

Alternative crossings less than 200 m apart may reduce the need for a new crossing; however, this is highly context-sensitive. Demand for crossings less than 50 m apart may indicate the road's status in the network hierarchy needs review to determine whether access functions for people walking should be prioritised over the traffic carrying function.

It is strongly recommended that the Notes field be filled out detailing the decision whether a facility is viable, the proposed facility type, assumptions, data sources, impacts and other information relevant to the assessment. Completed assessments should be printed and stored in a document management system in case decisions are questioned in the future.

9.2 Mid-block crossings

9.2.1 General Considerations for All Road Users

Difference

Austroads *Guide to Road Safety* Part 1 (AGRS Part 1) defines the vision and objectives of the road transport system to include enabling people and goods to move safely and efficiently and to provide a safe and reliable system that is accessible, affordable, and sustainable for all users.

Crossing treatments provide an important function in this system, ensuring conditions enable all users to cross roads. AGRS Part 2 describes safe system aligned measures for pedestrian and cyclist crossings. Table 9.2.1 draws on this information to summarise crossing treatment types, considerations and improvements on safety, accessibility and delay.

Replace Table 9.1 and Table 9.2 with the following Table 9.2.1.

The table identifies each treatment's position in the Safe System hierarchy, as identified in AGRS Part 2 and shown below:

- Primary treatment – Safe System transformation.
- Supporting treatment – Step towards Safe System.
- Supporting treatment.
- Non-Safe System treatment.

Table 9.2.1 – Applications, benefits and considerations for selecting pedestrian and cyclist crossing facilities

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
Pedestrian (zebra) crossing (not raised)	Exposure: - Likelihood: - Severity: - Non-Safe System Treatment	✓✓	✓✓✓	• Most suitable at sites where vehicle volumes are low to moderate and operating speeds are already below safe system thresholds for pedestrians. Examples include car parks, and streets where operational speeds are 20-30 km/h. • Not suitable on multi-lane roads. • At high entry angle left-turn slip lanes where vehicle operational speeds are 20-30 km/h.	• Additional controls should be considered to reduce motor vehicle approach speeds, which improves driver compliance and reduces crash severity (both rear end and pedestrian crashes). • Approach sight distance is required to the pavement marking. Refer to *Road Planning and Design Manual 2nd Edition* (RPDM) Volume 3 Parts 4A and 6A for visibility to people approaching crossing. • Whilst this treatment does not improve safety, it may be used in places where there are insufficient gaps in traffic to cross the road and safe system conditions are already established to enable access for all users. • If used at a location with a posted speed limit greater than 50 km/h, an RPEQ certified risk assessment (for example, a Safe System Assessment) shall be undertaken to support the use of the treatment at the site, including an assessment of the risk of a 'do nothing' option. Refer to Queensland MUTCD Part 10.

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
Raised pedestrian (wombat) crossing	Exposure: - Likelihood: ✓✓✓ Severity: ✓✓✓ Primary safe system treatment	✓✓✓	✓✓✓	• Most suitable where pedestrians cross two-lane, two-way, roads and operational vehicle speeds ≤ 50 km/h. • At high entry angle left-turn slip lanes or roundabouts. • Where communities require crossings (refer to *Raised priority crossings for pedestrians and cycle paths*). • Used as per requirements set by Queensland MUTCD Part 10.	• Increases conspicuity. • Provides positive speed control. • Avoids need for pedestrians to negotiate kerb ramps. • Low cost compared to signalised crossings. • May increase noise when mid-block and the proportion of large commercial vehicles exceeds 20%. Otherwise, likely noise neutral or reducing. • RPDM Volume 3 Part 4B and Queensland MUTCD Part 13 provides further guidance for platform design. • Road cushions placed either side of crossing have been shown to have similar speed control to platforms, and may be considered an equivalent safety treatment. • Drainage works are simplified where crossings are on crests or directly downstream of on grade inlets. See departmental Technical Guideline *Raised Priority Crossings for Pedestrian and Cycle Paths*.

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
				• May be used as retrofit treatment on higher order roads, where supported by a safe system assessment (refer to Queensland MUTCD Part 10)	• Queensland MUTCD Part 10 requires a Safe System Assessment (SSA) be undertaken when considering multi-lane crossings. This assessment should compare the raised pedestrian crossing treatment against other practicable alternatives for the site, including the do-nothing option. See Appendix 2 in departmental Guideline *Raised Priority Crossings for Pedestrian and Cycle Paths* for SSA example. • Mitigating treatments to address multiple-threat issues at raised crossings on multi-lane crossings include advanced yield lines, lane narrowing, visibility islands and achieving as close as possible to Safe System speeds for pedestrians and cyclists (30 km/hr) at the crossing point. See Queensland MUTCD Part 10. • See departmental Technical Guideline *Raised Priority Crossings for Pedestrian and Cycle paths* for further information about operational performance of raised crossings and multi-lane crossing case studies.

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
Cyclist priority path crossing	Exposure: - Likelihood: ✓✓✓ Severity: ✓✓✓ Primary safe system treatment	✓✓✓	✓✓✓	• Most suitable for places where cyclists cross two-lane, two-way, roads with low-high volumes and operational vehicle speeds ≤ 50 km/h. • Suitable for mid-block and side road crossings. • Roundabout crossings (in conjunction with raised pedestrian crossings). • Used as per requirements set by Queensland MUTCD Part 10.	• Give Way controlled. Refer to AGRD-4 and departmental Technical Guidelines *Selection and design of cycle tracks* and *Raised priority crossings for pedestrians and cycle paths*. • Provides improved level of service to people riding bikes through continuity and directness of paths. • People riding bikes are not required to dismount. • Raised platform reduces vehicle speeds at crossing point which improves safety. • Alternative to cul-de-sac of the side street.

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
Raised priority crossing	Exposure: - Likelihood: ✓✓✓ Severity: ✓✓✓ Primary safe system treatment	✓✓✓	✓✓✓	• Most suitable for places where pedestrians and cyclists cross two-lane, two-way, roads with low-high volumes and operational vehicle speeds ≤ 50 km/h. • Where communities require crossings (see departmental Technical Guideline *Raised priority crossings for pedestrians and cycle paths*). • Used as per requirements set by Queensland MUTCD Part 10. • Suitable for mid-block and side road crossings.	• Bike riders do not have to come to a complete stop before crossing at a Raised Priority Crossing. • For planning and design considerations refer to *Raised priority crossings for pedestrians and cycle paths*. • Generally, give way controlled. Refer to AS 1742-10. • Where sight lines are constrained at side roads, crossings may be Stop sign controlled. See Technical Guideline *Raised priority crossings for pedestrians and cycle paths*. • Commonly used at side road crossings, including on Principal Cycle Routes and to support safe routes to schools.

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
Roundabouts with raised pedestrian crossings	Exposure: - Likelihood: ✓✓✓ Severity: ✓✓✓ Primary safe system treatment	✓✓✓	✓✓✓	• Retrofit existing roundabouts to provide safe crossings. • Where a mid-block crossing is required across a road, and there is a T-junction with a minor road nearby, a roundabout with raised crossings may be appropriate to optimise safety outcomes for all users.	• Urban roundabouts should be designed to be single-lane with splitter islands and raised crossings that give priority to pedestrians and cyclists on all approaches, see Section 4. • Single lane roundabouts with raised crossings are excellent at achieving low injury risk levels for all users as they reduce impact forces for all users and reduce the number of conflict points for most users. • Providing a roundabout with raised crossings, provides an opportunity to connect parallel and perpendicular walking and cycling routes • Providing a roundabout instead of a T-intersection, or Y-intersection provides greater protection for right turning vehicle occupants, who may otherwise be subjected to FSI crash forces from through moving vehicles.
Children's crossing	Exposure: - Likelihood: ✓✓✓ Severity: - Supporting safe system treatment	✓✓	✓✓	• Usually installed near schools (within 200 m) where the requirements for the facility arise only during specific and limited times of the school day. Refer to QRSTUV: *Guide to Schools*.	• Part time operation, crossing priority only when flags are in position. • Specific for children and youths. • May be supervised. • Requires undertaking to manage flags. • Unless combined with another facility type, reverts to mid-block where motorists are not required to give way.

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
				• May be combined with a raised pedestrian crossing to reduce motor vehicle speeds and crossing width and maintain safety at the crossing for supervisors and during evening and weekend events outside school hours.	
Pedestrian traffic signals[2]	Exposure: - Likelihood: ✓✓✓ Severity: - Supporting safe system treatment	✓✓	✓	• Multi-lane roads and in areas with higher operational speeds. • Places where there is only pedestrian demand (no cycling / PMD demand). • Where a raised pedestrian / priority crossing is not suitable.	• At urban signalised intersections, a single-stage pedestrian crossing on all legs is the recommended default provision. • Delay times for people walking should be minimised as far as possible. Queensland research has found pedestrian compliance is highest where delay is less than 90 seconds. There is an almost 50% decrease in compliance for delays exceeding this. • Incorporating pedestrian detection technology reduces delay to all users and improves LOS for all users (refer to QGTM Part 9).

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
				• See 'Separated pedestrian and cyclist signals' below if crossing also provides for cyclists.	• Signalisation of single lane slip lanes not recommended due to delay and non-compliance. Refer to 3.2.11. • Queensland research has found an average pedestrian crossing signal compliance of: – 84% for a single stage crossing, and – 69% compliance for the first leg of a two-stage crossing and 48% compliance for the second leg.
Separated pedestrian and cyclist signals	Exposure: - Likelihood: ✓✓✓ Severity: - Supporting safe system treatment	✓✓	✓✓	• Multi-lane roads and in areas with higher operational speeds. • Where the crossing may be used by people walking and riding. • Where a raised pedestrian / priority crossing is not suitable.	• Bicycle riders travel about 4 times faster than pedestrians and can clear crossings quickly when already moving. If clearance time is set up for pedestrians, a lot of rider time is wasted. Separate bicycle lanterns allow timings to minimise wait time for riders. • Consider bicycle detection on path approaches for reduced need to stop.

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
Pedestrian traffic signals on raised platform[2]	Exposure: - Likelihood: ✓✓✓ Severity: ✓✓ Primary safe system treatment	✓✓✓	✓	• Multi-lane roads and in areas with higher operational speeds. • Improves safety compared to conventional at grade signalised crossing. • Creates delays for pedestrians and cyclists. Consider at sites where a raised pedestrian / separated crossing is not suitable.	• As per 'Pedestrian traffic signals'. • Consistent with AGRS Part 2. • May be considered a primary Safe System treatment, where vehicle speeds are below safe system thresholds (30 km/h at crossing).
Refuge crossing	Exposure: - Likelihood: ✓✓ Severity: - Supporting safe system treatment	✓	✓	• Where it is difficult to cross the full road in one stage due to: – delays or gap selection – length of crossing, and – insufficient sight distance.	• Refuges can make it easier for pedestrians to select safe gaps in the traffic by breaking crossings into multiple stages • Queensland research suggests refuges do not significantly impact vehicle speeds. See departmental Technical Guideline *Raised priority crossings for pedestrians and cycle paths* Arthur St case study

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
				• In environments with low-moderate vehicle volumes and very-low operational speeds. • As an interim or supplementary treatment in a higher speed environment, after more safe system aligned treatments, such as raised pedestrian or signalised crossings have been considered. • To provide supplementary crossings between safe system aligned crossing treatments.	• Queensland studies have shown parents have high levels of concern with children using refuge crossings. See departmental Technical Guideline *Raised priority crossings for pedestrians and cycle paths* risk score for various crossing types identified by parents / students. • Volumes and speeds should be such that the refuge enables all users (including a child or a person with a vision impairment) to safely judge or hear gaps in traffic. This is usually environments with low to moderate traffic volumes and speeds. • AGRS Part 2 reports 45–55% reductions in pedestrian casualties at refuges and flush or raised medians. • Consider combining with raised pedestrian / priority crossings to improve safety and accessibility. • Speed cushions may be used in advance of refuge crossings to reduce vehicle speeds.

Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
					• If more than one lane of moving traffic in any one direction is encountered by a pedestrian using a crossing or the posted speed limit is > 50 km/h, an RPEQ certified risk assessment (for example, a Safe System Assessment) shall be undertaken to support the use of this treatment at the site, including an assessment of the risk of a 'do nothing' option. Refer to Queensland MUTCD Part 10.

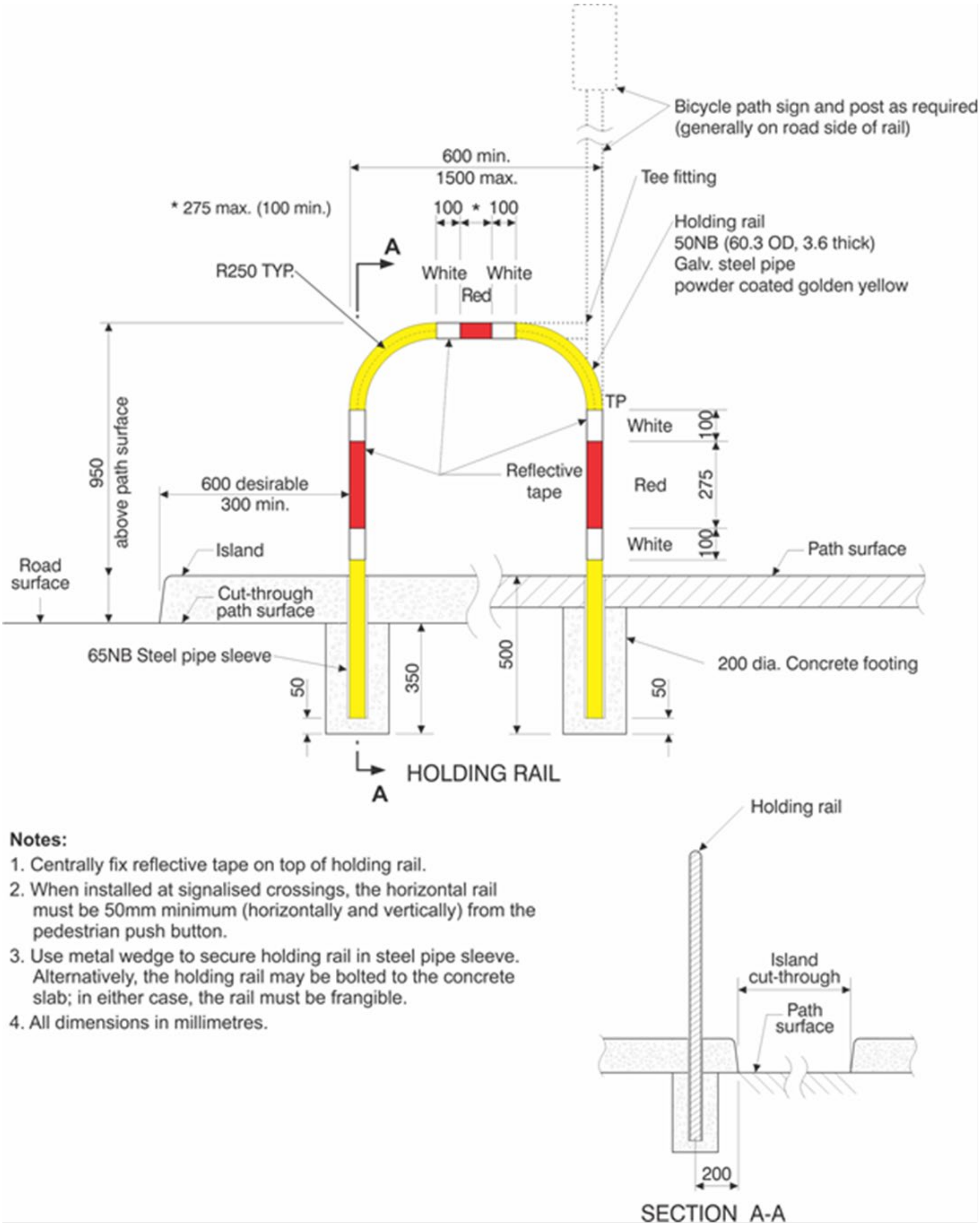
Treatment	Safety improvements (exposure, likelihood, severity)	Improves accessibility	Reduces pedestrian / cyclist delay	Application	Considerations[1]
Kerb extensions	Exposure: - Likelihood: ✓ Severity: - Supporting safe system treatment	-	-	• To shorten crossing distance and increase visibility. • In environments with very low-moderate vehicle volumes and operational vehicle speeds, kerb extensions enable all users (including a child or a person with a vision impairment) to safely judge or hear gaps in traffic to cross safely. • In conjunction with other controlled crossing treatments.	• Can store multiple users at part crossing distance. • Reduces crossing distance and exposure time. • Can reduce parking restrictions (refer to Queensland MUTCD Part 10). • Shall not create a squeeze point for people riding bikes. • Flat top road humps and/or pavement delineation across the road should not be provided at uncontrolled crossings. This treatment has resulted in confusion in Queensland and situations where both path users and road users assume priority.

Notes:

[1] See Austroads *Guide to Traffic Management* Part 9, Austroads *Guide to Road Design* Part 4, AS 1742.9, AS 1742.10, AS 1742.14, NZTA (2009) and NZTA (2008b).

[2] For recent developments in the use of crossings at signalised facilities, see Section 9.2.3.

Figure 9.2.1 – Holding rail



9.2.2 Bicycle Path Terminal Treatments at Road Crossings

Addition

Shared path and bicycle path termination treatments

See Appendix C for examples of bicycle path terminal treatments at road crossings which may be appropriate for use in Queensland.

9.2.3 Crossings at Signalised Facilities

Addition

Traffic signal phasing arrangements for people walking

Information on traffic signal phasing arrangements and options for special treatment of people walking at traffic signals can be found in QGTM Part 9.

9.3 Bicycle Treatments at Intersections

Addition

Refer to Transport and Main Roads Guideline *Selection and design of cycle tracks* for preferred intersection arrangements for people of all ages and abilities.

Appendix C: Bicycle Path Terminal Treatments at Road Crossings: Examples

New

Special termination treatments designed to slow people riding bikes must not introduce new hazards.

Figure C.1 – Path with minimal termination treatment

It is clearly signed as a shared path which should be sufficient to deter illegal use by unauthorised motor vehicles. As the roadway is not physically defined by kerb and guttering, a Give Way sign and line marking has been added to improve legibility for the path users at the termination. The holding rail may or may not be used by riders, but it does provide extra definition of the path location for vehicles using the roadway. Canberra, ACT.

Purpose and scope

The purpose of this section is to provide operational and 'best practice' guidance on safe access management (vehicle restriction) treatments for bicycle paths and shared paths. Design guidance is provided in the Austroads *Guide to Road Design* Part 6A.

Related documents

This section should be read in conjunction with the following:

a) *Road Planning and Design Manual 2nd Edition* Volume 3 Part 6A
b) Austroads *Guide to Road Design* Part 6A
c) Austroads *Cycling Aspects of Austroads Guides*

d) Queensland *Manual of Uniform Traffic Control Devices* Part 9, and

e) NSW *Bicycle Guidelines*, Roads and Maritime Services NSW.

Background

Historically, physical barriers in the form of terminal restriction devices ('banana bars'), bollards or U-rails have been included as standard terminal treatments for bicycle paths (and footpaths) when they connect with a road or another footpath. They have also been used as devices to slow people riding bikes on the approach to roads or in high conflict areas. This has often been done with no consideration of the requirement to manage vehicle access in terms of both the likelihood and consequences of vehicle access.

This has resulted in inappropriate application and overuse of these devices. These devices are an unnecessary expense to what is a relatively inexpensive piece of infrastructure. In some circumstances, they can also pose a crash hazard for people riding bikes.

Figure C.2 – Excessive use of physical barriers to slow people riding bikes on approach to a blind corner

In this example, vehicles are already restricted by log fences, the need to slow people riding bikes on the curve could be better addressed by improving sightlines by trimming vegetation and marking a centreline. Kedron, QLD.

Figure C.3 – Redundant path terminal barrier

This path terminal barrier is easily avoidable by both motor vehicles and people riding bikes. Ashgrove, QLD.

Figure C.4 – Redundant U-rail type terminal barrier

This different style of path terminal barrier, a set of U-rails at the entry to a park, are also easily avoidable by both motorists and people riding bikes, as illustrated by the dirt track. Arana Hills, QLD.

Figure C.5 – Redundant U-rail type barrier on a set of stairs

In this residential subdivision u-rails have been placed at both the top and bottom of a set of stairs which have a very low likelihood of illegal vehicle access. Everton Hills, QLD.

Figure C.6 – Hazardous positioning of a path terminal barrier

This example is on a >10% grade leading to a road crossing. Note the signage would not be legible while crossing the street, the single entry, slope and sharp left turn. Wavell Heights QLD.

Figure C.7 – Examples of easily avoidable and redundant physical barriers

Both of these examples show terminal restriction device that are redundant and inappropriate. Woolloongabba, QLD. Sippy Downs QLD.

Figure C.8 – Hazardous path terminal device, limited visibility due to lack of contrast

This path termination is designed as a vehicle gate. It does not consider the safety, amenity of path users, the connectivity with the bikeway on the other side of the road or the lack of visual contrast. Arana Hills QLD.

Path terminal treatments

Refer to the department's *Road Planning and Design Manual* Volume 3, Part 6A and Part 10 for design details and specifics.

Under the *Australian Road Rules*, a bicycle path or shared path is terminated when it meets a road and people riding bikes and walking have to give way to traffic before entering or crossing the roadway. Paths that continue on the other side of a roadway are considered crossings and are not covered by this document. Path crossings of roadways are covered in Austroads *Guide to Road Design* Part 4.

Advising people riding bikes of a road ahead

Refer to the department's *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A for design details and specifics.

Sight distance requirements are outlined in Austroads *Cycling Aspects of Austroads Guides*. This Austroads document sets out the required information including minimum stopping sight distance for people riding bikes; lateral clearances on horizontal curves; and minimum length of crest vertical curves.

Warning devices typically include traffic control devices, such as signage and pavement markings. These should be used to warn people riding bikes of the road ahead and motorists to watch for people riding bikes and walking and be installed so as to not form a hazard. This topic is addressed in the department’s Queensland *Manual of Uniform Traffic Control Devices; A Guide to Signing Cycle Networks: Showing the way to more cycle trips*, and the [*Traffic and Road Use Management* (TRUM) manual Volume 1]() Part 4.

Figure C.9 – Signs used for slowing people riding bikes and warning of a path termination

Signs are shown at their relative sizes.

Slowing people riding bikes

Refer to the department’s *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A for design details and specifics.

Crash data analysis performed by the department suggested that the frequency of crashes between people walking and riding bikes on footpaths and bikeways is extremely low (compared with road crashes). Data analysis showed that the average speed of each (shared use path) facility at peak times approximates a reasonable design speed for each location. It is therefore posed that the cycling community is able to self-moderate speeds that are appropriate to the location.

Restricting unauthorised vehicle access

Refer to the department’s *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A for design details and specifics.

Physical barriers placed at the termination of paths can pose a danger to people riding bikes presenting an obstacle at locations where people riding bikes typically need to be concentrating on ramps, footpaths, roads, motor traffic, other path users, and other hazards beyond or before the path.

In cases where paths through reserves are designed to be regularly used by park maintenance vehicles and a barrier is required, these should be designed to be removed to allow temporary vehicle access. Temporary barriers should not present a hazard to users when they are removed or the opened state with flush mounted footing covers and locking devices used.

Preferred treatment

This section provides detailed guidance on path terminal treatments using the 3-stage assessment approach. This approach has been designed to provide escalating options to asset managers, when seeking to address this issue.

Stage 1 – Signage

The application of signage and pavement markings must be done in accordance with the Queensland *Manual of Uniform Control Devices* and this section. Figure C.10 shows the various signs which may be used to mark path terminations in Queensland. Signs should be installed in conjunction with path line marking in accordance with the Queensland *Manual of Uniform Traffic Control Devices* and the *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A.

Stage 2 – Redesign terminal appearance

In some urban settings alongside major roads, signage can get lost in the 'urban clutter' and overlooked by road users who have reached cognitive limits in the amount of information that they can take in at any one time. In these instances, the redesign of the terminal appearance can be an effective method of access management without restricting legitimate users. This is often achieved through pavement markings, different coloured concrete, kerbs, ramps, soft landscaping, and other visual cues. The intent of this treatment is to make it as intuitive as possible to anyone who sees it, that this is not a continuation of the road, but rather a 'transition' point from one environment to another.

Figure C.10 – Examples of redesigned terminal appearances (USA)

In these two examples from the US, the colour contrast from the asphalt pavement and the design of the corner kerbing highlights that this is not a road. The kerb ramps in these examples are not standard width and regulatory signage has not yet been erected but legibility is good. Source Bicycle Path Access Control web-based resource.

Figure C.11 – Example of terminal appearance treatment using pavement markings

In this example, a yellow chevron marking has been used to clearly identify the bikeway entry. R8 1
A BICYCLES ONLY path sign and a pedestrian prohibition sign are located at the entry. A hold rail is provided for people riding bikes to assist with crossing and highlight the crossing to road users. There is no need for a terminal restrictor bar. A bicycle symbol pavement marking and green coloured surface treatment (as per QGTM Part 10) could also be an effective additional treatment for busier, more urban locations. Indooroopilly, QLD.

Stage 3 – Physical barriers

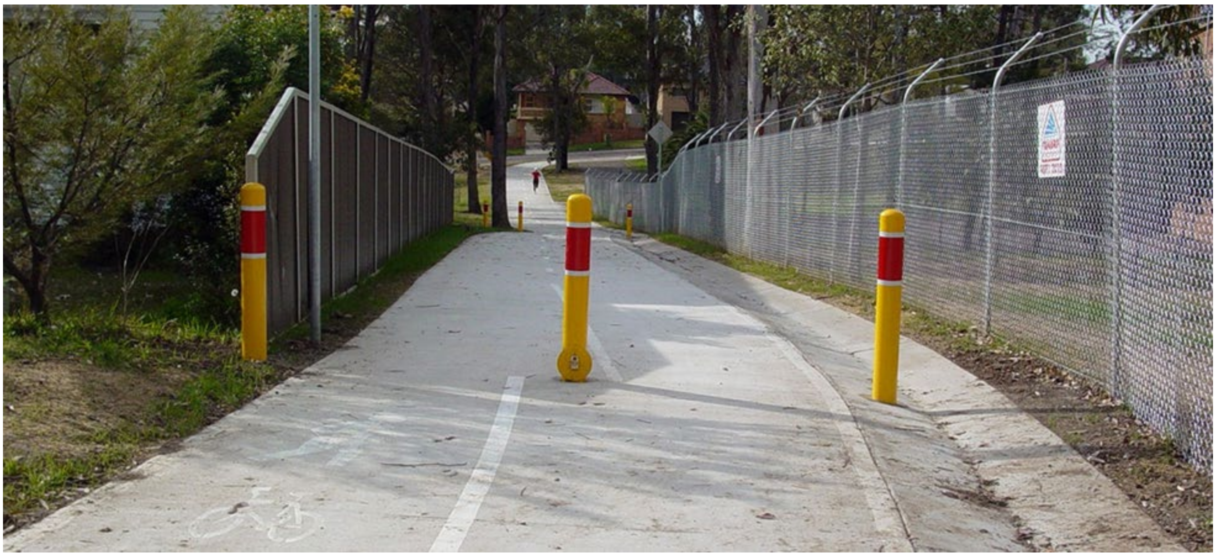
Physical barriers are the last option to be used and only after all other options (Stages 1 and 2) have been exhausted. They also pose the most danger to people riding bikes if not planned, designed and installed correctly when implementing Stage 3.

At the commencement of any work to install physical barriers, a road safety audit of the site must be undertaken to identify the risks to all path users in terms of likelihood and consequences.

The final design must also be signed off by a Registered Professional Engineer of Queensland (RPEQ) prior to construction.

Refer to the department's *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A for design details and specifics.

Figure C.12 – Maintenance vehicle access barrier on a shared path



This path is used on an ongoing basis by water supply authority vehicles on whose land the path is located. The two outside bollards are fixed while the centre bollard is removable. When the centre bollard is removed, a round flush fitting cover protects the hole and locking device. Although their height is lower than required, the bollards are finished in standard RMS NSW colour and reflectorized tape. Line marking has been used to 'direct' people riding bikes around the hazard caused by the low height of the bollard. Guildford NSW, photo: RMS.

Figure C.13 – Examples of the use of bollards to protect an asset, with instructive text

These bollards protect an expensive bridge structure. The inset photo shows an enlargement of the plate on the centre fold-down bollard which places a load limit on maintenance vehicles accessing the path. Roma Street Parklands. Brisbane, QLD.

Operational issues

The remainder of this section will highlight the issues that need to be taken into consideration. These include:

a) crash risks with physical barriers
b) path user capacity constraints
c) preferred treatments – design guidelines, and
d) preferred treatments – placement guidelines.

Crash risks with physical barriers

While it is easier for people riding bikes to negotiate a pole (or bollard) than a terminal restrictor bar, without crashing into it, the consequences of crashing into it are more serious than those of hitting the curved terminal restrictor bar ('banana bar'). As a result, bollards should be avoided, if possible. The curved terminal restrictor bar is designed to contact near the centre of mass of a typical person riding a bike and keep the person riding the bike upright, not going either underneath or over the top, resulting in additional injuries. It also incorporates a 'snag free' design, so no part of the device will cause a person riding a bike to be caught or affected in any way.

A study carried out by University of New South Wales in 2008 used numerical analysis of real-world crashes by people riding bikes to investigate speed, collision mechanism and movement trajectories where a person riding a bike lost control and collided with an Armco™ guardrail. This simulation provides an illustration of the types of crash forces involved when a person riding a bike collides with a low height physical barrier, such as a bollard. The study showed that high speeds (such as a downhill slope) and hitting an object low to the ground (such as a bollard) are significant crash risk factors for people riding bikes. See Figure C.14.

Figure C.14 – MADYMO simulation of a rider losing control after striking a concrete kerb, followed by a steel guard rail

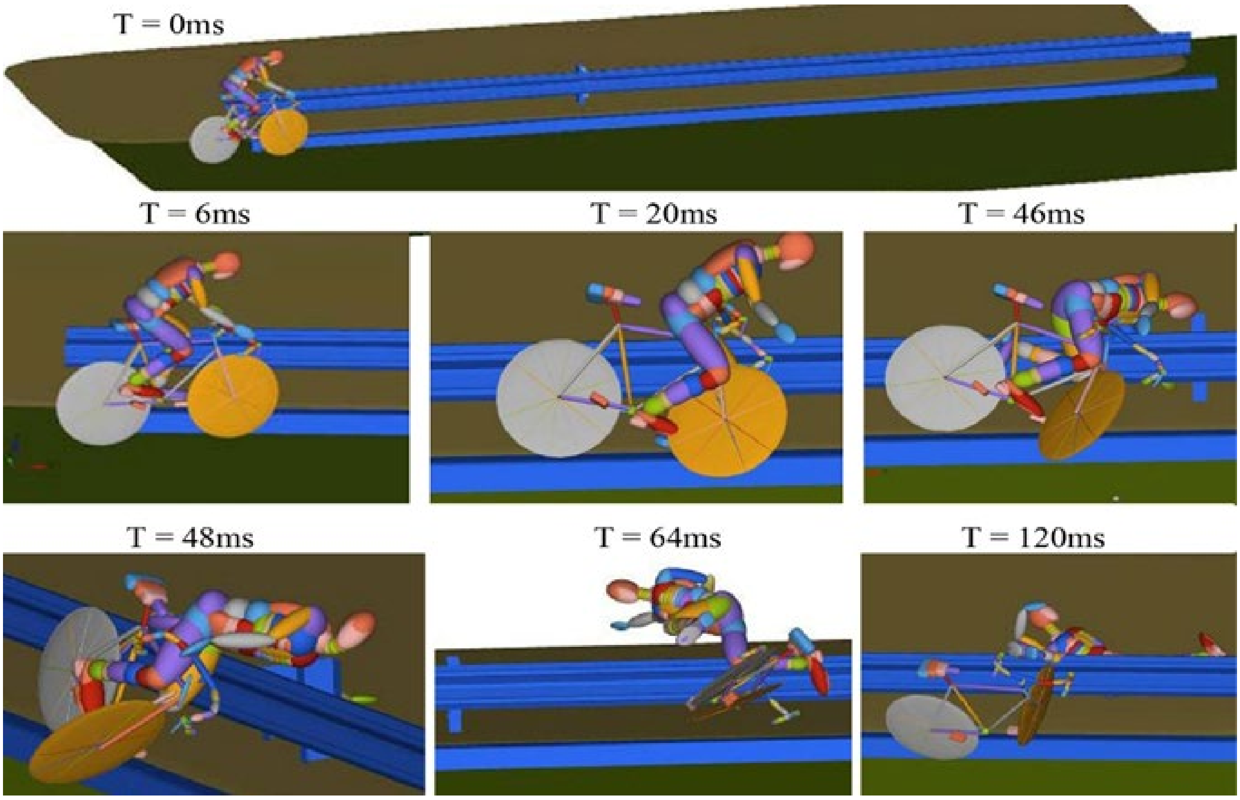


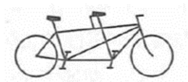
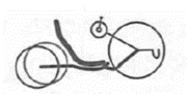
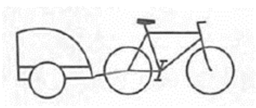
Figure from the UNSW report.

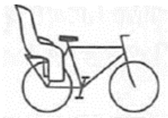
The simulation rebuilt the movement and position of rider during accident. The front tyre struck the kerb first (T=6 ms), then bicycle handlebar scraped along the guardrail (T=20 ms). After that, the victim was rotated (T=46 ms) and thrown over the guardrail (T=64 ms), hitting the ground (T=120 ms).

This led to severe brain injury with skull, rib and spinal fractures. According to the injuries suffered, it is likely that the accident occurred at speed of 35 km/h. This case is a very typical barrier crash scenario. The bicycle has high centre of gravity; thus, people riding bikes tend to be thrown forward over barrier when front wheel hits the object. This is considered extremely dangerous; because there is no safety feature to hold the person riding the bike stable and the bike itself will lose balance the moment its momentum is eliminated.

Designers should anticipate the use of wheeled recreational devices, mobility aids, and non-standard cycles, particularly in areas with high levels of utility cycling, on recreation routes and on routes serving schools and day care centres – Austroads *Guide to Road Design* Part 6A, Commentary 2 includes information on typical requirements. Figure C.15 provides guidance. A terminal restrictor bar at a height of 100 cm would be in the mid-range of average child’s eye height and would be a greater hazard to inexperienced children riding bikes, who would be more vulnerable given their lesser experience and cognitive ability than adults riding bikes.

Figure C.15 – Dimensions and eye heights of various types of bicycles

		Overall dimensions (cm)			Eye height (cm)	Special features
		Length	**Width**	**Height**		
Bicycle		165–180	40–75	90–110	140–185	
Child's bicycle		100–150	40–50	60–90	90–140	Small size
Tandem		275	40–75	90–110	140–185	Length + loaded weight
Adult tricycle		165–180	80	90–110	140–185	
Recumbent bicycle		165–200	40–75	110–130	110–130	Low eye height
Hand cycle		165–180	80	80–100	110–130	4 m turning radius
Bicycle + trailer		300	80	90–110	140–185	Length + loaded weight
Bicycle + trailer bike		300	40–75	90–110	140–185	Length + loaded weight

		Overall dimensions (cm)			Eye height (cm)	Special features
		Length	Width	Height		
Bicycle + child seat		165–180	40–75	120–140	140–185	Raised centre of gravity

Source Velo Quebec, Canada.

In accordance with the department's *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6 *Roadside Design, Safety and Barriers* where pedestrian facilities are incorporated behind a road safety barrier system, the desirable minimum height of the system is to be 1200 mm above the surface of the footway. Where provision for people riding pedal bikes is required, the desirable minimum height above the surface of the path should be 1400 mm. Refer to the *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A for the recommended terminal restrictor bar heights.

Path user capacity constraints

Terminal restrictor bars require every through movement to be done when another path user is not trying to pass at the same time (staggered) – setting up a very uncertain 'right of way' situation that results in an increased crash risk to people riding bikes and a very poor level of service to other users (people walking, mobility aids, wheeled recreational devices). The obligation to come to a complete halt if someone is coming the other way should not be necessary. The scratch marks depicted at Figure C.16 are common on many terminal restrictor bars and are evidence of a situation of insufficient width for the volume of path users (or misjudging a suitable location). The height is typically a snag hazard for handlebars.

Figure C.16 – Damage which indicates evidence of insufficient passing width

The scratch marks on this terminal restrictor bars are commonplace and are evidence of insufficient passing width for a two-way path. Gold Coast, QLD.

In width constrained areas such as bridges or embankments, the use of bollards can manage access without requiring additional width or protruding into the path user operating space. Refer to Figures C.12, C.13 and C.20.

The department's *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A requires the provision of an operating space of 1200 mm minimum for a person in a wheelchair. To meet the additional requirements for people walking while using mobility aids, a typical clearance of 1400 mm through a single-entry point (the Austroads standard) will provide only enough room for a single wheelchair to pass through.

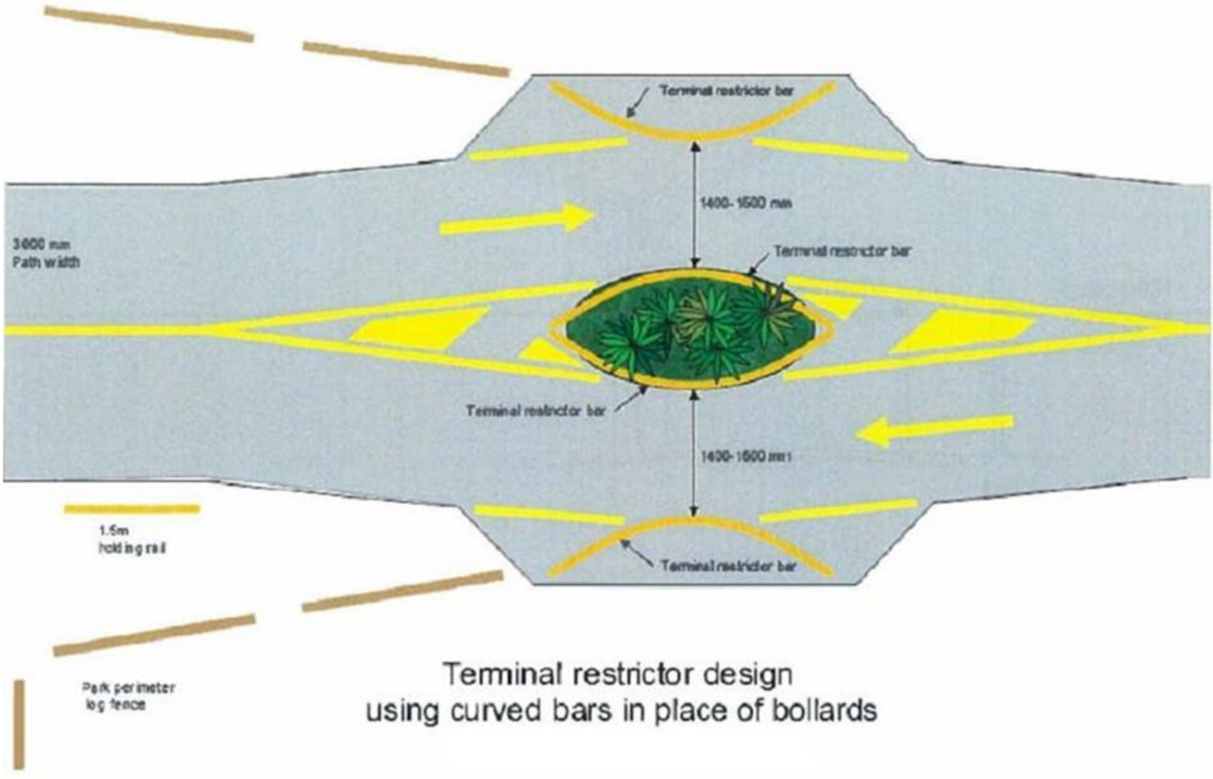
Having to stop can be difficult as following people riding bikes may not notice what is happening up front and may collide with those stopping – or a person walking may simply pause at the device, blocking it, without understanding the implications of his or her action. This increases the potential for path user conflict.

Passing width is an issue as terminal restrictor bars are required to leave a minimum clear opening between of 1.4 m and 1.6 m apart (as are bollards).

Refer to the department's *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A for terminal device operating widths for entry and exit treatments.

The following diagrams illustrate 'best practice' where terminal restrictor bars have been duplicated to form two single direction paths to minimise conflict with people riding bikes or walking through the constrained space, as well as the risk of head on collisions. Refer to the figures following and to the most recent versions of Brisbane City Council Standard Drawings (UMS) drawings which can be downloaded from www.brisbane.qld.gov.au by searching on 'UMS drawings'.

Figure C.17 – Bicycle / shared path termination treatment with separated entry and exit: general layout

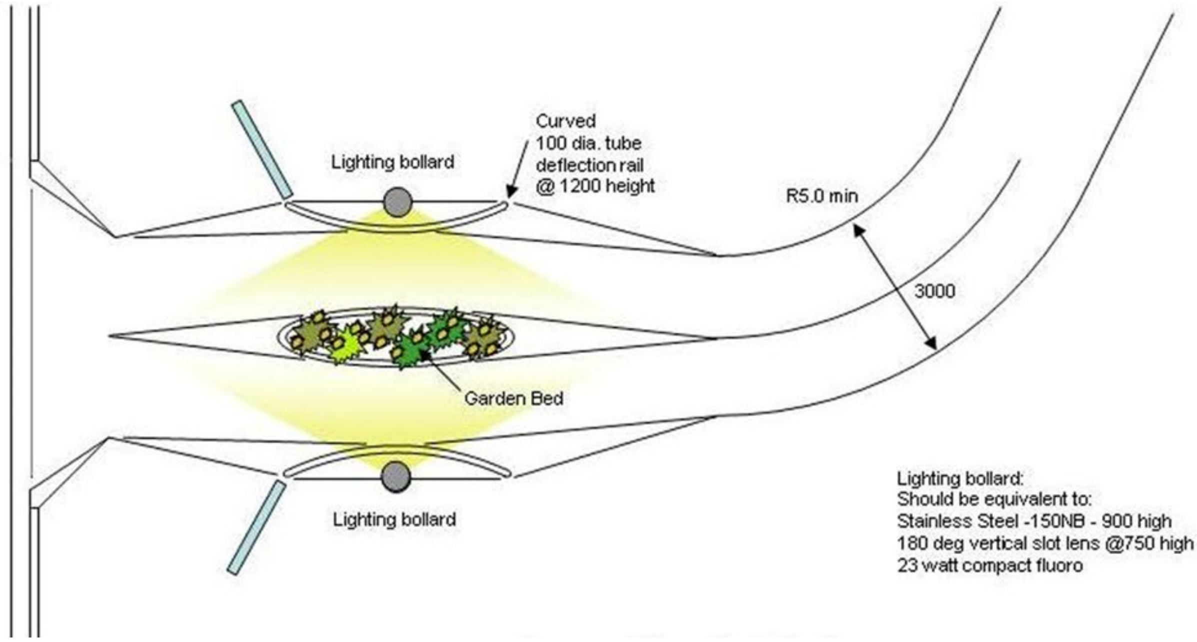


Preferred treatments – design guidelines

Figure C.17 shows the general layout for a bicycle path or shared path with terminal restrictor with separate exit and entry paths. The use of narrowing side bollards can negate the need for centre bollards. A centre bollard may be installed while plants are growing, then removed once the central tree and ground cover are big enough. Lighting requirements are outlined in Figure C.18. In this example, the central terminal restrictor bar has been replaced by a kerb raised garden bed.

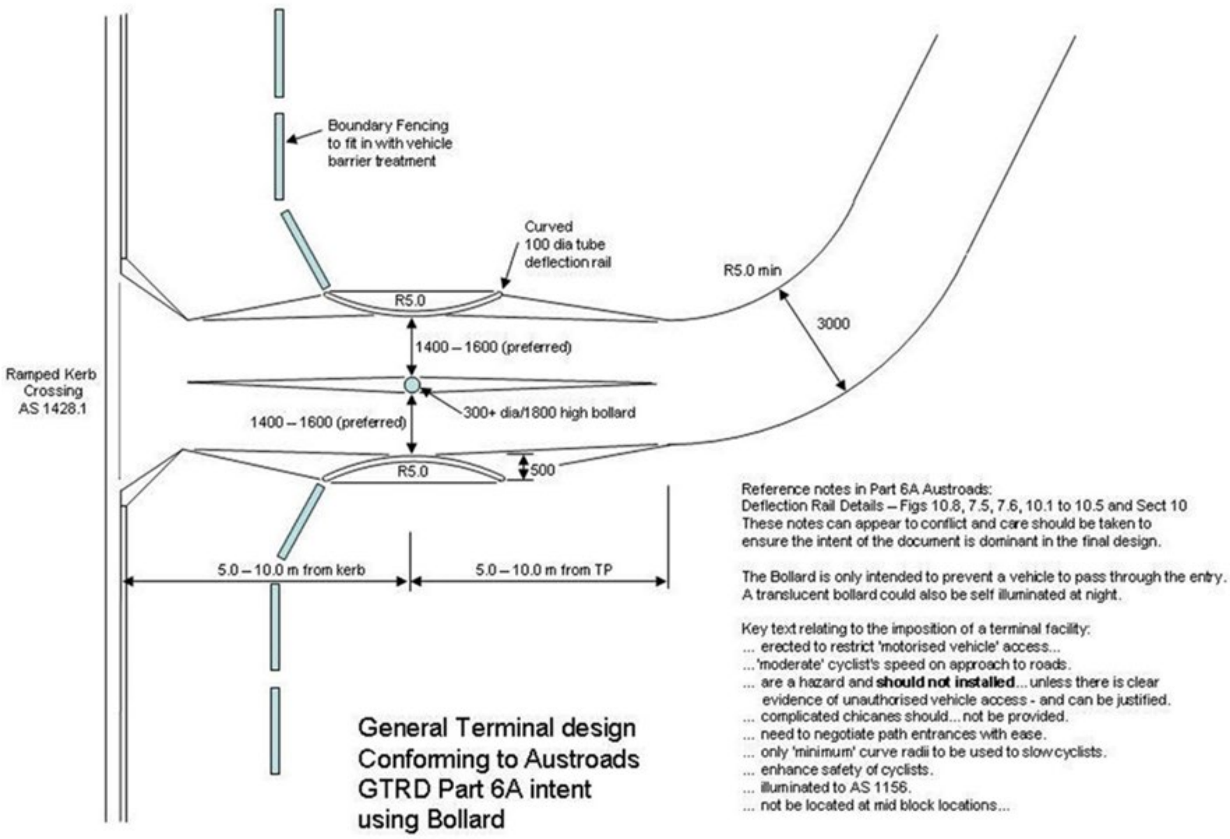
Entry requirements are illustrated in Figure C.19. This example shows a terminal treatment for a more constrained site where the central deflection bars (used in the examples shown in Figures C.17 and C.18) are replaced by a more compact arrangement using a central bollard.

Figure C.18 – Bicycle / shared path termination treatment with separated entry and exit: lighting requirements



Lighting is provided at the path terminal from behind the curved deflection rail.

Figure C.19 – Bicycle / shared path termination treatment with separated entry and exit: with bollard central separator



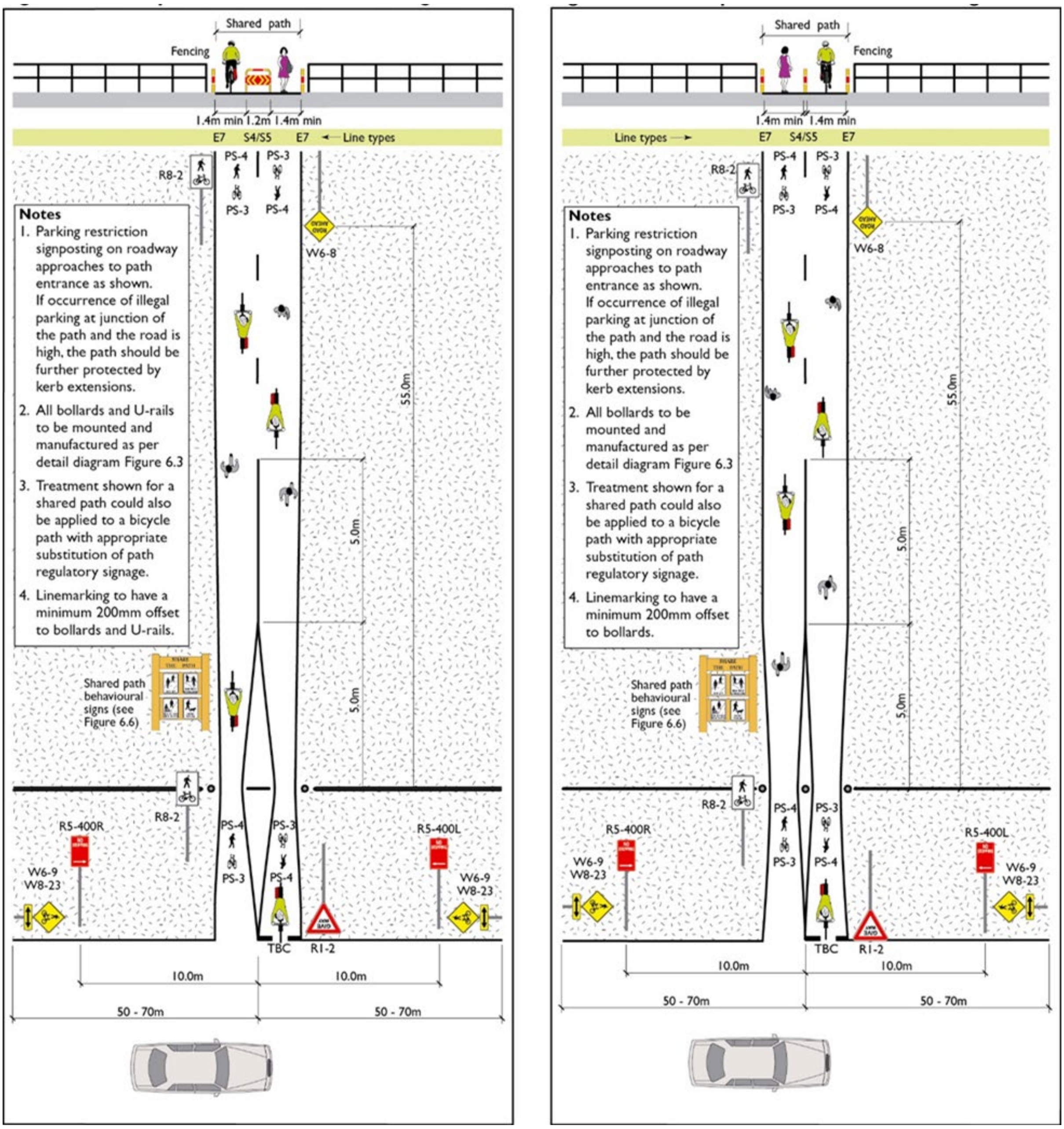
Every restrictive terminal device must be painted in high visibility colours and retroreflective tape applied. The terminal devices should also have lighting. Lighting specific issues and terminal device geometry are addressed in the department's *Road Planning and Design Manual 2nd Edition* Volume 3, Part 6A *Pedestrian and Cyclist Paths*. There has been mixed success with 'glow in the dark' products; assessment should be made on a site by site basis as to the appropriateness of this option.

Raised garden beds allowing one-way movement on parallel paths will act the same way as a centre bollard if they have 250 mm high garden edging paths 1600 mm wide (a motorised vehicle cannot pass through such a facility). A garden should provide for a more forgiving fall than a bollard or terminal restriction bar, while still restricting access. The plantings should act as 'cushions' (thick ground cover) if a person riding a bike falls into a garden bed. The plantings should also be a species that is not likely to irritate or injure a person who happens to fall into a garden bed.

Note that the growth of garden beds will need to be monitored and maintained to ensure that it does not cause any restrictions in sight lines. Small children and people who use wheelchairs can be hidden from sight if plantings are permitted to grow higher than 500 mm above path height.

In instances where paths are designed to take maintenance vehicles, fixed bollards can be unlocked and temporarily removed to allow vehicles through the barrier (see Figures C.12 and C.13 and Figure C.20, right hand side diagram following).

Figure C.20 – Path termination advice from the NSW Bicycle Guidelines (RMS 2005)



The inverted U rail in the left side illustration is designed to be removable to permit maintenance vehicle access. The bollards in in the diagram on the right-hand side are typically non-removable.

Preferred treatments – placement guidelines

Details of placement guidelines have been included in the department’s *Road Planning and Design Manual 2nd Edition* Part 6A.

Figure C.21 – Illustration of people riding bikes 'lean into' corner turns, and the hazardous positioning of this terminal barrier

This image illustrates a path restriction device at the bottom of a steep gradient on a curve. Note how the person riding the bike must 'lean into' the curve at the constrained point, occupying the entire opening width of the terminal restriction device. The rider needs to navigate the horizontal curve, adjust for a curved floating hazard at handlebar height and also watch for oncoming path users. Eliminating the horizontal path curvature reduces the cognitive load and potential risks.

For further information on this section, please contact:

Walking and Cycling Infrastructure, Traffic Engineering Directorate
Traffic Engineering Technology and Systems, Engineering and Technology, Department of Transport and Main Roads
Email: CyclePedTech@tmr.qld.gov.au

Transport and Main Roads assessment tool for vehicle access restriction

This assessment tool should be used for existing devices only.

Is the purpose of this device to restrict vehicle access?	No: Remove it	Yes: Continue to table following and make an assessment considering both the Bicycle Crash Risk Factors and the Motor Vehicle Access Management Factors listed.

Bicycle Crash Risk Factors	Yes	Partly	No	Considerations
Have there been complaints from people riding bikes?				• Can be an indicator of near misses • Allows for proactive investigation, there may be grounds for legal action if a complaint was not investigated. • Can identify hazards before they cause a crash.
Has there been a crash or serious injury?				If a crash or serious injury has already occurred the device **should be removed or relocated immediately**.
Does the device have any sharp edges, exposed elements or corners?				• This can influence the consequences (severity) of a crash. • Rounded edges will ‘deflect’ the crash forces and larger surface areas will ‘absorb’ impact forces.
Does the device protrude into bicycle operating space				• This can influence the **likelihood** of a crash. • Protruding objects can be a ‘snag’ hazard for pedals and handlebars.

Bicycle Crash Risk Factors	Yes	Partly	No	Considerations
Is the height of the device < 1 m and perpendicular to the direction of travel (for example, gate, mid path bollard or U rail)?				• This can influence the **consequences** (severity) of a crash. • As bicycles have a high centre of gravity they tend to be thrown forward and over a low to the ground obstacle. • Bollards must also be high enough to be visible from behind another person riding a bike (eye height of people riding bikes is typically 1.4 m) –bollards located mid-path are required to have a minimum height of 1.8 m to ensure visibility. Bollards in other locations may have minimum height of 1.2 m.
Does the device have a diameter <100 mm (for example, mid path bollard or pole)?				• This can influence the **consequences** (severity) of a crash. • Bollards with small diameters are considered 'spearing' or 'impaling' hazards for people riding bikes in the event of a crash. • Bollards are required to have minimum diameter of 100 mm (and a flat or rounded top) and a desirable diameter of 300 mm to avoid being a hazard.
Is the device at the bottom of a >4 % gradient slope?				• This can influence both the **likelihood and consequences** (severity) of a crash. • People riding bikes will naturally pick up speed at the bottom of a slope.

Bicycle Crash Risk Factors	Yes	Partly	No	Considerations
Is the device on a horizontal curve <R40 m?				• This can influence the **likelihood** of a crash. • On a horizontal curve the person riding a bike will have to 'lean into' the turn, occupying more space than remaining vertical (bicycles operate by both steering and balance). • People riding bikes must be able to approach these devices 'straight on' to minimise risk.
Is the device located at a mid-block location where bicycle speeds are likely to exceed 20 kph?				• This can influence both the **likelihood and consequences** (severity) of a crash. • People riding bikes will naturally pick up speed at mid-block on flat, straight, unimpeded sections of path.
Is the device in a location with visibility restrictions on either approach?				This can influence the likelihood of a crash. Visibility may be improved by cutting back vegetation or removing obstructions (lowering fence heights, etc.).
Is there sufficient colour contrast and reflectivity on the device?				• This can influence the **likelihood** of a crash. • Grey, black or stainless-steel colour will have insufficient contrast with concrete or asphalt. • Green or black will have insufficient contrast with grass or tree foliage.
Is the device sufficiently lit at night?				This can influence the likelihood of a crash. If there is usage of the path at night, then lighting of the hazard is essential.

Bicycle Crash Risk Factors	Yes	Partly	No	Considerations
Is the opening width adequate for the number of people riding bikes and walking who are using the site?				• This can influence the **likelihood** of a head on crash. • Look for evidence of insufficient width, specifically: scratch marks at the narrowest point. • Consider a separate entry and exit terminal (if needed at all), as most vehicles are min 1.8 m wide.
Is the device <5 m to an intersection with closely spaced conflict points or activity by people walking?				• This can influence the **likelihood** of a crash. • This is an indicator of the cognitive load placed on the person riding a bike: multiple consecutive conflict points or activity of people walking will require greater concentration to navigate safely. • Ideal setback of 5–10 m from an intersection or kerb.

Motor Vehicle Access Management Factors	Yes	Partly	No	Considerations
Is the current device able to be easily bypassed by a motor vehicle?				• If yes, then removing the device will not have any impact on the likelihood of motor vehicle access. • The device should be removed as it is not serving its intended purpose.
Does the path create an attractive 'shortcut' for motor vehicles between two (or more) roads?				• This can influence the **likelihood** that if the device were removed motor vehicles would use the path. • If no (and the path would take motor vehicles out of their way or parallel to an existing road), then the risk is minimal. • If yes, consider relocating and upgrading the device (lighting, high visibility fluorescent colouring, reflective tape, and separate entry / exit terminals).

Motor Vehicle Access Management Factors	Yes	Partly	No	Considerations
Is the likelihood high that, if a vehicle accessed this path, it would damage an expensive asset (for example, lightweight bridge)?				• This can influence the **consequences** of motor vehicle access if the device were removed. • If no (and there are no assets that are vulnerable to damage), then reducing the danger to people riding bikes must be a higher priority. • If yes, consider relocating and upgrading the device (lighting, high visibility fluorescent colouring, reflective tape, and separate entry / exit terminals).
Is the likelihood high that if a vehicle accessed this path, it would endanger vulnerable path users (children, disabled and elderly)?				• This can influence the **consequences** of motor vehicle access if the device were removed. • If no (and there is no / minimal risk to vulnerable path users), then reducing the danger to people riding bikes must be a higher priority. • If yes, consider relocating and upgrading the device (lighting, high visibility fluorescent colouring, reflective tape, and separate entry / exit terminals).
Is there a recurrent issue with unauthorised vehicle access that cannot be resolved by other methods (for example, signage, lighting, CCTV, police enforcement, and so on)?				• This can influence the **likelihood** that, if the device were removed, motor vehicles would use the path. • If no (in the event that other methods have not been attempted), these other methods must be attempted first. • If yes, consider relocating and upgrading the device (lighting, high visibility fluorescent colouring, reflective tape, and separate entry / exit terminals).

Commentary 15 – Geometric Features of Roundabouts and Crashes

Difference

Technical Note 136 *Providing for cyclists on roundabouts* has been withdrawn and replaced by the *Providing for people walking and riding at roundabouts* guideline and associated *Bicycle crash prediction tool for Queensland roundabouts,* available on the department's Cyclists and pedestrians guidelines web page.

Commentary 17 – The European Compact Radial Roundabout Design

Addition

The compact radial design is only suitable for single lane roundabouts due to vehicle 'path overlap' issues in multi-lane applications. Turbo roundabouts permit compact radial geometry and control 'path overlap' issues in multi-lane applications.