Government of **Western Australia**
Department of **Transport**

Empowering a thriving community

Planning and Designing for Active Transport in Western Australia

Providing for Bike Riding in Local Area Traffic Management Schemes

Prepared by Department of Transport

Document control

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Amendment record

This document will be reviewed and developed as part of a suite of guidelines for the Planning and Designing for Active Transport in Western Australia, to ensure its continuing relevance to the systems and process that it describes. If you would like to provide feedback or suggest any changes to this guidance, please contact the Department of Transport at cycling@transport.wa.gov.au

A record of contextual revisions is listed in the following table.

Revision Number	Revision Date	Description of Key Changes	Section/ Page No.

Contents

Acknowledgment of Country

We acknowledge the Traditional Custodians throughout Western Australia and their continuing connection to the land, waters and community.

As the Traditional Custodians of the lands on which all Western Australians live, work and play, we recognise the strong and invaluable connection that Aboriginal peoples have across this Country, from a cultural, social, environmental, spiritual and economic perspective.

Many of the paths, streets and trails where people walk, wheel and ride in Western Australia today, follow the songlines, trade routes and seasonal runs that Aboriginal peoples have followed for many thousands of years. Experiencing these actively, increases our sense of connection to place, and strengthens respect for the Traditional Owners, their journeys and experiences, their place, their Country.

We pay our respects to all members of Western Australia's Aboriginal communities and their cultures; and to Elders past, present and emerging.

About this Report

Alternative formats

This publication is available in alternative formats upon request.
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Abbreviations and Definitions

Austroads GRD Part 3	Austroads Guide to Road Design Part 3: Geometric Design
Austroads GRD Part 6A	Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling
Austroads GTM Part 8	Austroads Guide to Traffic Management Part 8: Local Street Management
DoT	Department of Transport (WA)
eRideables	An eRideable is an electric rideable device, such as a scooter, skateboard or other vehicle. For more information: www.wa.gov.au/organisation/road-safety-commission/erideables
LATM	Local Area Traffic Management - Use of physical devices, streetscaping treatments and other measures (including regulations and other non-physical measures) to influence vehicle operation, in order to create safer and more pleasant streets in local areas.
LTCN	Long Term Cycle Network
MRWA	Main Roads WA
Path	Any route intended for use by people walking or riding which is not part of a road and which may or may not be adjacent to a road. For the purpose of this document the term path will refer to both shared paths (specifically designed to a higher quality level of service to cater for both people walking and riding), and footpaths (which people riding are legally allowed to ride on, but which may have not been designed to as high standard as a shared path).
RTC	Western Australian Road Traffic Code 2000
WABN Plan	Western Australian Bicycle Network Plan 2014-2031 (and subsequent updates)

Quick Reference Guide

Table 1: Situations where LATM treatment may be appropriate and the preferred Design Criteria

No.	LATM Treatment	Road Hierarchy of Street: Access Road	Road Hierarchy of Street: Local Distributor Road	Road Hierarchy of Street: District Distributor	Road Space Available: Constrained	Road Space Available: Less Constrained	Bus Route: Existing or planned	Target Daily Traffic Volume <1,500	Target Daily Traffic Volume <3,000	On-road: Design Speed	On-road: Lane Width	On-road: Rider Position	Off-road: Bypass	Other Considerations	Report Reference
1	**Centre Blister Island**	✓	✓	✓	✓	✓	✓	✓	✓	30 km/h	3.0 m (3.2 if bus route)	Primary	1.5 m cycle only with transition*	Include raised speed hump/ plateau on approaches	Section 4.1
2	**Two Lane Slow Point**	✓	✓	✗	✗	✓	✗	✓	✓	30 km/h	3.0 m	Primary	1.5 m cycle only with transition**		Section 4.2
3	**Single Lane Slow Point**	✓	✗	✗	✓	✗	✗	✓	✗	30 km/h	3.0 m	Primary	1.5 m cycle only with transition**		Section 4.3
4	**Road Closures with Filtered Permeability (Traffic Filters)**	✓	✓	✗	✓	✓	✗	✓	✗	N/A	N/A	N/A	1.5 m cut-through cycle only lane width**	Include raised intersection/ plateau on through road	Section 4.4
5	**Modified T-Intersection**	✓	✓	✓	✗	✓	✓	✓	✓	30 km/h	3.0 m (3.2 if bus route)	Primary	1.5 m cycle only with transition**	Include raised speed hump/ plateau on approaches	Section 4.5
6	**Vertical Treatments**	✓	✓	✗	✓	✓	✓	✓	✓	30 km/h	3.0 m (3.2 if bus route)	Primary	1.5 m cycle only with transition**		Section 4.6
7	**Median Treatments**	✓	✓	✗	✗	✓	✓	✓	✓	Varies***	Varies	Varies	Not required	Raised central median not preferred	Section 4.7
8	**Build Outs / Kerb Extensions**	✓	✓	✗	✓	✓	✓	✓	✓	30 km/h	3.0 m (3.2 if bus route)	Primary	Not required		Section 4.8
9	**Roundabouts**	✓	✓	✓	✗	✓	✓	✓	✓	30 km/h	3.0 m (3.2 if bus route)	Primary	1.5 m cycle only with transition**	Radial roundabout type preferred	Section 4.9
10	**Driveway Links**	✓	✗	✗	✓	✗	✗	✓	✗	30 km/h	3.0 m	Primary	Not required		Section 4.10
11	**Perimeter Thresholds**	✓	✓	✗	✓	✓	✓	✓	✓	30 km/h	3.0 m (3.2 if bus route)	Primary	Not required	Locate 7-15 m setback from intersection ≤ 8m road corner radius	Section 4.11

* Alternatively can be on-road protected bike lane

** Alternatively can be a shared off-road path, with 2.5 m minimum width and clear line marking delineation

*** Depends on the specific type of treatment

1. Introduction

1.1 Purpose of this document

The purpose of this document is to provide advice and guidance to practitioners to incorporate the safe and efficient movement of people riding bikes into the planning and design of Local Area Traffic Management (LATM) schemes. It provides key principles and best practice for design to ensure people riding bikes are not negatively impacted or put at risk by LATM schemes and associated devices. Through doing so, this guidance also provides better outcomes for people riding, or using other micromobility devices, such as eRideables, who often share similar needs to people riding bikes.

This document forms part of the *Planning and Designing for Active Transport in Western Australia* guidelines suite being developed by the Department of Transport (DoT) to help better inform planning and design for bike riding in WA. The suite will be web based and updated regularly with new information.

This LATM guidance aims to provide practitioners with an understanding of the requirements of people riding bikes on the road and to ensure those requirements are effectively considered during the planning and design of LATM schemes. It is not intended as a document to guide the planning and design of a bike route that is suitable for people of all ages and abilities.

LATM research, design and practice is an evolving space. Accordingly, this document is actively maintained and may be regularly updated. Feedback or suggestions are welcome via cycling@transport.wa.gov.au

When initiating LATM schemes practitioners should refer to the Long-Term Cycle Network and/or local bike plan for their area. If the proposed LATM scheme falls onto a proposed bike route, further investigation into the appropriate facility for that route should be undertaken.

It remains the responsibility of the practitioner to be suitably informed of the specifics and context of their project and how these guidelines are applied.

While this document covers the key requirements for bike riding provision in LATM schemes, it is important that practitioners exercise appropriate engineering judgement during the planning and design process. To enable this, the document directs the reader to relevant sections of the *Western Australian Road Traffic Code (RTC) 2000*, Main Roads WA (MRWA) technical standards and supplements to Austroads Guides to Road Design and Traffic Management, as well as relevant Austroads guidelines where possible. Refer to Section 1.4 Standards and Legislative requirements which detail the relevant guides and their order of precedence in WA.

Safe active streets

This guide should not be used to design a safe active street.

Safe active streets are a modified street(s) along an identified bike route where speeds have been reduced to 30 km/h to allow for a safer shared street space. With lower traffic speeds, the streets are more comfortable and safer for people of all ages and abilities walking and riding, whilst remaining accessible for people driving.

Planning and design guidance for safe active streets is in development.

Trends and new technologies

There are long-term implications with technologies such as autonomous vehicles which could potentially phase out the demand for LATM. New technologies are emerging and continue to be trialled with widespread use expected to be many years away. Speed management is expected to be a necessary part of traffic practice for the foreseeable future. However, trends and new technologies should be regularly reviewed for consideration in LATM design and planning.

1.2 How to use this document

This guide is intended for use by local government officers, developers and consultants when designing LATM schemes. It aims to help practitioners understand the requirements of people riding bikes on the road and ensure that these requirements are factored into the planning and design process.

There is not a 'one-size-fits-all' solution that satisfies every road user. This guide provides suggested technical guidance to ensure practitioners have the tools to effectively consider the requirements of people riding bikes in the design of LATM schemes, whilst working within current accepted standards and practice.

This is a supporting guide for LATM design, and as such, practitioners should also refer to relevant standards and design guides for all aspects of LATM design.

Aspects of this guide represent a shift from common practice in WA and DoT welcomes feedback to refine this guide as the advice is implemented and evaluated on the ground.

These guidelines do not replace consultation with MRWA and other relevant stakeholders, which should still occur prior to the design and implementation of LATM schemes. Approval from MRWA will be required for signage and pavement marking for LATM proposals, including options that do not meet current approved standards.

Designated cycle routes vs every street

Bicycles are classified as vehicles in the WA ***Road Traffic Code 2000***. Accordingly, every street should be designed to cater for the safe movement of people riding bikes. This document provides guidance to practitioners to ensure all LATM installations are designed with the safety of people riding bikes in mind, regardless of whether the road is a designated cycle route.

Where a street or road is aligned with a bike route (as determined by the Long-Term Cycle Network, local bike plan and/or other source), the practitioner should undertake further investigation into the appropriate all ages and abilities facility for that route. Guidance can be sought from the ***Planning and Designing for Active Transport in Western Australia*** guidelines suite or DoT directly, prior to progressing the LATM scheme.

Practitioners are also encouraged to consult with WestCycle to confirm whether the route is likely to be used for group rides.

Innovative treatments

This document explores innovative treatments from other jurisdictions that are not widely utilised in WA. Refined and adapted treatments used in WA should be subjected to a Road Safety Inspection and evaluated for effectiveness.

Practitioners should exercise caution when incorporating untested or adapted innovative treatments within LATM designs. MRWA approval is required for innovative treatments and engagement should commence during the initial concept stage of the design process. Within this guide, innovative treatments are identified by the light bulb icon.

Treatment is encouraged but should be used with more caution given limited testing results in a local context. If used, the effectiveness of this treatment should be adequately assessed through evaluation and monitoring. Discussion and agreement with MRWA is recommended before proceeding.

Whilst encouraged, treatments should be used with more caution given limited testing results in a local context. If used, the effectiveness of the treatment should be adequately assessed through evaluation and monitoring.

For some innovative treatments, temporary signage and other tools may be necessary to educate road users on how to navigate the LATM treatment. This is important with regards to signalling to other road users that people on bikes may move into the primary position (refer to Section 2.3 Secondary vs primary position) before entering the device, maintain this position through the device and move into the secondary position after exiting the device.

Pedestrians

People walking need to be considered when planning and designing LATM schemes. This includes both parallel movements and perpendicular crossing movements.

Where a pedestrian crossing is required, practitioners could consider aligning the LATM device with the pedestrian crossing. If the pedestrian desire line is not aligned with the optimum location for the LATM device, the two facilities should be separated and installed at their respective locations to ensure the needs of all road users are met.

Practitioners should consult guidelines such as Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling, Austroads Guide to Traffic Management Part 8: Local Street Management, relevant MRWA supplements and DoT's Shared and Separated Path Guidelines.

Diverse bike types and eRideables

When designing LATM schemes it is important to consider the operating requirements of diverse types of bikes, including those that are typically longer and wider. This can include cargo bikes, recumbent bikes, hand-operated bikes and tricycles.

It is important that eRideables are also considered in LATM planning and design given people can legally ride eRideables at 25 km/h on local roads.

Specific requirements for different types of bikes and eRideables will need to be considered on a case-by-case basis. Modification to treatments suggested in this guide should be tested in the field and monitored for effectiveness.

1.3 Relationship with Safe System

The Safe System approach is adopted in WA and informs both state and federal road safety strategies. The system aims to improve road safety for all road users and is an underlying principle of this guide. As stated in the Austroads Safe System Assessment Framework (2016), its specific intent is "to ensure that no road user is subject to forces in a collision which will result in death or injury from which they cannot recover. Since road user error can be reduced but not eliminated, collisions are unavoidable, and therefore the road transport system must be designed to make collisions survivable".

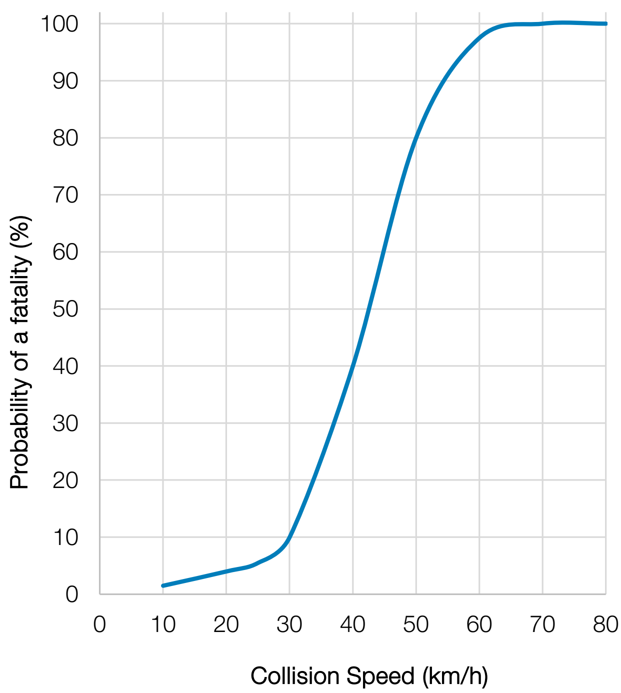
Safe System suggests that road environments where collisions are survivable are achievable. Local government practitioners can contribute towards a Safe System through the design, maintenance and speed management of roads. Safe System has been effective against the reduction in traffic related crashes, however, the reductions in motor vehicle accidents have not corresponded with reductions in incidents involving people walking and riding. This highlights the need for further education and guidance for practitioners delivering road planning and design, to ensure all road users are adequately considered.

Reducing speed on local roads is consistent with the principles of a Safe System that benefits all road users. Further, LATM treatments that reduce car traffic speeds at the expense of safety for people riding or walking, must be avoided.

Practitioners should consider 30 km/h target speeds for local roads as the chance of survival considerably increases as speeds decrease (Figure 1). Practitioners should refer to the MRWA document Speed Zoning: Policy and Application Guidelines.

Figure 1: Probability of a pedestrian fatality based on vehicle impact speed – applicable to people riding.

Source: Jurewicz et al. (2015a and based on Wramborg (2005)



Research suggests that the fatality risk to a person walking or riding increases exponentially when impacted by a motor vehicle being driven at speeds above 30 km/h:

- 90% fatality risk at 50 km/h;
- 40% fatality risk at 40 km/h; and
- 10% fatality risk at 30 km/h.

Nationally and internationally, authorities are moving towards a 30 km/h speed limit on local roads as it has been shown that travel times for motor vehicles are not adversely affected. In order to create a Safe System for bike riders on local streets, practitioners should aspire to:

- reduce the number of motor vehicles; and
- reduce the speed differential between motor vehicles and bike riders.

These Safe System objectives align with LATM and assist in achieving a safer street network for everyone.

1.4 Standards and legislative requirements

Figure 2: Order of precedence for relevant standards and guidelines.

1 Legal requirements including:

- *Western Australian Road Traffic Code 2000*
- *Disability Discrimination Act 1992*

2 Main Roads WA Technical Standards including:

- *MRWA Supplement to Austroads Guide to Road Design - Part 4A*
- *MRWA Supplement to Austroads Guide to Road Design - Part 6A*
- *MRWA Technical Guideline - Local Area Traffic Management*
- *MRWA Policy and Application Guidelines for Signage and Pavement Marking on Paths*

3 Australian Standards including:

- *AS1158 – Lighting for roads and public spaces*
- *AS1428 – Design for access and mobility*
- *AS1742 – Manual of uniform traffic control devices*

4 Austroads guidelines including:

- *Cycling Aspects of Austroads Guides*
- *Austroads Guide to Road Design Part 3: Geometric Design.*
- *Austroads Guide to Road Design Part 4: Intersections and Crossings*
- *Austroads Guide to Road Design Part 5B: Drainage, Open Channels, Culverts and Floodways*
- *Austroads Guide to Road Design Part 6A: Paths for walking and cycling*
- *Austroads Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings*
- *Austroads Guide to Traffic Management Part 8: Local Street Management*
- *Austroads Safe System Assessment Framework*

Practitioners should consult and consider the legal requirements, traffic engineering standards and relevant guidelines, as outlined in Figure 2.

MRWA technical standards take precedence over all Australian Standards and Austroads guidance. These supplements should be read in conjunction with the Austroads guidance as they contain state-specific information and guidance that can differ or expand on Austroads guidance.

Minimum passing distance legislation

In WA, the Road Traffic Code 2000 states that people driving must provide people riding bikes with a minimum passing distance of 1 metre on roads with a posted speed limit of 60 km/h or under, and 1.5 metres on roads where the posted speed limit is more than 60 km/h (Figure 3).

Practitioners need to be aware that overtaking space is often compromised when an LATM device is retrofitted in an existing environment.

This guide suggests that passing opportunities are only provided where they are safe, comply with minimum passing legislation and do not impede the bike rider envelope. Where LATM treatments are installed, the lane width within the treatment should not allow for overtaking (i.e., it should be clear to the person driving that overtaking is not a safe or possible). (Refer to Section 2.4 Overtaking width requirements).

Driving Change Road Safety Strategy

This guide aligns with Driving Change - Road Safety Strategy for WA 2020 – 2030. Driving Change aims to improve road safety through the Safe System principles of Safe Road Users; Safe Roads, Safe Speeds, Safe Vehicles and Post-Crash Response.

1.5 Road types

LATM treatments are most likely to be installed on the following road types as defined under the Road Hierarchy for WA (MRWA).

Access roads

Access roads are typically managed by local government and provide vehicle access to abutting properties. The maximum desirable volumes are 3,000 motor vehicles per day with a maximum 50km/h operating speed. Some roads in WA are classified as access roads but function more like a local distributor road, forming part of bus routes and subject to traffic calming.

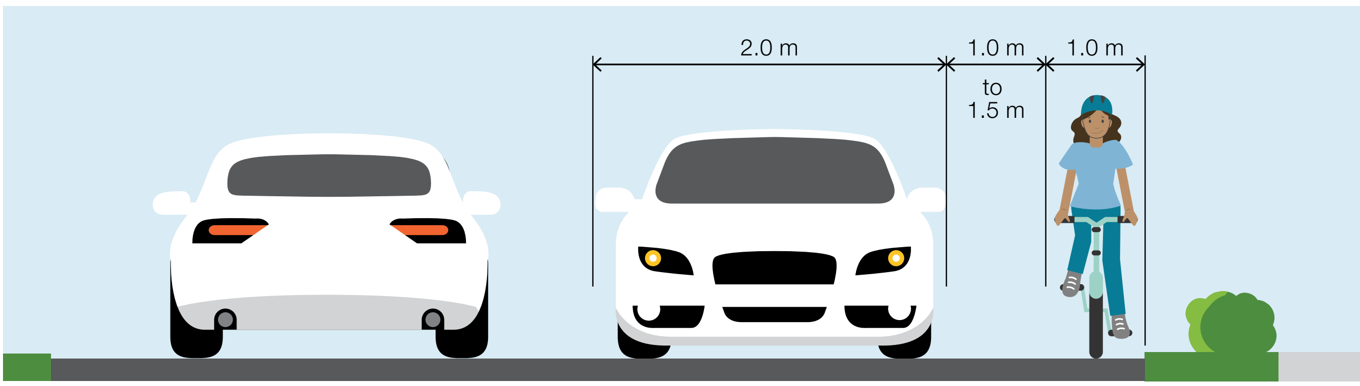
Local distributor roads

Local distributor roads are typically managed by local government. Their purpose is the movement of traffic within local areas and to connect access roads to higher order roads. The maximum desirable volumes are 6,000-7,000 motor vehicles per day with a 50-60 km/h operating speed. These are also referred to as neighbourhood connectors.

District distributor roads

District distributor (A and B) roads are typically managed by local government. Their purpose is higher capacity traffic movements between built up area land-use cells and generally not through them, forming a grid which would ideally space them about 1.5 kilometres apart. District distributor roads are generally devoid of LATM treatments. However, the impacts of median islands and kerb extensions within an LATM scheme are considered in Chapter 11 and Chapter 12.

Figure 3: Minimum Passing Distances for overtaking.



1.6 Movement and place

A Movement and Place Framework is currently in development for WA which may result in future updates to this document.

DoT endorses the principles of the movement and place concept which recognises that roads and streets perform different and sometimes competing roles; providing the safe, legible, and efficient movement of people and goods (i.e., movement) and providing welcoming and inclusive places people can spend time, interact, and participate in social, community and economic activities (i.e., place).

Currently the MRWA Speed Zoning Policy considers the movement and place concept as one aspect of determining target speeds to ensure that speed limits are consistent with the purpose and physical environment of the roadway. This policy refers to the Movement and Place framework outlined in the Austroads Guide to Traffic Management Part 4: Network Management.

1.7 LATM devices considered in this guide

LATM is a constantly evolving practice with various treatments being popular across different jurisdictions as indicated in Figure 4.

This guide provides design solutions to help improve the safety of people riding bikes on the 11 most commonly used physical displacement devices:

1. Centre blister island;
2. Two lane slow point;
3. Single lane slow point;
4. Road closures with filtered permeability;
5. Modified T-intersections;
6. Road humps/road cushions/flat-top road hump/ raised intersection platform (vertical treatments);
7. Mid-block median treatment;
8. Buildouts/kerb extensions;
9. Roundabouts;
10. Driveway links; and
11. Perimeter thresholds.

Further information on the functionality of these devices is available in Austroads GTM Part 8.

Figure 4: LATM devices in common use in 2018 (Damen 2018).

Most commonly used

- Stop, give-way or one-way signs
- Speed limit signs
- School zones
- Standard roundabout
- Lane narrowing/kerb extension
- Prohibited traffic movement sign
- Bicycle facilities
- Centre blister island
- Tactile surface treatment
- Flat-topped road hump
- Marked pedestrian crossing
- Wombat crossing
- Shared zone
- Threshold treatment
- Road cushion
- Road hump
- Raised intersection platform
- Modified T-intersection
- Half/part/diagonal road closures
- Slow points
- Mid-block median treatment
- Full road closure
- Driveway link

Less commonly used

2. Bike Rider Requirements

When planning and designing LATM schemes, practitioners should consider all road users including people riding bikes. This includes understanding that some people riding a bike will choose to ride on the road, whilst others will choose to ride on a path (where present).

The scope of any LATM scheme should include provisions that allow a person riding to easily and quickly choose whether to stay on the road, or transition to a separate facility (such as a cycle bypass or transition to a path).

This decision is influenced by the presence of motor vehicles and whether the person has the confidence to continue in the lane (or "hold the lane") through the device. To ensure the outcome of this decision is safe for all road users, LATM devices should be designed to accommodate both options. This is particularly important as a bike rider and a motor vehicle driver may approach and attempt to go through an LATM device at the same time. The transition between on-road and off-road cycling infrastructure is considered in this guide in relation to the angles and position of the transition ramps when bypassing a localised LATM device.

2.1 Traffic stress

Causes of traffic stress

A person riding a bike is smaller, travels at slower speeds and lacks physical protection. Accordingly, many riders experience a sense of stress or anxiety when sharing the road with motor vehicles.

This stress can be magnified due to the speed differential between the person riding a bike and the person driving a motor vehicle, the frequency of overtaking manoeuvres and the proximity of the overtaking vehicle to the bike rider.

Larger motor vehicles such as buses, trucks and those towing trailers can cause anxiety for a person riding a bike due to the size and length of the motor vehicles in the road lane, as well as turbulence and instability while being overtaken.

Some bike riders find on street parking a source of stress as there is a concern that car doors may be opened into their path of travel. However, if designed and incorporated correctly, on street parking can be used as a source of speed management.

Horizontal deflection LATM devices located at intersections, such as roundabouts and modified T-intersections can reduce the visibility of people riding bikes. These types of devices can create uncertainty for all road users thus increasing stress experienced by bike riders.

Reducing traffic stress

All road users should feel safe regardless of their mode of transport. People who feel stressed or unsafe while riding a bike are unlikely to continue to ride.

Road design can influence the speed and proximity of overtaking motor vehicles, and in turn, the stress felt by people riding bikes. Designing LATM schemes and devices that mitigate safety issues for bike riders will reduce the risks and level of stress experienced by people riding bikes.

2.2 Common design flaws

Common LATM design flaws that reduce safety and comfort, or potentially cause a hazard for people riding bikes, should be avoided. These include:

- Constrained traffic lane widths above 3 metres that create ambiguity for people driving cars on how to safely overtake bike riders.
- Providing a cycle bypass to an LATM device that terminates at a point where motor vehicles are angled towards the bike rider (before the motor vehicle straightens).
- Sharp horizontal tapers on cycle bypasses which cause bike riders to be unbalanced or entice an unsafe movement into a traffic lane that is more direct.
- Unprotected cycle lanes through central blister islands which give bike riders a false sense of protection while the motor vehicle path or direction is being deflected.
- Long continuous lengths of central medians with raised kerbing where overtaking a bike rider is ambiguous and unsafe (common on distributor roads).

- Roundabouts with large radii that enable turning movements at higher speeds.
- Road humps on routes commonly used for road cycling where people on bikes are more likely to ride two-abreast
- Two lane slow points with central medians (without a bypass for bike riders).
- Raised medians, or tree plantings in painted medians, which create unsafe and/or illegal overtaking manoeuvres around bike riders

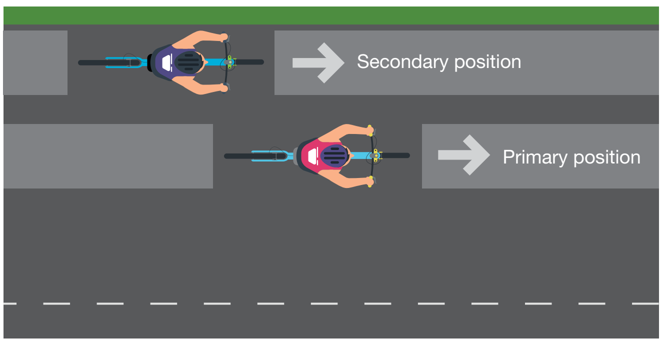
2.3 Secondary versus primary position

Understanding there are two positions where a person will ride on the road is necessary for designing for bike riding, especially in the context of LATM design where riders will interchange between these two positions.

The **secondary position** is where a person will ride to the left-hand side of the road to allow a motor vehicle driver to overtake them. This will usually be the default position, especially for those less confident riding in traffic.

A motor vehicle driver who has not experienced riding on the road themselves, may expect the bike rider to ride in the secondary position on the road carriageway (if there is no path available). However, the secondary position may not be considered safe by the bike rider under certain circumstances, and they may move into the primary position in the centre of the lane to help prevent unsafe overtaking manoeuvres by people driving. This can also increase the driver's visibility of the rider (see Figure 5).

Figure 5: Primary and secondary riding positions.
Adapted from www.safecyclingireland.org.



Riding in the **primary position** is often referred to as 'taking the lane' and is more likely to occur at squeeze points in LATM devices, central medians for pedestrian crossings and channelised intersections. Taking and holding the primary position is dependent on context, rider capability and bike type. For example, an electric bike can maintain speeds with less rider effort, particularly on uphill sections.

The primary position is the desire line of the rider's path of travel and will occur naturally through a horizontal deflecting LATM device and especially at roundabouts where riders want to avoid sharp horizontal movements that will contribute to a loss of momentum. Regardless of experience, the rider will likely take the primary position when there are no motor vehicles present in the lane. The primary position puts the rider in the middle of the traffic lane where they are more noticeable. This increases their forward visibility to assess the traffic conditions ahead, and riders are safer when they can easily see ahead and can be seen.

Awareness of dooring

Dooring is the act of opening a motor vehicle door into the path of another road user. On street parking is a common feature on local roads where LATM schemes are installed. People riding bikes will often move into the primary position where there is on street parking to avoid dooring.

Providing an adequate buffer zone or safety strip to accommodate door opening is an important consideration in all LATM design. The standard car door width is between 0.8 m to 1 m. A rider will need a minimum buffer of 0.8 m from a parked car to avoid the potential of doors opening into their path. Austroads Guide to Traffic Management Part 5 suggest that in areas where safety strips cannot be provided, consideration should be given to designing the traffic lane as a shared lane with reduced width and speeds.

If motor vehicles are parked on a street where there is no buffer zone, and there is adequate width for a motor vehicle driver to overtake a bike rider, the safest position for the rider will be the primary position as the secondary position will be within the door zone. This is one reason for avoiding median islands where there are parked cars (refer to Section 4.7 Median treatments).

Riding two-abreast

Under the RTC two riders can travel side-by-side, at no more than 1.5 metres apart. This is commonly known as riding two abreast and is legal in any traffic lane on single and multi-lane roads.

The outside riding position (i.e. to the right of another bike rider) is equivalent to the primary position when riding two abreast. This may require people driving motor vehicles to perform a wider overtaking manoeuvre to maintain a safe passing distance. For this reason, group riding should be factored into LATM design, specifically when the route is commonly used for group rides or where speed cushions are proposed, as riders in the outside line of the group will need to cycle over the speed cushion.

2.4 Overtaking width requirements

In WA, legislation requires any person driving a motor vehicle to pass a person riding a bike traveling in the same direction at a safe distance, being:

- 1.0 m on roads where the posted speed limit is 60 km/h or less;
- 1.5 m on roads where the posted speed limit is more than 60 km/h.

Safety issues

In most circumstances a motor vehicle will encounter opportunities to move into the opposing lane, maintain the minimum passing distance and safely overtake a person riding. However, the safety of people on bikes is often impacted by the risk of being ‘squeezed’ by people driving motor vehicles when overtaking on approach or within a LATM device. The potential for squeezing increases in constrained or ambiguous environments.

Lanes that are physically constrained for long distances prohibit this movement and are likely to cause driver frustration which may lead to unsafe overtaking attempts. This is not supported by this guide. Increasing lane widths to meet safe passing laws, while retaining the physical constraint, is also not supported as this is likely to encourage higher vehicle speeds.

Design solutions

Safe passing opportunities that comply with minimum passing legislation, and do not impede the bike rider envelope, should always be provided along a stretch of road. Roads should not be designed for people riding to indefinitely hold the primary position when motor vehicles are present.

While further investigation is required to determine the appropriate spacing of overtaking opportunities in WA, it is suggested that this should be no more than 400 m for streets with high bike riding volumes and low traffic volumes and speeds. Higher volume and speed roads will require more frequent overtaking opportunities (i.e., more often than 400 m).

For individual LATM devices, and short sections of physically constrained lanes (i.e., kerbed medians), this guide suggests designing treatments that do not allow people driving to overtake people riding when travelling through the treatment. To reduce the risk of people driving attempting to overtake people riding, this guide suggests maximum 3 m (3.2 m on bus routes) lane widths within an LATM device. Ensuring all road users achieve equitable speed on approach to the device may also reduce the risk of people driving attempting to overtake people riding (refer to Section 3.2 Equitable speed).

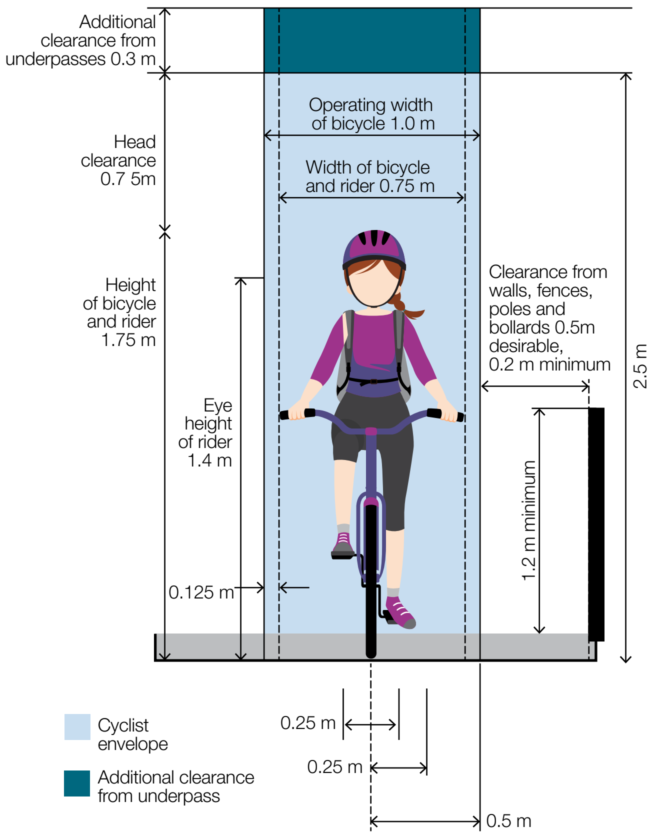
Operating envelope for bike riders

The operating envelope for bike riders is shown in Figure 6. It is the minimum requirement to accommodate a two-wheeled bike and provides for a small deviation for the rider’s stability while travelling in a straight line. The width required for the rider is 0.75 m (elbow to elbow). An additional 0.25 m should be provided to accommodate the side-to-side movement that naturally occurs when the rider is pedalling.

Adequate clearances from parked cars, overtaking motor vehicle drivers, barriers and fencing is required in addition to the 1 m operating envelope. When a person riding a bike is in the secondary position, and is being overtaken by a person driving a motor vehicle, it is assumed that the cycle envelope is measured from the kerb face. This places the bicycle wheel 0.5 m from the kerb. The person in the overtaking motor vehicle should not be expected or able to squeeze the rider closer to the kerb than the 1 m envelope. The secondary riding position will be dependent on the road carriageway being clear of debris with bike friendly drainage grates installed to prevent protrusion into the operating envelope.

Figure 6: A typical bike rider requires a 1.0 m x 2.5 m operating envelope.

Adapted from Cycling Aspects of Austroads Guides.



Considering other bike types and eRideables

The above operating envelope relates to a typical two wheeled bike. When designing LATM schemes it may be relevant to consider the operating requirements of other bike types, eRideables and other micromobility devices which can be longer and wider than a typical bike.

2.5 Visibility requirements

Street design incorporates an optimal amount of forward visibility for people driving. Reducing the forward visibility is a design technique to reduce the speed at which people drive a motor vehicle. However, reducing visibility significantly can breach the stopping distance necessary for a person driving to react and stop in time to avoid an obstacle, which could be a person walking or riding.

Definition: Sight distance is the visibility distance between a person driving and an object/obstacle which is measured along the length of the carriageway at a specified height above the finished surface level of the carriageway in the direction of travel.

The optimal amount of forward visibility for a 30km/h speed environment between obstacles/devices is approximately every 80 m (Handbook for Cycle Friendly Design. Sustrans, 2014). The position of LATM devices and street trees are a means of reducing forward visibility to optimal levels. However, practitioners should note 80m spacing is a guide and obstacles in roads should be designed appropriate to the local context.

Excessive forward visibility and generous carriageway width tend to increase driving speeds. Restricting forward visibility on local roads to around 80 m is important to developing safe street design that adheres to Safe System principles.

Stopping sight distance

Definition: Stopping sight distance (SSD) is the distance which people driving require to be able to see ahead and stop from a given speed.

Best practice indicates that a SSD of 23 m is required for roads with a 30 km/h speed restriction and 45 m is required for roads with speed restrictions of 50 km/h. With reference to Table 2, SSD is taken from the Manual for Streets (DoT UK, 2007), as Austroads guidelines refer to technical requirements for main roads rather than local streets. With reference to Figure 7, it is recommended that an allowance is made by adding 2.4 m to the SSD, which equates to the typical distance between the driver and the front of a motor vehicle. With reference to Figure 8, corrections are required where necessary if the road grade changes.

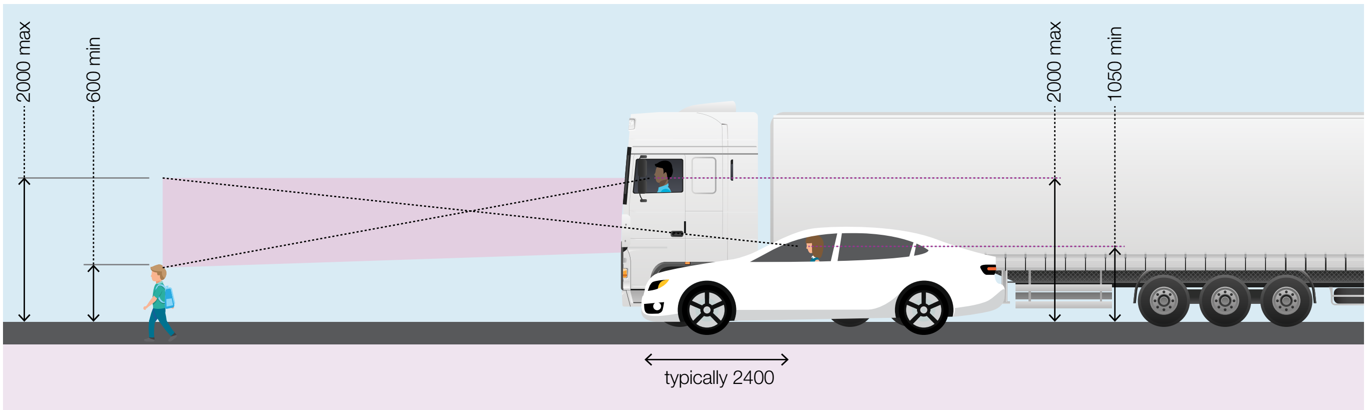
Table 2: Safe sight distance requirements.

Adapted from Manual for Streets (DoT UK, 2007)

Speed (km/h)	16	20	24	25	30	32	40	45	48	50	60
SSD (m)	9	12	15	16	19	20	25	28	30	31	37
SSD adjusted for bonnet length	11	14	17	18	23	25	33	39	43	45	59

Figure 7: Vertical visibility envelope.

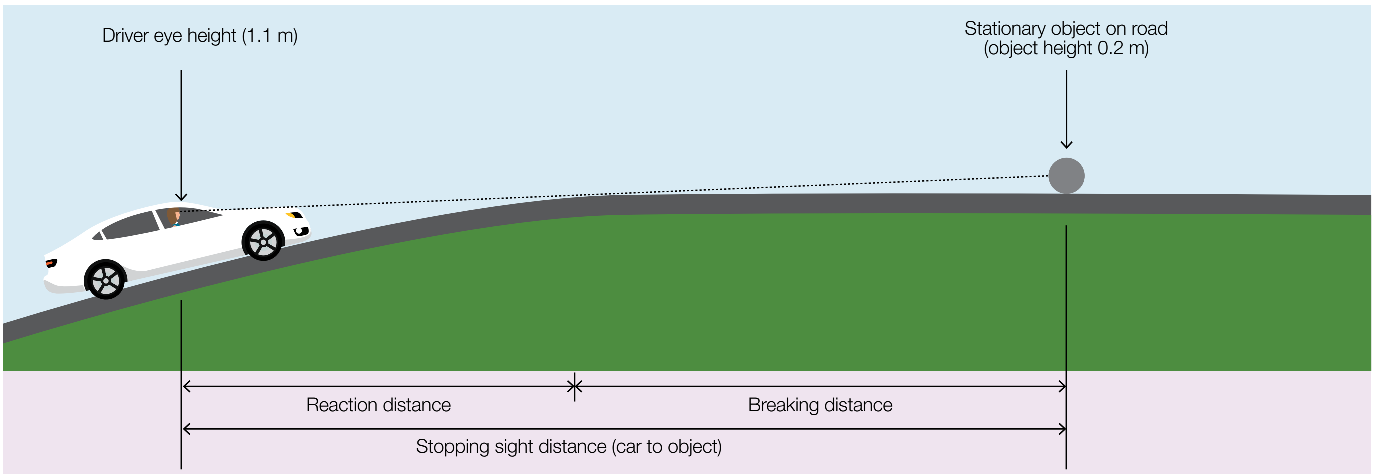
Adapted from Manual for Streets (DoT UK, 2007)



In designing for forward visibility, practitioners should note reaction times of 2 or 2.5 seconds are acceptable, but a reaction time of 1.5 seconds is not to be used in WA (MRWA 2023).

Figure 8: Car stopping sight distance.

Adapted from Austroads Guide to Road Design: Part 3.



3. Cycle Bypasses and Equitable Speed

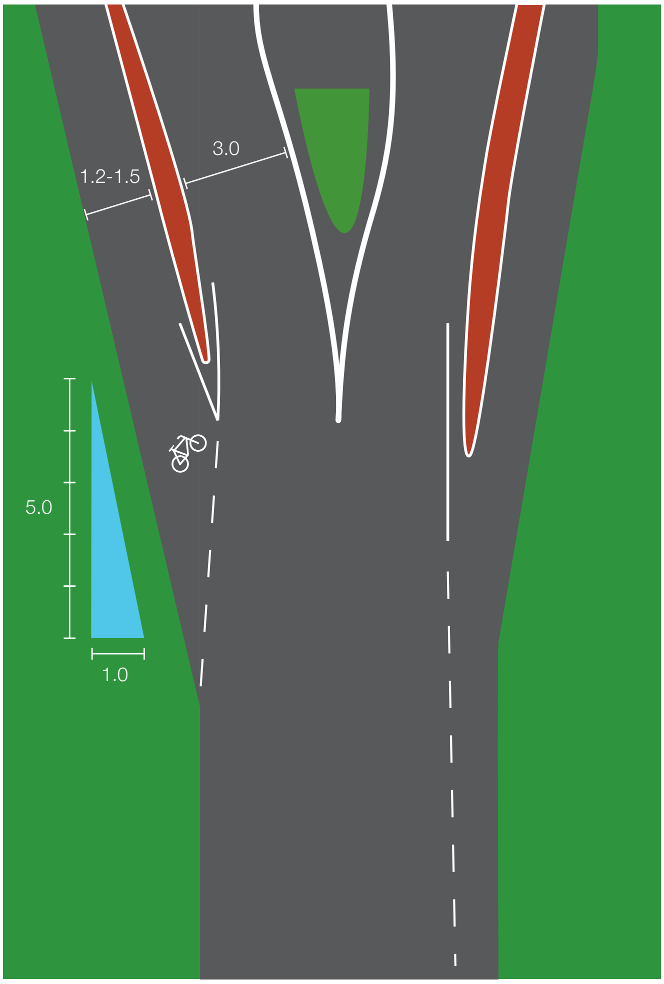
Creating an environment that improves safety for all road users and reduces stress experienced by people riding bikes can be achieved through the implementation of a cycle bypass, ensuring equitable speed on approach and through a LATM device, or both.

3.1. Cycle bypasses

Definition: A cycle bypass is a designated facility for bike riders at road level within an LATM treatment physically separated from motor vehicle traffic movement.

Figure 9: Cycle bypass with 1 in 5 taper.

A horizontal taper of 1-in-5 is recommended as an acceptable deviation to avoid a bike rider overbalancing and being forced into the traffic lane.



The following factors should be considered when assessing if a bypass is required:

- Traffic volumes greater than 150 motor vehicles/ hour during peak times.
- A speed differential between riders and motor vehicles of 20 km/h or more on approach (based on 15 km/h bike rider speed).
- Sun glare if the bike rider and approaching motor vehicles are likely to be travelling to the east or the west.
- Uphill versus downhill: The uphill lane should be given priority if the carriageway width is constrained.
- Bypasses offer significant safety benefit on streets adjacent to notable destinations such as schools, train stations, hospitals or businesses, where demand is likely to be higher.

3.1.1 Design considerations

- Establishing the need for a bypass should occur prior to considering requirements for on-street parking, carriageway width and driveway access.
- A cycle bypass should provide safe continuous movement for the rider through a speed reduction device.
- A cycle bypass should be at road level without requiring a rider to transition onto a path.
- If a cycle bypass cannot be provided due to site constraints, a transition should be provided to a path bypass, and this should commence approximately 10 m prior to the device. This distance should be tested in the field and may require modification to avoid driveway access.

Cycle bypass width

A 1.5 m wide cycle bypass should be applied to avoid potentially creating additional safety issues for riders. Where widths on the road carriageway are constrained, a narrow width can be considered, however this will have implications for diverse bike types such as cargo bikes or tricycles.

A bypass can still be considered with:

- 1.2 m width if deviation for bike riders is less than 1:5
- 1.5m width if deviation is significant – can narrow to 1.2 m at the apex.

The above design widths should be tested in a local context.

A horizontal taper of 1-in-5 (or better) is recommended as an acceptable deviation to avoid a person riding a bike overbalancing and being forced into the traffic lane.

Exiting a bypass at merge point

Terminating the physical protection of a cycle bypass before the person driving the motor vehicle has had adequate time to realign their travel path is a common design flaw. All cycle bypasses should be designed to ensure a person driving a motor vehicle does not move into the path of a person riding a bike. This requires the extension of the physical barrier beyond the point of motor vehicle realignment.

Liaison with MRWA is required to determine the appropriate reverse curve radius to extend an LATM bypass to allow for motor vehicle realignment (refer to MRWA standard drawing 200331-0143).

Desire lines for bike riders

The desire line for a bike rider is the most direct path or route that is chosen to minimise distance travelled. Cycling infrastructure provision should align with these desire lines wherever possible. Inconvenient deflections through a cycle bypass are likely to result in more riders staying on road in a potentially unsafe environment.

The need to deviate from the natural desire line is more inconvenient for a person riding a bike (who requires momentum to travel and can become unbalanced easier), than it is for a person driving a motor vehicle. Allowing a bike rider to remain on their desire line, while creating a deviation for motor vehicles, can be achieved where a person riding a bike:

- holds the traffic lane in the primary position (meandering between the left and right side of the traffic lane as it deviates to maintain a straight desire line) meaning a person driving a motor vehicle must give way behind them (refer to Section 2.3 Secondary vs primary position for more information); or
- is given a bypass that is straight or has minimal deviation while the traffic lane deviates more significantly.

Figure 10: Cycle bypass with limited protection.

Uphill versus downhill

If the road has an incline, it is particularly important to prioritise a bypass in the uphill direction as riders travelling uphill are likely to have a greater speed differential to traffic moving in the same direction. A cycle bypass should be provided in both directions if there is enough space.

Where the road is on a flat grade and there is insufficient width for a cycle bypass on both sides, practitioner discretion is required as to which side to provide a bypass.

Pedestrians crossing at a cycle bypass

If an LATM device is used within a pedestrian crossing area, practitioners should consider the pedestrian demand and signage requirements to determine the minimum width of refuges between the cycle lane and carriageway to minimise pedestrian queuing in the bypass lane.

Riding two-abreast

Two abreast riding does not need to be accommodated within bypass facilities, with all riders expected to ride in single file through a cycle bypass. Particularly when riding in a group, riders may choose to stay two abreast and take the lane in the primary position through the device, instead of using the bypass.

Drainage, bin placement and maintenance

Cycle bypasses should be deemed trafficable infrastructure and kept free of debris, bins and other obstacles. Cycle bypasses need to be designed to allow small sweepers access to remove debris and incorporate drainage systems that ensure water is displaced from the lane. Designated bin placement areas may be required to avoid bins obstructing the bypass on waste collection days (Figure 11).

Figure 11: Example placement of a bin zone adjacent to a cycle bypass or bike lane.

3.2. Equitable speed

An alternative solution is to create a road environment where motor vehicle speeds are reduced on approach and through an LATM treatment to reduce the speed differential between the motor vehicle driver and the bike rider. This is referred to as 'equitable speed'. Creating equitable speed improves safety for all road users and reduces the stress experienced by people riding bikes.

For speeds to be deemed equitable there must be less than 20 km/h difference between a person driving a motor vehicle and a person riding a bike. A bike rider travels at an average speed of 15 km/h. Therefore, to create an environment with equitable speed for all road users, the speed of people driving needs to be reduced to 35 km/h or less on approach to and through an LATM device.

Accordingly, this guide suggests a 30 km/h design speed for LATM devices. Creating equitable speeds is most applicable at roundabouts, intersection legs of a modified T-intersection and some mid-block treatments.

The preferred solution to achieve an equitable speed environment, between motor vehicle drivers and bike riders, is to provide speed cushions or full width speed humps across both lanes on the approach and exit. Horizontal pre-deflection is not recommended as it may result in squeezing of the person riding.

Equitable speed design considerations for each LATM treatment are detailed throughout Section 4 Detailed LATM Design Guidance.

4. Detailed LATM Design Guidance

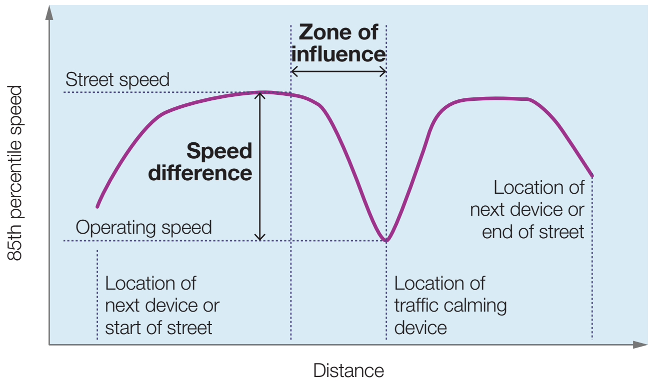
This section outlines design considerations and solutions for the 11 most commonly installed LATM devices to ensure people riding bikes are not negatively impacted or put at risk.

LATM treatments typically incorporate one or more of the following three elements to slow the speeds of people driving motor vehicles.

- Centrifugal forces associated with horizontal displacement which will increase on a tighter radius;
- Vibrations that occur with sharp changes in vertical transition; and
- Increased driver concentration and uncertainty as a result of road narrowing, limited forward visibility and contrasting pavement materials.

Figure 12: How a LATM device works

Source: Daniel, Nicholson and Koorey (2011).



Device spacing

The spacing between devices contributes to the speed reduction of the overall road or network. Figure 12 demonstrates the effect a device has on the entry and exit speed of the person driving a motor vehicle.

The optimum spacing of devices will depend on the outcome the practitioner is seeking. More closely spaced devices are likely to result in lower speeds.

This guide suggests designing streets with continuous LATM treatments closely spaced (approximately 80 m apart). This aims to reduce motor vehicle acceleration between devices which can be a cause of stress to people riding bikes.

4.1. Centre blister island

Definition: Centre blister islands are wide oval shaped islands constructed at the centre position (or median) of a street to narrow the lanes and divert the angle of traffic flow into and out of a device.

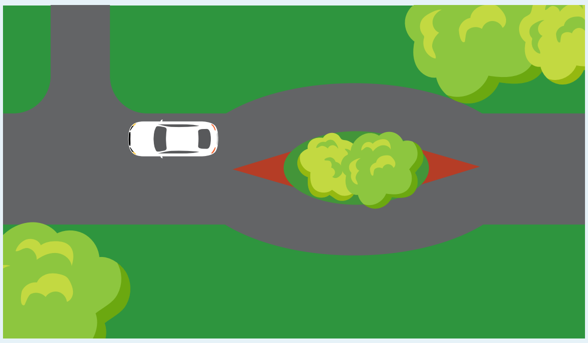
4.1.1. Types

There are two main types of blister islands (Figure 13):

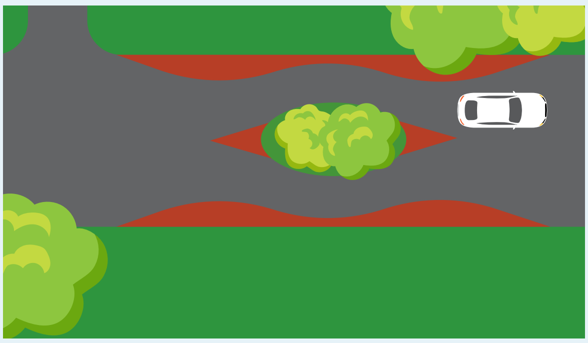
- Centre blister on narrower carriageways which may require road widening; and
- Centre blister on wider carriageways which may require kerb extensions.

Figure 13: Two main types of centre blister treatment.

Adapted from Austroads GTM: Part 8 – Page 90.



Blister islands on narrow carriageways may require widening.



Blister islands on wide carriageways may require kerb extensions.

4.1.2. Rationale

Centre blister islands are installed to reduce the speed of motor vehicle drivers, and to reduce forward visibility through horizontal deflection. They are typically applied to local distributor roads or access roads and can be implemented on bus routes.

4.1.3. Safety issues

It can be unsafe for riders to move to the primary position where the bike rider and motor vehicle driver approach the device at the same time. It is safer for riders to move to the primary position prior to entering the device and then return to the secondary position after exiting the device. However, there is typically no signage, road markings or other direction provided to advise riders to move to do this, or to advise people driving motor vehicles that this is an appropriate movement.

There is insufficient room to safely overtake a rider approaching the island or within the device itself. This may cause a person driving to attempt a dangerous overtaking manoeuvre before the device and squeeze the person riding against the kerb.

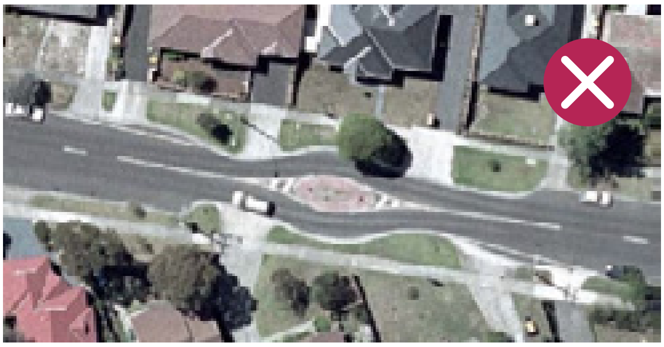
A person driving a motor vehicle who is negotiating the device may deviate across the path of a person riding in the secondary position (riding in the left side of the traffic lane).

Note: if the rider has taken the primary position, and there are central medians beyond the device and insufficient overtaking width), the rider may choose to remain in the primary position after exiting the device. Refer to Section 4.7 Median treatments.

The risks for the person riding are the same regardless of whether the blister island is on a narrower or wider carriageway. However, cycle bypasses should be easier to accommodate and require less road widening on a wider carriageway where kerb extensions are proposed.

Figure 14: Centre blister island treatment on narrow carriageway.

Figure 15: Centre Blister Island treatment on wider carriageway.



Unprotected bicycle lanes through a centre blister are not recommended, as the rider may continue to hold the primary position through the device to avoid being overtaken and to continue along their desire line. Overtaking manoeuvres by people driving motor vehicles within central blister island treatments cannot be maintained and, without physical bicycle lane protection, are potentially hazardous as the motor vehicle can enter the bicycle lane when it deviates horizontally.

Green coloured pavement treatments that are used to indicate conflict areas are not enough to protect a rider from motor vehicles and can give a false sense of security to the rider, as well as directing them away from their desire line in the centre of the lane.

Figure 16: Unprotected cycle lanes through centre blister island – not recommended.

Figure 17: Cycle bypass on uphill side of road.

Image courtesy of Nearmap.

Figure 18: Street view of cycle bypass on uphill side of road.

Image courtesy of Google Street View.

4.1.4. Design solutions

The following design solutions will assist in improving safety for all road users:

- Providing a separated bypass facility.
- Creating an approach and exit environment where a person riding a bike and a person driving a motor vehicle are travelling at equitable speeds (refer to Figure 20 and Section 3.2 Equitable speed).
  - This option should be used if there is inadequate width to accommodate cycle bypasses.
  - This option allows for more confident riders to take the primary position through the device and less experienced riders to bypass onto a path.
- Provision of hybrid solution where there is a cycle bypass on one side and an equitable speed solution on the other.

A hybrid solution is particularly relevant where the device is installed on a road with an incline.

Traffic conditions and volumes can dictate whether people riding use or bypass a blister island device, therefore:

- Designs should not assume that all bike riders will always utilise the cycle bypass.
- Designs that are unable to provide a separate facility such as a transition to a path or a cycle bypass are not safe for all road users.
- A protected kerbed bypass at road level should be used in conjunction with a blister island. A path bypass option should be provided where this is not feasible (refer Section 3.1 Cycle bypasses for more information).

Transitions to paths must allow a rider to exit from the kerb side lane (secondary position) without the design requiring them to move into the traffic lane (primary position) to make the transition.

Solid kerb protection through the device is preferred in this scenario (note: a desirable width of 1.5 m should be provided which is greater than in the example shown in Figure 23).

Austroads GTM Part 8 indicates 2 m is the minimum width of a centre blister for pedestrians crossing. If there are bike riders crossing at the centre blister, the minimum width should be increased to 2.5 m.

Austroads also indicates the minimum length of a centre blister is 3 m. The characteristics of the blister island may need to be altered to factor in the additional length requirements for a cycle bypass as shown in Figure 19 and Figure 20.

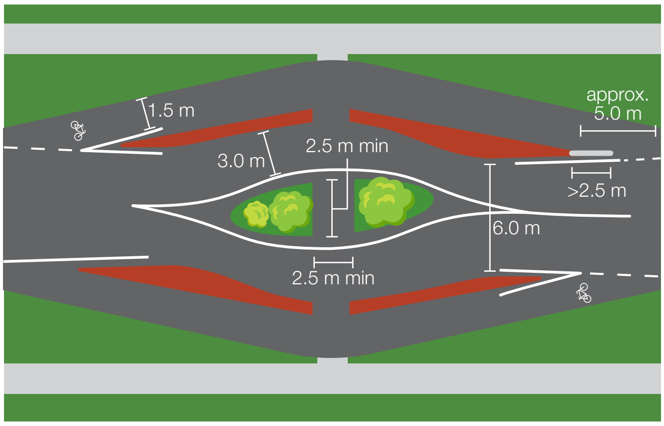
The minimum motor vehicle overtaking requirements cannot be maintained within central blister islands due to the narrowing aspect of this treatment. The reduced carriageway width needs to be upheld to reduce speeds and it is not safe for people driving motor vehicles to overtake people riding bikes while the motor vehicle is being displaced horizontally.

In the example (Figure 17 and Figure 18), a cycle bypass has been provided through the LATM treatment. Exposed merge points and an unprotected cycle lane after the device are not desirable outcomes.

The preferred solution is to create equitable speeds (refer to Section 3.2 Equitable speed) on entry and through the centre blister island. This can be created by installing a road hump on the approach and exits across both lanes (refer to Figure 20 for an innovative example). Horizontal pre-deflection is not recommended as it creates a squeeze point for people riding. The width between the cycle bypass and the traffic lane (carriageway) is a separate requirement and needs to consider pedestrian crossing demand and signage. The pavement markings are shown as indicative only and practitioners should consult MRWA for further guidance.

4.1.5. Innovative examples

Figure 19: Innovative example: design suggestion for cycle bypass to centre blister island.



Note: diagram shows the lining without a cycle lane on entries and an extended lining protection on exit (bottom left).

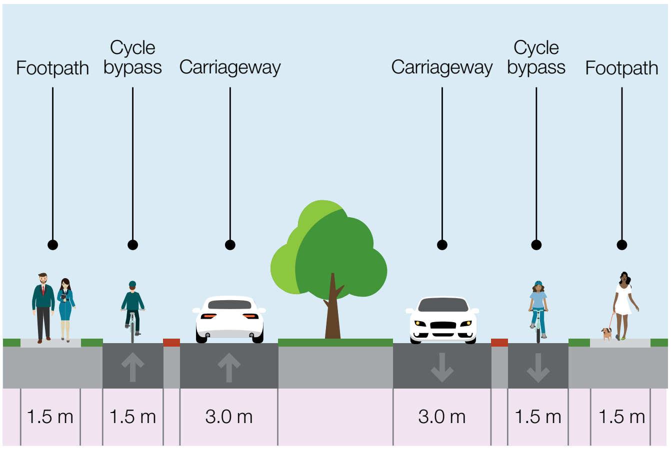
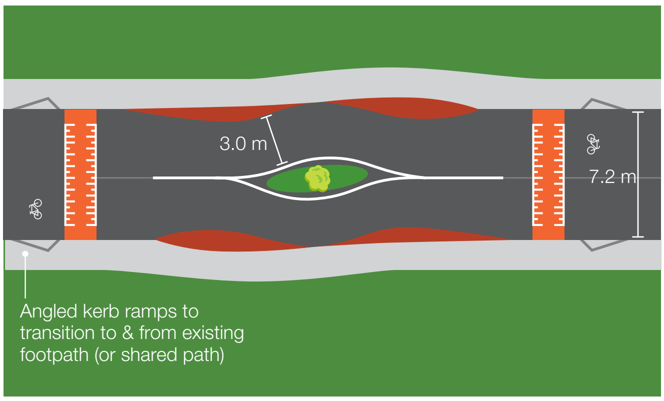


Figure 20: Innovative example: Design suggestion for centre blister island with equitable speed between motor vehicle and bike rider.



4.2. Two lane slow point

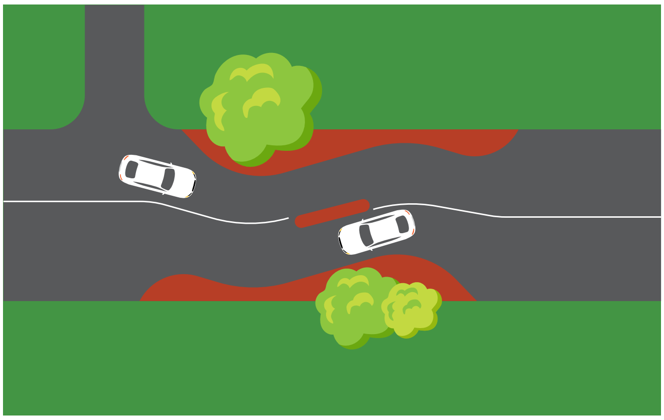
Definition: Two lane slow points are a series of kerb extensions with a central median island which narrows and/or angles the roadway.

4.2.1. Types

There are two main types of two lane slow point (Figure 21):

- Two lane angled slow point; and
- Two lane parallel slow point (similar to a localised median island).

Figure 21: Two lane angled (Image adapted from Austroads GTM Part 8) and parallel slow point.



(a) Two lane angled slow point

(b) Two lane parallel slow point - Lacks visual obstruction

4.2.2. Rationale

Two lane slow points are a common traffic calming device in Australia, however usage has declined with some devices even being removed. Two lane slow points are generally installed on streets with greater traffic volumes where there are less requirements to restrict two-way traffic movement. According to Austroads GTM Part 8, two lane slow points can be less effective than single lane slow points in controlling speeds and providing an adequate visual obstruction. Austroads GTM Part 8 indicates slow points should not be used on bus routes.

4.2.3. Safety issues

Two lane slow points cause greater safety issues for people riding bikes than one lane slow points. Typically, two lane slow points have insufficient space to accommodate overtaking within the device or on the entry and exit, particularly if there is oncoming traffic. Lane width within two lane slow points can vary depending on the carriageway configuration. This variation could result in drivers attempting to overtake within a device, causing a bike rider to be squeezed towards the kerb. To avoid this happening, riders may take the primary position prior to entering the device.

Alternatives to this treatment include full width road humps, raised pavements or colour surface changes (refer to Section 4.6 Vertical treatments).

4.2.4. Design solutions

The width of slow point lanes should be 3 m (or 3.2 m where the road is an existing or planned bus route). Greater widths encourage unsafe overtaking manoeuvres and limit the effectiveness of the device in reducing vehicle driver speeds.

To accommodate a rider through a two lane slow point, the safest and most preferred treatment option is the provision of a separated road level cycle bypass facility with physical protection. This treatment option may require carriageway widening.

Cycle bypasses should be designed to the recommendations provided in Section 3.1. Cycle bypass design considerations specific to slow points include:

- Cycle bypasses need to commence prior to the slow point as the device will force motor vehicles towards the kerb.
- Cycle bypasses should avoid the significant horizontal displacement of the motor vehicle through the slow point as a rider should not be forced to slow down or become unstable in a constrained environment.

Figure 22: Two lane slow point treatment with bypass.

Images courtesy of Google Street View.

Two lane angled slow point

Angled two lane slow points with a median, or chicanes, should be avoided unless adequate bypasses can be provided. Cycle bypasses should terminate after a motor vehicle has straightened and is back in its normal position on the road. An extended bypass design should factor in gaps for motor vehicle access, drainage and maintenance.

Figure 23: Angled two lane slow point with cycle bypass abruptly terminating.

Source: Main Roads WA (2019).

The two lane slow point in Figure 23 should be extended 2.5 m to 4 m to provide adequate protection for the rider where the person driving straightens their motor vehicle prior to the merge point.

Angled slow points can incorporate parking bays on the approach and departure lanes by using either lane narrowing, kerb extensions or pavement markings. There should be at least 4 m spacing between the start or end of the cycle bypass and the nearest parking bay, with this distance evaluated in the field for effectiveness.

Two lane parallel slow point

Two lane parallel slow points consist of a median island installed mid-block. This acts as a visual cue to motor vehicle drivers to reduce their speed and creates minor horizontal displacement. These treatments are often installed as a mid-block pedestrian crossing.

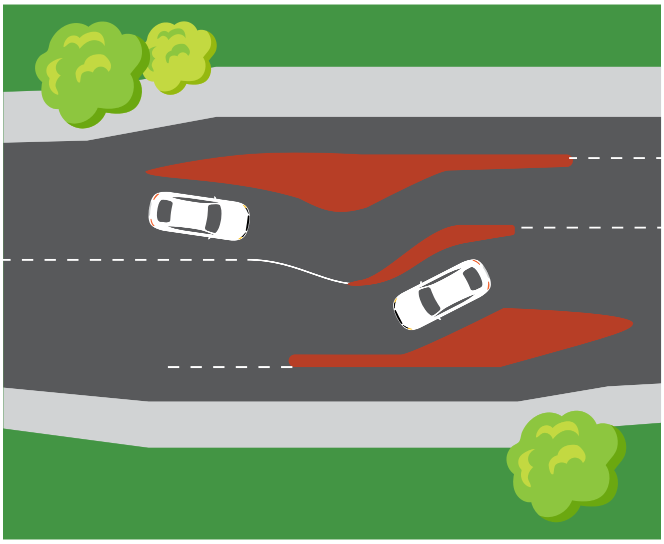
Figure 24: Two lane parallel slow point with speed cushion installed

Image courtesy of Nearmap.

Two lane parallel slow points are less effective at slowing the speeds of motor vehicle drivers than angled slow points. This can cause safety issues for people riding bikes unless they are part of a continuous treatment where road speeds are 30 km/h or below. A cycle bypass should be provided for this type of treatment.

A cycle bypass that commences prior to a two lane parallel slow point would mitigate the potential for people riding to be squeezed towards the kerb by people driving motor vehicles attempting to overtake a person riding a bike. The provision of a cycle bypass in this situation would require some carriageway widening which may have additional cost implications.

Figure 25: Two lane angled slow point with protected cycle bypass.



4.3. Single lane slow point

Definition: Single lane slow points are a series of kerb extensions that narrow and/or angle the roadway to provide enough room for only one motor vehicle to pass through at a time.

4.3.1. Types

Single lane slow points can be angled or parallel (Figures 26, 27 and 28).

Figure 26: Single lane angled slow point.

Figure 27: Single lane parallel slow point.

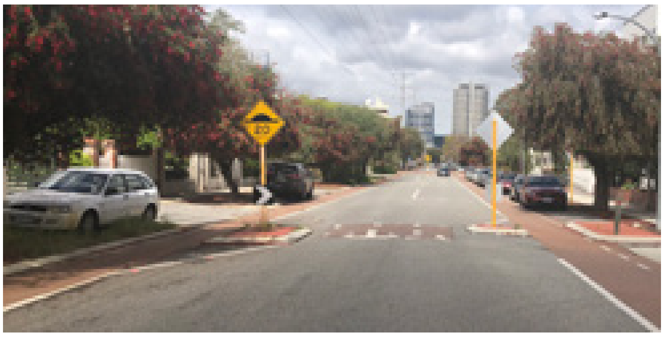


Figure 28: Typical single lane angled slow point.

4.3.2. Rationale

Single lane slow points reduce motor vehicle speed through visual narrowing and horizontal deflection. They are typically more effective than two lane slow points in controlling motor vehicle driver speeds and providing an adequate visual obstruction.

4.3.3. Safety issues

Single lane slow points employ kerb extensions and require riders to change from the secondary position into the primary position. This squeeze point can be of great concern to a rider if the approaching vehicle is travelling at a faster speed and attempting to perform an overtaking manoeuvre.

This treatment should only be considered without cycle bypasses if the entire road environment is designed for 30 km/h or lower.

4.3.4. Design solutions

Single lane slow points should be designed for:

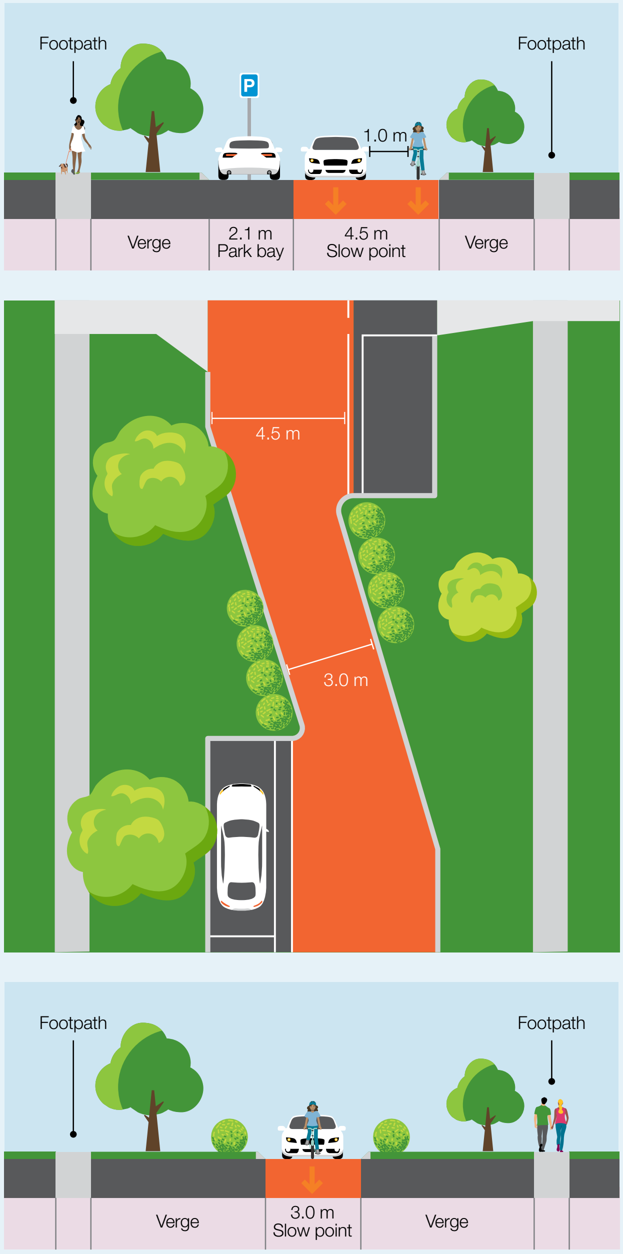
- a maximum speed through the device of 10 to 20 km/h.
- a lane width of 3 m; maintained through the device.
- treatments spaced at a maximum of approximately 80 to 100 m to minimise acceleration and deceleration between devices.

Incorporating cycle bypasses into the design of single lane point slow points can be easier than other slow point treatments. Only one direction of traffic needs to be accommodated at the point of deviation and the road width needed for the device is less than is required on centre blister islands or two lane slow points.

Angled devices are more common as they provide better deflection and are more effective in reducing vehicle speeds. The angle of the slow point determines the severity of the displacement and the reduction in forward visibility. Angled devices require less width as the kerb extensions are staggered. This makes providing cycle bypasses easier for angled devices than parallel positioned slow points.

Angled devices can also be used to create a meandering street environment which reduces forward visibility and allows street parking to be staggered on opposite sides of the street and on either side of the device.

Figure 29: Single lane angled slow point.



If cycle bypasses are not provided, and the operating speed is greater than 30 km/h, the street should be treated with vertical treatments such as road humps or plateaus prior to the device. This creates a more equitable speed and allows the person riding to take the primary position. If vertical treatments are not provided, pavement markings and signage should be considered as visual prompts to encourage drivers to reduce their speed.

On narrower roads, a cycle bypass may not be required if a shared traffic environment is created with a 30 km/h or lower speed limit, and parking is restricted to prevent obstruction on transitional kerb ramps on the approach to intersections.

As there is insufficient space for a vehicle to overtake a rider within the device, and approaching the device, some riders will move into the primary position prior to the device.

Upon exiting the device, these riders will likely return to the secondary position where it becomes possible for a vehicle to overtake. The movement to the primary position may put the rider at risk if they approach the device at the same time as a person driving a vehicle and there are no visual prompts advising the vehicle driver that this is an appropriate position for the rider. Some riders may desire to exit the road environment onto a path.

Single lane angled slow points are preferred where there is no bypass, except for situations where pedestrian movement is significant and warrants a parallel slow point, as parallel slow points provide a shorter crossing distance for pedestrians.

Single lane slow points with pedestrian crossing

This treatment is suitable to use at locations where there is expected to be pedestrian crossing demand. A suitable location for a slow point that incorporates a pedestrian crossing would be a path terminating at the road. Parallel slow points provide a shorter crossing distance for people walking.

At bypass treatments where there is a pedestrian crossing, there may be a need for bike riders to give way to pedestrians. The vertical deflection could be extended across the cycle bypass to reinforce that people crossing have right of way. For cycle bypass design considerations refer to Section 3.1.

If additional restraints are required to manage vehicle speeds, speed cushions or road humps across the entire carriageway width can be installed within the parallel slow point or on the approaches. It is preferable to install vertical treatments prior to the device to allow the rider to take the primary position prior to the device. More information on vertical treatments is provided in Section 4.6.

Figure 30: Single lane parallel slow point with cycle bypass and pedestrian crossing. Narrowed to reduce crossing distance.

Image courtesy of Google Street View.

4.3.5. Other considerations

- Give Way control on one of the approaches is required by MRWA. (Refer to MRWA Standard Detail Drawings for further information).
- Single lane slow points should not be used on bus routes.

4.4. Road closures with filtered permeability

Definition: Road closures with filtered permeability are physical obstructions that are used to redirect car traffic while allowing permeability of selected modes (usually people walking or riding, and sometimes buses). This treatment is also referred to as a modal filter.

4.4.1. Types

There are many variations to road closure treatments, such as its position at an intersection or mid-block, and the number of intersection legs that are restricted.

Filtered permeability can:

- be applied across the full extent of the road (full road closures) at intersections or mid-block;
- restrict entry or exit to one direction (half road closures);
- modify a four-way intersection into two 90-degree bends (diagonal road closures);
- modify a four-way intersection into a left-in left-out intersection;
- be applied to one leg of a roundabout; and/or
- incorporate two-way contraflow bike riding on one-way streets.

4.4.2. Rationale

Filtered permeability reduces car traffic speeds and volumes and is one of the most effective LATM treatments to make streets safer for all users. While its application may be localised, it is best applied within a neighbourhood context to ensure traffic is not inappropriately diverted within the local network.

For people riding or walking, filtered permeability is an effective form of LATM as long as the cut-throughs are appropriately designed.

4.4.3. Design Solutions

This section provides several case studies to demonstrate the application of filtered permeability.

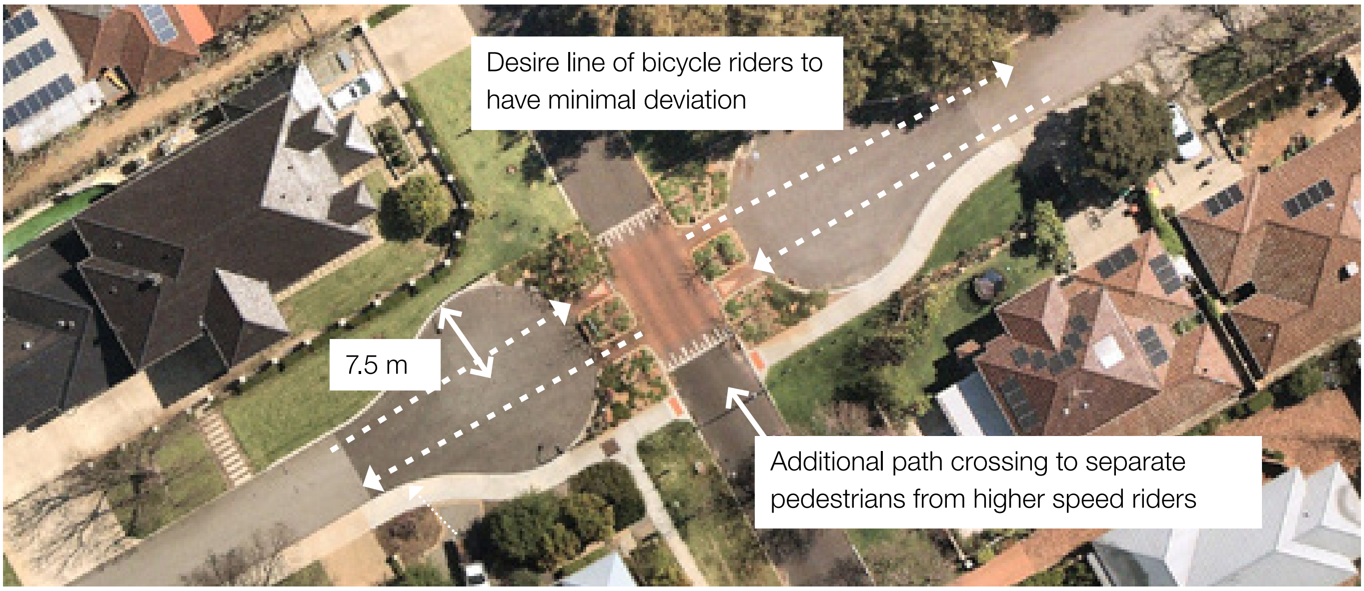
Four-way intersection with two leg closure

Closing two legs of a four-way intersection is a form of filtered permeability where car traffic movement is restricted on two legs. The closed legs should retain access for people walking and riding and provide safe crossing facilities of the route that remains open to car traffic.

The City of Melville implemented a full closure of two legs of a four-way intersection, maintaining access for people using active modes of travel at the intersection of Macrae Road and Gairloch Street in Applecross. This example of filtered permeability allowed the City to address the issue of vehicle drivers using Macrae Road as a 'rat run' to avoid Canning Highway. The reduction in volumes was also key to making Macrae Road safer for everyone (Figures 31 and 32).

Figure 31: Road closure with filtered permeability. *Image courtesy of Google Street View.*

Figure 32: Four-way intersection with two leg closure. *Image courtesy of Nearmap.*



To verify whether the closure would be safe and effective, the City of Melville installed a temporary treatment for one year before the permanent treatment was installed. Temporary trials for road closures can be an effective way to evaluate traffic movement patterns and community perceptions before investing in a permanent solution.

While the City of Melville is continuing to evaluate the treatment, they have reported that many residents who initially opposed the scheme are now supportive, stating the changes have created a more 'family friendly' road environment.

Features:

- A central buffer between each directional movement positions the rider in the appropriate part of the carriageway with minimal deviation. If vehicles are likely to obstruct the directional flow through the filter, the central buffer should be reduced or removed to prevent the rider having to deviate on entry or exit.
- Separate crossing points for on-road riders and path users (pedestrians and less confident riders).
- A speed plateau on the through road to reduce the speed and risk to people crossing. The plateau can be extended to include a pedestrian crossing.
- Treatments were installed as a temporary trial before permanent construction (see Figure 33).

Further technical considerations:

- Providing priority for bike riders along the route, the road crossing the bike route would be required to give way.
- Cut throughs are 1.5 m in width (for each direction of bicycle movement).
- If the road crossing is raised, the length of cut-throughs should be approximately 4 m (between cul-de-sac head and road crossing) to provide a smooth vertical profile.
- If the crossing is at road level, the length of cut-throughs should be a minimum of 2.5 m.
- Raised plateau treatment installation requirements are considered in Section 4.6 Vertical treatments.
- Bicycle symbols could be installed in the cut-through areas and/or at the approaches and exit points in the carriageway.

Figure 33: Macrae Road temporary road closure.

Figure 34: Macrae Road before road closure treatment.

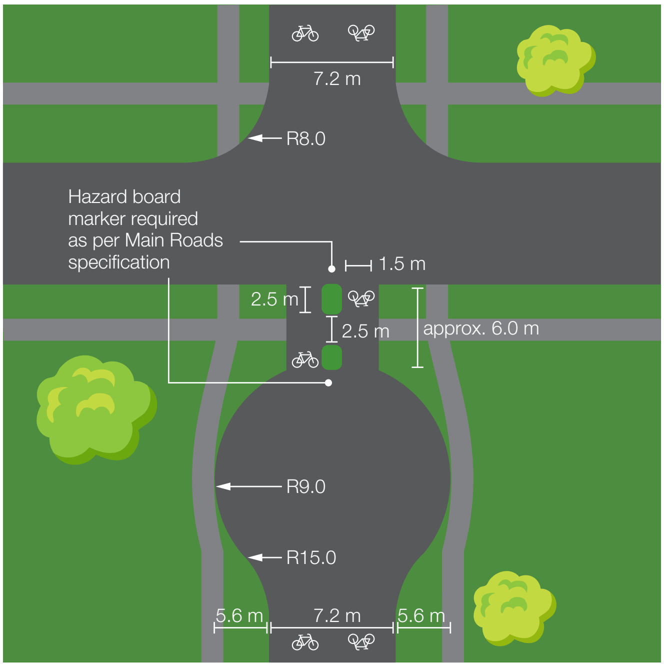
Figure 35: Macrae Road after road closure treatment.

Non signalised four-way intersection with single leg full closure

Closing one leg of a four-way intersection is another form of filtered permeability where traffic movement on the other leg is required. The closed intersection leg should retain access for people walking and riding as demonstrated in Figure 36.

This design suggestion provides the rider with two options to cross the road, either directly across following the desire line, or using a path provided if they are less confident to hold the primary position at the intersecting road.

Figure 36: Closure of one intersection leg of a four-way intersection.



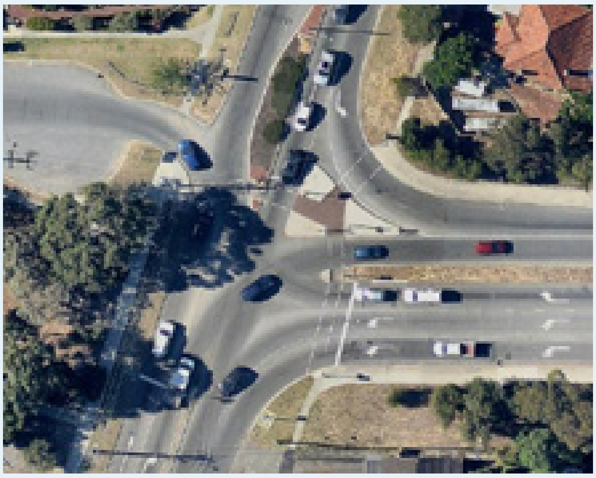
Signalised four-way intersection with single leg full closure

Beatrice Street, Doubleview in the City if Stirling was previously a left-in-only intersection at Odin Road. To reduce traffic volumes through the local area, and improve safety for road users, Beatrice Street was closed to car traffic with access for people walking and riding maintained and upgraded.

In addition to the technical considerations outlined above, where signals are required or changed, practitioners need to ensure that push buttons for both people walking and riding are positioned in a location that is accessible and aligned with the crossing.

Figure 37: Signalised four-way intersection with single leg full closure.

Image courtesy of Nearmap.



(a) Before

(b) After

Figure 38: Roundabout with single leg full closure.

Roundabout with single leg full closure

Closures can be applied to one-leg of a roundabout to reduce vehicle traffic volumes and improve safety for all road users.

Further information on roundabout design is provided in Section 4.9.

Mid-block (full closure)

To reduce through traffic, road closures can occur mid-block. The example in Figure 39 provides design guidance for a mid-block road closure with a cut through provided for people walking and riding. The pedestrian path continues around the closure while a cut through is provided for riders. Treatments are required to prevent cars driving through the cycle only area. Landscaping can be used to prevent vehicle traffic, whilst also improving amenity. Painted pavement or artwork can be used to communicate pedestrian priority.

The example in Figure 40 illustrates the use of planting and bollards to restrict vehicle movements.

Figure 39: Mid-block (full closure).

Figure 40: Mid-block (full closure).

Diagonal road closures

Diagonal road closures are unlike other road closures as they provide a convenient direct cut through for people walking and riding and still maintain the through movement of vehicles. This treatment needs to be considered carefully as it can cause visibility issues, obscuring the person riding from the person driving's sight line and vice versa, especially if trees and other vegetation have been incorporated into the design (Austroads GTM Part 8).

Diagonal road closures can be combined with a raised intersection plateau to reduce vehicle speeds at this location (refer to section 4.6 Vertical treatments). Road humps or pavement treatments should be provided before the diagonal road closure to reduce vehicle speeds and create equitable speeds with people on bikes.

Figure 41: Diagonal road closure

Image courtesy of Nearmap.

Cut through would be better in central position as long as speeds can be reduced to achieve sight distance requirements.

Figure 42: Diagonal road closure

One-way streets with contraflow cycle lanes

Contraflow cycling lanes can be installed within an LATM scheme to assist with narrowing the carriageway and restricting vehicle access in one direction, whilst maintaining access in both directions for people riding.

Contraflow cycle lanes should have a width of at least 1.5 m plus physical separation from through traffic and parked vehicles. Where space is constrained, the absolute minimum width should be 1.2 m. A greater width of 2 m should be considered where there is significant cycling demand.

Figure 43: Contraflow protected bike lane in one-way street.

4.4.4. Other considerations

Emergency service authorities require notification and up-to-date information about road closures, as well as adequate advisory routes for quick access to and through local areas.

Depending on the local context, filtered permeability design features may need to consider options for maintaining emergency vehicles access.

4.5. Modified T-intersection

Definition: Modified T-intersections deflect traffic movements to reduce traffic speed or reassign intersection priority.

4.5.1. Types

The two main types of modified T-intersection treatments are:

Type A: involves constructing a kerb blister at the head of a T-intersection and curved central medians to displace a vehicle's travel path to reduce traffic speed, which involves horizontal displacement in a similar manner to a two-lane slow point.

Type A treatments are **no longer supported by MRWA** for the following reason: the blister island and the curves direct vehicles towards where other vehicles are waiting which potentially creates a conflict rather than reduce conflict.

Figure 44: Type A modified T-intersection at Rigby Avenue, Spearwood

Type B: used to change the priority of T-intersections by treating two 90-degree legs as the priority carriageway. It is common to treat the lesser leg of the intersection with an entry statement to reinforce the status of the through carriageway.

Figure 45: Modified T-intersection with normal priority. *(Source: MRWA).*

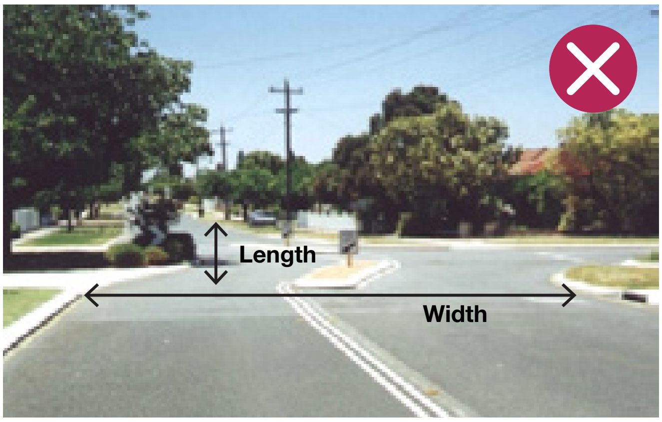
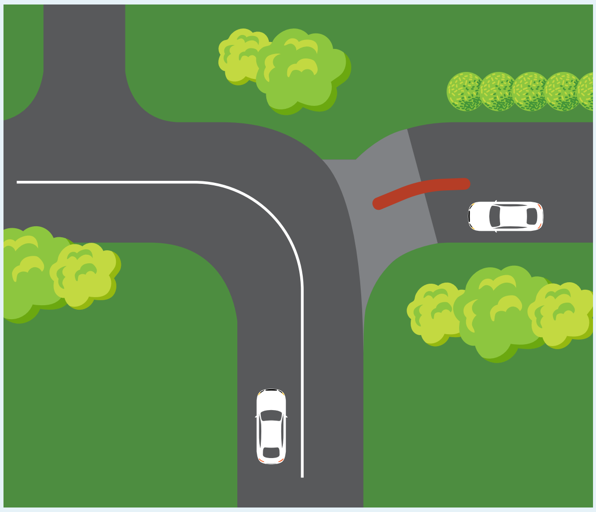


Figure 46: Type B – Modified T-intersection to reassign priority.

(Adapted from Austroads GTM Part 8) with example image (Image courtesy of Nearmap).



4.5.2. Rationale

Modified T-intersections slow car traffic via horizontal deflection and/or reassignment of priority. They act in a similar way to slow points but at a three-way intersection (Austroads GTM Part 8). Modified T-intersections are often used in a series to provide speed reduction. They are also used to discourage people driving vehicles from inappropriately using access roads with the aim of redirecting them to distributor roads.

4.5.3. Safety issues

As modified T-intersections incorporate median islands, there is insufficient width for a vehicle to safely overtake a rider approaching the islands or within the device.

This form of intersection is unforgiving in situations where a person driving a vehicle attempts to overtake a rider in the secondary position before the device, squeezing the rider against the kerb. Riders may also not be visible to vehicles, especially on Type B modified T-intersections where priority has been reassigned. Riders are more visible if they move into the primary position prior to the device and maintain the primary position through the device. However, there is typically no signage, road markings or other direction provided to advise riders to move to do this, or to advise vehicle drivers that this is an appropriate movement.

4.5.4. Design solutions

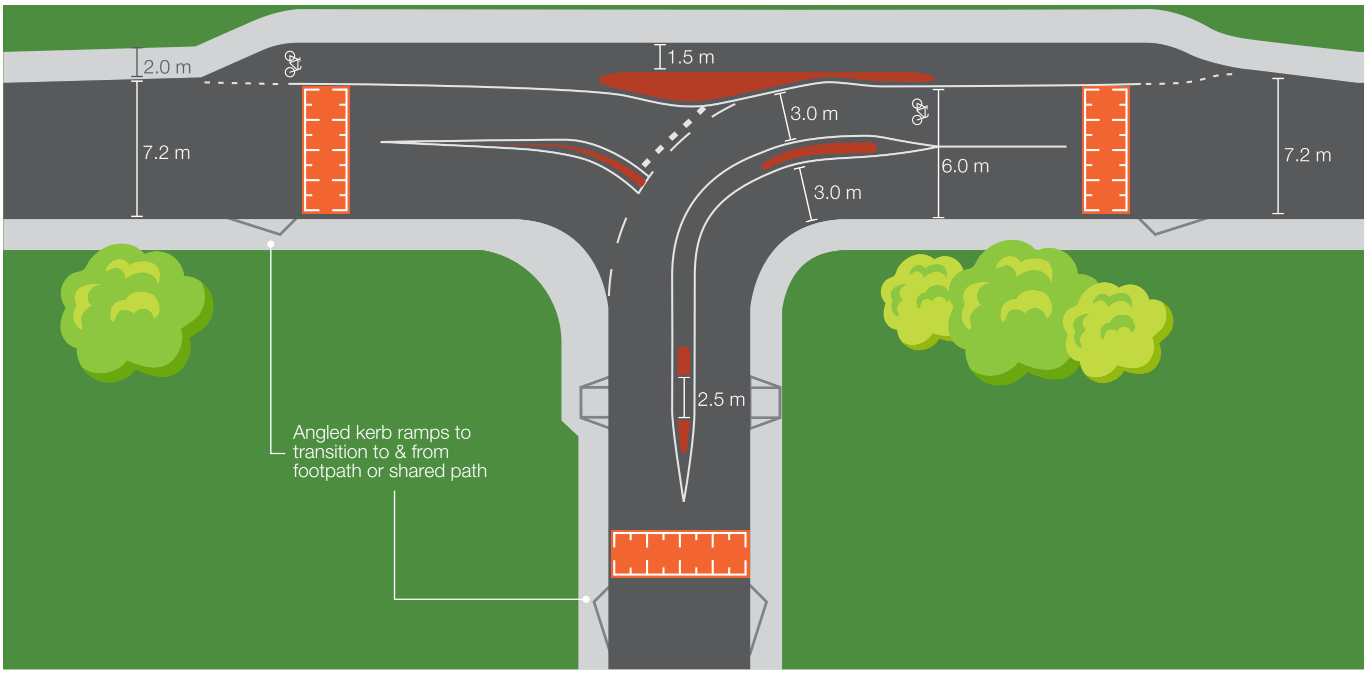
Modified T-intersections are often installed on roads with greater traffic volumes and speed. As such, it is critical that cycle bypasses or connections to the adjacent path network are offered.

The installation of bypasses may be difficult where through movement of vehicles from an intersecting road is required. If through movement is not required, filtered permeability is a potential solution (refer to Section 4.4).

4.5.5. Innovative examples

- A combination of a separated cycle bypass, and reducing entry and exit speeds to allow more confident riders to remain comfortably in the primary position, is recommended.
- For a cycle bypass in the directional traffic flow with no intersection, a gap is required to cater for riders turning right, whether they are entering from the side road or turning onto the side road from the bypass. A confident rider turning right onto the side road may take the lane and avoid the bypass. The design should cater for both movements.

Figure 47: Innovative example:
T-Intersection to reassign priority with cycle bypass and equitable speed.



- Creating an entry and exit environment where a rider and vehicle are travelling at equitable speeds is desirable and should be applied to modified T-intersection designs (see Figure 47). Equitable speed is particularly important where there are no bypass provisions. This allows confident riders to take the primary position through the device, and less experienced riders to move onto a path and cross the intersection via the median refuge. Horizontal pre-deflection is not recommended as it creates a squeeze point for riders.
- Kerbed blisters at intersection heads are an effective way of reducing forward visibility and therefore reduce traffic speed. The head itself can have a cut through to form the cycle bypass as shown in Figure 47. Bypass drainage and maintenance requirements should be considered.

4.5.6. Other considerations

Further to the general advice given, the following technical requirements should be included in any new Type B modified T-intersection:

- Cycle bypasses should adhere to design considerations provided in section 3.1.
- The width of constrained traffic lanes should be 3 m. A width of 3.2 m should be provided where the road is an existing or future planned bus route. Swept path analysis for design vehicles is required.
- Splitter islands should have semi-mountable kerbs and outline markings. Two broken separation lines should proceed the outline markings.
- Geometric elements should be designed with deflections similar to those used in roundabout design.
- Device geometry may be limited by drainage considerations.
- Avoid crests where sight distance is limited (refer to Austroads GRD Part 3).
- Ensure any landscaping does not impact sight lines of motor vehicle drivers and people using the crossing.

4.6. Vertical treatments

Definition: Vertical treatments are physical devices on a roadway that introduce vertical changes in the travel path to reduce vehicle speeds.

4.6.1. Types

The vertical treatments explored in this chapter include:

- Raised intersections;
- Raised pavements mid-block;
- Road humps;
- Sinusoidal humps; and
- Road cushions.

4.6.2. Rationale

Vertical deflection devices force a vertical change in the travel path of road users with the aim of reducing vehicle driver speed. Austroads GTM Part 8 suggests that vertical devices are more effective in speed control and crash reduction than horizontal devices.

4.6.3. Safety issues

When vertical treatments are not designed to cater for people riding, they can cause riders to become uncomfortable and/or unstable.

Some vertical treatments, in particular speed cushions (refer Section 4.6.4), can create safety issues for people riding in groups or busy bike routes as the people behind other riders may not see the device. Full width road humps are the preferred treatment.

4.6.4. Design solutions

LATM vertical treatments are generally preferred over horizontal treatments as vehicles are not forced into the desire line of riders.

This guide recommends a ramp grade of 1:20 (five per cent). This is more likely to create both a smooth transition for people riding, and a reduction in vehicle speed.

The optimal height for vertical treatments for vehicle speed reduction is 90 mm to 100 mm. However, vertical treatments of 75 mm or less are more comfortable for people riding bikes and recommended for bus routes.

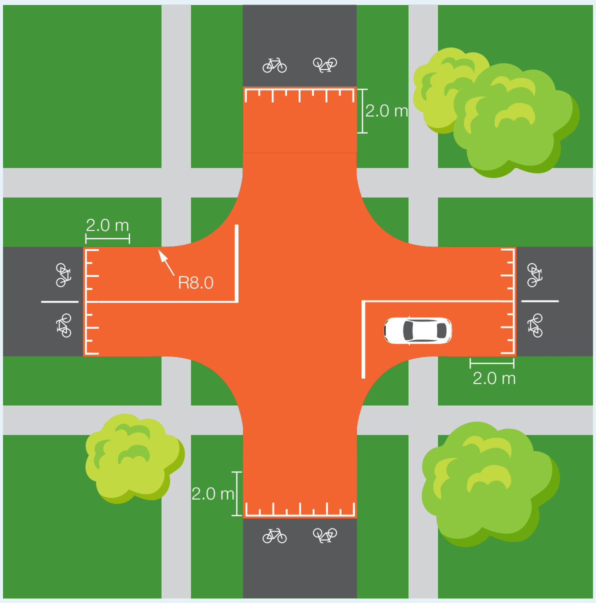
Cycle bypasses with vertical devices

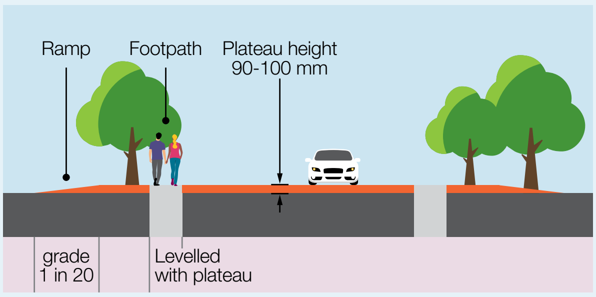
Cycle bypasses are less necessary for vertical treatments than for horizontal treatments, unless the transition vertically exceeds five per cent and could cause a person riding to become unstable. This is particularly important for roads on a downhill incline where bicycle speed can be considerable. Sometimes a combination treatment of a vertical device with a road narrowing device may require a bypass (refer Section 3).

Raised intersection pavements

Raised intersections are considered bicycle friendly because they require vehicle drivers to slow down on all intersection approaches. This increases safety for people walking and riding on or across the road.

Figure 48: Raised four-way intersection.





Raised mid-block pavements

Raised pavements in a mid-block situation are an effective traffic calming measure. Their function and technical specification are essentially the same as a raised intersection. Ramp grades should be 1:20 to best accommodate bike riders.

Figure 49: Raised mid-block Watts profile road humps.

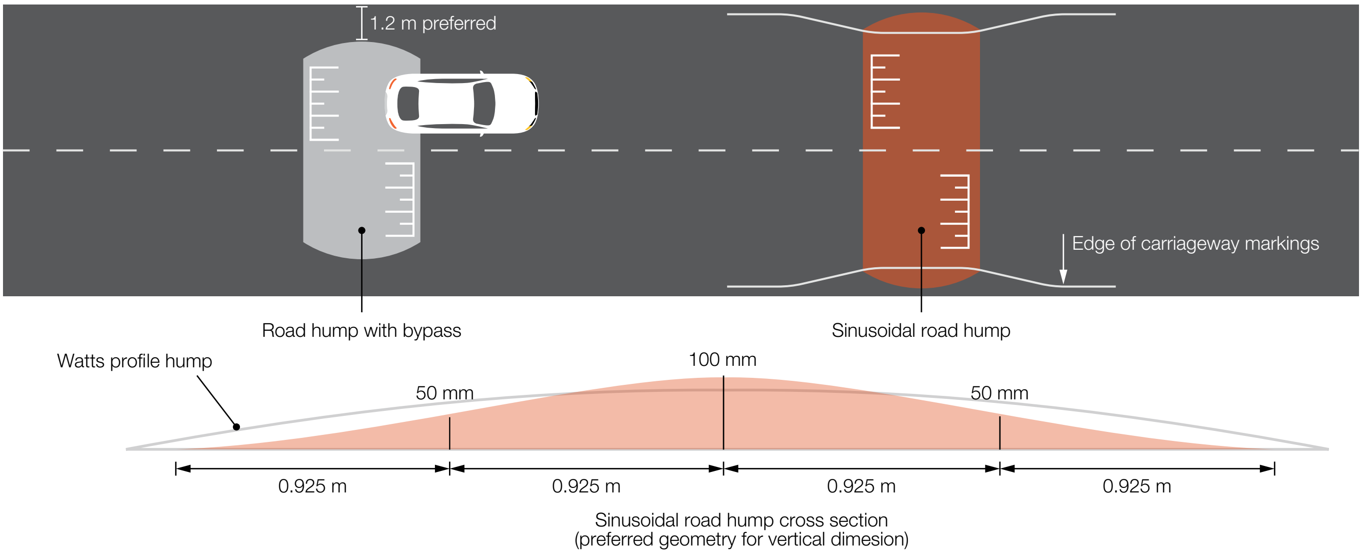
Flat-top road humps

Road humps are a recognised form of traffic calming with design features outlined in Austroads GTM Part 8.

Figure 50: Raised mid-block full width flat top road hump.

Figure 51: Sinusoidal speed hump

(Image adapted from: Handbook for Cycle Friendly Design, Sustrans, 2014).



Sinusoidal road humps

Sinusoidal road humps are designed with a shallower initial rise than the standard Watts profile or flat top plateaus. This alternate shape is more comfortable for people riding because of its shallower profile. A design example from Sustrans (2014) is provided for reference (Figure 51).

Speed cushions

Speed cushions only occupy part of the carriageway which allows bike riders to bypass them. They can be straddled by buses and tend to be preferred on bus routes. Speed cushions work effectively to slow motor vehicle drivers in combination with a central median to restrict vehicle drivers bypassing the slowing device. However, median islands can impact rider safety.

When designing speed cushions, Austroads GTM Part 8 stipulates:

- gaps of 0.75 m between the base of the cushions and kerb and also between adjacent cushions for drainage.
- installation height of 70 mm to 80 mm.
- width of at least 1.9 m.

At a width of 1.9 m and above, cushions tend to be much more effective at reducing speeds, (i.e. the operating speeds across them are lower). While 1.6 m wide cushions are generally more acceptable on bus routes to allow buses to straddle the cushions, they are likely to be less effective in reducing the speed of cars than the wider versions, as people driving vehicles may try to bypass the cushion which can be confronting for road users (including people on bikes) approaching from the opposite direction. Practitioners should refer to Main Roads Local Area Traffic Management guidance for further design requirements for speed cushions on local roads.

Speed cushions on approach to roundabouts

Speed cushions can be used on approach to roundabouts (Figure 52). Careful consideration should be given to the speed cushion's position, and the length of the splitter island, to ensure people riding are able to move to the primary position without obstruction. Inappropriate positioning creates the potential for vehicle drivers to transition onto the opposite side of the road to avoid the speed cushion and splitter island entirely. A preferable treatment is indicated in Section 4.9 Roundabouts.

Figure 52: Speed cushion on roundabout approach.

Splitter island is not long enough, so a frangible bollard has been installed to stop people driving vehicles manoeuvring around the speed cushion.

Long splitter island is good, but cushion should be moved back to the end of the of the splitter so that the rider has enough room to transition to the primary position.

Key issues to consider before the installation of speed cushions:

- Splitter island should be positioned so that motor vehicle drivers do not manoeuvre into the other lane to avoid the cushion.
- Speed cushions should be positioned near the end of the splitter island to ensure the bike rider can move into the primary position after the speed cushion but before entering the roundabout.
- Speed cushions are undesirable treatments for groups of riders as the position of the cushions in the carriageway is obscured by riders at the head of the group.
- Practitioners should carry out observation on the desired route on Saturday and Sunday mornings and consult WestCycle to identify if there are regular group rides.
- A flat-top speed hump or sinusoidal hump across the length of the carriageway is preferred under this scenario (refer above).

The above points need to be balanced if the identified route is also on a bus route where road cushions may be a more desirable treatment, and negotiation and compromise will be required, including consultation with the Public Transport Authority.

4.6.5. General considerations

Speed cushions should not be used on district distributor or higher classification roads, or roads with a high proportion of commercial traffic such as in an industrial area. Speed cushions are typically appropriate on roads with 4,000 or less vehicles per day.

Speed cushions should not be used where there are bends or crests on the road and should be sparingly used on bus routes, or where access to emergency facilities would be adversely affected, unless design is modified to provide passage of these vehicles.

4.7. Median treatments

Definition: Median treatments are installed to narrow traffic lanes and provide protection for crossing movements

Figure 53: Raised central median.

4.7.1. Rationale

The use of median islands can be an effective means of narrowing a carriageway, while also assisting the crossing movement of people walking or riding.

4.7.2. Safety issues

Median treatments can impose significant risk to people riding in the direction of the traffic lane. With the introduction of safe passing laws, it has become increasingly difficult to provide median treatments that are safe for all road users. Practitioners have additional responsibility to ensure median island installations do not create roads that could entice illegal and potentially unsafe overtaking behaviours (Austroads GTM Part 8). The key issues to consider in the design of median treatments are:

- Median treatments that are raised with concrete kerbs can create a potential hazard for people riding on the road if the traffic lane reduces to a constrained width (refer to Section 2.4 Overtaking width requirements). This creates ambiguity for vehicle drivers to safely and legally overtake riders.
- The introduction of constrained traffic lane widths of 3 metres or less should only be encouraged on low volume, low-speed streets. This typically means vehicle volumes of less than 3,000 per day and speeds of 30 km/h or less. The length of constrained lanes should consider the need to provide safe overtaking opportunities and clearance opportunities for vehicle breakdowns.
- Median islands are often provided to reduce speeds as they can create a visual barrier. However, narrowing carriageways without significant vehicle path deflection has little effect on speeds (Austroads Technical Report AP-T123/09 Impact of LATM on Speed and Safety, 2009). This can instead lead to the creation of a more unsafe road environment.
- Long stretches of continuous raised medians are particularly dangerous for people riding bikes as driver frustration may encourage people driving motor vehicles to perform a dangerous overtaking manoeuvre. Even if the road is treated with painted medians with closely spaced raised sections with street trees (for example, refer Figure 54), these can be dangerous for riders as vehicle drivers do not have enough space to overtake a rider without completely transitioning onto the opposing traffic lane. Refer to Section 2.4 Overtaking width requirements.

Figure 54: Flush central median with street trees.

This guide suggests alternative options to median treatments as described in the following sections.

4.7.3. Design solutions

Rather than treating the entire road with a raised central median, practitioners could consider narrowing road space by removing medians and building out verges to reduce forward visibility and thus traffic speeds. This can be achieved by using treatments such as plantings, parking bays and nibs. Vehicle drivers should still be able to overtake bicycles safely by crossing into the opposing lane (when safe to do so).

Where people are likely to cross the road, such as at intersections, localised widening can be provided, possibly with a cycle bypass. This can be in a similar manner to treatments suggested for a central blister island with bypass (Section 4.1).

Where a cycle bypass cannot be provided, equitable speeds should be created through raised treatments on the approach and/or pavement surface changes. Raised intersection plateaus could also be explored (Section 4.6).

Visual narrowing using pavement markings (coloured surface changes) is an alternate treatment to a raised central median. However, this approach should be used with caution as an LATM treatment, as it may not result in a reduction of vehicle operating speed and, where provided adjacent to a kerb, may be confused for a bicycle lane.

4.7.4. Innovative examples

Reallocating space to narrow the carriageway

Reallocating median island space to the edge of carriageway to enable room for protected bike lanes is another way to narrow the road and reduce vehicle driver speeds.

Protected bike lanes can be unidirectional or bidirectional and are typically placed at road level with physical protection from motor vehicles provided by permanent or temporary features such as:

- Kerbing;
- Planting/vegetation (permanent);
- Planter boxes;
- Frangible bollards;
- Temporary road barriers;
- Parking with dooring buffer; or
- A combination of the above.

Protected bike lanes can be considered a form of LATM however would typically be purpose-built as part of a bike route intended for people of all ages and abilities, rather than an LATM scheme independently.

As such, practitioners should refer to guidance specific to protected bike lanes. WA specific guidance is in development.

Figure 55: Protected bike lane, Banksia Terrace Kensington WA.

Image courtesy of Google Street View.

Figure 56: Protected bike lane, Railway Parade Maylands.

Figure 57: Light segregated cycle lane. *(Vancouver).*

4.8. Build outs/kerb extensions

Definition: Kerb extensions involve building the kerb out into the traffic lane to narrow the trafficable space.

Figure 58: Kerb extensions on Jenkins Ave, Nedlands.

4.8.1. Types

There several ways kerb extensions can be applied:

- At the entry of street;
- Mid-block; and
- As a chicane to reduce forward visibility.

4.8.2. Rationale

Lane narrowing and kerb extensions are typically used to reduce speeds by reducing visibility. They also improve delineation and minimise pedestrian crossing distances.

4.8.3. Safety issues

This treatment can be hazardous to people riding in the secondary position as narrowing the carriageway requires bike riders and vehicle drivers to move towards each other. This is particularly hazardous on district distributor roads with higher traffic volumes and speeds.

Due to the presence of parked cars, the risk of dooring is also relevant for this type of treatment (refer to Section 2.3). Practitioners often do not factor in the 0.8 m required to separate riders from opening doors.

If this treatment is applied where there is a central median or constrained situation as described in Section 4.7 (e.g., painted median with regular tree plantings), the carriageway width must be less than 3 m (3.2 m on bus routes) to discourage unsafe passing. Refer to Section 2.4 Overtaking width requirements for further explanation.

4.8.4. Design solutions

Kerb extensions should be clearly visible to approaching vehicle drivers and illuminated by adequate street lighting (Austroads GTM Part 8).

These treatments can be used in combination with mid-block median treatments, roundabouts, road humps, speed cushions or slow points. Kerb extensions are more effective when applied to one side and staggered along a street to create a meandering carriageway and embayed parking. This is common in safe active street design.

Where possible, build outs should be located to incorporate pedestrian desire lines as the kerb extension reduces crossing distance, improving pedestrian amenity and safety.

Figure 59: Kerb extension treatment.

4.9. Roundabouts

Definition: Roundabouts are a form of channelisation that incorporate a circular central island.

4.9.1. Types

There are two common geometric types of roundabouts and the primary difference between the two is the entry and exit curve radius

Tangential roundabouts are common in Australia and typically focus on capacity and reducing delays for people driving vehicles.

Radial roundabouts are more common in Europe and are deigned to reduce speeds and increase safety.

This guide suggests implementing radial roundabouts on local and access roads as they are more conducive to creating equitable speed for all road users, improving visibility and minimising safety issues.

Figure 60: Tangential roundabout

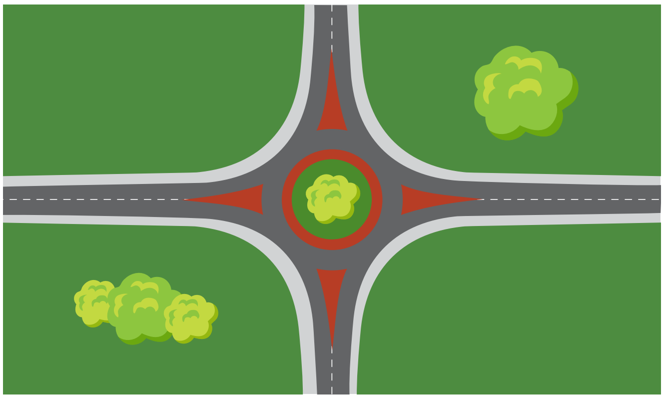
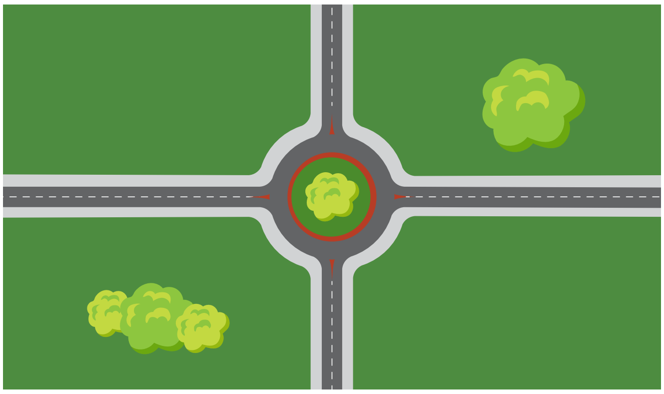


Figure 61: Radial roundabout



4.9.2. Rationale

The roundabout is the most used form of LATM in Australia that involves physical displacement (i.e., not including solutions that are signage only).

Austroads GTM Part 8 indicates that it is appropriate to use roundabouts at intersections where traffic flow from all approaches is approximately equal, and at intersections with a high crash rate, especially where crashes predominantly involved a right-angle or right-turn-through type. Roundabouts are likely to be installed for this purpose and therefore need to be appropriately designed to mitigate potential dangers for people walking and riding.

4.9.3. Safety issues

Roundabouts reduce the relative speeds of conflicting motor vehicles by providing impedance upon entering the roundabout and as a result, they typically improve safety for motor vehicle occupants. However, evidence exists that shows roundabouts are not as safe for people riding. Safety issues include:

- The large speed differential between vehicle drivers seeking to overtake a bike rider approaching or within the roundabout.
- Entering motor vehicle drivers not seeing bicycle riders already circulating the roundabout, especially when they are riding in the secondary position through the roundabout.
- Road users may not be aware that bike riders should move into the primary position prior to entering a roundabout and maintain this position through the device to increase their visibility and reduce the incidence of people driving attempting to overtake.
- Larger roundabouts are more dangerous for bicycle riders, due to the potential for higher approach and circulating speeds. Note: This guide does not apply to roundabouts on arterial roads or multi-lane roundabouts.

4.9.4. Design solutions

This guide suggests that other traffic calming solutions should be investigated prior to the installation of a roundabout. If a roundabout is deemed appropriate, the following should be considered:

- Creating equitable speeds of all road users on approach can assist with improving safety for people riding bikes.
- Roundabouts with vehicle pre-deflection being used to reduce crash severity are very common in some local government areas. At these types of existing intersections, these guidelines suggest a cycle bypass be installed. Note: roundabout design, even with a cycle bypass should consider that some people may choose to stay on the road through the roundabout (refer to Section 2).
- Roundabouts can be installed on intersections with four-legs or three-legs. It is easier to provide a cycle bypass on a roundabout that contains three-legs as the bypass can travel through the roundabout without being interrupted by an intersecting leg.
- Provide a transition from the carriageway to a path bypass on approach to a roundabout (Figure 62).
- Bicycle lanes are not recommended through roundabouts on local roads. Refer to Section 3.1 for cycle bypass design guidance.
- Road humps can be used to achieve equitable speed before the point where the rider decides how to navigate through or around the roundabout. The distance prior to the roundabout should be tested but should be between 40 m to 80 m to allow the bike rider to move to the primary position. Raised roundabouts could also be considered but should be used with caution and evaluated to ensure this leads to safer outcomes for people riding.
- When a carriageway runs downhill, it is more likely that some riders will prefer to hold the lane on approach to a roundabout rather than use a bypass. This is more common during off-peak times and when there is no vehicle traffic. Practitioners should take this into account when considering a bypass during the design of the roundabout.
- Bike rider momentum, particularly when a roundabout is constructed on an incline.

Figure 62: Transition ramp at roundabout for riders to merge onto shared path.

4.9.5. Innovative examples

Radial roundabouts

Practitioners should consider radial roundabouts in lieu of the conventional tangential design. This roundabout design creates greater deflection and repositions the vehicle driver in the centre of the roundabout to slow traffic movement. This allows more time for riders to check for vehicles and increases visibility of people riding within the roundabout. When designing radial roundabouts:

- A tight radius should be used (8 m is recommended, noting this may require further testing).
- The traffic lane width on approach legs to radial roundabouts should be 3 m (noting, this may require further testing).
- Road markings can be applied 10 m to 20 m prior to a roundabout to indicate to motor vehicle drivers that bike riders may move to the centre of the traffic lane prior to the intersection. This can assist in the reduction of vehicle driver speeds at the point where a rider may take up the primary position.

Figure 63: Innovative example: Radial roundabout in South Australia.

Source: GTA Consultants.

4.10. Driveway links

Definition: Driveway links are a single lane two-way meandering road extending over the length of two or more property frontages.

Figure 64: Driveway link example.

4.10.1. Rationale

This treatment extends the angled slow point concept (Section 4.3) across a greater length of street and increases the visual and physical impact of a slowing device. Driveway links may be considered where a full or partial road closure is not appropriate. Driveway links should have traffic volumes less than 1,000 vehicles per day to avoid congestion and increased crash risk.

4.10.2. Safety issues

Due to traffic volumes, the potential for bicycle and vehicle conflict is not common, but people riding may not be confident to hold the primary position within a driveway link while a person driving a vehicle is following.

4.10.3. Design solutions

Although driveway links are not a common form of LATM treatment, their nature restricts overtaking manoeuvres of a rider and separate facilities may be required to cater for bike riders.

The entry width of the driveway link should be 3 m.

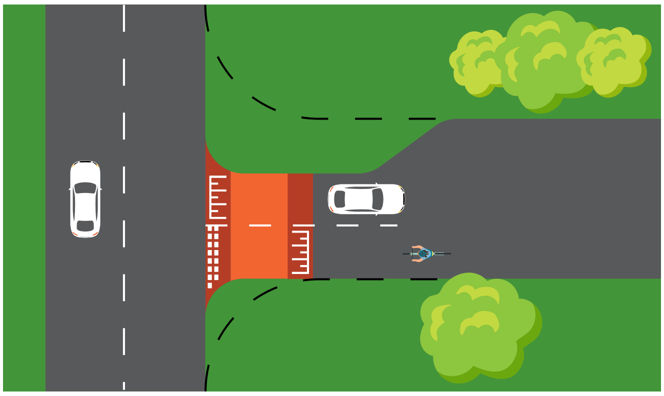
Give Way control on one of the approaches is recommended by MRWA (refer to MRWA Standard Drawing 200331-0133 for further information).

4.11. Perimeter thresholds

Definition: Perimeter thresholds are coloured or textured surface treatments that contrast with the adjacent carriageway to alert drivers they are entering a different driving environment.

Figure 65: Side road entry treatment

Image adapted from Handbook for Cycle Friendly Design, Sustrans, 2014.



Measures to consider:

- *reduced width*
- *tight radii*
- *raised crossing*
- *contrasting surface*

Figure 66: Side road entry treatment within a low speed precinct.

4.11.1. Rationale

Perimeter threshold treatments or raised entry statements are commonly used in New South Wales and Europe but less so in WA. This treatment tightens corner radii which promotes more deliberate turning movements by people driving motor vehicles.

4.11.2. Design solutions

The location of the raised plateau will depend on the context of the location. In low speed environments with higher pedestrian movements, the raised plateau should be located where the pedestrian desire line is (footpath). Pedestrians should not be expected to deviate away from the desire line.

- Narrowing the side-road carriageway to between 5 m and 6.5 m is desirable.
- The carriageway should be raised by 50 mm to 100 mm to the same level as the adjacent path.
- Consider materials that have a visual contrast with the carriageway surface to raise awareness and provide flat pedestrian crossing areas of at least 3 m width with tactile paving to indicate crossing location.
- Avoid a kerb height of more than 6 mm where pedestrians cross, as this is likely to interfere with the movement of people using wheelchairs.
- Regulatory traffic signs and pavement marking must be provided in accordance with Australian Standards and MRWA guidance.
- When installed at intersections, the plateau may extend to cover the entire intersection area similar to a raised intersection plateau (refer Section 4.6 Vertical treatments).
- Reduction in the posted speed on approach roads should be considered in tandem with this treatment.

4.11.3. Innovative examples

- Sustrans states that the optimal radius for this treatment to reduce motor vehicle driver speed is 8 m or less (Handbook for Cycle Friendly Design, Sustrans, 2014). Practitioners are encouraged to consult with MRWA when developing the initial concept.

5. References

Andriesse, R Et al. 2016, Discussion Paper Bicycle Boulevards in Urban Areas (trans. from Dutch by D. Van Den Dool), CROW.

Austroads 2017, Cycling Aspects of Austroads Guides, AP-G88-17, Austroads, Sydney, NSW.

Austroads 2009, Technical Report AP-T123/09 - Impact of LATM on Speed and Safety, Austroads, Sydney, NSW.

Austroads 2016, Safe system assessment framework, AP-R509-16, Austroads, Sydney, NSW.

Austroads 2020, Guide to traffic management part 8: Local street management, AGTM08-20, Austroads, Sydney, NSW.

Austroads 2021, Guide to road design part 3: Geometric design, AGRD03-16, Austroads, Sydney, NSW.

Austroads 2021, Guide to road design part 4: Intersections and crossings general, ARGRD04-23, Austroads, Sydney, NSW.

Austroads 2021, Guide to road safety part 1: Introduction and the safe system, AGRS01-21, Austroads, Sydney, NSW.

Austroads 2021, Guide to road safety part 3: Safe speed, AGRS03-21, Austroads, Sydney, NSW.

CROW 2006, Design manual for bicycle traffic. CROW, Utrecht, Netherlands.

Daniel, B. D., Nicholson, A., & Koorey, G. (2011). Analysing speed profiles for the estimation of speed on traffic-calmed streets. Road & Transport Research: A Journal of Australian and New Zealand Research and Practice, 20(4), 57-70.

Damen, P and Ralston, K 2015, The latest on local area traffic management practice in Australia and New Zealand – an update and comparison for local government. Level 5 Design.

Damen, P 2019, A new comparative update on experiences with local area traffic management in Australia and New Zealand, Level 5 Design.

Damen, P 2019, Local area traffic management: new findings from local government in Australia and New Zealand, Level 5 Design.

Deegan, B 2018, Light protection of cycle lanes: best practices discussion paper, International Transport Forum, Paris.

Department of Transport and Main Roads QLD 2015, Technical note 136, providing for cyclists at roundabouts. QLD.

Department for Transport United Kingdom, 2007, Manual for streets, London, UK.

Department for Transport United Kingdom 2008, Cycle infrastructure design. London, UK.

Department of Transport Western Australia 2017, Western Australian Bicycle Network Plan. Perth, WA.

Downward-Wilke, A 2012. Bicycle Lanes at Roundabouts, Viastrada, Melbourne.

Ebbelaar, L 2018, Macrae Rd and bike safety, Department of Transport WA (Your Move).

Judd, T 2018, Designing for 30km/h streets: can we do it in WA? Australian Institute of Traffic Planning and Management.

Maaza, C Et al. 2012, Low-Stress Bicycling and Network Connectivity, Mineta Transportation Institute.

Main Roads WA, 2015. Roundabouts and traffic signals Guidelines for the selection of intersection control, Main Roads WA, Perth.

Main Roads WA 2019, Local area traffic management guidance, Main Roads WA, Perth.

Main Roads WA, 2023. Supplement to Austroads Guide to Road Design - Part 3, Main Roads WA, Perth.

NACTO 2017, Designing for all ages and abilities - contextual guidance for high-comfort bicycle facilities, National Association of City Transport Officials, NY.

Oxley, J 2020, Fact Sheet NO.6: IMPROVING PEDESTRIAN SAFETY, Curtin-Monash Accident Research Centre.

Road Safety Commission WA 2017, Cyclists, Road Safety Commission WA.

Shaw, L Et al. 2012. Exploring the application of the Safe System Approach to cycling, Australasian

Road Safety Research, Policing and Education Conference.

Standards Australia 2009, Design for access and mobility, AS/NZS 1428.4.1:2009.

Sustrans 2014, Handbook for cycle friendly design. Sustrans, Scotland, UK.

The Royal Society for the Prevention of Road Safety Accidents (ROSPA) 2018, Road safety factsheet: rubber speed cushions. Birmingham, UK.

Transport for London 2014, Centreline removal trial. London, UK.

Transport for London 2016, London cycling design standards. London, UK.

Transport for New South Wales 2013, Continuous footpath treatments, Road and Maritime Services, NSW.

Weetman, R 2016. Design Details 1: nicer cities, liveable places. Wordpress.

Wegman, E. Aarts, L 2006, Advancing Sustainable Safety, SWOV Institute for Road Safety Research. Netherlands.

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