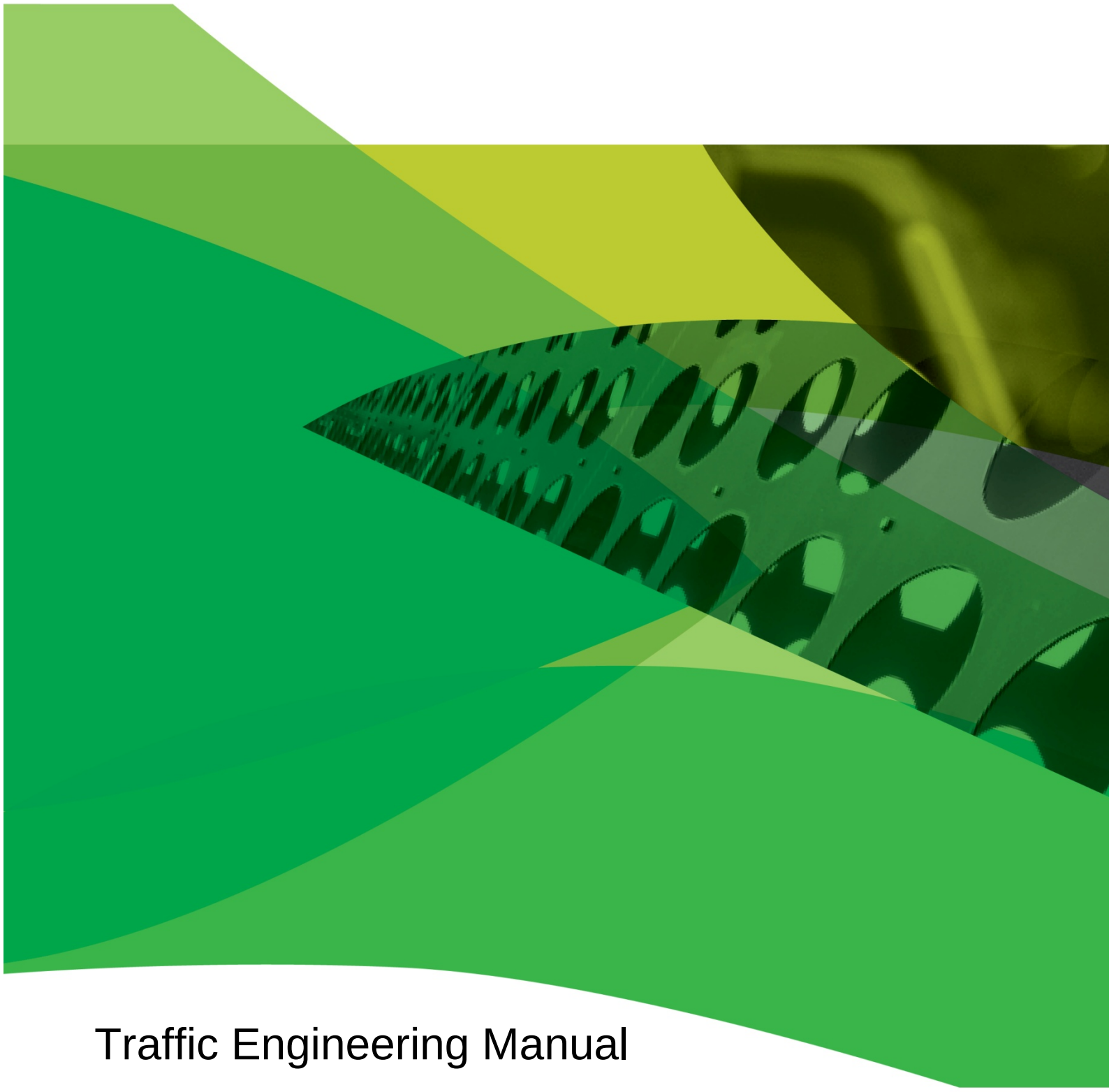


Traffic Engineering Manual

Volume 3 – Additional Network Standards & Guidelines

Guidance on Treating Bicycle Car Dooring Collisions

Edition 1, December 2016

vicroads.vic.gov.au

Table of Contents

Table of Contents **2**

1. Introduction **4**

VicRoads Movement & Place Framework and SmartRoads 5

Safe System Approach 5

Crash Reduction Factors 5

2. Summary of treatments **6**

3. Elimination treatments **9**

3.1 Relocation of parking **9**

Supporting treatments 9

Design concepts 10

Summary 10

3.2 Provision of alternative cycling routes **11**

Supporting treatments 12

Design concepts 12

Summary 12

3.3 Protected bicycle lanes **13**

3.3.1 One-way protected bicycle lanes **13**

Supporting treatments 14

Design concepts 15

Summary 23

3.3.2 Two-way protected bicycle lanes **23**

Supporting treatments 24

Design concepts 24

Summary 29

3.4 Off-road shared paths and bicycle only paths **30**

Design concepts 32

Summary 38

4. Reduction treatments **38**

4.1 Anti-dooring lanes **38**

Supporting treatments 39

Design concepts 40

Summary 41

4.2 Bicycle streets **42**

Supporting treatments 43

Design concepts 43

Summary 45

4.3 Lane sharing at intersections 45
Supporting treatments 46
Design concepts 47
Summary 47
5. Supporting treatments 48
5.1 Warning signs and pavement markings 48
Design concepts 49
Summary 50
5.2 Narrower parking spaces 50
Summary 51
5.3 Parking turnover reduction 51
Summary 52
6. Appendix A 52
Statistics – Car Dooring crashes 52
Document Information 55

1. Introduction

Car dooring involves a cyclist colliding with an open door of a vehicle. In many cases, the occupant of the vehicle has failed to see the cyclist when opening the door. Vehicle (car) doors extend approximately 1.2 m from the edge of the vehicle and therefore any cyclist riding within this distance from parked vehicles is at risk. Crashes are also caused when cyclists swerve into traffic to avoid car doors however it is difficult to account for the number of crashes that have occurred in this manner due to the nature of reporting.

This document lists possible treatments to address the issue of car dooring. All treatments (and supporting treatments) in this document are to be considered and assessed, with the rational and evaluation for the recommended treatment(s) documented.

The treatments are classified as follows:

- **Elimination treatments** – these treatments virtually eliminate the risk of dooring.
- **Reduction treatments** – these treatments reduce the risk of dooring.
- **Supporting treatments** – these treatments enhance the safety benefits already provided by the 'elimination' and 'reduction' treatments. Multiple 'supporting' treatments may be used to improve cyclist safety.

Car dooring is a serious issue for cyclists in Victoria, with the majority of crashes occurring in metropolitan Melbourne. The issue gained prominence following the death of a cyclist on Glenferrie Road in Hawthorn in 2010. Since 2010, two other cyclists have died as a result of crashes involving car doors and the number of injuries sustained as a result of dooring has almost doubled between 2005 and 2015 (see Figure 1).

Rule 269(3) of the Victorian Road Safety Road Rules 2009 stipulates that a person must not cause a hazard to any person or vehicle by opening a door of a vehicle, leaving a door of a vehicle open, or getting off, or out of, a vehicle. In 2012, the maximum court penalty for dooring increased to $1408 from $423.

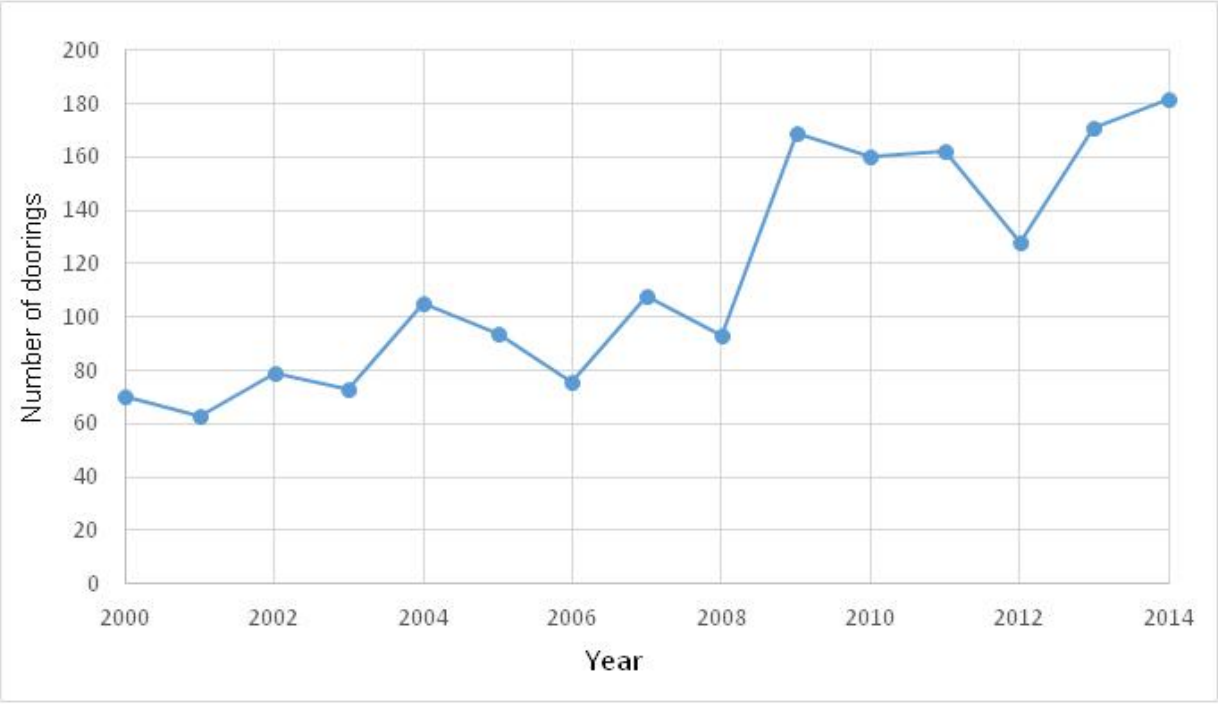


Figure 1: Total number of car doorings per year in metropolitan Melbourne

Refer to Appendix A for car dooring statistics.

VicRoads Movement & Place Framework and SmartRoads

The Movement and Place framework supports integrated transport and land use decision making by considering the variety of roles that roads and streets play. Many of Victoria's roads cater for high volumes of "movement" by various modes of transport, while others are quiet local streets. Streets and roads are also "places" such as shopping and leisure destinations, local neighbourhoods or tourist routes, and contribute to Victoria's liveability and character.

The primary objective of SmartRoads is to improve the long term operational management of arterial roads across Victoria by providing priority to modes of transport, on certain roads, and at particular times of the day. SmartRoads recognises the increasing importance of public transport, walking and cycling as transport modes. Under SmartRoads, certain roads have been classified as bicycle priority routes where there is a focus on providing facilities that promote and prioritise cycling movements.

Each treatment in this document will make reference to SmartRoads. This document will be updated further as the Movement and Place framework develops.

Safe System Approach

The Safe System approach to road safety is the key concept in Victoria's strategy to reduce fatalities and serious injuries from road crashes. The Safe System approach is built on the premise that people make mistakes which can lead to crashes and that there is a limit to the human body's tolerance to crash forces. Accordingly, the road transport system needs to be designed and managed to cater for human failure.

By applying the Safe System philosophy, the long term vision is to eliminate fatal and serious injuries arising from crashes. The achievement of a Safe System is a shared responsibility and it requires four interconnected cornerstones of safe travel to be working effectively together – safer people, safer vehicles, safer roads and safer speeds.

To create a Safe System, it is important to influence how people and vehicles can safely access the road system. Greater emphasis and effort needs to be placed on developing and maintaining more forgiving roads and roadsides, so both the likelihood of a crash occurring and the severity of crashes when they do occur are reduced.

In the event of a crash, pedestrians and cyclists are more vulnerable than vehicle occupants because they have little or no protection. Well designed and maintained paths will help in the safety of pedestrians and cyclists and also encourage more walking and cycling as the best way to stay healthy and get around.

VicRoads' key role is to help provide Victorians with safe and easy connections to the people and places that matter most to them. As part of the VicRoads' aim to achieve ongoing reductions in the number and severity of road crashes and the resultant cost of road trauma, several treatments have been developed to help improve the safety of cyclists. This document aims to eliminate and reduce the risk of car-dooring and increase the safety of cyclists.

Each treatment in this document will make reference to the Safe System approach.

Crash Reduction Factors

For the crash reduction factors for the various treatments listed in this document, practitioners should refer to the latest available research. At the time of publication, the following documents may be useful in providing guidance for these factors:

- Austroads Research Report AP-R508-16: Speed Reduction Treatments for High-speed Environments (2016)
- Austroads Technical Report AP-T151/10: Road Safety Engineering Risk Assessment Part 6: Crash Reduction Factors(2010)
- Austroads Research Report AP-R422-12: Effectiveness of Road Safety Engineering Treatments (2012)

It should be noted that other research may be available and practitioners may use this information where appropriate.

2. Summary of treatments

The following tables provide a brief overview of the treatments and their use in certain road environments.

For full details regarding a treatment's effectiveness and appropriateness in certain road environments, please refer to the detailed section for each treatment.

Table 1: Overview of treatments and their use in certain road environments

	Treatments to eliminate bicycle 'car dooring' collisions				
Road Use Classification (including SmartRoads Road Use Hierarchy categories)	Relocation of car parking	Relocation of cyclists	One-way protected lanes	Two-way protected lanes	Off-road paths
Preferred traffic route					
Tram priority route					
Bus priority route					
Pedestrian priority area (or network)					
Bicycle priority route					
Traffic route					
Freight route					
Collector road (without specific traffic priority)					
Local road (without specific traffic priority)					

KEY:

 Appropriate May be appropriate Unlikely to be appropriate

Table 2: Overview of treatments and their use in certain road environment

	Treatments to reduce bicycle 'car dooring' collisions		
Road Use Classification **(including SmartRoads Road Use Hierarchy categories)**	Anti-dooring lanes	Bicycle streets	Lane sharing
Preferred traffic route			
Tram priority route			
Bus priority route			
Pedestrian priority area (or network)			
Bicycle priority route			
Traffic route			
Freight route			
Collector road (without specific traffic priority)			
Local road (without specific traffic priority)			

KEY:

 Appropriate  May be appropriate  Unlikely to be appropriate

Figure 2 illustrates a number of treatment options that are available for different operating speed roads. For full details regarding a treatment's potential at different operating speeds, please refer to the detailed section for each treatment.

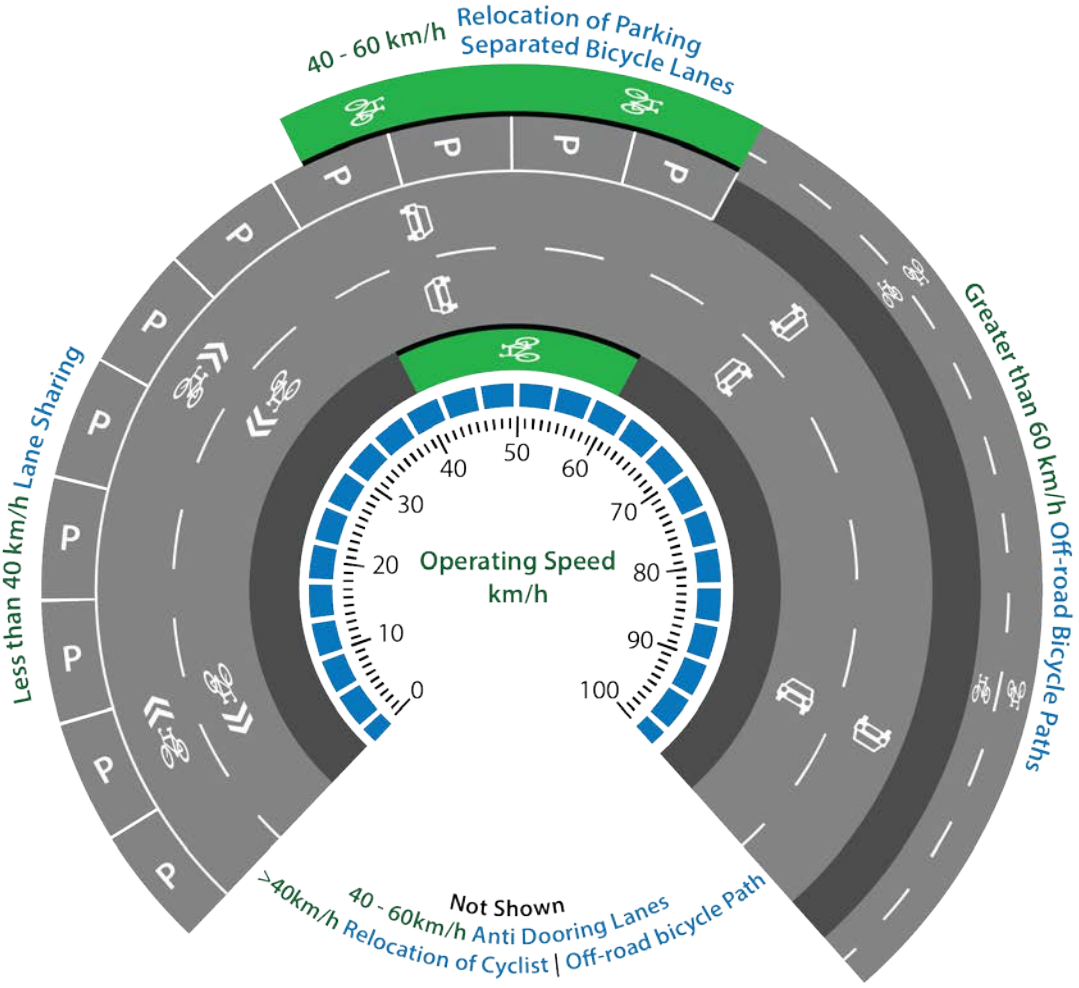


Figure 2: Treatment options based on operating speed[1]

[1] Concept taken from Traffic Planning Guide Series, source: http://copenhagenize.eu)

3. Elimination treatments

3.1 Relocation of parking

This treatment refers to the removal of on-street car parking spaces to mitigate the risk of car dooring. As vehicles no longer park alongside cyclists under this treatment, the issue of dooring is virtually eliminated. To compensate for the loss of parking, additional parking spaces may need to be provided on nearby streets or through off-street car parking facilities. Improvements to nearby public transport facilities could also be considered as another way to compensate for the loss of parking.

The treatment also frees up space within the road reserve for bicycle specific infrastructure.

Potential locations for the relocation of parking include:

- Roads with large volumes of cyclists, including roads identified as bicycle priority routes under the VicRoads SmartRoads strategy.
- Roads with a history of conflict between bicycles and parked vehicles. Roads with a relatively small number of commercially zoned premises.
- Areas where off-street parking is already provided.
- Narrow roads that may not have enough space for other treatment options and therefore cannot safely manage multiple road users with competing needs.
- Examples of relocation of parking include:
    - The use of permanent clearways.
    - Along tram priority routes (e.g. High Street, Northcote around tram stops).

Where such a treatment is to be considered, the following should be taken into account:

- On-street parking is generally the responsibility of local governments (municipal councils).
- Relocation of parking to local roads may cause congestion issues as some local roads may not be designed for large volumes of traffic. In addition, this may lead to safety issues for all road users.
- Encouraging vehicles to use off-street parking facilities may lead to an increase in crashes at entries and exits to parking facilities.
- Relocation of on-street car parking may be a difficult treatment to implement due to resistance from local traders and nearby residents.
- Provision of bicycle parking facilities to encourage mode shift and reduce demand on car parking spaces.

An evaluation of the no stopping and no parking trial on Beach Road between St Kilda and Mordialloc during weekends found a significant improvement in cyclist safety. There has been a significant reduction in the number of cyclists weaving around parked vehicles, an increase in the number of overtaking manoeuvres leading to a reduction in the number of groups with more than 20 riders and a reduction in the number of times that riders rode in more than one lane[2].

Supporting treatments

Listed below are supporting treatments that can be used with this primary treatment. For full details on each supporting treatment (including appropriate locations and other considerations), refer to the main ‘reduction treatments’ (Section 4) of this document.

Supporting treatments that may be used with the relocation of parking include:

- Fully separated bicycle lanes.

[2] VicRoads. 2011, “Beach Road – Route 33: Bay Street, Port Melbourne to Nepean Highway, Mordialloc Weekend Parking Bans

Design concepts

Figure 3 below shows a road with on-street parking removed and a bicycle lane provided through a shopping strip.

Figure 3: High Street, Northcote

Summary

Relocation of parking has the following pros and cons:

Pros

- Virtually eliminates the risk of car dooring by removing the conflict between bicycles and parked vehicles.
- Provides more space on the carriageway for bicycle specific infrastructure.
- May increase cycling participation due to improvements in safety.
- Relocation of on-street car parking leads to a more economical use of road space as it allows all forms of transport to flow more efficiently and safely.

Cons

- Parking may need to be provided in other locations, which may be costly to establish due to acquisition of land and construction.
- Off-street car parking facilities may lead to more crashes between cyclists and vehicles when vehicles enter and exit driveways.
- Without a well considered plan, nearby residential streets may become congested with parked vehicles leading to potential safety and amenity issues for all road users.

Further reading

- Details regarding parking design are contained in the Austroads Guide to Traffic Management Part 11: Parking (2008)
- VicRoads Supplement to Austroads Guide to Traffic Management Part 11 (2015).

3.2 Provision of alternative cycling routes

This treatment refers to relocating cyclists from busy streets onto local roads with lower volumes of traffic and lower parking turnover. It reduces car dooring by encouraging cyclists to travel through lower risk routes.

Potential locations for relocating cyclists include:

- Roads where a secondary, parallel option for cyclists is available.
- Roads with a history of conflict between bicycles and parked vehicles.
- Roads with large volumes of cyclists, including roads identified as bicycle priority routes under the VicRoads SmartRoads strategy.
- Collector and distributor roads that form part of a preferred traffic route or tram priority route under the VicRoads SmartRoads strategy – it may be desirable to move cyclists from these roads.
- Narrow roads where it may be difficult to install bicycle specific infrastructure. Examples of locations where this type of treatment has been used include:
    - Relocating cyclists from Brunswick Street to Napier Street, Fitzroy.
    - Relocating cyclists from Lygon Street to Canning Street or Rathdowne Street, Carlton.
    - Relocating cyclists from Hoddle Street/Punt Road to Nicholson Street/Lennox Street, Richmond.
    - Relocating cyclists from Victoria Parade to Albert Street, East Melbourne.

Figure 4 illustrates the routes that many cyclists are forced to take to safely navigate to their destinations using local roads. In this example, cars are given a direct route. Figure 5 demonstrates how the road network could be upgraded to promote bicycle riding and discourage motor vehicle travel.

Figure 4[3]

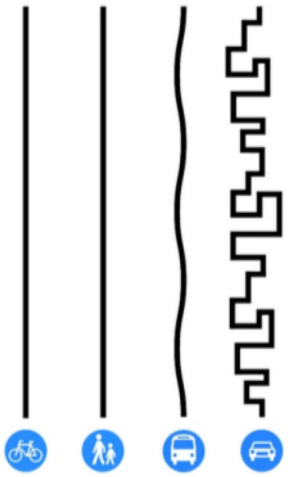


Figure 5[3]

Where such a treatment is to be considered, the following should be taken into account:

- Enhancement of the treatment is possible by encouraging motorists to avoid local roads. This can be achieved through traffic calming measures and diversions for motorists.
- Preferred routes for cyclists should flow and offer continuity. This can be achieved by ensuring that local roads link up to existing bicycle infrastructure and ensuring cyclists do not have to stop to give way to other traffic by changing priority at intersections. Routes should also be simple to navigate with as few turns onto new roads as possible.
- Significant effort should be directed towards encouraging cyclists to use local roads. This could be achieved through the use of signs guiding bicycle traffic and improved (or the provision of) bicycle infrastructure. Education and marketing of the alternative route may be required.

[3] Traffic Planning Guide Series http://www.copenhagenize.eu

- Opposition from riders where cyclists are to be banned from preferred traffic routes.
- Impact on local residents on the parallel route (e.g. in mobility and access to properties).
- Whether an upgrade to cycling infrastructure is required on the parallel route to ensure the safety of cyclists and efficiency of the route.

Supporting treatments

Listed below are supporting treatments that can be used with this primary treatment. For full details on each supporting treatment (including appropriate locations and other considerations), refer to the main 'reduction treatments' (Section 4) of this document.

Supporting treatments that may be used with the relocation of cyclists include:

- Warning signs.
- Narrower parking spaces.
- Parked vehicle turnover reduction.

Design concepts

Figure 6 shows a parallel local road being used as a bicycle route, avoiding the busier arterial road.

Figure 6: Bicycle bypass through road closure on Canning Street, Carlton North

Summary

Relocation of cyclists has the following pros and cons:

Pros

- Removes cyclists from areas of high car parking turnover and relocates them to local roads.
- Less interaction between cyclists and through traffic which may improve safety of cyclists.

Cons

- May increase the potential for crashes on local roads that may see an influx of cycling traffic.
- Treatment is only viable for roads that have a nearby, parallel road.
- Does not provide cyclists with direct access to popular destinations along the main road.

Further reading

- Further details on relocation of cyclists are contained in Austroads Guide to Traffic Management - Part 8: Local Area Traffic Management (2016) and VicRoads Supplement to Austroads Guide to Traffic Management Part 8 (2015).

3.3 Protected bicycle lanes

3.3.1 One-way protected bicycle lanes

A one-way protected bicycle lane (commonly known as 'Copenhagen bicycle lanes') is a style of bicycle infrastructure that positions the bicycle lane between parked cars and the footpath, with physical separation from through traffic and/or the parking lane. It virtually eliminates the risk of dooring as bicycles are not forced to ride in a narrow passage between moving traffic and parked vehicles.

Potential locations for one-way protected bicycle lanes include:

- On bicycle priority routes as defined in the VicRoads SmartRoads strategy.
- Wide roads which may have a necessity for on-street parking.
- Roads with a history of conflict between bicycles and parked vehicles.
- Routes used by commuters.
- Roads with large volumes of cyclists.
- Where parking is required during peak times.

Where such a treatment is to be considered, the following should be taken into account:

- Sight distance may be an issue at driveways and intersections where cyclists may be obscured by parked cars. Extra space may need to be positioned around these conflict points, which may result in a loss of car parking spaces.
- Due to conflicts between riders and motorists at signalised intersections, provisions in traffic signal phasing may be required to give cyclists priority and ensure safety of riders. Possible solutions include continuation of the separated lane to and through the intersection (with signal priority), bicycle early start and hook turn boxes (see design concepts).
- Motorists who have parked their cars are required to cross bicycle traffic to access the footpath. This may lead to an increase in crashes involving pedestrians.
- May reduce the width of the carriageway available for other road users.
- Where there is little separation between the bicycle lane and parking lane, there is a risk of cyclists colliding with open doors on the left passenger side of the vehicle however the risk of being doored by the passenger side is significantly lower given the large percentage of vehicles with only one occupant.
- Provision of infrastructure to allow mobility impaired users to cross the bicycle lane between the footpath and parking bay. This includes the use of kerb ramps and an allowance in the separator for mobility aids (see design concepts).
- Bicycle lanes need to be maintained which includes regular sweeping to remove debris.

Education campaigns may assist in raising awareness of one-way protected bicycle lanes. This includes signage at conflict points to ensure motorists are aware of the presence of bicycles and education to ensure pedestrians and cyclists understand the risk of crashes occurring and exercise proper caution.

The Future Melbourne (Transport) Committee produced an assessment of the La Trobe Street bicycle lanes in 2014. The assessment looks at three main issues - traffic and cyclist volumes, travel times and safety.

The assessment found that after protected bicycle lanes were installed:

- Volume of motor vehicle traffic has decreased by 25% in the morning (AM) peak and 10% in the afternoon (PM) peak.
- Volume of cyclists has doubled in the morning (AM) peak and tripled in the afternoon (PM) peak.
- Travel times for motorists temporarily increased after the installation of bicycle lanes but have returned to the original time after traffic signals were reprogrammed.

- In the five-year period prior to installation there were 36 crashes involving cyclists recorded on La Trobe Street. In the seven-month period after installation there were 9 crashes involving cyclists recorded. The number of crashes in the period after installation may be caused by the increased volume of cyclists using the route and this number may reduce as cyclists and motorists become more aware and adapt to the new environment.
- There was a reduction in the number of dooring crashes occurring on La Trobe Street[4].

CDM Research produced a report on cyclist collisions with car doors. Part of the research within the report looked at which door was most likely to cause a cyclist to crash. The findings are summarised in Figure 7[5].

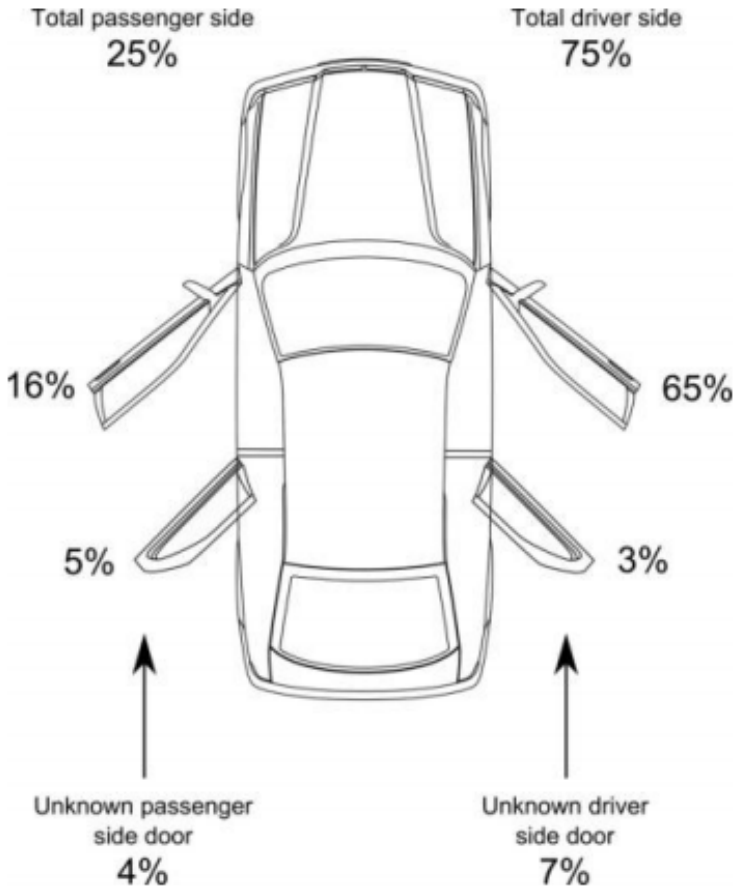


Figure 7: Door with which collision occurred (inner Melbourne, 2006-2010.[5]

Supporting treatments

Listed below are supporting treatments that can be used with this primary treatment. For full details on each supporting treatment (including appropriate locations and other considerations), refer to the main 'reduction treatments' (Section 4) of this document.

Supporting treatments that may be used with one-way protected bicycle lanes include:

- Warning signs
- Narrower parking spaces

[4] Future Melbourne (Transport) Committee, 2014, "La Trobe Street Bicycle Lanes Post Implementation Assessment"
[5] CDM Research, 2012, "Cyclist Collisions with Car Doors", Road Safety Action Group Inner Melbourne

Design concepts

Examples of one-way protected bicycle lanes can be found in Figures 8, 9 and 10.

Figure 8: One-way protected bicycle lane on Albert Street, East Melbourne

Figure 9: One-way protected bicycle lane on Wellington Street, Collingwood

Figure 10: One-way protected bicycle lane on La Trobe Street, Melbourne Central Business District

Figure 11 shows a typical cross section of a road with trams and one-way protected bicycle lanes.

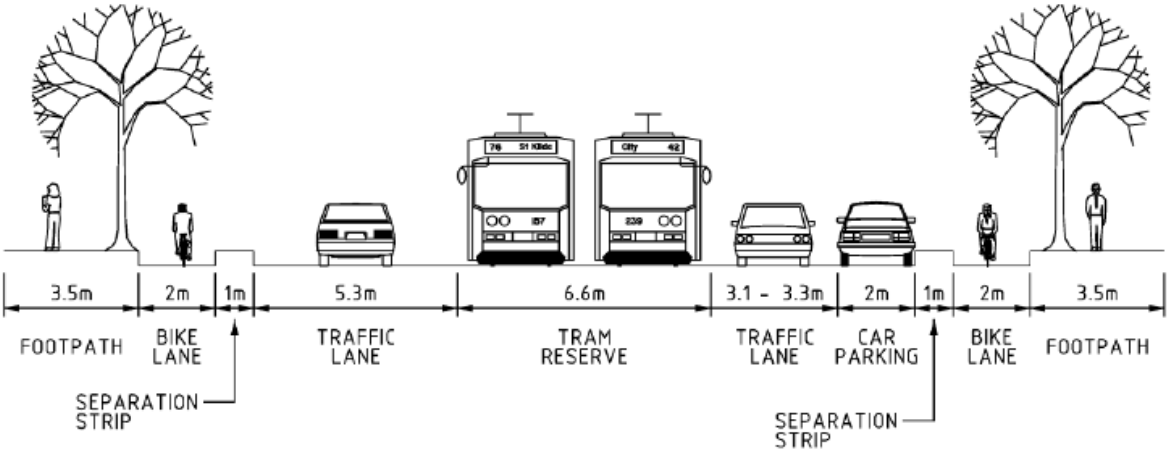


Figure 11: Typical layout of one-way separated bicycle lane[6]

As per Austroads Guide to Road Design Part 3, the minimum width for protected bicycle lanes is 1.8 m. Wider lanes of 2.0 m or greater will enable cyclists to pass one another. Physical separation from motor traffic should be provided by a raised traffic island or a safety strip that is desirably 1.0 m or greater wide (0.6 m minimum).

[6] Austroads Guide to Road Design Part 3 (2016)

Providing for mobility impaired users

An example of providing for mobility impaired users is shown in Figure 12.The figure shows a crossing point with a kerb ramp and additional space around disabled parking bays to accommodate wheelchairs.

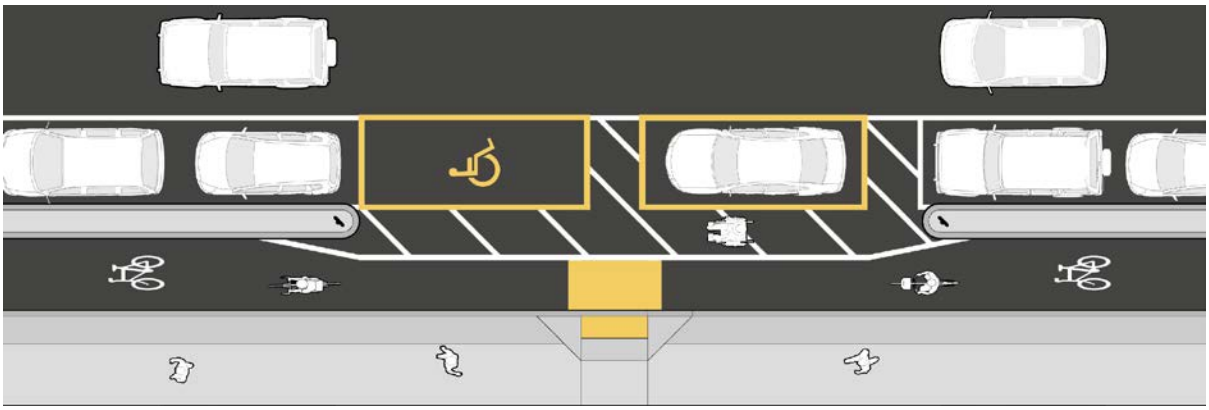


Figure 12: Providing for mobility impaired user across a protected bicycle lane[7]

At bus stops

An example of an arrangement at bus stops is shown in Figure 13. Note this is one example that can be used; practitioners may develop other options based on local or project requirements.

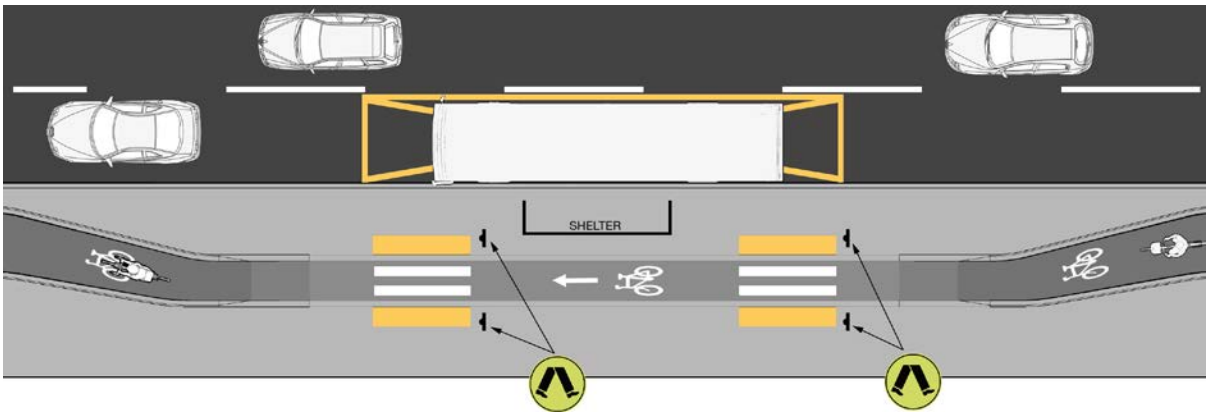


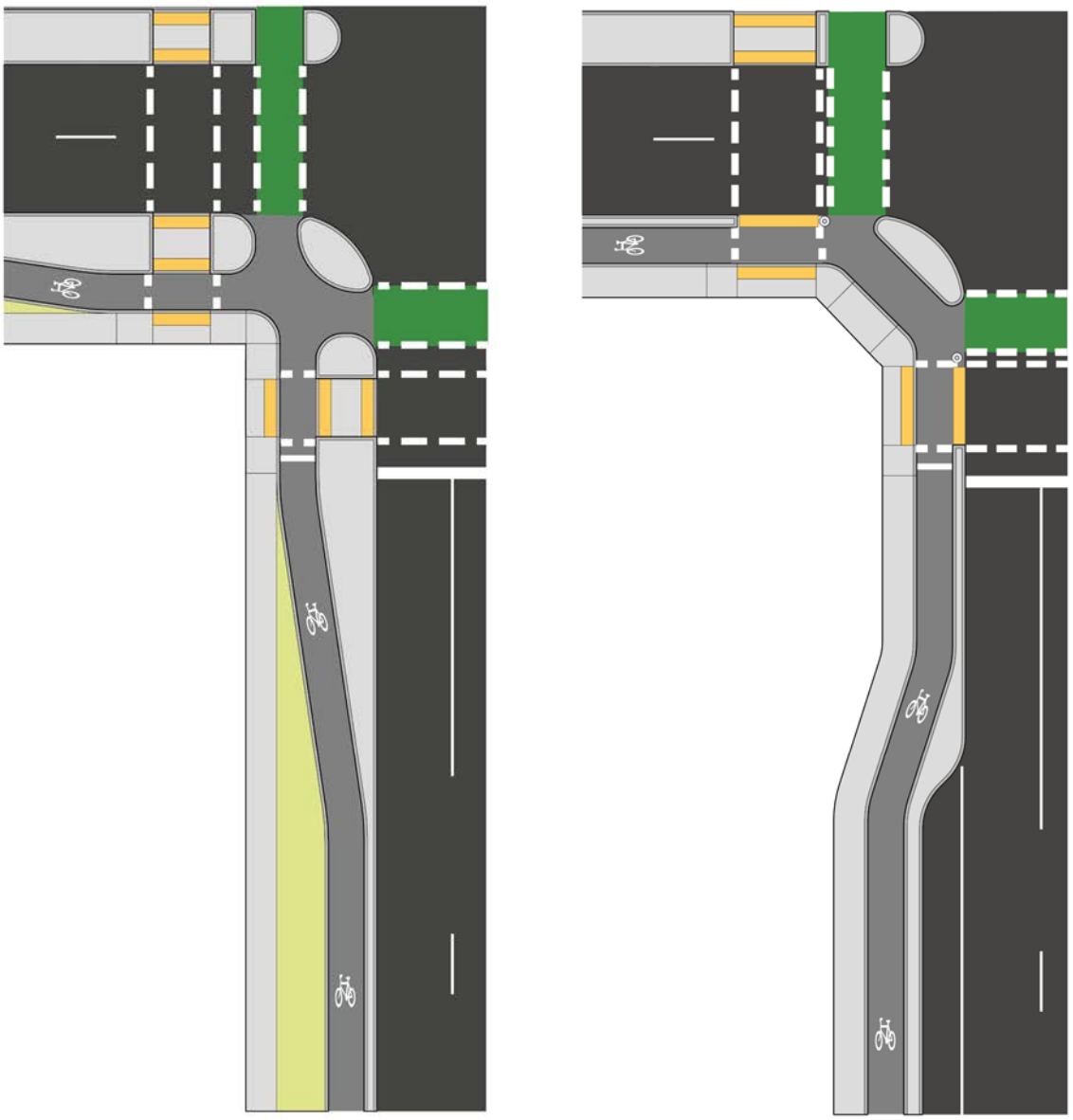
Figure 13: Protected bicycle lane arrangement at bus stops[8]

[7] Adapted from Massachusetts Department of Transportation (MassDOT) Separated Bike Lane Planning & Design Guide, Chapter 5, Section 5.1
http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms/SeparatedBikeLanePlanningDesignGuide.aspx

[8] Adapted from MassDOT Separated Bike Lane Planning & Design Guide, Chapter 5, Section 5.4
http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms/SeparatedBikeLanePlanningDesignGuide.aspx

At signalised intersections

Figure 14 shows how protected bicycle lanes can be provided at and on the approach to the signalised intersection.



Bend-out example ***Bend-in constrained example***

Figure 14: Protected bicycle lanes at an intersection[9]

[9] Adapted from MassDOT Separated Bike Lane Planning & Design Guide, Chapter 4, Section 4.3 http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms/SeparatedBikeLanePlanningDesignGuide.aspx

Driveways

Where the bicycle lane is adjacent to a road (e.g. kerb bicycle lane) and parking is allowed parallel to the bicycle lane, parking should be restricted in advance of the driveway to achieve adequate approach sight distance. A clear line of sight should be provided between motorists exiting and entering the driveway and approaching bicycles. Sight lines should be examined before major reconstruction projects to identify strategies to further improve visibility (e.g. relocating road furniture, lengthening kerb extensions, etc.)[10].

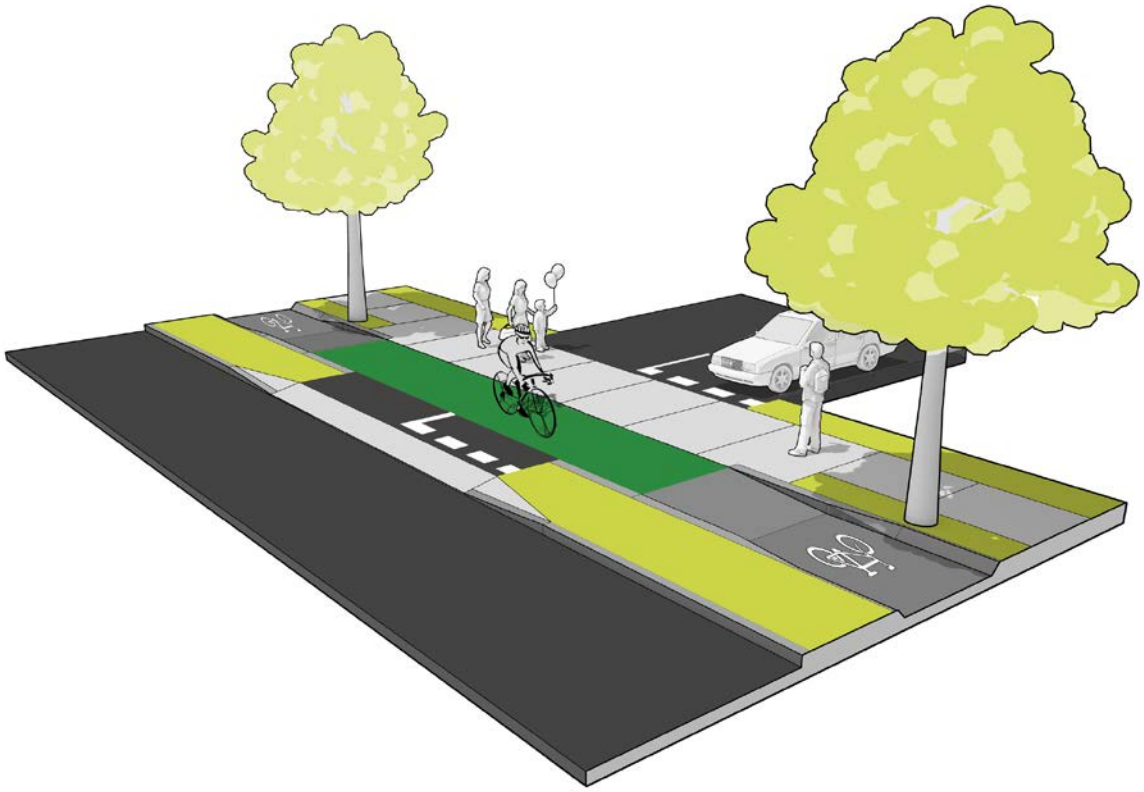


Figure 15: Example of side street / wide driveway bicycle path crossing[10]

Transition from protected separated bicycle lane

Figure 16 shows a possible transition arrangement between protected separated bicycle lanes and on-road bicycle lanes. Bicycle hook turn boxes are also shown for turns into the intersecting road.

Figure 17 shows a possible transition arrangement between protected separated bicycle lanes and a bicycle street. Bicycle hook turn boxes are also shown for turns into the intersecting road.

Figure 18 shows possible treatment options around left turn lanes where the bicycle lane is to remain on-road.

[10] Adapted from MassDOT Separated Bike Lane Planning & Design Guide, Chapter 4, Section 4.2 http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms/SeparatedBikeLanePlanningDesignGuide.aspx

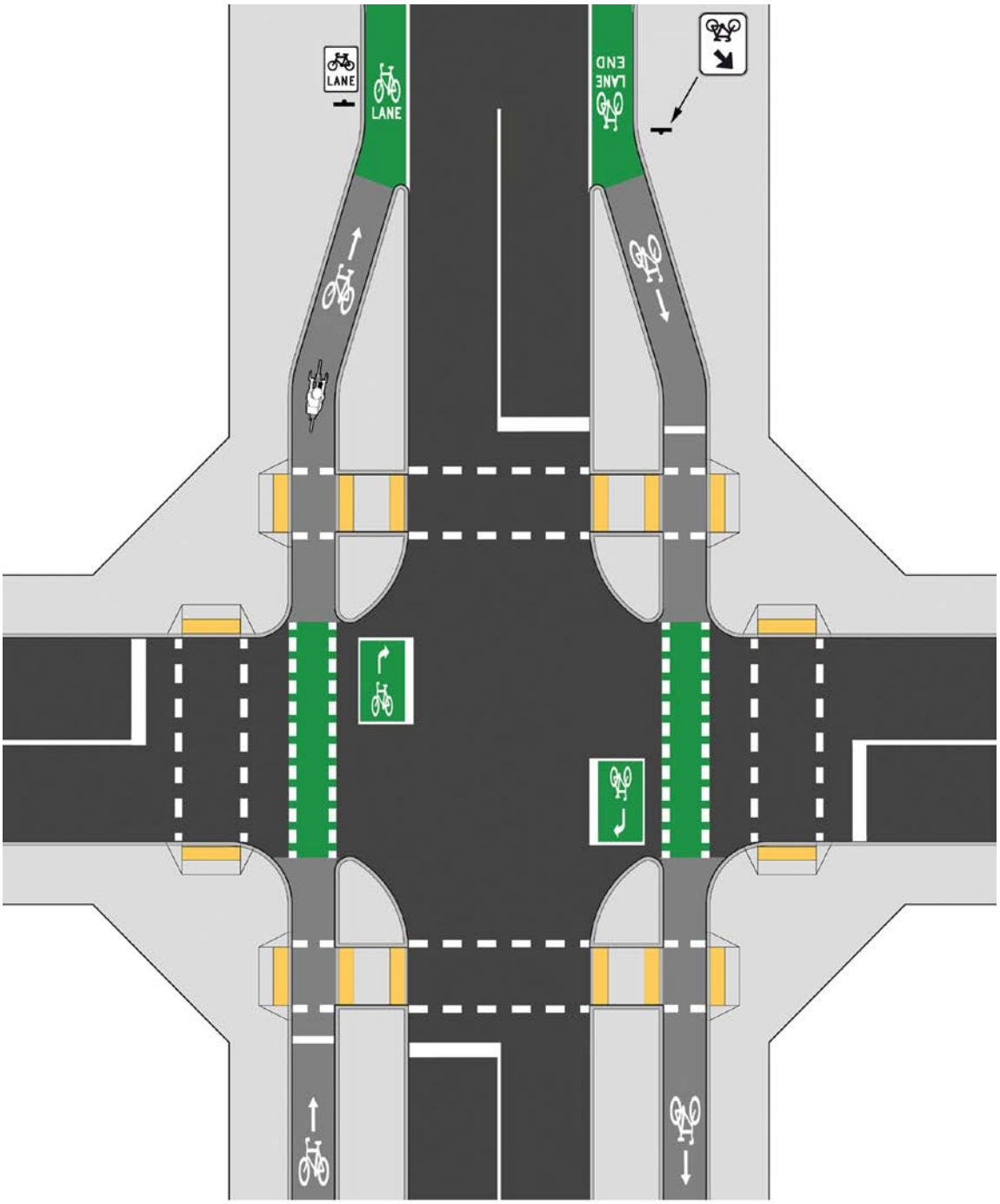


Figure 16: Transition from protected separated bicycle lane to a bicycle lane[11]

[11] Adapted from MassDOT Separated Bike Lane Planning & Design Guide, Chapter 4, Section 4.5 https://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms/SeparatedBikeLanePlanningDesignGuide.aspx

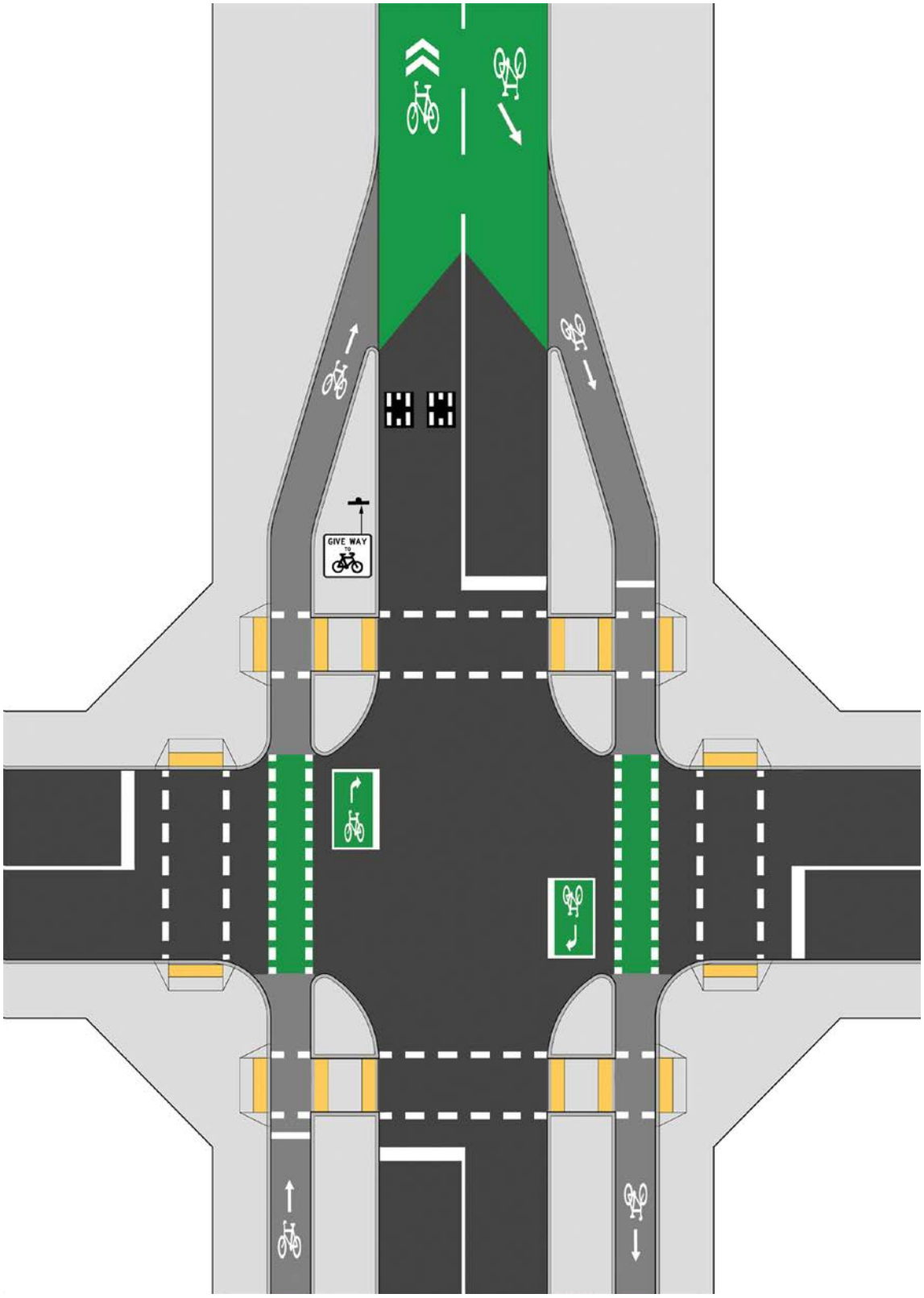


Figure 17: Transition from protected separated bicycle lane to a bicycle street[11]

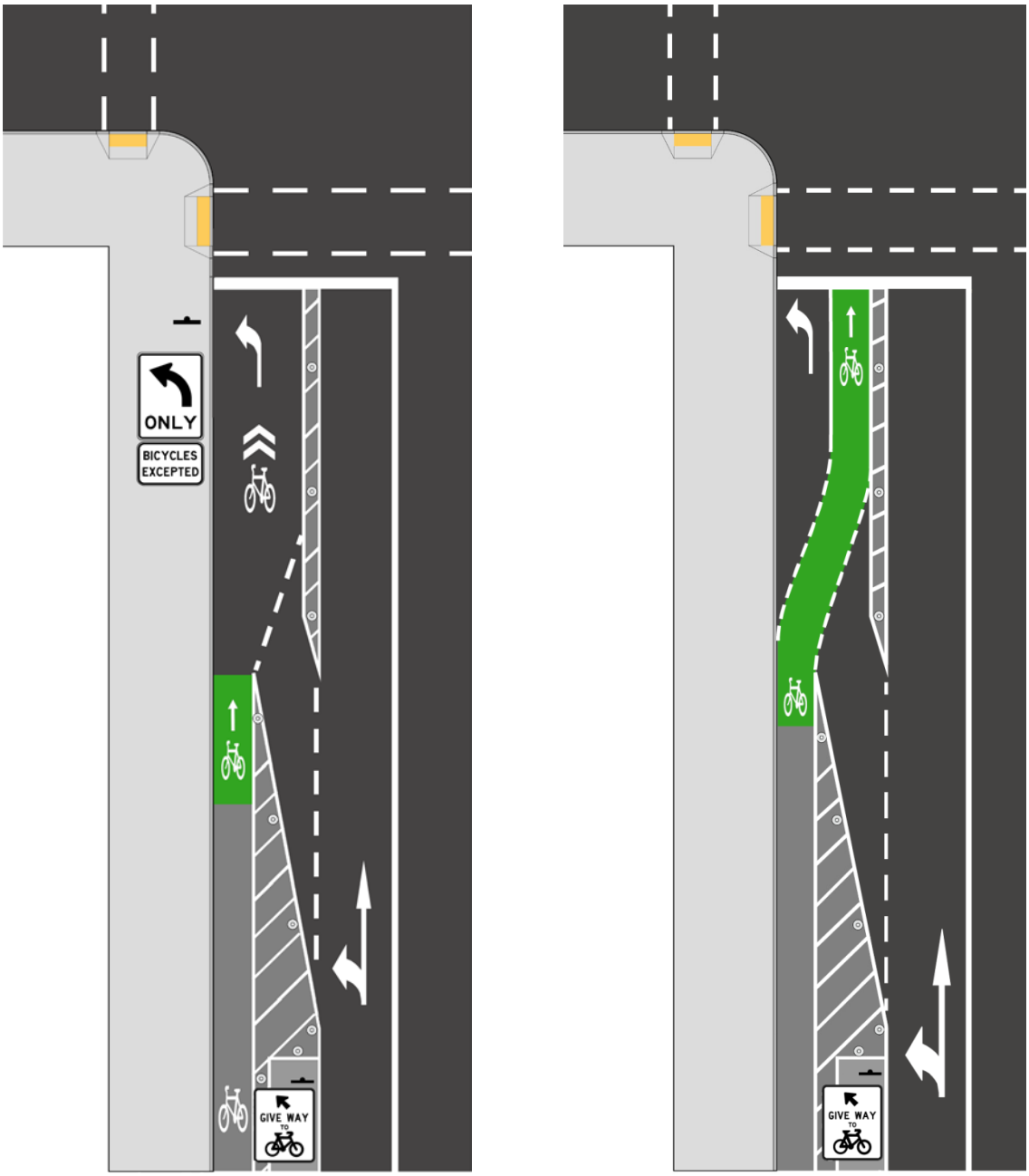


Figure 18: Shared left turn and bicycle lane treatments[9]

Examples of one-way separated bicycle lanes

Examples of one-way separated bicycle lane can be found on:

- Albert Street, East Melbourne.
- La Trobe Street, Melbourne.
- Swanston Street, Carlton.
- Wellington Street, Collingwood.
- St Kilda Road, Melbourne.

Summary

One-way protected bicycle lanes have the following pros and cons:

Pros

- Removes bicycles from the vicinity of car doors on the driver's side of the vehicle.
- Physically separates cyclists from moving (motorised) traffic.
- Connects easily to other on-road bicycle lanes and infrastructure.

Cons

- May lead to conflicts at intersections and property access points (driveways) where vehicles turn across the bicycle lane, which is escalated by the lack of visibility due to parked cars and other road furniture obstructing motorists' views.
- Additional road space may be required through redistribution of road reserve or land acquisition.

Further reading

- Austroads Guide to Road Design Part 3: Geometric Design (2016) – details on one-way separated bicycle lane in Section 4.8.5
- VicRoads Supplement to Austroads Guide to Road Design Part 3
- VicRoads Design Guidance for Strategic Cycling Corridors
- Cycling Aspects of the Austroads Guides
- Queensland Department of Transport and Main Roads Technical Note 128, Selection and Design of Cycle Tracks (May 2015), Section 3.4

3.3.2 Two-way protected bicycle lanes

This treatment is similar to one-way protected bicycle lanes but with both directions of bicycle traffic riding on one side of the road. Two-way protected bicycle lanes virtually eliminate the risk of dooring by removing cyclists from a position between parked cars and moving traffic.

Potential locations for two-way protected bicycle lanes include:

- Roads with limited space and one-way protected bicycle lanes in each direction are not feasible.
- Roads with a history of conflict between bicycles and parked vehicles.
- Roads with large volumes of cyclists, including roads identified as bicycle priority routes under the VicRoads SmartRoads strategy.
- Roads where there is an unbalanced flow of bicycle traffic (e.g. towards the city in the morning peak).

Where such a treatment is to be considered, the following should be taken into account:

- Sight distance may be an issue at driveways and intersections where cyclists may be obscured by parked cars. Extra space may need to be positioned around these conflict points, which may result in a loss of car parking spaces.
- May increase the number of crashes between cyclists travelling in opposing directions.
- Adds to conflict at intersections particularly as motorists are not accustomed to looking both ways for cyclists.
- Motorists who have parked their cars are required to cross the bicycle lane to access the footpath. This may lead to an increase in crashes involving pedestrians as they may not be used to looking both ways for cyclists.
- Difficult for cyclists to access the other side of the road (i.e. the side which does not have the two-way protected bicycle lane). Where the two-way protected bicycle lane terminates, it may require riders riding in the opposing direction to the adjacent traffic lane to cross to the opposite side of the road in order to continue riding – resulting in conflicts with other modes.

- Due to conflicts between riders and motorists at signalised intersections, provisions in traffic signal phasing may be required to give cyclists priority and ensure safety of riders. Possible solutions include continuation of the separated lane to and through the intersection (with signal priority), bicycle early start and hook turn boxes (see design concepts).
- Provision of infrastructure to allow mobility impaired users to cross the bicycle lane between the footpath and parking bay is generally required. This includes the use of kerb ramps and an allowance in the separator for mobility aids (see design concepts for one-way bicycle lanes as a guide).
- Bicycle lanes need to be maintained which includes regular sweeping to remove debris.

It should be noted that the one-way protected bicycle lane treatment is preferred over the two-way protected bicycle lane treatment as the latter may add to conflict at intersections and crossing points due to motorists and pedestrians not accustomed to looking both ways for cyclists.

According to an Organisation for Economic Co-operation and Development (OECD) report on Cycling, Health and Safety, in order to avoid crashes between cyclists and motorised vehicles at crossroads, separated cycle lanes along roads are preferably one-way. The report stated that "bi-directional cycle tracks along roads invariably lead to non-conventional manoeuvres at junctions and where such tracks terminate. These situations entail a significant risk of crashes". However, two-directional cycle tracks may be used where there are space constraints for two unidirectional bicycle lanes[12].

Supporting treatments

Listed below are supporting treatments that can be used with this primary treatment. For full details on each supporting treatment (including appropriate locations and other considerations), refer to the main 'reduction treatments' (Section 4) of this document.

Supporting treatments that may be used with two-way protected bicycle lanes include:

- Warning signs.
- Narrower parking spaces.

Design concepts

The minimum width for protected bicycle lanes is 2.0 m. Wider lanes of 2.5 m or greater will enable cyclists to pass one another. Physical separation from motor traffic should be provided by a raised traffic island or a safety strip that is desirably 1.0 m or greater wide (0.6 m minimum).

Examples of two-way separated bicycle lanes

Examples of two-way separated bicycle lanes can be found on:

- Fitzroy Street, St Kilda (see Figure 19).
- South Caloundra 'Aura' development, Queensland (see Figure 20 and Figure 21).
- Beaconsfield Parade, Middle Park (see Figure 22).

[12] OECD/International Transport Forum (2013), Cycling, Health and Safety, OECD Publishing/ITF.

Figure 19: Two-way protected bicycle lane on Fitzroy Street, St Kilda

Figure 20: Two-way protected bicycle lane in South Caloundra 'Aura' development, Queensland. Photo courtesy of Queensland Department of Transport and Main Roads

Figure 21: Two-way protected bicycle lane in South Caloundra 'Aura' development, Queensland. Photo courtesy of Queensland Department of Transport and Main Roads

Figure 22: Two way kerb bicycle path on Beaconsfield Parade, Middle Park

At signalised intersections

Figure 23 shows how protected bicycle lanes can be provided at and on the approach to a signalised intersection.

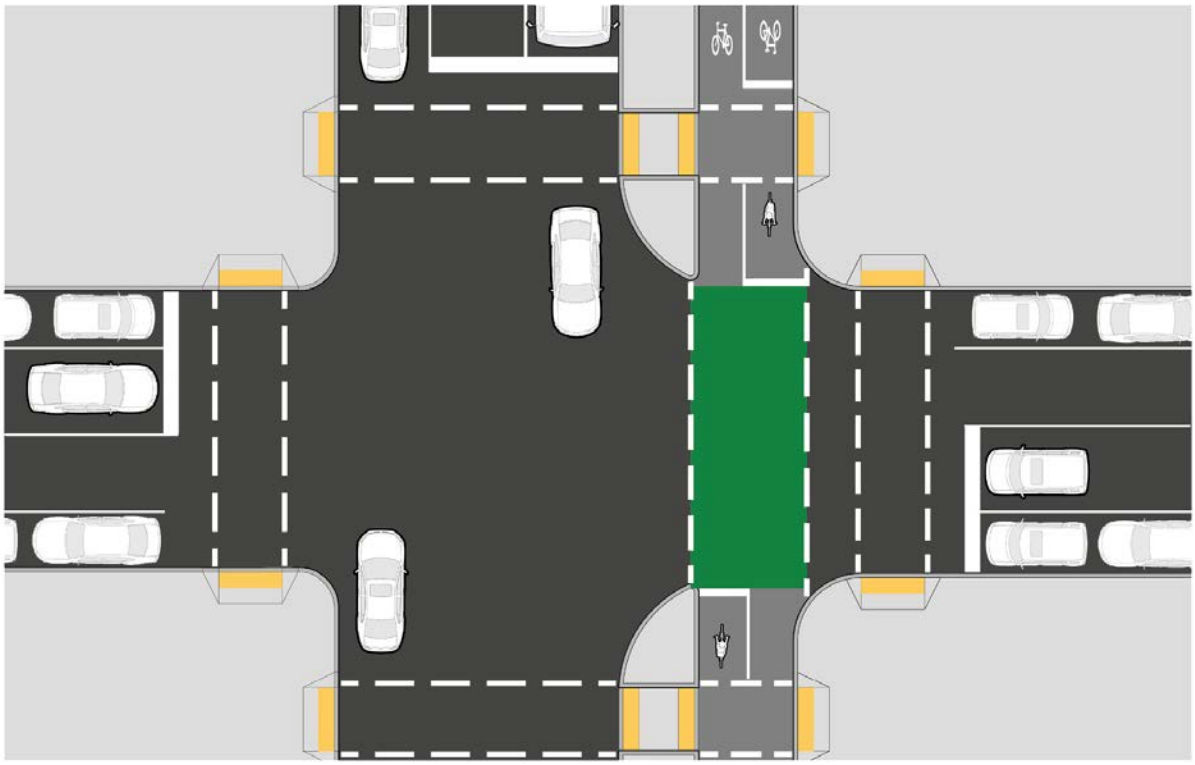


Figure 23: Protected bicycle lanes at an intersection[10]

Figures 24 and 25 show the transition between one-way protected bicycle lanes and two-way protected bicycle lanes at an intersection.

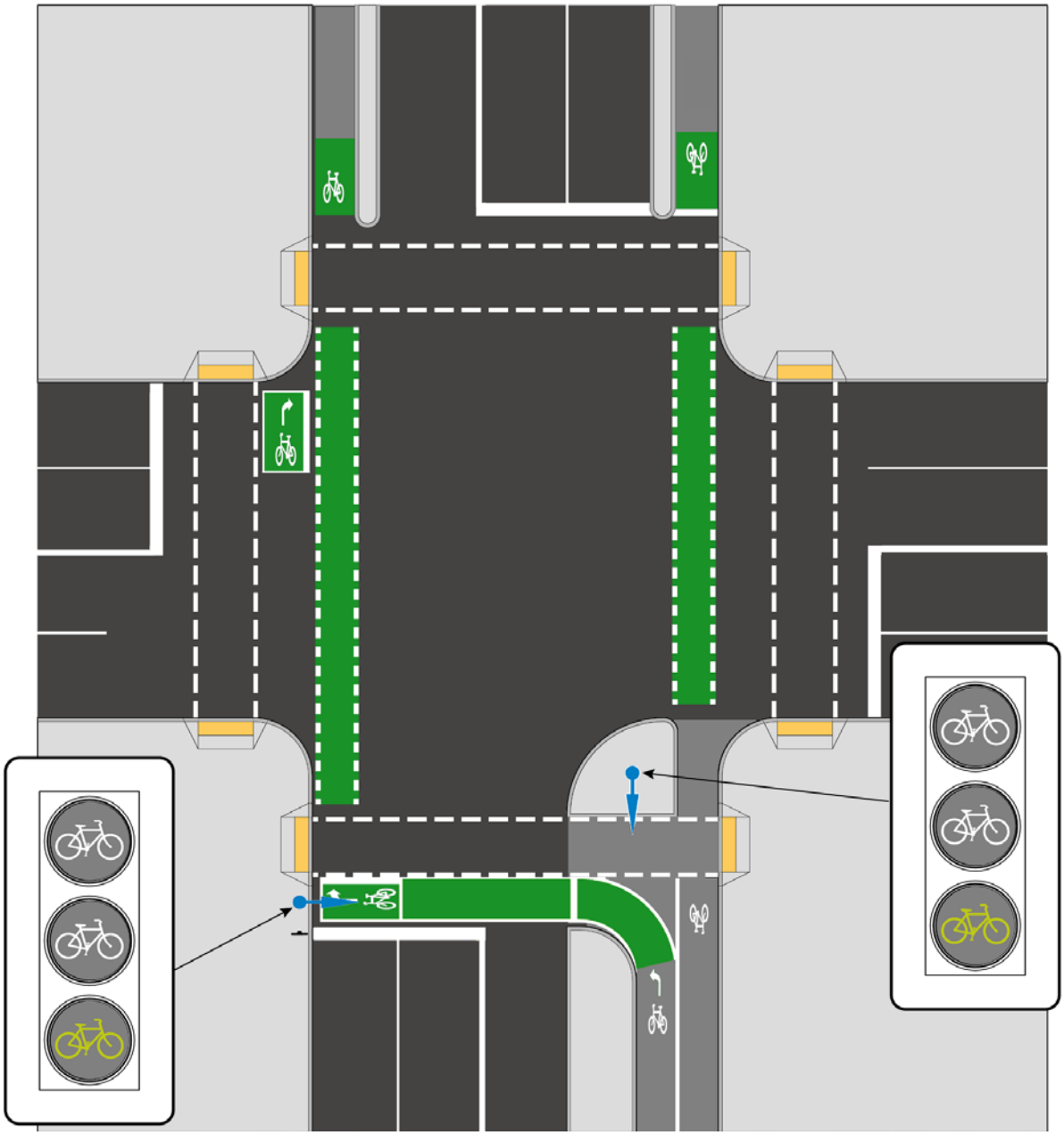


Figure 24: Transition from a one-way protected separated bicycle lane to two-way protected separated bicycle lane (with signal priority)[11]

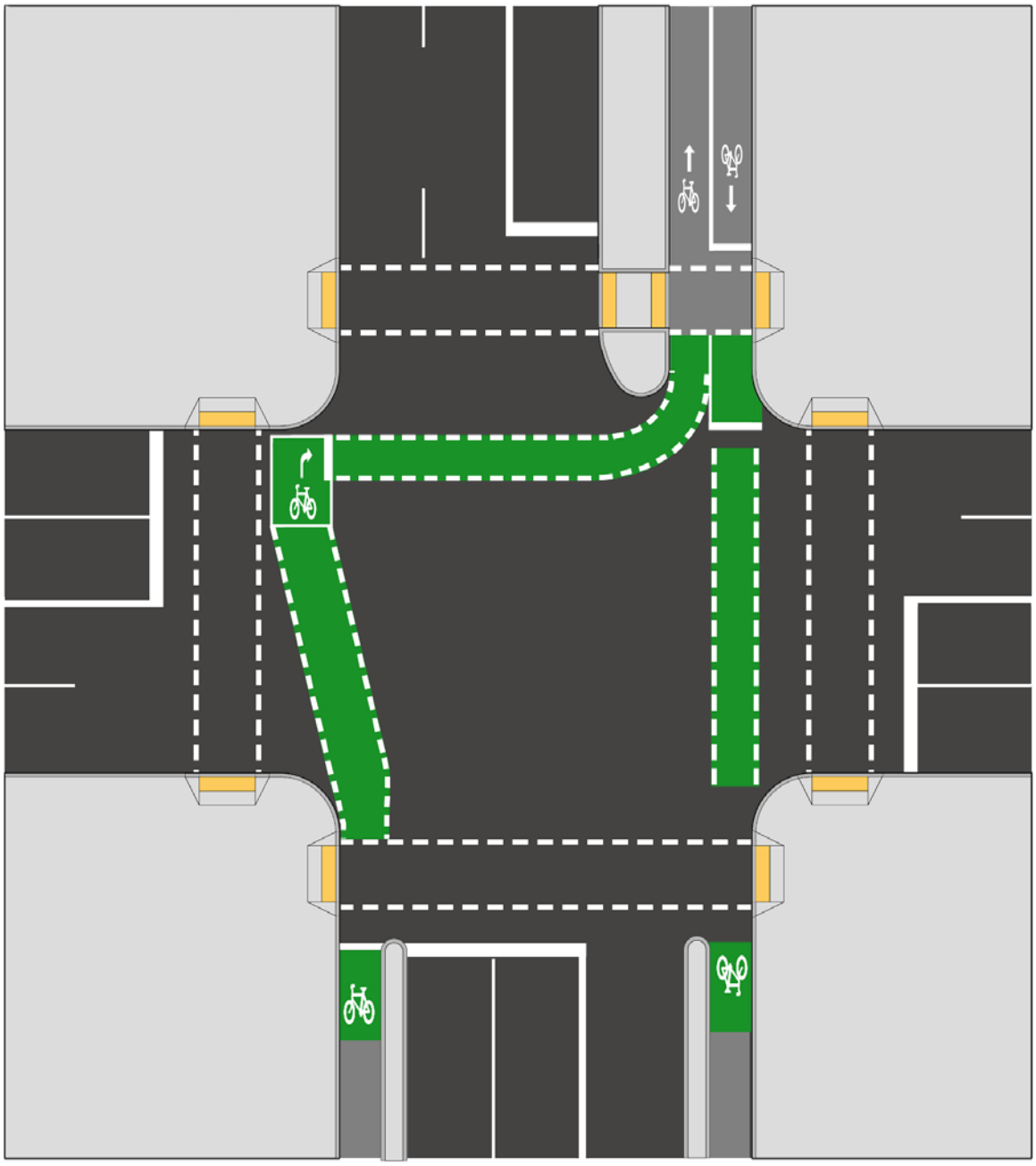


Figure 25: Transition from a one-way protected separated bicycle lane to two-way protected separated bicycle lane[11]

Summary

Two-way protected bicycle lanes have the following pros and cons:

Pros

- Uses less road space than one-way protected bicycle lanes.
- Removes bicycles from the vicinity of car doors on the driver's side of the vehicle.
- Physically separates cyclists from moving (motorised) traffic.

Cons

- May lead to an increase in head-on crashes between cyclists.

- Motorists who have parked their cars are required to cross bicycle traffic to access the footpath. This may lead to an increase in crashes involving pedestrians as they may not be used to looking both ways for cyclists.
- May lead to conflicts at intersections and property access points where vehicles turn to cross the bicycle lane, which may be escalated by lack of visibility due to parked cars obstructing motorists' views and an unnatural requirement to look both ways for cyclists.
- Cyclists only have direct access to destinations on one side of the road.

Further reading

- VicRoads Design Guidance for Strategic Cycling Corridors
- Cycling Aspects of the Austroads Guides
- Queensland Department of Transport and Main Roads Technical Note 128, Selection and Design of Cycle Tracks (May 2015), Section 3.4

3.4 Off-road shared paths and bicycle only paths

This treatment refers to encouraging cyclists to use off-road facilities adjacent to the road instead of riding on roads where there is a risk of dooring. This can be facilitated by the improvement of existing paths and the installation of new paths along routes with a significant amount of riders.

Potential locations for off-road paths include:

- Wide roads with land available either on the side of the road or in the centre of the road (e.g. large medians on divided roads).
- Where full separation from the traffic lane is required due to unsafe features on the road for cyclists.
- Roads near parkland.
- Near schools, parks and other facilities used by children.
- Along commuting routes.

Where such a treatment is to be considered, the following should be taken into account:

- Impact of mixing pedestrians and cyclists needs to be assessed at individual locations given the potential for collisions between the two modes. There is the possibility of creating bicycle only paths to separate cyclists from pedestrians.
- Priority at intersections needs to be carefully considered and clearly signed to ensure cyclists and motorists know who has priority. At some road crossing points, it may appropriate to give cyclists priority over motor vehicles.
- Some cyclists may continue to use roads even when off road paths are provided. In this case, where it is desired that all cyclists use the off-road facility, the design of the off-route path should consider priority for bicycles at road crossings and other measures to attract long distance riders.
- Off-road bicycle paths may be an attractive option for families, children and inexperienced cyclists.
- In areas where cyclists may be travelling at high speed or commuter routes with larger volumes, it may be desirable to separate them from pedestrians.
- The potential need for land acquisition in order to construct an off-road facility.
- Requirement for lighting especially on routes with night / dusk usage.

According to Cycling Aspects of the Austroads Guides (2014), there are six requirements for good design of off-road bicycle paths[13]:

- Space to ride – sufficient space for cyclists to negotiate the off-road facility.
- A smooth surface – regular maintenance to ensure the path is free from defects.

[13] Cycling Aspects of the Austroads Guides (2014).

- Speed maintenance – cyclists are able to maintain a constant speed without the risk of collision with pedestrians.
- Sight lines – good sight distances especially around curves.
- Connectivity – provide safe and efficient connections to other on-road and off-road facilities.
- Information – good signage is required to direct cyclists on, along and off the off-road facility.

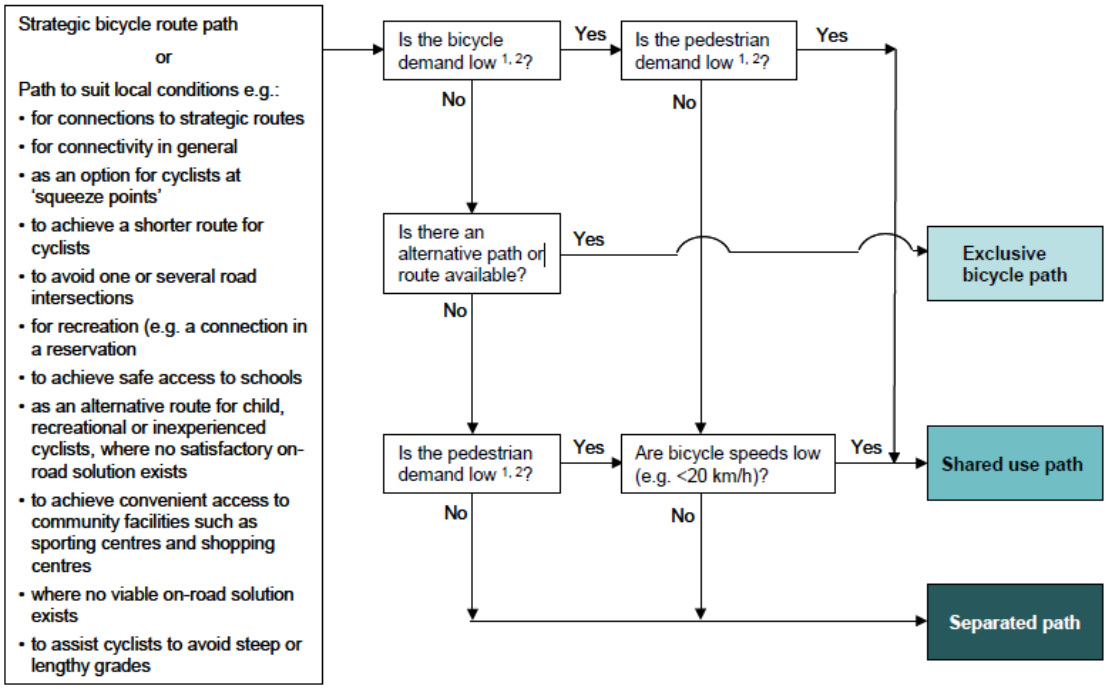
Where an off-road bicycle facility is to be provided, usually this involves the mixing of pedestrians and cyclists along the off-road path. There are three main types of paths that can be provided:

- Shared use path – a wide path where pedestrians and cyclists both use the same path.
- Segregated path – the pedestrian path is adjoining to the bicycle path, usually separated by linemarking or visually through the use of different colour pavements.
- Separated path – where the path for cyclists is physical separated from the path for pedestrians, e.g. by a barrier or median. The bicycle path component may also be known as an 'exclusive bicycle path'.

A separated path virtually eliminates the conflict between pedestrians and cyclists as they are physically separated. A segregated path also provides a level of separation; however as there is no physical separation, there is still the potential for a collision between a pedestrian and cyclist in the event they encroach onto each other's path.

Where there is a large differential speed between the two modes, there is an increased risk of injury to pedestrians in the event of a collision between a pedestrian and cyclist.

Section 7.3 of the Cycling Aspects to the Austroads Guide provides guidance regarding the types of paths that should be used. This decision making process is repeated below. Note that 'separated path' in the chart below also includes a segregated path. Practitioners should be aware that there may be other issues, constraints and practices that will have a bearing on the decision-making process.



1 The level of demand can be assessed generally on the basis of the peak periods of a typical day as follows:
a. Low demand: Infrequent use of path (say less than 10 users per hour)
b. High demand: Regular use in both directions of travel (say more than 50 users per hour).

2 These path volumes are suggested in order to limit the incidence of conflict between users, and are significantly lower than the capacity of the principal path types.

Source: Austroads (2009f) Figure 2.1.

Figure 26: Guide to the choice of path treatment for cyclists[13]

Further notes to Figure 26 above:

- Where the volume of pedestrians and/or cyclists is large or there is the potential for conflicts between the two modes, there may be a need to separate the path between cyclists and pedestrians, and at other associated locations where pedestrians and cyclists are adjacent to one another. It is recommended that where there are more than 50 cyclists per hour, separated (or at the very least segregated) paths should be provided.
- There is a large number of commuter riders compared to recreational riders.
- Limited sight distance between cyclists and pedestrians.
- Where the differential speed between cyclists and pedestrians is high.

Design concepts

Exclusive bicycle paths

For guidance on desirable widths and acceptable ranges of width for one-way exclusive bicycle paths, refer to the 'separated path requirement' guidance below. .

Table 3 below shows dimensions when the exclusive bicycle path is in two-way operation – an example of this situation would be an off-road bicycle path adjacent or connecting to a circulating path around an annular roundabout.

Table 3: Exclusive bicycle path (two-way) widths[14]

	Path Width (m)	
	Local access path / minor path	**Major path**
Desirable width (minimum)	2.5	3.0
Minimum width – typical maximum	2.5(1)-3.0(2)	2.5(1)-4.5(2)

Notes for Table 3:

1. ***A lesser width should only to be adopted where cyclist volumes and operational speeds will remain low or there are space restrictions.***
2. ***A greater width may be required where the numbers of cyclists and pedestrians are very high or there is a high probability of conflict between users (e.g. people walking dogs, roller bladders and skaters etc.).***

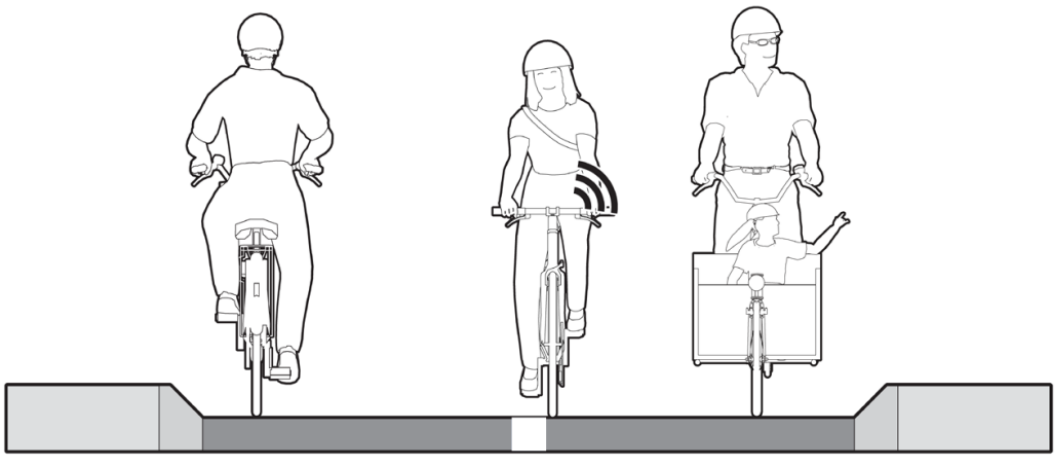


Figure 27: A desirable minimum width of 3.0 m allows passing movements to be comfortable undertaken (two-way path)[15]

[14] Section 7.5.4 of Cycling Aspects of the Austroads Guides (2014).

[15] Adapted from MassDOT Separated Bike Lane Planning & Design Guide, Chapter 3, Section 3.3 https://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms/SeparatedBikeLanePlanningDesignGuide.aspx

Separated path requirement

The tables below show desirable widths and acceptable ranges of width for separated paths. A path width greater than the desirable width may be required to enhance user amenity of the path. It should be noted that these types of paths provide physical separation between pedestrians and cyclists.

Table 4 below can be used for one-way exclusive bicycle paths (refer to the bicycle path component).

Table 4: Separated one-way path widths[14]

	Path width (m)		
	Bicycle path	**Footpath**	**Physical separator between bicycle path and footpath**
Desirable width (minimum)	1.5	1.5	1.0
Minimum width	1.2	1.2	0.5

Table 5: Separated two-way path widths[14]

	Path Width (m)		
	Bicycle path	**Footpath**	**Physical separator between bicycle path and footpath**
Desirable width (minimum)	2.5	1.5	1.0
Minimum width	2.0	1.2	0.5

Figure 28: Example of separated pedestrian and cyclist path

Segregated path requirement

The tables below show desirable widths and acceptable ranges of width for segregated paths. A path width greater than the desirable width may be required to enhance user amenity of the path. It should be noted that these types of paths do not provide physical separation between pedestrians and cyclists.

Table 6: Segregated one-way path widths[14]

	Path width (m)	
	Bicycle path	**Footpath**
Desirable width (minimum)	1.5	1.5
Minimum width	1.2	1.2

Table 7: Segregated two-way path widths[14]

	Path Width (m)	
	Bicycle path	**Footpath**
Desirable width (minimum)	2.5	1.5
Minimum width	2.0	1.2

Shared use path requirements

The table below shows desirable widths and acceptable ranges of width for shared use paths. A path width greater than the desirable width may be required to enhance user amenity of the path.

Table 8: Shared path width[14]

	Path Width (m)		
	Local Access path	**Commuter path**	**Recreational path (1)**
Desirable width (minimum)	2.5	3.0	3.5
Minimum width – typical maximum	2.5(2)-3.0(3)	2.5(2)-4.5(3)	3.0(2)-4.0(3)

Notes for Table 8:

1. ***A recreational path consists of cyclists which are, for the large majority, not commuter or sports riders.***
2. ***A lesser width should only to be adopted where cyclist volumes and operational speeds will remain low or there are space restrictions.***
3. ***A greater width may be required where the numbers of cyclists and pedestrians are very high or there is a high probability of conflict between users (e.g. people walking dogs, roller bladders and skaters etc.).***

Road crossings

An example of a mid-block off-road bicycle path crossing is shown in Figure 29.

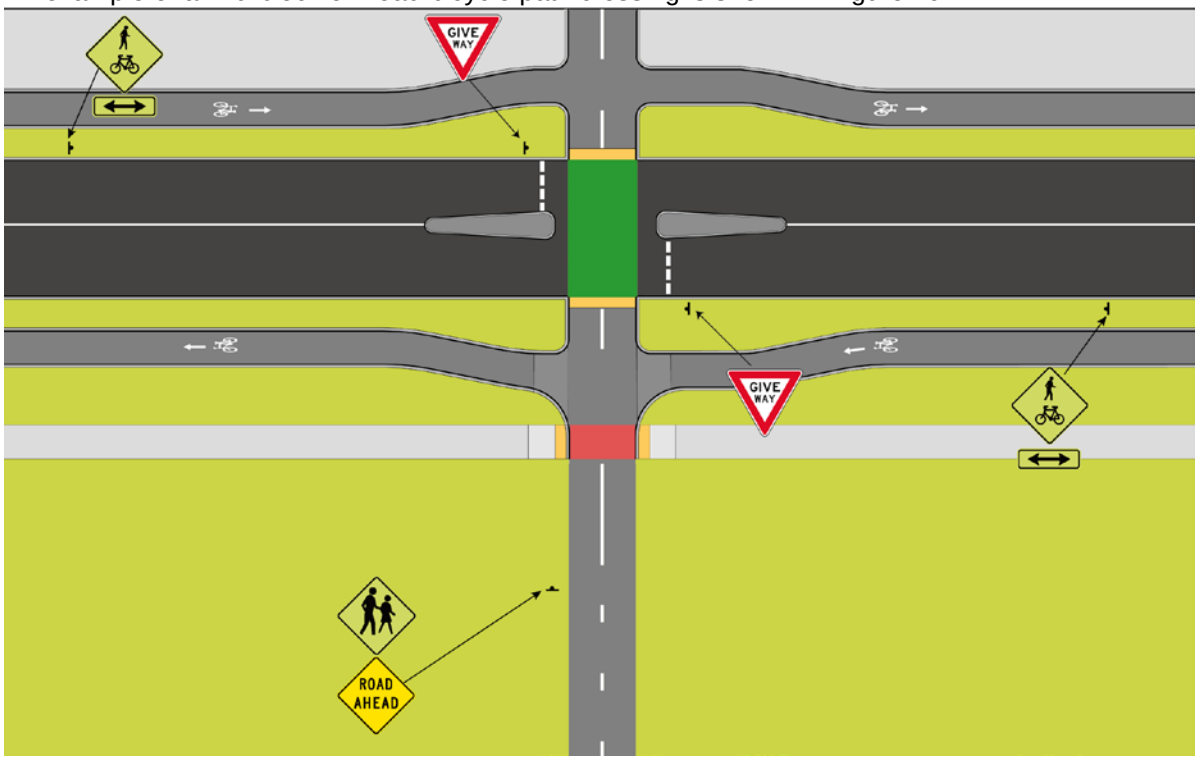


Figure 29: Mid-block off-road bicycle path crossing[11]

An example of a road crossing is shown in Figure 30.

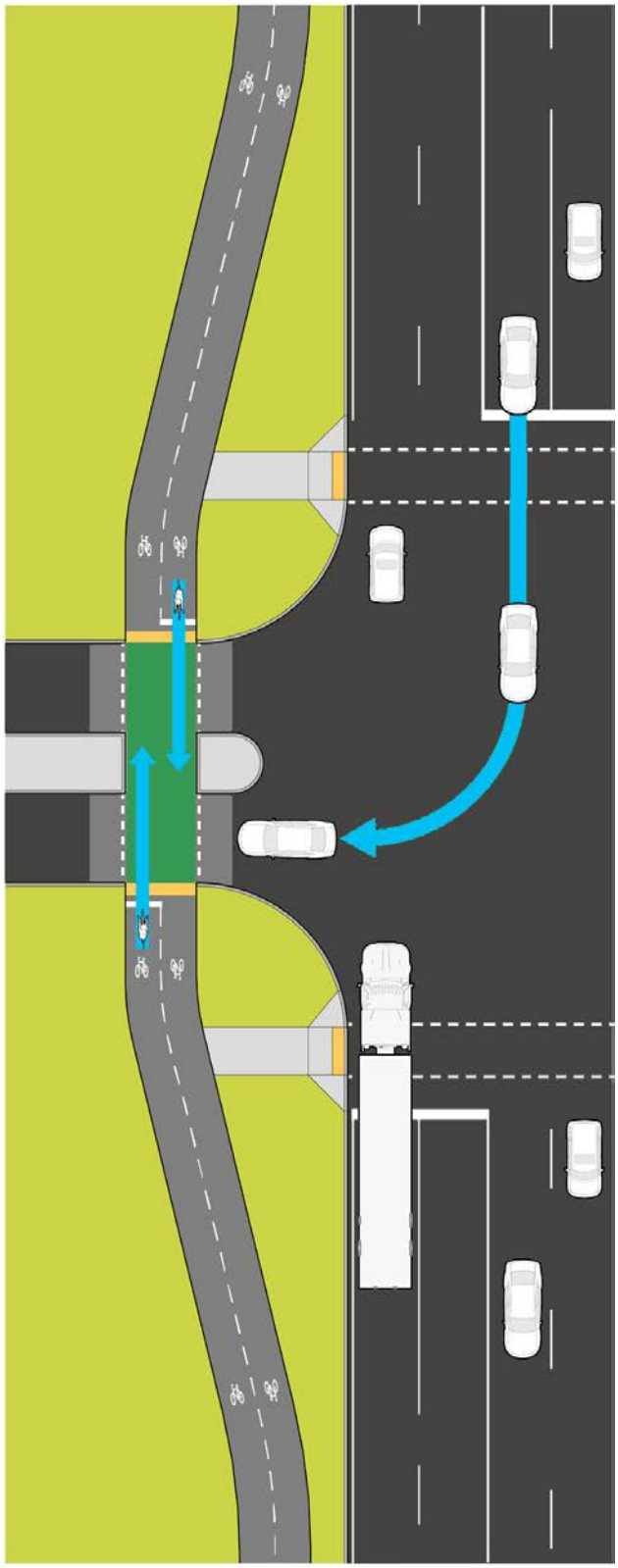


Figure 30: Off-road bicycle path road crossing[9]

Examples of off-road paths include:

- St Georges Road, Northcote – off-road path in the wide central median.
- Capital City Trail, Carlton North – off-road path (see Figure 31).
- O'Hea Street, Coburg - off-road bicycle path on the side of the road (see Figure 32).
- Upfield Rail Line Bicycle Path - off-road bicycle path alongside a railway line parallel to a significant. north-south arterial road (Sydney Road).

Figure 31: Capital City Trail, Carlton North - has bicycle priority at local road intersections to minimise stopping and starting for cyclists

Figure 32: O'Hea Street, Coburg - off-road bicycle path. Image source: Google Maps

Summary

Off-road shared paths and bicycle only paths have the following pros and cons:

Pros

- Easy to link up with existing off-road bicycle paths and two-way protected bicycle lanes.
- Virtually eliminates the risk of car dooring by relocating cyclists on to an off-road facility.
- Full separation between cyclists and motor vehicles.
- Offers a safe and comfortable environment for most cyclists especially those lacking experience or confidence (e.g. children).

Cons

- May lead to conflicts with vehicles entering and exiting driveways.
- Shared paths may increase the number of crashes involving pedestrians.
- The potential need for land acquisition in order to construct an off-road facility.

Further Reading

- Further details on bicycle paths are contained in Austroads Guide to Road Design - Part 6A: Pedestrian and Cyclist Paths (2009).
- Cycling Aspects of the Austroads Guides (2014).

4. Reduction treatments

4.1 Anti-dooring lanes

Anti-dooring lanes or dooring buffers are similar to conventional bike lanes positioned between on-street parking and the through traffic lane, however they have a small buffer between the parking lane and the bicycle lane to encourage cyclists to ride out of the “door zone” and closer to the traffic stream.

Potential locations for anti-dooring lanes include:

- Narrow roads that do not have enough space for other treatment options and therefore cannot safely manage multiple road users with competing needs.
- Roads with large volumes of cyclists, including roads identified as bicycle priority routes under the VicRoads SmartRoads strategy.
- Roads with a history of conflict between bicycles and parked vehicles.
- Roads within shopping areas where it may not be feasible to remove on-street parking.

Where such a treatment is to be considered, the following should be taken into account:

- A door can swing out to approximately 1.2m from a vehicle, therefore it is important to leave a substantial buffer to the preferred riding zone.
- Roads will continue to be used by both motorists and cyclists without offering significant physical separation.
- May be an improvement for roads with a small budget for projects or for roads that lack space for the other primary treatments.
- Reducing the speed along the road – whether through the speed limit and/or the operating speed – as a way to reduce the risk of a collision with a motor vehicle. In addition, a lower speed increases the reaction time available to motorists.
- This treatment may not be perceived as ‘safe’ by inexperienced cyclists due to the potential of collisions still remaining.
- Different designs are available to practitioners. The design on Glenferrie Road consists of 600mm wide green painted bicycle zone positioned 800mm from the edge of the parking lane. It also

includes a chevron buffer between the green painted zone and the general traffic lane/tram tracks as seen in Figure 34.

- On wide roads it may be possible to shift the bicycle lane away from cars by approximately one metre using painted chevrons. It may also be possible to provide an additional buffer between the bicycle lane and the traffic lane as shown in Figure 35. On narrower roads, it may only be possible to provide a small preferred riding zone with chevrons marked on the outside of the lane.
- The style of the buffer, whether through pavement markings or lane lines, should be in a format that can be easily interpreted by cyclists and motorists.

CDM Research produced an evaluation of the Glenferrie Road 'door zone' bicycle lanes. The report, prepared for VicRoads, describes the before and after characteristics of the anti-dooring lanes installed on Glenferrie Road. The evaluation focused on cyclist lateral tracking, motorist lateral tracking and road user perceptions.

The evaluation found that after the anti-dooring lane was installed:

- Riders took time to adapt but there was a lower proportion of cyclists riding within 0.8m from parked cars, a reduction from 13-20% prior to installation to less than 5% after.
- Average motorist lateral tracking shifted towards the centreline by 0.16m to 0.28m and the number of motorists encroaching the bike lane halved.
- 75% of cyclists felt more comfortable after the installation of the anti-dooring lane while only 4% felt less comfortable.

The evaluation recommended that:

- Further evaluations should be considered with the use of crash data.
- The preferred riding zone should be clear of any potential hazards.
- The treatment be retained at Glenferrie Road, Hawthorn and be trialled at other sites[16].

Supporting treatments

Listed below are supporting treatments that can be used with this primary treatment. For full details on each supporting treatment (including appropriate locations and other considerations), refer to the main 'reduction treatments' (Section 4) of this document.

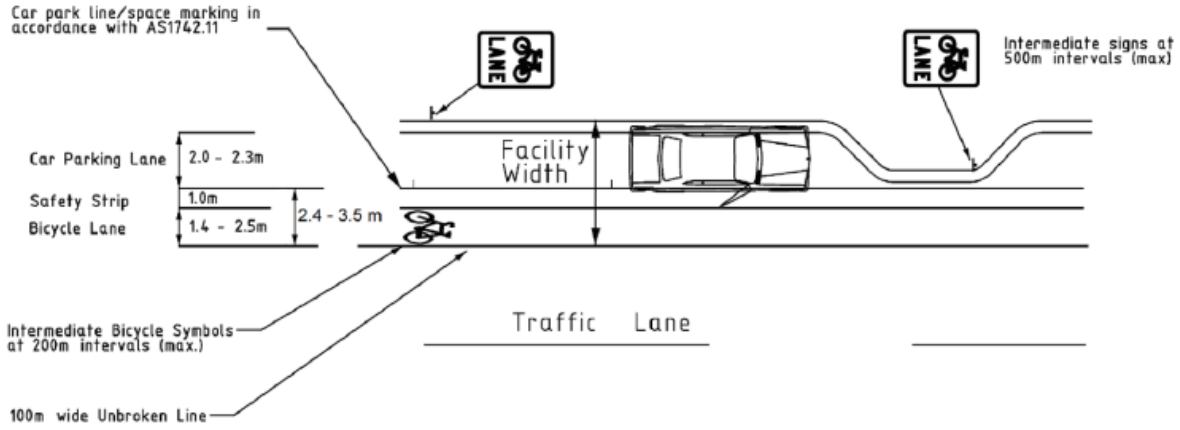
Supporting treatments that may be used with anti-dooring lanes include:

- Warning signs.
- Narrower parking spaces.
- Parking turnover reduction.

[16] CDM Research, 2015, "Evaluation of Glenferrie Road 'Door Zone' Bicycle Lanes"

Design concepts

Figure 33 shows a ‘safety strip’ recommendation between the parking lane and bicycle lane.



Source: Based on Austroads (2009a).

Figure 33: Typical bicycle/car parking lanes layout[17]

Figure 34: Glenferrie Road, Hawthorn

[17] Austroads Guide to Road Design Part 3: Geometric Design (20122016)

Figure 35: Pigdon Street, Princes Hill

Examples of anti-dooring lanes include:

- Glenferrie Road, Hawthorn (see Figure 34).
- Pigdon Street, Princes Hill (see Figure 35).
- William Street, Melbourne.
- Clarendon Street, East Melbourne.

Summary

Anti-dooring lanes have the following pros and cons:

Pros

- Pavement markings may act as a reminder for cyclists to be aware of car doors when they are riding down a potentially risky section of road.
- Can improve positioning of cyclists on the carriageway, as they are further away from parked vehicles.
- May help to encourage safer overtaking of cyclists as motorists will be forced to slow down due to the narrower road environment and move further away from the cyclist to pass.

Cons

- May push cyclists closer to through traffic, which may be uncomfortable for cyclists who are inexperienced or lacking confidence.
- On roads with trams, this treatment may push cyclists further towards trams, which may increase the chance of a collision with a pedestrian and the risk of skidding and falling on tram tracks.

Further Reading

- Austroads Guide to Road Design - Part 3 (2016).

4.2 Bicycle streets

Bicycle streets are roads where bicycles are given priority over motor vehicles. Bicycle riders are encouraged to ride in the general traffic lane whereby other vehicles are expected to share the traffic lane with bicycle riders. For the application of lane sharing at an individual intersection, refer to the 'lane sharing at intersections' treatment.

This treatment is most appropriate on undivided two lane roads where the operating speed is below 40 km/h and traffic volumes are low. The intention is to enhance the road environment to make cycling safer for all type of riders regardless of their level experience or confidence. Bicycle streets are to be clearly signed and line marked and may be used in combination with other treatments to provide a continuous safe riding environment.

The lower operating speed also reduces the risk of injuries for crossing pedestrians.

Details on the marking of a road as a bicycle street can be found in the design concepts section.

NOTE: VicRoads is currently investigating whether the Victorian Road Rules sufficiently allows cyclists to ride in the middle of the lane ('claiming the lane'). Some stakeholders perceive that there is a degree of ambiguity in the Road Rules regarding this issue. Practitioners wishing to use this treatment should seek legal advice to manage this risk.

Potential locations for bicycle streets include:

- On undivided two lane local roads where the approach operating speed is less than 40 km/h.
- Roads with a low volume of traffic.
- Roads with a substantial number of inexperienced bicycle riders.
- Local areas with a high number of cyclists.
- Where off-road bicycle facilities are not practicable.
- Roads with narrow width.

Where such a treatment is to be considered, the following should be taken into account:

- Reducing the operating speed on the bicycle street route (to below 40 km/h), whether through the use of:
    - Traffic calming measures, such as:
        - Slow points.
        - Road humps or raised platforms (mid-block and/or at intersections).
        - Increasing approach deflection to roundabouts.
        - Larger roundabout central island.
    - Reduced speed limits.
- Signs are required to highlight to all road users that bicycles have priority over motor vehicles and may be present in the centre of the lane.
- Physical treatments to raise the prominence of crossing pedestrians – such as raised crossing platforms and/or kerb extensions. Other treatments, such as the traffic calming measures mentioned above, assist in reducing the road's operating speed thus reducing the risk of injury to pedestrians.
- Removal of parking along the bicycle street to ensure cyclists (and other traffic) is not impeded by parking movements - also the risk of car dooring would be removed.
- Community acceptance and understanding of lane sharing.
- Cyclist confidence and safety in sharing the lane with general traffic.
- Mixing cyclists and motorists may lead to conflict if differential speeds are high, making this treatment more appropriate on low-speed roads.

Supporting treatments

Listed below are supporting treatments that can be used with this primary treatment. For full details on each supporting treatment (including appropriate locations and other considerations), refer to the main 'supporting treatments' section (Section 5).

Supporting treatments that may be used with this primary treatment include:

- Increased approach deflection at intersections (especially roundabouts).
- Raised platforms
- Static signage
- Bicycle activated warning signs (refer to the VicRoads Guidance on Bicycle and Pedestrian Treatments at Roundabouts document)

For pedestrians, the following supporting treatments can be used:

- Kerb extensions (narrowing of roadway)
- Raised pedestrian crossings and/or zebra crossings
- Pedestrian refuges

For details on the above supporting treatments, refer to the VicRoads Guidance on Bicycle and Pedestrian Treatments at Roundabouts document.

Design concepts

The design of bicycle streets should allow the following[18]:

- Bicycles riders have space to ride two abreast; motor vehicles give way to bicycles allowing safe overtaking.
- Vehicles give way to bicycles at intersections.
- At the terminus of the bicycle street:
    - An off-road transition is to be provided where riders are to continue on an off-road path.
    - Spacious median refuges where bicycles are to cross an intersection.
    - Where riders are to continue on an on-road bicycle lane, a clear and gradual transition arrangement is required to ensure cyclists are able to make the transition safely and that other vehicles are still aware of the continuing presence of cyclists (see Figure 16).

Figure 36 shows a schematic drawing of a bicycle street.

[18] Western Australia Department of Transport (2015), "Bike Boulevard Pilot Project Part of the Safe Active Streets Program"

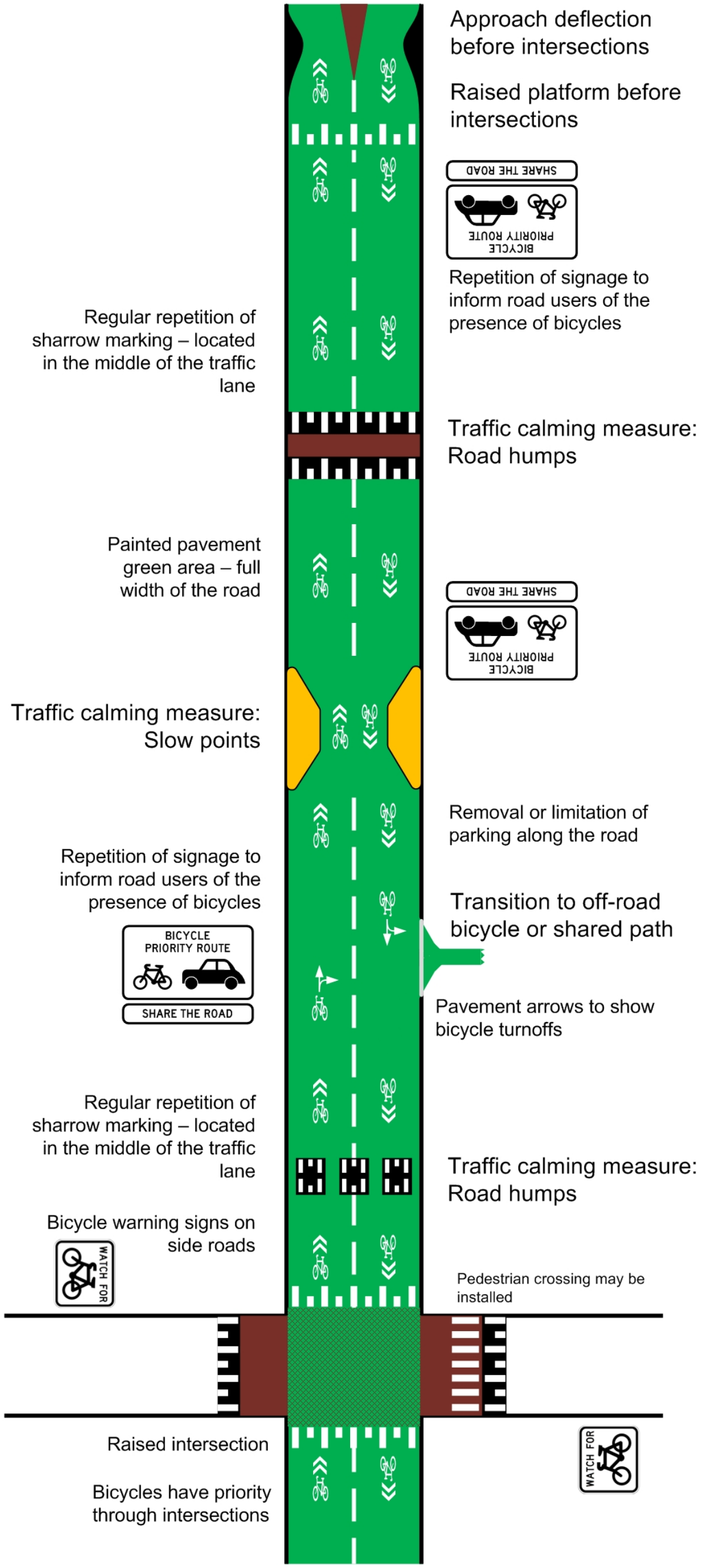


Figure 36: Example of a bicycle street

Summary

This treatment has the following pros and cons:

Pros

- The use of sharrows and green painted roadway may assist in raising awareness of cyclists.
- Provides guidance for cyclists to “claim the lane” and encourages cyclists to ride in the more prominent position on the road.
- Provides reassurance to cyclists that they are on designated cycle routes in the absence of segregated cycle paths.
- Traffic calming measures assist in lowering the operating speed along the road thus reducing the risk of serious injury in the event of a collision between road users.

Cons

- Although bicycle streets have the ability to raise awareness of cyclists, there is still the possibility of a collision between a motor vehicle and cyclist.
- Motorists may become frustrated by cyclists blocking lanes and the perceived additional travel time.
- Mixing with cars may be confronting for cyclists who are inexperienced or lacking confidence.
- May lead to an increase in rear end crashes between cyclists and motor vehicles.

Further reading

- Austroads Guide to Traffic Management - Part 8: Local Area Traffic Management (2016)
- VicRoads Supplement to AS 1742.9 – details on sharrows.
- Further information about Western Australia’s “Bicycle Boulevards” can be found at: http://www.transport.wa.gov.au/activetransport/safe-active-streets-program.asp
- Austroads Technical Report “Cycling Infrastructure” Selected Case Studies (2014).
- Austroads Research Report AP-R461-14 Assessment of the Effectiveness of On-Road Bicycle Lanes at Roundabouts in Australia and New Zealand” (2014).
- VicRoads Design Guidance for Strategic Cycling Corridors.

4.3 Lane sharing at intersections

This treatment refers to moving cyclists into the centre of the traffic lane at individual intersections and encouraging cyclists to mix with through traffic. The objective of this treatment is to position cyclists as far away as practicable from parked cars. This is sometimes referred to as “claiming the lane”. For the application of lane sharing along an entire street, refer to the ‘bicycle streets’ treatment above.

This can be achieved through the use of shared lane markings (e.g. sharrows, see Figure 37) in unison with road calming measures to slow through traffic.

Other measures may be implemented to highlight the presence of cyclists on the road, including the use of signage and pavement colouring.

Potential locations for lane sharing include:

- Roads with a low volume of through traffic.
- Low speed roads with operating speed of less than 40 km/h (in addition, there is a low differential speed between cyclists and motor vehicles).
- Roads with narrow width.
- Roads with a history of conflict between bicycles and parked vehicles.
- Roads with large volumes of cyclists.

Roads where the preferred cycling position does not change at different times of day due to parking restrictions/clearways.

Where such a treatment is to be considered, the following should be taken into account:

- Reducing the operating speed of the road, whether through the use of traffic calming measures or reduced speed limits. Roads that use this treatment may be developed into bicycle priority routes under the VicRoads SmartRoads strategy.
- Community acceptance and understanding of lane sharing.
- Cyclists confidence and safety in sharing the lane with general traffic.
- May not work on congested roads where cyclists may choose to filter between stationary traffic and parked cars regardless of lane markings.
- Mixing cyclists and motorists may lead to conflict due to differentials in speed and therefore this treatment is more appropriate on low-speed local roads.
- Implementing a 'bicycle street' where cyclists have priority over motor vehicles along a road – see Section 4.3 of the VicRoads Guidance on Bicycle and Pedestrian Treatments at Roundabouts.

CDM Research produced an evaluation of shared lane markings for cyclists in 2013. The work was prepared for VicRoads. The report describes the before and after characteristics at two sites on three Melbourne roads that has sharrows pavement markings.

The evaluation found that after sharrows were installed:

- There were significant changes in cyclist lateral tracking at four of the six sites. At two sites there was a significant reduction in the number of cyclists riding within the "dooring zone" (at the first site, 23% down to 4% and at the second site, 63% down to 40%).
- There was an increase at two sites in impatient or aggressive behaviour toward cyclists as a result of the sharrows.
- There was a significant difference between the average speed of cyclists and motorists. Motorists travelled on average 12-22km/h faster than cyclists.
- 54% of cyclists felt that sharrows made no difference to their safety, 40% felt that they made cycling a little safer and 6% felt that they made cycling a lot safer. No cyclists felt that the sharrows made them less safe.

The evaluation recommended that:

- Sharrows only be applied at existing sites.
- Sharrows should not be used where dedicated bicycle infrastructure can be provided instead.
- Sharrows should only be used where traffic volumes and speed are low enough that cyclists are safe to "share the lane"[19].

Supporting treatments

Listed below are supporting treatments that can be used with this primary treatment. For full details on each supporting treatment (including appropriate locations and other considerations), refer to the main 'reduction treatments' (Section 4) of this document.

Supporting treatments that may be used with lane sharing include:

- Warning signs.
- Parking turnover reduction.

[19] CDM Research, 2013, "Evaluation of Shared Lane Markings for Cyclists"

Design concepts

Figure 37 shows the typical application of sharrows on a road.

Figure 37: Example of sharrow pavement markings at a roundabout on Highett Street, Richmond

Examples of lane sharing can be found in the following locations:

- Lennox Street, Richmond.
- Roseneath Street, Clifton Hill.
- 'Bicycle Boulevards' in Western Australia.
- Fietsstraat or cycle streets, the Netherlands.
- 'Bicycle Boulevards', City of Berkley, US.

Summary

Lane sharing has the following pros and cons:

Pros

- Encourages cyclists to ride in the most prominent position in the lane.
- Cyclists may be more visible to drivers behind them, which may increase driver awareness.
- Positions cyclists further from the door zone by encouraging them to ride in the centre of the traffic lane.
- Provides unison with current approach taken for cyclists entering certain single lane roundabouts.
- Can be used to direct cyclists on a particular route through the use of sharrows.

Cons

- May only be used on low (operating) speed roads where the speed differential is lower between bicycles and cars.
- Although sharrows have the ability to raise the awareness of cyclists, there is still the possibility of a collision between a vehicle and cyclist.
- Motorists may become frustrated by cyclists blocking lanes and the perceived additional travel time.
- Mixing with cars may be confronting for cyclists who are inexperienced or lacking confidence.

Further Reading

- Guide to Traffic Management - Part 8: Local Area Traffic Management (2016) - details on the implementation of road calming measures such as speed humps, roundabouts, slow points, centre blister islands and line marking.
- VicRoads Supplement to AS 1742.9 (2015) – details on sharrows
- Further information about the Western Australia "Bicycle Boulevards" can be found at: http://www.transport.wa.gov.au/activetransport/safe-active-streets-program.asp

5. Supporting treatments

5.1 Warning signs and pavement markings

This treatment refers to the installation of warning signs and pavement markings to encourage cyclists to be vigilant around parked cars and to encourage them to ride further away from parked cars to assist in reducing collisions.

The use of signs and pavement markings should not be seen as the 'solution' to address the issue of collisions between cyclists and motor vehicles. Signs and pavement markings play an important role in raising awareness of potential collisions and, to be effective, should only be used in conjunction with the primary treatments listed in this document. Signs and pavement markings can also be used to alert motorists to the presence of cyclists and encourage them to check for cyclists before opening their doors. It should be noted that the effectiveness of certain signs and pavement markings is not confirmed due to the limitation of research.

Potential locations for warning signs include:

- At locations where a new treatment has been installed and where not all road users may be familiar with the operation of the new treatment.
- Roads with a history of conflict between bicycles and parked vehicles.
- Roads where the presence of cyclists is not expected.
- Busy shopping areas with high vehicle turnover.

Where such a supporting treatment is to be considered, the following should be taken into account:

- Positioning of the sign is crucial. Signs need to be prominently located in order to be seen by the relevant audience.
- Pavement markings need to be carefully considered so as not to confuse road users of the intended message. The message needs to be clear and concise. In some situations, a static sign may provide a clearer message given that it is at the driver's eye level.
- The message and design of the sign should be consistent and clear without any ambiguity.
- Practitioners need to be aware of the overall impact of the sign or pavement marking – monitoring and evaluation may be required to assess the overall effectiveness of the sign or pavement markings.

CDM Research produced an evaluation of the Glenferrie Road 'door zone' bicycle lanes in Hawthorn. The report, prepared for VicRoads, describes the before and after characteristics of the anti-dooring lanes. The report noted that along with bicycle lanes, a temporary variable message

sign was installed as shown in Figure 39. This sign displayed the message “Bikes: Avoid Doors / Ride on Green”. CDM Research noted that “it is likely that any effect observed during this period on cyclist lateral tracking could be partly attributable to this sign”. After installation it was observed that there was a significant reduction in the number of cyclists riding within the door zone and this could be partly attributed to the use of signage to complement anti-dooring lanes [20].

Design concepts

Figure 38: Pavement markings on Sydney Road, Brunswick.

Figure 39: A temporary variable message sign was used on Glenferrie Road, Hawthorn during the installation of the anti-dooring lane markings[20]

[20] CDM Research, 2015, “Evaluation of Glenferrie Road ‘Door Zone’ Bicycle Lanes”

Examples of signs are shown in Figures 40 and 41 . Further examples of signs and their usage can be found in Australian Standards AS 1742.2 - Traffic control devices for general use (2009) and AS 1742.9 - Bicycle facilities (2000) and the VicRoads Supplement to those two Australian Standards.

Figure 40: G9-57 watch for bicycles sign

Figure 41: W6-7 bicycle warning sign

Summary

Warning signs have the following pros and cons:

Pros

- May improve positioning of cyclists on the carriageway.
- Signs and pavement markings play an important role in raising awareness of potential collisions.
- Low cost to implement.

Cons

- As a standalone measure, not as effective as physical treatments such as those that separate cyclists from parked vehicles / through traffic.
- Limited research has been conducted to confirm effectiveness of certain signs and pavement markings

Further reading

- Australian Standards AS 1742.9 (2008) - details on bicycle signs
- VicRoads Supplement to AS 1742.9 (2015) - details on bicycle signs
- Australian Standards AS 1743 (2016) - details on signing principles

5.2 Narrower parking spaces

This treatment refers to reducing the width of on-street parking spaces which may improve parking discipline and therefore provide more space on the carriageway for cyclists.

Potential locations for narrower parking spaces include:

- Roads that serve multiple road users with competing needs.
- Narrow roads with limited space.
- Busy shopping strips where bicycle infrastructure is to be provided or additional space is to be made on the road for cyclists.

Where such a supporting treatment is to be considered, the following should be taken into account:

- Narrower parking bays may encourage motorists to park closer to the kerb.
- May provide more space for cyclists to pass parked vehicles safely without travelling into the traffic stream.
- May be relatively easy to implement and could be used in unison with anti-dooring lanes.
- Possibility to make parking bays longer to reduce the number of movements required to enter a narrow parking space.

- Under road rule 211 of the Road Safety Road Rules 2009, vehicles which are wider than the marked bay are legally allowed to park in the bay. As a result, these vehicles will encroach into the roadway and cause a hazard to passing cyclists.
- Possible opposition from local traders in the event parking spaces are removed.

As part of the evaluation produced by CDM Research on the Glenferrie Road 'Door Zone' Bicycle lanes, there was an analysis of the affect of reducing the width of parking bays. At selected sites along Glenferrie Road, parking bays were reduced from 2.3m to 2.0m wide. As a result of this, vehicles were recorded as moving closer to the kerb by 0.1m showing that narrower parking spaces shift vehicles closer to the kerb. The evaluation also found that replacing parking 'T's" with solid edge lines had no effect on the positioning of parked vehicles.[20]

Summary

Narrower parking spaces have the following pros and cons:

Pros

- Gives cyclist more space between parked cars and moving traffic.
- Relatively easy and inexpensive to introduce.
- May provide a more effective use of carriageway width.

Cons

- Does not eliminate risk of dooring, simply gives cyclists more space to avoid doors.
- Potential for more manoeuvrers by vehicles entering the parking space which may result in more collisions with cyclists.

Further Reading

- AS 2890.5: Parking Facilities: On-street parking (1993) – details on parking bay dimensions.

5.3 Parking turnover reduction

This treatment refers to extending the amount of parking time for on-street car parking to reduce vehicle turnover. This may lead to a decrease in the amount of doors being opened as there will be a less number of different vehicles using a parking bay.

Potential locations for parking turnover reduction include:

- Roads in shopping areas where there are parking restrictions (especially with short parking time restrictions).

This supporting treatment may not be appropriate for:

- Parking spaces abutting supermarkets or convenience stores where there is naturally a high amount of parking turnover.

Where such a treatment is to be considered, the following should be taken into account:

- On-street parking is the responsibility of local governments and therefore individual council policies may prevent the implementation of this treatment.
- Easy and inexpensive to implement but may not have significant impact in reducing the number of crashes involving car doors.
- Further trials and/or research may be conducted to measure effectiveness of this treatment if necessary.

A CDM research report titled 'Cyclist Collisions with Car Doors' looked at possible ways of reducing car dooring. One option suggested in the report was turnover reduction. While there is limited evidence to support this treatment due to a lack of research, it may work successfully on the theory that crashes only occur when occupants enter or exit vehicles and that the number of door opening events could be reduced by increasing parking time restrictions. The report suggests that this

treatment would only be appropriate in locations with existing short parking time restrictions and appropriate shops where people may wish to stay for longer periods of time.[21]

Summary

Turnover reduction has the following pros and cons:

Pros

- The number of vehicles entering and exiting on-street car parking spaces may be reduced and therefore the number of door opening events may also be reduced.

Cons

- Decreases the probability of dooring occurring rather than offering physical safety improvements

6. Appendix A

Statistics – Car Dooring crashes

Across Victoria, in the 5-year period ending December 2014, there were 803 dooring incidents between a cyclist and a motor vehicle. Of these:

- 2 were fatal
- 194 serious injuries
- 607 other injuries

The majority of crashes occur on weekdays with the largest number occurring during morning and afternoon peaks.

Figure 42 shows the locations of car dooring crashes in and around the Melbourne Central Business District and inner suburbs.

Corridors with the highest rate of dooring crashes include:

- St Kilda Road
- Collins Street
- Elizabeth Street
- Chapel Street
- Brunswick Street
- Smith Street
- Sydney Road
- Swan Street

[21] CDM Research, 2012, “Cyclist Collisions with Car Doors”, Road Safety Action Group Inner Melbourne.

[23] Johnson, M., Newstead, S., Oxley, J. & Charlton, J. 2013, "Cyclists and open vehicle doors: Crash characteristics and risk factors", *Safety Science,* vol. 59.

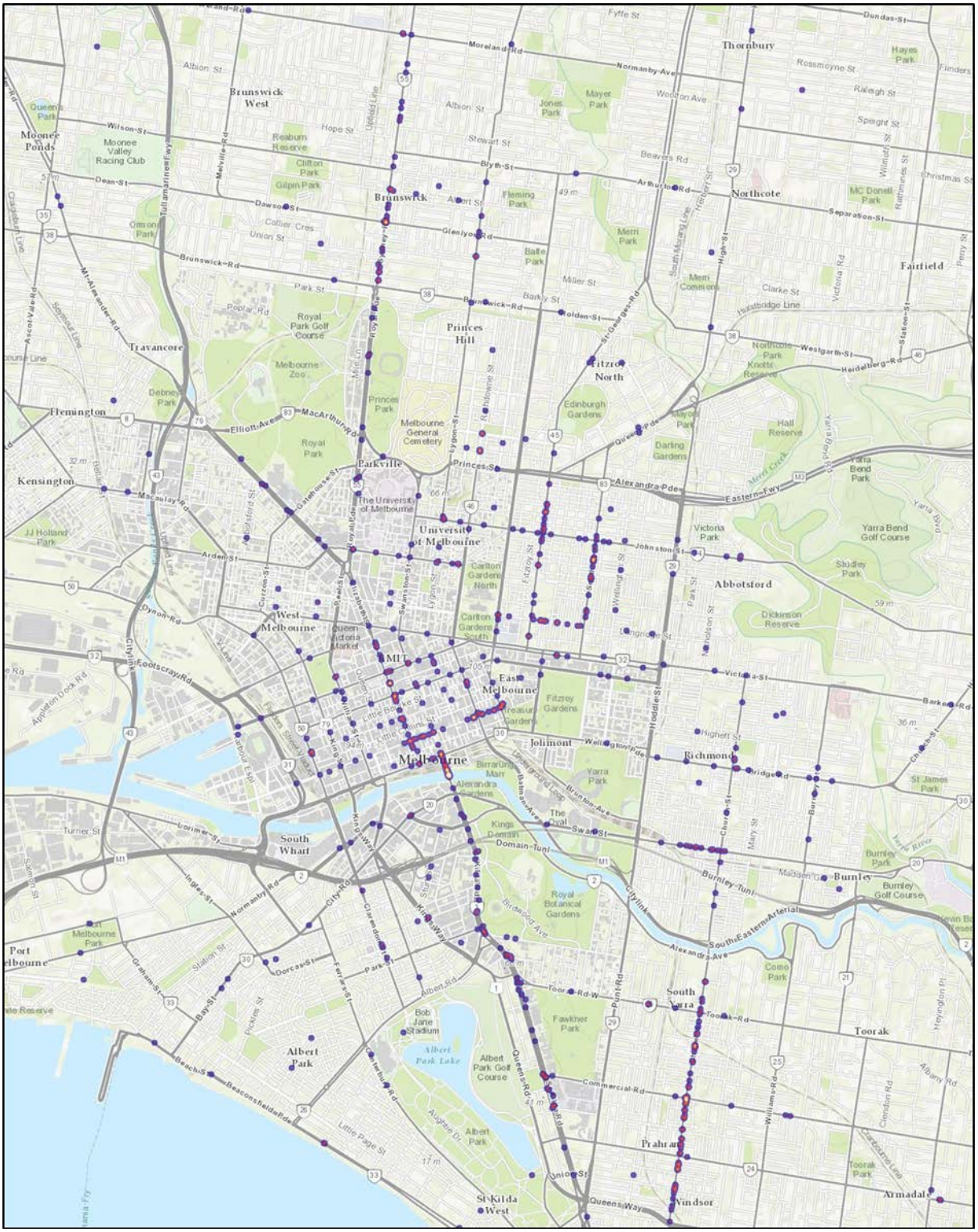


Figure 42: Dooring locations (between 2010 and 2014)

Figure 43 shows the average hourly volume of bicycles at off-road sites throughout the day in Melbourne. Figure 44 shows the number of dooring incidents that have occurred in each hour of the day across Metropolitan Melbourne.

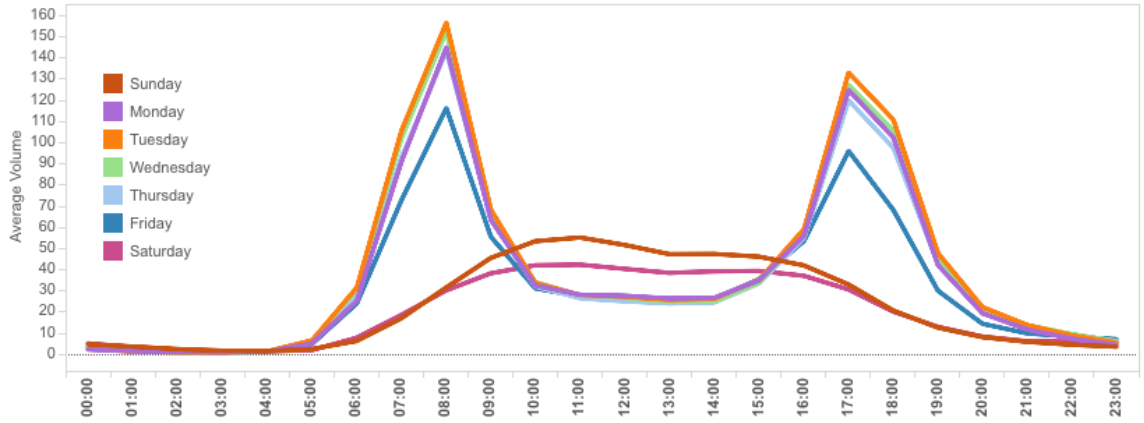


Figure 43: Average hourly bicycle volume by day at off-road sites across Melbourne[22]

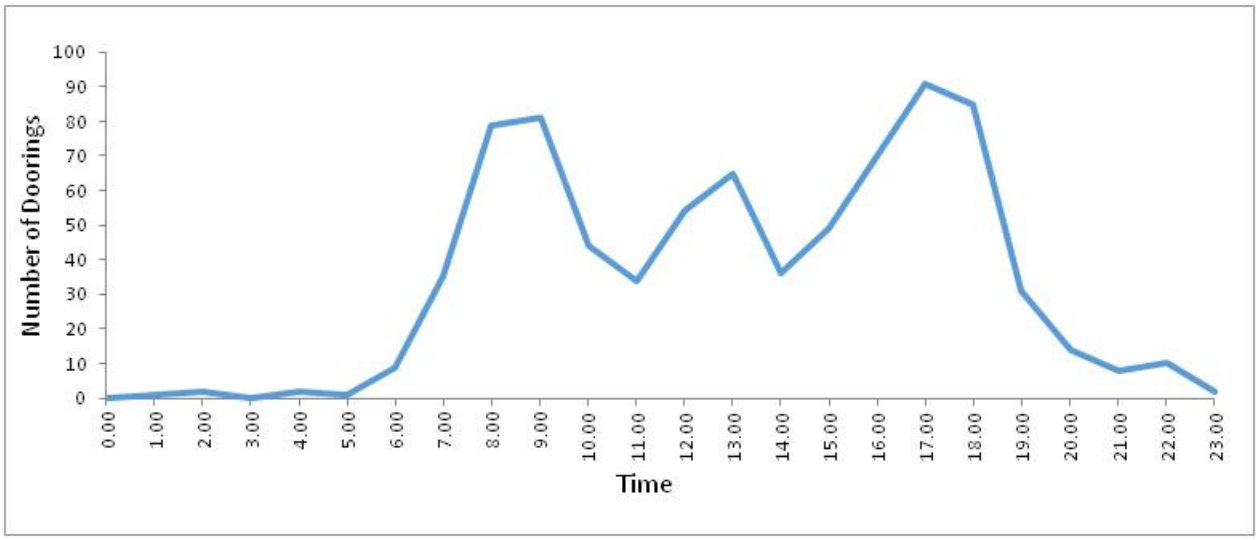


Figure 44: Doorings incidents per hour in metropolitan Melbourne. Source: CrashStats

[22] VicRoads, 2016, Road use and performance

Document Information

Title:	Guidance on Treating Bicycle Car Dooring Collisions
Department:	Traffic Engineering
Directorate:	Network Design Services
Approved by:	Jeremy Burdan
	Manager – Traffic Engineering
Date of Approval:	December 2016

Amendment Record

Edition / Revision	Pages(s)	Issue Date	Amendment Description
Edition 1	55	December 2016	First Edition

VicRoads wishes to acknowledge the significant contribution of Safe System Solutions in providing this document.

Office G2, 10-14 Hope Street, Brunswick, Vic, 3056

P: +61 3 9381 2222

E: info@SafeSystemSolutions.com.au

W: www.safesystemsolutions.com.au

For enquiries regarding this guideline, please contact the VicRoads – Traffic Engineering team via tem@roads.vic.gov.au or 9854 2417.