Transport for NSW

Cycleway Design Toolbox

Designing for cycling and micromobility

NSW GOVERNMENT

DECEMBER 2020 | Version 0.1

You are here

Cover image credit: Chris Southwood / City of Sydney

Contents 2

Navigation tip

This document is a clickable PDF to enable ease of navigation. Navigate to particular sections directly from the table of contents above, and click on underlined text throughout the document to navigate to the relevant section for more information. This icon (found on the top right corner of all page spreads) will navigate you back to the table of contents.

aurecon

spackman mossop michaels

The Cycleway Design Toolbox was produced by Aurecon and SMM on behalf of Transport for NSW

1. Design Principles

1. Design principles

1.1 Aim and objective of the toolbox

The aim of the Cycleway Design Toolbox (the Toolbox) is to provide guidance for practitioners on how to design for cycling and micromobility in the context of New South Wales and Greater Sydney.

This Toolbox provides practitioners with a range of design tools, being a comprehensive suite of best practice designs across a range of typical on- and off-road environments that can be tailored to their specific environment. It can be used to justify the planning, design and delivery of high-quality cycling infrastructure by demonstrating the positive impact on level of service for people cycling.

1.2 Six design principles

There are five internationally-recognised design principles that cycling-friendly infrastructure needs to meet: safe, connected, direct, attractive and comfortable (see Figure 12). This Toolbox includes an additional principle: to be adaptable.

These design principles will assist practitioners in effectively integrating cycling facilities into urban and suburban environments in ways that balance a range of requirements including a variety of different customer needs, and movement and place outcomes.

Practitioners should aim to provide infrastructure that achieves these six design principles to the highest quality possible. By providing infrastructure that is suitable and accessible for all ages and abilities, (Figure 1.1 below), cycling and micromobility will become a viable mode of transport for a wider range of potential users.

1.3 What is cycling and micromobility?

For the purposes of this document, cycling and micromobility includes human or electric-powered personal mobility devices such as conventional bicycles, tricycles, electric assist bicycles (e-bikes), kick scooters, cargo bikes (which can carry loads or passengers) as well as share bikes. In the future it may also include e-scooters, delivery robots and other innovative personal mobility devices.

They can provide seniors and people with disabilities more personal freedom and mobility to access essential services and to socialise.

This guide aims to provide a future proof network for these types of devices. Throughout this document where the words cycling, cycleway or bicycle riders are used, it is implied that they are inclusive of micromobility.

Figure 1.1 Users of all ages and abilities

1 These principles were first identified by the Dutch Design Manual for Bicycle Traffic (CROW, 2006). They have since been updated and/or incorporated in many other cycling infrastructure design standards and guidance publications throughout the world.

Figure 1.2 Six design principles

Safe

Cycling infrastructure must not only be safe but should also be perceived to be safe so that people of all ages and abilities feel comfortable using the facilities.

Encounters with motorised traffic should be avoided as much as possible by means of separation in time or space to remove exposure and avoid conflicts. Providing a dedicated and protected space for cycling may involve reallocating existing road space or providing a parallel route.

Where separation is not possible, improvements for all road users can be achieved by reducing motor traffic volumes and speed, for example by introducing filtered permeability or traffic calming measures.

Other hazards pose safety risks to people cycling such as obstructions/debris that reduce sight lines or available path width, poor surface quality, visibility (particularly at dark), and conflicts with other road users. Providing separation from conflict with pedestrians also provides an increased sense of safety for pedestrians, particularly the elderly and frail.

Connected

Cycling infrastructure should be designed and planned to enable people to reach their day-to-day destinations easily, along routes that are connected, simple to navigate, and of a consistent quality that is appropriate for the expected use of that route.

Bicycle riders should have assurance that there will be high quality cycling routes between all their origins and destinations, and between different modes of transport across their journey. A poorly connected cycling network will reduce coherence and act as a disincentive for cycling or even place riders into dangerous situations. A cycle route is only as effective as its weakest link.

Direct

Measured in both time (effort) and distance, direct routes should provide bicycle riders with the shortest and fastest way of travelling from place to place, and make cycling an attractive alternative to driving or even public transport, particularly for local journeys.

Minimising the effort required to cycle by enabling riders to maintain momentum is an important aspect of directness and an essential feature of high-quality design.

Permitting bicycle riders to make movements prohibited to motor traffic, allowing contraflow cycling, and creating links between cul-de-sacs will enhance the directness of their given routes. Parallel routes that are not along main streets and roads must be genuinely comparable in both distance and legibility and avoid interruption (such as waiting longer at crossroads or traffic signals)

Attractive

Cycling is a pleasurable activity, in part because it involves such close contact with the surroundings.

Attractiveness of a cycleway facility relates both to the perceived safety and the quality of infrastructure, including the aesthetics of the surrounding environment. This may include, for example, trees and shade, quality public open space, welcoming destnations such as cafes and shops, and artworks. The surroundings encountered when cycling range from attractive to intimidating and can encourage or discourage cycling along a particular route – it may even determine whether users choose cycling as a means of transport.

Cycling infrastructure should connect to and help deliver public spaces that are well designed and be places that people want to spend time

Comfortable

Comfortable conditions for cycling require routes that are clearly demarcated from motor vehicles and pedestrians with high-quality, well-maintained and smooth surfaces.

Designers should consider comfort for all users including children, families, older people, and people with disabilities.

Routes should provide adequate width for the volume of users, enable minimal stopping and starting, avoid steep gradients, and limit interaction with high speed or high volume motorised traffic including noise and pollution where possible. An effective design should clearly communicate to people cycling the appropriate speed for that environment.

Adaptable

Delivering a piece of infrastructure is only a part of a project's overall lifecycle.

Adaptability should be embedded in the design of cycling infrastructure to ensure that it can evolve to accommodate changes in the needs and demands of its users over time, including innovations in micromobility.

For infrastructure to be adaptable in a meaningful way, the adaptation process must be relatively cheap and easy. Long term maintenance also needs to be considered.

2. General Cycleway Design

2. General cycleway design

2.1 General cycleway design

When planning and designing cycling infrastructure, practitioners need to consider the desired outcomes and experience of all road users. An integrated approach to planning is required that accounts for both the movement function and place intensity of the location, its associated infrastructure and local context. Designing for cycling infrastructure is therefore both a transport planning task and an urban design task.

2.1.1 Designing cycling friendly infrastructure

The first step when planning and designing cycling infrastructure is to assess and prioritise current functions, related to both Movement and Place, to ensure that it is well integrated into the existing streetscape. Integrating new cycling infrastructure will support the creation of a pleasant and attractive environment for people walking and cycling and may reduce the Level of Traffic Stress (Level of Traffic Stress) by reducing traffic volume and speed. In order to minimise costs and disruption, as well as to maintain space for pedestrians, it is preferable to reallocate road space from other uses (such as traffic lane widths, vehicle movement and parking) than sacrifice footpath or quality public open space to accommodate cycling infrastructure. Table 2.1 outlines different strategies, approaches and resulting design implications in achieving the desired outcomes and maximising the propensity for walking and cycling.

Strategy	Approach	Design implications
Assess and prioritise movement and place functions for all modes	Prioritise people walking and cycling	• Reduce number of traffic or parking lanes • Introduce one-way flows for motorised traffic • Reduce traffic lane widths
	Adjust road space allocation	• Allocate more road space to pedestrians and people cycling, to align with strategic priorities
Reduce traffic flow	Filtered permeability	• Close off streets to through traffic, while maintaining connectivity for people walking and cycling
	Introduce one-way flows for motorised traffic	• Allow contraflow cycling
Reduce traffic speed	Traffic calming devices	• Flat-top speed humps with gentle ramp gradients • Speedometer
	Road diet - intersections	• Reduce intersection size • Reduce crossing distance at intersections • Protected intersections • Provide lead time for people cycling and walking
	Road diet - roads	• Reduce road width (physically, or with linage) • Install kerb blisters / kerb extensions
Improve crossings for people walking and cycling	Prioritise pedestrian and cycling movements over motorised traffic	• Raised top pedestrian and cycling crossings at unsignalised crossing points • Provide lead time and / or automated signals for people cycling and walking at signalised crossing points
	Remove slip lanes	• Reduce traffic speed and offer additional space to store waiting pedestrians (increasing safety)
Reduce speed limit to 30 km/h or below	Adjust environment and infrastructure to provide visual cues on appropriate speeds	• Introduce traffic calming measures • Install kerb buildouts

Figure 2.1 Strategies, approaches and design implications for walking and cycling

2.1.2 Main design considerations

Cycleway facility width

Cycleways should be designed with the maximum possible width allowing for safe recovery and overtaking, catering for future growth in ridership, and accommodating riders of all ages and abilities.

A sufficiently wide cycling facility will also allow for higher cycling speed, allow people to ride side-by-side (such as parents and children) and cater for the emergence of innovative forms of micromobility. Where higher bicycle volumes are expected or steeper gradients occur (leading to significant speed differences), a wider design should be considered.

To help achieve the optimal width of a bicycle path, the following measures should be considered to 'gain width' (refer to Figure 2 1 for more examples):

- Reduce traffic lane width, particularly if the road does not carry public transport services
- Reduce the number of traffic lanes, remove turning lanes and slip lanes, or introduce one-way traffic
- Reallocate space used for car parking.

Separation

To enhance the safety of all users, bicycle riders should be separated from motorised traffic. Separation between people walking and cycling should also be considered, appropriate to the local circumstances.

Incorporating a buffer between people cycling and parked cars is a key safety design feature for cycling facilities. The amount of physical separation required between the bicycle path and the main carriageway depends on traffic aspects such as speed, volume and heavy vehicles, and the surrounding environment (trees, green space, road signage and other objects). The buffer can take the form of a median, kerb, verge or planting. In the absence of kerbside car parking, or in instances when traffic is travelling in the same direction, a narrower buffer could be considered.

Pedestrian access along new cycling routes is to be carefully considered to avoid a downgrading of pedestrian accessibility. Where new bicycle facilities are installed, raised pedestrian crossings (zebras) should be considered at intersections and/or at regular intervals to ensure there is no increase in risk to pedestrians crossing the street.

Kerb treatments provide separation between people walking and cycling. A slanted edge (less than 45-degree angle) is preferred, due to its forgiving design. Vertical edges (90-degree standard kerbs) pose a safety risk to people cycling, but may be considered when using existing kerbs and drainage (to reduce costs) or due to safety considerations for pedestrians (reduce trip hazards).

When a lower degree of separation is required, for example in areas with low pedestrian activity or low levels of cycling, flush kerb treatments with line markings and distinguishable surfacing (colour and texture) may be considered.

Accessibility for people in wheelchairs, pushing prams or wheeling luggage is a critical safety consideration in the design and planning of cycling infrastructure. Design features such as distinguishable surfacing (colour and texture) can guide the visually impaired and provide cues for upcoming crossings/interactions with the cycling facilities. As previously noted, separation between people walking and cycling should be considered, appropriate to the local circumstances, to enhance safety for the visually impaired.

Intersection treatments

Key design considerations when planning and designing intersections along a cycling route include:

- Managing conflicts between different road users, accounting for their preferred route options and turning movements
- Prioritising road users in line with strategic policy objectives, ensuring people walking and cycling are given priority and ample crossing time

Where a cycling route intersects with a side street, the preferred treatment is a continuous cycleway with priority to bicycle riders. By prioritising vulnerable road users and removing ambiguity, a higher level of safety will be achieved for walking and cycling customers. This may also be subject to road rules and other technical guidance such as Austroads.

Other considerations

To enhance road safety, debris or obstructions along or adjacent to the cycleway should be minimised.

Where pedestrian activity is high (ie. school zones, shopping/retail districts, transport interchanges, etc), demarcated pedestrian crossings should be installed. Sufficient space for boarding and line markings should be provided at bus stops, and sight lines should be maintained.

2.2 Cycleway Facility Selection Tool

The Cycleway Facility Selection Tool detailed in Figure 2.2 is a simple method of assessing the suitability of several design options, centred on three key factors:

- Movement and Place typology
- Speed of motorised traffic
- Volume of motorised traffic

Additional factors to assess suitability should be considered, such as local context, availability of useable space, presence of driveways and side streets, on-road car parking, level of pedestrian activity, and predicted demand for the facility.

The tool comprises two levels of facility types:

Required for priority routes / Preferred for local routes
Offers a high Level of Service and safety to bicycle riders. Required for priority cycleways, preferred for local cycleways.

Suitable, but not preferred
Offers a lower Level of Service or safety to bicycle riders. Suitable, but not preferred, for cycleways.

2.2.1 Clarifications

Practitioners are encouraged to work through the Movement and Place framework to classify the specific road or street segment according to the project purpose and desired outcomes.

Once a classification has been agreed in collaboration with key stakeholders, the desired traffic speed and projected traffic volumes can be utilised to find the most appropriate facility type for that particular segment using the Cycleway Facility Selection Tool (Figure 2.2). Practitioners can then navigate to the corresponding section of the Toolbox to find suitable design options based on their local environment.

Within the local context, there may be pressure to 'downgrade' from the preferred cycleway facility, for example to reduce costs, or minimise impacts on other modes such as car parking, bus or traffic movement when expected use of the facility is low or where there is a lack of useable space. However, it should be emphasised that this will result in low levels of service, may pose significant safety risks to bicycle riders, and result in less mode shift to sustainable transport than expected.

Note
Refer to Glossary B.2.1 for definitions of cycleway facilities (eg bike path, bike lane, shared path, quietway etc).

One-way (unidirectional) bicycle paths located on both sides of the road are preferred over **two-way bicycle paths**, as these enhance road safety, improve operations at intersections, provide connected and legible routes, and enable local access.

Shared paths with both pedestrians and bicycle riders sharing the space may be considered where the predicted demand or activity is low and where there are limited interactions along the cycleway (ie. driveways, side streets). Shared paths are not preferred in areas with high pedestrian activity, where there is significant cross cycleway movement, or where cycling speeds may be high. Mixing pedestrian and cycling movements in these locations could pose safety risks to users and offer a low Level of Service to bicycle riders.

Shared zones, similarly, should only be considered in environments where the predicted demand or activity is low. Mixing pedestrian, cycling and motor vehicle traffic in locations with high activity or high motor vehicle traffic speeds could pose significant safety risks to users.

A **quietway** is a high-quality 'mixed traffic' treatment, where bicycle riders travel on-road. The design philosophy of a quietway is that people cycling are equal road users to motor vehicle traffic. Supported by very low traffic speeds (e.g. 30kmh or lower) adequate design elements and visual cues, drivers are encouraged to reduce speed and discouraged to overtake bike riders or other vehicles. quietways are preferred on local streets with low volumes and few heavy vehicles.

Priority cycling routes are those serving a regional, function and/or catering for higher levels of cycling demand. Due to the higher order function and to support rider safety, bicycle paths - and quietways on low speed, low traffic streets - are the **required** facility types on priority cycling routes.

Local cycling routes provide first-mile and last-mile connections to local destinations and networks of priority routes and cater for lower levels of cycling demand. Bicycle paths and quietways are the **preferred** facility types on local routes, but shared paths may also be **suitable** (but not preferred) where pedestrian and cycling activity, as well as cross-cycleway movements, are low.

Given the safety implications for people cycling, mixed traffic treatments (with the exception of quietways) and on-road bicycle lanes are **unsuitable** for priority cycling routes.

Refer to the Cycleway Facility Selection Tool for priority and local routes in Figure 2.2 below.

Priority routes

Street typology (Movement and Place)	Civic space	Local street	Main street	Main road
Motor vehicle speed	≤10 km/h	≤30 km/h	≤50 km/h	>50 km/h
Motor vehicles / day	n/a	≤2,000	>2,000	n/a
Bicycle path (One and two-way)		●	●	●
Quietway		●		
Shared path (Low pedestrian activity and low cross-cycleway movement)				
Shared path (High pedestrian activity or high cross-cycleway movement)				
Shared zone	◐			

● Required for priority routes ◐ Suitable, but not preferred for priority routes

Figure 2.2a Cycleway Facility Selection Tool - Priority Routes

Local routes

Street typology (Movement and Place)	Civic space	Local street	Main street	Main road
Motor vehicle speed	≤10 km/h	≤30 km/h	≤50 km/h	>50 km/h
Motor vehicles / day	n/a	≤2,000	>2,000	n/a
Bicycle path (One and two-way)		●	●	●
Quietway		●		
Shared path (Low pedestrian activity and low cross-cycleway movement)		◐	◐	◐
Shared path (High pedestrian activity or high cross-cycleway movement)				
Shared zone	◐			

● Required for priority routes ◐ Suitable, but not preferred for priority routes

Figure 2.2b Cycleway Facility Selection Tool - Local Routes

3. Cycleway Facility Design

3. Cycleway facility design

Practitioners will find a range of design options and treatments for cycleway facilities in the following pages. This section provides a suite of optimal road and intersection configurations across a range of cycleway facility types, with accompanying design considerations and best practice examples.

The suitability of facility types described in this chapter is based on the following:

Required for priority routes / Preferred for local routes

Offers a high Level of Service and safety to bicycle riders. Required for priority cycleways, preferred for local cycleways.

Suitable, but not preferred

Offers a lower Level of Service or safety to bicycle riders. Suitable, but not preferred, for cycleways.

Note

The choice to provide one cycling facility type over another should not only respond to the unique characteristics of the site, but more importantly, should be considered as part of a design process that requires consultation and engagement between a range of experts, including professionals from urban design, landscape architecture, road and traffic engineering, as well as meaningful engagement with the community to ensure that any solution meets their needs.

Refer to Glossary B.2.1 for definitions of different cycleway typologies.

The following cycleway infrastructure types are illustrated in this chapter:


nab

3.1 Bicycle path (one-way)

3.1.1 Overview

The preferred facility for a high priority cycling route is a bicycle path, especially where on-road operating speeds exceed 30 km/h. A bicycle path is an off-road facility that is physically separated from motor vehicle traffic and pedestrians, and is exclusively for use by bicycles and potentially other micromobility devices.

These facilities minimise conflict and the risk of injury for all road users. They also improve the level of service for people cycling, maximising potential ridership.

To further increase level of service, bicycle paths should ideally be continued through intersections with crossing side streets, prioritising flow along the bicycle path.

One-way (uni-directional) bicycle paths located on each side of a road and operating in the same direction as adjacent motor vehicle traffic are the preferred design for cycleway facilities. One-way bicycle paths reduce delay, improve road safety (both at intersections and along road sections) and improve operations at intersections when compared with two-way bicycle paths. One-way bicycle paths also offer improved coherence, legibility and local access, and should therefore be installed where adequate space allows.

To cater for expected growth in ridership and emerging forms of micromobility, bicycle paths should be designed with sufficient width and minimal horizontal deflections (ie. straight alignment). This also increases safety and comfort.

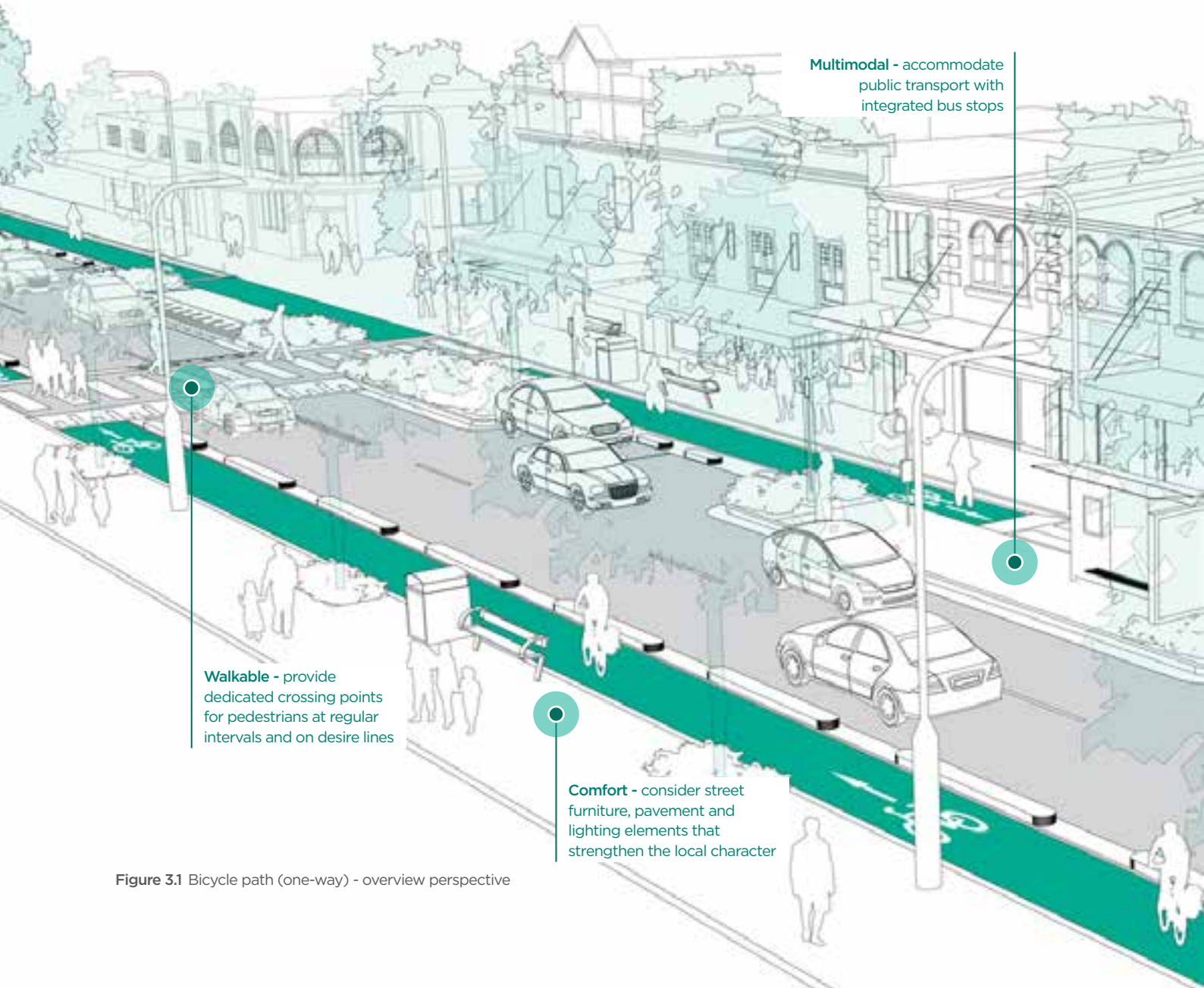


Figure 3.1 Bicycle path (one-way) - overview perspective

3.1.2 Urban design

Introducing one way bicycle paths into an existing street requires a reconfiguration of spatial operations. As much as possible, designs should aim to fit bicycle paths within existing kerb alignments and minimise impacts on footpaths, stormwater systems and lighting, electrical and communications services.

Space required for one way bicycle paths can be attained by:

- Minimising widths of traffic and parking lanes.
- Reducing the number of traffic lanes or converting traffic operations to one way.
- Reducing parking lanes with priority allocated to loading and special use zones.
- Providing in-lane bus stops.

Pedestrian access needs to be carefully considered to avoid a downgrading of accessibility as a result of the implementation of new bicycle facilities.

Regular crossing points are to be provided at intersections, side streets and to address mid-block desire lines. This can include:

- Signalised pedestrian crossings.
- Marked pedestrian crossings.
- Footpath continuations.
- Shared Environment Intersections.
- Road narrowing / kerb extensions with kerb ramps.
- Slip lane removal.

Opportunities to incorporate trees and landscaping as well as street furniture, pavement, lighting and wayfinding will strengthen the character and attributes of a street. To achieve an integrated outcome, these elements need to be considered when assessing street operation and configuration options.

Outcomes must provide safe, comfortable, and enjoyable environment for pedestrians and bicycle riders and achieve an appropriate balance of movement and place functions.

Facility design - Bicycle path (one-way)

3.1.3 Main design considerations

Cycleway facility width (Safe and Comfortable)

An ideal one-way bicycle path should maintain a preferred width of 3.0m, however a suitable width may be 2.0m in locations for up to 150 riders per hour (Austroads minimum 1.5m). The preferred width of 3.0m allows for safe overtaking, caters for future growth in ridership, and accommodates riders of all ages and abilities. A 3.0m width will also allow for higher speeds along the bicycle path to cater for the emergence of innovative forms of micromobility. Where higher bicycle traffic volumes are expected and steeper gradients occur, a wider design should be considered.

To help achieve the preferred width of a bicycle path, the following measures should be considered to 'gain width' (refer to Section 2 for more examples):

- Reduce traffic lane width, especially if the road does not service public transport
- Reduce the number of traffic lanes, removing turning lanes or slip lanes, or introducing one-way traffic
- Reallocate space used for carparking

In highly constrained areas where insufficient usable space is available, a narrower bicycle path can be considered. As a minimum, the bicycle path should be 1.5m wide to align with Austroads, but 2.0m at isolated locations is preferred in constrained conditions.

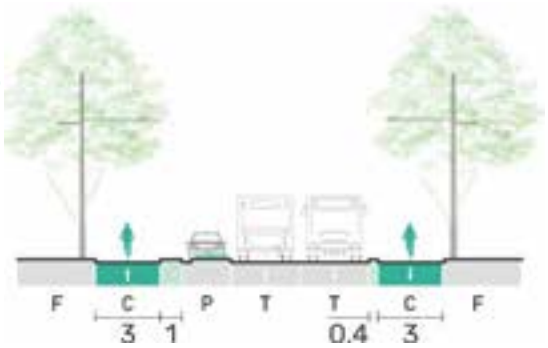


Figure 3.2 Typical cross section - optimal configuration (unconstrained)

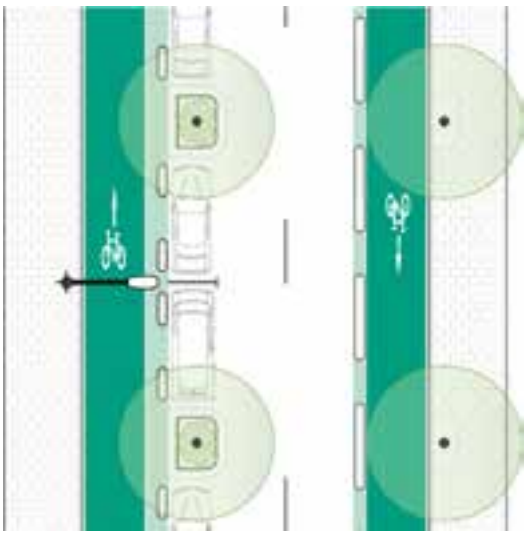


Figure 3.3 Typical plan - optimal configuration (unconstrained)

Separation (Safe and Comfortable)

Incorporating a buffer between people cycling and parked cars is a key safety design feature for cycling facilities, with the ideal buffer width of 1.0m (the 0.5m wide raised median in Figure 3.5 is accompanied by a further 0.5m line-marked clearance to provide additional space for overtaking should a rider deem it safe to do so, while maintaining a total buffer of 1.0m between the bike path and the parked cars). The amount of physical separation required between the bicycle path and the main carriageway depends on traffic aspects such as speed, volume and heavy vehicles, and the surrounding environment (trees, green space, road signage and other objects). The buffer can take the form of a median, kerb, verge, landscaping, street furniture or planting. In the absence of kerbside car parking, or in instances when traffic is travelling in the same direction, a narrower buffer of at least 0.4m could be considered.

Kerb treatments provide separation between people walking and cycling. A slanted edge (less than 45-degree angle) is preferred, due to its forgiving design.

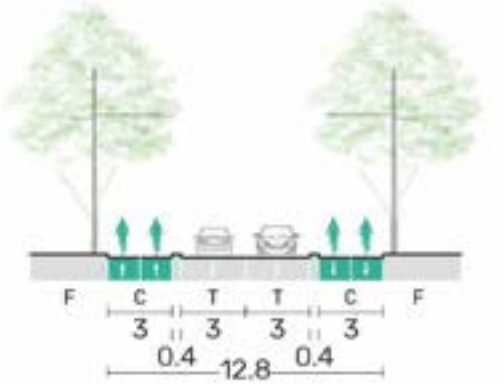


Figure 3.4 Typical cross section - optimal configuration (12.8m carriageway)

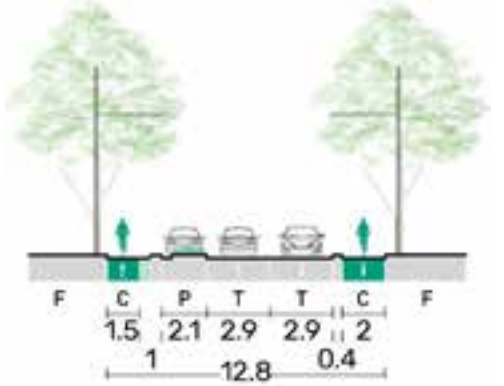


Figure 3.5 Typical cross section - constrained configuration (12.8m carriageway)

More information can be found in Austroads Guide to Road Design Part6A Section 5.1.5, Table 5.5

Facility design - Bicycle path (one-way)

Vertical edges (90-degree standard kerbs) pose a safety risk to people cycling, but may be considered when using existing kerbs and drainage (to reduce costs) or due to safety considerations for pedestrians (reduce trip hazards).

When a lower degree of separation is desired, for example in areas with low pedestrian activity or low levels of cycling, flush kerb treatments with line markings and distinguishable surfacing (colour and texture) may be considered. This is referred to as a Separated Path with a combined minimum width of 3.0m (including 1.5m for the bicycle path section). See Austroads (2017) Part 6A, Section 5.1.3 and Appendix A3.

To enhance road safety, debris or obstructions along or adjacent to the cycleway should be minimised.

Where pedestrian activity is high (ie. school zones, shopping/retail districts, transport interchanges, etc), demarcated pedestrian crossings should be installed. Sufficient space for boarding should be provided at bus stops, and sight lines should be maintained.

Intersection treatments (Safe, Direct and Connected)

The preferred treatment for an intersection where a facility interacts with a side street is a continuous cycleway with priority given to people cycling to provide high level of service and improved safety for riders. Any such facility needs to be checked against Austroads guidance and the NSW Road Rules to ensure compliance.

The interaction between pedestrians and people cycling requires careful consideration. Any bend-outs should be as smooth as possible to allow for ease of manoeuvring and provide waiting space for vehicles a safe distance from the carriageway. As much as possible, vehicle movements that cross the bicycle path (ie. side streets, driveways, car parks, laneways) should be minimised. Where conflict zones are unavoidable, the infrastructure should be designed to reduce the speed of motorised traffic and adequate sight lines preserved where possible to allow for reciprocal visibility.

Figure 3.6 Bicycle path (one-way), Campbell Street, Surry Hills

Figure 3.7 In-lane bus stop, Campbell Street, Surry Hills

Figure 3.8 Bicycle path (one-way), Campbell Street, Surry Hills

3.1A Bicycle path (one-way) - Bent-out intersection

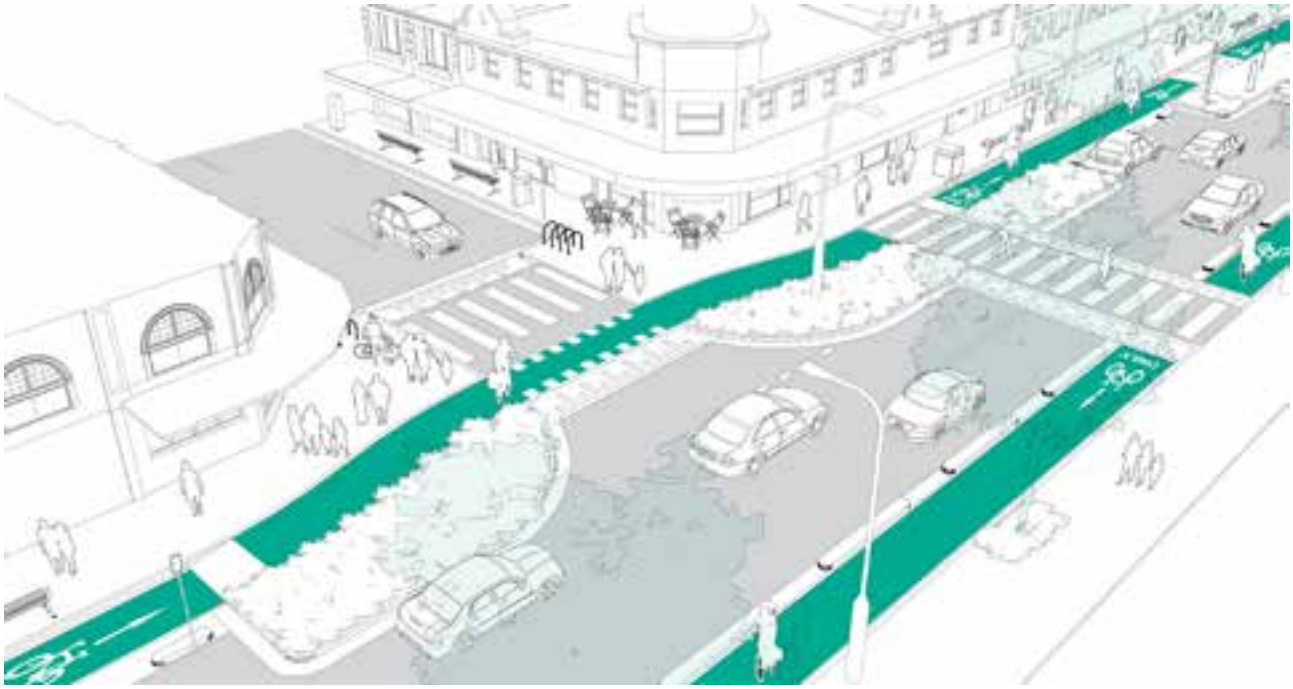


Figure 3.9 Bicycle path (one-way), bent-out intersection - perspective

Continuous bicycle path, bent-out intersection

- Main design principle: provide high level of service to people walking and cycling and reduce speed of intersecting traffic
- Design elements:
  - Prioritised pedestrian crossing and bicycle path
  - Raised intersection and clear road marking to indicate to all road users that the pedestrians and bicycle riders have priority over turning vehicles
  - Smooth bend out to avoid uncomfortable manoeuvring for people cycling
  - Bent-out to store waiting vehicle outside carriageway, and perpendicular crossing of bicycle path
  - No high objects(>1.0m) between the bicycle path and the road, to allow for reciprocal visibility
  - Kerb build outs to narrow intersection to reduce vehicle turning speeds and increase reciprocal visibility
- At smaller intersections there may be insufficient space to incorporate bend-outs in the design of the bicycle path. Several alternative treatments may be appropriate. For example, the bicycle path could be kept close to the road, and turning vehicles required to wait on-road before turning.

More information can be found in Austroads Guide to Road Design Part4 Section 9.3.3, Fig. 9.2 and Part6A Section 7.3.1, Fig 7.2 & 7.3

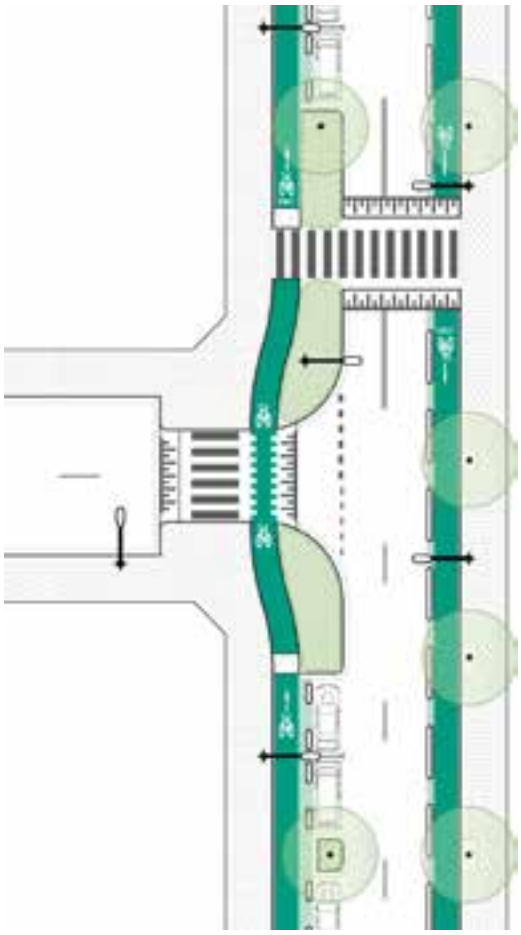


Figure 3.10 Bicycle path (one-way), bent-out intersection - plan

3.1B Bicycle path (one-way) - Raised intersection

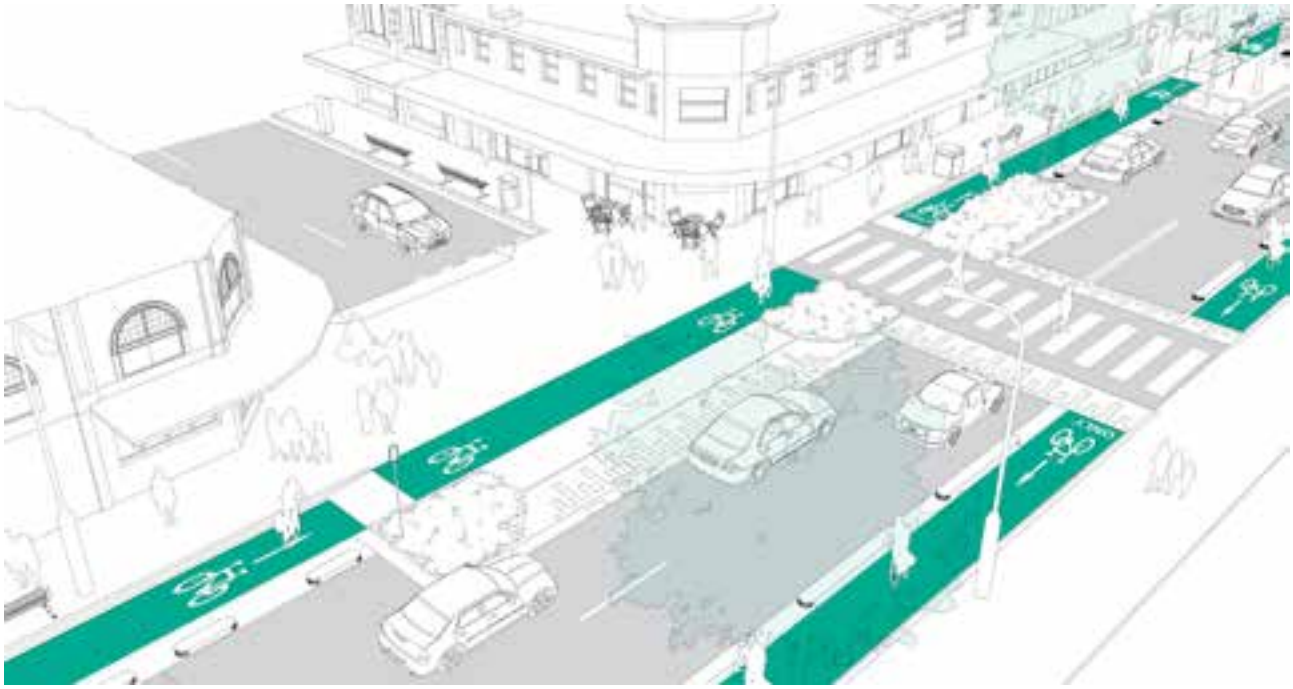


Figure 3.11 Bicycle path (one-way), continuous cycleway raised intersection - perspective

Continuous bicycle path, raised intersection

- Main design principle: reduce speed of intersecting traffic and provide high level of service to people walking and cycling
- May be considered in circumstances where there is insufficient space for a suitably wide bend-out
- This intersection has not yet been applied within the Australian context, but would provide a higher level of service and enhanced safety for people walking and cycling than existing guidance and treatments
- Design elements:
  - Prioritised continuous bicycle path and footpath
  - Raised intersection and clear road marking to indicate to all road users that pedestrians and bicycle riders have priority over turning vehicles
  - No high objects (>1.0m) between the bicycle path and the road, to allow for reciprocal visibility
  - Surface treatments providing texture and visual cues
  - Kerb build outs to narrow intersection (to reduce vehicles turning speeds and increase reciprocal visibility) and enable waiting motor vehicles to store outside carriageway

More information on similar facility type can be found in Austroads Guide to Road Design Part4 Section 9.3.3, Fig. 9.3

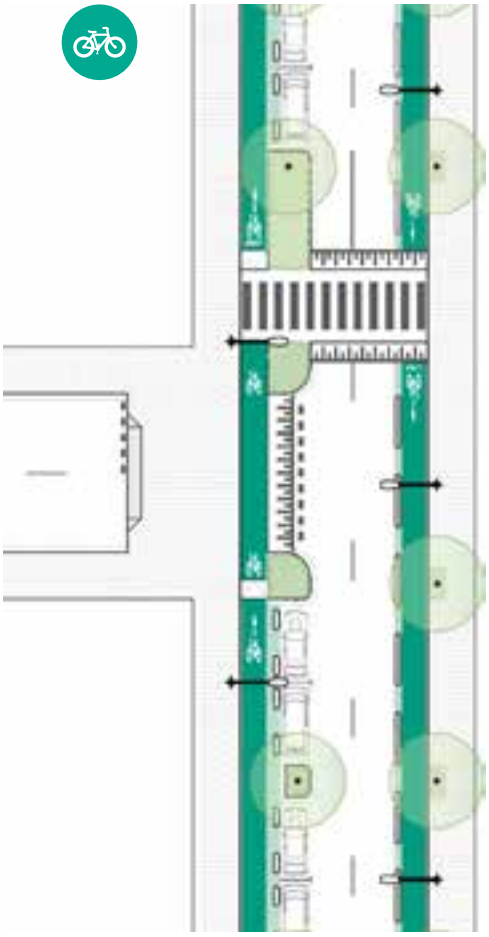


Figure 3.12 Bicycle path (one-way), continuous cycleway raised intersection - plan

3.1C Bicycle path (one-way) - Shared environment intersection

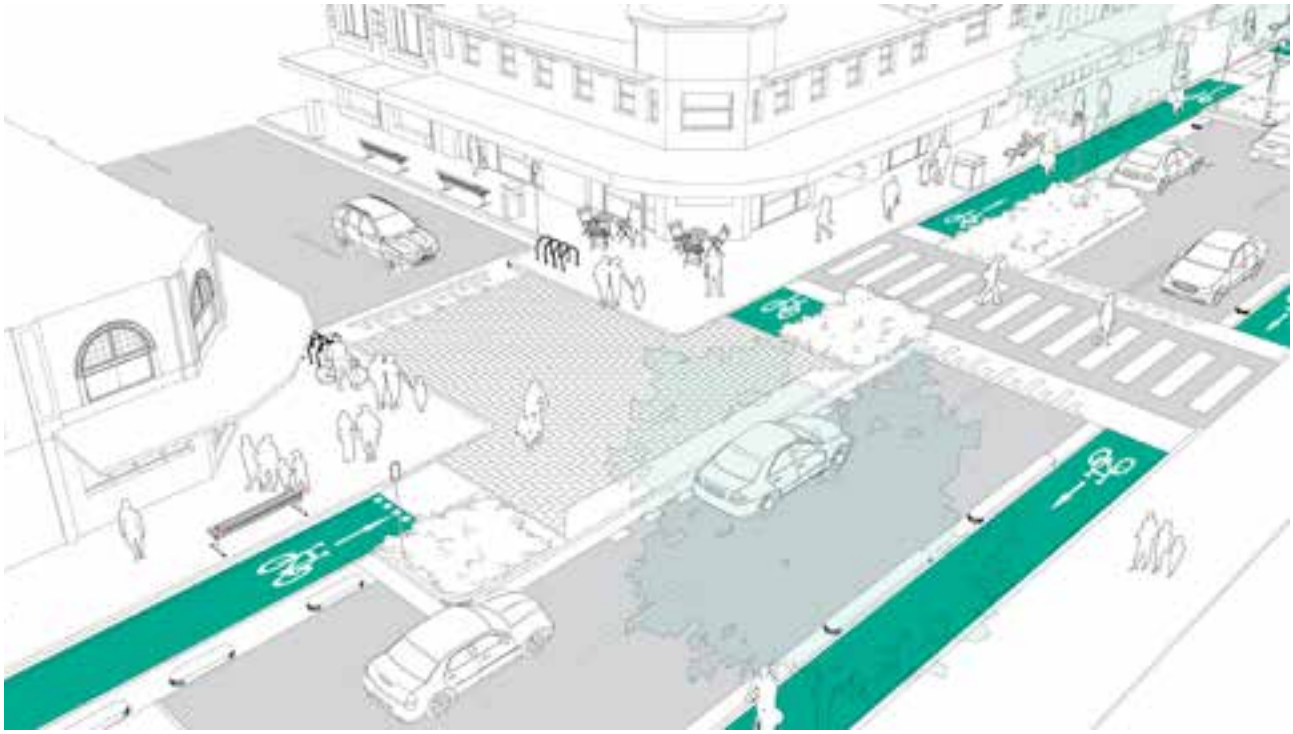


Figure 3.13 Bicycle path (one-way), shared environment intersection - perspective

Shared environment intersection

- Main design principle: reduce speed of intersecting traffic and people cycling, and provide high level of service to people walking
- This intersection type offers a lower level of service to people cycling compared to continuous bicycle path treatments (3.1A and 3.1B), as riders are not prioritised. Moreover, as priority is not clearly defined, safety issues may occur and vehicles waiting to enter the carriageway could block people cycling. Hence this is marked as 'suitable' for some environments, but is not the 'preferred' treatment.
- Design elements:
  - Raised intersection and clear road marking
  - No high objects(>1.0m) between the bicycle path and the road, to allow for reciprocal visibility
  - Narrow side street designed to reduce speed of motorised traffic
  - Surface treatments providing texture and visual cues for the shared environment intersection

More information on this facility type can be found in technical direction TfNSW TTD 2020/03 Shared environment intersection treatment

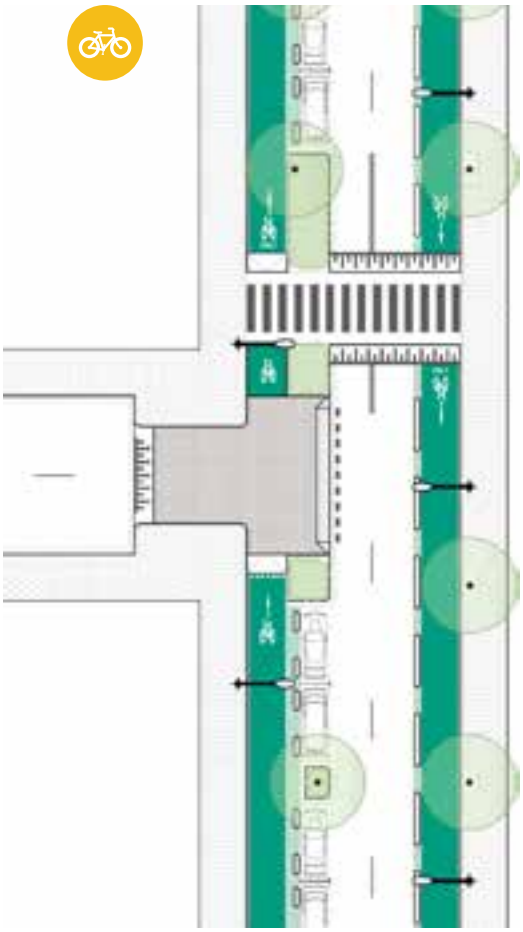


Figure 3.14 Bicycle path (one-way), shared environment intersection - plan

3.1D Bicycle path (one-way) - Roundabout

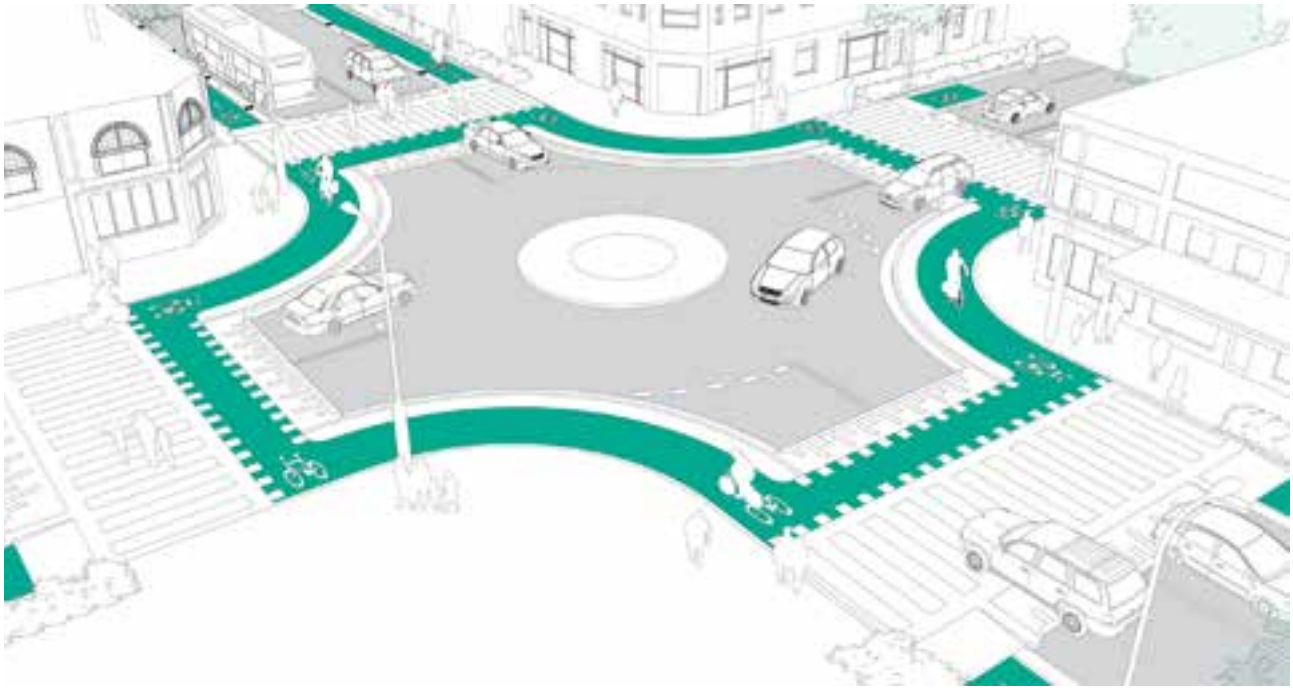


Figure 3.15 Bicycle path (one-way), separated roundabout - perspective

Roundabout

- Main design principle: reduce speed of intersecting traffic and people cycling, and provide high level of service to people walking and cycling
- Design elements:
  - Prioritised and continuous bicycle paths around the roundabout and pedestrian crossings on all legs
  - Raised crossing platforms and clear road marking
  - Narrow all branches of roundabout and apply deflection angle for motorised traffic to reduce speed
  - Raised island in the centre for use by wide-turning vehicles (ie. trucks and buses)

More information

Where space allows, a design similar to that applied in South Melbourne should be considered as it provides a smooth alignment, is easy to navigate, and provides a high level of service to people cycling. More information on this facility type can be found in City of Melbourne Bike Lane Design Guidelines Section 13.4, Fig. 18

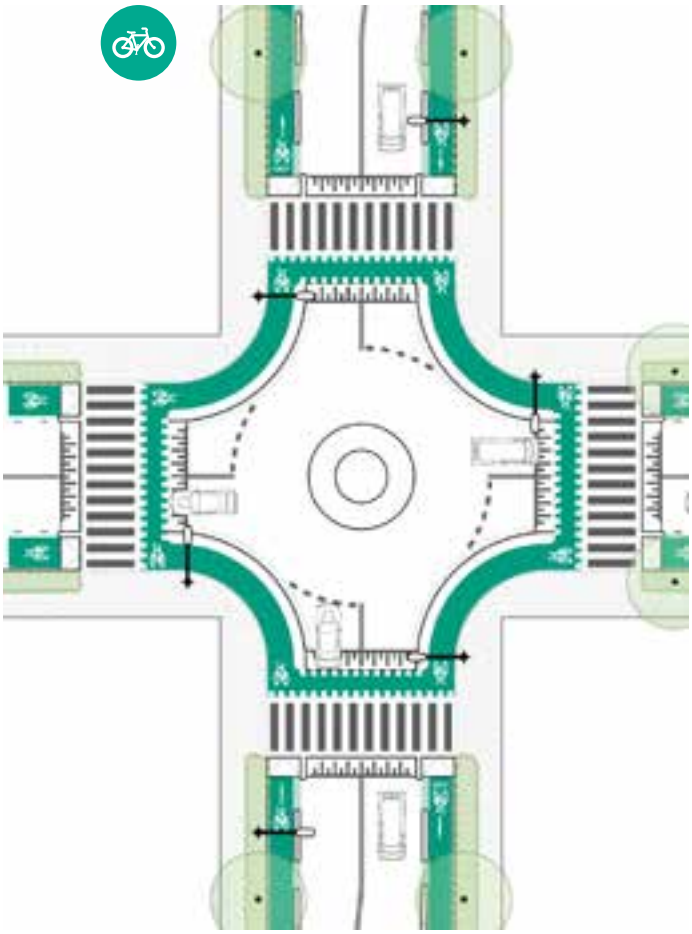


Figure 3.16 Bicycle path (one-way), separated roundabout - plan

3.1E Bicycle path (one-way) - Protected signalised intersection

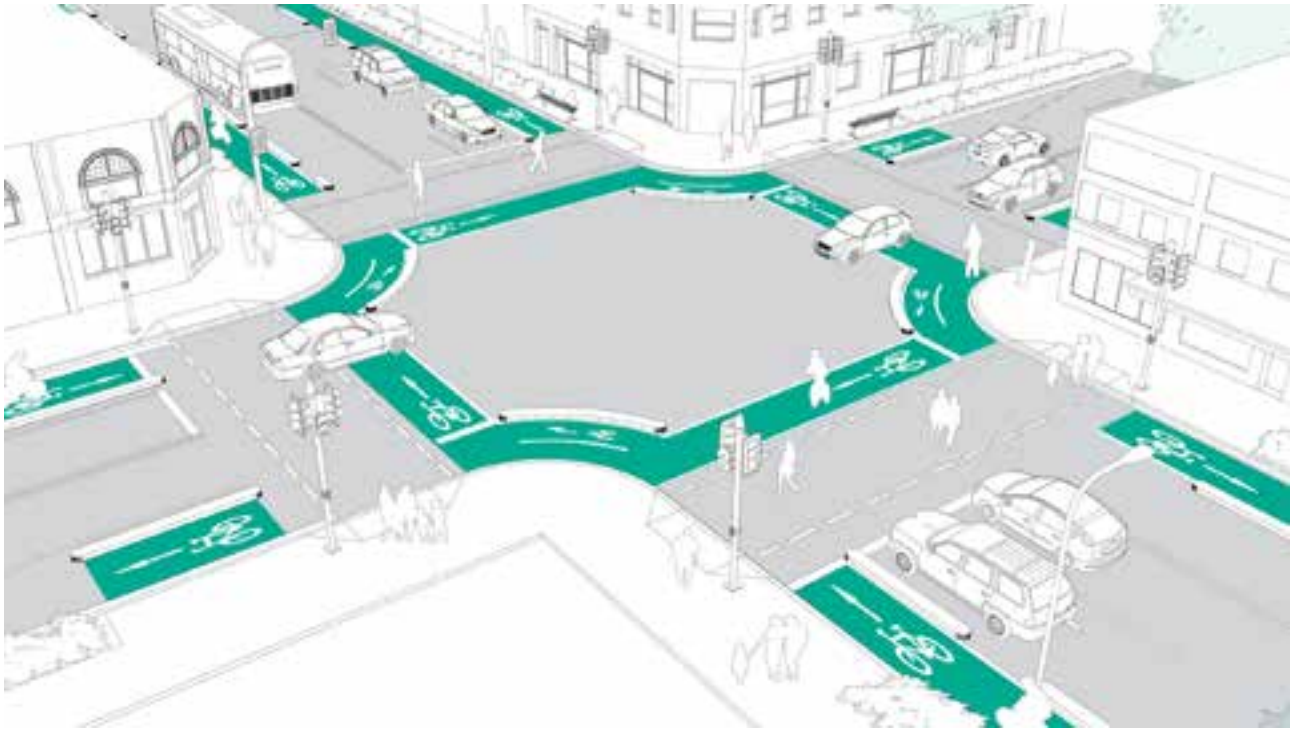


Figure 3.17 Bicycle path (one-way), protected signalised intersection - perspective

Protected signalised intersection

- Main design principle:
  - Provide safe and adequate crossing facilities for people walking and cycling
- Design elements:
  - Crossing facilities for people walking and cycling on all legs
  - Reduced waiting times for people walking and cycling through adjusted traffic signal controls
  - Signal lead phase and dedicated green time for bicycle movements to remove signal conflicts
  - Automatic loop detectors for bicycles, reducing wait time
  - Buffer areas for right turning riders
  - Barriers to protect riders from turning vehicles

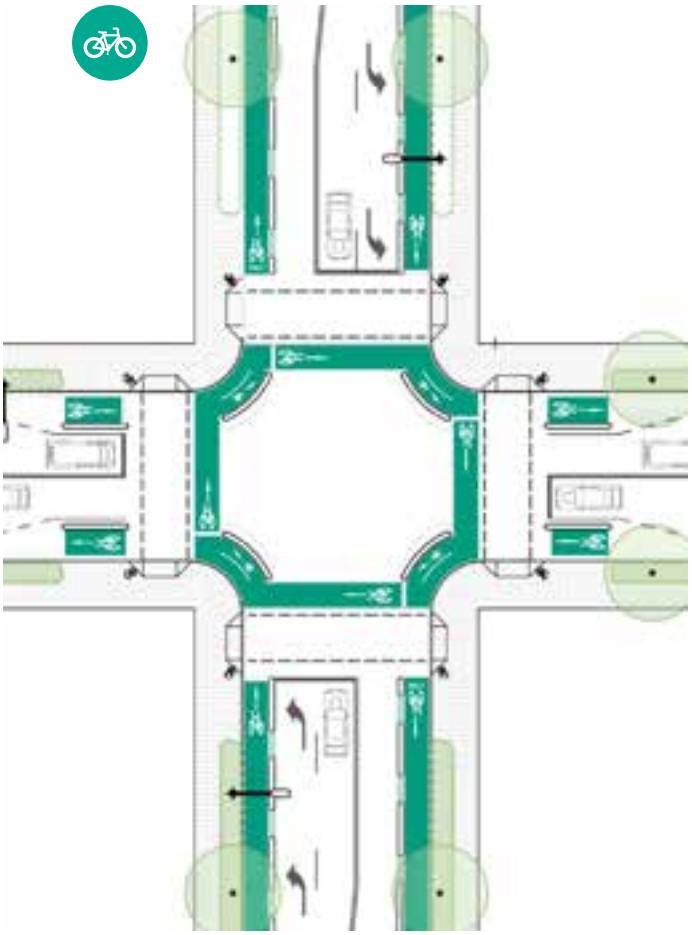


Figure 3.18 Bicycle path (one-way), protected signalised intersection - plan

3.1F Bicycle path (one-way) - Signalised intersection

Figure 3.19 Bicycle path (one-way), signalised intersection - perspective

Signalised intersection

- Main design principle: provide adequate crossing facilities for people walking and cycling
- Design elements:
  - Crossing facilities for people walking and cycling on all legs
  - Where possible, reduced waiting times for people walking and cycling through adjusted traffic signal controls
  - Signal lead phase and dedicated green time for bicycle movements to remove signal conflicts
  - Automatic loop detectors for bicycles, reducing wait time
  - Buffer areas for right turning riders (hook turn waiting area)
- Suitable where right turn bicycle movements are low or where dedicated right turn signal phasing can be provided, but offers less protection for bicycle riders than the protected intersection treatment

More information on this facility type can be found in Austroads Guide to Road Design Part4 Appendix B Section B.6, Fig. B10

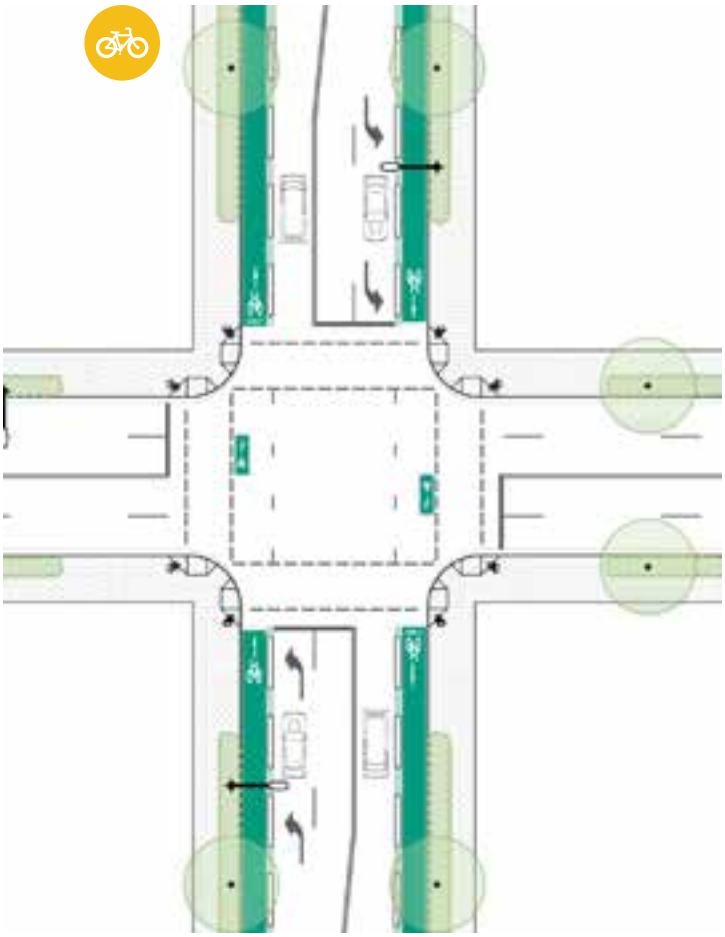


Figure 3.20 Bicycle path (one-way), signalised intersection - plan

3.2 Bicycle path (two-way)

3.2.1 Overview

The preferred facility for priority cycling routes is a bicycle path, especially where on-road operating speeds exceed 30 km/h. A bicycle path is an off-road facility that is physically separated from motor vehicle traffic and pedestrians, and is exclusively for use by bicycles and other micromobility devices.

These facilities minimise conflict and the risk of injury for all road users. They also improve the level of service for people cycling, maximising potential ridership.

To further increase level of service, bicycle paths must be continued through intersections with crossing side streets, prioritising flow along the bicycle path.

A two-way bicycle path on one side of the road should be considered if it is not possible to integrate two one-way bicycle paths on either side of the road, for example caused by numerous driveway crossings with limited visibility, or if conditions on one side of the road are highly advantageous, such as along a railway line, where there are no conflicts.

To cater for expected growth in ridership and emerging forms of micromobility, bicycle paths should be designed with sufficient width and minimal horizontal deflections.

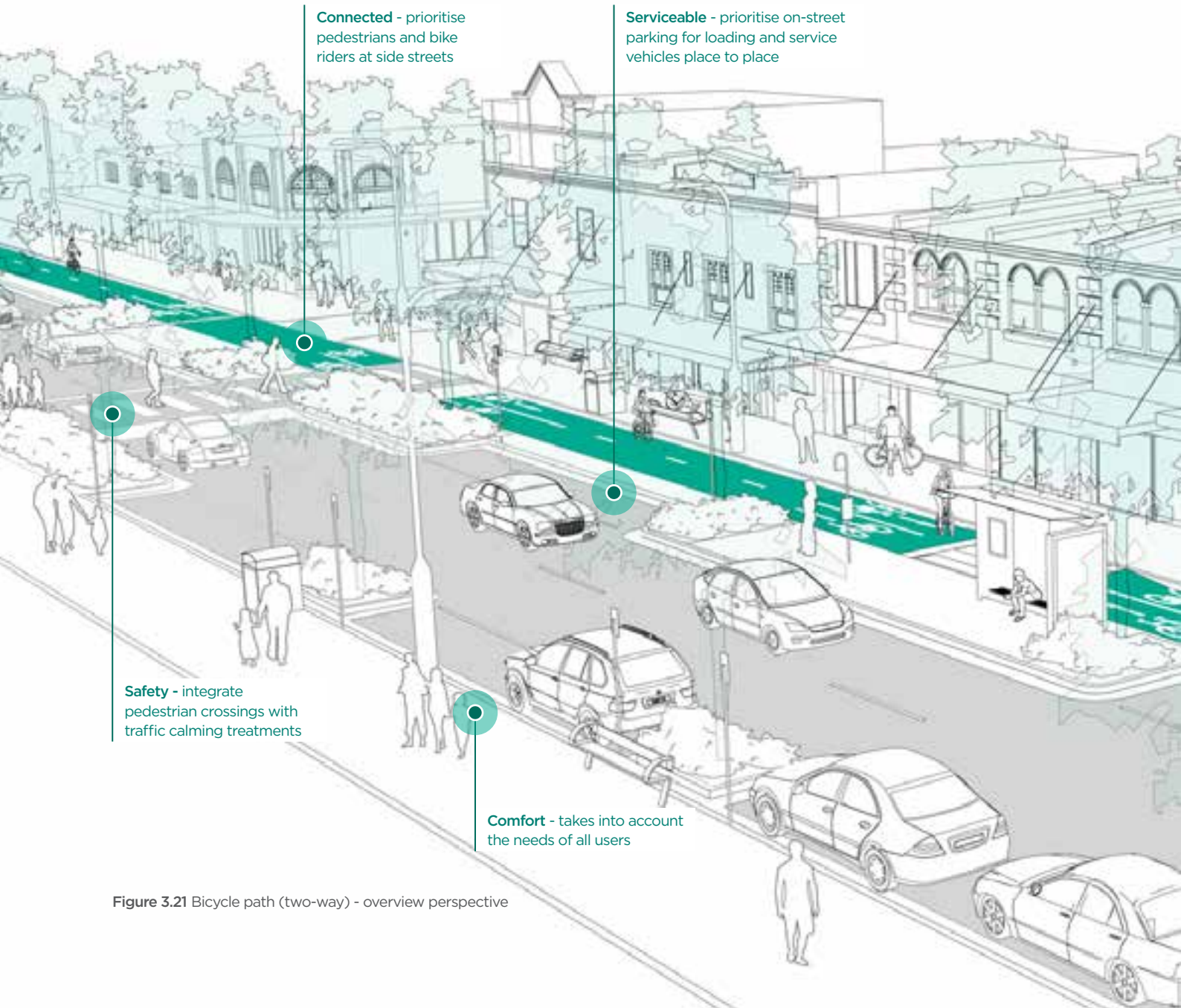


Figure 3.21 Bicycle path (two-way) - overview perspective

3.2.2 Urban design

Good places increase in value over time and are created by the interactions or activities of the people who use them. The implementation of a two-way bicycle path provides opportunity to improve the quality of the public domain.

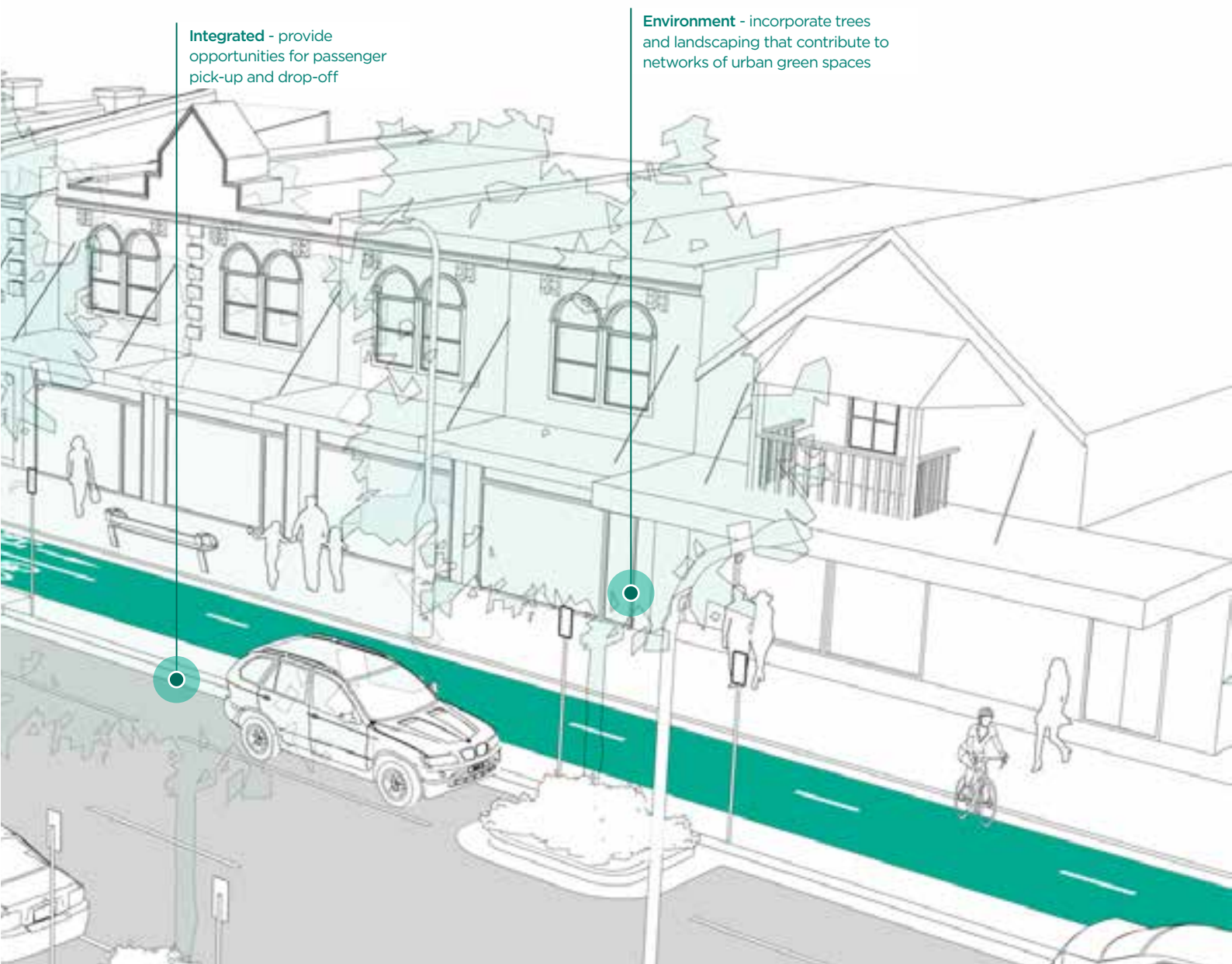
In addition to improved conditions for cycling, the design of these facilities can deliver more liveable streets.

Two-way bicycle path designs may include:

- Threshold treatments including coloured and textured road surface treatments to support a 30 km/h speed limit
- Kerb extensions to narrow the roadway and reduce vehicle speeds
- Flat top speed humps (ie. raised road platforms) with gentle ramp gradients
- Continuous footpath treatments at intersections with local roads

Implementing these design features will enhance opportunities to incorporate additional streetscape improvements including:

- New trees to provide shade and amenity
- Seating or outdoor dining to increase social activity and support local business.
- Planting and water sensitive urban design
- Bicycle parking and servicing facilities
- Highlighting local history



Facility design - Bicycle path (two-way)

3.2.3 Main design considerations

Cycleway facility width (Safe and Comfortable)

An ideal two-way bicycle path on a priority regional route should maintain a preferred width of 4.0m. This allows for safe overtaking, caters for future growth in ridership, and accommodates riders of all ages and abilities. A minimum 3.0m (preferably 4.0m) wide two-way bicycle path will also allow for higher speeds along the bicycle path to cater for commuters and the emergence of innovative forms of micromobility.

To help achieve the preferred width of a bicycle path, the following measures should be considered to 'gain width' (refer to Section 2 for more examples):

- Reduce traffic lane width, especially if the road does not service public transport
- Reduce the number of traffic lanes, removing turning lanes or slip lanes, or introducing one-way traffic
- Reduce space used for carparking

In constrained areas where insufficient usable space is available, a narrower bicycle path can be considered. As a minimum, the bicycle path of 2.4m may be suitable for specific locations. Austroads guidance is that 2.0m is the absolute minimum where there is very low use, although this is not suitable for priority or commuter cycle routes. However, when higher bicycle traffic volumes or higher cycling speeds are expected, for example due to steeper gradients, a wider design must be considered.

Separation (Safe and Comfortable)

Incorporating a buffer between people cycling and parked cars is a key safety design feature for cycling facilities, with the ideal buffer width of 1.0m. The amount of physical separation required between the bicycle path and the main carriageway depends on traffic aspects such as speed, volume and heavy vehicles, and the surrounding environment (trees, green space, road signage and other objects). The buffer can take the form of a median, kerb, verge, landscaping, street furniture or planting. A narrower buffer of at least 0.4m could be considered.

Kerb treatments provide separation between people walking and cycling. A slanted edge (less than 45-degree angle) is preferred, due to its forgiving design. Vertical edges (90-degree standard kerbs) pose a safety risk to people cycling, but may be considered when using existing kerbs and drainage (to reduce costs) or due to safety considerations for pedestrians (reduce trip hazards).

More information on this facility type can be found in Austroads Guide to Road Design Part6A Section 5.1.5, Table 5.4

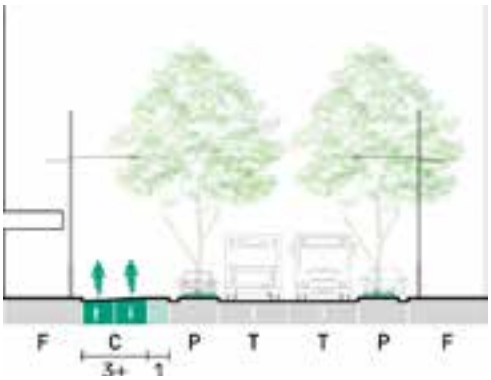


Figure 3.22 Typical cross section - optimal configuration (unconstrained)

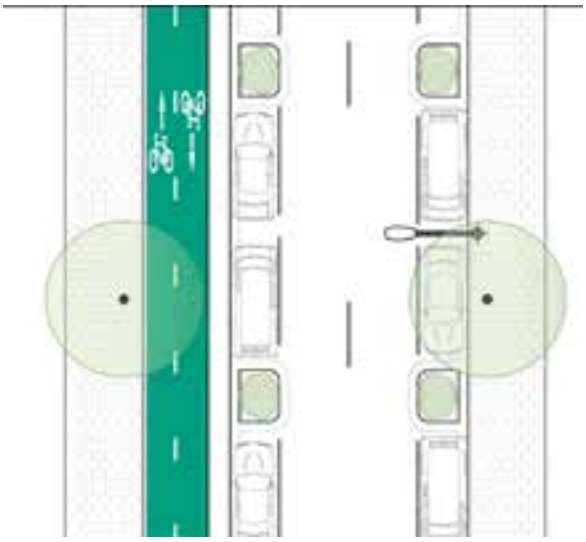


Figure 3.23 Typical plan - optimal configuration (unconstrained)

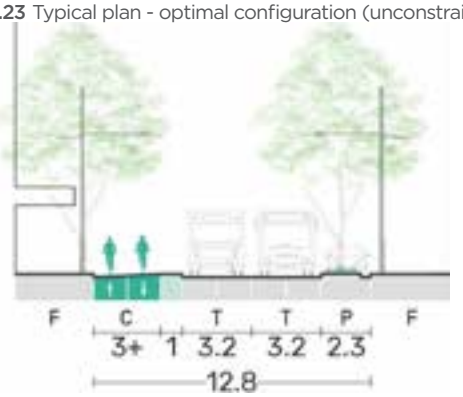


Figure 3.24 Typical cross section - optimal configuration (12.8m carriageway)

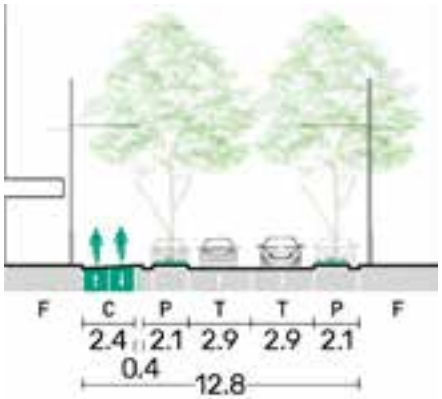


Figure 3.25 Typical cross section - constrained configuration (12.8m carriageway)

Facility design - Bicycle path (two-way)

When a lower degree of separation is required, for example in areas with low pedestrian activity or low levels of cycling, flush kerb treatments with line markings and distinguishable surfacing (colour and texture) may be considered. This is referred to as a Separated Path with a combined desirable minimum width of 4.5m (including 2.5m for the bicycle path section). See Austroads (2017) Part 6A, Section 5.1.3 and Appendix A3.

To enhance road safety, debris or obstructions along or adjacent to the cycleway should be minimised.

Where pedestrian activity is high (ie. school zones, shopping/retail districts, transport interchanges, etc), demarcated pedestrian crossings should be installed. Sufficient space for boarding should be provided at bus stops, and sight lines should be maintained.

Intersection treatments (Safe, Direct and Connected)

The preferred treatment for an intersection where the cycleway interacts with a side street is a continuous cycleway with priority given to people cycling to provide high level of service and improved safety for riders.

Any bend-outs should be as smooth as possible to allow for ease of manoeuvring and provide waiting space for vehicles a safe distance from the carriageway. As much as possible, vehicle movements that cross the bicycle path (ie. side streets, driveways, car parks, laneways) should be minimised or removed. Where conflict zones are unavoidable, the infrastructure should be designed to reduce the speed of motorised traffic and adequate sight lines preserved where possible to allow for reciprocal visibility.

Priority across the intersection should be indicated with green cycleway markings to improve visibility of people cycling and provide visual cues to drivers that riders are given priority.

Two-way path to optimal one-way path (Adaptable)

In the long term, providing a two-way bicycle path on one side of the road might be the first step towards achieving the preferred one-way bicycle path on both sides of the road.

Figure 3.26 Bicycle path (two-way), Bourke Street, Surry Hills

Figure 3.27 Bicycle path (two-way), Bourke Street, Surry Hills

Figure 3.28 Bicycle path (two-way), Queens Road, Westmead

3.2A Bicycle path (two-way) - Bent-out intersection

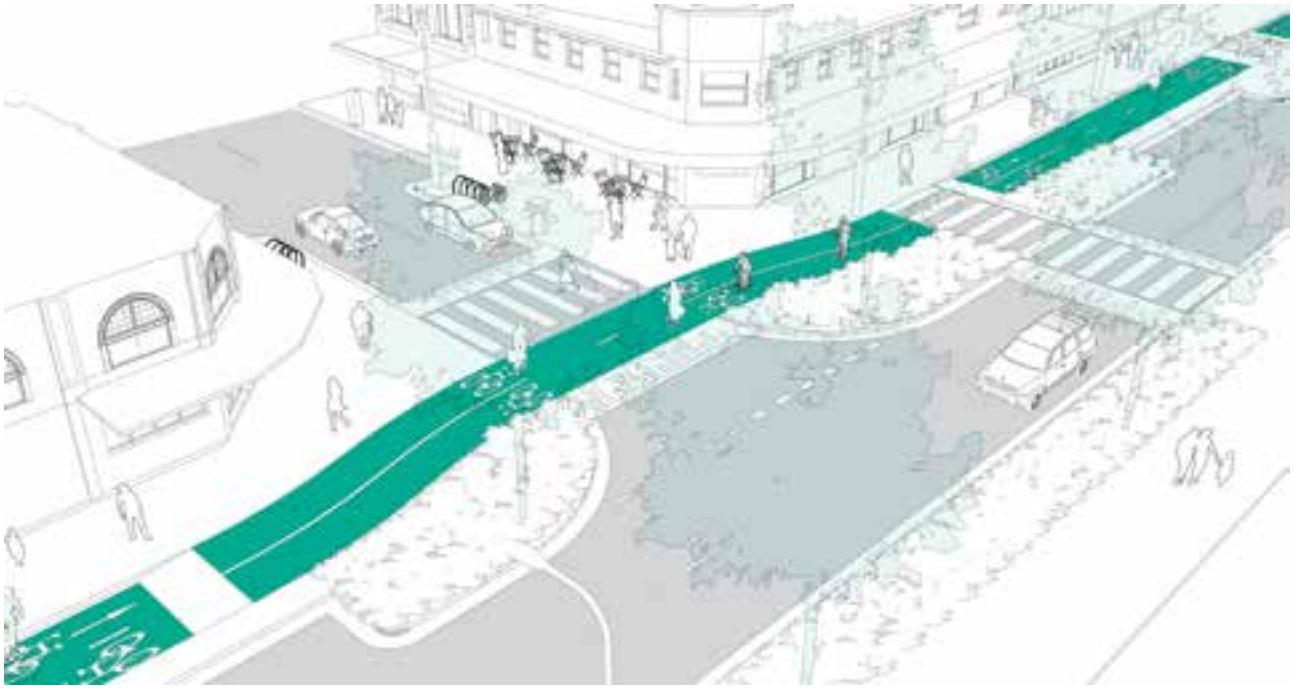


Figure 3.29 Bicycle path (two-way), bent-out intersection - perspective

Continuous bicycle path, bent-out intersection

- Main design principle: provide high level of service to people walking and cycling and reduce speed of intersecting traffic
- Design elements:
  - Prioritised pedestrian crossing and bicycle path
  - Raised intersection and clear road marking to indicate to all road users that pedestrians and bicycle riders have priority over turning vehicles
  - Smooth bent-out to avoid uncomfortable manoeuvring for people cycling
  - Bent-out to store waiting vehicle outside carriageway, and perpendicular crossing of bicycle path
  - No high objects (> 1.0m) between the bicycle path and the road, to allow for reciprocal visibility. This is particularly important as road users might not expect two-way cycleway traffic when turning
  - Kerb build outs to narrow intersection to reduce vehicle turning speeds and increase reciprocal visibility
  - At smaller intersections there may be insufficient space to incorporate bend-outs in the design of the bicycle path. In that case, the bicycle path could be kept close to the road, and turning vehicles required to wait on-road before turning

More information on this facility type can be found in Austroads Guide to Road Design Part4 Section 9.3.3, Fig. 9.2 and Part6A Section 7.3.1, Fig 7.2 & 7.3

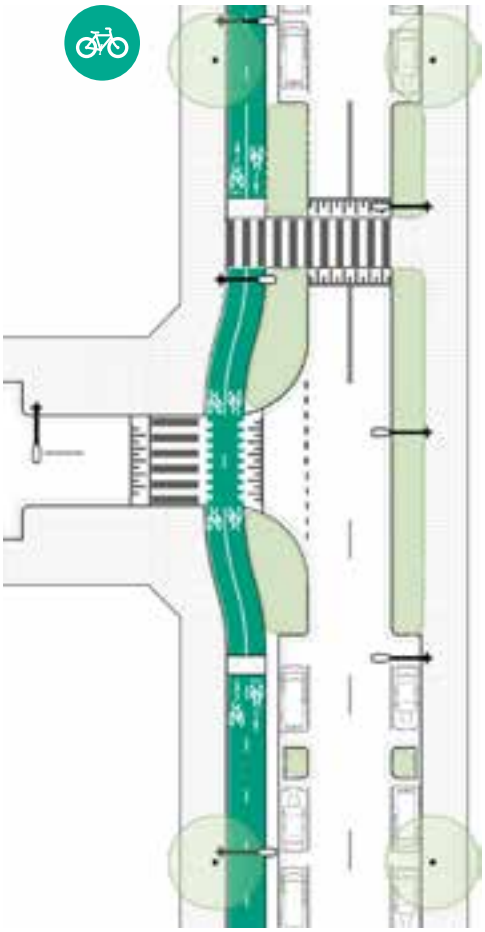


Figure 3.30 Bicycle path (two-way), continuous cycleway raised intersection - plan

3.2B Bicycle path (two-way) - Raised intersection

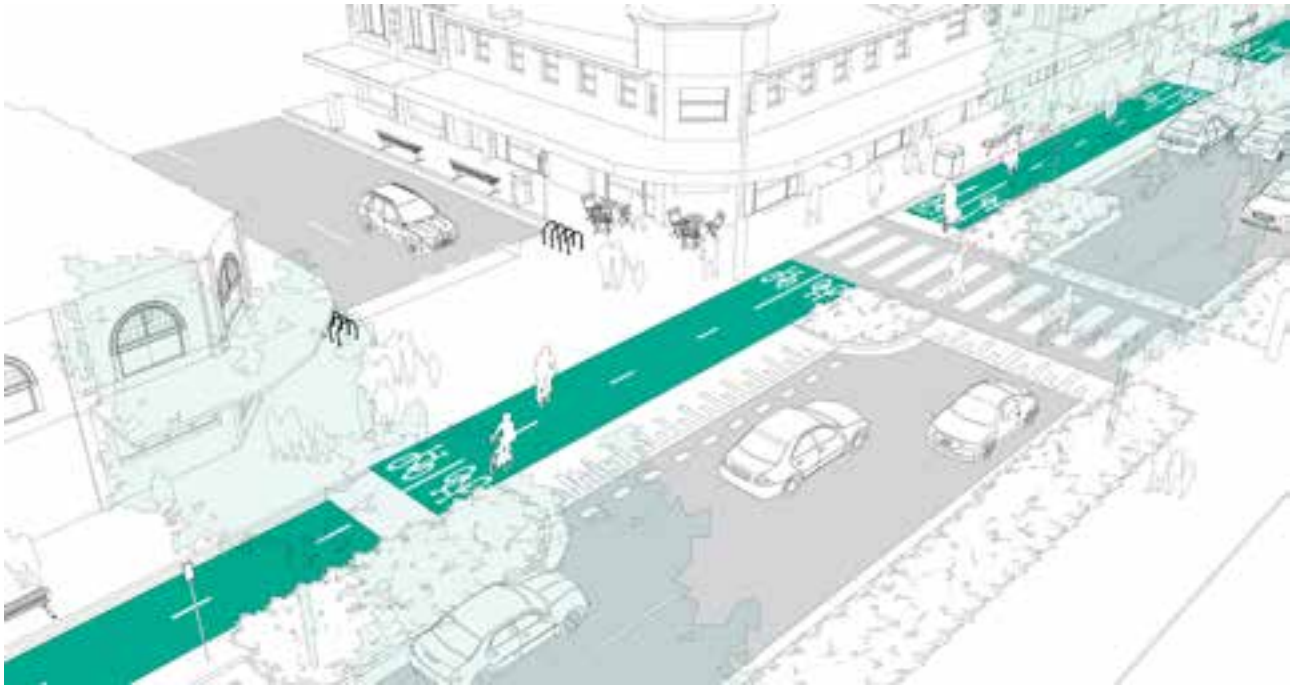


Figure 3.31 Bicycle path (two-way), continuous cycleway raised intersection - perspective

Continuous bicycle path, raised intersection

- Main design principle: provide high level of service to people walking and cycling and reduce speed of intersecting traffic
- Design elements:
  - Prioritised continuous bicycle path and footpath
  - Raised intersection and clear road marking to indicate to all road users that pedestrians and bicycle riders have priority over turning vehicles
  - No high objects (> 1.0m) in the space between the bicycle path and the road, to allow for reciprocal visibility. This is particularly important as road users might not expect two-way cycleway traffic when turning from the main road
  - Kerb build outs to narrow intersection (to reduce vehicles turning speeds and increase reciprocal visibility) and enable waiting motor vehicles to store outside carriageway
  - Surface treatments providing texture and visual cues
- This intersection has not yet been applied within the Australian context, but would provide a higher level of service and enhanced safety for people walking and cycling than existing guidance and treatments
- May be considered in circumstances where there is insufficient space for a suitably wide bend-out

Discussion on intersections without space for bent-out intersections should include reference to relevant TDs such as 2020/03

More information on a similar facility type can be found in Austroads Guide to Road Design Part4 Section 9.3.3, Fig. 9.3

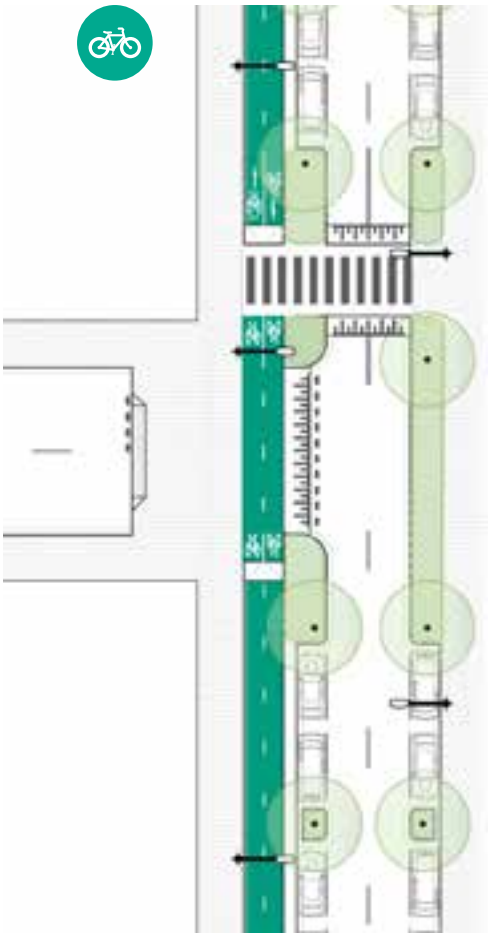


Figure 3.32 Bicycle path (two-way), continuous cycleway raised intersection - plan

3.2C Bicycle path (two-way) - Shared environment intersection

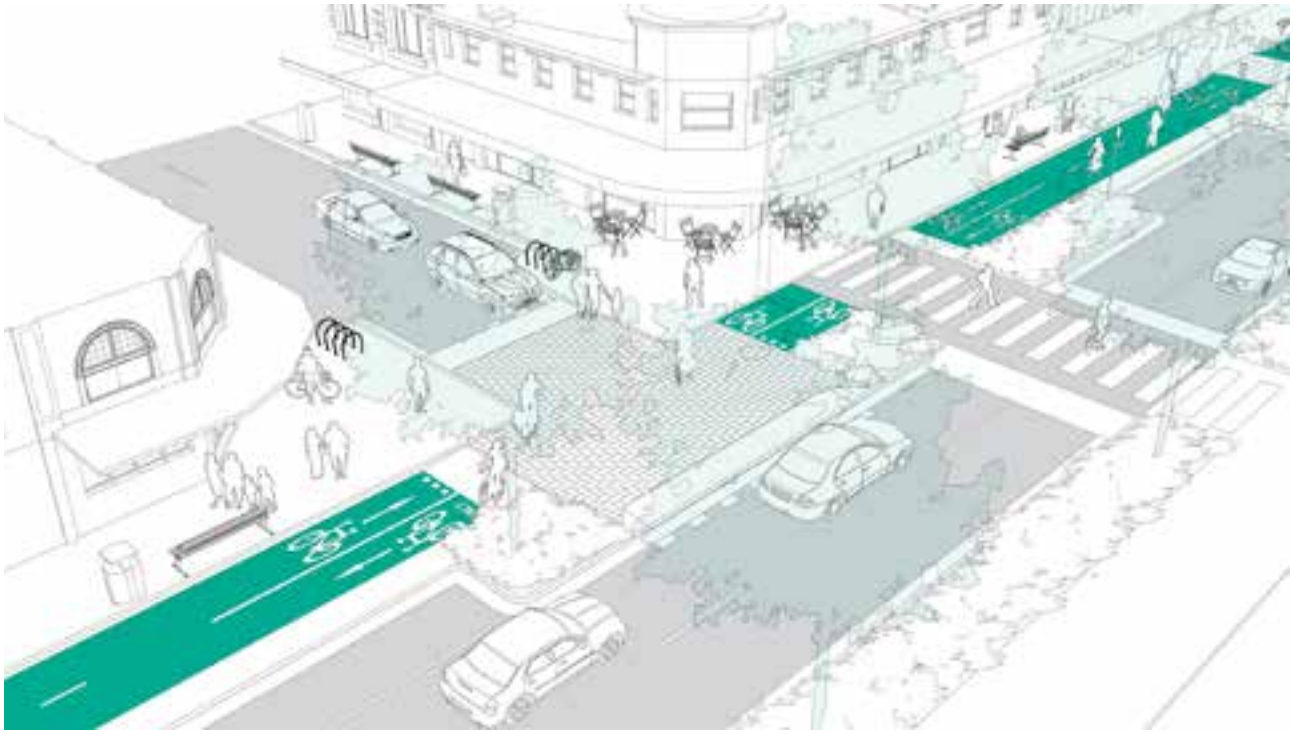


Figure 3.33 Bicycle path (two-way), shared environment intersection - perspective

Shared environment intersection

- Main design principle: provide high level of service to people walking and cycling and reduce speed of intersecting traffic
- Design elements:
  - Raised intersection and clear road marking
  - No high objects (> 1.0m) between the bicycle path and the road, to allow for reciprocal visibility
  - Narrow side street designed to reduce speed of motorised traffic
  - Surface treatments providing texture and visual cues for the shared environment intersection
- This intersection type offers a lower level of service to people cycling compared to continuous bicycle path treatments (3.1A and 3.1B), as riders are not prioritised. Moreover, as priority is not clearly defined, safety issues may occur and vehicles waiting to enter the carriageway could block people cycling. Hence this is marked as 'suitable' for some environments, but is not the 'preferred' treatment.

More information on this facility type can be found in technical direction TfNSW TTD 2020/03 Shared environment intersection treatment

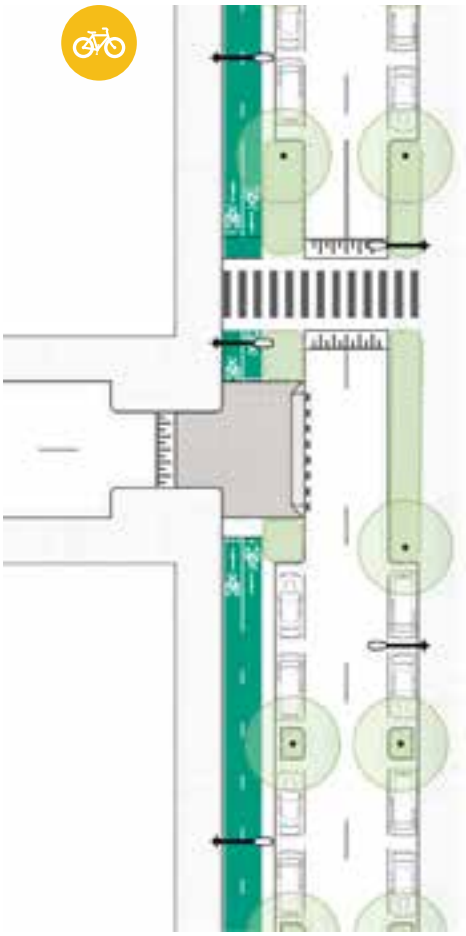


Figure 3.34 Bicycle path (two-way), shared environment intersection - plan

3.2D Bicycle path (two-way) - Roundabout

Figure 3.35 Bicycle path (two-way), separated roundabout - perspective

Roundabout

- Main design principle: provide high level of service and safety to people walking and cycling, and reduce speed of intersecting traffic and people cycling
- Where space allows, a design with a smooth alignment (preventing 90 degree turns for riders) should be considered to make it easier to manoeuvre
- Design elements:
  - Prioritised and continuous bicycle path along the roundabout and pedestrian crossings on all legs
  - Raised crossing platform and clear road marking
  - Narrow all branches of roundabout and apply deflection angle for motorised traffic to reduce speed
  - Raised island in the centre for use by wide-turning vehicles (ie. trucks and buses)
  - This intersection has not yet been applied within the Australian context, but provides a higher level of service and enhanced safety for people walking and cycling than existing guidance and treatments

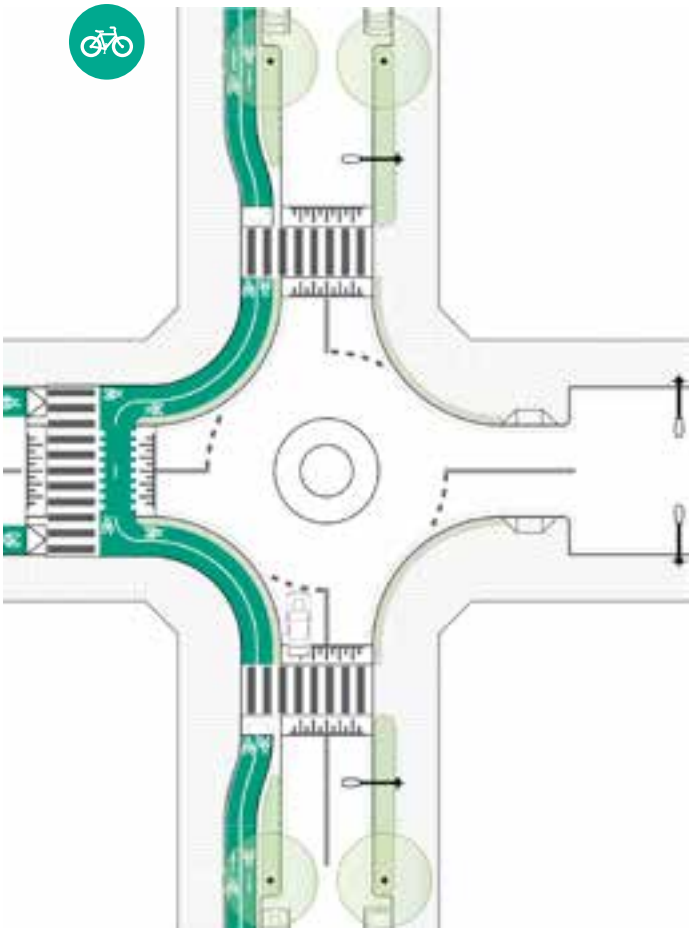


Figure 3.36 Bicycle path (two-way), separated roundabout - plan

3.2E Bicycle path (two-way) - Roundabout with shared path

Figure 3.37 Bicycle path (two-way), roundabout with shared path - perspective

Roundabout with shared path

- Main design principle: provide cycling facility separated from traffic, with prioritised crossings for people walking and cycling
- Where space does not allow a design with a continuous bicycle path along the roundabout, a design with shared path facilities around the roundabout can be considered.
- Design elements:
  - Bicycle path ends before the roundabout
  - Shared path facilities around the roundabout
  - Raised crossing platform and clear road marking, prioritising crossings for people walking and cycling
  - Narrow all branches of roundabout and apply deflection angle for motorised traffic to reduce speed
  - Raised island in the centre for use by wide-turning vehicles (ie. trucks and buses)
- An alternative for this facility type would be to transform the intersection for bicycles into a priority intersection, prioritising the continuous bicycle path.

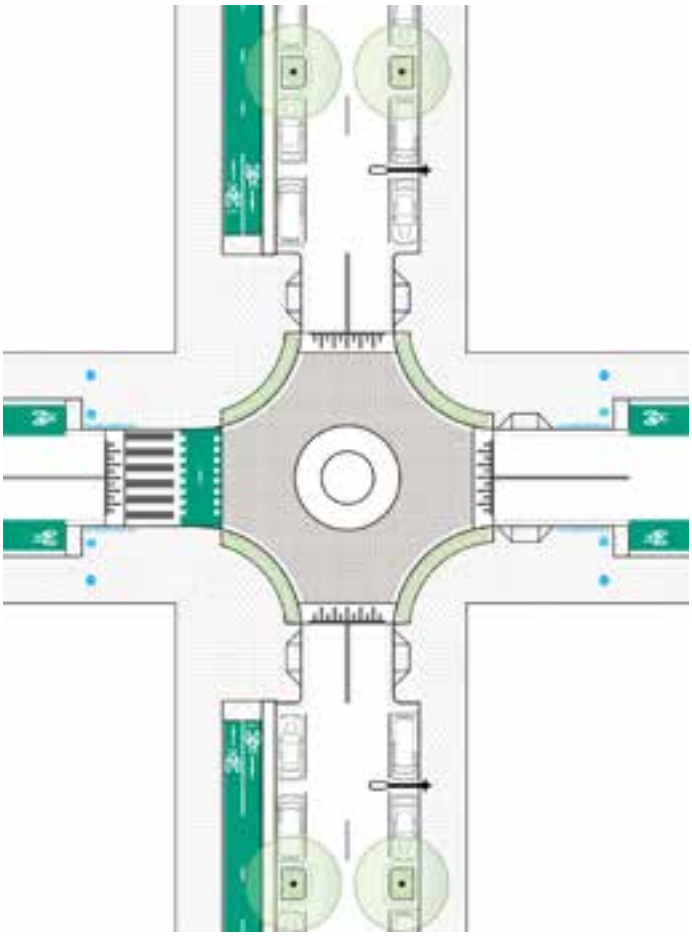


Figure 3.38 Bicycle path (two-way), roundabout with shared path - plan

3.2F Bicycle path (two-way) - Signalised intersection

Figure 3.39 Bicycle path (two-way), signalised intersection - perspective

Signalised intersection

- Main design principle: provide adequate crossing facilities for people walking and cycling
- Design elements:
  - Crossing facilities of the intersection for people walking and cycling on all legs
  - Where possible, reduced waiting times for people walking and cycling through adjusted traffic signal controls
  - Where possible, signal lead phase and dedicated green time for bicycle movements to remove signal conflicts
  - Separate turning lanes for riders turning and crossing the main road
  - Automatic loop detectors for bicycles, reducing wait time
- Traffic signal phasing will need to be amended where this facility has been installed at an existing signalised intersection.

More information on this facility type can be found in Austroads Guide to Road Design Part4 Appendix B Section B.6, Fig. B10

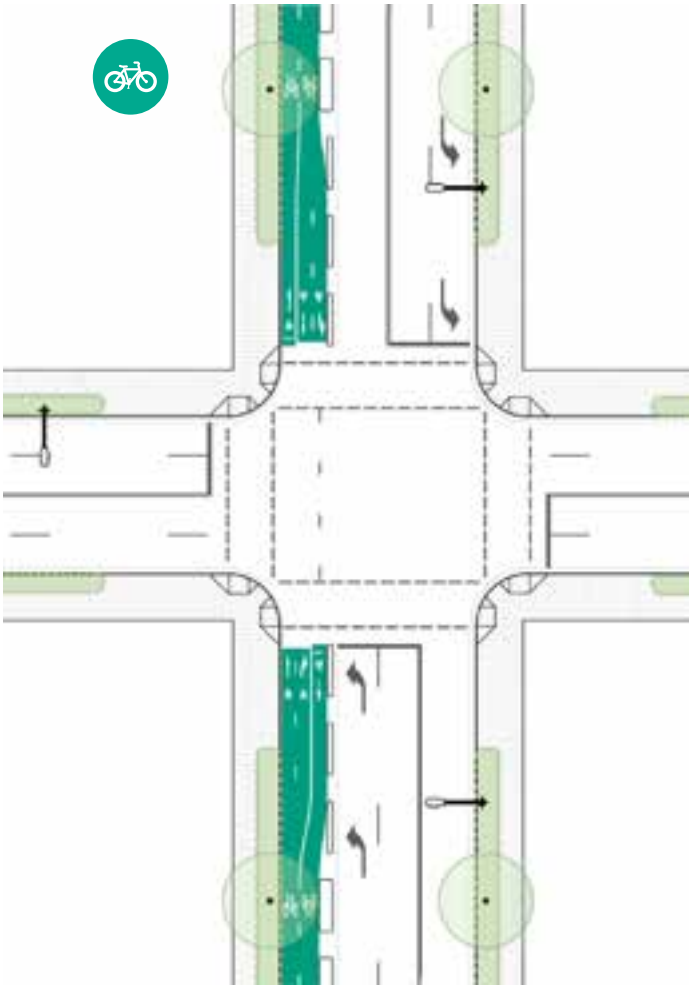


Figure 3.40 Bicycle path (two-way), signalised intersection - plan

3.3 Quietway

3.3.1 Overview

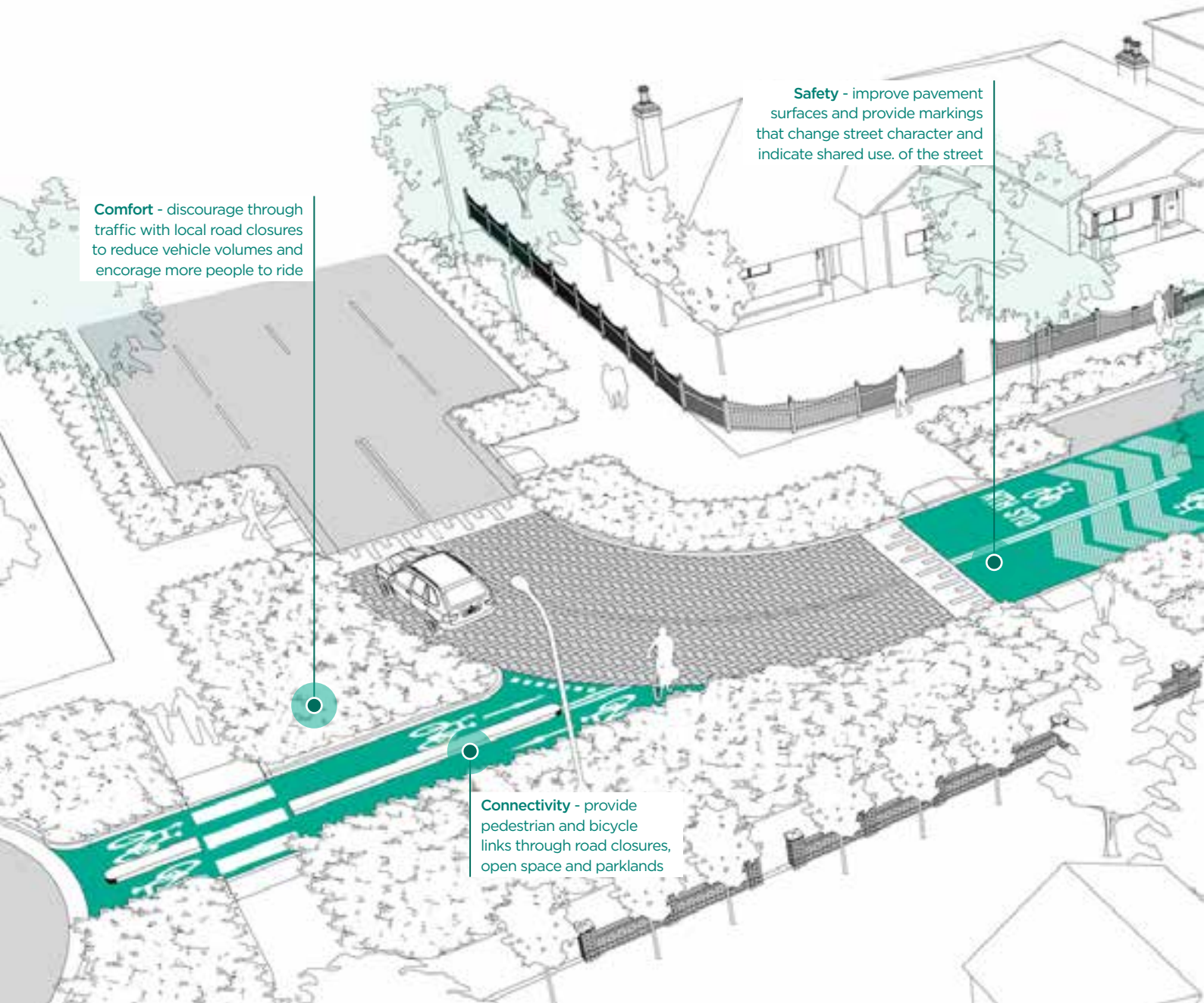
A quietway is a high-quality mixed traffic treatment where bicycle riders travel in a mixed traffic environment with motorised traffic, and are positioned in the centre of the traffic lane. The key design philosophy of a quietway is the safe integration of people cycling as equal road users to motor vehicles – they are environments where the motor vehicle is a guest on the roadway. This requires drivers to reduce travelling speeds to 30km/h or lower, and discourages them from overtaking through effective design treatments that send visual cues to road users about appropriate speeds and behaviours.

Quietways are not suitable in road environments with trucks or buses and potentially modal filters in order to minimise motorised traffic volumes. London's Low

They can be applied to quiet local streets and laneways with low volumes and speed of motorised traffic, and the implementation of quietways must always be delivered in conjunction with a reduction in speed limits.

Quietways should be designed to provide visual cues to all road users that dictate the appropriate speed and behaviours for the environment. Key design elements include:

- Differing pavement texture and colour designed to increase awareness and adjust behaviour of all road users, with consideration given to green pavement to indicate priority to people cycling
- Inclusion of a median strip, where appropriate, making it difficult for motor vehicles to overtake
- Narrow traffic lanes designed to reduce speed and discourage overtaking
- Modal filters to reduce volume of traffic while



- Bicycle insignias painted on the roadway to indicate priority for people cycling, ideally accompanied by sharrow markings
- Traffic calming features, such as flat top speed humps, raised road platforms with gentle ramp gradients, and kerb blisters / kerb extensions to narrow the roadway
- Priority over side streets and driveways, using raised threshold and continuous footpath treatments at entry and exit points to the quietway

3.3.2 Urban design

Quietways are implemented on quiet local streets and laneways or on low traffic volume, low speed streets within parklands or reserves. Design of these streets need to ideally also respond to the following principles:

Local streets:

- Sensitive to place with self-explaining speed limits and infrastructure that aligns with the surrounding context
- Contributes to networks of urban green corridors although economic viability is a consideration
- Mitigate against very hot days through increased shading such as urban street tree planting and implementing water-sensitive design to mitigate against flash flooding
- Limits through- traffic where vehicle volumes are high
- Improve streetscape and cycle route lighting

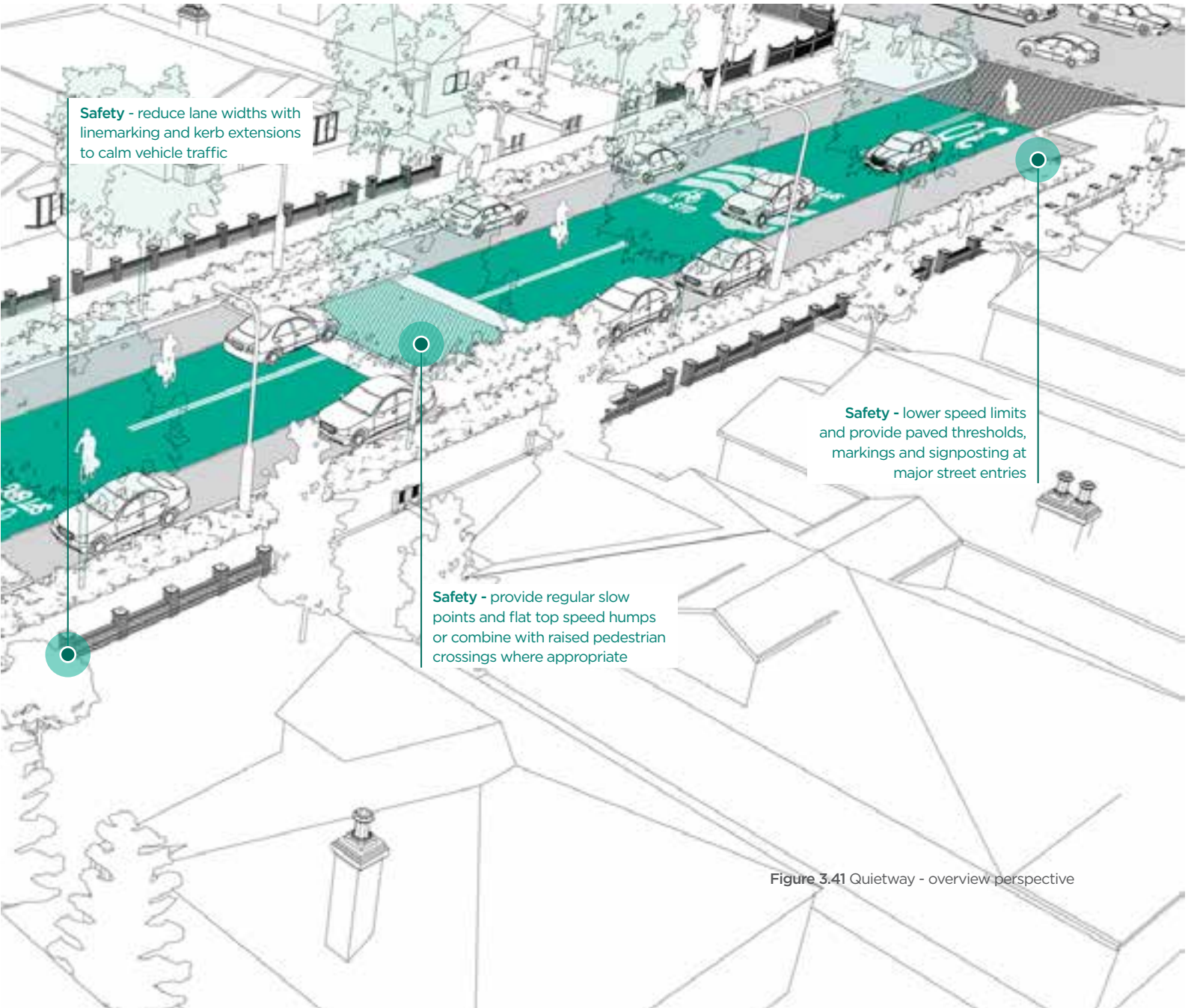


Figure 3.41 Quietway - overview perspective

Facility design - Quietway

3.3.3 Main design considerations

Several key design considerations dictate when a quietway is the appropriate cycleway treatment:

- Low volume (>2,000 passenger car unit/day) and speed of motorised traffic
- Unsuitable on roads that carry a significant amount of through traffic, commercial vehicles or trucks, or are positioned along bus routes
- Not suitable as part of a high priority commuter cycling route unless key design elements are applied to provide crucial visual cues to all road users on appropriate speeds and behaviours

Quietways should be located on roadways with gentle (ideally flat) gradients as steep uphill sections would cause conflicts between motor vehicles and people cycling.

If the roadway only allows for one-way traffic flows, cycling facilities should be provided that enable contra-flow cycling to increase route options. Contra-flow facilities should be separated by a median, where appropriate. If this is not achievable, contrasting paint colour and markings could be considered as a minimum.

Quietway experience (Safe, Comfortable and Attractive)

Alongside the incorporation of key design elements that provide visual cues to road users on appropriate speeds and behaviours, the implementation of quietways must go hand-in-hand with awareness programmes to enhance driver education on the function and operations of these new street environments.

To enhance road safety, the following measures should be taken:

- Reduce traffic volumes to <2,000 Passenger car unit per day
- Minimise or eliminate through-traffic by applying filtered permeability, closing streets to motor vehicles, or incorporating pinch points at the entry and exit
- Reduce speed limits to <30km/h
- Reduce road width to <3.0m per lane, but preferably less
- Apply traffic calming measures such as raised/tactile centre medians as shown in Figure 3.44
- Impede sight lines through carefully located landscape features or street furniture

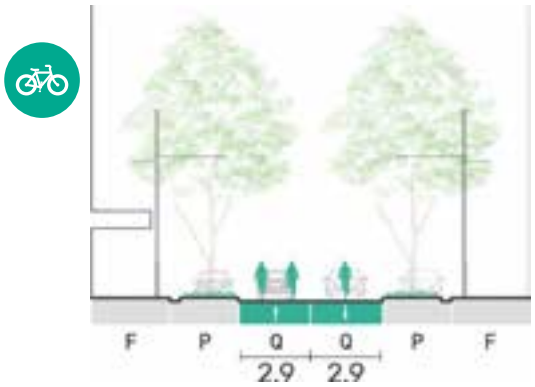


Figure 3.42 Typical cross section - optimal configuration

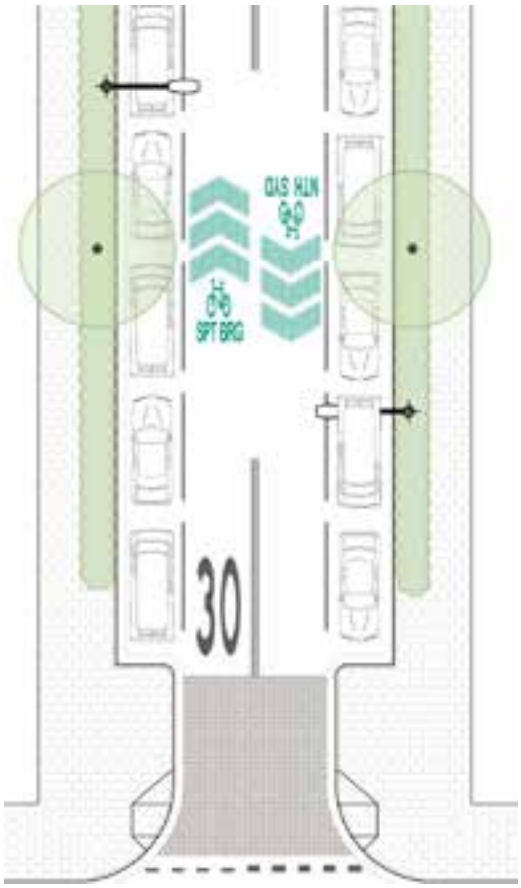


Figure 3.43 Typical plan - optimal configuration

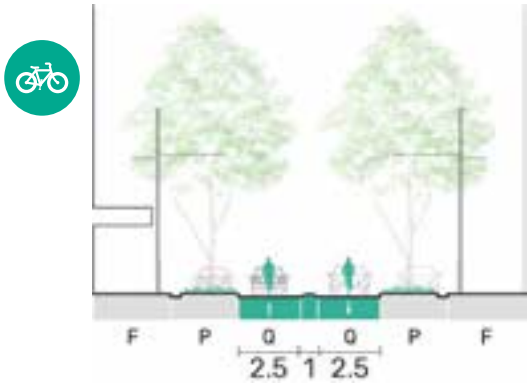


Figure 3.44 Typical cross section - alternate configuration

- Parking and loading zones should be provided outside the main carriageway to prevent dooring

Quietways can deliver enhanced safety due to increased interaction between road users.

Refer to Section 2 for more further treatments that can be applied to reduce traffic volume or speed.

Entrance and exit points (Safe and Comfortable)

At the entrance and exit points of a quietway, prominent features such as signs, architectural or landscape features must be provided to indicate a change in the street environment.

At the entrance and exit points of a quietway, prominent features such as road signs, architectural or landscape features must be provided to indicate a change in the street environment.

Continuous footpath treatments should be considered at entry and exit points to assist in traffic calming, and changed surface treatments can be used to provide visual cues to road users that they are entering a quietway. These should be clearly distinguishable by colour, texture and/or materials.

Bicycle insignias painted on the roadway should be incorporated in the design to indicate priority for people cycling, ideally accompanied by sharrow markings.

These design features will help to indicate a changing road environment, ensuring that road users adjust their speed and behaviour in response.

Consideration must be given at intersections where the quietway may connect to a different type of cycle facility.

Figure 3.45 Quietway, Spit East Foreshore
(Credit: Ben Williams Photography)

Figure 3.46 Quietway, Spit East Foreshore
(Credit: Ben Williams Photography)

Figure 3.47 Modal filter, Ellalong Road, Cremorne

3.3A Quietway - Raised intersection

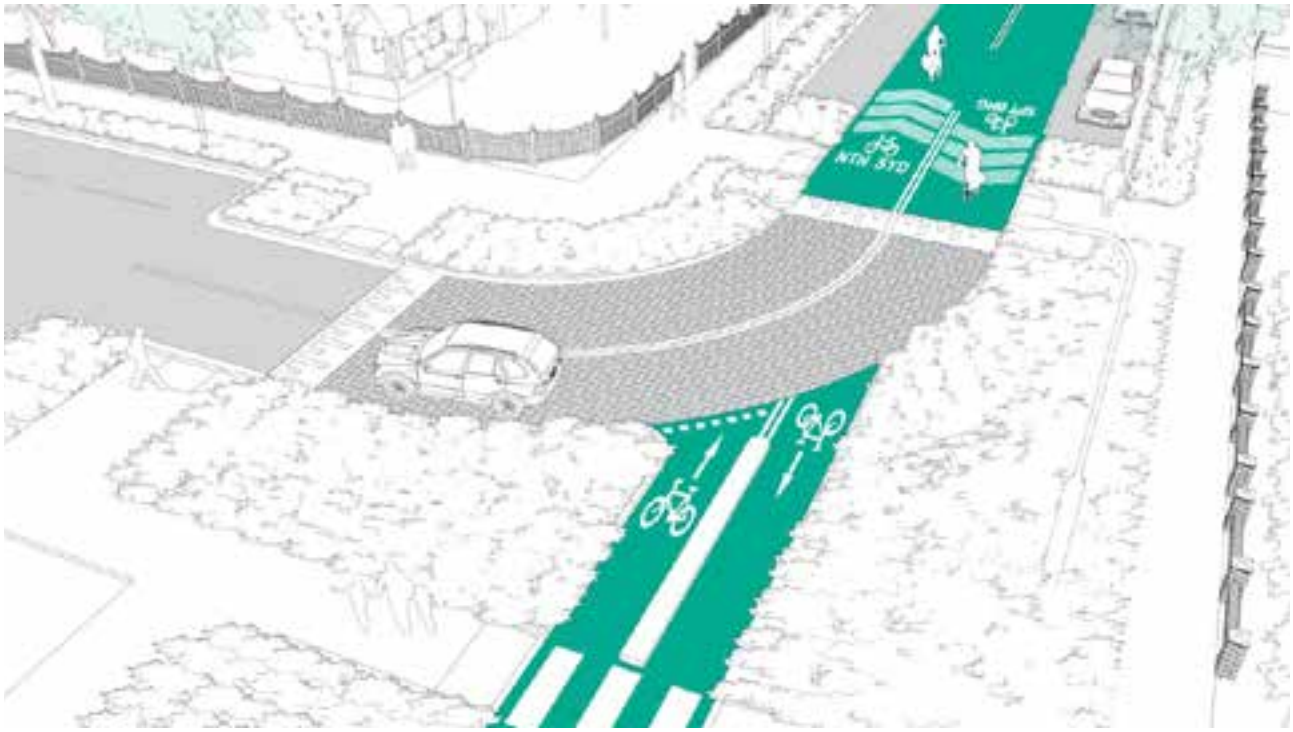


Figure 3.48 Quietway, raised intersection - perspective

Raised intersection

- Main design principle: reduce traffic speed, and raise awareness of potential conflict points
- Design elements:
  - Flat top speed humps (ie. raised road platforms) with gentle ramp gradients
  - Narrow roadway designed to reduce speed of motorised traffic
  - Design features that provide visual cues to road users including changed surface pavement, clearly distinguishable by colour, texture and/or materials

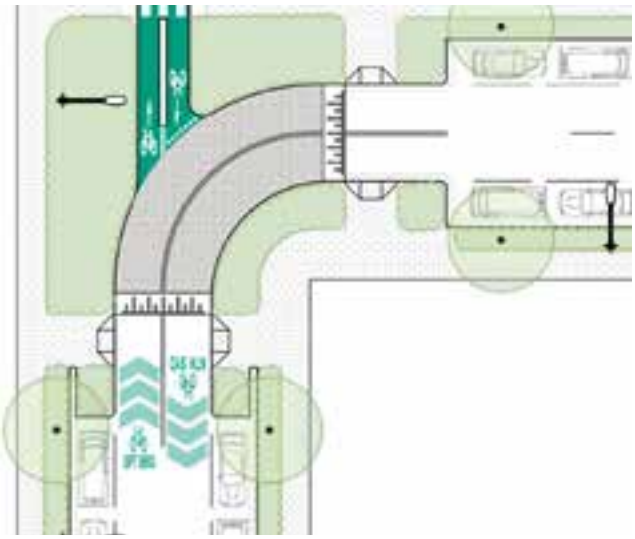


Figure 3.49 Quietway, raised intersection - plan

More information on this facility type can be found in Austroads Guide to Traffic Management Part 8 Local Street Management Section 8.2.5, Fig. 8.9

3.3B Quietway - Modal filter

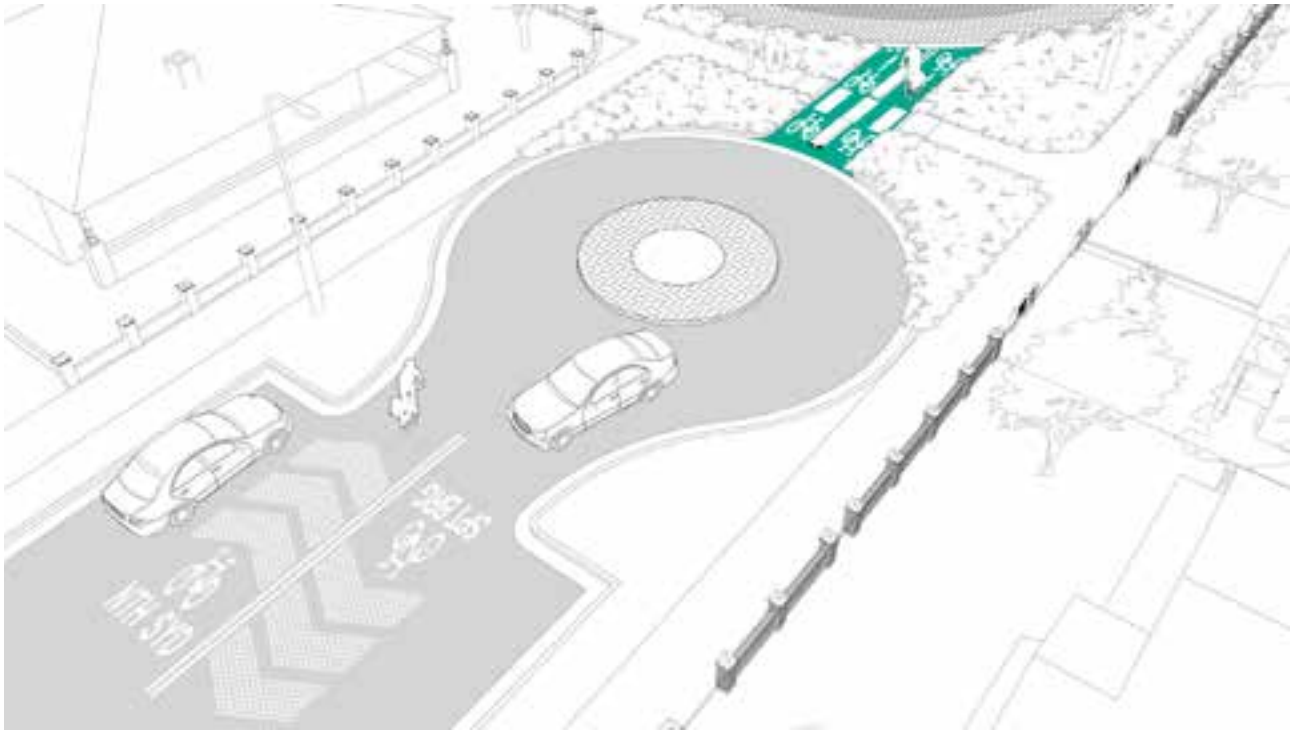


Figure 3.50 Quietway, modal filter - perspective

Modal filter (Filtered permeability)

- Main design principles:
  - Reduce motorised traffic volumes
  - Maintain connectivity for people walking and cycling, reducing travel time
  - Create a more attractive environment for walking and cycling
- Design elements:
  - Full road closure for motorised traffic
  - Turning loop
  - Connections for people walking and cycling
  - Landscaping elements

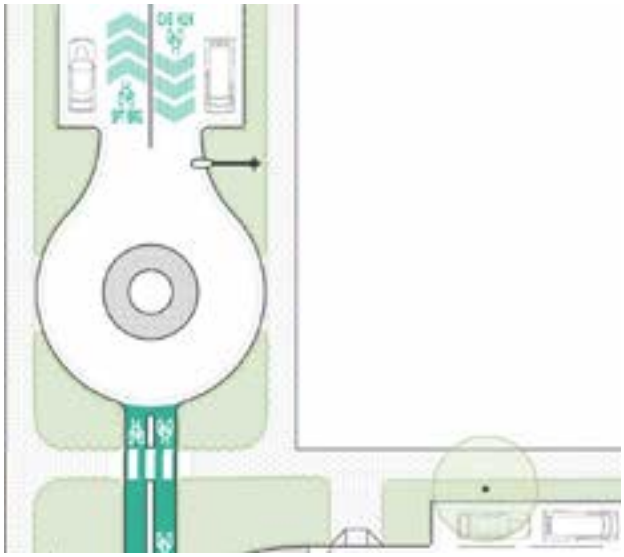


Figure 3.51 Quietway, modal filter - plan

More information on this facility type can be found in Austroads Guide to Traffic Management Part 8 Local Street Management Section 8.4.1, Fig 8.20

3.3C Quietway - Midblock treatment

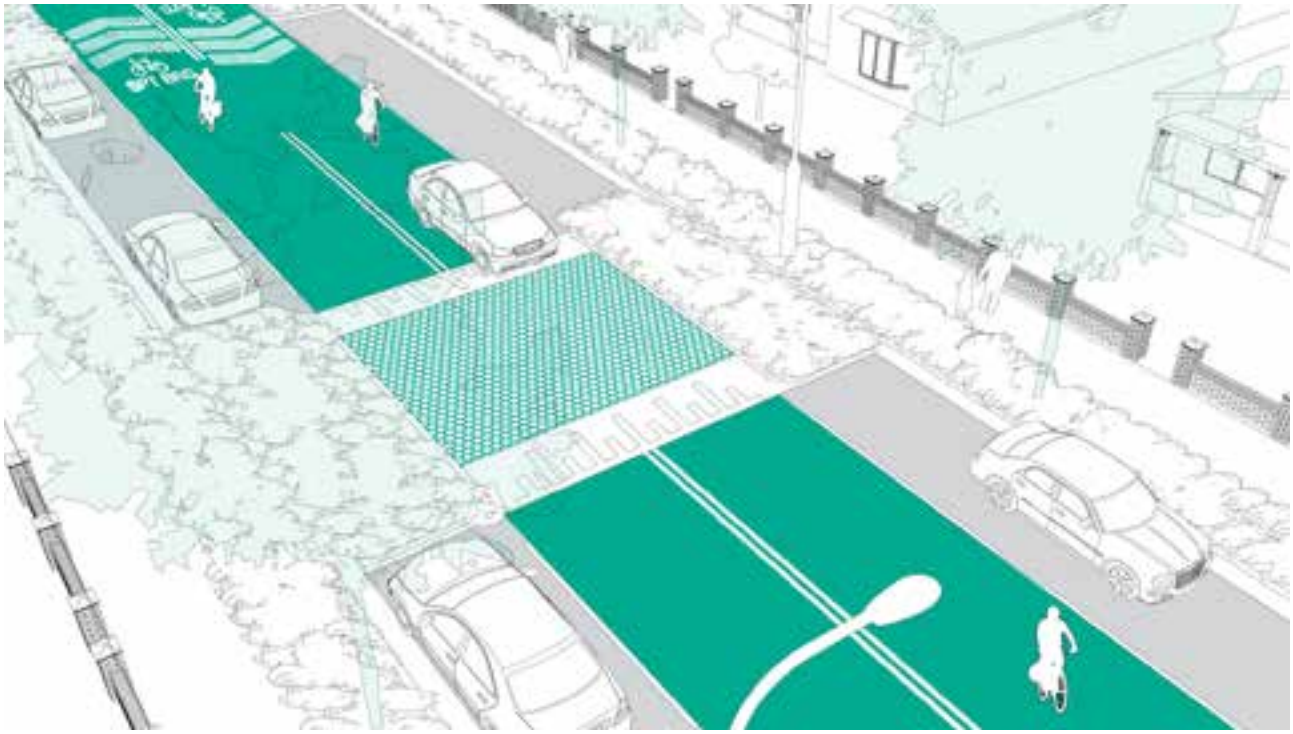


Figure 3.52 Quietway, slow point - perspective

Slow point and flat-top speed hump

- Main design principle: reduce speed of vehicles, and raise awareness of potential conflict points
- Design elements:
  - Flat top speed humps (ie. raised road platforms) with gentle ramp gradients that incorporate either a pedestrian crossing or kerb build-out
  - Narrow roadway designed to reduce speed of motorised traffic
  - Design features that provide visual cues to road users including changed surface pavement, clearly distinguishable by colour, texture and/or materials

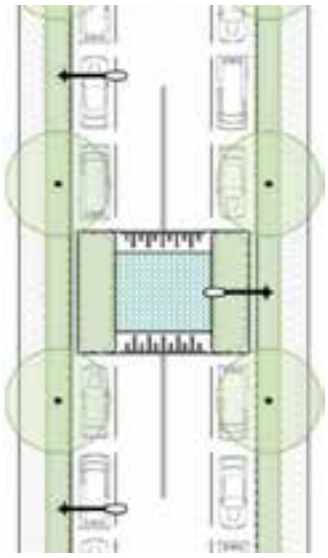


Figure 3.53 Quietway, slow point - plan

More information on this facility type can be found in Austroads Guide to Traffic Management Part 8 Local Street Management Section 8.2.3, Fig 8.5,8.6 (Flat Top Speed Hump) and Local Street Management Section 8.3.2, Fig 8.11 (Slow Point)

3.3D Quietway - Entrance and exit points

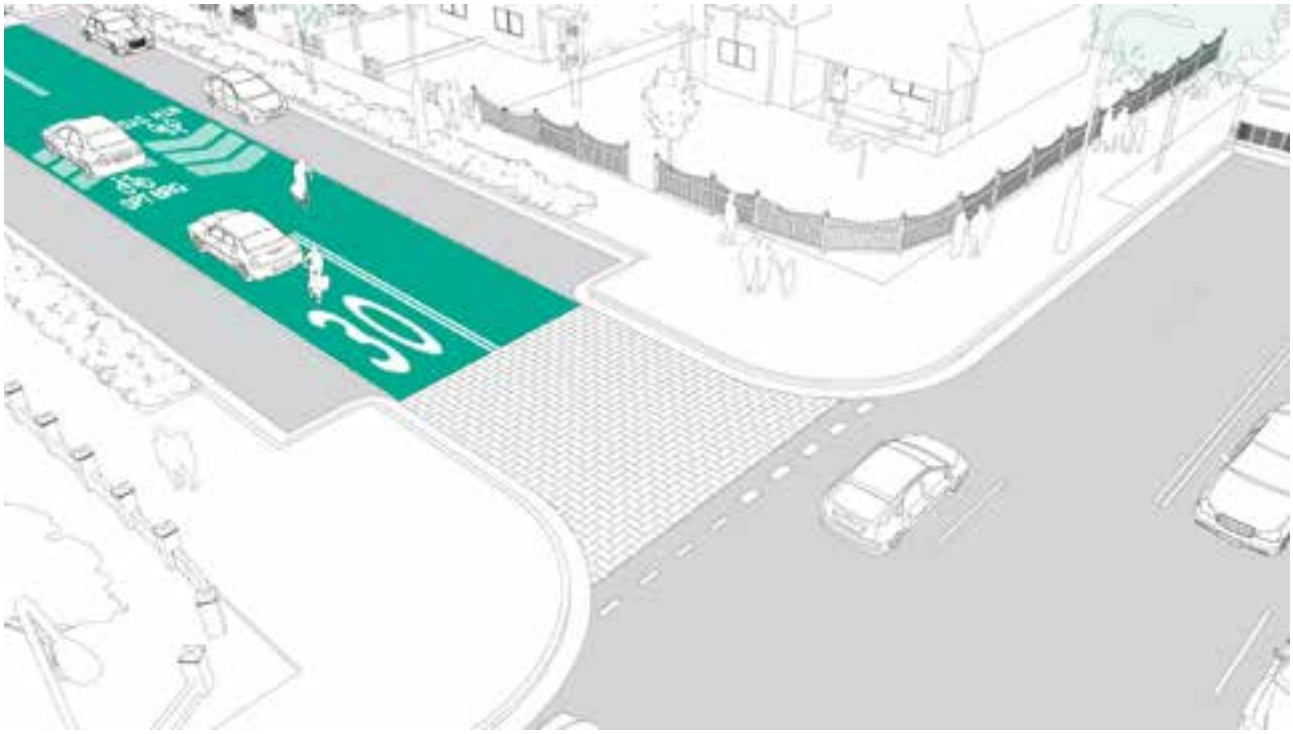


Figure 3.54 Quietway, threshold treatment - perspective

Entrance and exit points

- Main design principles:
  - Provide visual cues to road users that indicate a change in the street environment to dictate appropriate speed and behaviour
  - Reduce motorised traffic volumes
  - Maintain connectivity for people walking and cycling, reducing travel time
  - Create a more attractive environment for walking and cycling
- Design elements:
  - Surface treatments, architectural or landscape features providing texture and visual cues to indicate a change in the street environment
  - Bicycle insignias painted on the roadway should be incorporated in the design to indicate priority for people cycling, ideally accompanied by sharrow markings
  - Raised intersection treatments with gentle gradients
  - Narrow side street designed to reduce speed of motorised traffic
  - Landscaping elements

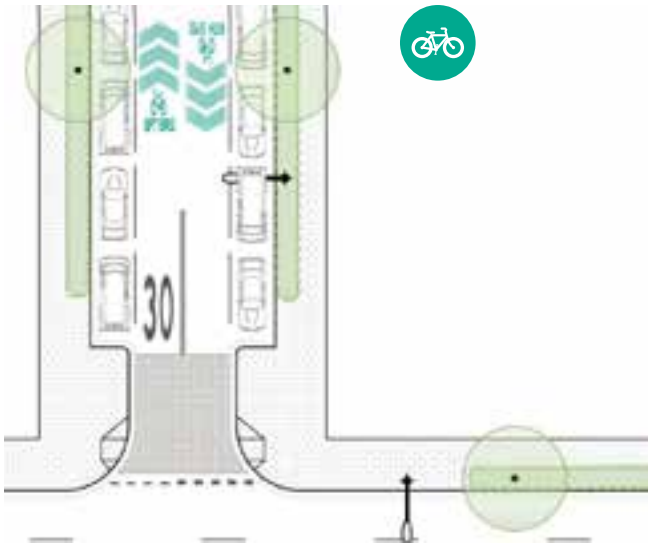


Figure 3.55 Quietway, threshold treatment - plan

More information on this facility type can be found in Austroads Guide to Traffic Management Part 8 Local Street Management Section 8.5.8, Fig 8.29

3.4 Shared path

3.4.1 Overview

A shared path is a facility that accommodates two-way bicycle and pedestrian movements along either the footpath or an off-road environment without delineation.

Shared paths may be considered where demand for both pedestrian and bicycle facilities exist, but predicted walking and/or cycling volumes are sufficiently low that separate facilities are not justified.

Shared paths provide lower levels of service to both people walking and people cycling than a separated facility due to the potential for conflicts with pedestrians, which must be carefully managed.

Shared paths may be considered in environments such as:

- Within parklands and nature reserves

Shared paths are not suitable in the following environments:

- Locations with intersecting pedestrian and bicycle movements, such as near entrances to schools, rail interchanges or near busy pedestrian crossings
- Locations with moderate to high bicycle or pedestrian activity, including where there is significant pedestrian queuing and storage such as at busy signalised pedestrian crossings or during special events
- Sections with relatively high cycling speeds
- Narrow sections along the route
- Routes that comprise interactions with numerous driveways, side streets or other functions crossing

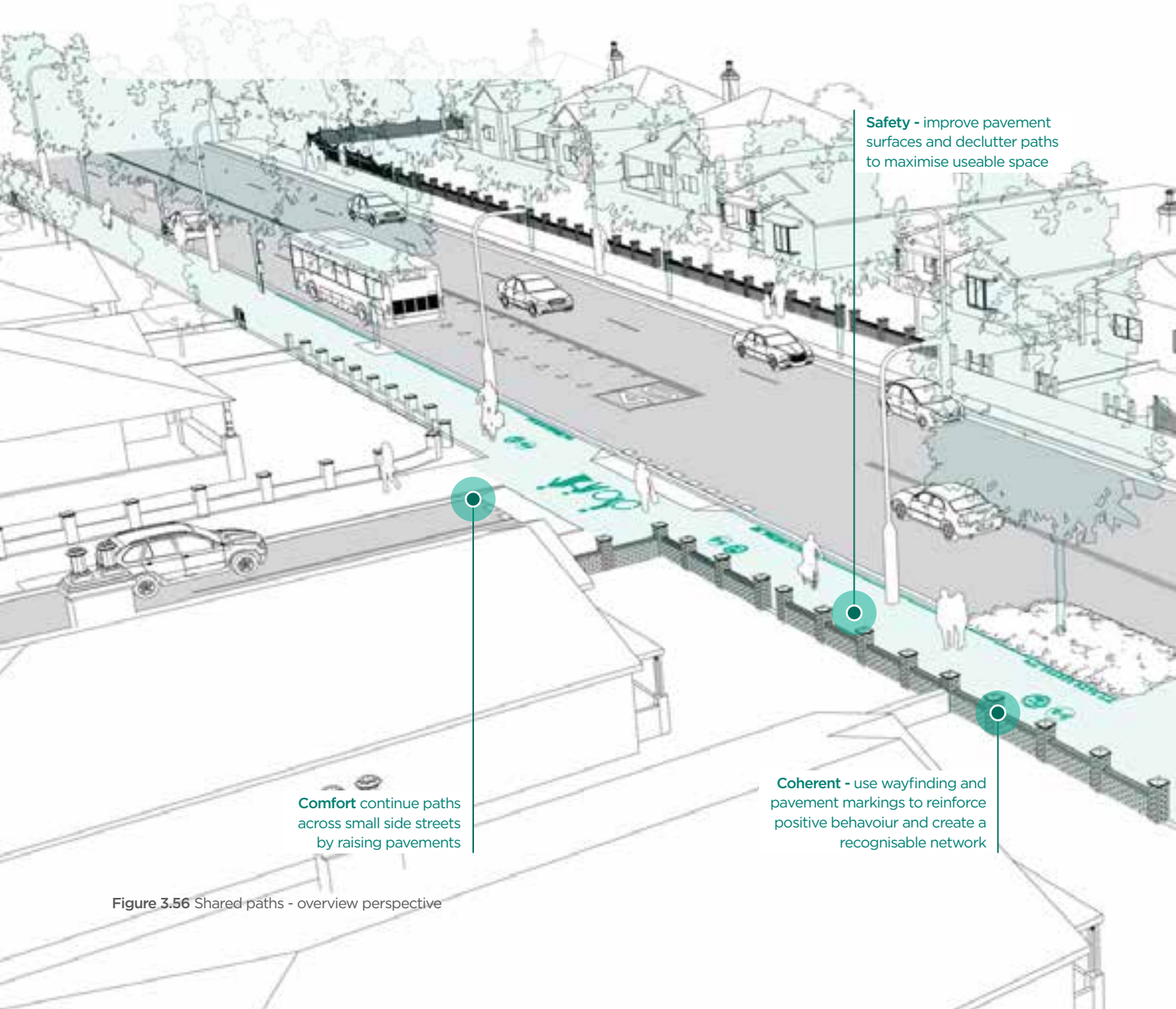
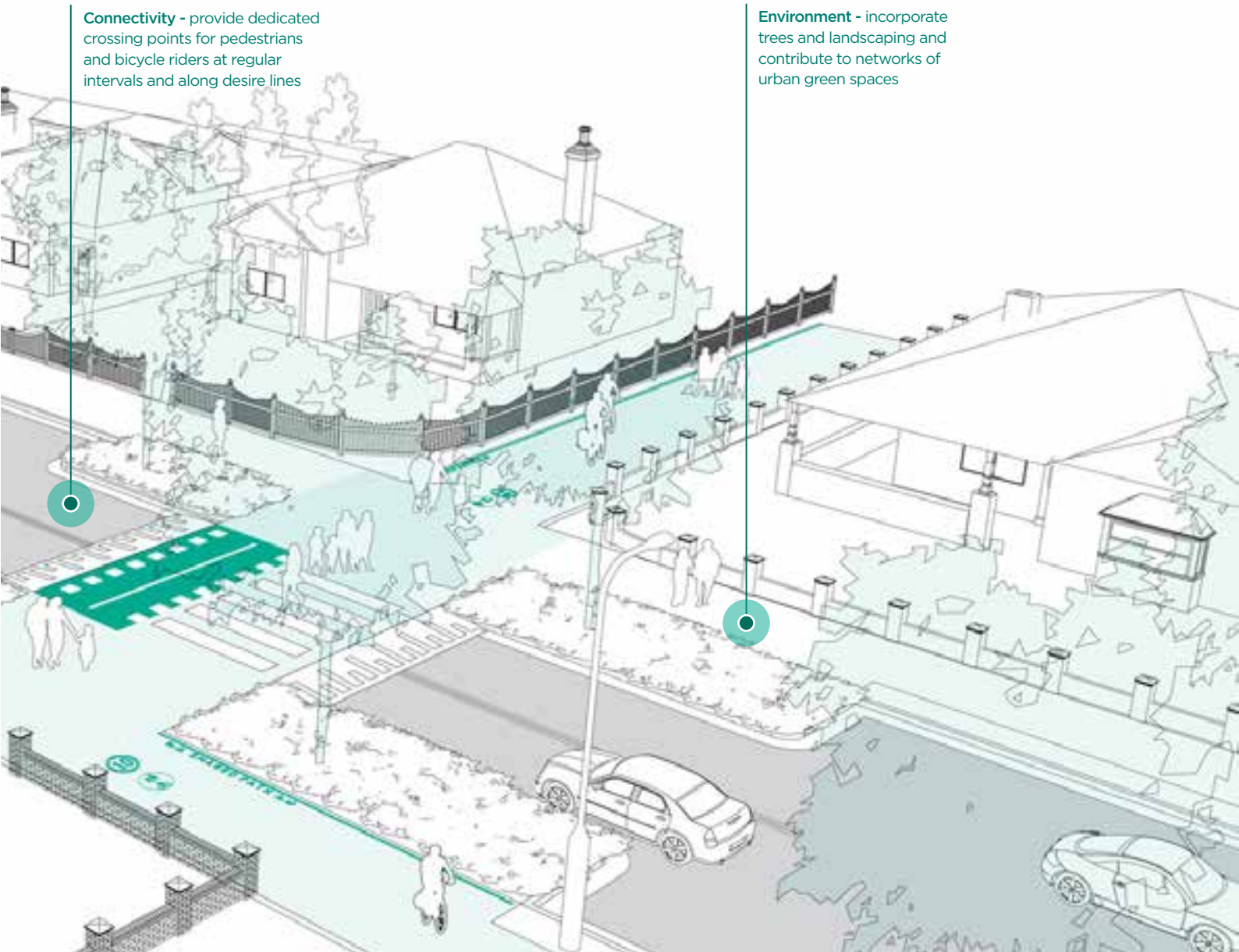


Figure 3.56 Shared paths - overview perspective

3.4.2 Urban design

Shared paths are implemented in a wide variety of locations - within parklands and reserves, along intercity connections or as links between dedicated facilities. Design of these facilities need to respond to the following principles:

- Sensitive to place
- Mitigate against very hot days through increased shading such as urban street tree planting and implementing water-sensitive design to mitigate against flash flooding
- Considers the whole street, including footpaths, from property line to property line, and the interfaces with land use
- Contributes to a network of public space, where people can live healthy, productive lives, meet each other, interact, and go about their daily activities
- Accommodates the needs of all users, including people walking and using public transport
- Contributes to networks of urban green corridors



Facility design - Shared path

3.4.3 Main Design Considerations

Shared paths are not suitable in the following environments:

- Locations with high bicycle or pedestrian activity
- Sections with relatively high cycling speeds
- Narrow sections along the route
- Routes that comprise interactions with numerous driveways, side streets or other functions crossing the cycleway

Shared path width (Safe and Comfortable)

The ideal width of a shared path is dependent on the predicted volumes of pedestrian and bicycle movements, the expected speed of people cycling, the amount of interactions that cross the shared path, and sight lines.

The desired minimum width of a shared path is 4.0m, allowing for safe overtaking and pedestrian interactions. Wider shared paths should be considered in environments where:

- Space allows
- Higher numbers of people walking or cycling are expected
- Higher cycling speed is expected
- Higher amounts of 'cross shared path movements' exist
- Limited sight lines are prevalent

When designing a shared path the functional width should be taken into account. The functional width takes the actual width and subtracts any space used for street furniture, road signage, utilities, bus shelters, etc.

Depending on local conditions narrower shared paths can be considered.

To help achieve the optimal width of a shared path, the following measures should be considered to 'gain width' (refer to Section 2 for more examples):

- Reduce traffic lane width, especially if the road does not service public transport
- Reduce the number of traffic lanes, removing turning lanes or slip lanes, or introducing one-way traffic
- Reduce space used for carparking
- Declutter the street by moving utilities underground, where possible and separating street furniture through delineation

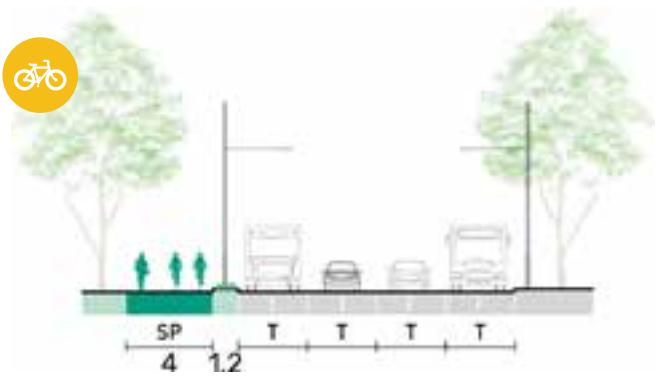


Figure 3.57 Typical cross section - optimal conditions

Figure 3.58 Shared Path, Powells Creek, Homebush

Figure 3.59 Shared Path Tench Reserve, Penrith

Facility design - Shared path

Separation (Safe and Comfortable)

The absence of a clear delineation between space for people walking or cycling is a key feature of a shared path. Separation between opposite directions using line markings or distinguishable pavement surfaces (ie. in colour or texture) may be considered.

A buffer between the shared path and motorised traffic or parked cars should be incorporated, particularly along main roads where speeds exceed 50 km/h or carry high volumes of traffic.

The amount of physical separation required between the shared path and the main carriageway depends on traffic aspects such as speed, volume and heavy vehicles, and the surrounding environment (trees, green space, road signage and other objects). The buffer can take the form of a median, kerb, verge or planting, with a minimum buffer width of 1.0m.

In the long term, a shared path could be the first step towards achieving a separated facility aligned with the preferred facility.

A shared path consists of the following design elements:

- Potentially a median strip
- Link to RMS technical direction on shared paths

Figure 3.60 Shared path, Bourke Street, Waterloo

More information on this facility type can be found in Austroads Guide to Road Design Part6A Appendix A Section A.3, Fig. A2, and Part4 Appendix B Section B.5.2, Fig B.6 and City of Sydney Shared Pathways Pavement Markings Guide

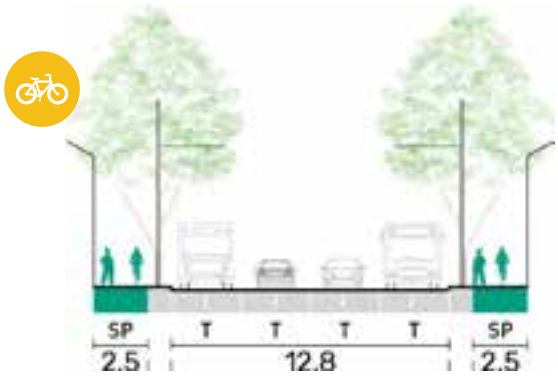


Figure 3.61 Typical cross section - constrained conditions

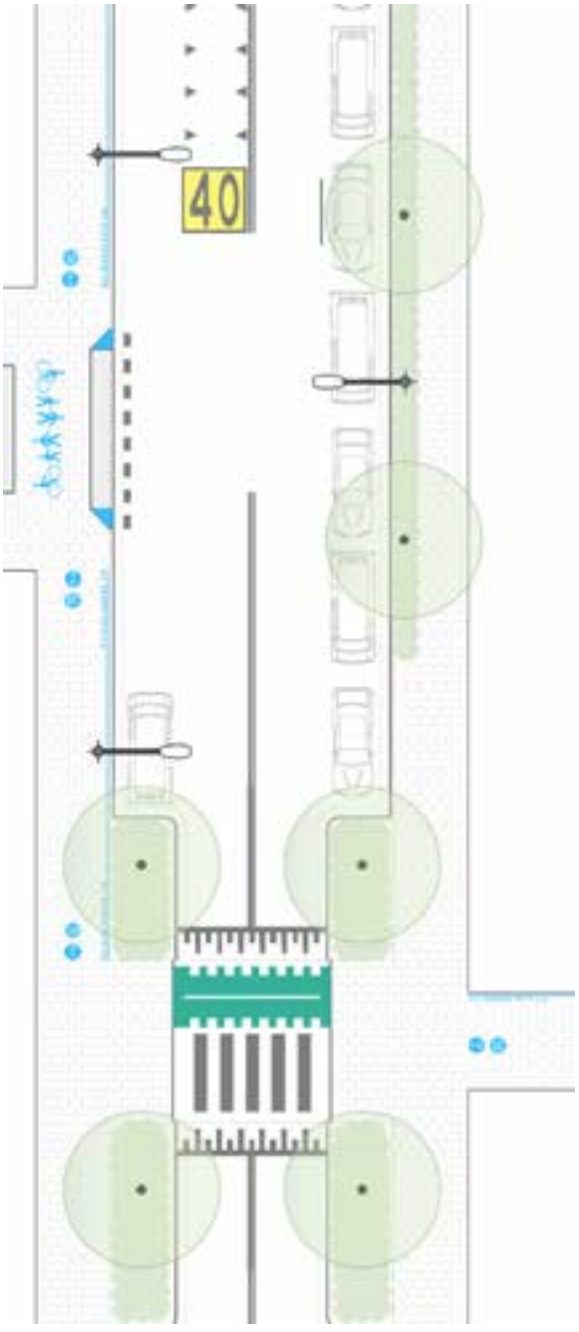


Figure 3.62 Typical plan - constrained conditions

3.5 Shared zone

3.5.1 Overview

A shared zone is a segment or network of road(s) that is shared safely by pedestrians, bicycles and motorised traffic. Priority is given to pedestrians, and safety is achieved through close interaction between all road users.

In areas with high place intensity, such as civic spaces, shared zones may be considered. However, shared zones should not be implemented as part of high-quality high-priority routes that aim to facilitate movement of riders.

Shared zones may be considered on road segments and at intersections where there are high levels of pedestrian activity and traffic volume and speed is low. This includes areas such as school zones, commercial districts and transport interchanges. The design of the road must present visual cues to all road users that dictate appropriate speed and enable interaction between users.

Shared zones are unsuitable on roads with significant movement function where traffic volumes are high, commercial vehicles are prevalent, and/or bus routes exist.

Awareness and behaviour programmes should be delivered in conjunction with shared zone treatments to ensure the safe interaction of road users.

3.5.2 Main Design Considerations

Shared zone experience (Safe, Comfortable and Attractive)

A shared zone should be designed to provide visual cues to road users on appropriate speed and behaviour. This can include design features such as:

- Removal of kerbs to facilitate ease of movement and indicate priority for pedestrians
- Reduction of speed limits to <10km/h
- Traffic calming measures to provide visual and physical cues of appropriate travelling speed
- Impeding sight lines for drivers through strategically positioned landscape features or street furniture
- Incorporating changed surface treatments at entry and exit points and consistent surface treatments across the entire roadway within the shared zone

By positioning people walking and cycling on the centre of the road and incorporating the above design features, conflicts between motorised traffic and people walking and cycling can be reduced, leading to enhance road safety for all users.

Refer to Section 2 for more examples of effective treatments that support reductions in traffic volume and speed.

Entrance and exit points (Safe and Connected)

At the entrance and exit points of a shared zone, prominent features such as road signs, architectural or landscape features must be provided to indicate a change in the street environment.

Continuous footpath treatments should be considered at entry and exit points to assist in traffic calming, and changed surface treatments can be used to provide visual cues to road users that they are entering a shared zone. These should be clearly distinguishable by colour, texture and/or materials.

Consideration must be given at intersections where the shared zone may connect to a different type of cycle facility. If necessary, some on-street parking could be removed on the approach to intersections to enable a formal kerbside bike lane to be established.

Where parking is provided in a shared zone, it is only allowed in marked bays. Refer to RMS technical direction 'Design and implementation of shared zones including provision for parking - TTD 2016/001 February 2016'

More information on this facility type can be found in technical direction TfNSW TTD 2016/001 Design and implementation of shared zones

More information on the entrance and exit points can be found in Austroads Guide to Traffic Management Part 8 Local Street Management Section 8.5.8, Fig 8.29


40

4. Public Bicycle Parking

4. Public bicycle parking

4.1 Integrated bicycle parking

Bicycle parking is integral to any cycle network and to wider transport systems incorporating public transport. The provision and availability of bicycle parking at the beginning and end of every journey has a significant influence on cycle use – parked bicycles provide evidence of demand and patterns of use, and can form part of a monitoring regime to measure growth and demand in cycling.

In the same way that a bus route would not operate without bus stops or a road network without car parking, bicycle parking must be provided along the cycle network for it to be practical and useable. Investment in new routes and cycling infrastructure may not reach its full potential if bicycle parking is not considered as part of the planning and design stages (ideally considered as early as possible).

Personal security within bicycle parking areas may be a concern for users if the location is remote and lacks active and passive surveillance. Bicycle parking and routes to it should be clearly marked, located in a highly visible area, well-maintained, well-lit and integrated into the built environment.

The provision of bike parking should accommodate all types of bicycles and micromobility devices, and may even help tackle barriers for potential riders, such as:

- Insufficient bicycle parking
- Lack of space to store a bicycle at home
- Bicycle theft and vandalism

Addressing these issues will encourage more people to ride and therefore bring economic benefits to businesses, health benefits to bicycle riders and improvements to the transport network. It may also contribute to reduced reliance on commercial car parking and enhance placemaking opportunities.

The provision of bicycle parking facilities should align with the principles outlined in Figure 4.1: accessible, convenient, secure, integrated, and maintained.

For more information

More information on standards and guidelines on bicycle parking can be found in Austroads Bicycle Parking Facilities: Guidelines for Design and Installation (AP-R527-16) and Australian Standards - AS2890.3 (2015)

4.2

4.3 Types of public bicycle parking

Public bicycle parking facilities offer different levels of security and convenience, and should be chosen to meet the needs and preferences of target user groups at different locations. Types of bicycle parking facilities include:

- **Bicycle hub** – large-scale solution suitable for long-term parking at public transport hubs or town centres
- **Bicycle locker** – suitable for long-term parking that includes overnight storage
- **Bicycle shed** – suitable for day parking for members of the public and public transport users
- **Bicycle rack** – suitable for short-term parking such as visitor or customer parking, either on or off-street

Bicycle hubs provide opportunity to deliver large-scale bicycle parking facilities, typically comprising hundreds or thousands of bicycle parking spaces, and are particularly appropriate when integrated within a town centre or at key transport interchanges. Hubs can include supporting amenities such as workshops, changerooms, lockers and showers, and should always have active and passive surveillance. Bicycle hubs should be funded by the relevant state or local authorities and provided free of charge to users to enable effective uptake. Bicycle hubs can be supplemented by additional bicycle parking facilities such as racks or lockers at various locations or entrances, as appropriate for the environment.

Bicycle lockers are lockable, individual use storage areas that offer the highest level of bicycle parking security. They enable multimodal transport journeys by providing opportunity for users to store their bike at train stations, ferry wharves and bus interchanges. Bicycle lockers should be funded by the relevant state or local authorities and provided free of charge to users to enable effective uptake.

Bicycle sheds are enclosed shared shelters that typically accommodate between 20 and 50 bicycles. They enable multimodal transport journeys by providing opportunity for users to store their bike at train stations, ferry wharves and bus interchanges. Bicycle sheds should be funded by the relevant state authority and provided free of charge to users to enable effective uptake.

Bicycle racks are designed to accommodate short-term, local trips with facilities that benefit from consistent passive surveillance. They should be carefully located so as not to impede on pedestrian movements.

Regardless of the parking facility type selected, a proportion of the bicycle parking (typically 5%) should be provided for non-standard bicycles (ie. cargo bikes) and a range of micromobility devices.

Other facilities such as bicycle shelters, in which clusters of bicycle racks are installed under a dedicated shelter structure, also may become increasingly popular.

Temporary bicycle racks are available to cater for high-demand periods or special events which would bring additional cost and planning to everyday bike parking operations. This is often run as a cloakroom style system which matches the bicycle to its owner to avoid theft.

Although temporary in nature, these facilities should still aim to achieve the provisions laid out in Figure 4.1, including passive and active surveillance, and convenient connectivity to a cycleway facility.

Bicycle hire schemes require a nuanced approach in consultation with the Local Government Authority and the service provider to ensure that bicycles and other micromobility devices are provided with sufficient and designated parking/storage areas, the cost of which would be borne by the service provider.

Principle	Description
Accessibility	• Provide accessible and convenient connectivity to cycleway facility/route • Have a convenient kerb ramp near the provided bicycle parking facility for road to footpath transitions • Minimum 5% of parking allocated for forms of micromobility other than conventional bicycles • Provide spare capacity to account for growth in demand and turnover • Each destination should provide more than one type of bike parking facility to cater for different user needs and preferences in terms of security, convenience and ease of use
Location	• Maximum distance of 50m or 1-minute walk to users' ultimate destination, and within sightlines of destination entrance where appropriate • Located at all station entrances accessed by road and cycleway to minimise need to travel through or around the destination to access bike parking • Signage towards location of bicycle parking
Security	• Be placed in view of passers-by or overlooked by the public (passive surveillance) • Covered by existing or additional CCTV cameras where practical (active surveillance) • Be well lit by new or existing lighting
Integration	• Does not obstruct or hinder pedestrian access, loading zones and parking • Be attractive and designed to blend in with the surrounding environment, providing shelter for bicycles and riders where possible • Bicycle stands which can be combined with matching street furniture reinforces the positive image of the bicycle parking facility
Operations and Maintenance	• Introduce regular tidying up, cleaning and maintenance routines • Ensure any damaged stands, wayfinding/signage, structures, electronic access, etc are repaired immediately

Figure 4.1 Alignment of bicycle parking provision with principles

4.4 Key locations for public bicycle parking

The location and comprehensiveness of public bicycle parking in public spaces varies based on the destination served, and the type of facility provided should be appropriate to the given location.

Key locations in relation to public bicycle parking facilities include:

- **Transport interchanges** – vital to maximizing potential for multi-modal trips
- **Town centres, high streets and community destinations** – most common destination for daily trips
- **Parks** – often combined with recreational activities
- **Residential streets** – demand from residents and visitors

4.4.1 Transport interchanges

Cycling increases the reach of public transport services and enables longer journeys that could not be reached by cycling alone. Cycling also provides reliable journey times between the station and home/destination.

Design elements for public bicycle parking at transport interchanges include:

- Provision based on accommodating target cycling access mode share (ideally a minimum 2%), plus additional capacity of at least 20% for additional growth and flexibility
- Maximum distance of 50m between station entrance and bicycle parking
- Bicycle parking placed closer to station entrance than all available car parking
- Spare capacity of at least 20% should be provided to cater for growth and turnover
- Opportunity to consider provision of bicycle hub for large-scale bicycle parking that may include complementary facilities such as shower/changing facilities and toolkits/pumps
- Access to lockable bike parking facilities - bicycle hubs, sheds and lockers - should be integrated with public transport ticketing systems (ie. using registered Opal cards without a user pays element) to support seamless 'Bike+Ride' transfer between cycling and public transport modes

4.4.2 Town centres, high streets and community destinations

Unplanned or poorly planned bicycle parking has the potential to distract from visual amenity at best and present an obstruction at worst.

Design elements for public bicycle parking in town centres, high streets and community destinations include:

- Bicycle parking facilities dispersed throughout commercial centre to support access and convenience for users
- Reallocation of car space to bike parking should be prioritised over the use of footpath space to avoid obstructions along footpath (this can be done by replacing parking spaces, closing off side streets to through traffic, creating new public spaces for walking and bicycle parking)
- Position bike parking in locations that do not impinge on key pedestrian desire lines and use bespoke or high-quality designs to minimise the visual impact
- Provision of special bicycle parking zones should be designated by certain businesses for short-term bicycle parking needs such as delivery riders and bicycle couriers

4.4.3 Parks

Journeys to and within parks are often coupled with recreational purposes and therefore have unique public bicycle parking requirements.

Design elements for public bicycle parking in parks include:

- Provision of bicycle parking facilities located at or near entrances/exits
- Separation between people walking and bicycle riders where pedestrian activity is high
- Low cycling speeds achieved through appropriate design measures such as carefully located seating, slight curves to the alignment or planting buffers

4.4.4 Residential streets

Residents who do not have sufficient space for parking within their house or property may require suitable long-term public bicycle parking facilities along their residential street. Visitors also require appropriate facilities for short-term parking needs.

Design elements for public bicycle parking in residential streets include:

- Provision of a mix of bicycle parking types, including potential for long-term storage solutions such as bicycle sheds and short-term solutions such as bicycle racks
- Consideration should be given to active and passive surveillance for people and property

4.5 Amenities

Complementary provisions like on-street toolkits and digital cycle counters support cycling infrastructure and provide a strong visual cue that cycling infrastructure is an important part of the transport system. On-street toolkits and pumps can be provided across the network and at key destinations to increase the convenience for current and potential riders. Costs for security and maintenance of on-street toolkits should be considered when installing these. Digital cycle counters showing the real-time volume of bicycle riders per day or per and provide evidence of the level of use of a given facility, which can be valuable to decision-makers when considering the future development of the network.

Figure 4.2 Bicycle parking can be stacked for efficient use of space, and should be provided in high-quality, sheltered hubs with good lighting and active surveillance

(Credit: Amy Dickens, bicycle parking facility in Copenhagen, Denmark)

Figure 4.3 Bicycle hubs are the preferred parking facility for transport stations and interchanges where demand is high. They should be well signed, have level access, and be accompanied by complementary amenities like bathrooms, tyre pumps, tool kits, showers and change rooms, as appropriate

(Credit: George Weeks, bicycle parking hub in Utrecht, The Netherlands)

Figure 4.4 Bicycle parking can be provided in residential areas and should be sheltered in a location with passive surveillance to deter theft and enhance the safety of users

(Credit: The Academy of Urbanism)

Figure 4.5 Bicycle sheds can be integrated seamlessly into station design and provide ample space for commuters for the first or last mile of their journey. They should be fully integrated with the Opal card system to enable ease of access. They should be located in an area of the station that has active (ie. CCTV) and passive (ie. regular passers-by) surveillance at all times, and that is well-lit

(Credit: Michael O'Brien, Marrickville Station)

Figure 4.6 Clever bike rack designed to accommodate up to 12 bicycles within a single on-street car parking space, allowing footpaths to remain unobstructed

(Credit: Yvonne Poon, taken in Bondi Junction)

Figure 4.7 Bespoke or high-quality designs help to minimise the visual impact of bicycle parking

(Credit: Don O'Brien, taken in Worthington, Ohio, USA)

5. Specific Locations

5. Specific locations

5.1 Parks and greenways

With high levels of place intensity and low levels of movement function, parks and greenways provide people cycling with attractive and pleasant environments with separation from motorised traffic, attracting users of all ages and abilities. Increased levels of cycling can impact on a park's environment and must be managed in line with relevant legislation to ensure the space is safe and enjoyable for all users.

Cycling facilities in parks and greenways can range from long, meandering paths like the Parramatta Valley cycleway, to short, circular routes like Centennial Park.

Design considerations

- Conflicts between pedestrians and people cycling (through separation or wide paths to accommodate overtaking and interaction)
- Gentle gradient and smooth surface
- Clear sight lines through the elimination of blind or sharp corners

Figure 5.1 Ismay Reserve in Homebush provides high-quality shared paths that provide strong and visible signage to users to share the space

(Credit: Transport for NSW)

Figure 5.2 Centennial Park provides riders of all ages and abilities with a pleasant and safe space to cycle, scoot and walk

(Credit: Jullietta Jung)

5.2 School zones

Cycling and scooting to school supports increased activity levels in children. Under NSW regulations, children under 16 (and an accompanying adult, if required) are permitted to use the footpath, which impresses the importance of providing an environment that is cycle friendly. School zones often have intense levels of movement functions at peak periods, which needs to be taken into consideration when planning and designing cycling infrastructure.

Design considerations

- Behaviour awareness and bicycle safety education programmes to develop on-road skills must accompany any infrastructure changes
- Width of footpath facilities should be as wide as possible to accommodate congestion during school drop-off and pick-up
- Sight distance on approach to crossing and width of crossing
- Unsignalised crossing points must be clearly demarcated with accompanying signage and provide priority to pedestrians, bicycle riders and scooters
- Signalised crossing points should provide lead time to pedestrians and bicycle riders to reduce potential conflicts with motor vehicles
- Cycleways must link to existing network to enable safe and connected journeys
- Bicycle parking facilities should be appropriately sized for children's bicycles and reach

Figure 5.3 Cycling and scooting to school supports increased activity levels in children
(Credit: City of Sydney)

5.3 Main streets

With significant place intensity and high movement function, cycling infrastructure along main streets needs to be carefully considered to provide the safest and most appropriate outcome for all users – pedestrians, bicycle riders, and motor vehicle traffic alike.

Design considerations

- Conflicts between pedestrians and people cycling, particularly in areas with large amounts of active frontages can be avoided or minimised by separating people walking from bicycle riders
- Placement of service/delivery vehicle parking/loading areas should be considered along side streets or alleyways, where possible
- Crossing points should provide lead time for pedestrians and bicycle riders ahead of vehicular movements
- Bus stops and bus shelters should be well integrated into the streetscape and minimise impact on pedestrian or cycling facilities
- Bicycle parking opportunities to be provided along the street
- Improvement of amenity through planting of street trees or garden beds and provision of outdoor seating or dining areas
- Provision of special bicycle parking zones should be designated by certain businesses for short-term bicycle parking needs such as delivery riders and bicycle couriers
- Communication and signage to alert bicycle riders and motor vehicle drivers to new (and unfamiliar) cycling infrastructure, especially intersection treatments

5.4 Transport interchanges

Cycling increases the reach of public transport services and enables riders to make journeys that could not be made by cycling alone. It also provides reliable journey times between home and the station without being influenced by peak hour congestion.

Design considerations

- Conflicts between pedestrians and people cycling
- Bicycle parking facilities need to be incorporated into the interchange design and be conveniently located, as close as possible and within sightlines of entry points
- Wayfinding strategies to be implemented to guide bicycle riders to interchanges and bicycle parking facilities
- Cycleway facilities need to connect to bicycle parking facilities at interchanges
- Provision of areas to support bicycle hire
- Secure bicycle parking facilities need to be provided
- Integration of changerooms, showers and lockers
- Prioritise cycling access and parking within interchanges consistent with any interchange access mode hierarchies, including where there is conflict with feeder public transport (e.g. bus) and private motor vehicle access and parking

5.5 Industrial zones

With limited place intensity and high volumes of heavy vehicles, industrial areas do not provide ideal environments for cycling facilities. Road surface quality may also be poor due to intense use by heavy vehicles, and limitations of heavy vehicle design create known blind spots which may result in riders not being seen by a heavy vehicle driver.

Opportunity to provide high-quality cycling facilities exist within industrial zones, particularly when industrial zones are redeveloped/rezoned into residential or commercial areas.

Design considerations

- Cycling facilities must be separated from motor vehicle traffic to reduce the potential for conflicts with heavy vehicles
- Priority across industrial side streets and driveways should be given to people cycling
- Open sight lines and high levels of visibility for bicycle riders and motor vehicles, particularly at wide driveways
- Social safety and security, particularly at night due to lack of active uses and insufficient lighting
- Maintenance of cycleways
- Conflicts between people walking and people cycling (through separation or wide shared paths to accommodate overtaking and interaction)

Figure 5.4 Industrial zones provide rich opportunities for implementing high-quality cycling infrastructure, Wilson St, Sydney (Transport for NSW)

5.6 Rail corridors

Rail corridors provide ideal conditions for cycleways due to their relatively flat gradient, minimal crossing points, and open space free from buildings and landowners. Although both movement function and place intensity are relatively low along rail corridors, there are safety risks that need to be considered in the planning and design of cycling infrastructure.

Design considerations

- Assess and mitigate risk of rail systems infrastructure to avoid conflicts with or injury to people cycling
- Early and ongoing engagement with rail operator regarding safety and processes
- Any crossing points should:
  - Provide level access for people cycling
  - Be positioned at right angles to the railway
  - Clearly signed and well-maintained interface
  - Provide appropriate traffic control devices to warn, regulate, advise and control pedestrians and bicycle riders
  - Direct pedestrians and riders, either through fencing or crossing design, to face oncoming trains and trams, and situations where the train or tram approaches from over the pedestrian and riders' shoulder must be designed out
- Enhance lighting and/or passive surveillance, especially at night
- Complex integration between government authorities, rail operators and safety requirements for retrofitting an existing, live corridor
- Railway Level Crossings (refer to section 6 'Provision for Cycling at Rail Crossings' of Cycling Aspects of Austroads Guides)
- Requirement for Accredited Engineering Organisation qualified designer/input to meet Assets Standards Authority standards and consideration for technical directions for design ATL1 and ATL2

More information

Active Transport Links on the Rail Corridor

Figure 5.5 Positioned along a rail corridor, Alison Road in Centennial Park provides a safe, flat and direct route that is clearly and physically separated from all rail infrastructure

(Credit: Jullietta Jung)

6. Temporary Measures

6. Temporary measures

6.1 Pop-up cycleways

Temporary measures like pop-up cycleways provide opportunities for practitioners and local authorities to offer more people an alternative mode of transport. They also provide opportunities to showcase how improved cycling connections can look and feel like, and how it may function. Over time, this can inspire increased ridership and support for future bicycle infrastructure and reduce 'bikelash'. The instruments available for redistributing road space in favour of cycling include:

- Temporary designation of new cycling facilities
- Widening of existing ones
- Closure of secondary roads to through traffic, either physically or by time restrictions

More information

NSW Street Treatments for COVID Recovery (Transport for NSW, August 2020)

6.1.1 Planning temporary cycling infrastructure

Creating more space for people cycling in a short time frame presents the opportunity to test a variety of solutions, measure and observe their use or impact, and adapt as needed.

However, there are also risks associated with suddenly changing road environments, so practitioners should consider the following when planning and designing temporary measures.

Reduce traffic speeds

Speed limit reductions should be proposed in conjunction with all pop-up cycleway facilities to enhance road safety. Speed limits must be safe system aligned and consider the place function of the area, the physical separation provided and the expected number and type of vulnerable road users using the pop-up facilities.

Figure 6.1 High-quality pop-up cycleways, like this one along Sydney Road, enable a range of users to cycle comfortably

(Credit: Transport for NSW)

Figure 6.2 This two-way pop-up cycleway along Sydney Road provides riders with a dedicated and protected space so that riders of all ages and abilities can enjoy

(Credit: Transport for NSW)

Figure 6.3 Installing the infrastructure required to support a pop-up cycleway is relatively quick and simple, as demonstrated on Henderson Road

(Credit: Transport for NSW)

Figure 6.4 Pop-up cycleway facilities, like this one on Henderson Road, can be constructed quickly and with limited or no permanent changes to the road surface

(Credit: Transport for NSW)

Traffic separation

Cycling facilities should be physically separated from high volume or high speed motor vehicle traffic, where possible. This is particularly important for temporary measures, as drivers will not be used to the new street layout. For local streets, consideration should be given to completely closing the road to car traffic, or alternatively to closing the road to through traffic and giving priority to bicycles. For wide roads, the conversion of a car lane is the most effective strategy to create more space for people cycling.

Safe system approach

Temporary infrastructure should anticipate the potential for human error and ensure that it does not lead to serious injury or death. Design features should be included to provide physical barriers that themselves do not pose safety risks to users through the use of flexible or soft materials. The design should also incorporate a buffer zone between turning vehicles and people cycling.

An appreciation should be given to the time it takes for road users to adjust to the new traffic environment. Facilities should be designed in a way that they are easily understood by all road users. Conflicts at intersections should be limited by adding design features such as pedestrian refuges, bike boxes or temporary kerb buildouts.

Future network planning

Temporary cycling infrastructure should aim to connect disparate sections of the existing network, accounting for future connectivity and demand. Temporary measures should be implemented in roadways or corridors where future cycleways are planned to optimise connectivity and performance into the future.

Key considerations

- Road speeds should be reduced on roadways adjacent to separated cycleways to enable safe navigation for all road users as a result of the changed street environment
- One-way bicycle paths can be the quickest type of cycleway to implement; they are less disruptive to other road users and are less likely to require changes to traffic control signals
- Two-way bicycle paths may require less street space but can take more time to implement as they require changes to signalised intersections
- Temporary separated cycleway can be installed on bus routes and adjacent to bus stops but not in bus lanes
- Changes to signalised intersections require TfNSW approval, with the level of intervention impacting on approval time
- A two-stage site specific risk assessment should be carried out by a suitably qualified road safety auditor in line with the NSW Centre for Road Safety Guidelines for Road Safety Audit Practices:
  - On final designs prior to construction
  - After construction and prior to opening

Figure 6.5 Two-way cycle facilities require less street space and may require changes to signalised intersections

(Credit: Transport for NSW)

Figure 6.6 Pop-up facilities should be provided along routes that are designated as part of any future permanent network, including connectivity with other modes of transport to enable ease of interchange.

(Credit: Transport for NSW)

6.2 Tactical urbanism

'Tactical urbanism' or 'pop-up' urbanism refer to city, organisation and/or citizen-led approaches to neighbourhood building that make temporary, scalable and low-cost changes, and provide a cheap way to pilot innovative ideas, refine them and implement them more widely. These temporary projects can help to encourage meaningful public engagement and generate support for permanent projects by enabling people to experience what is possible.

Interim approaches have been utilised in cities around the world to reclaim streets and repurpose them as parks, plazas, cycleways and gardens.

Examples of tactical urbanism measures in relation to cycleway facilities include creating or widening cycleways with brightly coloured blocks or planters, or reclaiming a kerbside parking space for bicycle parking facilities. It could also include the creation of adjacent public spaces to activate the street.

There are five key lessons for ensuring interim projects move from pop-up to permanent[2]:

1. Uncover value – identify underutilised space and transform it to contribute to safety, community building or economic goals.
2. Engage stakeholders – public outreach can generate new ideas, build community support and improve local understanding of urban issues.
3. Document and measure – before and after photos and metrics to support permanent implementation.
4. Attract attention – use colourful materials, art and creative promotional materials to draw attention to the transformation.
5. Scale up – pilot new approaches to transform policy and inspire new programmes.

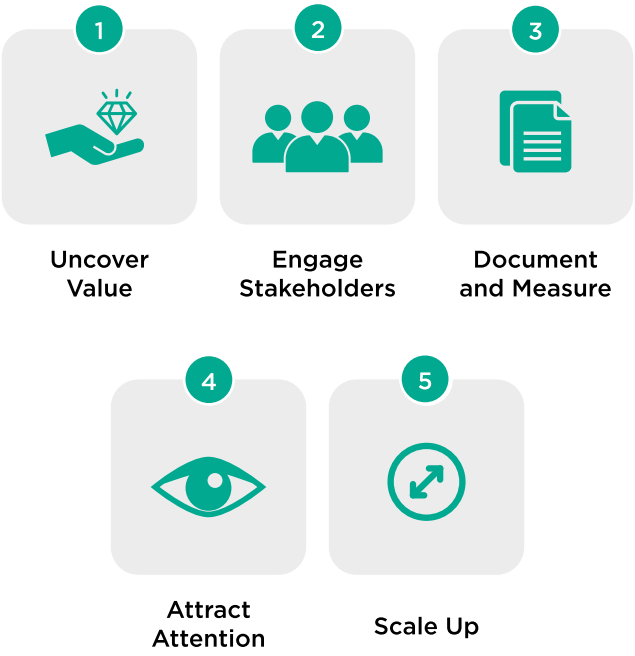


Figure 6.7 Five key lessons for interim projects to move from pop-up to permanent

Figure 6.8 Reclaiming the street with a temporary public space along George Street in The Rocks

(Credit: Transport for NSW)

2 Global Designing Cities Initiative, Hanson and Abdulsamad. From Pop-Up to Permanent: Five lessons in tactical urbanism (2018): https://globaldesigningcities.org/2018/04/18/from-pop-up-to-permanent-five-lessons-in-tactical-urbanism/

Appendix A
Strategic Context

Appendix A: strategic context

A.1 Future Transport 2056

In 2018, Transport for NSW (TfNSW) released Future Transport 2056 which establishes a 40-year strategy for transport in NSW.

This includes:

- Ensuring walking or cycling is the most convenient option for short, everyday trips around centres and local areas, supported by a safe road environment and appropriate infrastructure.
- Encouraging customers to use the transport system differently by shifting to walking, cycling or public transport.
- Keeping pedestrians and bicycle riders safe by implementing road safety measures and ensuring speed limits align to the road environment, consistent with the Movement and Place framework.

To support these objectives, Future Transport 2056 has set a vision for a safe, connected cycling network across Greater Sydney by 2056.

A.2 Cycling design guidelines

Austroads released the Cycling Aspects of Austroads Guide (2017) which compiles guidance on the design, construction and maintenance of cycling and end-of-trip facilities from the Austroads Guide to Road Design, Guide to Traffic Management and Guide to Road Safety.

The Austroads Guide is a nationally agreed guidance document for all road design and traffic engineering that sets a minimum baseline for acceptable cycleway design. It considers compliance and standards rather than best practice to meet a range of customer needs.

This Cycleway Design Toolbox is a complementary document developed by TfNSW giving specific cycleway design guidance for NSW. It provides clear guidance where there is a need to physically separate bicycle traffic from motorised traffic and how to provide priority for bicycle riders at signalised and unsignalised intersections and driveways. Importantly, the Toolbox establishes a set of design principles that assists in the integration of cycling facilities into city streets in ways that better balance movement and place.

A.3 The value proposition for high quality cycling infrastructure

Cycling and the investment in quality infrastructure brings various benefits to customers and the general public including:

- Health and wellbeing benefits, including lower healthcare costs to individuals and society
- Reduced air and noise pollution
- Reduced congestion and improved journey times reliability
- More efficient use of space
- Supporting the economy by improving access to key employment centres and local neighbourhoods
- Enabling active transport to local schools

A.4 Intended users and vehicles

All ages and abilities

The aim of good quality cycling infrastructure is to provide a suitable environment for a wide range of rider ages and abilities, including inexperience, timid riders, peope living with disability, as well as children and families. By providing for these types of riders, the cycling infrastructure will generally also meet the needs of more experienced riders.

According to research undertaken by TfNSW, focus should be given to providing high-quality, safe and connected cycling infrastructure that caters to the 48% of potential riders who are “interested but concerned” (Cycling Customer Value Proposition Research 2013). In this research, over 70% of customers stated that they would ride a bicycle if they had access to safe cycling routes. Targeting these potential riders means focusing cycleway design on the aspects customers value the most such as safety, separation from cars, direct routes and having access to information such as wayfinding.

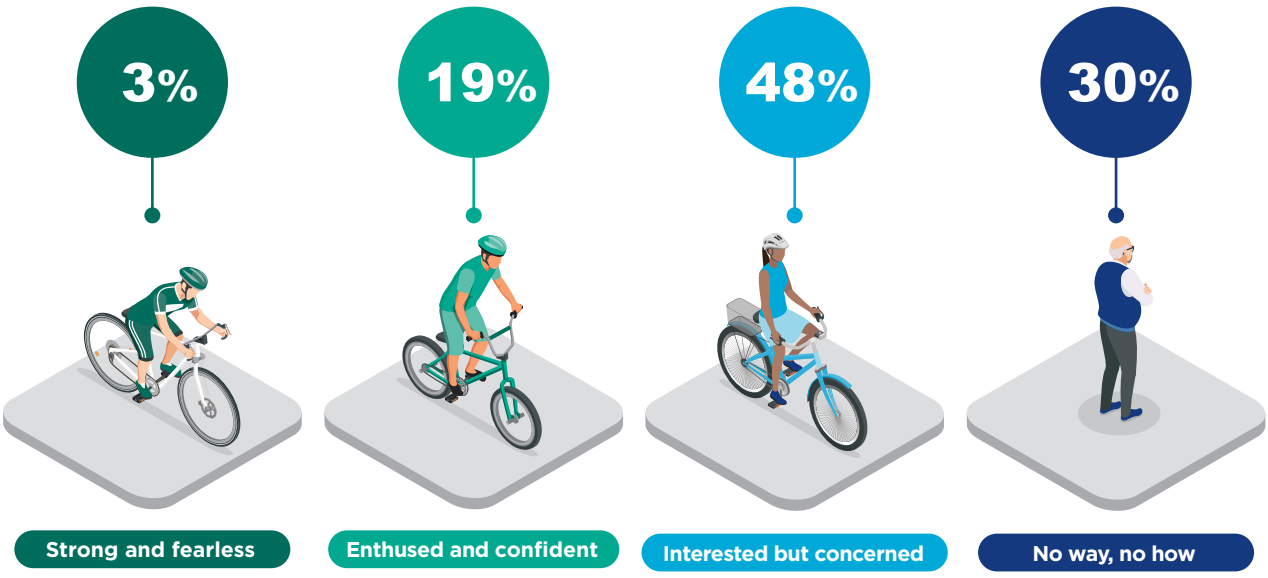


Figure A.1 The four types of bicycle riders

Design envelope

While it is not possible to identify all design situations in these guidelines, an appreciation of the basic geometric parameters applicable to bicycles and micromobility devices will assist in delivering appropriate designs for all components of cycling facilities.

Design envelopes of bicycle riders have been developed by Austroads and have been in use for many years. Figure A.2 below is an example of an Austroads envelope that provides minimum space requirements to aid designers. The current 1.0m width of the Austroads design envelope allows for the width of a bicycle and relatively minor variation in tracking.

However, with innovation happening in bicycle design, and a range of different types of bicycles and micromobility devices available on the market to cater for carrying cargo, families, pets and the mobility impaired, amongst others, the dimensions of the design envelope needs to be redefined (refer to Figure A.3 below). Similarly, the rise of a diverse range of micromobility options to provide consumers with convenient first and last mile transport solutions has introduced a new cohort of potential users of the cycling network.

Cycling infrastructure must be designed to accommodate all users on all types of bicycles or micromobility devices, with the broadest dimensions accounted for.

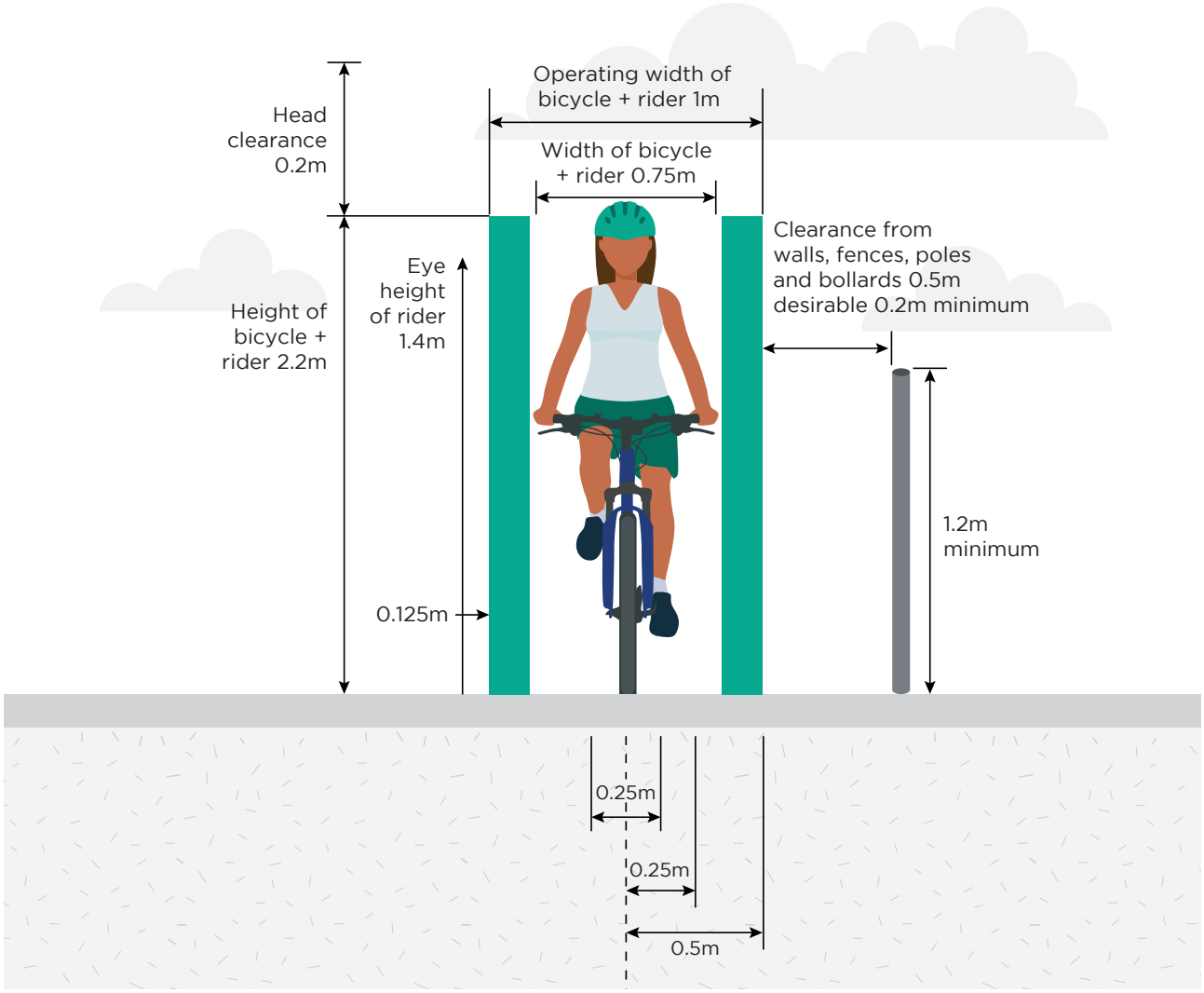


Figure A.2 Design envelope of a bicycle rider from Austroads (2017)

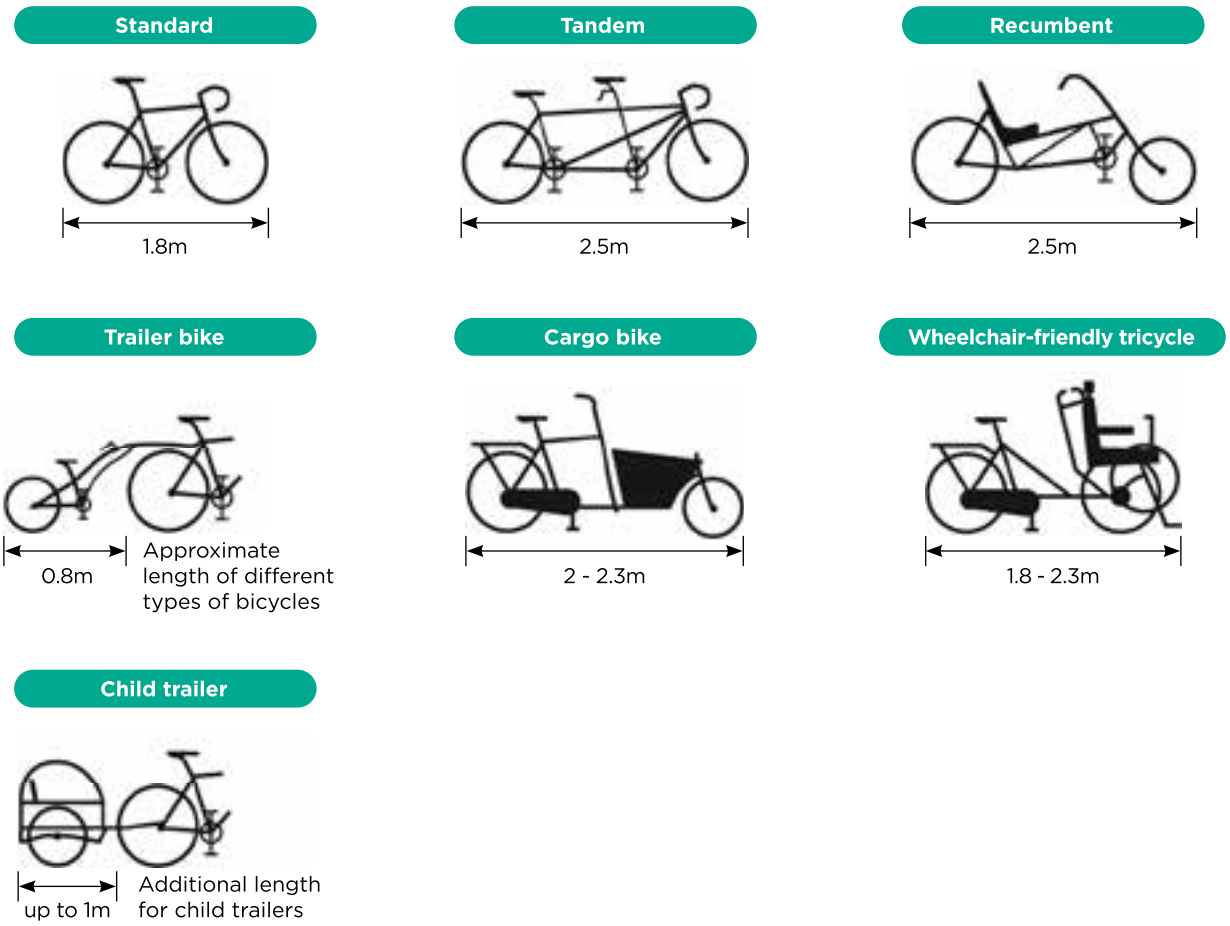


Figure A.3 Approximate lengths of different types of bicycles

Classification		Code	Description
Curb weight	Ultra lightweight	WT1	Curb weight ≤ 23 kg
	Lightweight	WT2	23 kg < curb weight ≤ 45 kg
	Midweight	WT3	45 kg < curb weight ≤ 91 kg
Vehicle width	Standard	WD1*	Vehicle width ≤ 0.9 m
	Wide	WD2**	0.9 m < vehicle width ≤ 1.2 m
	Extra-wide	WD3	1.2 m < vehicle width ≤ 1.5 m
Top speed	Ultra low-speed	SP1	Top speed ≤ 13 km/h
	Low-speed	SP2	13 km/h < top speed ≤ 32 km/h***

Note: The SAE definition is not yet endorsed in NSW but provides a useful reference point.

* Minimum

** Preferred

*** 25 km/h is current top speed in NSW

Figure A.4 Classification system for micromobility

Factors	Comments	Design implications
Rider – speed, mass, acceleration	Energy is required to start the bicycle in motion and maintain the rider's desired speed, which depends on the rate of acceleration and the combined weight of the rider and device of the rider and cycle Stopping and restarting may require significant additional effort	Routes that are direct and allow riders to maintain a steady speed are preferred Avoid layouts that require riders to stop, slow down, or deviate unnecessarily from their desired route
Surface quality and resistance	The greater the surface resistance, the more effort is required to cycle Rough or uneven surfaces are dangerous for riders, particularly inexperienced riders and small-wheeled micromobility devices (eg scooters and skateboards)	Cycle routes should be paved with smooth surfaces in high-quality materials that withstand weather and be well-maintained at all times of year
Gradient	The steeper the gradient, the more energy is required to overcome it Whilst electric bicycles assist, it can't be assumed all riders have electric assistance	Directness of route may need to be balanced with avoiding steep gradients.
Wind	Wind resistance can add significantly to the effort required to cycle	In locations with strong prevailing winds, consider windbreaks using planting, trees, hedges or fences

Figure A.5 Factors and design implications for operational principles for bicycle riders and micromobility users

Vehicle operational principles

The effort required to cycle and maintain a consistent speed is affected by physical conditions and the local environment: surface quality, surface material, gradients, deflections and undulations, and wind resistance (Figure A.5).

Depending on the personal traits of the rider and whether they have electric assistance, urban cycling speeds average between 15km/h and 25km/h. This can vary from under 10km/h on an uphill gradient to over 60km/h on a prolonged downhill gradient. Bicycle riders may be capable of up to 40km/h on flat unobstructed routes.

For main routes, it is advisable to incorporate a design speed of 30km/h, with special consideration given to down-gradient of >3% where design speeds should be closer to 35-40km/h. Under Austroads guidelines, high-quality, high-priority routes should have design speeds of25- 40km/h, local bicycle routes 20-30km/h and mixed environments <20km/h.

A.5 Level of Service and Level of Traffic Stress

Level of Service

While minimum requirements provide guidance around what constitutes adequate cycling conditions, there are several factors that should be taken into consideration, all of which can contribute positively or negatively to the experience of cycling. These make up distinct elements of the five core design principles (see Section 1.2) that contribute to an overall level of service within a given situation or design.

The Level of Service assessment provides an argument for how improvements for cycling could be made throughout the planning and design stages. The purpose of the Level of Service assessment is to frame discussion about design options so that schemes are appealing for existing riders and can entice new riders onto the network.

A nuance when measuring the Level of Service is that different riders will have a different threshold for comfort and safety. The focus should therefore be on designing infrastructure that all riders feel comfortable using.

The Department for Transport (UK) recently released their Cycle Infrastructure Design guidance (2020) which includes a comprehensive Level of Service tool. The tool provides a simple scoring assessment based on attributes of the main design requirements and can support practitioners in identifying strengths and weaknesses of their proposed design at all stages of planning. The London Cycling Design Standards also have a comprehensive Level of Service assessment matrix (refer to LCDS Figure 2.3) that brings in a sixth design principle of adaptability.

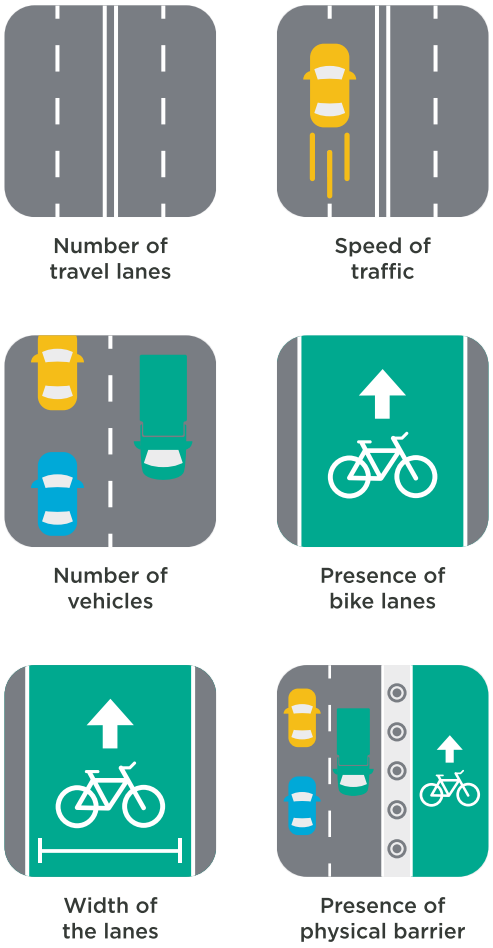


Figure A.6 Factors influencing level of stress for bicycle riders

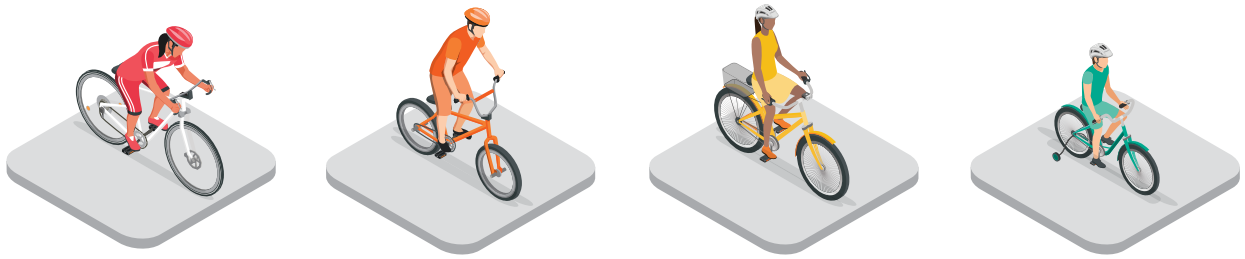
Level of Traffic Stress

The term bicycle Level of Traffic Stress was first coined by the Mineta Transportation Institute and has since assumed industry best practice for assessing the comfort and connectivity of cycling networks.

Undertaking an Level of Traffic Stress assessment for cycling facilities can assist in guiding the selection of facility type. For the cycling network to attract users of all ages and abilities, including risk-averse riders, a low-stress cycle network is essential.

The aim of the Level of Traffic Stress approach is to achieve low stress connectivity between the origins and destinations of bicycle riders by enabling them to avoid routes that exceed their tolerance and comfort for traffic stress without the need for significant detours.

There are four levels of traffic stress (refer to Figure A.7) based around several characteristics, including road width, traffic volumes, traffic speeds, parked cars, ease of intersection crossing and whether bicycles are separated or mixed with traffic.



Stress level 4

Mixed traffic riding on road, typically along roads with high speeds and multiple travel lanes

High risk of bike rider injury or fatality

Uncomfortable for most riders, only acceptable for the "strong and fearless"

Stress level 3

Mixed traffic riding on road or bike lane along busy road

Significant risk of bike rider injury or fatality

Acceptable for "enthused and confident" who still prefer a dedicated space

Stress level 2

On-road facility on low speed road, typically buffered from traffic

Moderate risk of bike rider injury or fatality

Adults who are "interested but concerned" can feel safe riding

Stress level 1

Fully separated from traffic along roads with low traffic volumes

Low risk of bike rider injury or fatality

Suitable for all

Figure A.7 Characteristics of stress level ratings

A.6 Safe System Approach

Cycling provides environmental, health and social benefits to the community. However, a significant barrier to cycling is the perceived and actual risk for riders on the road. The Safe System Approach has been adopted in Australia and involves a holistic view of road safety with four essential elements:

- Safe road use (behaviour)
- Safe roads and roadsides (infrastructure)
- Safe speeds
- Safe vehicles

This approach represents a paradigm shift away from focusing on the behaviour of road users to developing a system that can accommodate user error through safer infrastructure, vehicles and speeds.

The four essential elements that comprise a Safe System must work together as a whole so that the impact of a mistake does not result in fatality or serious injury. A Safe System is central to moving Towards Zero fatalities and serious injuries on NSW roads.

From a cycling point of view this corresponds to the appropriate selection of infrastructure type based on road demand and speeds as well as appropriate design and location of the cycling network. It incorporates aspects like having adequate lighting, line markings, minimising curves and steep gradients, and a smooth road surface. Ultimately, a transport system that is safe for the most vulnerable road users is safe for all.

A.7 Movement and Place

The Movement and Place framework establishes a process for developing outcomes that consider the role of city streets in the context of public space.

The framework highlights the importance of 'place' in the decision-making process and the need for a collaborative planning, design and engineering approach that involves practitioners across a variety of disciplines specialising in movement (Transport Planning and Engineering) and place (Landscape Architecture / Urban Design).

Delivery of a high quality cycling network provides a great opportunity to not only improve conditions for cycling, but to create more liveable streets that deliver better outcomes for all.

Six step process

The Movement and Place approach comprises a six-step process of collaboration, which all projects should follow:

1. Establish the project scope and context
2. Understand place
3. Understand movement
4. Identify issues, and opportunities
5. Develop options
6. Select the preferred option

Using the core indicators, projects should seek to report on and enhance all core indicators. Of particular relevance to cycling infrastructure and design are the following four (of 9) core indicators: mode share, permeability, Safe Systems assessment and casualty crash rate (and to a lesser extent: environmental quality, tree canopy, and mix of uses).

Street environments

Classification of street environments help to provide a quick understanding of where movement and place interact. The Movement and Place framework identifies four main types of streets:

Civic spaces

Streets that have a significant meaning, activity function, or built environment. They are in major centres or community hubs and are often pedestrian priority, shared spaces.

Local streets

Most streets within our transport networks are local streets. They often have important local place qualities with lower levels of activity.

Main streets

These streets have significant movement and place qualities. Balancing the functions of these streets is a common challenge.

Main roads

Roads that are central to the efficient movement of people and freight. They include motorways, primary freight corridors, major public transport routes, the principal bicycle network, and key urban pedestrian corridors.

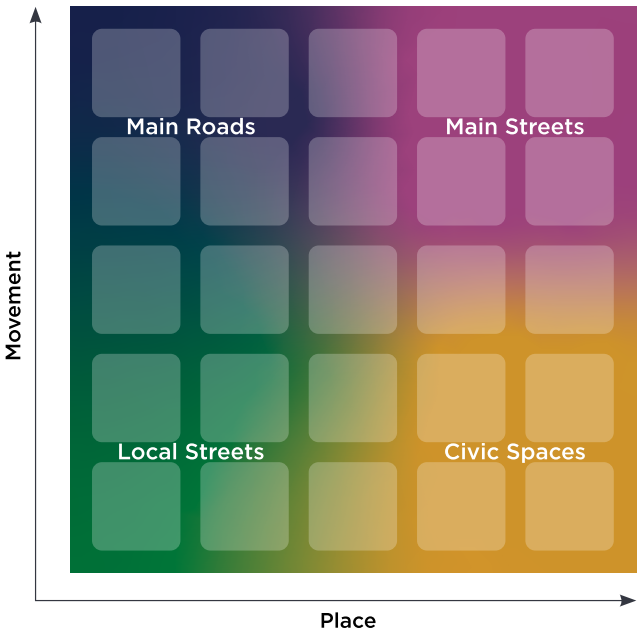


Figure A.8 'Movement and Place' street typology

Appendix B
Additional Information

Appendix B: Additional information

B.1 List of figures

B.2 Glossary

B.2.1 Cycling facilities

Bicycle lane	On road facility type – separated from other vehicles by road markings. May be located between parked cars and moving traffic lanes
Bicycle path	Off road facility type – for bicycle use only
Cycleway	Cycling facility (on or off road, could be any of the facilities below)
Mixed traffic	On road facility type - shared with motor vehicle traffic
Shared path	Off road facility type - shared with pedestrians
Shared zone	On road facility type - very low speed street (10km/h) shared between pedestrians, bicycle riders and motor vehicle drivers
Quietway	On road facility type - low speed traffic environment (e.g. 30kmh or less) shared with motor vehicles

B.2.2 Other

Micromobility	A range of small, lightweight devices operating at speeds typically below 25 km/h. Micromobility devices include bicycles, Ebikes, electric scooters, electric skate-boards, shared bicycles, and electric pedal assisted (pedelec) bicycles.
Practitioners	Professionals involved in designing, delivering and integrating cycleways, such as transport planners, urban planners, road designers, traffic engineers at relevant governing bodies (local councils, state government, consultants). This also includes professionals involved in delivering projects impacted by the cycleway, such as public transport interchanges using cycleways as 'feeder links' and road projects on the cycleway corridors
Pedestrian	A person walking rather than travelling in a vehicle
Level of Service	Level of Service is a mechanism used to determine how well a transportation facility is operating from a traveler's perspective. Typically, six levels of service are defined and each is assigned a letter designation from A to F (best to worst) Austroads Level of Service Metrics (for Network operations Planning), January 2015

B.3 Abbreviations

TfNSW	Transport for NSW

B.4 Key reference documents

These key reference documents provide a comprehensive understanding of cycleway design, planning and policy, and provided inspiration and insights to the development of this Toolbox. Practitioners are encouraged to consult these documents.

Austroads (AUS), Cycling Aspects of Austroads Guides (2017): https://austroads.com.au/publications/traffic-management/ap-g88-17

City of Melbourne (AUS), Bike Lane Design Guidelines (2019): https://www.melbourne.vic.gov.au/sitecollectiondocuments/bike-lane-design-guidelines.pdf

CROW (Netherlands), Design Manual for Bicycle Traffic (2016)

Department of Transport (UK), Cycle Infrastructure Design (2020): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/906344/cycle-infrastructure-design-ltn-1-20.pdf

Department of Transport and Main Roads (AUS), Selection and design of cycle tracks (2019): https://www.tmr.qld.gov.au/-/media/busind/techstdpubs/Cycling/Selectiondesignofcycletracksguideline.pdf

Transport for NSW (AUS), Practitioner's Guide to Movement and Place (2020): https://www.governmentarchitect.nsw.gov.au/resources/ga/media/files/ga/manuals-and-guides/practitioners-guide-to-movement-and-place-2020-06-04.pdf?la=en

B.5 Additional reference documents

Alta Planning + Design (US), Level of Traffic Stress – What it Means for Building Better Bike Networks (2017): https://blog.altaplanning.com/level-of-traffic-stress-what-it-means-for-building-better-bike-networks-c4af9800b4ee

Alta Planning + Design's Innovation Lab (US), Mobility Hub Typology Study (2020): https://altaplanning.com/wp-content/uploads/PBOT-Mobility-Hub-Typology_June2020.pdf

Arup and Sustrans (UK), Cycling for Everyone (2020): https://www.sustrans.org.uk/media/7377/cycling_for_everyone-sustrans-arup.pdf

Auckland Transport (NZ), Evaluating Quality of Service for Auckland Cycle Facilities (2016): https://at.govt.nz/media/1973340/cycle-facilities-quality-of-service-evaluation-guide.pdf

Austroads (AUS), Bicycle Parking Facilities: Guidelines for Design and Installation (2016): https://austroads.com.au/publications/active-travel/ap-r527-16/media/AP-R527-16-Bicycle_Parking_Facilities_Guidelines_for_Design_and_Installation.pdf

Austroads (AUS), Bicycle Parking Facilities: Updating the Austroads Guide to Traffic Management (2016): https://austroads.com.au/publications/active-travel/ap-r528-16/media/AP-R528-16-Bicycle_Parking_Facilities_Updating_Austroads_Guide_to_Traffi....pdf

Austroads (AUS), Classifying, Measuring and Valuing the Benefits of Place on the Transport System (2020): https://austroads.com.au/publications/network/ap-r626-20/media/AP-R626-20_Classifying_Measuring_and_Valuing_Benefits_of_Place_on_the_Transport_System.pdf

City of Sydney (AUS), Cycleway Treatment Reference Guide (2019)

City of Sydney (AUS), On the Go: How Women Travel Around our City (2020): https://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0016/321154/On-the-Go-How-women-get-around-our-city.pdf

City of Sydney (AUS), Standard Cycleways Treatment Overview (2015)

City of Vancouver (US), Transport Design Guidelines: All Ages and Abilities Cycling Routes (2017): https://vancouver.ca/files/cov/design-guidelines-for-all-ages-and-abilities-cycling-routes.pdf

Department of Transport (UK), £2 billion package to create new era for cycling and walking (2020): https://www.gov.uk/government/news/2-billion-package-to-create-new-era-for-cycling-and-walking

Department of Transport (UK), Cycling and Walking Investment Strategy (2017): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/874708/cycling-walking-investment-strategy.pdf

European Platform on Sustainable Urban Mobility Plans (EU), Developing and Implementing a Sustainable Urban Mobility Plan (2013): https://www.eltis.org/sites/default/files/guidelines-developing-and-implementing-a-sump_final_web_jan2014b.pdf

Experi (Germany), Pop-up infrastructure for active mobility in Berlin (2020): https://storymaps.arcgis.com/stories/9f47ef654c7841e1a8d35034088d75b7

Greater Sydney Commission (AUS), A Metropolis of Three Cities (2018): https://gsc-public-1.s3-ap-southeast-2.amazonaws.com/greater-sydney-region-plan-0618.pdf?pMbPYxwen5lHg4GSB6td4yKiKVogFi4c

Infrastructure NSW (AUS), Building Momentum: State Infrastructure Strategy 2018-2038 (2018): https://insw-sis.visualise.today/documents/INSW_2018SIS_BuildingMomentum.pdf

London Cycling Design Standards (UK), Junctions and Crossings (2016): http://content.tfl.gov.uk/lcds-chapter5-junctionsandcrossings.pdf

Mobycon (Germany), Making safe space for cycling in 10 days (2020): https://mobycon.com/wp-content/uploads/2020/05/FrKr-Berlin_Guide-EN.pdf

National Institute for Public Health and the Environment (Netherlands), Cycling in the Netherlands (2018): https://crowplatform.com/wp-content/uploads/Cycling-in-the-netherlands.pdf

New Zealand Transport Agency (NZ), Separated Cycleway Options Tool (2016): https://www.nzta.govt.nz/assets/Walking-Cycling-and-Public-Transport/docs/cycling-network-guidance/tech-notes/TN001-separated-cycleway-options-tool-april-2016.pdf

Portland State University (US), Four types of cyclists? Examining a typology to better understand bicycle behaviour and potential (2012): http://www1.coe.neu.edu/~pfurth/Other%20papers/Dill%202013%204%20types%20of%20cyclists%20TRR.pdf

Programme Officers (UK), Cycle Traffic and the Strategic Road Network (2016): http://programmeofficers.co.uk/Preston/CoreDocuments/LCC057.pdf

Roads and Maritime Services (AUS), Facilities for the Principal Cycle Network: A practical guide for local government (2017)

RTA (AUS), NSW bicycle guidelines (2005): https://webarchive.nla.gov.au/awa/20091127012606/http://pandora.nla.gov.au/pan/111781/20091127-1200/www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/nswbicyclev12_i.pdf

SAE International (US), Taxonomy and Classification of Powered Micromobility Vehicles (2018): https://www.sae.org/standards/content/j3163_201809/

The Danish Cyclist Federation (Denmark), Bicycle parking manual (2008): http://www.cycling-embassy.dk/wp-content/uploads/2010/08/Bicycle_Parking_Manual.pdf

The Guardian (Online), Milan announces ambitious scheme to reduce car use after lockdown (2020): https://www.theguardian.com/world/2020/apr/21/milan-seeks-to-prevent-post-crisis-return-of-traffic-pollution?CMP=share_btn_link

Transport for London (UK), Cycle Parking Implementation Plan (2019): http://content.tfl.gov.uk/cycle-parking-implementation-plan.pdf

Transport for London (UK), Cycleways Signing Guidance (2019): http://content.tfl.gov.uk/cycleways-signing-guidance.pdf

Transport for London (UK), Cycling Action Plan (2018): http://content.tfl.gov.uk/cycling-action-plan.pdf

Transport for London (UK), Guide to Healthy Streets Indicator (2017): https://healthystreetscom.files.wordpress.com/2017/11/guide-to-the-healthy-streets-indicators.pdf

Transport for London (UK), London Cycling Design Standards (2020): https://tfl.gov.uk/corporate/publications-and-reports/streets-toolkit

Transport for London (UK), London Streetspace Plan – Interim Guidance to Boroughs: http://content.tfl.gov.uk/lsp-interim-borough-guidance-main-doc.pdf

Transport for London (UK), New cycle route quality criteria – Technical Note (2019): http://content.tfl.gov.uk/cycle-route-quality-criteria-technical-note-v1.pdf

Transport for London (UK), New cycle route quality criteria (2019): https://tfl.gov.uk/corporate/publications-and-reports/cycling

Transport for London (UK), Pedestrian Comfort Guidance for London (2010): http://content.tfl.gov.uk/pedestrian-comfort-guidance-technical-guide.pdf

Transport for NSW (AUS), Beyond the Pavement (2020): https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/centre-for-urban-design/beyond-pavement.pdf

Transport for NSW (AUS), Design and implementation of shared zones including provision for parking (2016): https://www.rms.nsw.gov.au/trafficinformation/downloads/ttd_2016-001.pdf

Transport for NSW (AUS), Future Transport 2056 (2017): https://future.transport.nsw.gov.au/sites/default/files/media/documents/2018/Future_Transport_2056_Strategy.pdf

Transport for NSW (AUS), NSW Street Treatments for COVID Recovery (2020): https://www.rms.nsw.gov.au/projects/01documents/popup-covid-19-infrastructure/nsw-street-treatments-for-covid-recovery.pdf

Transport for NSW (AUS), Sydney Metro Northwest Pedestrian-Cycle Network and Facilities Strategy (2015): https://www.sydneymetro.info/sites/default/files/Syd-Met-NW-Ped-Cycle-Strategy.pdf%3Fext%3D.pdf

Transport for NSW (AUS), Transport for NSW Cycling Customer Value Proposition (CVP) research (2013)

Treatment for NSW (AUS), Draft Greener Places Design Guide (2020): https://www.governmentarchitect.nsw.gov.au/guidance/greener-places-guide

VicRoads (AUS), VicRoads Design Guidance for strategically important cycling corridors (2016): https://www.vicroads.vic.gov.au/traffic-and-road-use/cycling/bicycle-infrastructure-design

WA Main Rods (AUS), Guidelines for Assessing Cycling Level of Service (2006)

Welsh Government (UK), Active Travel Guidance (2020): https://gov.wales/active-travel-guidance?utm_source=Sustransandutm_medium=emailandutm_campaign=11440743_Policy%20Scan%20Marchanddm_i=6EB,6T7QF,RCHB6W,R9UT1,1

Western Sydney Planning Partnership (AUS), Western Sydney Street Design Guidelines (2020)

B.6 Acknowledgements

Project team

Alex van Gent, Aurecon

Bright Pryde, Aurecon

Fergus McCarthy, SMM

Ian McCarthy, Aurecon

Julia Kim, Aurecon

Mat Dally, SMM

Rachel Flitman, Aurecon

Sara McGufficke, SMM

Tiffany Saputra, Aurecon

Project working group

Benny Horn, Transport for NSW

Beth Robrahn, City of Sydney

Duncan Hancox, Transport for NSW

Fiona Campbell, City of Sydney

Jullietta Jung, Transport for NSW

Ken Shepherd, Transport for NSW

Leon Paap, Transport for NSW

Marc Lane, Government Architect NSW

Mark Crispin, City of Parramatta

Sara Stace, Transport for NSW

Tony Arnold, Transport for NSW

Transport for NSW

Alex Mengel

Alexandra Lyle

Anne Sutherland

Bec Purser

Ben Cebuliak

Catherine McBean

Chris Andrews

Chris Zito

Claire Chow

David Ballm

David Potter

David Spiteri

David Webb

Dean Simmonds

Duncan Tjin

Dylan Connell

Eilish Pankhurst

Elisabeth Peet

Emma Burke

Erin McCarthy

Gareth Collins

Gigi Lombardi

Graham Richardson

Hugh Robinson

James Dobinson

Jessica Farrell

Joe D'Aspromante

Joel Azzopardi

John Larcombe

Julie Sundkvist

Ken Ho

Khaled Jebara

Kristie Beattie

Lara Kirchner

Leesa Smith

Lewis Haig

Luke Wilby

Lyndall Johnson

Martin Oaten

Matthew Jones

Matthew McKibbin

Michael Kileen

Myfanwy Lawrence

Narelle Lee

Neill Miller

Nerida Morgan

Nick Croft

Nicolas Kocoski

Nicole Li

Peter Ellis

Robbie Chiu

Sandra Robinson

Sherrie Killiby

Susie Garland

Thijs Blokker

Tim Fitzsimmons

Tim Raimond

Yanos Fill-Dryden

Councils

Bayside Council

Blacktown City Council

Blue Mountains City Council

Burwood Council

Camden Council

Campbelltown City Council

Central Coast Council

City of Canada Bay Council

City of Canterbury-Bankstown

City of Lake Macquarie Council

City of Parramatta

City of Ryde

City of Sydney

Fairfield City Council

Georges River Council

Hawkesbury City Council

Hornsby Shire Council

Hunter's Hill Council

Inner West Council

Ku-ring-gai Council

Lane Cove Council

Liverpool City Council

Maitland City Council

Mosman Council

Newcastle City Council

North Sydney Council

Northern Beaches Council

Penrith City Council

Randwick City Council

Strathfield Council

Sutherland Shire Council

The Hills Shire Council

Waverley Council

Willoughby City Council

Wollongong City Council

Woollahra Municipal Council

Department of Planning, Industry and Environment (DPIE)

Brook Wharton

Caroline Butler-Bowden

John Kurko

Martin Reason

Nicola O'Brien

Vanessa Gordon

External organisations

Alistair Ferguson, Bicycle NSW

Bastien Wallace, Bicycle NSW

Peter McCue, NSW Office of Sport

Rema Hayek, NSW Health

transport.nsw.gov.au

TP201