Guideline

Including provisions for bicycles in road pavement rehabilitation and resurfacing projects

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Queensland Government

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1 Purpose and scope

This Guideline has been developed to provide practitioners with guidance on the inclusion of provisions for bicycles in programmed road pavement rehabilitation and road surfacing projects. It promotes low-cost options that can be implemented with this work, given the practicalities and limitations of these project types.

This Guideline:

- documents the process for using existing road pavement rehabilitation and resurfacing programs to implement low-cost bicycle facility enhancements
- details milestones in the concept to implementation project phases for the review of feasibility of these bicycle facility enhancements, and
- provides typical design considerations, both in accordance with and supplementary to the Austroads suite of guides, for overcoming typical constraints encountered.

1.1 Related documents

This Guideline should be read in conjunction with the following guidelines:

- Austroads *Guide to Road Design Part 3 Geometric Design*
- Austroads *Guide to Road Design Part 4 Intersections and Crossings*
- Austroads *Guide to Traffic Management Part 5 Road Management*
- Austroads *Guide to Traffic Management Part 10 Traffic Control and Communication Devices*
- Austroads *Guide to Traffic Management Part 11 Parking*
- Department of Transport and Main Roads *Cycling Infrastructure Policy* June 2017
- Department of Transport and Main Roads Queensland *Manual of Uniform Traffic Control Devices Part 2 Traffic Control Devices for General Use*
- Department of Transport and Main Roads Queensland *Manual of Uniform Traffic Control Devices Part 9 Bicycle Facilities*
- Department of Transport and Main Roads Technical Note TN108 Mid-*block bicycle lane termination treatments.*

The documents following have been referenced in this Guideline.

- *A Guide to Signing Cycle Networks*, Department of Transport and Main Roads, 2009
- AS 2890.3:1993 *Bicycle Parking Facilities*, Standards Australia, 1993
- AS 3996:1992 *Metal Access Covers, Road Grates and Frames*, Standards Australia, 1992
- AS 3996: 2006 *Metal Access Covers, Road Grates and Frames*, 2006
- *Community Engagement: Policies, Principles, Standards and Guidelines*, Department of Transport and Main Roads, May 2010
- *Cost-Sharing Based on Responsibilities within State-Controlled Roads*, Department of Transport and Main Roads and LGAQ
- *Cycling Aspects of Austroads Guides*, Austroads Publication AP-G88/11, 2011

- *Guide to Road Design* Part 4A *Unsignalized and Signalised Intersections*, Austroads
- *Guide to Road Design* Part 6A *Pedestrian and Cyclist Paths*, Austroads
- *Guide Specification for Safety Edge*, December 2010, FHWA
- *Principal Cycle Network Plan for Far North Queensland*, Department of Transport and Main Roads, 2009
- *Road Planning and Design Manual* (2nd edition), Department of Transport and Main Roads
- *South East Queensland Principal Cycle Network Plan*, Department of Transport and Main Roads, 2007
- *Supplement to Austroads Guide to Traffic Management, Traffic and Road Use Management (TRUM) manual Volume 1 Part 10 Traffic Control and Communication Devices*, Department of Transport and Main Roads
- Technical Specification MRTS02 *Provision for Traffic*, Department of Transport and Main Roads, October 2010

1.2 Background

Including bicycle lanes in programmed road pavement rehabilitation and resurfacing projects has been identified as a possible low-cost method to achieve commitments under the Transport and Main Roads *Cycling Infrastructure Policy*.

A safe environment for on-road cyclists can be provided by providing a smooth surface, adequate width and sight lines, minimal pinch points, connectivity and clear information. These aspects are achieved most effectively if they are considered early in rehabilitation or resurfacing program development.

Integrating road surface allocation and delineation review with the road pavement rehabilitation and resurfacing programs could allow for implementation of bicycle lanes at a significantly lower cost than by altering road delineation through separate projects.

Early consideration of facilities for people who ride bicycles ensures that, if suitable locations are identified, project scope and funding can be arranged to streamline delivery within a single project.

For information regarding cost sharing arrangements related to cycle lane establishment and maintenance, refer to:

> https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Cost-sharing-based-on-responsibilities-within-state-controlled-roads.aspx

1.3 Scope

This Guideline details the processes and considerations to include facilities for people who ride bicycles in the development of road pavement rehabilitation and resurfacing projects on state-controlled roads, within urban areas, specifically:

- programmed maintenance – typically resurfacing, and
- rehabilitation works.

This Guideline does not cover:

- emergency reconstruction works
- maintenance work types without the potential to implement cycling facilities (for example, purely electrical work or roadside amenity maintenance)
- funding program requirements, limitations and expectations

1.4 Benefits

The benefits of the procedure documented in this Guideline include:

- increased separation of cyclists from motor vehicles throughout the network
- modifying road layout changes at the most cost-effective time
- applying a consistent process across Transport and Main Roads Districts
- timing design modifications to reduce effects on delivery
- early identification of funding requirements to access appropriate program funding streams
- demonstrating due diligence and continuous improvement processes in road space allocation and management aiding legal defensibility.

2 Implementation practicalities and limitations

Separated facilities that cater for all ages and cycling abilities are likely to result in the greatest uptake of cycling; however, sealed shoulders and bicycle lanes can improve safety and comfort, particularly for existing riders. This may assist to grow cycling mode share and enhance the case for physical separation in the future.

The *Handbook of Road Safety* 2nd edition (Elvik et al 2009) found that, on roads with cycle lanes, there are fewer crashes (best estimate -9%) than on roads without cycle lanes. Intersection design and operations are critical for cyclist safety.

Situations often arise in retrofitting projects where trade-offs are required. A Registered Professional Engineer of Queensland (RPEQ) should consider providing some improvement to the operational and safety performance of the road layout as opposed to maintaining the pre-existing layout. There will be situations where Normal Design Domain (NDD) provisions are not possible due to physical road constraints or cost. A solution that does not comply with normal design values may not necessarily be deficient and may result in a safer situation than reinstating the previous deficient delineation. Figures 2.1 and 2.2 demonstrate the implementation of a non-standard solution that have been evaluated as a safety improvement.

Transport and Main Roads *Guidelines for road design on brownfield sites* should be considered where NDD values cannot be met or where proposed treatments are non-standard or unusual. In these situations, the performance of the implemented treatments is to be monitored for evaluation.

Figure 2.1 – Prior to the resurfacing project

Figure 2.2 – After resurfacing project, with shared left turn

3 Planning

3.1 Principal Cycle Network Plans

For all road pavement rehabilitation and resurfacing projects, it is essential to determine the status of the section in relation to the relevant Principal Cycle Network Plan (PCNP). The PCNPs can be accessed on the departmental website via:

https://www.tmr.qld.gov.au/Travel-and-transport/Cycling/Principal-Cycle-Network-Plans

Road links which are not identified as principal cycle networks require 'implicit provisions' for cyclists, please refer to the Transport and Main Roads *Cycling Infrastructure Policy* for further detail.

3.2 Bicycle use of the road

The Transport and Main Roads *Cycling Infrastructure Policy* states: '(The department) will progressively plan, design, construct, maintain and operate the state-controlled transport network on

the basis that cyclists will use the network.' In accordance with the *Policy,* all work on roads must be done on the basis that cyclists will use the roads.

A standard classified traffic survey will provide the most comprehensive information available on bicycle usage of a given road. Evidence of bicycle use on the road network is also mapped by cyclists using smartphone apps such as Strava™. These crowd-sourced data can be viewed online using the Strava™ heatmap; only about 5–10% of all cyclists log their rides using Strava™ but such information may assist to identify locations where traditional traffic counts would be most cost-effective or to demonstrate that cyclists are using a route.

3.3 Cyclist requirements and implications for road pavement rehabilitation and resurfacing

Due to the majority of bicycles having no suspension and narrow tyres; surface roughness, surface irregularities, cracking, edge drops, or potholes make it difficult for a cyclist to maintain control. These defects can cause a cyclist to fall or swerve into the path of motor vehicle traffic.

Surface tolerances for cyclists are specified in Austroads *Guide to Road Design* (GTRD) Part 6A Section 5.10. Pedestrian surface tolerances should be considered if kerbside parking is present.

Where these defects occur within a bicycle lane or shoulder, cyclists must determine the safest option: either cycling amongst motor traffic or on a poor road surface. Both options can present serious safety hazards, particularly on roads with higher traffic speeds and volumes.

Maintained shoulders improve safety and reduce delay. A safe environment for on-road cyclists can be provided by addressing the following six basic requirements:

- a smooth, sealed surface
- adequate width to ride
- adequate sight lines (for example, to hazards, vehicles, pedestrians)
- no pinch points (narrowing of their space to ride)
- good connectivity, and
- clear information.

These requirements are most effectively addressed by ensuring consideration early in any road pavement rehabilitation resurfacing program development.

During the construction phase, the needs of cyclists should be considered in traffic management, irrespective of whether a cycling facility is incorporated into the works. Depending on the works, post-construction monitoring may also be required; for example, recently completed utility trench construction may need to be monitored and controlled to ensure subsidence does not result in the formation steps hazardous to cyclists.

3.4 Procedure and overview of timing

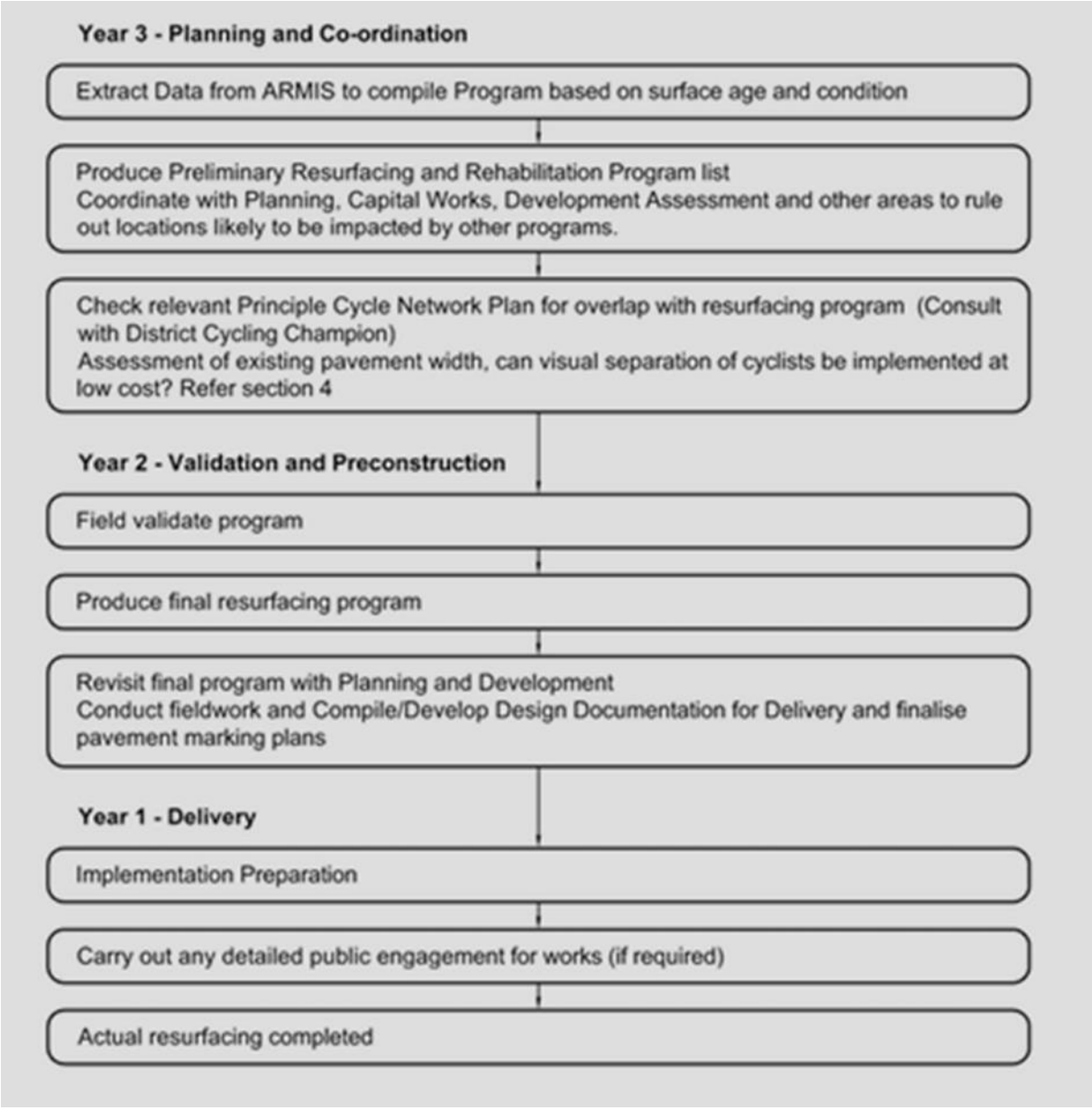
The six basic requirements for on-road cyclist safety are most effectively addressed by considering cycling needs very early in any pavement rehabilitation or resurfacing program development. Early consideration could reduce any unnecessary delay in program delivery.

Figure 3.4 shows the recommended process for consideration and implementation of bicycle lanes through road pavement rehabilitation and resurfacing projects to achieve a safer cycling outcome.

This process aims to assist delivery of bicycle lanes where widening is not necessary, and to identify sections where additional funding sources may need to be called upon.

If project requirements exceed the funding scope of a pavement rehabilitation and road resurfacing program, then additional programs may need to be called upon to enable a single project funded by mixed sources. When applying for funding from other programs, the funding split relevant to each program must be clearly defined.

Figure 3.4 – Procedure and overview of timing



4 Preliminary planning and design considerations

4.1 The process

The following process should be applied to determine if cycling provisions are suitable for implementation with pavement rehabilitation and road resurfacing projects:

- determine if there is sufficient carriageway width to incorporate cycling provisions (for example, bicycle lanes, sealed shoulders and so on)
- review the available traffic and crash records, including those relating to cyclists
- determine if the pavement rehabilitation or resurfacing project can cater for safe exit and entry points, for the inclusion of cycling facilities (refer *Manual of Uniform Traffic Control Devices* (MUTCD) Part 9 and TC1962)
- survey the site, measure existing widths and identify critical points (this could also include other data sources such as aerial photography, 'As Constructed' information or maintenance plans)
- produce a sketch plan based on this guideline with critical dimensions
- consider whether consultation is required and undertake (refer to Section 3.4 for further discussion of this issue) and
- finalise layout drawings, certification and approvals required to implement bicycle lanes in conjunction with the pavement rehabilitation or resurfacing project.

4.2 Options to consider

Typical options to consider include:

- remarking traffic and parking lanes by reducing lane widths and installing a bicycle lane (additional markings are not always required)
- paving and sealing shoulders to create a functional bicycle lane
- rationalising car parking (this may require parking restrictions on one side / both sides of the road)
- reducing painted median width to allow more sealed width for bicycle lanes
- removing a vehicle lane
- providing marked stand-up lanes at intersections
- setting back or removing raised islands for continuity of sealed shoulders through intersections, and
- providing indented parking bays (where there is high demand) and using existing parking space for a bicycle lane.

Note: Effects on underground and overhead services must be considered and may significantly escalate costs.

Section 5 describes how these options may apply in the context of a pavement rehabilitation or road resurfacing project. Options should be compared with the pre-existing layout as a base case.

4.3 Consultation

If the addition of a sealed shoulder or bicycle lane will have an effect that requires consultation, this should be carried out at a suitable time to eliminate delay to project delivery.

4.4 Implementation and staging

Where incorporating cycling facilities into pavement rehabilitation or road resurfacing projects does not create a logical and safe start and end, the following should be considered:

- designing a longer section of cycle network and bringing forward adjacent resurfacing projects to create a logical, continuous and safe bicycle facility
- relocating lane and edge lines without installing bicycle symbols and signs
- installing other appropriate warning treatments
- the risks associated with doing nothing.

5 Surface considerations

This section outlines some design options and modifications that should be considered when retrofitting provisions for bicycles. This list is not exhaustive, and the designer should follow the relevant design guidelines, standards and procedures for bicycle facility design.

All design options and modifications mentioned in Table 5 are supplementary to relevant guidance in the Austroads *Guide to Road Design* Part 3. Other potentially useful reference documents are noted for use as required.

Treatments referenced in Table 5 following are in accordance with Austroads *Guide to Traffic Management* Part 5 Section 4.4 which should be referred to for further and specific technical guidance.

Table 5: Methods of creating additional bicycle operating space during pavement rehabilitation or road resurfacing works

Surface issue	Considerations / notes
Transverse Stepping	Transverse steps exceeding 20 mm are a crash risk for cyclists; temporary ramping may be required during construction. Final construction should join smoothly to other surfaces and projections such as kerb ramps driveways, access chamber lids and drainage structures.
Intersections	In accordance with the Queensland Road Rules, bicycle lanes should extend across unsignalized intersections through the provision of continuity lines.

Surface issue	Considerations / notes
Colouring of bicycle lanes	Austroads' *Guide to Traffic Management* Part 10 *Traffic Control and Communication Devices* and the Department of Transport and Main Roads Supplement to the *Guide*, the *Traffic and Road Use Management* (TRUM) manual Volume 1 Part 10, provides guidance and the warrants used for justifying colouring of lanes. Coloured pavement treatment should only be considered for use on bicycle lanes where a potential conflict between cyclists and vehicles may exist. Installation should be reserved for the areas of highest need because the cost of installation and ongoing maintenance is high. Construction of coloured pavement treatment should be carried out in accordance with Transport and Main Roads Technical Standards and associated Specifications. For further advice or to obtain a copy of Supplementary Specification MRTS10B, please contact the Principal Engineer (Asphalt and Surfacings) of the department's Pavements, Research and Innovation Unit on telephone (07) 3066 7726.
Delineation	Raised Reflective Pavement Markers (RRPMs) may be used to assist in the delineation of bicycle lanes and to deter motorists from cutting into a bicycle lane on bends or other locations. RRPMs should not be installed in the cycle lane. The preferred RRPM location at a bicycle lane is to the right of the line, refer MUTCD Part 2 Section 5.6.5.2(d).
Removal of redundant pavement marking and RRPMs	Removal of redundant pavement markings and RRPMs should also be considered to reduce confusion and discomfort to both motorists and cyclists. The pavement should be left smooth and with a surface texture similar to the existing pavement following the removal. All RRPMs should be removed from within the bicycle lane or marked shoulders to avoid being a hazard to cyclists.
Eliminate road service hazards (refer Figure 5(A)) Gaps in surface Weaving inducing, unpredictable	Ensure utility covers are flush with surrounding pavement. Mill existing surface to enable a neat join with the new surface. New drainage gullies are constructed as per TMR Standard Drawing SD1311. Grates and frames installed to ensure gaps in the surface do not exceed tolerances. Grates on any road permitting cyclist access are compliant with Appendix D of AS 3996:2006 *Metal Access Covers, Road Grates and Frames.*
Drainage (consideration of kerb flow width, minimising cyclist exposure during inclement weather)	Remove surface undulations that potentially can hold water. Remove low shoulders against channel lips that potentially can hold water. Provide additional catchpits in areas where excessive water runoff may occur. Ensure sustainable drainage principles.

Surface issue	Considerations / notes
Surface and edge condition	Surface imperfections such as potholes, pavement patches and cracks, depressed utility covers, drainage pits and grates, timber bridge decks and excessive debris can make cycling unsafe and uncomfortable. Cyclists have indicated that surface quality is twice as important to their choice of route as traffic volumes and the availability of cycle facilities. Ensure edge of asphalt overlay and resurfacing is not within marked shoulders or bicycle lanes (refer Figure 5(B)). The edge of the surfacing course should not be steeper than 1 in 3 (refer Figure 5(C)). Milling of the pavement at the kerb interface may be required to ensure a smooth transition between surfaces. If surface tolerances are not achieved the width of the bicycle lane must not include the channel (refer Figure 5(D)). Refer Austroads *Guide to Road Design* Part 6A Section 5.10 *Surface*.
Chip Seal	High stress areas (turning heavy vehicles) may require an asphaltic surfacing. A maximum 10 mm chip size is preferred on bicycle lanes or shoulders. Where an existing seal uses larger stones in the bicycle lane or shoulder, consider an emulsion slurry during the next resurfacing. Refer Austroads *Guide to Road Design* Part 3 Section 4.8.9 *Sealed Shoulders*. A maximum of 7 mm should be achieved where spray seals are used. Refer Austroads *Guide to Road Design* Part 6A Section C.3.2

Figure 5(A)– Road surface hazards

Resurfacing with junction pit depressed

Gap between grate and road pavement

Figure 5(B) – Poorly implemented resurfacing transition within shoulder and failures in previous kerb key in

Figure 5(C) – Wearing course extent and proximity to traffic lanes

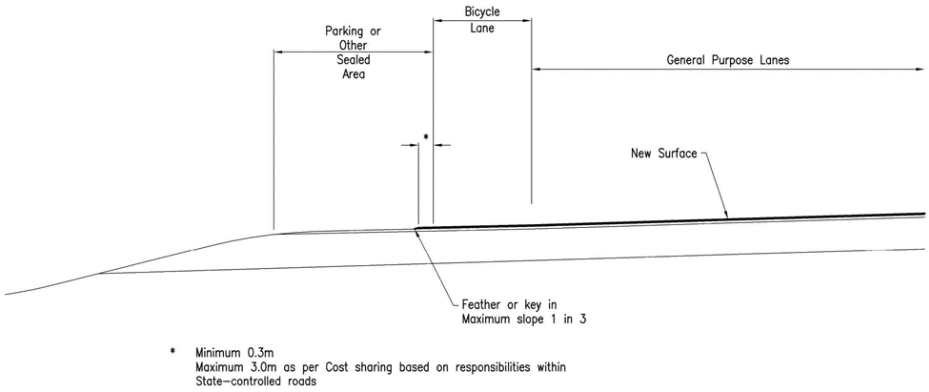
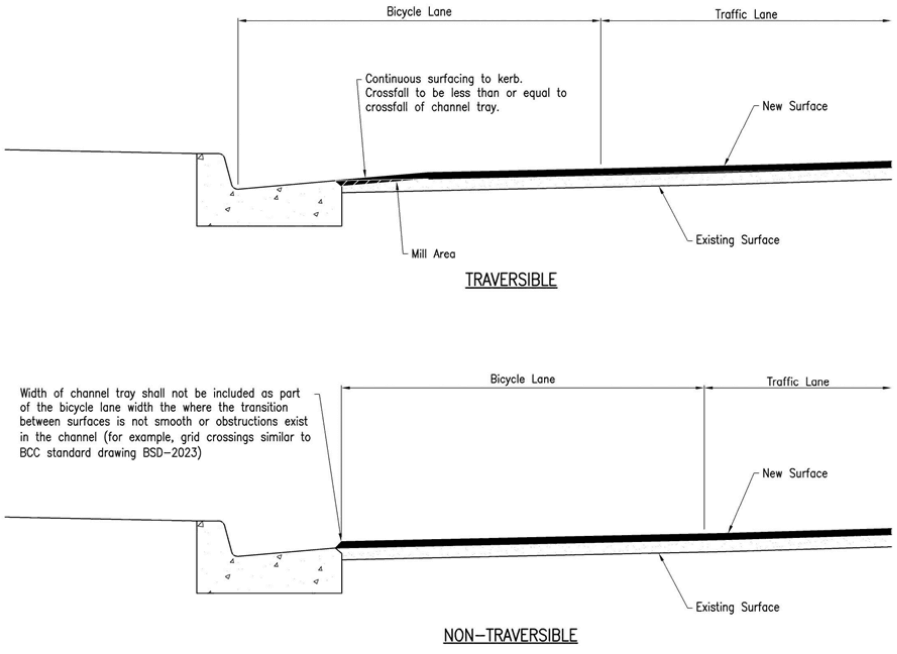


Figure 5(D) – Overlay mill diagram



6 Layout considerations

This section outlines options and modifications that should be considered in the planning and design phase of a project. This list is not exhaustive, and the designer should follow the relevant design guidelines, standards and procedures for bicycle facility design.

6.1 Bicycle lane

This section is supplementary to content specified in Austroads *Guide to Road Design* Part 3 Section 4.8.7.

Bicycle lanes are preferred over marked shoulders and wide kerbside lanes as bicycle lanes are considered explicit provision under the Transport and Main Roads *Cycling Infrastructure Policy*.

Bicycle lanes should be set out from the edge of the adjacent general-purpose lane, not from the kerb (refer Figure 6.1). This presents drivers with a consistent, visible and predictable cyclist path of travel.

A yellow line may also be necessary to control parking and ensure the bicycle lane remains safe and effective.

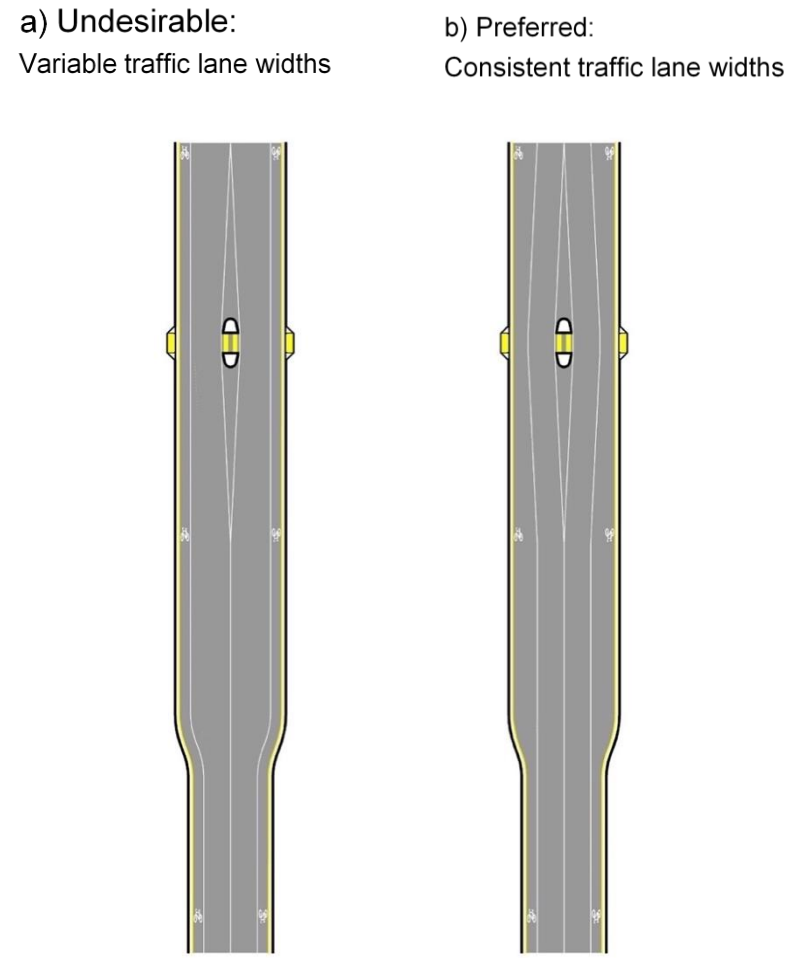
Width of traffic lanes should be reduced before the width of the bicycle lane is reduced.

The feasibility of rationalising on-street parking or the required number of traffic lanes should be considered before reducing lanes to minimum widths.

A minimum 1.0 m-wide bicycle lane should be used only in special circumstances with due consideration given to:

- low potential for motor vehicle encroachment, due to road geometry
- no on-street parking
- no hazards such as steel grates within the bicycle lane
- posted speed 60 km/h or less
- traffic volumes
- heavy vehicle volumes
- short length of constrained width
- unjustifiable cost to provide a desirable width facility, and
- proximity of pedestrians adjacent to the facility.

Figure 6.1 – Example set out from lane alignment, not kerb alignment



6.2 Wide kerbside lane

This section is supplementary to content specified in Austroads *Guide to Road Design* Part 3 Section 4.8.11.

Wide kerbside lane may be appropriate on downhill side of the road where the posted speed is 60 km/h or less, as the speed differential between bicycle and motor vehicles may not be significant. A risk assessment should be undertaken during design development to ensure this option is appropriate for the road environment being considered.

6.3 Rationalise on-street parking

This section is supplementary to content specified in Austroads *Guide to Traffic Management* Part 11 Section 8.1.

On-street parking is typically a significant constraint in the provision of cycling facilities. On-street parking should only be permitted where it is safe to do so. An assessment method is outlined in Transport and Main Roads' Technical Note TN139 *Use of On-street Space (kerbside road space) for Safer Cycling*. Where on-street parking on principal cycle network is assessed as high risk, on-street parking should be reconfigured or restricted until parking can be safely accommodated. Projects considering parking rationalisation should consider use and supply within the entire walkable catchment of the project site. Loss of parking on an arterial road may represent a small fraction of the

total supply. Effects on adjacent land uses can be mitigated by ensuring footpath and crossing infrastructure is appropriate in the walkable catchment to enhance parking use of side streets.

6.3.1 Parking kerbside (cyclists car side)

This section is supplementary to content specified in Austroads *Guide to Traffic Management* Part 11.

As per Austroads *Guide to Traffic Management* Part 11, indenting parking can assist to create space for bicycle lanes; however, this can be an expensive method of providing for parking. Rationalisation of parking may be necessary to ensure project costs remain justifiable. Side street and off-road parking should be frequently at capacity before indented parking is provided within the walkable catchment. Further details are available in the Transport and Main Roads Technical Note TN138 *Verge Parking and Indented Parking*.

Supplementary to guidance contained in the Austroads *Guide to Road Design* Part 3, relevant to parallel parking:

- the safety strip shown should be delineated
- a wider safety strip is preferred and may be achieved by reducing the parallel parking space width to 2.1 m
- re-marking of parking bays to position the bicycle lane either kerbside or car side may be appropriate.

In terms of angle parking, the following is supplementary to guidance contained in Austroads *Guide to Road Design* Part 3:

- The 'safety strip' should be delineated. As cyclists require a high level of protection when adjacent to angle parking, the widest possible safety strip is preferred. If angle parking must be retained, conversion to rear-in may improve visibility and safety for on-road cyclists.

6.4 Kerbside bicycle lane combined with clearway

This section is supplementary to content specified in Austroads *Guide to Traffic Management* Part 11.

Locating parking to the right of a kerbside bicycle lane is a desirable and efficient method to physically protect cyclists from moving traffic (a typical arrangement is shown in Austroads *Guide to Road Design* Part 3 and) enables:

- clearway operations promising motor vehicle capacity when needed
- retention of parking (off-peak or in off-peak direction), and
- a facility for cyclists.

6.5 Roundabouts

Refer Transport and Main Roads Technical Note TN136 *Providing for Cyclists on Roundabouts.*

6.6 Signalised intersections

This section is supplementary to content specified in Austroads *Guide to Road Design* Part 4.

Bicycle lanes should not be marked within signalised intersections; however, the approach width of through lanes and bicycle lane should carry through the intersection. In retrofit situations, this may require traffic island modification to eliminate pinch points from the intersection. BICYCLE LANE ENDS signage is not necessary at signalised intersections.

Expanded storage areas are preferred where the bicycle lane is located on the left of a left-turning general purpose lane as they assist heavy vehicle driver visibility of cyclists at intersections. Expanded storage areas are also appropriate where a bicycle lane is not provided on the departure side of the intersection.

When retrofitting bicycle lanes to an existing signalised intersection, the location of detector loops may need to change. Additional detection areas may be required for the bicycle lane, hook turn box or bicycle storage area. Video or thermal camera detection technology may be an alternative to using loops to call signal phases.

TC1769 treatment may be used when a bicycle lane cannot be provided at a pre-existing left-turn auxiliary lane with widening constraints. An evaluation of this treatment (Troutbeck 2014) concluded that the TC1769 treatment results in more drivers undertaking the desirable behaviour of slowing to the speed of the cyclist when compared with the standard bicycle lane treatment. The report also recommended that constraining the auxiliary lane weave area may further improve desirable behaviours: this should be considered for trial application.

Exclusive (trap) left-turn lanes are problematic for cyclists who want to proceed through the intersection. Auxiliary left-turn lanes are preferred. It may be possible to reconfigure some pre-existing exclusive left-turn lanes to an auxiliary lane layout (refer Figure 6.6(A)) If an auxiliary lane layout is not possible for some reason then a weave right layout is a treatment of last resort (refer Figure 6.6(B)). Additional retrofit options are shown in Figures 6.6(A), 6.6(B), 6.6(C) and 6.6(D).

Figure 6.6(A) – Preferred treatment (convert to auxiliary left-turn lane)

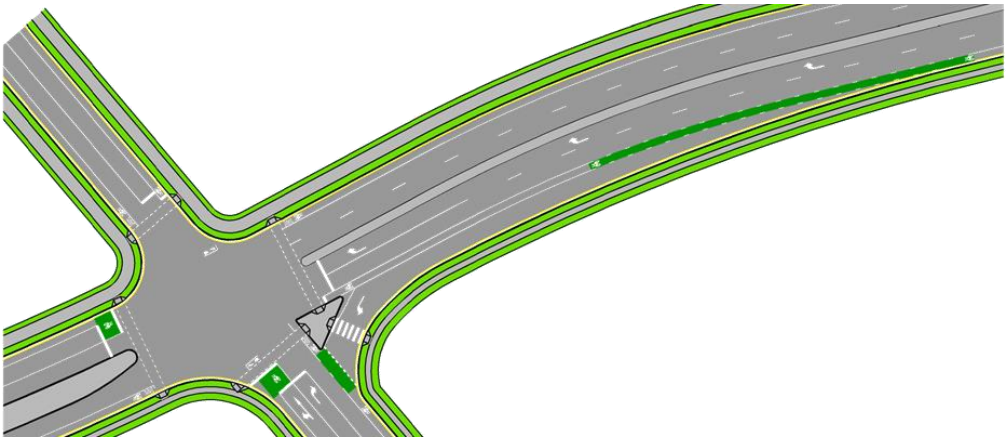


Figure 6.6(B) – Minimum treatment exclusive left-turn lane (car side bicycle lane)

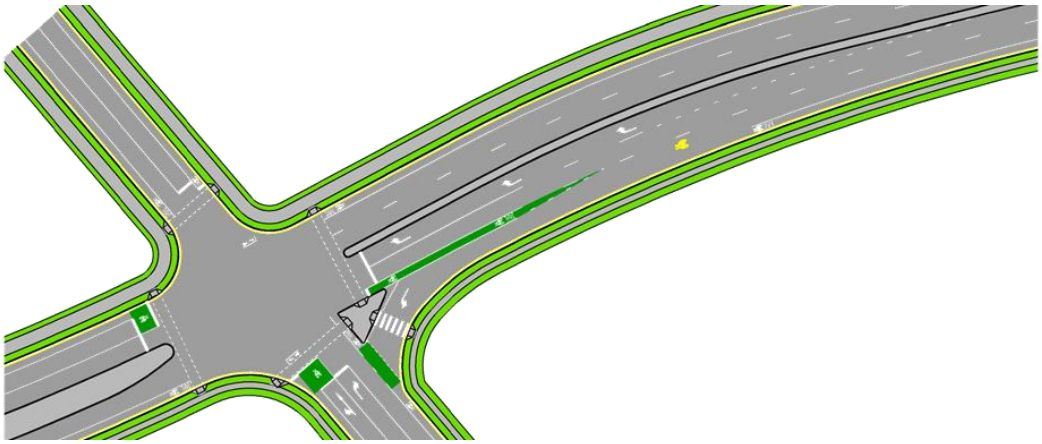


Figure 6.6(C) – Alternative treatment (for low-volume and low-speed environment)

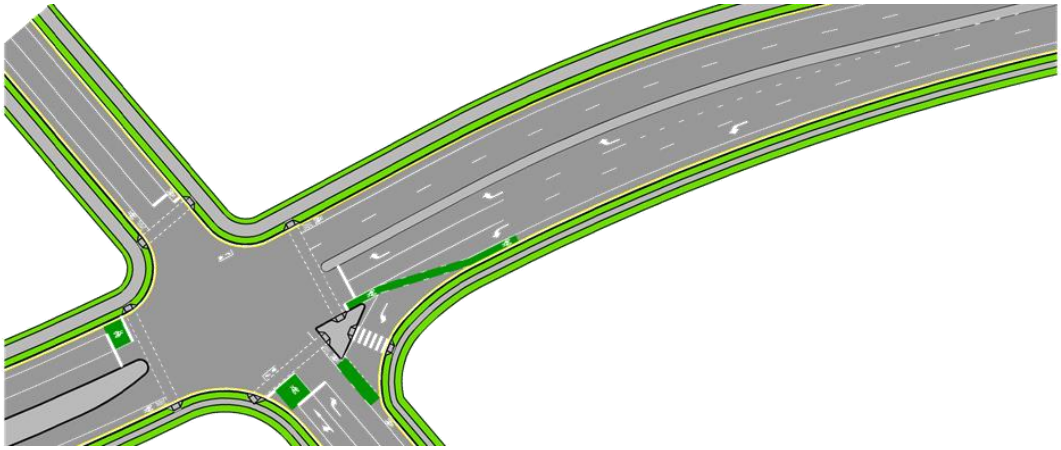
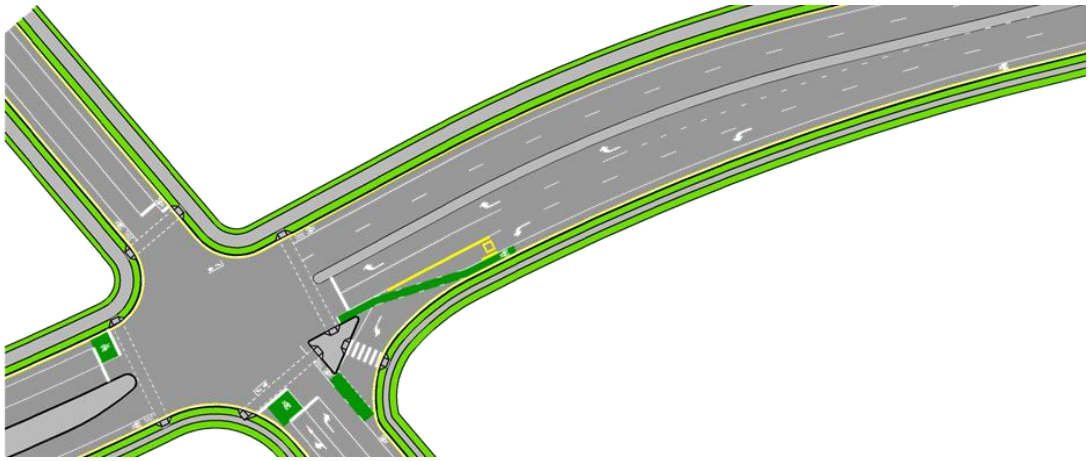


Figure 6.6(D) – Alternative treatment (incorporating splitter kerbs and speed cushion on approach)



7 Further information

For further information on this Guideline, please contact:

Vulnerable Road Users, Traffic Engineering Practice
Road Operations, Engineering & Technology
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