Guideline

Bicycles and heavy vehicles

February 2019

Queensland Government

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1 Purpose and scope of this Technical Guideline

This Technical Guideline has been developed to raise awareness of the types of problems that could be encountered due to interaction between bicycle riders and heavy vehicles (HVs). It also presents a range of options on actions that will achieve optimal outcomes in line with existing Technical Standards incorporating network planning, infrastructure design, development control and traffic management, technology and education to assist road authorities to identify and counteract these risks. This Technical Guideline contains conceptual information, explanations, interpretations, factors to be considered, suggestions and advice about good practice in relation to bicycles and HVs.

2 Related documents

This Technical Guideline should be read in conjunction with:

- Australian Bicycle Council, *Traffic Signal Features for Bicycles (2017)* report.
- Austroads *Guide to Road Design* Part 3 *Geometric Design*
- Austroads *Guide to Road Design* Part 4 *Intersections and Crossings – General*
- Austroads *Guide to Road Design* Part 4B *Roundabouts*
- Austroads *Guide to Road Design* Part 6A *Paths for Walking and Cycling*
- Austroads *Guide to Road Safety* Part 1 *Road Safety Overview*
- Austroads *Guide to Traffic Management* Part 4 *Network Management*
- Department of Transport and Main Roads, Queensland *Manual of Uniform Traffic Control Devices*
- Department of Transport and Main Roads, Technical Guideline *Raised priority crossings for pedestrian and cycle paths*
- Department of Transport and Main Roads Technical Note TN128 *Selection and Design of Cycle Tracks*
- Department of Transport and Main Roads Technical Note TN136 *Providing for Cyclists at Roundabouts*
- Department of Transport and Main Roads Technical Note TN139 *Use of On-street Space (kerbside road space) for Safer Cycling*
- Department of Transport and Main Roads Supplement to Austroads' *Guide to Traffic Management*, the *Traffic and Road Use Management* (TRUM) manual Volume 1 Part 10, *Traffic Control and Communication Devices*.
- Land Transport New Zealand, *Balancing the needs of cyclists and motorists (Study 2)*, Research Report No. 273 2005.
- Standards Australia AS1742: *Manual of Uniform Traffic Control Devices*
- UK Department for Transport *Aerodynamics for Efficient Road Freight Operations*, Department for Transport, 2010

3 Definitions

The following definitions will assist with the understanding of this Technical Guideline.

Articulated truck	A combination vehicle consisting of a prime mover or a rigid truck towing one trailer. This excludes rigid trucks towing a ‘dog’-type trailer.
Heavy Vehicle (HV)	Heavy vehicles are over 4.5 tonnes gross vehicle mass and include rigid truck, articulated truck, bus and road train / B-double / triple vehicle (unit) types.
Rigid truck	A rigid vehicle has two axle sets, a driver’s position, a steering system, motive power and a single rigid chassis. Includes rigid trucks towing a ‘dog’-type trailer.
Multi-combination vehicle	A vehicle towing more than one trailer.

4 Background

Interaction between bicycle riders and HVs typically has serious consequences. This is evidenced by the number of coronial inquests into the deaths of bicycle riders in recent years resulting from crashes with HVs. This Technical Guideline considers the recommendations from these coronial inquiries and provides options based on the latest research and best practice for improving safety for bicycle riders when sharing road space with HVs.

This section provides an overview of Queensland-wide crash data and a brief outline of the role that aerodynamic forces can play in crashes involving HVs and people riding bicycles. Section 5 summarises the countermeasures available to road authorities to assist in reducing the incidence and associated severity of these interactions.

4.1 Crash data

In the five-year period 2013–2017, there were 167 crashes involving bicycle riders and HVs, with 11 (6.6%) of these resulting in a bicycle rider fatality. This compares to 2637 crashes involving bicycle riders and cars which resulted in eight (0.3%) bicycle rider fatalities during the same period.

Table 4.1 and Figure 4.1 demonstrate:

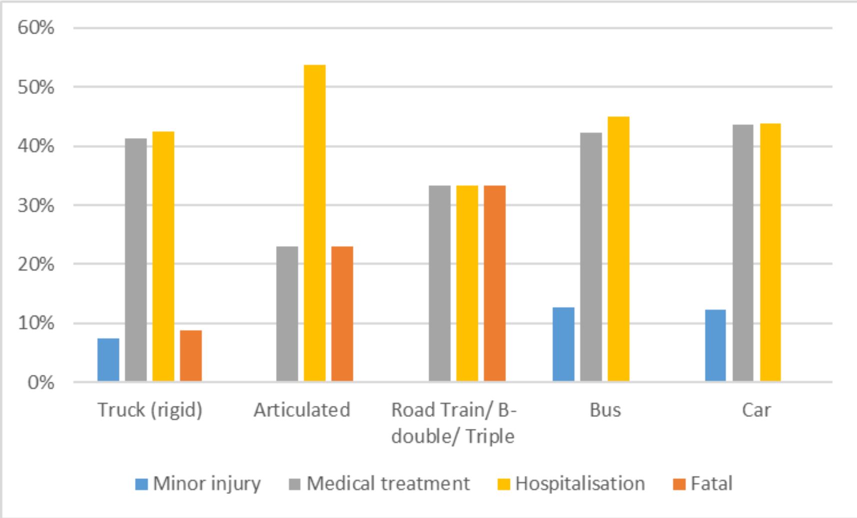
- the total number of crashes by different types of HVs (with cars included as a comparison)
- the proportion of serious (fatal and hospitalisation) crashes by vehicle type.

Table 4.1 – Heavy vehicle and car crashes involving bicycle riders 2013–2017

Unit type	Total number 2013–2017	Percentage serious crashes (fatal and hospitalisation)
Car	2637	44%
Bus	71	45%
Truck (rigid)	80	51%
Articulated	13	77%
Road train / B-double / triple	3	67%
Total	**2804**	

(Source: WebCrash https://www.webcrash.transport.qld.gov.au/webcrash2)

Figure 4.1 – Heavy vehicle and car crashes involving bicycle riders by severity 2013–2017



(Source: WebCrash https://www.webcrash.transport.qld.gov.au/webcrash2)

It can be seen from this that bicycle crashes are more likely to result in a serious outcome where HVs are involved, particularly rigid and articulated trucks.

4.2 Aerodynamic forces

It is important to understand the role of aerodynamic forces in minimising the potential for sideswipe crashes, which can occur without an initial collision between a HV and bicycle. Incidents can occur due to rapid lateral force reversal of the aerodynamic bow wave push and wake pull as the HV passes the bicycle rider. This effect is proportional to the HV's size, speed and distance from the rider. HVs with poor aerodynamic properties (that is, lacking side-skirts, lacking fairings or with large drawbar gaps between units) have larger areas of turbulence and pose a greater risk of destabilising cyclists. The aerodynamic effects of HVs are therefore critical in selecting design dimensions for cycling facilities. Aerodynamic forces become relevant where traffic speeds exceed 60 km/hr. The issue of side wind force exerted on cyclists from HVs is discussed in Austroads *Guide to Road Design* Part 3 which lists the clearances that should be provided between a cyclist envelope and a truck in the adjacent lane to enhance cyclist safety. These clearances should also be considered in the context of Austroads *Guide to Traffic Management* Part 4 which provides guidance on the separation of cyclists and motor vehicles based on vehicle speed and volumes.

Crosswinds can notably increase aerodynamic effects in both directions or where the roadway is enclosed (for example, tunnels, under bridges). This may create a 'wind tunnel' effect. Additional separation should be considered where increased effects are considered likely to occur.

Further guidance on the issue of side wind force exerted on bicycle riders from HVs is provided in Austroads *Guide to Road Design* Part 3 *Geometric Design* and includes the clearances that should be provided between the envelope for a person on a bicycle and a truck in the adjacent lane to enhance bicycle rider safety.

4.3 Safe System approach

The Safe System approach seeks safer travel by influencing all aspects of the road transport system. It recognises there will always be human error and, when an incident does occur, it aims to limit physical forces within human tolerance. The interaction between HVs and vulnerable road users can be improved by applying this approach (refer Austroads *Guide to Road Safety* Part 1 for more detail).

5 Countermeasures

A range of potential approaches are addressed in this Technical Guideline which could be used to reduce the incidence (likelihood) and severity of bicycle rider and HV crashes. These include:

- network planning
- infrastructure design
- technology
- development control and traffic management, and
- driver and rider education and training.

5.1 Network planning

In space-constrained urban areas, there will always be a need to best provide for bicycle riders using the same road space as HVs.

Where possible, designated cycle routes (as part of local government cycle network plans and Principal Cycle Network Plans (PCNPs)) should avoid corridors that HVs use frequently. Where this is not possible, exclusive space for people riding bicycles should be provided; for example:

- establishing or enhancing in-corridor pathways
- separated cycle tracks
- bicycle lanes.

Where exclusive space cannot be provided within the road corridor, alternative options should be considered, such as:

- offering signed routes for bicycle riders through areas where HVs are restricted or where road closures prevent through traffic
- reviewing HV routes and restrictions to determine whether some routes can be removed or turns prohibited following parallel corridor upgrades
- limiting on-street parking or reducing posted speed limits until exclusive space can be provided
- raising awareness for motorists and HV drivers of the likely presence of bicycle riders through signage for example, TC sign TC1878 SHARE THE ROAD (which illustrates the minimum passing distance for vehicles passing bicycle riders) or TC1633 CYCLIST TRAINING CIRCUIT (for use on approved rural cycling circuits).

5.2 Infrastructure design

Where bicycle riders and HVs share road space, and separated treatments cannot be provided, improvements can be made to increase bicycle rider safety (see Table 5.2(a)).

Table 5.2(b) outlines potential intersection treatment options to improve bicycle rider safety in the presence of HVs, resulting in a safer environment for all road users. Evaluation of suitability of treatment options should consider road function, traffic speed and proportion and type of heavy vehicles.

Table 5.2(a) – Mid-block treatment options to improve bicycle rider safety in the presence of heavy vehicles

Option	Description	More information
In-corridor pathways		
 *Source: Google Street View* The Pritchard Street overpass, Lytton, provides both on-road bicycle lanes and an off-road shared path on a route frequented by HVs accessing the Port of Brisbane	In-corridor pathways (that is, paths located within the road verge) should be considered where greater separation from moving vehicles is required. Path types include shared paths, separated paths and bicycle paths.	• Austroads *Guide to Road Design* Part 6A *Paths for Walking and Cycling* • Austroads *Guide to Traffic Management* Part 4 *Network Management*
Cycle tracks		
 Two-way cycle track, George Street, Brisbane	A cycle track is a physically separated bicycle-only facility in the urban road corridor that provides the combined benefits of a bicycle lane (priority at intersections) and a bicycle path (safety and comfort). The key features of cycle tracks are the priority crossing through unsignalised intersections and specialised controls at signals. These intersection features maintain the directness and level of service expected of a cycle track. Cycle tracks will help achieve a direct, safe and comfortable cycle network for the transport of people of all ages and abilities.	• Austroads *Guide to Road Design* Part 3 *Geometric Design* • Technical Note TN128 *Selection and design of cycle tracks*

Option	Description	More information
Bicycle lanes		
	Providing wide sealed shoulders with marked bicycle lanes in accordance with relevant standards and guidelines should be considered. Implementation has been shown to provide the following benefits to all road users: • safety is improved for all road users when space is clearly allocated to bicycles • general traffic flow is improved as slower bicycle riders do not delay the general traffic when space is clearly allocated for bicycle lanes • wide sealed shoulders allow emergency vehicles to bypass congested road conditions and quickly reach traffic incidents • stopping sight distance and visibility is generally increased at curves and for vehicles entering the roadway from a driveway or side street.	Austroads *Guide to Road Design* Part 3 *Geometric Design*
On-street parking rationalisation		
	On-street parking has been implicated in fatal and serious crashes involving bicycle riders. 'Dooring' of a bicycle rider typically leads to the rider landing prone in the adjacent traffic lane and at risk of being hit by a closely-following vehicle. Crashes involving a person lying prone on the road will almost certainly be fatal. HVs are a particular risk in this instance as their extra mass, width and reduced stopping capability limit their crash avoidance capability. Where on-street parking bays restrict visibility, space and access, they should be restricted if possible. This will improve safety and efficiency for all road users, not just people riding bicycles. Where funding allows, or there is a previous cycling crash history or a change to a recent parking permission, CCTV camera footage could be implemented to provide information on compliance with new parking restrictions.	Technical Note TN139 *Use of On-street Space (kerbside road space) for Safer Cycling*

Option	Description	More information
Clearway lanes		
 Showing peak flow direction with parking prohibited Showing situation with parking allowed (counter-peak flow direction and off-peak times) *Source: Austroads Guide to Road Design Part 3 Geometric Design*	Clearway lanes are a method to reduce interaction between HVs and bicycle riders. Clearways provide a movement function during peak hours and place function (on-street parking) during off-peak so they may assist to mitigate concerns arising from rationalisation of on-street parking. The preferred arrangement is a 24/7 kerbside bicycle lane adjacent to a clearway lane.	Austroads *Guide to Road Design* Part 3 *Geometric Design*
Sealed road shoulders		
	The width of a sealed shoulder suitable for cycling should reflect the surrounding speed environment. Desirable width should be applied in accordance with relevant standards and guidelines. Wider shoulders are necessary in environments with higher vehicular speeds, where greater aerodynamic forces may be expected and/or where there is a higher frequency of HVs. Where sealed shoulders are added to rural roads, pavement life can be increased by reducing edge breaks and other pavement defects caused by motor vehicles.	Austroads *Guide to Road Design* Part 3 *Geometric Design*

Option	Description	More information
Shoulders on left-hand horizontal curves		
	Where a road has a left-hand horizontal curve in the direction of travel, there is often a propensity for vehicles (in particular HVs) to 'cut the corner' and encroach onto the left-hand shoulder (that is, the area often used by bicycle riders). Correctly designed and applied curve widening should minimise the occurrence of this encroachment. Correct curve widening may be supplemented by additional measures to further reduce encroachment. Examples of such treatments include: • wider edge lines of 150–200 mm • closer spacing of raised reflective pavement markers on the edge line • providing a painted chevron adjacent to the edge line (although this may reduce the available surface friction on painted areas) • providing painted bicycle symbols on the shoulder • provide advance bicycle warning signage.	Austroads *Guide to Road Design* Part 3 *Geometric Design*
Curve widening		
	It is imperative that the adjacent traffic lanes have enough width to accommodate the swept path of the appropriate heavy design vehicle. This may be a rigid truck, a semi-trailer or a multi-combination vehicle. The relevant local authority should be consulted to determine the appropriate design vehicle (this decision should also consider any forecast changes in traffic composition). Curve widening of the traffic lanes allows larger vehicles to be fully accommodated in their traffic lane without encroaching into the shoulder.	Austroads *Guide to Road Design* Part 3 *Geometric Design*

Option	Description	More information
Kerb treatments		
	In urban environments, semi-mountable-style kerb and channelling offer safety advantages to bicycle riders. It provides them with an escape route if a HV travels too close for safety or comfort. Barrier kerb can limit opportunities to quickly and safely exit the road, transition ramps may overcome this problem.	Austroads *Guide to Road Design* Part 3 *Geometric Design*
Bicycle lane separation devices		
 Bicycle lane separation device on Captain Cook Highway, Cairns	Where bicycle lanes exist and there is a need to deter HVs from entering the bicycle lane, separation devices can be considered.	Transport and Main Roads Supplement to Austroads *Guide to Traffic Management,* the *Traffic and Road Use Management* (TRUM) manual Volume 1 Part 10, *Traffic Control and Communication Devices*

Table 5.2(b) – Intersection treatment options to improve bicycle rider safety in the presence of heavy vehicles

Option	Description	More information
Protected intersections		
	HV swept paths through left turns can encroach towards the kerb and may collide with a person riding a bicycle on-road. Providing a protected intersection improves visibility of riders and locates riders outside the trailer swept path.	Technical Note TN128 *Selection and design of cycle tracks*
This cycle track at Remora Road, Hamilton, provides protection for bicycle riders from buses and other vehicles at this signalised intersection.		
Intersection bypass		
	Where no alternative route is available due to space restrictions, providing an opportunity for bicycle riders to detour around the squeeze point at the intersection could be considered. The use of entry and exit ramps from the road carriageway to the off-road path can facilitate this option, in conjunction with the next option *Resurfacing and decluttering footpaths*.	Austroads *Guide to Road Design* Part 3 *Geometric Design*

Option	Description	More information
Resurfacing and decluttering footpaths		
	Where the alternative route through the intersection is via off-road paths and crossings, the following options are viable to improve overall safety and encourage use by people on bicycles: • resurfacing of paths to create a smoother surface • clearing of debris and overhanging trees and removal of unnecessary signage on the paths • clear indication of an alternative route via coloured surface treatment, guidance signage and kerb / transition ramps to improve access between the paths and road.	• Austroads *Guide to Road Design* Part 3 *Geometric Design* • Austroads *Guide to Road Design* Part 6A *Paths for Walking and Cycling*
Turn prohibitions		
	Restricting or banning turns for HVs in locations where safe turning movements cannot be provided is an option, particularly for left turns. This should be considered in conjunction with alternative route planning for the HV.	
Pedestrian crossings		
	Bicycle riders can legally ride across pedestrian crossings in Queensland; however, path user conflict can be reduced by widening paths, waiting areas and kerb ramps associated with the crossing. Further, in conjunction with any widening of existing entry points, the width of the entire pedestrian crossing may also need to be addressed.	• Austroads *Guide to Road Design* Part 3 *Geometric Design* • Austroads *Guide to Traffic Management* Part 6 *Intersections, Interchanges and Crossings*

Option	Description	More information
Mountable aprons at corners		
	People on bicycles or walking can be affected negatively by wide crossings, but they can also be at risk if the curb radius is too small (for example, design to prevent tracking of HV rear wheels over pedestrian queueing areas at signalised intersections). Mountable aprons on lower order roads can reduce turning speeds at corners for both passenger vehicles and HVs while still accommodating large design vehicle turn paths. Provision of raised priority crossings could also be considered in these situations.	• Technical Note TN 128 *Selection and design of cycle tracks* • Technical Guideline *Raised priority crossings for pedestrian and cycle paths*
Removing parking bays		
	A method to reduce the interaction between HVs and people on bicycles is to connect off-road cycling facilities directly to exclusive bicycle lanes. At key connections and points where bicycle riders must make a decision, parking bays which restrict visibility, space and access should be removed. Parking bays often force bicycle riders into the way of other traffic when cars are parked. Where funding allows, or there is a previous cycling crash history or a change to a recent parking permission, CCTV camera footage could be implemented to provide information on compliance with new parking restrictions.	• Austroads *Guide to Road Design* Part 3 *Geometric Design* • Technical Note TN139 *Use of On-street Space (kerbside road space) for Safer Cycling*

Option	Description	More information
Head start and expanded bicycle storage areas		
 Adelaide Street, Brisbane	Bicycle storage areas are delineated space for bicycles to wait on-road at the front of queue at a signalised intersection. This space is typically painted green for recognition and lawfully enables bicycles to lane filter and position themselves in the box ahead of other traffic. This configuration may increase the likelihood that a HV notices and maintains vision of a person on a bicycle using the box.	Austroads *Guide to Road Design* Part 4 *Intersections and Crossings – General*
Bicycle hook turns		
 *Source: Google Street View* Bicycle hook turn storage area line marked on the road within a multi-lane signalised intersection showing cyclists where to position themselves to do a 'hook turn'. Mccombe Street, Cairns	In Queensland, bicycle riders are permitted in some instances to make a right turn at intersections if they keep to the left of the road. The process a bicycle rider undertakes to carry out the hook turn is dependent on the specific traffic light control; therefore, there may be options to increase the safety of vulnerable road users and their interaction with HVs in these situations by applying further judgement and consideration to the intersection configuration.	• Austroads *Guide to Road Design* Part 4 *Intersections and Crossings* • *Manual of Uniform Traffic Control Devices* Part 9 *Bicycle Facilities*

Option	Description	More information
Roundabout approach and circulation speeds		
	Treatments such as aprons should be implemented at roundabouts to provide HV access through roundabouts and ensure motor vehicle speeds do not exceed the human tolerance to physical crash forces (30 km/h). Where pedestrians and people riding bicycles cross at-grade, approach speeds should be limited to 30 km/h to ensure vulnerable user safety crossing at the splitter islands.	Technical Note TN136 *Providing for Cyclists at Roundabouts* Austroads Guide to Road Design Part 4B *Roundabouts*

5.3 Technology

5.3.1 Traffic signal features for bicycles

Options to provide for and improve safety of people on bicycles at signalised intersections include:

- 'head-start' bicycle lanterns to make people on bikes more visible to vehicles, reduce the potential for conflict with vehicles and allow safer progress through busy intersections, and
- separate bicycle signal phases to eliminate conflict between turning vehicles and bicycle riders.

More information on features that can be incorporated into the design and operation of traffic signals to accommodate bicycles can be found in the Australian Bicycle Council report, *Traffic Signal Features for Bicycles* (2017).

5.3.2 In-vehicle technology

There are several vehicle safety features that can be used to reduce incidents or the severity of injury from an incident between HVs and other road users, particularly vulnerable road users. These include:

- side underrun protection to UN-ECE R73
- front underrun protection to ADR84/00
- rear underrun in accordance with the Australian Design Rules
- gap seals between cab and body / trailer (reduced turbulence for bike riders and improved fuel efficiency)
- blind spot minimisation or elimination through:
  - class V mirrors on bonneted vehicles and class V and VI mirrors on cab over vehicles
  - fitting of additional left-hand-side blindspot mirrors (such as a bug-eye mirror)
  - fitting of sensors or cameras with associated driver alerts
- audible alert of left-turn manoeuvre for other road users (in accordance with the Australian Design Rules)
- prominent signage warning other road users of blind spot areas of the HV and dangers of getting too close or manoeuvring past the inside of the vehicle
- park brake alarm
- truck stability control to ADR35/06
- trailers with ABS and roll stability control to ADR38/05
- autonomous emergency brakes (AEB).

5.4 Development control and traffic management

5.4.1 Development conditions

Development conditions included in tender stage regarding HV traffic generation could include some of the in-vehicle technology measures outlined in Section 5.3.2.

5.4.2 Procurement for construction projects

Conditions relating to the safety of bicycle riders and other vulnerable road users can be included in construction contracts for major infrastructure projects. The contract conditions should require:

- fitting of specialist safety equipment to HVs carrying out work on the major projects, and
- training of drivers of HVs working on the major projects in safety of bicycle riders and other vulnerable road users.

5.4.3 Speed management

The *Manual of Uniform Traffic Control Devices* outlines the process for establishing where reduced speed limits may be appropriate. Roads and streets that are within 'High Active Transport User Areas' have land uses and developments that generate or attract levels of pedestrians and bicycle riders that are considered higher than typical. Speed limits of 30 km/h or 40 km/h may be adopted in these areas to reduce the risk of serious injury in crashes involving bicycle riders / pedestrians and vehicles / HVs.

5.4.4 Heavy vehicle routes / restrictions

In areas where bicycle riders and other vulnerable road users are present in large numbers, and there is an identified risk from the presence of HVs, restricting HV times of operation or requiring HVs to use alternative routes should be considered.

5.5 Driver and rider education and training

Proactive and ongoing driver and rider education campaigns are an important complement to this network planning, infrastructure design, technology and development control and traffic management options. Education programs and proactive promotional activities aimed at bicycle riders and HV drivers using social media and other channels have previously included the following types of messages:

- information for all road users about sharing the road with HVs, including being aware of blindspots, wide turning circles and stopping distances
- information for all road users about sharing the road with bike riders, including observing the minimum passing distance rules, and
- that all road users (including HV drivers, motorists and bicycle riders) play their part in sharing the roads safely.

Transport and Main Roads will continue to promote and educate road users on the importance of sharing the road with all road users through social media and other channels. As well, hazard detection, proper use of mirrors and signals and environmental observation / scanning is part of the training drivers must complete to obtain their HV licence for multi-combination vehicles. There are also workplace, health and safety requirements for operators to address hazard detection and hazard management as part of workplace practices. Ongoing engagement with transport operators and through safety awareness campaigns is critical to ensure drivers understand the risks associated with driving HVs around bicycle riders and vulnerable road users.

5.6 Further information

For further information on this Technical Guideline, please contact:

Transport and Main Roads – Engineering & Technology Branch
Email: CyclePedTech@tmr.qld.gov.au.