Road Space Initiatives for Motorcycles

FINAL REPORT

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SKM

Contents

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Executive Summary

Background

Powered two-wheelers, such as motorcycles and scooters, are an increasingly popular mode of travel in Victoria. With greater representation of powered two-wheelers on Victoria's roads, VicRoads is reviewing motorcycle-related road space management initiatives. VicRoads' focus is on initiatives that could have the potential to improve mobility and safety for motorcyclists while not compromising the safety of other road users. This project has the endorsement of the Victorian Motorcycle Advisory Council and is funded by the Motorcycle Safety Levy.

The purpose of this report was to review:

- the range of motorcycle road space initiatives that could be considered in Victoria;
- the impacts of these initiatives on motorcyclists and other road users; and
- potential areas for further research and field trials.

Road Space Measures Considered in This Report

Three main categories of motorcycle road space measures were considered in this study:

- advanced positioning of motorcycles in traffic queues, primarily through the use of advanced stop lines;
- shared lanes where motorcycles share a special lane with other selected vehicles (for example, a bus lane); and
- exclusive lanes where motorcycles have exclusive use of an on-road or off-road facility.

The road space measures that were reviewed are summarised in the following table.

Table i: Motorcycle road space initiatives covered in this study

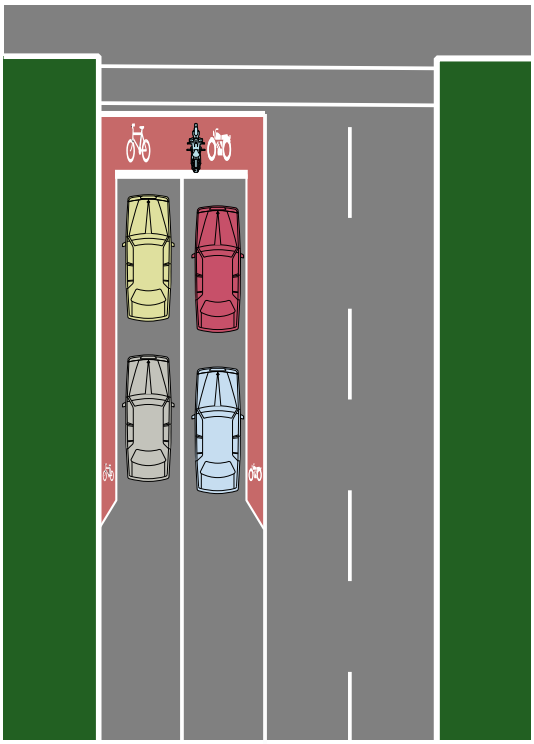
Category	Initiatives	Report Chapter
Advanced positioning	▪ Advanced stop lines	▪ Chapter 3, page 9
Shared lanes	▪ Bus lanes ▪ Emergency lanes ▪ Bicycle lanes ▪ Tram lanes	▪ Chapter 4, page 20 ▪ Chapter 5, page 27 ▪ Chapter 6, page 31 ▪ Chapter 7, page 37
Exclusive lanes	▪ Motorcycle-only lanes	▪ Chapter 8, page 40

Advanced Stop Lines (ASLs)

Advanced stop lines (or “bicycle boxes”) are used at some signalised intersections in Victoria to provide queuing space for cyclists. A similar measure has been proposed for motorcycles at signalised intersections to help position motorcycles at the head of traffic queues. This could potentially reduce motorcycle queuing time and provide greater separation from the rest of the traffic stream.

If implemented in Victoria, motorcycle ASLs would not be effective unless motorcycles could move safely into the reserved area at the head of the traffic queue. In the UK, this issue has started to be addressed through trials of feeder lanes at selected intersections (see Figure i). Feeder lanes, however, would be difficult to fit into available road space in many parts of the Victorian arterial road network.

- Figure i: ASL with feeder lanes



Evidence from UK trials of motorcycle ASLs shows that they can be shared quite effectively by cyclists and motorcyclists, and may help prevent the pedestrian crossing being blocked by encroaching vehicles.

Trials might be considered to assess the safety issues associated with motorcycle ASLs. Key issues for investigation could include:

- motorcycles being caught in the start-up flow of traffic when they cannot reach the ASL before the signal turns green;
- visibility issues with motorists not seeing motorcycles moving to the front of the queue;
- the potential for (illegal) crossing of the road centre line by motorcycles in order to bypass the traffic queue; and
- increased potential for motorcycle crashes with red-light running vehicles on the cross street.

Assessment: ASLs have the potential to reduce motorcycle queuing times and provide separation from other traffic. However, there are presently unresolved issues with facilitating motorcycle movement to the head of the traffic queue, and also untested safety issues. Trials and a review of relevant legislation might be considered to help resolve outstanding questions.

Bus Lanes

Motorcycles, scooters and other powered two-wheelers are permitted in most bus lanes in New South Wales. In some other states, such as Queensland and the ACT, they are permitted in bus lanes when indicated by special bus lane signage.

If motorcycles were permitted in Victorian bus lanes, operational issues may arise in situations where “B” traffic signals are used to provide priority to buses. Motorcycles might block the bus lane and prevent buses from proceeding when the B signal is shown.

New South Wales and Queensland have addressed this issue by defining some bus lanes as “bus-only lanes”. In these special lanes, no other vehicles are allowed. Typically, bus-only lanes would be used on the approach to B signals to enable buses to have unimpeded access to the intersection.

Evidence from simple traffic models suggests that buses would experience minimal delays when sharing lanes with motorcycles on low-frequency bus routes (e.g. less than 40 buses per hour). On high-frequency bus routes, the models suggest that delays to buses may become unacceptable with lane-sharing. However, under these conditions, there would presumably be significant interference to motorcycles, making the bus lane a less attractive option for motorcyclists.

Several trials have been carried out in the UK to assess the impact of permitting motorcyclists in bus lanes. The trials have not yet produced conclusive results on the safety impacts of lane-sharing. In any case, local trials would be recommended before considering widespread sharing of bus lanes by motorcycles in Victoria.

Assessment: There is persuasive evidence from Australia and overseas that more general sharing of bus lanes can be achieved without undue operational or safety problems. The main outstanding issue to be resolved is the protection of bus priority at B-signals. Trials may also be considered to gain a better understanding of local safety issues.

Emergency Stopping Lanes

Emergency stopping lanes on freeways are designed for emergency use and are not engineered for driving. Stopped vehicles, road debris, high vehicle speeds and abutting barriers all contribute to significant safety hazards if these lanes were to be used by motorcycles.

One exception is the westbound emergency lane on the Eastern Freeway, which operates as a bus and taxi lane during the morning peak. In this case, the lane has been engineered as a driving lane and, as far as motorcycle sharing is concerned, would have similar considerations to a bus lane.

However, the high-speed environment introduces additional safety hazards that motorcycles might not normally experience if using a bus lane. These include traffic merging from on-ramps and the “bottleneck” effect at the Hoddle Street off-ramp. During congested traffic conditions, the differential speeds between the emergency lane and other

driving lanes may make it hazardous for motorcycles to merge in and out of the emergency lane.

Assessment: The usage of emergency lanes by motorcycles is not recommended, due to the many physical, operational and safety hazards associated with their use. The Eastern Freeway emergency/bus lane may be an exception, as it has been designed as a driving lane at certain times of the day. However, there are still a number of unresolved safety issues around lane merging that need to be considered before the Eastern Freeway lane might be considered for use by motorcycles.

Bicycle Lanes

The use of bicycle lanes by motorcycles has sparked some debate between motorcyclist and cyclist groups. The main point of contention seems to be around the occasional use of bicycle lanes by motorcyclists to overtake traffic queues. Some motorcyclists argue that this is simply legalising a practice that happens already, whereas cycling groups are concerned that even a small amount of encroachment into bicycle lanes will compromise the safety and integrity of the lanes.

In other countries, similar debates have resulted in some powered two-wheelers being admitted to bicycle lanes. For instance, reduced-speed mopeds have been permitted to use bicycle paths in Belgium, Germany and the Netherlands (Noordzij *et al*, 2001).

The key unresolved issues are:

- Bicycles and motorcycles have distinctly different power, weight and speed characteristics. Any form of lane sharing would require significant speed reductions by powered two-wheelers so that the speed differential with bicycles is minimised.
- The behavioural responses of motorcyclists and cyclists to lane sharing are largely unknown. In a best-case scenario, motorcycles might use bicycle lanes occasionally, at low speeds and without placing undue pressure on cyclists. In the worst case, cyclists may feel less safe with motorcycles cutting in and out of the lane at higher speeds.
- Enforcement of compatible behaviours (e.g. low-speeds and no overtaking) may be difficult, and rules may disadvantage both motorcyclists and cyclists.

Assessment: On balance, it is difficult to make a case for the introduction of motorcycles to bicycle lanes. The incompatibilities between bicycle and motorcycle performance characteristics, the potential negative impacts on cyclists and the difficulty in enforcement tend to outweigh the relatively small benefits to motorcycles.

Tram Lanes

Motorcycle usage of full-time or part-time tram lanes is not expected to have a significant impact on trams and other road users. However, tram tracks are often avoided by motorcyclists because of slipping hazards and potential steering issues on the rails (particularly in wet weather). The benefits to motorcycles are also expected to be fairly minimal except in very congested conditions.

Assessment: Tram lanes are not recommended for motorcycle use because of the minimal benefit to motorcyclists and the potential safety hazards associated with slippage on tram tracks.

Motorcycle-Only Lanes

In countries with high motorcycle usage, such as Malaysia and Taiwan, exclusive motorcycle lanes have been used to separate motorcycles from other traffic and reduce motorcycle crash rates. In these countries, motorcycle lanes have been implemented both on-road (adjacent to other traffic lanes) and off-road as separate motorcycle routes.

If implemented in Victoria, on-road lanes would require a significant amount of road space (up to a full traffic lane in each direction). Given the relatively small number of motorcycles in the traffic stream and the significant reduction in capacity for other road users, motorcycle-only lanes would not be economically justifiable in current conditions.

Assessment: Motorcycle-only lanes are not currently economically justifiable because of the low volumes of motorcycles on Victorian roads and the significant reduction in capacity for other road users.

Preferred Motorcycle Routes

Motorcycle road space measures will be most effective if they are used consistently across the network and are concentrated on the routes that are best suited to motorcycle use.

The Victorian Automobile Chamber of Commerce has recently advocated the idea of “Safe Routes” for two-wheelers. Similar in concept to the Principal Bicycle Network, the “Safe Routes” network would consist of routes that are signed and promoted as being better-quality routes for two-wheeled transport. These routes would also form the focus of any road-space and intersection measures to support bicycles, scooters and possibly other powered two-wheelers.

The idea of preferred motorcycle routes attracted considerable interest in the workshop held with stakeholders (see Appendix BAppendix B:). Benefits of such a scheme could include better co-ordination of state and local government efforts, better connectivity and consistency of motorcycle routes and maps for novice riders. However, before such a network could be realised, the issues surrounding the potential use of advanced stop lines, bus lanes and bicycle lanes would need to be addressed.

Conclusions

Of the measures considered here, the most promising are **advanced stop lines**, the sharing of **bus lanes** and the use of the **bus/emergency lane** on the Eastern Freeway during bus times.

The following actions are suggested to provide further evidence for considering implementation of motorcycle road space measures:

- conduct consultation with the bus industry and motorcycle groups to confirm situations where motorcycles could be considered for admission to bus lanes;
- conduct a trial of a motorcycle advanced stop line and feeder lane, observing behaviour of all road users and impacts on capacity before and after implementation;
- in consultation with motorcycle groups, consider opening the Eastern Freeway bus lane to motorcycles during bus times (subject to an appropriate safety review);
- consider how VicRoads' network operating plans might accommodate motorcyclists and what opportunities exist to develop priority motorcycle routes in urban areas;
- develop suitable evaluation and modelling methods to determine where and when road space measures for powered two-wheelers would be warranted.

Part 1: Background and Approach

This report is the second of a two-part study into road space management which SKM undertook for VicRoads in association with Oxford Systematics.

Part A of the study (reported separately) considered the management of bus lanes in Victoria. Part B of the study (to which this document relates) is funded from the Motorcycle Safety Levy and considers motorcycle road space initiatives. These initiatives have the potential to improve the mobility and safety of motorcyclists on Victoria's roads without compromising the safety of other road users. The report considers road space measures used in Australia and overseas and evaluates which initiatives could be applicable in Victoria.

This section provides background to the study and sets out the concepts that will be used to evaluate the various road space initiatives for motorcycles.

1. Introduction

1.1. Background

Powered two-wheelers, such as motorcycles and scooters, are an increasingly popular mode of travel in Victoria. There was a 37.3% increase in the number of registrations of these vehicles in Victoria between 2003 and 2008, compared to a 10.5% increase in passenger vehicles over the same period[1].

With greater representation of powered two-wheelers on Victoria's roads, VicRoads is reviewing the issue of road space allocation. More specifically, VicRoads is investigating motorcycle-related road space management initiatives which have the potential to provide improved mobility and safety for motorcycles without compromising the safety of other road users. This project has the endorsement of the Victorian Motorcycle Advisory Council and is funded by the Motorcycle Safety Levy.

This project stems from the actions in the Victorian Government's Action Plan for powered two-wheelers (2009)[2] – specifically to "conduct research into both the road safety and transport impacts of road space management opportunities, such as lane filtering, advanced stop lines and use of bus and transit lanes to identify possible initiatives for trialling."

To date, motorcycle road space management initiatives have not been used in Victoria. In New South Wales, the allocation of shared road space to buses and motorcycles is more widespread. In some south-east Asian countries where motorcycles are a major component of the traffic stream, exclusive priority may sometimes be given to motorcycles.

What is not well understood is:

- the range of motorcycle road space initiatives that could be considered in Victoria;
- the impacts of these initiatives on motorcyclists and other road users; and
- exactly what areas should be considered for field trials or focussed research.

This report considers a range of motorcycle road space concepts reported in the literature and assesses the potential impacts if these were to be considered for implementation in Victoria.

The analysis is supported by the Victorian Government's transport system objectives[3], which provide a framework to guide the planning of transport infrastructure and policy in Victoria.

[1] Australian Bureau of Statistics (2009), *Motor Vehicle Census, Australia – March 2008*, Publication No 9309.0.

[2] Victorian Government (2009), *Victoria's Road Safety and Transport Strategic Action Plan for Powered Two Wheelers 2009-2013*.

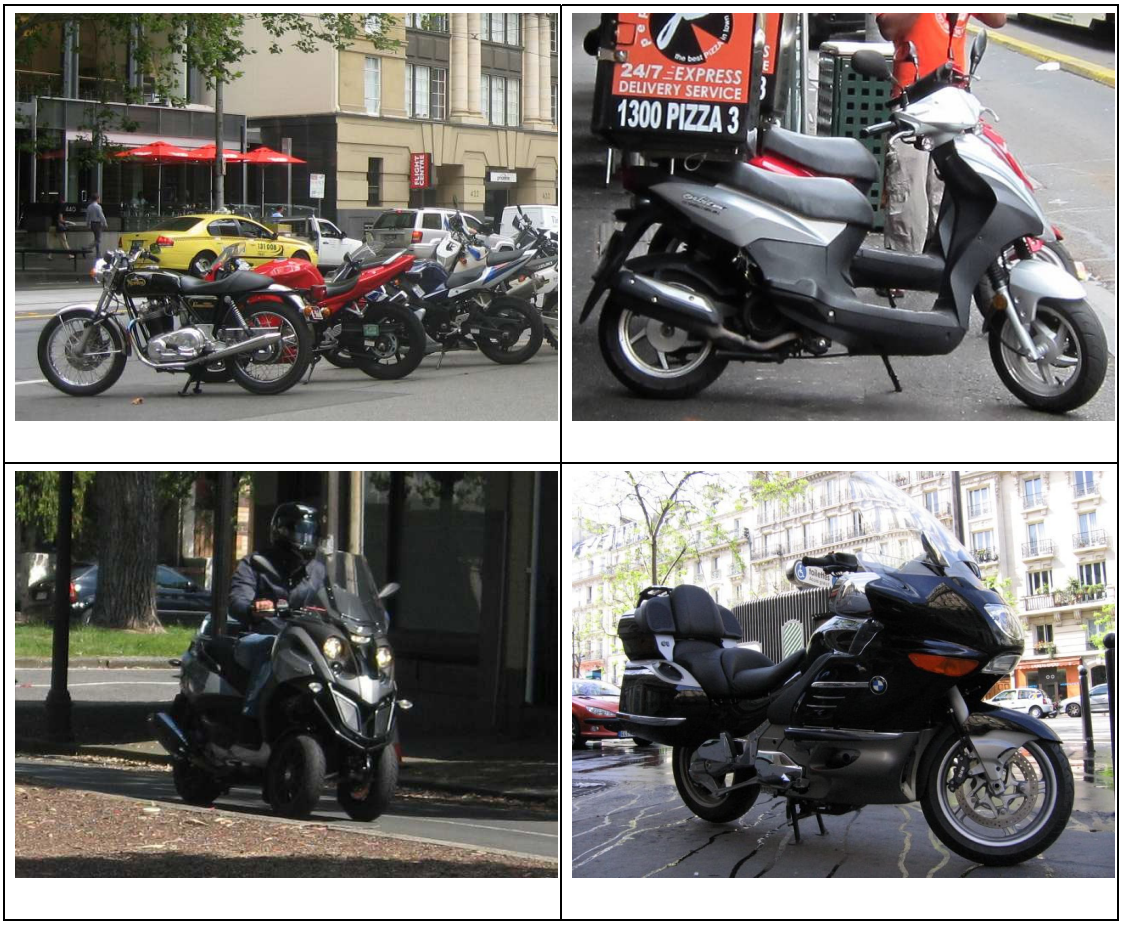
[3] Victorian Government (2009), *Towards An Integrated and Sustainable Transport Future: A New Legislative Framework For Transport in Victoria*, Policy Statement, July 2009.

1.2. Definitions

In this report, **motorcycles** are defined as any vehicle that can be registered as a motorcycle in Victoria. Included in this definition are two- and three-wheeled motorcycles (of various types, engine sizes and purposes), mopeds, scooters, motor tricycles and motorcycles with sidecars.

These are often collectively referred to as **powered two-wheelers (PTWs)**, and this term is used interchangeably with the term “motorcycle” in this report. Powered two-wheelers often have similar characteristics and face similar issues (see Figure 1).

- Figure 1: Examples of powered two-wheelers



2. Assessment of Road Space Initiatives

2.1. Australian and International Initiatives

A number of Australian states have released motorcycle safety strategies in recent years, focussing on measures to reduce motorcyclist injuries and fatalities[4]. Most of these measures are based on improving licensing and rider education, safety research, protective clothing, road design, parking and security. Victoria released an integrated plan in 2009 with the publication of *Victoria's Road Safety and Transport Strategic Action Plan for Powered Two Wheelers 2009-2013.* Our contact with other Australian state road authorities suggests that Victoria is the only state that is currently actively investigating motorcycle road space initiatives.

Overseas, most of the published literature on motorcycle road space initiatives has covered three main areas:

- **advanced positioning** of motorcycles in traffic queues, primarily through the use of advanced stop lines;
- **shared lanes** where motorcycles share a special lane with other selected vehicles (for example, a bus lane); and
- **exclusive lanes** where motorcycles have exclusive use of an on-road or off-road facility.

Parts 2, 3 and 4 of this report cover each of these areas in detail, quoting the findings from international studies and experience.

The specific road space initiatives evaluated within each category are shown in the following table. These were drawn from the published literature and a workshop held with motorcycling stakeholders convened by VicRoads on 22 January 2010.

Table 1: Motorcycle road space initiatives covered in this study

Category	Initiatives	Report Chapter
Advanced positioning	▪ Advanced stop lines	▪ Chapter 3, page 9
Shared lanes	▪ Bus lanes ▪ Emergency lanes ▪ Bicycle lanes ▪ Tram lanes	▪ Chapter 4, page 20 ▪ Chapter 5, page 27 ▪ Chapter 6, page 31 ▪ Chapter 7, page 37
Exclusive lanes	▪ Motorcycle-only lanes	▪ Chapter 8, page 40

Motorcycles are already permitted in transit (high-occupancy vehicle) lanes in Victoria, so transit lanes were not evaluated in this study.

[4] Queensland Dept of Transport and Main Roads (2009), Q*ueensland Motorcycle Safety Strategy 2009-2012*.
SA Dept for Transport, Energy and Infrastructure (2005), *Motorcycling Road Safety Strategy 2005-2010.*
City of Sydney (2008), *Motorcycle and Scooter Strategy and Action Plan 2008-2011*.

2.2. Costs and Benefits

All of the measures considered in this report have the potential to provide benefits to motorcyclists. In most cases, any such benefits would relate to travel time and safety improvements for motorcyclists.

While this study does not attempt to complete an economic analysis of each option, some consideration of the implementation costs is needed to weigh up the relative value of the options under consideration.

With the exception of exclusive motorcycle lanes, most of the measures would involve changes to signage and line-marking. These are relatively inexpensive treatments. Consequently, they are unlikely to have a significant influence on the economic feasibility of the initiatives.

The costs associated with exclusive motorcycle lanes (Chapter 8) would be much higher, as they would require upgrades to road infrastructure (e.g. road widening, new carriageway, grade separation). In these cases, a separate site-by-site analysis of road capacity, economic benefits and costs, and network performance impacts would be needed to make an informed decision on their implementation.

Implementation of any of these road space measures would also require changes to the Victorian Road Safety Rules 2009, as well as changes to relevant publications (such as the "Road To Solo Driving" guide for learners). A public education and communication campaign would also be needed to inform drivers of the changes. Costs for these actions should also be factored into any implementation strategy.

2.3. Transport System Objectives

As part of the Victorian Transport Plan released in 2008, the Victorian Government announced a framework of transport system objectives to be considered in the planning and management of Victoria's transport system[5]. These are summarised in Table 2 with comments on their potential application to motorcycle road-space policy.

[5] Victorian Government (2009), *Towards An Integrated and Sustainable Transport Future: A New Legislative Framework For Transport in Victoria*, Policy Statement, July 2009.

- Table 2: Victorian Transport System Objectives and potential application to motorcycle road-space policy

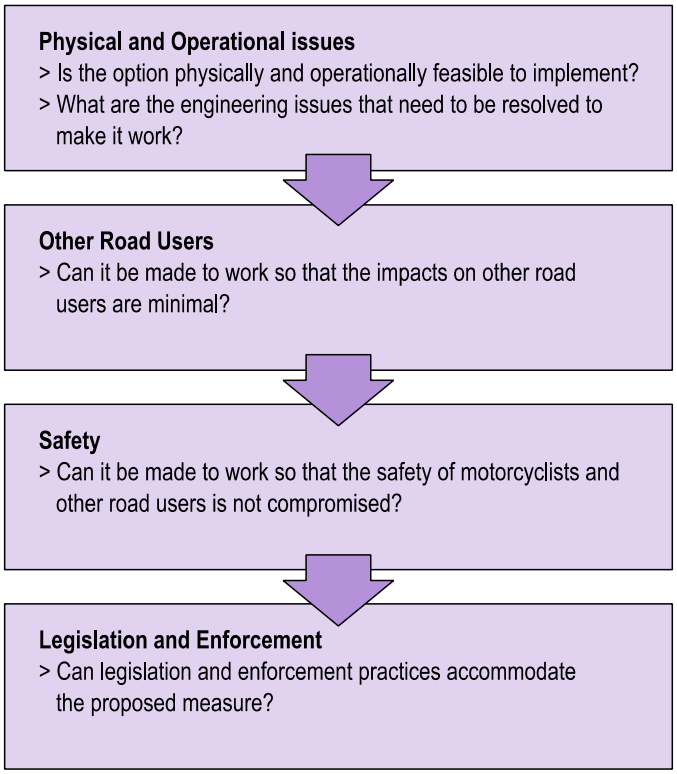
Objective	Description	Potential Motorcycle Policy Applications
Efficiency, co-ordination and reliability	Optimising journey times and network capacity, maximising efficient use of resources, increasing reliability and seamless multi-modal connections.	▪ encouragement of mode shift from cars to smaller vehicles such as motorcycles ▪ improving motorcycle travel times and reliability by facilitating movement to the head of traffic queues
Safety, health and wellbeing	Continuous improvement of transport system safety, minimising risk of harm, promoting forms of transport that benefit health and wellbeing.	▪ reducing motorcycle casualties by increasing motorcycle conspicuity on road and reducing conflicts with other vehicles
Economic prosperity	Enabling efficient movement of persons and goods, reducing costs, fostering market competition, promoting investment and financial sustainability.	▪ increasing person throughput across the network by all modes
Environmental sustainability	Protecting the natural environment, minimising transport emissions and loss of biodiversity, promoting low-impact forms of transport and improving the performance of energy use in transport.	▪ encouragement of vehicles with lower emissions, such as some powered two-wheelers
Social and economic inclusion	Minimising barriers to access and tailoring infrastructure to support people who find it difficult to use the transport system.	▪ minimising barriers to the safe use of lower cost vehicles, such as motorcycles
Integration of transport and land use	Maximising access to local destinations and ensuring complementary development of transport and land use.	▪ providing access and end-of-trip facilities (such as parking) for motorcycles at key activity centres

The measures considered in this study primarily relate to the efficiency and safety objectives.

2.4. Assessment Framework

Figure 2 shows the assessment framework used to evaluate each of the motorcycle road space initiatives. It is recognised that the present lack of Australian field studies into motorcycle road space measures does not yet permit a rigorous evaluation. This issue is discussed further in the concluding chapter.

■ Figure 2: Assessment framework



The framework is used by applying each of these criteria in turn. Where possible, quantitative evidence from other studies is used to support the evaluation. Each criterion is rated using the qualitative scale shown in Table 3.

■ Table 3: Assessment ratings

✓	Any outstanding issues could be readily addressed
○	Safety is not expected to improve nor deteriorate. Available data do not support a conclusion either way
⚠	Some issues need to be resolved before implementation could be considered
✗	Issues are difficult to overcome. Implementation is not advisable.

If all criteria are assessed with a ✓ or ○, then the motorcycle initiative could potentially be considered for implementation in Victoria. If ⚠ assessments are given, then the initiative would require further refinement before it could be considered. If no suitable solutions are found, then it may not be suitable for application in Victoria. Finally, if ✗ ratings are given, then the initiative is not considered appropriate at the present time.

A full discussion of the ratings is provided in each chapter and these are summarised in Chapter 10.

Part 2: Advanced Positioning

At signalised intersections, motorcycles generally have sufficient acceleration to clear the intersection within a few seconds from a standing start. Positioning motorcycles at the head of the traffic queue can provide the dual benefit of saving motorcycle queuing time and separating motorcycles from the rest of the traffic stream.

In addition to safety benefits, Wigan (2000) notes advanced positioning provides a significant addition to intersection capacity in congested conditions and reduced travel times for powered two-wheelers.

This section reviews road space treatments that could assist motorcyclists to reach the front of the traffic queue at signalised intersections.

3. Advanced Stop Lines

3.1. Introduction

Advanced positioning is typically facilitated by advanced stop lines (ASLs). An advanced stop line is a second stop line located several metres after the main vehicle stop line on a signalised intersection approach. The vehicle stop line and advanced stop line create a "box" that can be used by certain categories of vehicle (see Figure 3).

- Figure 3: Advanced stop line for motorcycles (from *IHIE Guidelines For Motorcycling*, UK)

There is very little published literature on the use of advanced stop lines by motorcycles, although the Motorcycle Council of NSW reports their use in some Belgian, Dutch, Japanese and Swiss towns[6]. Transport for London has trialled their use in a number of locations, but they are largely seen as an experimental treatment without rigorous guidelines for their implementation.

At present, advanced stop lines are only implemented for bicycles in Victoria. If motorcycles were to share the advanced stop line space with bicycles, appropriate engineering measures and changes to the Victorian Road Safety Rules 2009 would be needed to support this practice. These considerations are discussed further below.

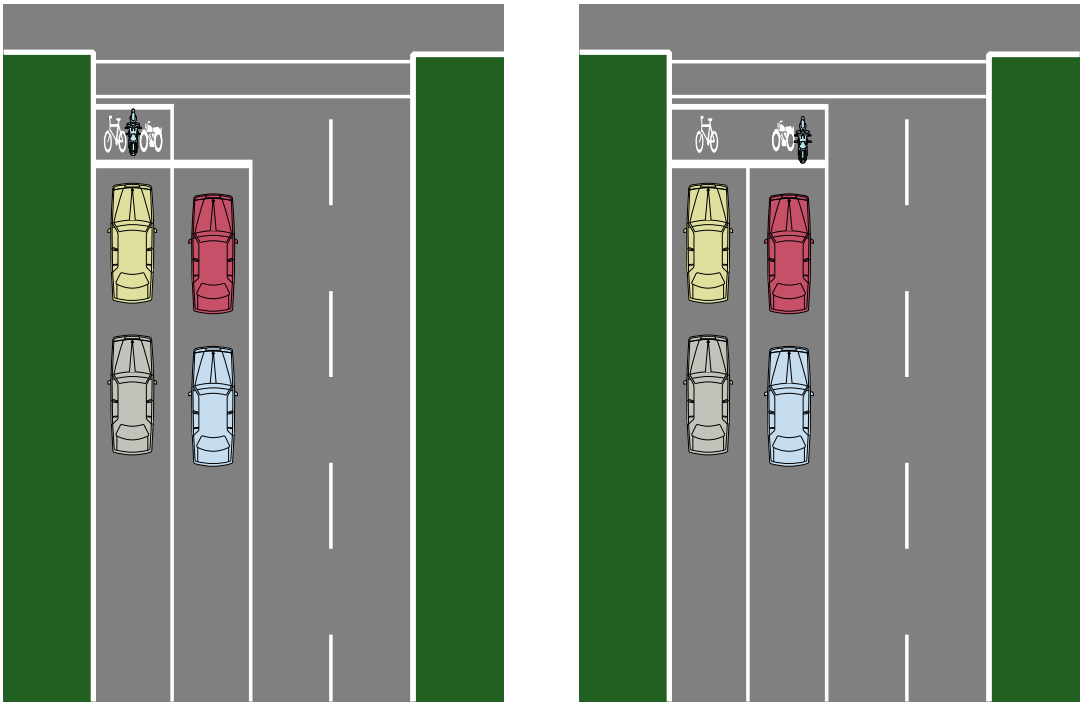
3.2. Physical and Operational Issues

Space Allocation

Most bicycle ASLs in Victoria span a single lane. Usually this is the kerbside lane unless there is a dedicated kerbside left-turning lane. If motorcycles were to share the space with cyclists, the space may need to be expanded to at least two lanes. Figure 4 shows a single-lane ASL arrangement adapted for motorcycle use (left) and a double-lane arrangement (right).

[6] Motorcycle Council of NSW (2010), 'Transport Planning and Facilities' web page, http://roadsafety.mccofnsw.org.au/a/22.html, accessed on 28 April 2010.

■ Figure 4: Single and multiple-lane ASLs



In the UK, advanced stop lines for bicycles usually span all lanes. This arrangement allows cyclists to move across the front of the traffic queue in order to make a right-hand turn. Where motorcyclists are permitted to use the advanced stopping area, the intent is that they use the right-hand portion of the box to leave clear space for cyclists near the kerb. The UK Highway Code permits motorcycle filtering through slow-moving traffic, providing motorcyclists with a means of reaching the head of the queue if traffic permits.

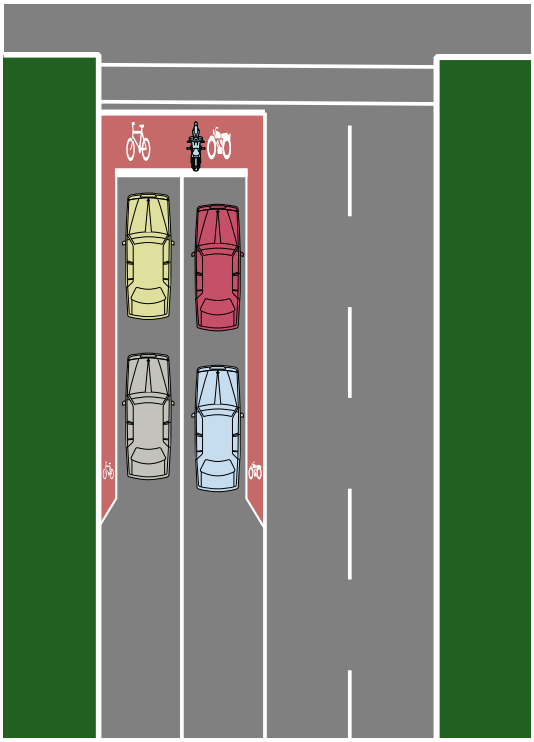
ASLs may cause confusion and safety issues if they span dedicated turning lanes where the traffic signals provide for controlled left or right turns (i.e. green arrows). In these situations, turning vehicles could be blocked by two-wheelers unless the two-wheelers were also obliged to turn on the green arrow. Incorporating ASLs into turning lanes with controlled turns is not recommended in Victoria (VicRoads 2000).

Finding: To provide adequate queuing space and access, advanced stop lines for motorcycles would need to span more than one traffic lane in most cases. Dedicated turning lanes that are controlled by green arrow signal phases should not be spanned.

Feeder Lanes

Advanced stop lines provide no benefit to motorcyclists unless the rider can bypass traffic and move to the head of the queue.

■ Figure 5: Feeder lanes



In the UK, feeder lanes are sometimes used to create a safer passing space (see Figure 5). In this arrangement, cyclists use a kerbside feeder lane and motorcyclists use a central lane. The UK Department for Transport recommends feeder lane widths of 1.5 metres but also notes that narrower widths have been used effectively[7]. With these width requirements, many urban arterials in Melbourne would have difficulty accommodating feeder lanes without widening of the roadway.

Finding: ASLs would not be effective unless motorcycles can move safely to the head of the traffic queue. Moving to the head of the queue could be facilitated by specially-marked feeder lanes. However, space constraints will make it difficult to implement feeder lanes in many parts of the Victorian arterial road network.

3.3. Other Road Users

Delays to Other Vehicles

Motorcycles typically have greater acceleration than cars and other motor vehicles. They are generally capable of crossing an intersection more quickly than other vehicles. Consequently, the delay to other vehicles from motorcycles using ASLs is likely to be negligible.

[7] UK Department for Transport (1996), *Further Development of Advanced Stop Lines*, Traffic Advisory Leaflet 5/96.

Shared Use of ASLs By Motorcyclists and Cyclists

The Transport Research Laboratory (TRL) carried out an investigation of advanced stop lines in the London Borough of Newham in 2003. The TRL study set up a trial where motorcycles were allowed to use cyclist advanced stop lines (ASLs) at two intersections. The two-lane approaches at each intersection were fitted with ASLs and motorcycle feeder lanes on the outside of the existing traffic lanes (similar to Figure 5). Motorcycle and bicycle volumes were similar, with each making up approximately 1.5% of the total traffic volume at the test locations.

Results from the TRL study reported by Tilly and Huggins (2003) and quoted in IHIE (2003) showed that:

- *"Before the trial of the shared use of ASLs a majority of motorcyclists (77%) and cyclists (51%) were supportive of motorcyclists using ASLs.*
- *"After implementation 73% of motorcyclists thought the layout was an improvement along with 48% of cyclists.*
- *"80% of cyclists surveyed thought that the layout was better or unchanged and only 5% believed it had become worse [build up of grit and debris in the ASL was cited as a reason].*
- *"Across all sites the number [of motorcyclists] using the new ASL filter lane 'after' was greater than the number that filtered on the outside 'before'.*
- *"The number of motorcyclists filtering between the nearside kerb and queuing traffic fell from 13% to 6%.*
- *"There was no change in the number of cyclists managing to reach the front of the traffic queue.*
- *"The percentage of motorcyclists managing to reach the front of the traffic queue rose from 40% 'before' to 53% 'after'.*
- *"Conflict between motorcyclists and cyclists did not arise.*
- *"Overcrowding was not an issue.*
- *"Motorcyclists would tend to wait on the right hand side of the ASL reservoir, cyclists on the left. Conflict could arise, however, between left turning motorcyclists and right turning cyclists. This was not an issue as the majority of movements were straight ahead."*

In a commentary on this study, Carey-Clinch (2003)[8] found a "lack of notable conflict [which] is interesting and appears to indicate that cyclists and motorcyclists are far more capable of sharing priority measures such as ASLs than has previously been thought." He also found that "cyclists did not show signs of being scared of PTWs…[and] PTW riders and cyclists did not display aggressive behaviour towards each other".

Finding: The evidence suggests that shared use of ASLs by cyclists and motorcyclists might work effectively once both road user groups are familiar with the ASL code of behaviour. Consultation and trials by cyclists and motorcyclists would help to establish any potential issues in Australian road conditions.

[8] Carey-Clinch, C (2003), 'An Observational Study of the Use of Advanced Stop Lines By Motorcycles And Bicycles', UK Motorcycle Industry Association.

Exclusive Use By Motorcyclists

None of the research reports reviewed in this study considered the exclusive use of ASLs by motorcyclists. Although we can only speculate on the lack of research in this area, there are several key arguments that might be made against the exclusive use of ASLs by motorcycles:

- having different classes of ASL could create confusion for motorcyclists, cyclists and other road users; a consistent usage of ASLs across the network would generally be preferred;
- assuming that ASLs provide an overall safety benefit for cyclists and motorcyclists, then arbitrarily excluding cyclists would appear to result in reduced safety benefits; and
- enforcement is likely to be difficult.

If motorcycle volumes were very high (such as in some south-east Asian countries), then there may be a case for exclusive motorcycle facilities (see Chapter 8). However, this is currently not the case in Victoria.

Vehicle Encroachment Into ASL Spaces

In the UK studies of ASLs, vehicle encroachment into the ASL space was noted as a recurring issue. In a London study carried out in 2005, twelve bicycle ASL sites were observed and a range of data collected on cyclist and motorist behaviour (TRL 2005). The study found that at the selected sites:

- 37% of all vehicles at the head of the queue encroached more than halfway into the ASL's reserved space[9]; and
- a further 12% of vehicles crossed the stop line at the far end of the ASL space.

The study also found that 88% of motorcycles encroached more than halfway into the ASL's reserved space, suggesting that the bicycle ASLs were commonly being used as de facto motorcycle ASLs.

A before-and-after study conducted by VicRoads in 1998 also found that vehicle encroachment at ASLs is quite common, with about 67% of vehicles encroaching into ASL spaces on St Kilda Road in Melbourne (VicRoads 2000).

Finding: Vehicle encroachment into ASL reserved space is prevalent and would require supporting education campaigns to discourage this behaviour.

Pedestrians

The TRL study also considered encroachment into the pedestrian crossing area at the twelve advanced stop line sites and two further control sites (without ASLs). The study found that:

[9] Common UK practice is to make ASL areas 4-5 metres in length, longer than the current VicRoads recommendation of 2.5 metres (see VicRoads Cycle Note #5).

"...more vehicles were found to stop in the pedestrian crossing (i.e. over the stop line) on average at the control sites compared with the sites with an ASL. Therefore, it seems that an ASL can provide a buffer zone that discourages vehicles from blocking the pedestrian crossing." (TRL 2005)

Finding: ASLs may provide some benefit to pedestrians by discouraging vehicles from blocking the pedestrian crossing at signalised intersections.

3.4. Safety

A number of safety concerns have been expressed in UK studies of ASLs, mostly in relation to bicycles, but with equal applicability to motorcycles:

- As discussed in section 3.2, vehicles can encroach into the advanced stopping area, limiting the space available for two-wheelers.
- If the traffic signal turns green while two-wheelers are approaching the ASL, they may become caught in the start-up flow of the traffic. While this is not normally a problem, it can be dangerous if the two-wheeler moves across the face of the traffic queue in order to position itself for a right-turn in the rightmost lane.
- Large vehicles, such as trucks, have high driving positions and drivers may not see two-wheelers if they are directly in front of the truck.
- Motorists changing lanes may not expect motorcycles to overtake them in the same lane, possibly leading to crashes.
- Drivers may not expect motorcyclists to overtake on the right-hand side to reach the stop line (although a clearly-marked feeder lane may help to increase driver awareness). The motorcycle's approach may be obscured by other vehicles and be in the driver's rear-view "blind spot".

In addition, VicRoads has expressed the concern that ASLs may potentially encourage some motorcyclists to bypass the traffic queue by (illegally) crossing the centre line of the road in order to access feeder lanes and the ASL area.

In a workshop undertaken as part of this study, a representative from the Monash University Accident Research Centre (MUARC) also highlighted a potential safety issue with red-light running. With vulnerable road users (motorcyclists and cyclists) positioned at the front of the traffic queue, they may be more susceptible to crashes with red-light runners as they move into the intersection. In an experiment conducted by MUARC in the mid 1990s, the incidence of especially dangerous red-light running in Melbourne was estimated to be about 0.02% of vehicle movements at intersections (Kent *et al* 1995). Here, "especially dangerous" red-light running referred to vehicles that moved through the intersection after the all-red signal period.

Each of these safety issues should be carefully evaluated – possibly through trials – before ASLs are considered for wider implementation.

If ASLs are implemented for motorcycles, VicRoads should also consider increasing the minimum length of ASL holding areas from 2.5 metres to about 4.0 metres[10]. This will provide more space for motorcycles and increase their visibility from trucks, four-wheel drives and other high vehicles.

Finding: If ASLs are implemented, VicRoads should consider increasing the length of ASL holding areas to improve the visibility of motorcycles. A trial of ASLs (with feeder lanes) is recommended to assess safety issues before wider implementation could be considered.

3.5. Legislation and Enforcement

Victorian Road Safety Road Rules

The following discussion is based on the study team's interpretation of the Victorian Road Safety Road Rules 2009. Formal legal advice should be sought before making any decisions regarding regulatory changes.

The Victorian Road Safety Road Rules 2009 currently require all drivers to stop before a stop line at a signalised intersection (Rule 56, subrules 1 and 2). The following provision is made for stopping at bicycle ASLs:

> "*If there is a bicycle storage area before any traffic lights referred to in subrule (1) or (2), a reference to the stop line in subrule (1)(a) or (2)(a)—*
>
> *(a) in the case of a driver of a motor vehicle, is a reference to the first stop line that the driver comes, or came, to in approaching the lights;*
>
> *(b) in the case of a rider of a bicycle, is a reference to the stop line that is nearest to the intersection.*" (Rule 56, subrule 3).

Here, a bicycle storage area is defined as:

> *"an area of a road before an intersection with traffic lights—*
>
> *(a) that has painted on it one or more bicycle symbols; and*
>
> *(b) that is between two parallel stop lines, regardless of whether the lines are of equal length—*
>
> *but does not include any stop line."* [11]

If motorcycles were to use ASL reserved spaces legally, subrule 3 and the storage area definition would need to be updated to include specific mention of motorcycles.

[10] The design guidance from the UK Department of Transport states "The cycle reservoir should be between 4m and 5m in depth. If the reservoir is shallower than this cyclists can feel intimidated by the close proximity of the vehicles queuing behind them. If the reservoir is deeper than this, motorists may feel encouraged to encroach into it."

[11] There is a subtle difference between the Australian Road Rules and Victorian Road rules on this point. The Australian Road Rules assume that bicycle storage areas will be connected to a bicycle lane, whereas the Victorian Road Rules provide for the case where no bicycle lane links to the storage area.

In addition to the stopping rule, the following additional rules apply to bicycle riders at ASLs:

> "***247A Entering a bicycle storage area***
>
> *(1) A rider of a bicycle approaching a bicycle storage area at an intersection that has traffic lights or traffic arrows showing a red traffic light or red arrow must not enter the bicycle storage area other than from a bicycle lane, unless the rider is not required to ride in the bicycle lane under these Rules.*
>
> *(2) Subrule (1) does not apply if the bicycle storage area cannot be entered from a bicycle lane.*
>
> ***247B Giving way while entering or in a bicycle storage area***
>
> *(1) A rider of a bicycle must when entering a bicycle storage area, give way to—*
>
> *(a) any vehicle that is in the area; and*
>
> *(b) if the area is before any green or yellow traffic lights, any motor vehicle that is entering or about to enter the area, unless the motor vehicle is turning in a direction that is subject to a red traffic arrow; and*
>
> *(c) if the area forms part of a lane to which traffic arrows apply—any motor vehicle that is entering or about to enter the area at a time when those arrows are green or yellow.*
>
> *(2) A rider of a bicycle that is in a bicycle storage area that extends across more than one lane of a multi-lane road must, if the area is before any green or yellow traffic lights, give way to a motor vehicle that is in any lane other than the lane that the bicycle is directly in front of, unless the motor vehicle is turning in a direction that is subject to a red traffic arrow.*" (Rule 247)

These rules are also considered to be appropriate for motorcyclists, with appropriate updates to terminology and the exclusion of bicycle lanes as a means of entering the ASL storage area.

Finding: The Victorian Road Safety Road Rules 2009 would need to be updated to allow motorcyclists to use advanced stop lines, principally by modifications to existing regulations on bicycle storage areas. Formal legal advice should be sought, however, before making regulatory changes.

Enforcement

Although the Victorian Road Rules currently stipulate penalties for drivers encroaching into bicycle storage areas, enforcement is likely to be difficult in practice. The current Victorian learner drivers' handbook mentions bicycle storage areas, but drivers who took their driving tests before 1998 may not be as aware of their responsibilities in relation to ASLs. The TRL study surmised that encroachment may be due to drivers "not noticing the ASL, not

understanding the ASL, or choosing to violate it" (TRL 2005). TRL recommended that more research be done into the reasons for vehicle encroachment so that a suitable approaches (such as signage and driver education) could be developed to reduce encroachment.

If motorcyclists were permitted to use ASLs, the issue of encroachment would need to be addressed in the driving community. In our view, a driver education and positive reinforcement campaign would be preferable to an enforcement campaign. Using a "carrot" rather than "stick" approach may also help to avoid hostility between drivers and riders.

Finding: Enforcement is likely to be difficult, but as more ASLs are used, driver understanding and acceptance may increase, particularly if supported by positive education campaigns.

3.6. Assessment

Based on the discussion above, the key outstanding issues are:

- facilitating motorcycle movement to the head of the queue;
- the design of ASLs at multi-lane intersections, particularly where there are controlled left or right turns; and
- untested safety issues in Australian conditions.

Motorcycle feeder lanes have not been implemented in Australia, so a trial of their use (where space is available) would be advisable before considering for the ASL application.

Although it is premature to specify warrants for ASL implementation without proper testing and consultation, it is expected that the following factors might need to be considered by VicRoads before implementation:

- potential volumes of powered two-wheelers and traffic at proposed locations;
- the presence of other complementary measures on PTW routes (see Chapter 9);
- VicRoads' network operating plans for the area under consideration;
- geometric constraints;
- turning lane configuration;
- bus priority measures, such as B signals;
- presence of bicycle facilities (such as bicycle ASLs and lanes); and
- site-specific safety issues.

The following chart provides a summary assessment of the ASL alternatives.

	Physical / Operational	Other road users	Safety	Legislation and enforcement	Overall Assessment	
Advanced stop lines	✓	✓	⚠	⚠	Further safety research and legal review needed. Provides no benefit unless motorcycles can reach the front of queue	⚠
ASLs with feeder lanes	⚠	✓	⚠	⚠	Trials of feeder lanes considered before considering implementation	⚠

Part 3: Shared Lanes

The shared use of special-purpose lanes, such as bus lanes, can provide motorcyclists with improved travel times, better reliability of travel and increased separation from other traffic. In addition, the use of a shared lane may help motorcyclists bypass stationary traffic queues in congested conditions.

At the same time, the small footprint of motorcycles and their acceleration capabilities mean that they usually make good “lane companions”, as they rarely obstruct or delay other traffic.

This section considers a range of shared lane scenarios and evaluates the benefits and limitations of each. The specific types of lanes considered in this section are:

- bus lanes;
- emergency stopping lanes on freeways;
- bicycle lanes; and
- tram lanes.

Motorcycles are already permitted to use transit (high-occupancy vehicle) lanes in Victoria and this report does not explicitly cover their use. From a strategic perspective, however, transit lanes are an important road-space management tool, and their use will potentially assist the mobility and safety of motorcyclists when implemented sensibly.

4. Bus Lanes

Motorcycles, scooters and other powered two-wheelers are permitted in general bus lanes in New South Wales. In some other states, such as Queensland and the ACT, they are permitted in bus lanes when indicated by special bus lane signage. This section considers the merits of making all bus lanes accessible to motorcyclists in Victoria.

A more detailed discussion of bus lane sharing, including motorcycle issues, is provided in the report “Road Space Management of Bus Lanes” from Part A of this study.

4.1. Physical and Operational Issues

Implementation

The Victorian Road Safety Road Rules permit motorcycles to use bus lanes when they are signed as such. Allowing motorcycles to use bus lanes could therefore be achieved by updating bus lane signage to include provision for motorcycles.

B Signal Issues

Operational issues may arise with the use of B traffic signals which are commonly used in bus queue-jump lanes. Queue-jump lanes are special lanes at intersections that allow the bus to move to the front of the traffic queue. They are usually accompanied by a “B” signal aspect to allow the bus to exit the queue-jump lane and move ahead of the rest of the traffic stream. Figure 6 shows an example of a typical queue-jump lane and Figure 7 depicts a B signal in operation.

Two main issues arise with allowing motorcycles into bus lanes where there is a B signal:

- potential issues with motorcycles blocking the lane and obstructing buses from proceeding when the B signal is shown; and
- confusion about whether the B signal can be used by motorcycles.

■ Figure 6: Queue-jump lane at a four-way intersection (note “B” bus priority signal)

Photo courtesy of Chris Loader, Bus Association Victoria

■ Figure 7: B signal

It is uncertain whether there would be legal issues with motorcycles using the B signal. According to the Road Rules, vehicles are not allowed to proceed when a red traffic signal is displayed (Road Rule 56), however Part 17 Note 1 and Road Rule 285 allow “the driver of a vehicle other than a public bus [to proceed on a B signal] in the same way as … the driver of a public bus, if the driver is (a) driving in the bus lane to which B signals apply or (b) the driver is permitted to drive in the lane under these Rules”.

If VicRoads considers options where motorcycles or other vehicles must proceed using B signals then we recommend that legal advice be sought.

Regardless of the legal considerations, there would be a significant problem in the integrity of the B signal if motorcycles were permitted in bus lanes controlled by B signals. Motorcyclists would be expected to:

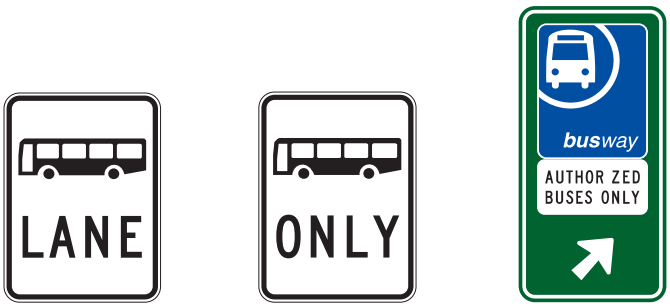
- proceed with a B signal to exit some bus lanes; and
- not proceed with a B signal in situations where there is no bus lane.

There appear to be several alternatives to deal with this situation if motorcycles were to be admitted to bus lanes:

- remove the few bus lanes where the exit is via a B signal[12];
- where space is available, construct a separate lane or holding area so that motorcycles do not block buses when a B signal is displayed;
- introduce a new signal aspect that allows motorcycles to proceed at the same time as buses; or
- not introduce motorcycles to the bus lane in these situations.

Other Australian states have dealt with this issue by defining several different types of bus lane. For example, NSW and Queensland make a distinction between “bus lanes”, “bus only lanes” and busways (see Figure 8). Although the Australian Road Rules form the basis of the rules in each state and territory, each state is entitled to introduce modified road rules to suit specific situations in those states.

- Figure 8: Bus lane signage (Queensland)



General bus lane	Bus-only lane	Busway
Cyclists and taxis permitted	No other vehicles permitted	No other vehicles permitted

If Victoria was to consider introducing motorcycles into bus lanes consistently across the road network, then there would be value in emulating the NSW and Queensland practice of distinguishing between shared bus lanes and bus-only lanes. This would allow the B-signal issue to be resolved in a reasonably consistent way.

Finding: Bus lanes with B signals should be implemented so that motorcycles do not block buses that wish to proceed on a B signal. This could be achieved by prohibiting motorcycle use of bus lanes with B signals as is done in other Australian states.

[12] We understand that there are about half a dozen bus lanes in Melbourne where exit is currently by a B-signal.

4.2. Other Road Users

Notwithstanding the discussion in the previous section, motorcycles do not usually obstruct buses, as their dynamic profile allows them to accelerate quickly and move at the ambient traffic speed. In NSW, where motorcycles are more widely permitted in bus lanes, we are not aware of any reported problems of buses being disrupted by motorcycles.

Evidence From UK Trials

A number of trials have been carried out in the UK to assess the impact of permitting motorcyclists in bus lanes. Beginning in 2002, London conducted a four and a half year trial of several bus routes where the safety and the impacts of motorcycle admission on other users were closely monitored. The trials found that "permitting motorcycles into the bus lanes did not have a negative impact on the percentage of buses delayed at the stop on the majority of the sites studied" (Ker *et al* 2005).

Interviews with road users[13] found that motorcyclists and car drivers who were not also bus users were supportive of allowing motorcycles into bus lanes. All other groups interviewed did not support the measure, citing safety as their main concern (Transport for London 2008).

The study found over the trial period there was a greater increase in motorcycle use on the trial routes in comparison to several "control" routes where motorcycles were not permitted (Transport for London 2007). Despite the growth in motorcycle use on the trial routes, it was observed that "less than 15% of motorcyclists used five of the [eight permitted bus] lanes" (York *et al*, 2008). This was unlikely due to lack of knowledge, as the trials were well publicised and signage was changed to include clearly indicate motorcycles being permitted in the lanes.

London is currently undertaking a further, more extensive trial that began in January 2009. In this trial, motorcyclists are allowed to use most of London's red route (priority) bus lanes. The outcomes of this trial will be evaluated based on crash rates, usage by cyclists and motorcyclists, journey times and feedback from users. Interim results from the study suggest that permitting motorcycles in bus lanes has made little difference to the travel habits of most other road users, while increasing the perception of safety for riders of powered two-wheelers (Transport for London 2009).

Evidence From VicRoads' Bus Lanes Study (Part A)

In considering the use of bus lanes by motorcycles, VicRoads would need to consider the wider context of other vehicles also using bus lanes. VicRoads has been approached by various road user groups seeking permission to travel in bus lanes. If more vehicle types were permitted in bus lanes, these could affect the use of bus lanes by motorcycles.

Part A of the current study investigated potential delays to buses caused by the presence of other vehicles in the bus lane. It suggested that delays were likely to be minimal on low-frequency bus routes (e.g. less than 40 buses per hour) with a small number of additional

[13] TfL's attitudinal studies targeted motorcyclists, cyclists, bus drivers, pedestrians and the general public.

vehicles permitted in the bus lane. On high-frequency bus routes, the study suggested that delays may become unacceptable, which could also result in interference to motorcycles using the bus lane. The study also acknowledged that the manoeuvrability of motorcycles would allow motorcyclists to move in and out of the bus lane more easily than other vehicles, suggesting that motorcycles were less likely to delay buses than other vehicles.

Finding: In assessing the impact of motorcycles in bus lanes, consideration also needs to be given to other non-bus vehicles that may potentially use the bus lane. Evidence from Australia and overseas suggests that motorcyclists can share bus lanes without causing undue delays or obstructions to other road users.

4.3. Safety

A common argument put forward in the literature for allowing motorcyclists into bus lanes is the perceived safety benefit of motorcycles being able to bypass traffic queues instead of weaving or filtering through traffic.

During the London bus lane trials, the trends in collisions involving vulnerable modes (motorcyclists, cyclists and pedestrians) varied at each trial location. At some locations, there was a safety benefit for vulnerable users; at other locations, collision rates increased. However, none of these results was statistically significant, meaning that the studies could not be conclusive on changes in crash rates. The findings also did not take into account wider collision trends and migration between routes as a result of the trial.

Though the evidence on crash rates was not conclusive, the reports from the London trials suggested that there may be several safety issues to monitor:

- There was increased incidence of motorcyclists exceeding the posted speed limit (York *et al*, 2008).
- The authors of the TRL report suggested that if motorcyclists were permitted to use the bus lane "safety benefits may be reduced if there is a highly trafficked side road along the bus lane, or taxis and buses are manoeuvring to and from the kerb along a section of the lane" (York *et al*, 2008).
- If the width of the bus lanes is insufficient for a motorcyclist to overtake a stopped bus then this will result in motorcyclists weaving into the general traffic stream. The spacing of bus stops will affect this behaviour: "frequent bus stops can encourage last minute lane-changing by motorcyclists, resulting in potential conflict with moving traffic in the general traffic lane." (Department for Transport 2007)

In Victoria, the pavement surfacing of bus lanes may need to be assessed- to ensure that it does not become slippery in wet weather, creating a hazard for motorcyclists.

Finding: There is presently no conclusive evidence to indicate safety benefits or disbenefits if motorcycles were to be introduced into bus lanes. Trials or simulations could possibly be used to test the safety implications of certain manoeuvres, such as the overtaking of stationary buses.

4.4. Legislation and Enforcement

B Signals

The B signal issue, discussed earlier on page 20, concerns the legality of motorcycles using B signals in bus lanes. If Victoria was to eliminate situations where motorcycles might face a B signal, then it may become necessary to distinguish between bus lanes where motorcycles can be permitted and those where they should not be permitted (typically queue-jump lanes with B signals). The NSW road rules make provision for these different types of bus lane.

Line Marking

The following discussion is based on the study team's interpretation of the Victorian Road Safety Road Rules 2009. Formal legal advice should be sought before making any decisions regarding regulatory changes.

Some motorcycle riders have raised concerns that the continuous line separating bus lanes from other traffic lanes may prevent motorcycles from legally moving into and out of the bus lane. However, the Victorian Road Safety Rules 2009 do make provision for movement of vehicles to and from bus lanes (or other special purpose lanes):

> ***"147 Moving from one marked lane to another marked lane across a continuous line separating the lanes***
>
> *A driver on a multi-lane road must not move from one marked lane to another marked lane by crossing a continuous line separating the lanes unless—*
>
> *(a) the driver is avoiding an obstruction; or*
>
> *(b) the driver is obeying a traffic control device applying to the first marked lane; or*
>
> *(c) the driver is permitted to drive in both marked lanes under another provision of these Rules; or*
>
> *(d) either of the marked lanes is a special purpose lane in which the driver is permitted to drive under these Rules and the driver is moving to or from the special purpose lane.*"

If motorcycles were permitted in a bus lane – by signage or by a change to the Victorian Road Safety Rules – then Rule 147 would seem to adequately cover movement in and out of the lane. However, legal advice should be sought to confirm this is the case.

Enforcement

Regular enforcement is an important foundation of bus lane effectiveness. If enforcement is difficult and infrequent, driver non-compliance rates will rise, leading to reduced efficiency of the bus lane.

In relation to enforcing use of bus lanes, Green and Luk (2007) note that it is easiest to "detect, identify and enforce compliance based on vehicle types". Motorcycles are easily distinguishable from other vehicle types such as cars and buses, and are therefore not expected to cause any additional enforcement burden for police.

Finding: Modifying the Victorian Road Rules to define separate classes of bus lane may be advisable to distinguish situations where bus lanes can be shared and where they should not be used by motorcycles (such as queue-jump lanes with B-signals). Enforcement of bus lanes with motorcycles permitted is not expected to place any additional burden on police.

4.5. Assessment

Although motorcycles cannot presently use bus lanes in Victoria, there is persuasive evidence from Australia and overseas that more general sharing of bus lanes can be achieved without undue operational or safety problems.

The main issue to be resolved is the use of B signals, which would be used by buses but not by motorcycles travelling in bus lanes. This issue is best addressed through a review of legislation to clarify the use of B signals and the situations where bus lanes should not be shared with other vehicles (such as queue-jump lanes).

The following chart provides a summary of the bus lane assessment.

	Physical / Operational	Other road users	Safety	Legislation and enforcement	Overall Assessment	
Bus lanes					Could be considered for further safety trials	

5. Emergency Stopping Lanes

Motorcycles are not allowed to use emergency stopping lanes on freeways unless they are:

- avoiding a collision
- intending to stop in the lane for safety reasons;
- the motorcycle is disabled; or
- signage indicates that a motorcycle may drive in the lane.

At the time of writing, motorcycles are not permitted to drive in any Victorian emergency lanes. However, on the western end of the Eastern Freeway, buses, taxis and private hire cars are permitted to use the emergency lane during peak periods. This raises the question of whether motorcycles should also be permitted to use the lane when it operates as a de facto bus lane. There is little incentive for motorcyclists to use an emergency stopping lane unless there is congestion in the other lanes.

This section considers the use of emergency lanes by motorcycles during times when buses, taxis and private hire cars are permitted in the lane, and also more generally when buses do not use emergency lanes.

5.1. Physical and Operational Issues

The variability in emergency lane widths, edge conditions and surfacing around Victoria means that admission of motorcycles to emergency lanes is fraught with hazards, particularly in the high-speed environments on freeways. Examples of specific issues include:

- stopped vehicles obstructing the lane;
- emergency lanes on some sections of the Hume Freeway have transverse humps to deter vehicles from drifting off the road, but are potentially dangerous to motorcyclists;
- dirt and debris tends to collect in the emergency lane, making the surface hazardous for riding;
- raised thermoplastic edge line marking (such as “Vibraline”) is often used in high-speed environments to provide drivers with a visual, sensory and audible warning of the edge of carriageway – and could potentially be hazardous if motorcycles manoeuvred in and out of the emergency lane;
- in some sections of the Monash and West Gate Freeways, the emergency lane is quite narrow or discontinuous, making it impractical as a driving lane; and
- noise walls and barriers adjacent to the freeway may directly abut the emergency lane.

The Eastern Freeway bus lane scenario is different, because the lane is designed to operate as a driving lane during certain times of the day. It offers a more suitable riding surface and is consistent with expectations of the lane being used as a driving lane. There are no strong operational reasons why motorcycles could not use the lane at the same time as buses, although sight lines and the lane configuration at on- and off-ramps should be reviewed.

Finding: General emergency lanes are not engineered for driving and are not appropriate for use by motorcycles. An exception is the Eastern Freeway emergency lane which operates as a bus lane at designated times, and could potentially be shared by motorcycles during these times.

5.2. Other Road Users

As discussed in Chapter 4, there is little evidence to suggest that motorcycles delay buses or other vehicles using bus lanes. On the Eastern Freeway, we would not expect buses or taxis to be unduly affected by the presence of motorcycles in the bus/emergency lane.

However, if motorcycles were to travel in general emergency lanes, there would be serious safety implications – both for drivers stopping in the emergency lane and for motorcyclists. Similar implications would apply on non-metropolitan freeways where cyclists are permitted to use the emergency lane. Safety issues are discussed further in the "Safety" section below.

Finding: In the Eastern Freeway bus/emergency lane, motorcycles should be able to share the lane without causing undue delay to buses or other vehicles. However, outside of bus times, and in emergency lanes more generally, rapidly-moving motorcycles will not be compatible with other users of the lanes.

5.3. Safety

A number of safety issues have already been raised in relation to motorcycle usage of general emergency lanes:

- unsuitable pavement surfaces on some freeways;
- narrow or discontinuous lanes;
- abutting noise walls and barriers;
- cyclist usage of emergency lanes on rural freeways; and
- risks associated with motorcycles moving at high speed in lanes that may contain stationary vehicles.

Unless the lanes were engineered to provide a consistent riding environment, then the safety hazards would be too great to allow motorcycles to use emergency lanes.

The Eastern Freeway provides an example of where appropriate engineering and lane regulation have been implemented to allow buses to use the lanes safely.

The transit (T2) lane on the Eastern Freeway can already be used by motorcycles, but motorcycles need to move across several lanes of traffic in order to access the lane. Although this manoeuvre is easier in uncongested conditions, during morning peak times it can become more difficult. Opening the emergency/bus lane for motorcycles at these times

would allow some motorcyclists to avoid the lane-changing manoeuvre, and potentially enhance safety as a result[14].

If motorcycles were to be permitted in the Eastern Freeway emergency lane, safety conditions at on- and off-ramps should be reviewed to ensure that sight lines and lane configurations are appropriate. Where buses need to merge into the main driving lane at on- and off-ramps, the safety impact on motorcycles should also be assessed.

Finding: In the Eastern Freeway bus/emergency lane, motorcyclist safety and mobility may be improved by allowing motorcyclists into the lane during bus times. However, more generally across the road network, emergency lanes could not be used safely by motorcyclists unless the lanes were engineered and regulated as proper driving lanes.

5.4. Legislation and Enforcement

Present legislation prohibits motorcycles (and other vehicles) from using an emergency lane for non-emergency purposes unless signage permits access to the lane. This arrangement is considered satisfactory and should be maintained.

We are not aware of any freeways in Victoria where emergency lane non-compliance is an issue. Emergency lanes tend to be self-enforcing, as they generally do not provide a hospitable travelling environment for motorcyclists or other vehicles.

Finding: Given the difficulties in admitting motorcycles to emergency lanes, no legislative or enforcement changes are considered necessary, however legal advice should be sought to confirm this is the case.

5.5. Assessment

The usage of emergency lanes by motorcycles is not recommended, due to the many physical, operational and safety hazards associated with their use. An exception is the Eastern Freeway emergency lane which operates as a bus lane at certain times of the day. In this case, many of the arguments raised in Chapter 4 for allowing motorcycles into bus lanes are valid, implying that motorcycles could use the lane at these times.

These findings are summarised in the assessment table below.

[14] This statement is not supported by any factual evidence or trial data, but seems to be a logical conclusion from considering the hazards of lane-changing in heavy traffic.

	Physical / Operational	Other road users	Safety	Legislation and enforcement	Overall Assessment	
General emergency lanes					Hazardous and inadvisable to implement	
Bus/emergency lanes					Could be considered for possible future implementation during bus times	

6. Bicycle Lanes

Melbourne and some Victorian regional centres have a growing network of bicycle lanes to provide dedicated road space for cyclists. By encouraging separation between bicycles and other vehicles, bicycle lanes help to increase cyclist safety and conspicuity.

The question of whether motorcycles should be allowed to use bicycle lanes has recently been debated in the local media (Bartlett 2009, Brown 2009)[15]. Although the debate has been touted as a standoff between motorcyclists and cyclists, the two groups actually seem to have similar perceptions of the main issues:

- bicycles and motorcycles have distinctly different power, weight and speed characteristics, and would not be good companions in a narrow bicycle lane;
- in urban areas, bicycle lanes are often adjacent to parked cars, with car doors opening into the lane and creating a collision hazard; and
- in moving traffic, motorcyclists often prefer to ride well out into the traffic lane so they are more visible and not squeezed by other vehicles.

The main point of contention seems to be around the occasional use of bicycle lanes by motorcyclists to overtake traffic queues. Some motorcyclists argue that this is simply legalising a practice that happens already, whereas Bicycle Victoria is concerned that even a small amount of encroachment into bicycle lanes will compromise the safety and integrity of the lanes. (Brown 2009).

In other countries, similar debates have resulted in some powered two-wheelers being admitted to bicycle lanes. In Amsterdam, for instance, scooters (but not motorcycles) are permitted in bicycle lanes. Reduced-speed mopeds are permitted to use bicycle paths in Belgium, Germany and the Netherlands (Noordzij *et al*, 2001). Our literature review did not find any published experiments or trials of motorcycles in bicycle lanes.

David Purchase from the Victorian Automobile Chamber of Commerce was reported in the Melbourne *Age* newspaper as saying that scooters should have access to bike lanes but higher powered motorcycles should not. However, Steve Bardsley, president of scooter club Melbourne Crusaders, said in response, "...riders aren't happy to be lumped in with pushbikes. 'We wish they'd talked to us, really. We want to keep as far away from cyclists as possible.'" (Bartlett 2009)

The underlying questions to be addressed by this chapter are:

- Is there a reasonable case for admitting powered two-wheelers into bicycle lanes?
- If so, what should the thresholds be (in terms of power, size, weight and speed)?

[15] The groups interviewed in these media reports included the Motorcycle Riders' Association, Bicycle Victoria, Victorian Automobile Chamber of Commerce and the Melbourne Crusaders scooter club.

6.1. Physical and Operational Issues

There is a great deal of variability in the speed, acceleration, braking and weight characteristics of powered two-wheelers, just as there is significant variability in the types of bicycles and cyclist abilities.

Table 4 compares the performance characteristics of a selection of typical motorcycles, scooters, mopeds, electric and pedal cycles. Elements of this table are discussed in the following sub-sections.

- Table 4: Powered two-wheeler and bicycle performance comparisons

Model	Honda ST1300	Honda CB400	Honda SH150i	Honda Lead	Honda Today 50	200W electric bicycle	Giant road bicycle
Class	Touring motorcycle	Mid-range motorcycle	Scooter	Scooter	Moped	Power-assisted bicycle	Bicycle
Engine capacity (cm3)	1,261	400	153	100	49	N/A	N/A
Width (mm)	1,330	725	700	710	630	550	550
Mass (kg) (no petrol, no rider)	289	194	127	102	71	23	9
Top speed (km/h)	240	185	105	85	50	30	Varies
Acceleration 0-100 km/h (s)	3.8	5.4	13	N/A	N/A	N/A	N/A
Kinetic energy in 60 km/h zone with 75kg rider (joules)	51,000 (60 km/h)	37,000 (60 km/h)	28,000 (60 km/h)	25,000 (60 km/h)	14,000 (50 km/h)	3,400 (30 km/h)	1,300 (20 km/h)
Kinetic energy at 20 km/h with 75kg rider (joules)	5,600 (20 km/h)	4,200 (20 km/h)	3,100 (20 km/h)	2,700 (20 km/h)	2,300 (20 km/h)	1,500 (20 km/h)	1,300 (20 km/h)
Permitted in bicycle lanes	No	No	No	No	No	Yes	Yes

Sources: Honda web site, electric bicycle supplier web site, Giant Bicycle web site, motoprofi.com

Note: The variation in rider mass (e.g. 50-110 kg) introduces a range to each of these variables. The assumed mass of a light rider (75 kg) has been used as a baseline for comparison. Note also that there are wide variations in electric bicycle specifications. The example given in the table represents a typical electric bicycle available in Victoria.

Width Constraints

Bicycle lanes are commonly 1.2–1.5m wide in typical urban settings in Victoria (e.g. 60 km/h zones). In high-speed environments (e.g. 100 km/h zones), they are more often 2.5-3.0m wide to provide greater separation from other traffic. If powered two-wheelers were permitted in bicycle lanes, larger motorcycles, such as tourers with side compartments, might be too wide to use the typical narrow urban lanes safely. Three-wheelers categorised as "motorcycles" would generally not fit into standard urban bicycle lanes at all. However, most solo motorcycles and scooters could physically fit into bicycle lanes.

Kinetic Energy

Kinetic energy is commonly used as a measure of the "hitting power" of a vehicle when it crashes. During a crash, the kinetic energy of the vehicle is dissipated as heat, sound and deformation (of the vehicle, rider and obstacle).

Two measures of kinetic energy are shown in Table 4:

- the energy when the vehicle is travelling at its practical maximum speed in a 60 km/h zone (i.e. free-flowing traffic conditions);
- the energy when the vehicle is travelling at 20 km/h (i.e. congested traffic conditions).

In maximum speed conditions, the kinetic energy of a scooter or motorcycle is 20-30 times that of a typical bicycle[16] [17]. This supports opinions expressed by motorcyclists and cyclists that the two vehicle types are incompatible in higher-speed situations (see the discussion on page 31).

At lower speeds, the energy comparisons indicate better compatibility, although typical scooters and motorcycles still have 2-3 times the kinetic energy of a bicycle.

Finding: At speeds above 20km/h, powered two-wheelers generally have kinetic energy characteristics that are incompatible with bicycles. Any form of lane sharing would require significant speed reductions by powered two-wheelers so that the speed differential between PTWs and bicycles is minimised. Large motorcycles (often, but not necessarily, with larger engine capacities) may prove to be physically incompatible.

Further Comments

The effects of kinetic energy apply to the *difference* in speed between the vehicles involved in a collision. The key issue is therefore the range of speeds that might be expected by bicycles and powered two-wheelers if they were to share a bicycle lane. The braking performance of bicycles is also substantially less than that of motorcycles, so there are further aspects of speed variation that need to be considered in any risk assessment before the nominal 20 km/hr speed could be used as a definitive threshold.

[16] The higher mass of some electrically-powered two-wheelers categorised as "bicycles" make the kinetic energy distinctions less clear cut. A complicating issue is that some electric bicycles look like light scooters.

[17] Larger touring motorcycles may have more than 40 times the kinetic energy of a bicycle but, as noted earlier, they are unlikely to be able to use bicycle lanes due to width constraints.

The trend in vehicle regulation in Australia is to move from vehicle categories and detailed specifications to performance-based standards. In this case, vehicle dynamics would be the basis for compatibility decisions as they now are for trucks. While some work has been done on some of the possible performance-based criteria for mopeds and bicycles (Wigan 1979), this issue has yet to be formally addressed for modern motorcycles, bicycles and crossover vehicles (of which electric bicycles are but one example).

6.2. Other Road Users

Aside from the performance comparisons above, there is little hard evidence to enable conclusions to be drawn about how motorcycles might affect other users of bicycle lanes. Experimentation would be needed to gather physical and behavioural evidence of the true impacts. The outcomes will depend on the relative volumes of cyclists and motorcyclists, as well as ambient speeds and traffic conditions.

In the absence of clear-cut evidence, this study adopted a “what if” process to explore the possible outcomes:

- consider scenarios where the sharing of bicycle lanes may be acceptable;
- consider scenarios where sharing is unlikely to be acceptable;
- make a judgement on the likelihood of these scenarios occurring; and
- consider the safety implications and necessary policy measures if sharing was to occur.

Figure 9 lists the scenarios that were considered in the “what if” analysis[18].

[18] Note that these “what if” scenarios are speculative and are not based on observed behaviour. Experimental trials would be needed to confirm whether these assumptions are realistic, and to determine whether other behaviours (such as some cyclists disobeying traffic signals) would have an impact on the shared use of bicycle lanes.

■ Figure 9: Acceptability of lane-sharing scenarios

	Less Likely	More Likely
Acceptable	Motorcycles travel at slow speeds (< 20 km/h) and do not overtake cyclists	Occasional usage of bicycle lanes by motorcycles to bypass traffic queues while cyclists are not present
Not Acceptable	Motorcycles place pressure on cyclists who are "too slow" (or vice versa) High motorcycle volumes crowd cyclists in the lane	Encroachment of motorcycles causes cyclists to feel less safe Motorcyclists travel at speeds incompatible with bicycles

It would be difficult to implement enforceable rules to prevent the "not acceptable" outcomes in Figure 9 from occurring. Shared use of bicycle lanes would require a voluntary effort on the part of motorcyclists and cyclists to ensure that speeds and behaviour were compatible. In an ideal situation, this could work well; in practice, it is unlikely that consistent riding behaviour could be achieved.

Finding: Although motorcycles and bicycles could share lanes successfully in a low-speed, non-overtaking scenario, this could not be easily enforced. It is likely that the presence of motorcycles would cause cyclists to feel less safe in a bicycle lane, detracting from the government's objective of encouraging travel by non-motorised modes.

6.3. Safety

Aside from the speed-compatibility issues discussed in the previous sections, the use of bicycle lanes would make motorcycles more susceptible to roadside hazards. These might include parked cars opening doors into the bicycle lane and vehicles turning out of side streets. For these reasons, many motorcyclists are understood to prefer riding well out into the traffic lane rather than close to the kerb.

Finding: Lack of speed compatibility with cyclists and the presence of pedestrians and roadside hazards may increase the collision risk for motorcyclists in bicycle lanes.

6.4. Legislation and Enforcement

As noted in section 6.2, it is unlikely that enforceable rules could be introduced to reduce the safety risks of motorcycles in bicycle lanes. As a minimum, rules would need to include:

- maximum speed of 20 or 30 km/h (i.e. similar to typical bicycle speeds); and
- no overtaking in the bicycle lane.

However, as well as limiting motorcycle behaviour, they could potentially disadvantage cyclists (for example, when cyclists travel quickly downhill).

Finding: Rules such as "no overtaking in the bicycle lane" and speed limiting the bicycle lane to 20 or 30 km/h could be considered. However, these rules would be difficult to enforce in practice and may disadvantage motorcyclists and cyclists.

6.5. Assessment

On balance, it is difficult to make a case for the introduction of motorcycles to bicycle lanes without further safety and behavioural research. The incompatibilities between vehicle speeds, weights, acceleration and deceleration, the potential negative impacts on cyclists and the difficulty in enforcement tend to outweigh the relatively small benefits to motorcycles.

	Physical / Operational	Other road users	Safety	Legislation and enforcement	Overall Assessment	
Bicycle lanes					Negative impacts appear to outweigh benefits. Further research may assist.	

7. Tram Lanes

Tram lanes are on-road lanes that are used exclusively by trams to reduce tram travel times and increase tram reliability. They may be **full time** (operating at all times) or **part time** (operating between specified times of day). Off-road tram reservations, such as the Port Melbourne light rail, and median reservations, such as Dandenong Road, are not appropriate for motorcycles and are not considered in this study.

7.1. Physical and Operational Issues

Full-time tram lanes commonly use separation strips to discourage traffic from straying into the tram lane. The separator strips have a raised profile and would be hazardous for motorcycles wanting to change lanes.

7.2. Other Road Users

The impacts on trams and other road users are not expected to be very significant. This assertion would need to be tested through consultation with tram operators, drivers and stakeholders if motorcycle use of tram lanes was to be considered. Many of the same arguments presented in the bus lane chapter (see page 23) can also be made in the case of tram lanes.

7.3. Safety

Many motorcyclists avoid riding on tram tracks, as the tracks are a slipping hazard, particularly in wet weather (see Figure 10). Tram tracks may also cause unexpected tracking of the motorcycle's front wheel, and uneven pavement between the tracks can also be hazardous. These are some of the biggest disincentives for motorcyclists to use tram lanes.

- Figure 10: Tram tracks are often hazardous for motorcyclists

Raised tram lane separators (section 7.1) have also been identified as a hazard when motorcycles move between lanes.

Passengers crossing the road or waiting for trams may also not expect motorcycles to be using tram lanes, leading to the potential for increased risk of collisions and near-misses.

7.4. Legislation and Enforcement

The Victorian Road Safety Rules 2009 do not permit motorcycles to travel in tram lanes except to avoid obstructions, or when entering or leaving a road (Rules 155 and 158). The Road Rules make provision for vehicles to be admitted to the tram lane if a sign permits them to do so. Motorcycles could therefore be admitted to tram lanes on a site-by-site basis with appropriate signage.

If motorcycles were to have a more general right of admission to tram lanes, then changes to the Road Rules might be warranted. However, given the disincentives for motorcyclists to use tram lanes, it is unlikely that this would be worthwhile.

7.5. Assessment

The hazards associated with tram tracks and lane separators make the use of tram lanes by motorcycles unattractive. Except in very congested conditions, the benefits to motorcyclists are expected to be minimal.

	Physical / Operational	Other road users	Safety	Legislation and enforcement	Overall Assessment	
Tram lanes					Little benefit for motorcyclists	

Part 4: Exclusive Lanes

The use of separate exclusive lanes for motorcycles is perhaps the ultimate treatment for improving motorcyclist safety and mobility. Segregating motorcycles from the rest of the traffic stream eliminates conflict with other vehicles and provides motorcyclists with uninterrupted riding conditions.

Exclusive lanes have been used effectively in some South East Asian countries where motorcycle usage is much higher than in Australia. This chapter looks at how exclusive lanes could be implemented in Victoria, and the practical constraints that would discourage their widespread use.

8. Motorcycle-Only Lanes

In countries with high motorcycle usage, such as Malaysia and Taiwan, exclusive motorcycle lanes have been used to separate motorcycles from other traffic and reduce motorcycle crash rates. Motorcycles are relatively cheap in these countries and, in some cities, motorcycle usage rates exceed those of cars. Figure 11 shows an extreme example of motorcycle congestion in Taipei, illustrating the contrast in conditions between Australian urban areas and some parts of South East Asia.

- Figure 11: Extreme motorcycle congestion in Taipei, Taiwan (Hsu *et al* 2003)

The International Road Assessment Program (iRAP) lists two main forms of motorcycle lane:

- **Inclusive lanes** which are generally located to the left of a carriageway and separated from traffic by a physical barrier or line-marking (see Figure 12). At intersections inclusive motorcycle lanes rejoin the main carriageway and crashes can be more common at these locations.
- **Exclusive lanes** which are carriageways entirely separated from those used by other traffic and intended for the sole use of motorcyclists (see Figure 13).

Motorcycle-only lanes are not presently used in any Australian states. This chapter considers whether motorcycle-only lanes would have practical applications in Victoria.

- Figure 12: Examples of inclusive motorcycle lanes (Gitano 2008, iRAP 2010)

- Figure 13: Examples of exclusive motorcycle lanes
  (i) Intersection bypass (Gitano, 2008), (ii) Off-road path (iRAP 2010).

8.1. Malaysia – A Case Study

To understand the use of exclusive lanes in a country like Malaysia, the context of motorcycle use must be understood. Subramaniam (2008) quotes the following facts about Malaysia (in 2006):

- a population of 27 million;
- 15.8 million registered vehicles;
- 7.5 million registered motorcycles; and
- 10.4 million registered drivers.

In the period between 1990-2000, almost 3,000 motorcyclists were killed every year in traffic accidents (Sulistio 2004).

To address the high crash rate, Malaysia installed its first motorcycle-only lane in the 1970s, with many more being constructed in later years. They were generally constructed along roads with high volumes and speeds (e.g. freeways). A study commissioned by the Malaysian government into motorcycle lane widths found that "an exclusive motorcycle lane needs a control width 3.81m (inclusive marginal stripe 0.38m at both edge) for two riders travel side by side comfortably at a speed of 70 km/h (enforced speed limit for exclusive motorcycle lane) (sic)" (Munusamy 2008).

Zulakmal (2009) recommended that "the decision to provide a motorcycle lane is based on the volume of traffic, the percentage composition of motorcycles and the annual number of accidents involving motorcycles for every lane-kilometre of road."

Motorcycle-only lanes in Malaysia have contributed to a significant reduction in accident severity. Fatalities were reduced by 39% on Federal Highway F02 after motorcycle lanes were introduced (Radin Umar 2008). At the same time, there was a marked increase in minor accidents due to motorcycles colliding with each other.

In summary, the provision of motorcycle lanes is seen primarily as a safety initiative in Malaysia. The treatment is endorsed by iRAP as an effective means of reducing fatalities on routes where motorcycle volumes are significant.

8.2. Physical and Operational Issues

iRAP recommends the following design and safety requirements for motorcycle lanes:

- "*Unless they are well designed, motorcycle lanes can increase motorcycle to motorcycle crashes.*
- *Motorcycle lanes should be at least 1.8 meters wide (for each direction).*
- *Motorcycle lanes should be at least 3.6 meters wide if overtaking is permitted.*
- *Horizontal and vertical alignment must be suitable for speeds at which motorcycles will be traveling on the lane.*
- *Off-ramps must be designed so that motorcyclists exiting the lane are not at risk of being hit from behind by other motorcyclists.*
- *Crash barrier support posts facing the lane are a hazard and must be protected.*
- *Centre line marking should be provided in lanes that are wider than 3.5 metres.*

- *The surface of motorcycle lanes must be properly maintained. Because motorcycles have only two points of contact with the road, slippery or rough road surfaces are a crash risk.*" (iRAP 2010)

Given the width requirements of motorcycle lanes, their implementation in Victoria would require a significant amount of road space and may also require the removal of on-road parking. With Victoria having a relatively small proportion of motorcycles in the traffic stream, it is unlikely that the benefits to motorcycles would be sufficient to warrant the reduction in road space for other traffic and public transport, and the consequent reduction in throughput of people.

An exception might be in the case of a new road link, such as a high-speed, high-capacity freeway. In this case, a motorcycle lane could be considered in the road design so that it is well-integrated with other traffic streams. However, present motorcycle volumes would mean that such lanes would be underutilised unless there was a significant increase in motorcycle ridership.

Finding: In Victoria, the significant road space requirements of motorcycle lanes (1.8 – 3.6 metre width) and low motorcycle volumes mean that retrofitting these lanes to existing roads or incorporating them into new roads is unlikely to be economically feasible.

8.3. Other Road Users

If motorcycle lanes were to be retrofitted to existing roads, they would lead to the loss of at least one traffic lane or on-road parking unless the road was widened. In most cases, the negative capacity impacts would be significant for other vehicles.

Roads with bicycle lanes would present further difficulties. As well as there being insufficient road width in many cases, motorcyclists and cyclists would need to cross over each other's lanes when turning at intersections.

Finding: Unless roads were widened to incorporate motorcycle lanes and much higher volumes of motorcycles were to be reached, the loss of road capacity for other vehicles is likely to be unacceptable.

8.4. Safety

The evidence from Malaysia, Taiwan and Vietnam points to quite significant reductions in motorcycle-related fatalities with motorcycle lanes (Radin Umar 2008, Hsu *et al* 2003). However, the number of other injury crashes rose in these countries after motorcycle lanes were implemented – largely because of the concentration of motorcycles in one part of the road space.

In the Australian context, we expect that motorcycle lanes would also provide safety benefits to motorcyclists, though possibly with a less dramatic effect on fatality rates, given the lower volumes of motorcycles and compulsory helmet-wearing laws.

Finding: There is clear evidence to show that motorcycle lanes have helped to reduce fatalities in South East Asian countries with high motorcycle usage. In Victoria, some safety benefits would also be expected, but possibly not to the same extent.

8.5. Legislation and Enforcement

The Victorian Road Safety Road Rules do not presently make allowance for motorcycle-only lanes. If motorcycle-only lanes were to be considered for introduction in Victoria, Part 11 Division 6 of the Rules[19] would need to be updated to cover their use. Other sections of the Road Rules would also need to be reviewed and updated as necessary. Legal advice should be sought to confirm the necessary rule changes if motorcycle-only lanes were to be considered.

8.6. Assessment

Motorcycle lanes have been shown to provide safety benefits to motorcyclists in South East Asia. In Australia, the physical constraints of available road space would make powered two-wheeler lanes infeasible unless there was a significant increase in the volume of powered two-wheelers.

	Physical / Operational	Other road users	Safety	Legislation and enforcement	Overall Assessment	
Motorcycle-only lanes					Not economically justifiable at present	

[19] This division covers bicycle, tram and other special-purpose lanes.

Part 5: Application in Victoria

The final section of this report looks at how the motorcycling measures discussed in the previous chapters could be implemented in Victoria.

Chapter 9 discusses the development of priority motorcycling routes which would be the focus of motorcycling improvements. VicRoads' SmartRoads strategy and the 'Safe Routes' for two-wheelers concept proposed by VACC are used to illustrate some of the avenues that could be explored.

Chapter 10 draws together all of the findings of the previous chapters and suggests some further steps for advancing motorcycle road space management in Victoria.

9. Motorcycle Route Development

Motorcycle road space measures will be most effective if they are used consistently across the network and are concentrated on the routes that are best suited to motorcycle use.

This chapter reviews two schemes that have a bearing on motorcycle route development in Victoria:

- "Safe Routes" for two-wheelers, a campaign being run by the VACC; and
- VicRoads "SmartRoads" strategy for establishing priorities for road access.

9.1. "Safe Routes" For Two-Wheelers

The Victorian Automobile Chamber of Commerce (VACC) has advocated the concept of "Safe Routes" for two-wheelers in recent years.

The VACC proposition is that:

> "*a system of 'Safe Routes' be identified, signed and promoted across the city for users of two wheeled transport. That these routes have clearly designated lanes, with traffic management features designed to encourage their use. (This would encourage car drivers using these routes to become more alert to bicycle and scooter riders and to thus adopt better road sharing practices.)*" (VACC 2006).

To support the "Safe Routes" principles, VACC has also advocated the use of various road space measures such as:

- filtering (or feeder) lanes on intersection approaches to facilitate advanced positioning;
- advanced stop lines at intersections;
- the sharing of bicycle lanes by scooters and mopeds;
- the allowance of hook turns by all two-wheelers at intersections; and
- the admission of scooters and motorcycles to bus lanes.

Just as the Principal Bicycle Network identifies priority routes for bicycle treatments and funding, the "Safe Routes" network would help prioritise measures to support motorised two-wheelers and bicycles.

Benefits

The "Safe Routes" network could provide a useful decision-making support tool for VicRoads and local councils who have responsibility for the arterial and local street networks. The benefits of focusing road space measures on a set of agreed routes could include:

- better co-ordination of state and local government efforts;
- better connectivity and consistency of motorcycle routes;
- improved driver awareness of two-wheelers on nominated routes; and
- maps of preferred motorcycle routes (e.g. Melway, Google, learner education).

Challenges

For the “Safe Routes” network to be visible and effective, it would need a combination of mid-block measures and intersection measures.

The intersection measures proposed by VACC (e.g. advanced stop lines) could be feasible if motorcycles can get to the front of the traffic queue (see Chapter 3). However, the provision of feeder lanes to provide access to ASL stopping areas would be difficult (see section 3.2) unless roads were widened on intersection approaches.

In mid-block situations, the sharing of bus lanes by two-wheelers is generally feasible. However, given the limited number of bus lanes at present, one would expect that riders would seek access to bicycle lanes as an alternative “safe space”.

It appears that the “Safe Routes” concept would work best if powered two-wheelers were permitted to use bicycle lanes. As discussed in Chapter 6, though, the sharing of bicycle lanes is problematic because it is difficult to enforce the low speeds necessary for bicycles and powered two-wheelers to share the lanes safely. However, if enforcement mechanisms could be put in place, a trial might be feasible to gather data on lane-sharing issues.

9.2. SmartRoads and Network Operating Plans

SmartRoads is a strategic approach developed by VicRoads to manage the competing demands for limited road space by allocating priority to different transport modes at particular times of the day.

SmartRoads uses a set of guiding principles to establish how priority should be allocated to each road and intersection, depending on the road’s function and the adjoining land uses. The collection of priority movements in an area form the network operating plan for the region.

Some examples of the SmartRoads principles are:

- pedestrians will be encouraged by facilitating walking access in activity centres during periods of high demand;
- trams and buses will be given priority on key public transport routes that link activity centres during morning and afternoon peak periods;
- cars will be encouraged to use alternative routes around activity centres to reduce the level of ‘through’ traffic;
- bicycle trips will be encouraged by further developing the bicycle network; and
- while trucks will have full access to the arterial road network, they will be given priority on important transport routes that link freight hubs and at times that reduce conflict with other transport modes.

The SmartRoads framework allocates motorcycles to the “car” category for the purpose of prioritising modes. Provision of road space measures for motorcycles would therefore tend to focus on the car routes identified in the network operating plan.

10. Conclusions

10.1. Summary of Assessments

Table 5 summarises the assessments for all of the road space measures evaluated in this study.

- Table 5: Summary of assessments

Road Space Measure	Physical / Operational	Other road users	Safety	Legislation and enforcement	Overall Assessment	
Advanced stop lines	✓	✓	⚠	⚠	Further safety research and legal review needed. Provides no benefit unless motorcycles can reach the front of queue	⚠
ASLs with feeder lanes	⚠	✓	⚠	⚠	Trials of feeder lanes needed before considering implementation	⚠
Bus lanes	✓	✓	●	✓	Could be considered for further safety trials	✓
General emergency lanes	✗	✗	✗	✓	Hazardous and inadvisable to implement	✗
Bus/emergency lanes	✓	✓	●	✓	Could be considered for possible future implementation during bus times	✓
Bicycle lanes	⚠	⚠	⚠	⚠	Negative impacts outweigh benefits. Further research may assist.	✗
Tram lanes	⚠	✓	⚠	✓	Little benefit for motorcyclists	✗
Motorcycle-only lanes	✗	⚠	✓	✓	Not economically justifiable at present	✗

Of the measures considered here, the most promising are **advanced stop lines**, the sharing of **bus lanes** and the use of the **bus/emergency lane** on the Eastern Freeway during bus times.

- For advanced stop lines to be effective, motorcycles must be able to reach the front of the traffic queue. Although feeder lanes would be ideal for this purpose, space constraints may mean that they cannot be fitted into the available road space.
- The sharing of bus lanes would be relatively straightforward to implement. Changes to signage are all that would be required in most cases, along with an appropriate public education and communications strategy. However, queue jump lanes with “B” traffic signals are not suitable for motorcycle use and will need to be carefully distinguished from other bus lanes.

Of the remaining measures, the use of bicycle lanes by motorcycles is perhaps the most controversial. Although smaller powered two-wheelers moving at slow speeds could coexist with bicycles, research into compatible and incompatible combinations of two-wheelers would be needed before a definitive conclusion can be reached. The emergence of higher-powered electric bicycles (presently outside Australia) and electric motorcycles may also raise future questions about access to bicycle lanes.

Motorcycle-only lanes have been shown to provide safety benefits in cities with high motorcycle usage. In Victoria, where the proportion of motorcycles in the traffic stream is small, the benefits of dedicated lanes would be outweighed by the costs to other road users in most cases.

10.2. Next Steps

The following actions are suggested to provide further evidence for considering implementation of motorcycle road space measures:

- conduct consultation with the bus industry and motorcycle groups to confirm situations where motorcycles could be considered for admission to bus lanes;
- conduct a trial of a motorcycle advanced stop line and feeder lane, observing behaviour of all road users and impacts on capacity before and after implementation;
- in consultation with motorcycle groups, consider opening the Eastern Freeway bus lane to motorcycles during bus times (subject to an appropriate safety review);
- consider how network operating plans will accommodate motorcyclists and what opportunities exist to develop priority motorcycle routes in urban areas;
- develop suitable evaluation and modelling methods to determine where and when road space measures for powered two-wheelers would be warranted.

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Appendix B: Stakeholder Workshop

A workshop was held on 17 May 2010 to present the findings of this study to stakeholders from VicRoads, the Department of Transport, Victoria Police, local government, bus representatives, motorcycle groups and other road-user advocacy groups. The purpose of the workshop was to provide VicRoads with feedback on the study findings and identify any issues for further consideration as motorcycle road space policies are developed.

This appendix summarises the main themes that arose at the workshop. The views expressed do not necessarily represent VicRoads' position on these themes, but reflect the opinions of individual stakeholders.

B.1 List of Attendees

Attendee	Group Represented
Jason den Hollander	Bicycle Victoria
Kate Simnet	City of Yarra
Melissa Schellekens	Department of Transport (Walking & Cycling)
Paul Smith	Department of Transport (PT Policy)
Steven Herbert	Department of Transport
Bruce Corben	Monash University Accident Research Centre
Marcus Wigan	Oxford Systematics
Emily McLean	RACV
Craig McPherson	Sinclair Knight Merz
Samantha Cockfield	Transport Accident Commission
Steve Stafford	Ventura Bus Lines
Jill Earnshaw	VicRoads
Tania McClure	VicRoads
Mike Smith	VicRoads (Motorcycle Programs)
A/S/Sgt Shane Cowman	Victoria Police
David Russell	Victorian Automobile Chamber of Commerce
Malcolm Carrison	Victorian Hire Car Association
Wendy Taylor	VMAC rider representative
Tony Ellis	VMAC rider representative
Andrew Luck	VMAC rider representative

B.2 Workshop Themes

Objectives

- We need to be clear about the purpose of what we're trying to achieve with road space initiatives for motorcycles:
  - What benefits will motorcyclists get?
  - Different lane types have different objectives. For example, the purpose of bus lanes is to facilitate the movement of buses and improve their travel time reliability. These objectives should not be compromised in considering motorcycle access.

Preferred PTW Routes

- This topic generated considerable interest and discussion from workshop attendees. The concept of “preferred routes” has been advocated in VACC’s "Safe Routes" campaign for scooters over the last few years.
- "Preferred Routes" is a better term than "Safe Routes"."Safe" routes implies there are "unsafe" routes. Motorcyclists also need to accept some responsibility for riding safely – safe riding can’t be delegated to the infrastructure.
- Nominating preferred routes would guide novice scooter and motorcycle riders in choosing routes that are easier and less hazardous.
- Routes would require delineation such as signs and road marking. An indication of accident blackspots might also be helpful.
- Communication and education will be important. It could form a part of licensing tests for motorists and motorcyclists.
- Preferred routes should be considered throughout rural and regional areas of Victoria, not just in metropolitan Melbourne. For example: feeder roads to the Great Ocean Road from the Princes Highway.
- Victoria Parade could be a potential route – it is wider than many congested urban routes. However, it would need to be viewed in the context of the wider network.
- Preferred routes do not necessarily require infrastructure (e.g. motorcycle lanes or advanced stop lines).
- What criteria should be used to decide whether routes are better or worse?
  - Could we develop iRAP/AusRAP guidelines for motorcycles?
  - Convenience and time are also important, not just safety.
  - Network Operating Plans (SmartRoads) could include preferred motorcycle routes.
  - Criteria could also take account of tram tracks, heavy vehicles, etc.
- Mapping and route identification
  - May be opportunities to incorporate into GPS navigation.
  - Signage may be of limited usefulness, e.g. signing of bike routes is not always helpful.
  - Little research has been done on route choice for motorcycles.

Bicycle Lanes

- The Victorian Cycling Strategy is a fundamental part of the Victorian Transport Plan. It encourages more on-road cycling and has strong Ministerial support. Melissa Schellekens' view was that the Strategy doesn't support motorcycle usage of cycling infrastructure – indeed this could compromise the objectives of the strategy (e.g. promoting healthy activity, reducing carbon emissions).
- Motorcyclist responses:
  - » Bicycle lanes would tend to be used only when traffic is congested.
  - » Using bicycle lanes would be seen as a bonus, not a right. Therefore, motorcyclists may be prepared to travel more slowly, especially in a narrow lane.
- Cyclists responses:
  - » General concern that the introduction of motorcycles would cause cycling numbers to decrease.
  - » There may be more feelings of vulnerability among cyclists. (Even a motorcyclist participating in the workshop said that he would feel this way when riding a bicycle.)
- Copenhagen-style lanes may need to have different access and usage permissions than standard bicycle lanes.
- Kinetic energy comparisons also need to consider the vulnerability of the riders/drivers involved in crashes.
- Enforcement
  - » Differentiating between scooters and motorcycles can be difficult, therefore different rules for smaller PTWs and larger PTWs could be difficult to enforce.
  - » Enforcement of differential speed limits can be done with laser speed detection devices.
  - » Enforcement of a "no overtaking in bicycle lanes" rule could be done.
  - » Fairness: need to address cyclist infringements as well as motorcyclist infringements.
- Participants felt that motorcycles entering a bicycle lane could clip cyclists accidentally, leading to increased injury risk. There is presently no good data available to test this assertion.
- If motorcycles were to be permitted in bicycle lanes, more consistent lane widths and delineation would be needed.

Advanced Stop Lines

- MUARC highlighted the potential issue of ASLs placing vulnerable motorcyclists (and cyclists) at greater risk of collision with red-light running vehicles from cross streets.

Bus Lanes

- Responses:
  - » Ventura was not supportive of motorcycles using bus lanes, particularly on high-frequency routes such as the Eastern Freeway bus/emergency lane.
  - » Bicycle Victoria is still considering its position on the issue.
  - » MUARC said that it wouldn't feel comfortable without a full safety assessment, particularly for the high-speed environment on the Eastern Freeway.

Eastern Freeway Bus/Emergency Lane

- The speed differential between adjacent lanes is a key issue:
  - Entering and exiting lane is most hazardous.
  - There are important performance differences between motorcycles and scooters. Low-powered mopeds (with a maximum speed of 50 km/h) might interfere with buses and other vehicles in the lane.
- There are important safety considerations at on-ramps and the Hoddle Street off-ramp with merging and queuing traffic.
- Emergency vehicle access needs to be considered.

Performance Issues

- Not all PTWs have similar capabilities, e.g. low-powered mopeds look like a motorcycle but have far less speed and acceleration potential. This needs to be considered when developing policies that affect all powered two-wheelers.
- Performance-based standards are being used in the freight industry to distinguish between vehicle capabilities – a similar approach might be used with PTWs. However, enforcement of different rules for each performance category could be difficult if PTWs have similar appearance.

Tram Lanes

- The T-light issues needs to be considered in tram lanes (analogous to the B-light issue in bus lanes).
- Part-time lanes may have some value for PTWs as they tend not to use raised separators and special signals.

Data Needs

- There are very few supporting sources of data to help evaluate road space initiatives. Some basic requirements for proceeding further are:
  - Motorcycle and scooter volumes
  - Motorcycle crash rates in shared-lane situations (Australia and/or overseas)
  - Level of motorcyclist crash exposure on certain routes (e.g. AusRAP for motorcycles)
  - Monitor any international trials of motorcycle usage of bicycle lanes.