Guideline

Route Assessment for Multi-Combination Vehicles (MCV) and Performance Based Standards (PBS) Vehicles in Queensland

May 2022

Queensland Government

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Preface

These Route Assessment Guidelines were prepared to assist Transport and Main Roads officers in assessing the suitability of State Controlled Roads for the operation of Queensland's existing 'as-of-right' restricted access vehicles, and vehicles approved under the National Heavy Vehicle Regulator's (NHVR) Performance Based Standards (PBS) scheme. These vehicles are collectively referred to henceforth as Multi-Combination Vehicles (MCV). The guidelines may also assist in determining road upgrade requirements to allow future MCV access.

The technical information used to inform these guidelines was drawn from many sources, including prior versions of the document, Austroads design guides, and research papers. Notwithstanding this, the guidelines will be subject to on-going review and users can therefore expect the information and advice to be continually updated.

Rather than providing a strict set of requirements that must be adhered to, the guidelines are intended to present Transport and Main Roads officers with a range of road and safety-related considerations, to ensure that the major relevant factors are considered in the route assessment process. Where numerical values are provided for certain road-related parameters, they should be regarded as a guide.

Common sense and sound judgement guided by technical expertise, local knowledge, or experience should be relied upon above all else. In many cases, deficiencies on a proposed route can be accepted if a risk assessment demonstrates that it is not unsafe to do so. A guiding principle is that MCV routes be selected so as to minimise risk to other road users and property whilst facilitating efficient freight movement.

When assessing a potential route, the assessor should initially perform a desktop assessment using maps and available technical records. The desktop assessment exercise should inform the assessor of particular aspects of the route that require physical inspection, and the need for consultation with external parties, particularly where the route intersects an asset owned by others, such as a railway level crossing. Under no circumstances should a route assessment be undertaken by desktop methods only.

The contents of the Figures, Tables and Charts contained within this report are subject to change over time – especially where new vehicle technology and improved manufacturing processes could fundamentally affect vehicle operations.

Appendix A contains a glossary of the technical terms used throughout these guidelines.

1 Introduction

Route assessment is the process of reviewing technical parameters and other characteristics to determine the suitability of access by a certain type or class of heavy vehicle. It has been a necessary access management function since the introduction of restricted access high-productivity vehicles such as B-doubles and road trains, in recognition of their additional geometric and structural demands. The technical parameters considered in the route assessment process are predominantly geometric, but the impacts of vehicles on structures, traffic interaction, and amenity must be considered.

This section provides general information about route assessment, vehicle classes, the Performance Based Standards (PBS) scheme, and prior approaches to route assessment in Queensland. It assists readers unfamiliar with those topics to place these guidelines into the context of prior assessment and regulation schemes in Queensland, and explains the role of PBS in route assessment.

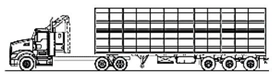
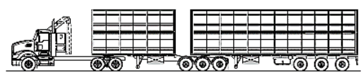
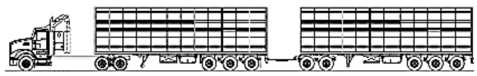
Readers familiar with these topics seeking information on the route assessment process are advised to proceed to the technical sections of this document (Sections 4, 5 and 6).

1.1 Background

1.1.1 Prior treatment of restricted access vehicles

Historically, Transport and Main Roads defined a set of heavy vehicle networks in Queensland, and upper length limits for vehicles operating on those networks, as regulated under the prescriptive limits of the *Transport Operations (Road Use Management) Act* 1995 (Queensland Government 1995). Table 1.1.1 outlines those prescriptive vehicle networks, typical combinations, and overall length limits.

Table 1.1.1 – Prescriptive vehicle networks and overall length limits

Vehicle network	Typical combination	Layout diagram	Overall length limit (m)
General Access	Semi-trailer		19.0
B-double	B-double		26.0
Type 1 Road Train	A-double		36.5
Type 2 Road Train	A-triple		53.5

In 2006, the Queensland Department of Transport and Main Roads published a set of route assessment guidelines for Multi-Combination Vehicles (MCV). Those guidelines were used to assess existing roads for B double and Type 1 and 2 road train combinations. The guidelines assumed that B-triple and AB-triple combinations demonstrate similar performance to conventional Type 1 road trains, and innovative combinations such as BAB-quads, AAB-quads and ABB-quads demonstrate similar performance to conventional Type 2 road trains. This allowed routes suitable for those combinations to be assessed under the guidelines. The guidelines were last updated in 2013.

It was always intended to conduct research to investigate the assumption regarding similarities in performance between innovative and conventional combinations and update the guidelines accordingly.

The guidelines applied only to new route assessments; all existing MCV routes, which had been approved prior to 30 June 2006 and are deemed to perform satisfactorily were not subject to reassessment.

1.1.2 The development of the PBS scheme and impacts on route assessment

The Performance Based Standards (PBS) scheme is an alternative regulatory scheme for heavy vehicles. It provides the industry with opportunities to increase heavy vehicle productivity by exceeding conventional mass and dimension limits provided performance is deemed satisfactory and conventional axle masses are not exceeded.

PBS was initially developed by Australian regulators throughout the 2000s as a response to the demands of the growing road freight task. It was formally approved by the Australian Transport Council (ATC) in October 2007, and then endorsed by the Council of Australian Governments (COAG) as part of national regulatory reforms. At that time, it was 'trialled' by jurisdictions alongside the existing prescriptive regulations, until it was formally adopted by the National Transport Commission (NTC) in a regulatory sense in 2011.

Operation under the PBS scheme is determined on the basis of the vehicle's performance within a set of twenty safety- and infrastructure-related standards (NTC 2008). Hence, the scheme is 'performance' based, and allows vehicles to be longer and heavier, rather than relying on prescriptive limits that constrain mass and dimensions. Table 1.1.2 lists the standards.

Table 1.1.2 – Summary of the safety and infrastructure standards

Standard type	Summary
Safety standards	Startability, gradeability, acceleration capability, overtaking provision, tracking ability on a straight path, ride quality (driver comfort), low speed swept path, frontal swing, tail swing, steer tyre friction demand, static rollover threshold, rearward amplification, high speed transient off-tracking, yaw damping coefficient, handling quality, directional stability under braking.
Infrastructure standards	Pavement vertical loading, pavement horizontal loading, tyre contact pressure distribution, bridge loading.

Performance in some of the standards is not presently assessed as the performance requirements have not been defined. Additionally, some standards rely on prescriptive limits to achieve the required level of performance. Further detail on the standards is provided in NTC (2008), and not repeated here, for brevity. A basic concept of PBS is matching the right vehicles to the right roads. Hence, PBS was designed around four levels of access, intended to roughly match the existing heavy vehicle networks in each state. This was intentional so that jurisdictions could simply gazette their general and restricted access heavy vehicle networks to be used by PBS vehicles.

To support that task, a review of all Australian jurisdictions' individual route assessment guidelines was conducted to produce a set of national guidelines (NTC 2007a), intended for use by the jurisdictions in the classification of PBS networks in their respective states and territories.

The PBS guidelines were generally more comprehensive than the jurisdictions' own guidelines at the time of their publication. For various reasons, most jurisdictions chose to retain their original guidelines; some opted to update them to include new aspects that they considered appropriate.

1.1.3 Introduction of Class A and B vehicles and networks

Because of the strong influence of combination length on gazetting existing networks for PBS, the NTC split three of the four PBS levels into two sub-levels, defined by the maximum lengths of the vehicles that could be operated on those networks. This created 'Class A' and 'Class B' categories within PBS Level 2, 3 and 4.

Length limits under Class A were the same as limits for prescriptive vehicle networks. This meant that existing prescriptive networks could be wholly opened to Class A PBS vehicles. Length limits under Class B were higher, to allow the industry to develop innovative vehicle combinations to deliver the required productivity gains, but this meant that those networks would not have the same coverage as the Class A networks. It was envisaged that parts of the Level 2, 3 and 4 networks could be gradually opened up to Class B vehicles, wherever route assessments showed that they could be safely accommodated.

At the time, it was envisaged that vehicles up to 30 metres overall length could be operated on parts of the existing prescriptive (B-double) networks, and vehicles up to 42 metres and 60 metres overall length could be operated on parts of the Type 1 and 2 road train networks, respectively. Over time, the proportion of networks open to the longer vehicle classes was expected to increase.

Table 1.1.3 outlines the differences in overall length for the PBS Class A and B vehicles.

Table 1.1.3 – Difference in overall length for the PBS Class A and B vehicles

PBS vehicle access class	Vehicle combination upper length limits (m)	
	Class A	Class B
Level 1	20.0	
Level 2	26.0	30.0
Level 3	36.5	42.0
Level 4	53.5	60.0

1.1.4 Prior treatment of PBS vehicles and route assessment in Queensland

Transport and Main Roads initially gazetted a PBS network of Class A routes by directly copying pre-existing networks for restricted access vehicles (for example, B-doubles, road trains) to the applicable PBS classes. Under that approach, the pre-existing B-double network was copied onto the PBS Level 2A network, and the Type 1 and 2 road train networks were copied onto the PBS Level 3A and 4A networks respectively. To cater for Class B vehicles, the department subsequently developed a draft supplement to the PBS guidelines as an interim measure, which was used in the task of assessing Class B networks (TMR 2014).

The guide identified that the increased length of the Class B vehicles over Class A vehicles would place increased infrastructure demands on roads, and provided some recommendations and updated data relating to the following road parameters:

- signal timing, stacking distance and storage lengths at intersections

- warning times and stacking distances at railway level crossings
- overtaking provision, and
- rest areas, and de-coupling and enforcement bay sizes.

The supplementary guideline also included two additional parameters that were not previously covered in the department’s original guide (TMR 2013), relating to grades and floodways. Despite the creation of the supplementary guide (which remained in draft format and was never released), the department's original guideline (TMR 2013) remained the primary document used in route assessments, whilst the NTC guidelines (NTC 2007a) and Transport and Main Roads supplement (TMR 2014) were used mainly in the assessment of Class A routes to determine their suitability to accommodate Class B vehicles.

Table 1.1.4(a) presents an outline of the vehicle types / classes that are covered in each of the guidelines, and Table 1.1.4(b) gives some examples of which guidelines should be used in different assessment scenarios.

Table 1.1.4(a) – Vehicle classes included in the route assessment guidelines

Guideline	Vehicle Classification
PBS Network Classification Guidelines (NTC 2007a)	Vehicles complying with either PBS Level 1, 2A, 3A or 4A*
Route Assessment Guidelines for Multi-Combination Vehicles in Queensland (TMR 2013)	B-doubles, B-triples, and Type 1 and 2 road trains, including AB-triple, BAB-quad, AAB-quad, and ABB-quad combinations
Draft *Queensland Network Classification Guidelines* for Level 2B, Level 3B, and Level 4B roads (TMR 2014)	Vehicles complying with either PBS Level 2B, 3B or 4B

*Note: advice is given on intersection clearance times and stacking distances for Class A and B vehicles.

Table 1.1.4(b) – Examples of the use of route assessment guidelines

Heavy vehicle access		Guideline(s) to be used
Current level	**Desired level**	
Level 1	Level 2A	*Transport and Main Roads Multi-combination vehicle guidelines* (TMR 2013)
Level 2A	Level 2B	*NTC PBS Guideline* (NTC 2007a), and *Draft Transport and Main Roads supplement guidelines* (TMR 2014)
Level 2B	Level 3A	*Transport and Main Roads Multi-combination vehicle guidelines* (TMR 2013)

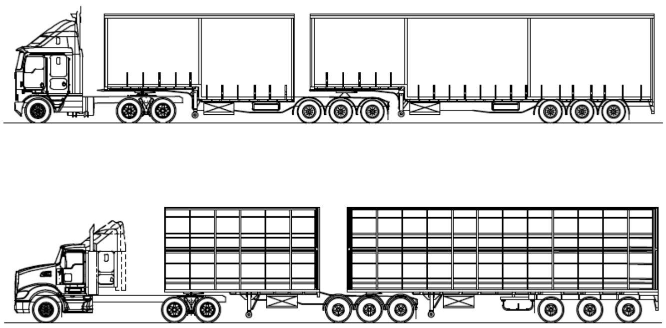
This arrangement, although only an interim solution, was impractical. This route assessment guideline replaces the department's *Route Assessment Guideline* (TMR 2013), its draft supplement (TMR 2014), and the need to use the *PBS network classification guideline* (NTC 2007a).

1.2 Vehicle classification and productivity benefits

1.2.1 B-doubles

A B-double combination comprises a prime mover and two semi-trailers connected by a fifth wheel coupling, as shown in Figure 1.2.1(a). B-doubles are more productive than standard semi-trailers as they are longer and have an extra axle group. As a result, they are commonly used for palletised freight, and can also be designed to suit commodities including grain, bulk liquid (tanker), car transport, and livestock. B-doubles carrying low density freight may be fitted with tandem axle groups on the trailers, but would be restricted to a lower gross mass.

Figure 1.2.1(a) – General freight 26 m B-double (top) and 26 m livestock B-double (bottom)



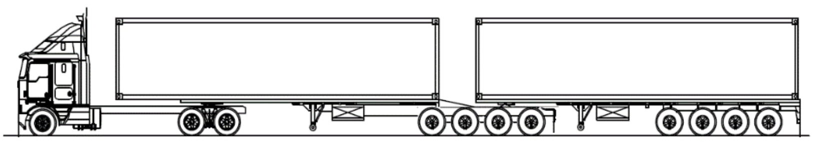
26 m B-double

26 m livestock B-double

Under the Mass, Dimensions and Loading (MDL) regulations within the Heavy Vehicle National Law (HVNL 2015), B-doubles can be up to 26 metres long, and have a gross mass of up to 62.5 tonnes under General Mass Limits (GML). The HVNL also specifies minimum axle group spacings, to limit bridge impacts. Queensland mass regulations allow B-doubles fitted with Road-Friendly Suspension (RFS) and Intelligent Access Program (IAP) to operate at Higher Mass Limits (HML) axle loads, allowing up to 68.5 tonnes gross mass (with 6.5 tonne steer axle and tandem drive). Queensland has gazetted networks for 23 metre B-doubles, 25 metre B-doubles, and Higher Mass Limit vehicles.

Under PBS, B-doubles are not restricted in overall length, but are typically limited to 30 metres because of the length limit for PBS Level 2B access. Twin steer, tri-drive prime movers and quad-axle trailers can also be used. An example of a 30 metre B-double fitted with quad axle groups is shown in Figure 1.2.1(b).

Figure 1.2.1(b) – Quad-quad 30 m PBS Level 2B B-double



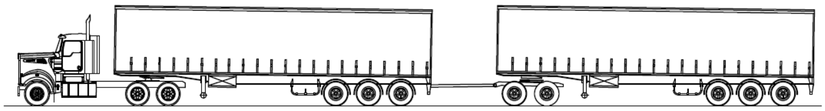
PBS-approved Level 2B B-doubles up to 30 metres overall length have on-road performance that is equivalent or better than conventional 26 metre B-doubles, with the exception of their low speed manoeuvrability and bridge loading impacts. As a result, PBS B-doubles are generally fitted with steerable trailer axles, and bridge capacity limits their gross mass.

1.2.2 Type 1 Road trains

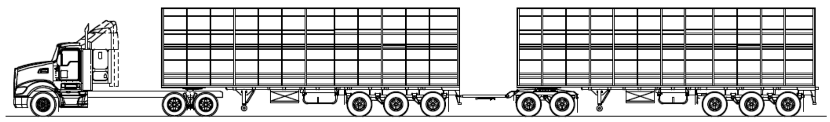
1.2.2.1 A-doubles

A-doubles, also referred to as ‘double road trains’, comprise a prime mover and two semi-trailers connected by a converter dolly, as shown in Figure 1.2.2.1(a). They are more productive than B-doubles as they have an extra axle group and increased length. They are commonly used for palletised and containerised freight, and can also be designed to suit specific commodities including mined ore, and livestock. Again, the numbers of axles within groups on the prime mover, dollies, and trailers, can vary.

Figure 1.2.2.1(a) – General freight 34.5 m A-double (top) and livestock 33.5 m A-double (bottom)



general freight 34.5 m A-double



livestock 33.5 m A-double

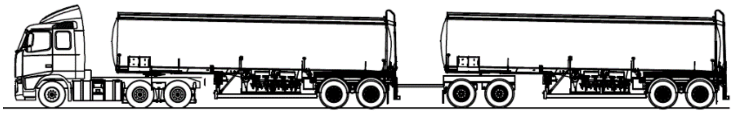
Under the National Class 2 Heavy Vehicle Road Train Authorisation (Notice) 2015 (No. 1) within the HVNL (HVNL 2015), A-doubles are classed as a ‘Type 1 road train’, can be up to 36.5 metres long, and have a gross mass of up to 79 tonnes under GML. Queensland mass regulations allow A-doubles fitted with RFS and IAP to operate at HML axle loads, allowing up to 85.5 tonnes gross mass (with 6.5 tonne steer axle and tandem drive). Queensland has gazetted networks for Type 1 road trains.

Under PBS, innovative A-double designs have emerged with various axle configurations, and overall lengths ranging between 26 metres and 30 metres. Again, PBS, do not restrict overall length, but A-double combinations are typically limited to 26 metres or 30 metres because of the length limit for PBS Level 2A and 2B access, respectively.

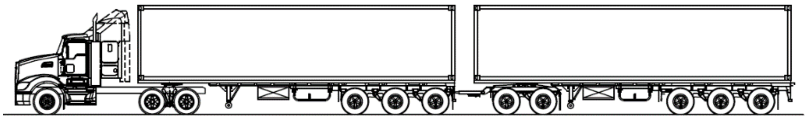
Short combinations up to 26 metres long have been readily adopted by bulk liquid transporters, as they have better low speed manoeuvrability than equivalent B-doubles, and the additional axle group allows greater gross mass (Figure 1.2.2.1(b) top).

Longer combinations up to 30 metres long have gained popularity in shipping container transport, as the additional length allows two 40-foot containers to be carried (Figure 1.2.2.1(b) bottom).

Figure 1.2.2.1(b) – 26 m PBS Level 2A A-double (top) and 30 m PBS Level 2B A-double (bottom)



26 m PBS Level 2A A-double



30 m PBS Level 2B A-double

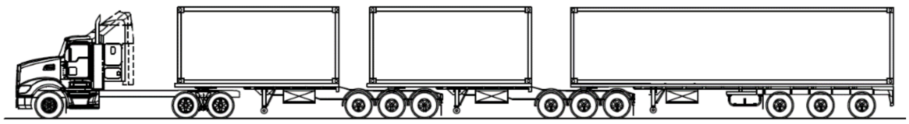
PBS-approved Level 2B A-doubles up to 30 metres overall length have on-road performance that is equivalent or better than conventional 26 metre B-doubles, with the exception of their high-speed dynamic performance, and bridge loading impacts.

As a result, load height restrictions may be used to reduce trailer Centre-of-Gravity height, and bridge capacity limits their gross mass. Queensland has existing networks for 26 metre and 30 metre PBS A-doubles, which are the PBS Level 2A and 2B networks, respectively.

1.2.2.2 B-triples

B-triple combinations comprise a prime mover, two lead trailers, and a semi-trailer connected by fifth wheel couplings as shown in Figure 1.2.2.2. They are more productive than B-doubles and A-doubles due to their extra length and when compared against a B-double, their additional axle group. They can carry more freight volume than an A-double of equivalent overall length.

Figure 1.2.2.2 – General freight 33.15 m B-triple



Under the National Class 2 Heavy Vehicle Road Train Authorisation (Notice) 2015 (No. 1) within the HVNL (HVNL 2015), B-triples are also classed as a Type 1 road train, can be up to 36.5 metres long, and have a gross mass of up to 82.5 tonnes under GML. Queensland mass regulations (TMR 2010) allow B-triples fitted with RFS and IAP to operate at HML axle loads, allowing up to 91.5 tonnes gross mass (with 6.5 tonne steer axle and tandem drive).

Under PBS, B-triples are not restricted in overall length, but would be typically limited to 36.5 metres because of the length limit for PBS Level 3A access.

Comparatively few innovative B-triple combinations have been developed under PBS, because high-productivity A-double combinations are more attractive to the industry, and the level of access offered to B-triple combinations is relatively low.

PBS-approved Level 3A B-triples up to 36.5 metres overall length have on-road performance that is equivalent to or better than conventional 36.5 metre A-triples, with the exception of their low speed manoeuvrability. 36.5 metre PBS B-triples would operate in Queensland on the PBS Level 3A network.

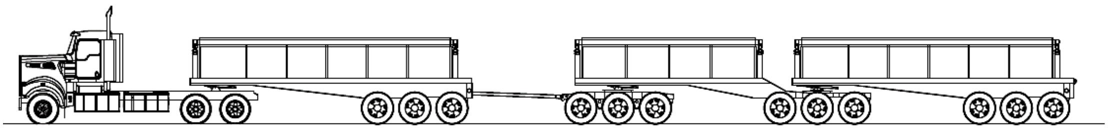
1.2.3 Type 2 Road trains

1.2.3.1 AB-triples

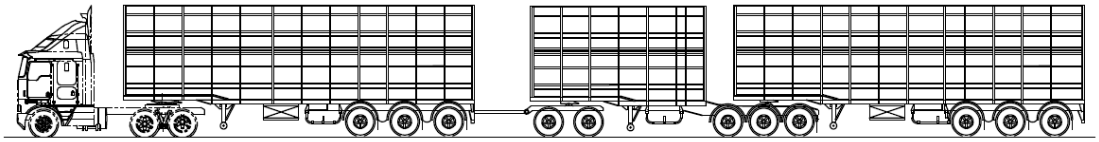
AB-triples comprise a prime mover and semi-trailer, towing a B-double trailer set connected to the first trailer by a converter dolly, as shown in Figure 1.2.3.1. They are commonly used for specific commodities such as mined ore and livestock.

AB-triples can be fitted with either tandem or triaxle groups on the trailers and converter dolly, but the most common scenarios are tandem dollies and triaxle trailers, or triaxle groups throughout.

Figure 1.2.3.1 – 35.5 m side tipping AB-triple (top) and 36.5 m livestock AB-triple (bottom)



35.5 m side tipping AB-triple



36.5 m livestock AB-triple

Under the National Class 2 Heavy Vehicle Road Train Authorisation (Notice) 2015 (No. 1) within the HVNL (HVNL 2015), AB-triples are classed as either a Type 1 or Type 2 road train, depending on their overall length. AB-triples within 36.5 metres are classed as a Type 1 road train, while longer AB-triples, up to 44 metres long, are classed as Type 2 road trains.

AB-triples can have a gross mass of up to 103 tonnes under GML. Queensland mass regulations allow AB-triples fitted with RFS and IAP to operate at HML axle loads, allowing up to 108 tonnes gross mass (with 6.5 tonne steer axle and tandem drive).

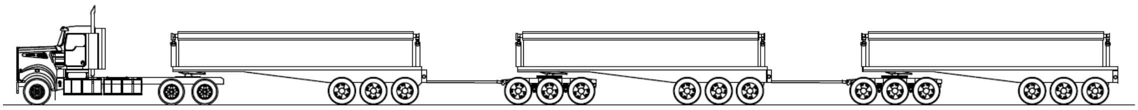
Under PBS, AB-triples are not restricted in overall length, but would be typically limited to 36.5 metres or 42 metres because of the length limit for PBS Level 3A and 3B access.

A twin-steer, tandem drive, or tri-drive prime mover can be used, and trailers can be fitted with quad axle groups, allowing gross mass to increase. PBS AB-triple combinations have been readily adopted by the mining industry, some fitted with quad axle groups.

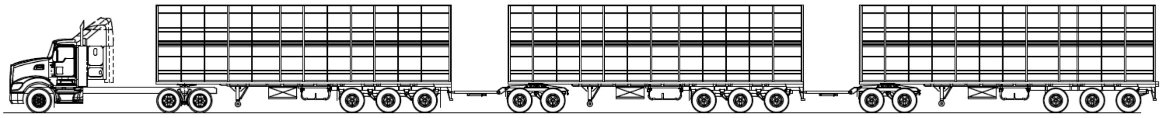
1.2.3.2 A-triples

A-triples comprise a prime mover and three semi-trailers connected by converter dollies, as shown in Figure 1.2.3.2. They are commonly used for specific commodities such as aggregate and livestock. A-triples can be fitted with either tandem or triaxle groups on the trailers and converter dolly, but the most common scenarios are tandem dollies and triaxle trailers, or triaxle groups throughout.

Figure 1.2.3.2 – 43.7 m side tipping A-triple (top) and 49 m livestock A-triple (bottom)



43.7 m side tipping A-triple



49 m livestock A-triple

Under the National Class 2 Heavy Vehicle Road Train Authorisation (Notice) 2015 (No. 1) within the HVNL (HVNL 2015), A-triples are classed as a Type 2 road train, can be up to 53.5 metres long, and have a gross mass of up to 115.5 tonnes under GML.

Queensland mass regulations (TMR 2010) allow A-triples fitted with RFS and IAP to operate at HML axle loads, allowing up to 125 tonnes gross mass (with 6.5 tonne steer axle, tandem drive, and tandem axle dollies).

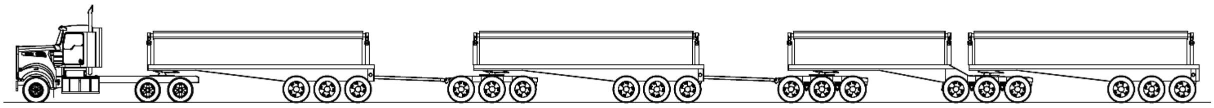
Under PBS, A-triples are not restricted in overall length, but would be typically limited to 53.5 metres because of the length limit for PBS Level 4A access.

Comparatively few innovative A-triple combinations have been developed under PBS. This could be because quad-trailer combinations are more productive, but have the same levels of on-road performance, and are generally granted equivalent access.

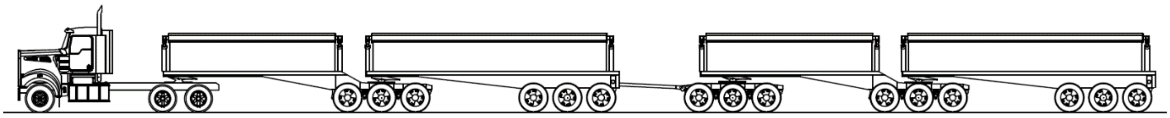
1.2.3.3 Quad combinations

Quad combinations are Type 2 roads trains that comprise A-double and B-double trailer sets and converter dollies to create various configurations, including ABB-quad, BAB-quad, and BAA-quad, as shown in Figure 1.2.3.3.

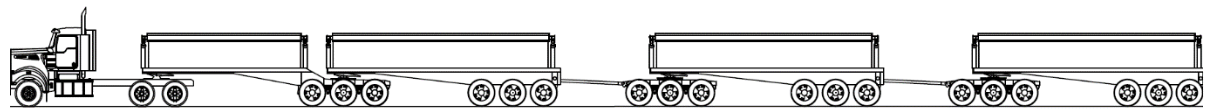
Figure 1.2.3.3 – 48 m side tipping AAB-quad (top), 42 m BAB-quad (middle) and 48 m BAA-quad (bottom)



48 m side tipping AAB-quad



42 m BAB-quad



48 m BAA-quad

Under the National Class 2 Heavy Vehicle Road Train Authorisation (Notice) 2015 (No. 1) within the HVNL (HVNL 2015), quad combinations are classed as a Type 2 road train, can be up to 53.5 metres long, with varying gross masses depending on their axle group configuration.

Under PBS, quad combinations are not restricted in overall length, but would be typically limited to 53.5 metres or 60 metres because of the length limit for PBS Level 4A and 4B access, respectively.

Such combinations have been readily adopted by the mining industry, again some fitted with quad axle groups. These vehicles typically have on-road performance that is equivalent or better than conventional A-triples.

2 Application of the guideline

While any state-controlled road can be assessed using these guidelines, the nature of the assessment varies for roads that are part of different existing networks. This is because some networks have been assessed using prior versions of these guidelines, and as a result, only a sub-set of the assessment tasks are required.

For the purposes of determining the level of assessment required, the heavy vehicle networks in Queensland can be grouped as follows: ‘General Access’, ‘Restricted Access’ and ‘PBS’.

2.1 General access roads

General Access roads in Queensland permit vehicles to be 19 metres in length, and 50 tonnes gross mass (50.5 tonnes with steer axle concession). Those roads are classified as PBS Level 1, as they were transitioned by Transport and Main Roads in 2007 to aid in the uptake of PBS vehicles.

Vehicles achieving PBS Level 1 standards have no greater infrastructure impacts and no less safety performance than existing ‘as-of-right’ General Access vehicles, hence no technical assessment is required. Notwithstanding this, local restrictions such as posted load limits for roads and/or bridges need to be ascertained, and it is good practice to consider traffic interaction, amenity, and freight issues whenever new access levels are set.

Vehicles achieving PBS Level 2 standards, and being within 26 metres overall length (Level 2A vehicles) may have greater infrastructure impacts than existing ‘as-of-right’ General Access vehicles. Hence, the route assessment guideline should be applied in its entirety to determine whether access for such vehicles can be supported. These aspects are summarised in Table 2.1.

Table 2.1 – Current general access networks, potential new classifications, and required assessment

Current classification (mass and length limits)	Potential new classification (mass and length limits)	Required assessment tasks
General access (19.0 metres, 50 tonnes)	PBS Level 1 (20.0 metres, 50.5 tonnes)	Ascertain posted road and bridge load limits. Consider traffic interaction, amenity, and freight issues.
	PBS Level 2A (26.0 metres, 85.0 tonnes)	Apply the guideline in its entirety.

It should be noted that, for pavement horizontal loading considerations, 85.0 tonnes is the maximum allowable mass under PBS Level 2 for a vehicle with two driven axles. However, many routes will be unable to support this mass due to bridge constraints.

The route assessment process will address both geometric and structural considerations. It is envisaged that gross mass limits will need to be imposed for many roads as dictated by structural assessments.

2.2 Restricted access roads

For pavement horizontal loading considerations, restricted access roads in Queensland permit 23 metre and 25 metre B-doubles to operate at up to 68.5 tonnes, 36.5 metre Type 1 road trains to operate at up to 113.0 tonnes, and 53.5 metre Type 2 road trains to operate at up to 158.5 tonnes, on separate networks.

Similar to the PBS Level 1 network, most of the roads within those networks were copied by the department to PBS Level 2A, 3A and 4A in 2007. It is possible that remaining Restricted Access roads could be classified as Level 2A, 3A or 4A, or their Class B equivalents.

While those networks already carry vehicles that are longer and heavier than General Access vehicles, PBS vehicles can be even longer and heavier. Hence, the route assessment guideline should be applied in its entirety to determine whether access for such vehicles can be supported. These aspects are summarised in Table 2.2.

Table 2.2 – Current restricted access networks, potential new classifications, and required assessment

<table>
<tr><th>Current classification (mass and length limits)</th><th>Potential new classification (mass and length limits)</th><th>Required assessment</th></tr>
<tr><td rowspan="2">B-double
(23.0 metres, 68.5 tonnes)</td><td>PBS Level 2B
(30 metres, 85.0 tonnes)</td><td rowspan="7">Apply the guideline in its entirety.</td></tr>
<tr><td>PBS Level 3A
(36.5 metres, 110.0 tonnes)</td></tr>
<tr><td rowspan="2">B-double
(25.0 metres, 68.5 tonnes)</td><td>PBS Level 2B
(30 metres, 85.0 tonnes)</td></tr>
<tr><td>PBS Level 3A
(36.5 metres, 110.0 tonnes)</td></tr>
<tr><td rowspan="2">Type 1 road train
(36.5 metres, 113 tonnes)</td><td>PBS Level 3B
(42.0 metres, 110.0 tonnes)</td></tr>
<tr><td>PBS Level 4A
(53.5 metres, 150.0 tonnes)</td></tr>
<tr><td>Type 2 road train
(53.5 metres, 158.5 tonnes)</td><td>PBS Level 4B
(60 metres,150.0 tonnes)</td></tr>
</table>

Again, routes may be unable to support the full mass allowed under PBS due to bridge and pavement loading constraints, and gross mass limits will need to be imposed as dictated by structural assessments.

2.3 PBS-classified roads

PBS-classified roads in Queensland will have been either copied from previous General Access or Restricted Access networks, or assessed using prior guidelines (for example, TMR 2013a, 2014). Examples of assessed networks are the PBS Level 2B route between Toowoomba and the Port of Brisbane, and various PBS Level 2B roads around Townsville that connect the Port of Townsville with nearby industrial areas.

The level of assessment required differs if a PBS road is being assessed to determine whether a new access level, or access class, can be applied. That is, if a road is currently classified as PBS Level 2A, fewer assessments are required if the classification seeks to determine whether the road can be re-classified as PBS Level 2B, then would be required to determine whether it can be re-classified as PBS Level 3A. This is because Class B vehicles are longer than Class A vehicles, but meet the same safety standards including swept path, hence only aspects related to increased length are required to be assessed.

These aspects include (but may not be limited to), overtaking provision, clearance times, stacking distance, and parking. Again, it is good practice to consider traffic interaction, amenity, and freight issues whenever new access levels are set.

In contrast, both mass and length of PBS vehicles increases substantially as PBS Level increases, hence the route assessment guideline should be applied in its entirety to determine whether PBS roads can be re-classified at a higher level. These aspects are summarised in Table 2.3.

Table 2.3 – Current PBS networks, potential new classifications, and required assessment

<table>
<tr><th>Current classification (mass and length limits)</th><th>Potential new classification (mass and length limits)</th><th>Required assessment</th></tr>
<tr><td rowspan="2">PBS Level 1
(20.0 metres, 50.5 tonnes)</td><td>PBS Level 2A
(26.0 metres, 85.0 tonnes)</td><td rowspan="6">Re-classification
from Class A
(assessed and gazetted)
to Class B:
• Assessment of overtaking provision, clearance times, stacking distance, and parking.
• Consider traffic interaction, amenity, and freight issues.</td></tr>
<tr><td>PBS Level 2B
(30.0 metres, 85.0 tonnes)</td></tr>
<tr><td rowspan="2">PBS Level 2A
(26.0 metres, 85.0 tonnes)</td><td>PBS Level 2B
(30.0 metres, 85.0 tonnes)</td></tr>
<tr><td>PBS Level 3A
(36.5 metres, 110.0 tonnes)</td></tr>
<tr><td rowspan="2">PBS Level 2B
(30 metres, 85.0 tonnes)</td><td>PBS Level 3A
(36.5 metres, 110.0 tonnes)</td></tr>
<tr><td>PBS Level 3B
(42.0 metres, 110.0 tonnes)</td></tr>
<tr><td rowspan="2">PBS Level 3A
(36.5 metres, 110.0 tonnes)</td><td>PBS Level 3B
(42.0 metres, 110.0 tonnes)</td><td rowspan="5">Re-classification
from Class A
(non-assessed but gazetted)
to Class B
or from any Level
to a higher Level:
• Apply the guideline in its entirety.</td></tr>
<tr><td>PBS Level 4A
(53.5 metres, 150.0 tonnes)</td></tr>
<tr><td rowspan="2">PBS Level 3B
(42.0 metres, 110.0 tonnes)</td><td>PBS Level 4A
(53.5 metres, 150.0 tonnes)</td></tr>
<tr><td>PBS Level 4B
(60.0 metres, 150.0 tonnes)</td></tr>
<tr><td>PBS Level 4A
(53.5 metres, 150.0 tonnes)</td><td>PBS Level 4B
(60.0 metres, 150.0 tonnes)</td></tr>
</table>

3 The route assessment process

Route assessments should be undertaken by Transport and Main Roads officers authorised by a Regional Director. Due to the wide range of issues to be considered in the assessment, the formation of an assessment team is recommended. Collectively, the team members should have experience with the heavy transport industry and a substantial knowledge of the following:

- the principles of heavy vehicle operation, including vehicle configurations, maximum dimensions and axle load limits
- limitations on the ability of heavy vehicles to accelerate, brake, ascend grades, descend grades, and negotiate corners

- heavy transport issues, legal requirements and permit systems, and
- road safety concepts and principles.

When conducting a route assessment, the assessor(s) should initially perform a desktop assessment using maps, satellite imagery, and available technical records. The desktop assessment exercise should inform the assessor(s) of particular aspects of the route that require physical inspection, and the need for consultation with external parties, particularly where the route intersects an asset owned by others, such as a railway level crossing.

Under no circumstances should a route assessment be undertaken by desktop methods only, however it should be noted that the desktop assessment may identify certain aspects that may prevent a route from being reclassified. In the physical inspection, the route or roads being assessed should be driven at least once in each direction, to ensure that all factors are considered.

The guidelines describe various technical aspects that are unlikely to be able to be addressed via a desktop exercise or physical site inspection, and may require further investigation.

These include (but are not limited to):

- the suitability of intersections to provide a sufficiently clear area for the movement of MCVs
- the presence of any road hazards, and possible treatments, and
- the measurement of noise impacts.

Transport and Main Roads officers may also conduct a monitored field trial to address any concerns raised during the desktop exercise or site inspection. The safety and infrastructure risks of the field trial should be carefully managed via a risk assessment, and the necessary permits will be required. Prior to initiating a field trial, the assessor(s) should document the purpose of the trial, the methodology for conducting the trial, and how the trial's results will be used to inform the route assessment.

The assessor(s) should always consider consultation as part of the assessment process. Engineers from the rail and port branches, local police, council staff and other stakeholders can be called to assist in route assessments in conjunction with authorised departmental officers. Local community concerns should be taken into account and balanced against the economic, road safety, traffic management and other technical issues.

The need for formal community consultation should be considered, and where deemed necessary, carried out as per the Queensland Guide to Community Engagement. The technical justifications identified by the assessor(s) for denying a route classification should be documented.

Transport and Main Roads does not have to issue a route classification if the route has been given a favourable assessment using these guidelines, however the technical justification for doing so should be transparent and justified.

4 Geometric route assessment considerations

A previous edition of the Transport and Main Roads *Route assessment guidelines* (TMR 2013) provided a range of geometric considerations and associated numeric values. Those values (where provided) applied to existing as-of-right restricted access vehicles (B-doubles, and Type 1 and 2 road trains).

To determine the applicability of the numerical values to vehicles approved under the PBS scheme, and other current as-of-right combinations, they were compared against the performance requirements of the PBS scheme, and performance assessment results from earlier research (SMEC 2016).

It was generally found that the numeric values applicable for B-doubles, Type 1 road trains and Type 2 road trains correlated well with the performance requirements applicable to PBS Level 2, 3 and 4 vehicles, respectively, and current 'as-of-right' combinations. The guidelines' numeric values were updated accordingly. Instances where the numeric values did not apply to either PBS vehicles or as-of-right combinations were described.

4.1 Speed considerations

Speed (km/h) is referenced throughout this guideline and is to be treated as follows:

- **Speed Limit -** the legal speed limit for the stretch of road being assessed. This includes the unsigned default speed limit.
- **Operating Speed -** the speed at or below which 85% of vehicles have been observed to travel under free flowing conditions (i.e. When traffic volumes are low):
  - On an existing road, the operating speed should be determined by on-site data collection. If this is not available, or for a new road, refer to Section 3.6 of the *Austroads Guide to Road Design Part 3* (Austroads (2021)) for a description of the Operating Speed Model.
  - Where the operating speed cannot be determined through speed measurement or by the Operating Speed Model, adopt an operating speed 10 km/h higher than the legal speed limit.
- **Approach Speed - t**he operating speed on a stretch of road immediately before a geometric feature, such as the start of a curve, or an intersection, or a change in gradient.

4.2 Lane widths on straight sections

The assessment of lane width addresses operational road safety and infrastructure risks. Those risks increase if insufficient lane width is available for heavy vehicles. Haldane (2002) noted that heavy vehicles that require more lane width than is available risk crossing either the centre or edge line of the road. Crossing the centreline presents a considerable safety risk as it could lead to head-on or sideswipe crashes. Crossing the edge line can have various impacts ranging from damage the edge of the pavement seal, to the initiation of a rollover, if tyres on one side of one trailing unit leave the sealed surface.

The ability of the trailers of a multi-unit heavy vehicle combination to remain within the path tracked by the prime mover is referred to as the vehicle's 'Tracking Ability on a Straight Path' (TASP), whereas a measurement of the ability of trailers to remain within the path tracked by the prime mover under an abrupt evasive manoeuvre, such as avoiding an approaching motor vehicle, is called 'High Speed Transient Off-tracking' (HSTO).

The tracking ability of a vehicle depends on many road, environment, and driver-related factors (NTC 2007a), which predominantly include:

- the number of trailing units
- the vehicle's overall length

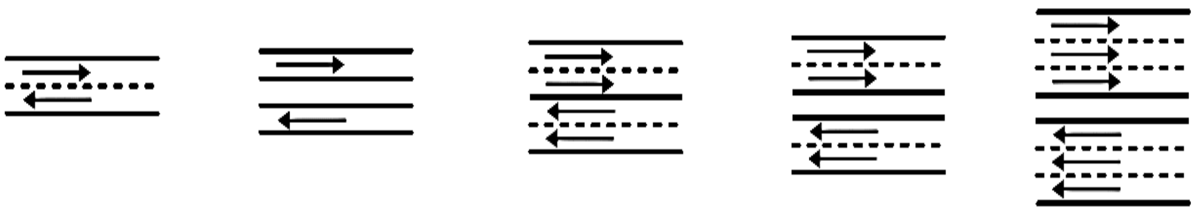
- the vehicle's travel speed
- the degree of steering input and path correction by the driver
- the geometry of the road (for example, crossfall, surface roughness)
- the location and type of coupling between trailers (for example, fifth wheel, pin-type)
- suspension performance characteristics (for example, vertical and roll stiffness, roll steer coefficient), and
- tyre performance characteristics (for example, cornering stiffness).

The risks associated with insufficient lane and carriageway widths differs with the road environment (urban or rural). Urban environments include additional risks of colliding with parked vehicles, cyclists or pedestrians. Hence, they require assessment of width on both kerbside lanes and non-kerbside lanes, incorporating the characteristics of the carriageway. In urban areas, it is preferable for least two continuous through lanes to be available in the direction of travel, though some short sections of single through lane may be acceptable. Through lanes provide travel without obstruction due to parked vehicles or stationary turning queues and therefore Table 4.2(a) and Table 4.2(b) present the preferred minimum seal and carriageway widths in urban and rural areas, respectively.

The terminology used to describe the carriageway type is explained in Figure 4.2. Listed speed limits refer to the posted speed limit for the road being assessed.

Prior research (SMEC 2016) highlighted that some as-of-right combinations including A-doubles, A-triples, AB-triples, and AAB-quads that are loaded with high centre-of-gravity (COG) loads (for example, livestock) may require additional lane width than equivalent vehicles carrying other loads.

Figure 4.2 – Explanation of carriageway types



Undivided carriageway – 2 way	Divided carriageway – single lane	Undivided carriageway – 2 lane	Divided carriageway – 2 lane	Divided carriageway – 3 lane

Table 4.2(a) – Minimum carriageway and seal widths in urban areas (Source: TMR 2013a)

Road feature	B-doubles and PBS Level 2 vehicles		Type 1 road trains and PBS Level 3 vehicles		Type 2 road trains and PBS Level 4 vehicles	
	60-70 km/h*	80-100 km/h*	60-70 km/h*	80-100 km/h*	60-70 km/h*	80-100 km/h*
(Undivided carriageway – 2-way) width between road edge and road centre (metres)						
Basic	3.2	3.5	3.3	3.7	3.6	4.1
with marked separation line	3.5	3.7	3.6	4.0	3.9	4.4
with on-road cyclists	4.7	5.5	4.8	5.7	5.1	6.1
with regular parallel parking	5.7	6.0	5.8	6.2	6.1	6.6
with regular angle (45°) parking	9.2	9.5	9.3	9.7	9.6	10.1
(Divided carriageway – single lane) width between road edge and edge of median / traffic island (metres)						
Basic	3.5	3.7	3.6	4.0	3.9	4.4
with on-road cyclists	5.0	5.7	5.1	6.0	5.4	6.4
with regular parallel parking	6.0	6.2	6.1	6.5	6.4	6.9
with regular angle (45°) parking	9.5	9.7	9.6	10.0	9.9	10.4
(Undivided carriageway – 2 lanes) width between road edge and road centre (metres)						
Basic	6.6	7.0	6.7	7.1	7.0	7.5
with on-road cyclists	8.1	9.0	8.2	9.1	8.5	9.5
with regular parallel parking	9.1	9.5	9.2	9.6	9.5	10.0
(Divided carriageway – 2 lanes) width between road edge and edge of median / traffic island (metres)						
Basic	6.6	7.0	6.7	7.1	7.0	7.5
with on-road cyclists	8.1	9.0	8.2	9.1	8.5	9.5
with regular parallel parking	9.1	9.5	9.2	9.6	9.5	10.0
(Divided carriageway – 3 lanes) width between road edge and edge of median / traffic island (metres)						
Basic	9.7	10.5	9.8	10.5	10.1	10.6
with on-road cyclists	11.2	12.5	11.3	12.5	11.6	12.6

* Legal speed limit for the particular section of the road being assessed.

Table 4.2(b) – Minimum carriageway and seal widths in rural areas (Sources: NTC 2007a and Gough 2019)

Vehicle Classification	AADT (vehicles)	Minimum Width[1] (metres)	
		Lane[2]	Shoulder[3]
B-doubles and PBS Level 2 vehicles	< 150	3.7 m single lane seal on an 8.7 m formation	
	< 500	2.8	1.0
	500 – 1,500	3.1	1.2
	1,501 – 3,000	3.2	1.5
	> 3,000	3.5	1.5
Type 1 road trains and PBS Level 3 vehicles	< 150	3.7 m single lane seal on an 8.7 m formation	
	< 500	2.9	1.2
	500 – 1,500	3.2	1.2
	1,501 – 3,000	3.3	1.5
	> 3,000	3.5	1.5
Type 2 road trains and PBS Level 4 vehicles	< 150	4.0 m single lane seal on a 9.0 m formation	
	< 500	3.0	1.3
	500 – 1,500	3.3	1.5
	1,501 – 3,000	3.6	1.8
	> 3,000	3.9	1.8

Notes:

1. Total width requirements will increase by the relevant amount (typically 1.0 m) where wide centreline treatments are used.
2. Lane width is the trafficable width divided by the number of lanes.
3. Shoulder width includes both sealed and unsealed portions of the shoulder.

Minor width deficiencies should not preclude a route from a road classification level, particularly if the deficiencies only apply to a small portion of the route.

To provide network continuity and connectivity, a relaxation of carriageway width may be considered. In such cases, a risk assessment should be undertaken considering all factors which would contribute to the safe operation of vehicles and their interaction with other users.

The Transport and Main Roads “A Road Management Information System” (ARMIS) system provides road data including lane width, carriageway width and carriageway configuration, and formation and seal characteristics, and should be used in the assessment of lane widths. High-resolution satellite imagery can also be used, but may be less accurate. Lane widths can also be physically measured, which should be done during the site inspection to confirm the accuracy of the ARMIS data.

Lane width is not required to be considered in assessments that only investigate whether the Class of an assessed PBS route can be upgraded (for example, PBS 2A to 2B). This is because the PBS tracking ability performance requirements do not differ between PBS Class A and Class B vehicles at the same level.

Some additional requirements are recommended for rural roads:

- Carriageway widths less than 9.0 metres on two-lane roads with both lanes sealed should be accompanied by embankment and table drains of slope 1:4 (or flatter) together with clear areas to reduce the likelihood of heavy vehicles travelling close to the centreline. Some short sections (less than 200 metres) can be accepted.
- As heavy vehicles tend to travel along the centre of roads with single lane seals without giving way to approaching light motor vehicles, such roads should have carriageways of sufficient width to allow light motor vehicles to pass by either side of a heavy vehicle travelling along the centre of the sealed lane. The maximum crossfall over the entire carriageway width of such roads is 1:10 to allow for heavy vehicles to pass each other at low speed while travelling along the unsealed shoulder. This requirement is reflected in Table 4.2(b) above for roads with AADT of less than 150 vpd.
- Carriageway widths of less than 10.0 metres on roads with a single lane seal should be accompanied by embankment and table drains of slope 1:6 (or flatter), to allow smaller vehicles to move clear of an oncoming heavy vehicle that stays on the seal. Again, some short sections are acceptable where sight distance allows smaller vehicles to stop prior to the restricted width section.
- The preferred minimum road widths for unsealed roads are:
  - 8.0 metres for B-Double and PBS Level 2 routes.

4.3 Lane widths on curved sections

Heavy vehicles require extra lane width in horizontal curves, in addition to that required for straight sections as outlined above. The ability of the trailers to remain within the prime mover's tracked path is referred to as 'high-speed steady state off-tracking'. The same factors that influence TASP performance also influence tracking ability in curves.

The previous version of this guideline provided recommendations for curve widening to account for such off-tracking. It is difficult to determine how well those additional requirements cater for vehicles approved under the PBS scheme and existing 'as-of-right' combinations, as 'high-speed steady state off-tracking' is not a PBS standard and was hence not assessed in the earlier study (SMEC 2016).

Notwithstanding this, the values for B-doubles, Type 1 road trains and Type 2 road trains should be applied to PBS Level 2, 3 and 4 vehicles respectively, as there is no reason to expect that their off-tracking performance will be substantially worse than existing comparative vehicles. The recommendations for lane widening in curves are shown in Table 4.3.

Table 4.3 – Curve widening per lane in metres (Sources: TMR 2013a and NTC 2007a)

Curve radius (metres)	B-doubles and PBS Level 2 vehicle	Type 1 road trains and PBS Level 3 vehicles	Type 2 road trains and PBS Level 4 vehicles
30	Use of Austroads turning templates recommended		
40			
50			
60			
70	1.31		
80	1.16	1.62	
90	1.05	1.45	
100	0.90	1.26	1.80
120	0.80	1.15	1.61
140	0.71	1.00	1.45
160	0.62	0.87	1.25
180	0.53	0.75	1.07
200	0.45	0.62	0.90
250	0.37	0.51	0.75
300	0.30	0.41	0.60
350	0.26	0.35	0.51
400	0.22	0.30	0.45
450	No curve widening required	0.27	0.40
500		0.25	0.35
600		0.21	0.30
700			0.25
800			0.22

In assessing the suitability of lane width in curves, the assessor should multiply the applicable value by the number of lanes, and round to the nearest 0.25 metres. The requirement for widening ceases when the widening is less than 0.25 metres, due to the practical limitations for widening a two-lane road, which is approximately 0.5 metres.

Again, minor curve width deficiencies should not preclude a route from a road classification level. The ARMIS system may be provide curve seal width information, and high-resolution satellite imagery can also be used, but may be less accurate. Curve widths can also be physically measured, which should be done during the site inspection to confirm the accuracy of the ARMIS data and/or measurements from satellite images.

Lane width is not required to be considered in assessments that only investigate whether the Class of an assessed PBS route can be upgraded (for example, PBS 2A to 2B). This is because the PBS tracking ability performance requirements do not differ between PBS Class A and Class B vehicles at the same level.

4.4 Bridge widths

Bridges are typically the narrowest points on carriageways. To minimise the risk of collisions between vehicles and bridge parapet strikes, it is desirable to have adequate width along all bridges to provide sufficient lateral clearance between two opposing vehicles, as well as appropriate clearance to the edges of the bridge. The minimum bridge carriageway widths for national highways, and all other roads, are shown in Table 4.4(a) and Table 4.4(b), respectively. In some cases, the specified widths may be insufficient for a heavy vehicle and either a passenger vehicle, or another heavy vehicle, to pass safely when travelling at highway speeds. However, this can be tolerated as it is expected that all road users (and heavy vehicle drivers) will slow to an appropriate speed.

Table 4.4(a) – Bridge carriageway widths – national highways (Source: TMR 2013a)

Bridge details		Two Way				One Way							
		Two Lane				Single Lane				Two Lane			
Length (m)	AADT	Shldr	Lane	Shldr	Tot.	Shldr	Lane	Shldr	Tot.	Shldr	Lane	Shldr	Tot.
≤ 20	< 3,000[1]	1.5	7.0	1.5	10.0	2.0	3.5	1.0	6.5	–	–	–	–
≤ 20	≥ 3,000[1]	2.0	7.0	2.0	11.0	2.0	3.5	1.0	6.5	2.0	7.0	1.0	10.0
> 20	< 1,000 per lane[2]	0.6[3]	7.0	0.6[3]	8.2	2.0	3.5	1.0	6.5	–	–	–	–
> 20	≥ 1,000 per lane[2]	1.2[3]	7.0	1.2[3]	9.4	2.0	3.5	1.0	6.5	2.0	7.0	1.0	10.0

Notes:

1. These AADTs are projected within 10 years.
2. These AADTs are projected within 20 years.
3. The minimum allowable shoulder width is listed.

Table 4.4(b) – Bridge carriageway widths – roads other than national highways (Source: TMR 2013a)

Bridge details		Two Way				One Way							
		Two Lane				Single Lane				Two Lane			
Length (m)	AADT[1]	Shldr	Lane	Shldr	Tot.	Shldr	Lane	Shldr	Tot.	Shldr	Lane	Shldr	Tot.
Any	< 100	1.0	6.0	1.0	8.0	0.6	3.0	0.6	4.2	–	–	–	–
Any	100 – 499	1.0	6.0	1.0	8.0	2.0	3.0	1.0	6.0	–	–	–	–
Any	500 – 999	1.0	6.5	1.0	8.5	2.0	3.25	1.0	6.25	–	–	–	–
≤ 20	1,000 – 2,000	1.5	6.5	1.5	9.5	2.0	3.25	1.0	6.25	–	–	–	–
> 20	1,000 – 2,000	1.0	6.5	1.0	8.5	2.0	3.25	1.0	6.25	–	–	–	–
≤ 20	> 2,000	2.0	7.0	2.0	11.0	2.0	3.5	1.0	6.5	2.0	7.0	1.0	10.0
> 20	> 2,000	1.0	7.0	1.0	9.0	2.0	3.5	1.0	6.5	1.0	7.0	1.0	9.0

Notes:

1. All AADTs are projected within 20 years. The appropriate lane widths listed for the ‘two lane’ configuration should be added to determine the appropriate widths for multi-lane bridges. If a bridge is part of a cycle route and/or is in a built-up area, additional shoulder with should be required to allow adequate cyclist access, and pedestrian facilities are also required.

Minor width deficiencies should not preclude a route from a road classification level. The ARMIS system may be used to provide bridge width information, and high-resolution satellite imagery can also be used, but may be less accurate. Bridge width is not required to be considered in assessments that only investigate whether the Class of an assessed PBS route can be upgraded (for example, PBS 2A to 2B). This is because the PBS tracking ability performance requirements do not differ between PBS Class A and Class B vehicles at the same level.

It is noted that Table 4.4(b) indicates a reduced shoulder width for bridges with lengths over 20 metres and AADT over 2,000 vehicles. This is consistent with previous publications.

4.5 Geometric requirements for turns, intersections and roundabouts

Turns and intersections should be assessed to ensure that they can be safely negotiated by vehicles within each classification. When vehicles perform turning manoeuvres at low speeds, the rear of the vehicle passes closer to the inside of the turn than the front of the vehicle. The assessment should determine whether there is sufficient clear area for the required class of vehicles.

Turns and intersections with standard geometry should be assessed using Austroads turning path templates (Austroads 2013). The process for use of the templates is detailed in the guide and hence, not repeated here. Research undertaken in the most-recent update of the templates confirmed that swept path plots for some vehicles are representative of typical swept path performance for PBS vehicles.

Comparison against previous research (SMEC 2016) confirmed that some vehicles are representative of typical swept path performance for current ‘as-of-right’ combinations. Hence, it is recommended applications of the templates are as follows:

- the 26 metre B-double template can be used to assess the suitability of routes for B-doubles and PBS Level 2 vehicles
- the 36.2 metre A-double and 35.4 metre B-triple templates can be used to assess the suitability of routes for A-doubles, B-triples, AB-triples, and PBS Level 3 vehicles, and
- the 53.4 metre A-triple template can be used to assess the suitability of routes for A-triples, AAB-quads, and PBS Level 4 vehicles.

Austroads did not provide turning templates for quad combinations, however the 53.4 metre A-triple template can be used as a substitute, as such combinations are expected to have equal or better swept path performance.

Where the geometry of the intersection or turning manoeuvre is irregular, or the intersection is a roundabout, the simulation program ‘VPATH’ should be used to conduct the assessment. VPATH allows the approximate turning path of the vehicle to be plotted, and outputs a swept path plot.

One limitation of VPATH is that it only comprises a relatively small library of vehicle types, although it can be customised to cater for PBS vehicles. The services of an authorised PBS Assessor can be called upon, as assessors can model any vehicle undertaking any turning manoeuvre.

The following requirements should be adhered to in the consideration of template or simulation results, and the general suitability of turning manoeuvres:

- the wheel paths of the rear trailer of the combination should remain at least 500 mm from the face of any kerb or the outer edge of any shoulder

- the path of the vehicle should remain at least 1.0 metre from the wheel path of an adjacent vehicle, and
- the overhang path should remain at least 500 mm from a nearby roadside object.

It should be noted that the Austroads templates and VPATH vehicles are representative of the swept path performance of the majority of similar vehicles within the fleet, but may not be indicative of the absolute worst case. Conversely, the actual swept path achieved by drivers in on-road scenarios may be substantially better than predicted by the templates or computer programs. Assessors should rely on common sense and sound judgement guided by technical expertise, local knowledge, or prior experience. Field trials can be particularly useful as a means of assessing swept path performance in the field, but they need to be carefully managed.

Turning manoeuvres are not required to be considered in assessments that only investigate whether the Class of an assessed PBS route can be upgraded (for example PBS 2A to 2B). This is because the swept path performance requirements do not differ between PBS classes.

Additional recommendations for left and right turns, negotiating roundabouts, and terminal connections follow.

4.5.1 Left turns

Left turns onto or from arterial roads are permitted provided the turns can be executed without having a significant adverse effect on the traffic flow, taking into account the speed environment, sight distance, traffic volume and composition. When making left turns, the wheel paths must not cross into the path of oncoming traffic.

4.5.2 Right turns

The following factors should be considered when assessing the suitability of right turns along a proposed route:

- road width and number of traffic lanes being crossed
- approach vehicle speeds
- traffic volumes
- traffic composition
- provision of protected right turn lanes
- the size and frequency of gaps in the opposing stream of traffic, and
- proximity of nearby traffic signals.

Urban Townsite Areas

Right turns from arterial roads should generally be limited to intersections and junctions controlled by traffic signals with exclusive right turn phases because of the additional time required to execute the turn and the larger gap required for oncoming traffic.

Right turns from arterial roads not controlled by traffic signals may be considered where traffic volumes are low or at locations provided with protected right lanes with a storage capacity appropriate to accommodate the anticipated length of the vehicle, in addition to normally expected queue lengths from other vehicles. It is preferred that right turns onto arterial roads are performed at intersections and junctions controlled by traffic signals.

Rural Areas

It is desirable that right turns onto or from arterial roads be made from appropriate turning lanes, including adequate provision for acceleration and deceleration.

4.5.3 Roundabouts

A vehicle may encroach on the roundabout central island if specially constructed encroachment areas are available. Mountable aprons on splitter and central islands in roundabouts can be very useful in accommodating MCV manoeuvres while still providing control of other vehicles. However, pedestrian and cyclist needs should also be considered.

Carriageway widths need to be developed through consideration of the number of lanes needed for overall traffic and swept path analysis for MCVs. Normal roundabout design practice allows heavy vehicles to encroach onto adjacent lanes. Otherwise, the resulting lane widths required to completely contain MCVs are excessive, therefore encouraging high speeds for other vehicles using the roundabout. Designs should be checked to ensure that any widening to accommodate MCVs does not permit other vehicles to exceed safe design speeds through the roundabout. Computer-generated swept paths should be used to check the adequacy of roundabout island and outer kerb diameters. Refer to the Turning Paths Section of this document, Section 4.5 Geometric requirements for turns, intersections and roundabouts.

4.5.4 Terminal connections

Consideration should be given to the following:

- Entry and exit should be in a forward direction.
- Entry and exit should not unduly affect the movement of other vehicles on the road system.
- Computer-generated swept paths should be used to initially assess the suitability of the connection.
- Sight distances at the terminal / destination connection with the road should meet the Safe Intersection Sight Distance (SISD) and Minimum Gap Sight Distance (MGSD) recommendations provided in provided in Section 4.10.
- Vehicles must be able to completely enter the terminal / destination without overhang onto the roadway or footpath.
- All manoeuvring, uncoupling, coupling or standing must be off public roads.
- When turning left into terminals vehicles should turn from a position that is wholly within the left lane, and
- Right turns to and from terminal connections may be considered subject to the prevailing road environment, traffic volume and traffic mix. When turning right into a terminal the vehicle should turn from the lane nearest to the centre of the road. If there are any restraints on a vehicle turning right other than at a controlled intersection, careful consideration is required.

The above requirements for terminals are in addition to any local government requirements regarding land use. Such local government requirements might have a bearing on the type of goods handled at the terminal.

4.6 Crossfall and superelevation

Crossfall is defined as the slope of the surface of a carriageway measured normal to the design or road centreline (Austroads 2010). It is an integral part of road design and enables drainage of the carriageway, and provides superelevation on horizontal curves.

The difference between crossfall and superelevation is shown in Figure 4.6. Both crossfall and superelevation are important considerations relating to the rollover risk posed to heavy vehicles.

Crossfall on straight sections causes heavy vehicles to lean to the edge of the road and increases the lane width required by the heavy vehicle due to its influence on tracking ability.

When a heavy vehicle negotiates a horizontal curve, the lateral acceleration it experiences causes it to lean to the outside of the curve. If the lateral acceleration reaches or exceeds the vehicle’s rollover threshold, the vehicle is likely to rollover.

The superelevation of a curve should assist the vehicle to negotiate the curve. Superelevation is particularly important for vehicles with high COG payloads, such as double-deck livestock vehicles.

Previous Transport and Main Roads guidelines recommended that crossfall for sealed freight routes should not exceed 3% but noted that a higher crossfall (between 4% and 6% per cent) is required for unsealed roads to ensure there is adequate drainage and minimal maintenance.

It is practically difficult to assess whether a route comprises sections with unsuitable crossfall, as the actual level of crossfall will vary along the route, and it would be difficult to locate the critical areas. An additional problem is that reliable data may not be available.

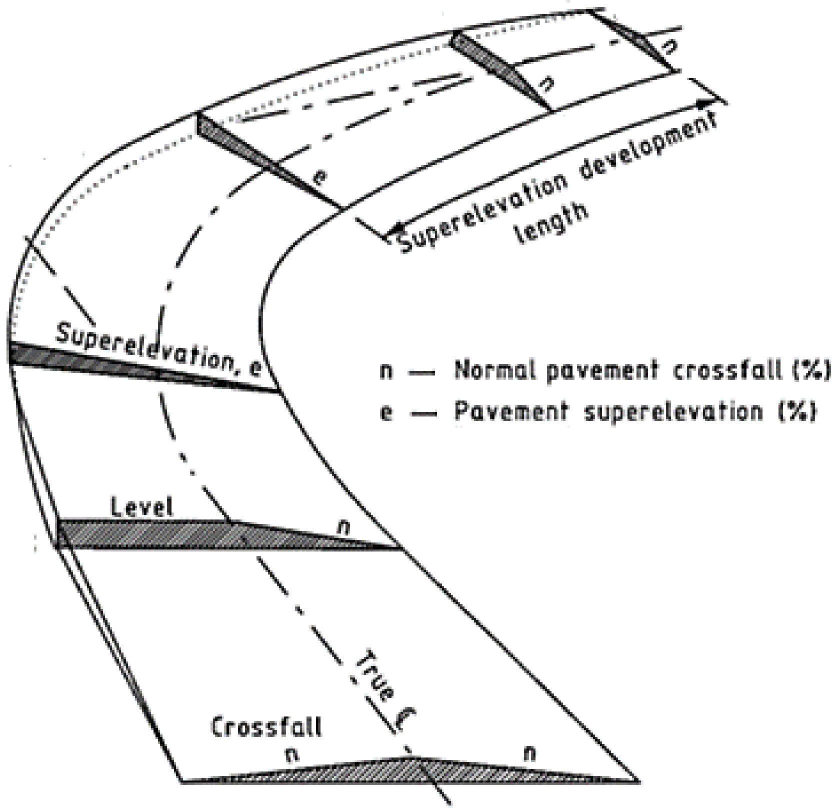
Hence, it is recommended that assessors undertake a physical inspection of the route (rather than a desktop review) to visually locate any sections of road that may comprise adverse or unsafe crossfall.

Previous Transport and Main Roads guidelines have provided advice on the assessment of superelevation. Figure B1 in Appendix B – Technical data depicts the relationship between curve radius and superelevation for varying travel speeds.

This information is used to determine the suitability of the combination of superelevation and curve radius for a given speed environment. Posted or legal speed limits should not be 15 km/h greater than the speed for a given combination of superelevation and curve radius, unless appropriate advisory signage is in place.

Advisory signage (where used), should indicate a lower speed than that determined using Figure B1.

Figure 4.6 – Typical superelevation profile on two lane roads (Source: Austroads 2010)



Some road train routes carrying a high proportion of high COG freight (for example, double-deck livestock) may have been constructed with a maximum curve superelevation of 4%, particularly for low speed environments.

PBS vehicles are expected to demonstrate better rollover performance than existing, as-of-right vehicles, due to the Static Rollover Threshold (SRT) performance requirement in PBS, which was designed to yield a higher level of performance than the conventional fleet. The SRT requirement is the same for all PBS vehicles, regardless of length or mass, hence there is no reason to consider that longer or heavier PBS vehicles have an elevated rollover risk.

Crossfall and superelevation are not required to be considered in assessments that only investigate whether the Class of an assessed PBS route can be upgraded (for example, PBS 2A to 2B). This is because the PBS roll stability requirements do not differ between PBS classes.

4.7 Clearance times at signalised intersections

The operational timing of traffic signals (including pedestrian facilities) should be assessed to ensure that the green and inter-green phases allow heavy vehicles to safely clear an intersection from rest. Insufficient clearance time can increase the safety risks, as vehicles may still be completing either turning or through manoeuvres at the start of the green phase of an opposing traffic stream.

The minimum stopping sight distances should be assessed in accordance with Section 4.10 of this document. The minimum green time and inter-green time in a green phase should be sufficient for vehicles in each road class to clear an intersection from a stationary position at the stop line. Average acceleration capability requirements for Scheme vehicles during straight line acceleration on roads without grade (0%) are shown in Table 4.7(a).

Table 4.7(a) – Acceleration capability of Scheme vehicles at flat grade (Source: PBS 2007)

PBS Road Class Level	Vehicle Types	Maximum length (metres)	Time to Travel 100 m from Free Rest (seconds)
1	Semi-Trailer	20	20
2	B-Double and A-Double	30	23
3	Type 1 Road Train (A-Double, B-Triple)	42	26
4	Type 2 Road Train (AB-Triple, A-Triple, Quad Combinations)	60	29

Allowance should be made for grades and/or turning movements as required. The requirements for the minimum green, inter-green times are calculated using the data in Table 4.7(a) and the lengths of current representative vehicle types as shown in Table 4.9. These results together with the stacking distances on the approach and departure side are shown in Table 4.7(b).

There should also be sufficient stacking distance between adjacent intersections to allow a vehicle to clear the first intersection before stopping at the second intersection as indicated in Table 4.7(b).

Table 4.7(b) – Clearance times and distances at signalised intersections at flat grade

Road Class	Signalised Intersection Clearance			# Stacking distances at intersection (metres)	
	Intersection width in the direction of travel (metres)	* Minimum green plus inter-green(s)			
		Access Class 'A'	Access Class 'B'	Access Class 'A'	Access Class 'B'
Level 1	20	12.0		23.5	
	25	13.0			
	30	14.0			
Level 2	20	15.0	15.5	29.5	33.0
	25	16.0	16.5		
	30	16.5	17.5		
Level 3	20	18.0	19.0	40.0	45.0
	25	19.0	20.0		
	30	19.5	20.5		
Level 4	20	25.0	26.5	57.0	63.0
	25	26.0	27.5		
	30	27.5	28.5		

Notes:

***** Assumes driver reaction time of 0.5 seconds. Additional driver reaction time shall be added as per Table 4.7(d).

Assumes a margin of 3.5 metres for stacking distances.

The clearance times calculated by adding the correct driver reaction time to those in Table 4.7(b) of the NTC *Network Classification Guidelines 2007* are for flat roads. To calculate the clearance times, taking into account the effect of longitudinal grade, the following times in Table 4.7(c) shall be added to the times calculated for flat roads as described in Table 4.7(b).

Table 4.7(c) – Additional clearance time required at intersections

Road Class	Intersection width in the direction of travel (metres)	Additional clearance time required at intersection (seconds)				
		Grade on approach				
		1%	2%	3%	4%	5%
Level 2	20	2.5	4.0	5.5	7.5	10.0
	25	2.5	4.0	5.5	7.5	10.5
	30	2.0	3.5	5.5	8.0	10.5
Level 3	20	1.5	3.5	5.5	8.0	11.5
	25	1.5	3.0	5.5	8.0	11.5
	30	1.5	3.5	5.5	8.5	12.5
Level 4	20	0	0	2.5	6.5	13.5
	25	0	0	2.5	6.5	14.0
	30	0	0	2.5	7.0	14.5

The above additional time to account for the effect of longitudinal grade on the approach to an intersection was calculated based on a combination of in-field testing and computer simulation results undertaken by Transport and Main Roads in 2014.

When calculating clearance times and distances at signalised intersections (Table 4.7(b)), driver reaction time according to Austroads *Guide to Road Design Part 3: Geometric Design*, *Chapter 5.2.2 Driver Reaction Time, Table 5.2* shall be used, and has been reproduced as Table 4.7(d) in this document (refer below).

Table 4.7(d) – Driver reaction times (Source: Austroads 2010)

Reaction time RT (seconds)	Typical road conditions	Typical use
2.5	• Unalerted driving conditions due to the road only having isolated geometric features to maintain driver interest. • Areas with high driver workload / complex decisions. • High speed roads with long distances between towns.	Absolute minimum value for high speed roads with unalerted driving conditions. General minimum value for: • high speed rural freeways • high speed rural intersections, and • isolated alignment features.
2.0	• Higher speed urban areas. • Few intersections. • Alerted driving situations in rural areas. • High speed roads in urban areas comprising numerous intersections or interchanges where the majority of driver trips are of relatively short length. • Tunnels with operating speed ≥ 90 km/h.	• Absolute minimum value for the road conditions listed in this row. • General minimum value for most road types, including those with alert driving conditions.
1.5	Alert driving conditions, for example: • high expectancy of stopping due to traffic signals • consistently tight alignments for example, mountainous roads • restricted low speed urban areas • built-up areas – high traffic volumes • interchange ramps when sighting over or around barriers, and • tunnels with operating speed ≤ 90 km/h.	• Absolute minimum value. • Only used in very constrained situations where drivers will be alert. • Can be considered only where the maximum operating speed is ≤ 90 km/h. • Should not be used where other design minima have been used.

Notes:

The driver reaction times are representative for cars at the 85th percentile speed and for heavy vehicles. The deceleration rates for heavy vehicles cover the inherent delay times in the air braking systems for these vehicles.

The above times typically afford an extra 0.5 second to 1.0 second reaction time to drivers who have to stop from the mean free speed. It is considered, for example, that the mean free speed is more representative of the speed travelled by older drivers.

If the proposed heavy vehicle route includes vehicles turning off at signalised intersections, additional time allowance should be made when calculating clearance times, as turning vehicles do not accelerate as quickly. In principle, routes that include a signalised intersection where the heavy vehicle turn off leg is uphill should generally be avoided and, in any case further investigated. If there is no alternative and turning off uphill at a signalised intersection is unavoidable, additional allowance in clearance times is necessary to address slower acceleration for turning vehicles.

4.8 Warning times at controlled level crossings

The warning time refers to the delay between the commencement of the flashing lights at a railway crossing and the start of the descent of the boom gate. It should be of sufficient length to allow vehicles to pass without striking the gate, if starting from rest at the stop bar. A numeric requirement for warning times has not appeared in previous Transport and Main Roads guidelines.

The equation shown in the previous section can be used to check the likelihood that a vehicle will be able to clear the level crossing, if starting from rest, for a given warning time. Again, the overall length of the vehicles must be taken into account, particularly when assessing whether the Class of a PBS route can be upgraded (for example, PBS 2A to 2B), as Class B vehicles are longer than Class A vehicles.

It is considered unlikely that warning times will be adequate, as the typical warning time for urban level crossings is 8 seconds. Use of the equation indicates that a B-double will only be able to travel approximately 20 metres in that time, if starting from rest.

Warning time should be increased as required, but assessors should consider a number of other factors. Although a vehicle starting from rest is the 'worst case' in terms of acceleration time, it may be a rare occurrence.

Hence, assessors should consider the likely vehicle speed, alongside any downhill and uphill grades towards the signals, and the phase times and size / brightness of any signal lanterns, the vertical geometry that may prevent visibility of the intersection), the possibility of the sun affecting visibility of the signals, and any vegetation that may obscure the signals.

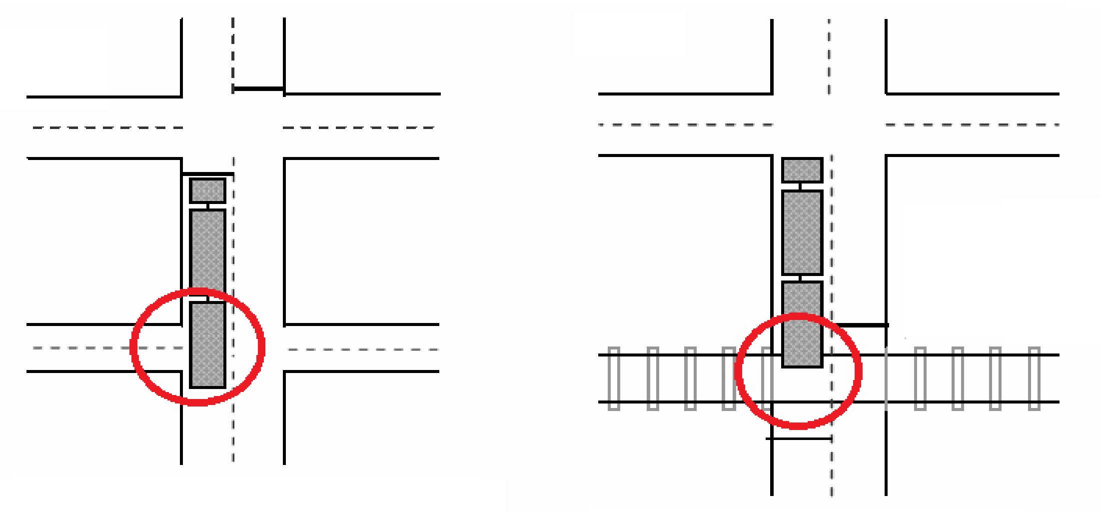
Consideration should also be given to the ride quality of the railway level crossing and the potential effects on load stability or vehicle dynamics if the ride quality is low.

4.9 Stacking distance at intersections and level crossings

Stacking distance refers to the length of the area available for vehicles to stop at intersections and level crossings. Inadequate stacking distance between intersections and other traffic features can increase safety risks, as vehicles could protrude into the path of oncoming vehicles, or trains, if a level crossing is involved.

Consideration of both 'approach' and 'departure' stacking distances is required. Figure 4.9(a) shows examples of inadequate approach stacking distance at an intersection, and inadequate departure stacking distance at a railway crossing. The potential conflict zone is denoted by the red circle.

Figure 4.9(a) – Examples of inadequate approach and departure stacking distances (Source: TMR 2013)



Stacking distance can be readily assessed as part of a desktop study using high-quality satellite imagery. Stacking distance can also be measured in a field test. In both instances, it should be measured from the marked give-way or stop line, to the outer edge of the shoulder of the through lane, or the edge of the rail line for level crossings.

In the absence of a marked line, the stopping position can either be assessed in a physical site inspection, conservatively taken as 2.0 metres from the edge of the outer shoulder of the through road, or 5.0 metres from the edge of the rail line for level crossings.

The minimum stacking distance provided should be the length of the vehicle, plus a suitable margin. A margin of 5.0 metres has been previously suggested as the minimum for level crossings (AS 1742.7:2016) and is considered applicable to other scenarios.

Diagrams outlining the application of the minimum stacking distance requirement are shown in Figure 4.9(b) and Figure 4.9(c). Overall maximum vehicle lengths are shown in Table 4.9.

Figure 4.9(b) – Minimum stacking distance requirement for level crossings (Sources: NTC 2007 and AS 1742.7:2016)

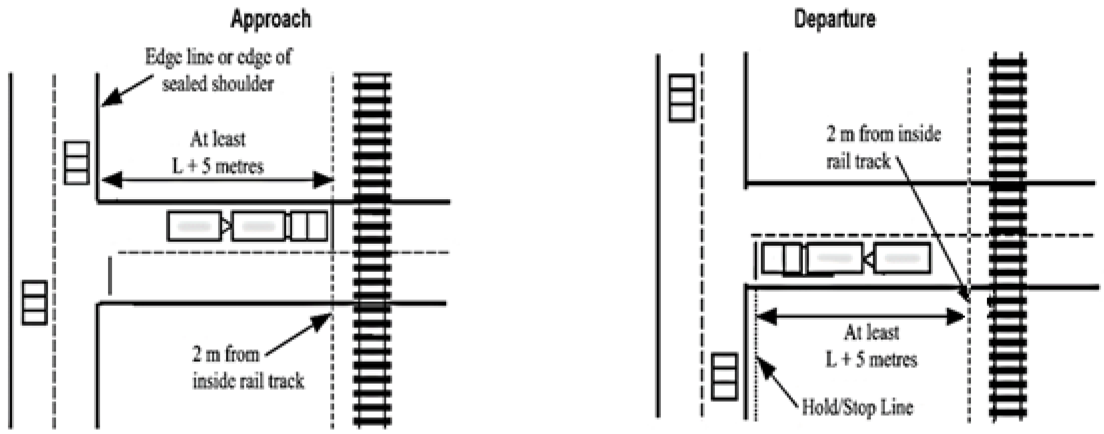


Figure 4.9(c) – Minimum stacking distance requirement for intersections (Sources: NTC 2007 and AS 1742.7:2016)

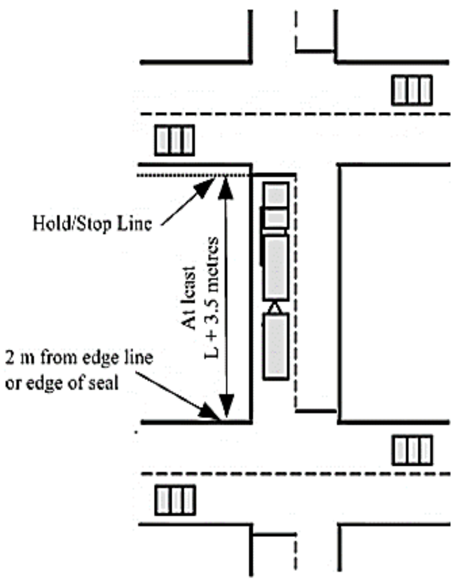


Table 4.9 – Overall maximum vehicle lengths

Vehicle Classification	Length (metres)
PBS Level 1	20.0 m
B-double, PBS Level 2A	26.0 m
PBS Level 2B	30.0 m
Type 1 road train (for example, A-double, B-triple, AB-triple), PBS Level 3A	36.5 m
PBS Level 3B	42.0 m
Type 2 road train (for example, A-triple, quad combinations), PBS Level 4A	53.5 m
PBS Level 4B	60.0 m

Assessors should use their judgement to determine whether a greater stacking distances or margins are appropriate given the expected traffic volumes and impacts on traffic flow. At level crossings where stacking distances are potentially insufficient, consideration should be given to the level of train movements and main road traffic. It may be possible accept short stacking distances where the number of train movements and the AADT of the through roads are both low (for example, less than 10 trains per day, and less than 500 vehicles).

Where stacking distances are inadequate and the assessor determines that there is a definite need, consideration should be given to the treatments shown in Figure B2 and Figure B3 in Appendix B – Technical data.

In all cases involving level crossings, the assessor must liaise with the appropriate rail owner and local council. The assessor should also refer to the requirements of the Department of Transport and Main Roads *Manual of Uniform Traffic Control Devices, Part 7, Railway Crossings.* Contact details for the relevant authorities are as follows:

- Queensland Rail (ODRL Coordinator) – Tel: (07) 3072 1719, email: roadloads@qr.com.au
- Aurizon Rail Network (ODRL Team) – Tel: (07) 3019 2331.

4.10 Sight distance at intersections

Sight distance is defined as the distance, measured along the carriageway, over which visibility occurs between a driver and an object or between two drivers at specific heights above the carriageway in their lane of travel.

Adequate sight distance is required at intersections to ensure that drivers of heavy vehicles have sufficient distance available to stop, if required.

There are three separate sight distance parameters that require consideration, Approach Sight Distance (ASD), Safe Intersection Sight Distance (SISD), and Minimum Gap Sight Distance (MGSD):

ASD is the minimum sight distance required to ensure that drivers are aware of the presence of the intersection, refer Figure 4.10(a). It is required at all minor road approaches to intersections.

- SISD is the minimum sight distance required to ensure that a driver can stop before colliding with an object that may be present on the roadway within the intersection, refer Figure 4.10(b). It should be available on both approaches of the major road at all intersections.
- MGSD is based on distances corresponding to the critical acceptance gap that drivers are prepared to accept when undertaking a crossing or turning manoeuvre at intersections.

Figure 4.10(a) – Plan view of Approach Sight Distance at an intersection (Source: Austroads 2021a)

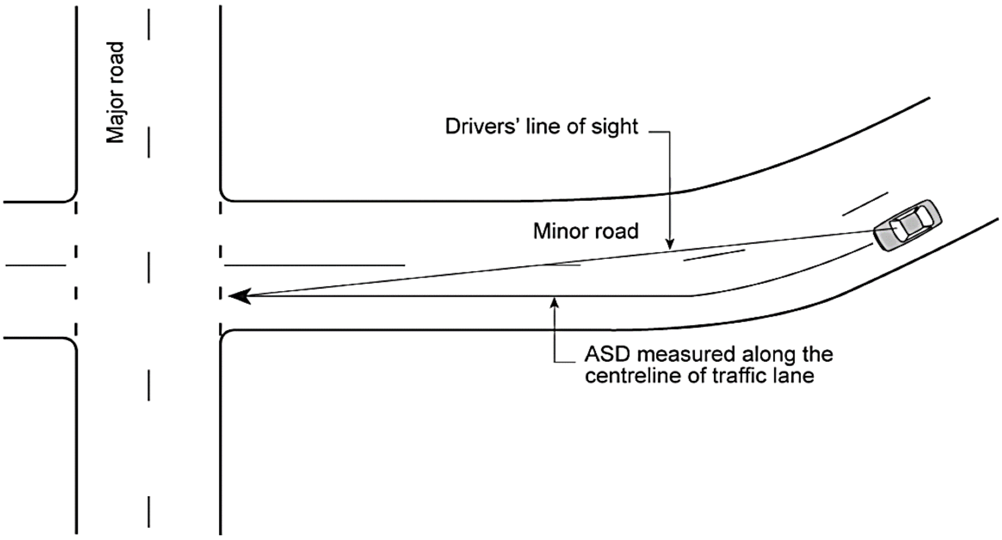
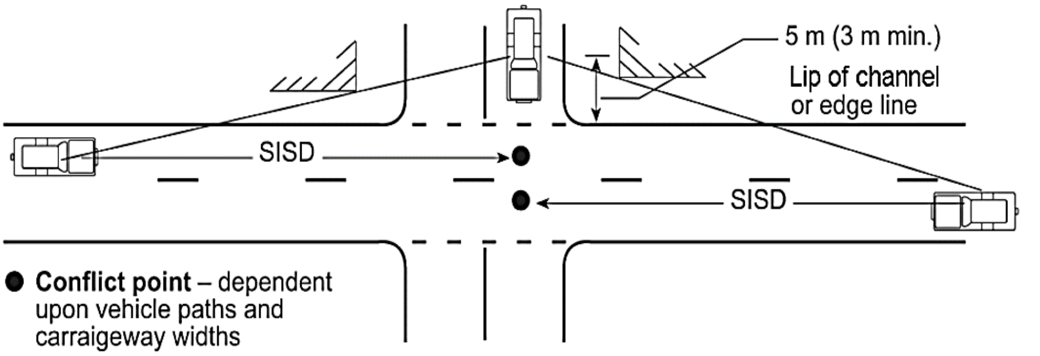


Figure 4.10(b) – Plan view of Safe Intersection Sight Distance (Source: Austroads 2021a)



Prior Transport and Main Roads publications listed ASDs and SISDs, but not MGSDs, for B-doubles, and Type 1 and Type 2 road trains, for varying grades and travel speeds. Comparison of those values against the results of an Austroads heavy vehicle braking study (Austroads 2009b) shows that they are applicable to vehicles approved under the PBS scheme, and existing 'as-of-right' combinations.

The department is currently conducting research into the application of MGSD to MCVs. Observations conducted as part of this research indicate that MCVs tend to "force" their way into the traffic stream when there is sufficient sight distance available. However, until such time as this research has been completed and reviewed, it is suggested that the techniques outlined in the Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (Austroads (2017)) for light motor vehicles are used.

The recommended ASDs and SISDs are shown in Table B1 and Table B2 respectively of Appendix B – Technical data. ASD and SISD should not be measured from satellite imagery, unless a physical site inspection had already determined the location and nature of obstructions to vision, else it could be overestimated.

The measured ASDs and SISDs should be rounded to the nearest five metres, and should meet or exceed the listed values. If either ASD or SISD cannot be achieved, the intersection should be supplemented with appropriately-designed controls, such as signage, pavement markings and signals. As with ASD and SISD, sight distance at rail crossings should not be measured from satellite imagery, unless a physical site inspection had already determined the location and nature of obstructions to vision, else it could be overestimated.

ASD and SISD are not required to be considered in assessments that only investigate whether the Class of an assessed PBS route can be upgraded (for example, PBS 2A to 2B). This is because the brake performance requirements do not differ between PBS classes.

4.11 Sight distance at uncontrolled level crossings

When a heavy vehicle is approaching a passive railway crossing, the operator must have sufficient opportunity to either decelerate to the stop at the holding line, or pass completely through the railway crossing without substantially altering their travelling speed. The braking performance and increased length of varying classes of MPVs should be taken into account.

This issue was researched in an Austroads study on heavy vehicle sight distance requirements at railway level crossings (Austroads 2009b), and data on the sight distance requirements for various classes of heavy vehicles and various approach train speeds, as shown in Table 4.11. Note that the data relates to a heavy vehicle speed of 80 km/h, refer to Austroads 2009b for sight distance requirements for 60 km/h and 100 km/h.

Table 4.11 – Sight distance requirements (Source: Austroads 2009b)

Vehicle Classification	Grade (%)	Sight distance (m) for vehicle speed of 80 km/h		
		80 km/h train	100 km/h train	120 km/h train
B-doubles and Level 2A PBS vehicles	-4	222	277	333
	0	203	254	305
	+4	189	237	284
Level 2B PBS vehicles	-4	235	294	353
	0	215	269	323
	+4	200	250	300
Type 1 road trains and Level 3A PBS vehicles	-4	240	301	361
	0	221	276	331
	+4	206	257	309
B-triple and Level 3B PBS vehicles	-4	244	305	367
	0	225	281	337
	+4	210	263	315
Type 2 road trains and PBS Level 4A vehicles	-4	259	324	389
	0	241	301	361
	+4	226	283	340
PBS Level 4B vehicles	-4	275	344	413
	0	254	317	381
	+4	238	297	357

4.12 Overtaking provision

Consideration of overtaking provision is required to ensure that other road users have sufficient opportunity to overtake heavy vehicles. Slow-moving heavy vehicles may cause hazards due to the difference between their speed and the desired travel speed of other road users, or prompt others to attempt unsafe overtaking manoeuvres.

On undivided carriageways, opportunities for drivers to overtake MCVs are governed by factors such as vehicle speeds, overtaking sight distances, traffic volumes, traffic composition and horizontal/ vertical road alignment.

At higher traffic volumes, the provision of dedicated overtaking opportunities to satisfy acceptance criteria is justified. The acceptance criteria for rural highways and rural main roads, based on ranges of traffic volumes are shown in Table 4.12(a).

Table 4.12(a) – Acceptable criteria for overtaking opportunities (Source: TMR 2013)

AADT	Maximum average distance per overtaking opportunity (km)	Maximum distance between overtaking opportunities (km)	Notes
500 or below	N/A	N/A	Provision of dedicated overtaking opportunities is usually not justified.
500 – 1,000	15	30	–
1,000 – 1,800	8	15	–
1,800 and above	5	10	At AADT > 2,700, dedicated overtaking opportunities may be necessary.

Consideration should be given to seasonal variation in traffic composition when applying AADT values. As an example, the numbers of vehicles towing caravans increases during holiday periods, and such vehicles may have additional difficulty in overtaking a slow moving MCV.

If the road or highway does not meet the above criteria, consideration should be given to whether:

- the volume and composition of traffic can tolerate the lack of overtaking opportunities, or
- a time-of-day curfew, or seasonal restriction, is appropriate.

Separate to the above, traffic microsimulation software is available for the assessment of overtaking opportunities. The TRARR (TRAffic on Rural Roads) software package developed by ARRB can be used to model the relationship between overtaking opportunities and traffic performance on a case-by-case basis.

As such, it can assess traffic performance on a specific road and determine the required lengths of added overtaking lanes, and where they should be located. For further information, refer to ARRB 2016, and the TRARR User Manual.

Where dedicated overtaking opportunities are not provided, the degree to which the road environment provides opportunities for vehicles to overtake should be investigated. This is done via the physical measurement of available overtaking sight distances, and comparison against numeric requirements.

Overtaking sight distance is made up of two parts, being:

- establishment distance – the length of clear visibility ahead in which a driver can establish that an overtaking opportunity exists and commence the overtaking manoeuvre, and
- continuation distance – the length of road ahead in which clear visibility remains available for a driver to complete the overtaking manoeuvre, or abandon the manoeuvre if necessary.

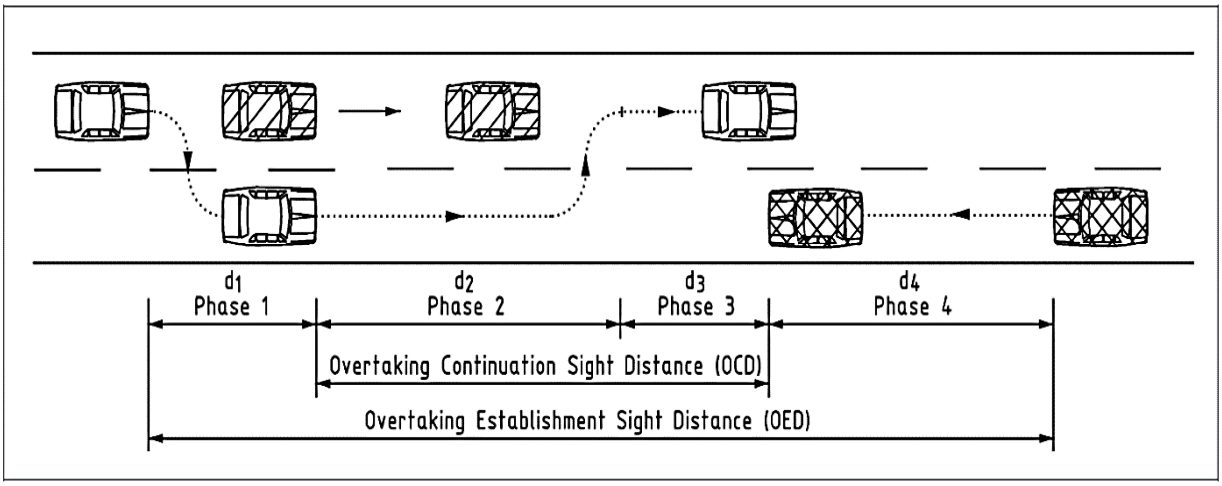
Further explanation is provided by Austroads 2010, which describes the four parameters of an overtaking model, refer Figure 4.12.

Overtaking manoeuvres begin when the overtaking vehicle leaves its position in the left lane and crosses the road centreline (the start of Phase 1), and ends when the vehicle again crosses the centreline and returns to its lane (the end of Phase 2).

Phase 3 and Phase 4 relate to the movement of a vehicle in the opposing lane.

Establishment distances comprises all four Phases, and continuation distance comprises Phase 2 and Phase 3.

Figure 4.12 – Four phases of an overtaking manoeuvre (Source: Austroads 2010)



The establishment and continuation sight distances were studied by Transport and Main Roads (SMEC 2015), and the recommended minimum values are shown in Table 4.12(b) and Table 4.12(c) respectively.

It is expected that given their relatively low eye height (approximately 1.10 metres), most car drivers would not be able to distinguish differences in sight distance about 1,000 metres. Hence, listed sight distance values above 1,000 metres can be regarded as met when the actual sight distance exceeds 1,000 metres.

TRARR can also be used to provide some indication of sight distance requirements for specific roads. Whilst it was not developed with that purpose in mind, required sight distances can be partly determined based on the lengths of the modelled overtaking lanes which provide the most benefit to traffic performance in TRARR simulations.

Table 4.12(b) – Minimum establishment sight distances (Source: SMEC 2015)

Road section operating speed (km/h)	Overtaken vehicle speed (km / h)		Establishment sight distance (metres)				
	Semi-trailer, B-double, PBS Level 2	Type 1 and 2 Road train, PBS Level 3/4	Semi-trailer, PBS Level 1	B-double, PBS Level 2A	Type 1 road train, PBS Level 2B, 3A	Type 2 road train, PBS Level 3B, 4A	PBS Level 4B
70	60	60	570	600	640	690	720
80	69	69	710	740	790	860	900
90	77	77	850	890	950	1,040	1,080
100	86	84	1,020	1,070	1,130	1,240	1,290
110	94	84	1,230	1,290	1,200	1,310	1,360

Table 4.12(c) – Minimum continuation sight distances (Source: SMEC 2015)

Road section operating speed (km/h)	Overtaken vehicle speed (km/h)		Continuation sight distance (metres)				
	Semi-trailer, B-double, PBS Level 2	Type 1 and 2 Road train, PBS Level 3/4	Semi-trailer, PBS Level 1	B-double, PBS Level 2A	Type 1 road train, PBS Level 2B, 3A	Type 2 road train, PBS Level 3B, 4A	PBS Level 4B
70	60	60	300	320	360	420	450
80	69	69	370	400	450	510	550
90	77	77	440	470	530	620	660
100	86	84	530	560	630	740	790
110	94	84	620	680	660	770	820

Sight distance can only be assessed via physical site visits. Assessors should drive the route in both directions, noting overtaking opportunities, and measuring the available sight distances via the vehicle's trip computer, or other suitable means (for example, hand-held GPS device).

4.13 Entry lane length onto main roads and highways

Consideration of the length of entry lanes for main roads and highways is required to ensure that heavy vehicles do not cause hazards due to the difference between their speed and the adjacent traffic speed, and impede traffic flow, thereby resulting in Level of Service (LoS) reductions. Generally, heavy vehicles should be able to achieve 70% of the through road traffic speed at the merge point, if the road main road or a highway, with a moderate to high traffic volume.

Previous editions of Transport and Main Roads publications listed minimum acceleration lane lengths for B-doubles, and Type 1 and Type 2 road trains, for varying acceleration lane grades and main road travel speeds.

Those values are applicable to vehicles approved under the PBS scheme, and existing 'as-of-right' combinations, as the power-to-weight ratios are largely similar, with the exception of quad-trailer road trains, which are expected to have low acceleration performance, particularly for combinations with gross masses above 120 tonnes.

The recommended minimum acceleration lane lengths are shown in Table 4.13. Missing values indicate that it is not possible for a vehicle to accelerate from rest up to the required speed within 2,000 metres. The acceleration lane lengths values refer to scenarios where the through road is a main road or highway, with moderate to high traffic. Acceleration lane lengths can be relaxed in scenarios where traffic volume is lower, or the through road is not a main road.

Table 4.13 – Minimum acceleration lane length (Sources: TMR 2013 and Gough 2019))

Vehicle Classification	Average grade of the acceleration lane (%)					
	Downhill			Level	Uphill	
	-4	-2	-1	0	1	2
Through road speed limit = 80 km/h (heavy vehicle entry speed = 56 km/h)						
B-double, Level 2 PBS vehicle	190	270	350	510	1,090	–
Type 1 road train, Level 3 PBS vehicle	200	280	370	570	1,500	–
Type 2 road train, Level 4 PBS vehicle up to 120 tonnes	220	330	460	790	–	–
Through road speed limit = 110 km/h (heavy vehicle entry speed = 77 km/h)						
B-double, Level 2 PBS vehicle	410	630	910	1,620	–	–
Type 1 road train, Level 3 PBS vehicle	420	670	970	1,870	–	–
Type 2 road train, Level 4 PBS vehicle up to 120 tonnes	470	760	1,180	–	–	–

The acceleration lane should extend for no more than 200 metres parallel to the nearest through lane so that drivers in the through lane(s) do not see the acceleration lane as an added lane and use it as such.

Acceleration lane length can be readily assessed as part of a desktop study using high-quality satellite imagery, and can also be measured in the field. It is not required to be considered in assessments that only investigate whether the Class of an assessed PBS route can be upgraded (for example, PBS 2A to PBS 2B). This is because the engine and driveline performance requirements do not differ between PBS classes.

Two additional considerations related to signage and visibility apply for acceleration lanes:

- the point where the acceleration lane meets the through road shall be visible at an adequate distance along the through road to ensure that there is enough time for other traffic to slow down or stop if required, and
- there should be adequate signage on the through road to warn traffic of the presence of entering heavy vehicles that may be moving slowly.

4.14 Overhead clearance

Heavy vehicles, particularly those with high loads, are more likely to strike overhead objects or structures. Assessors should confirm that adequate overhead clearances are available along the entire length of the proposed route.

Taking into account the possibility that the resealing of the road passing under a bridge may cause a reduction in available overhead clearance, and that there may be a delay in having this reduction reflected in the road data systems, the minimum overhead clearance at rigid overhead obstructions such as bridges, overpasses and signs is 400 mm above the height of the vehicle being investigated:

- with reference to Table 4.14 below, the minimum clearance between a structure and the surface of the road below it should therefore be 5 m (4.6 m maximum vehicle height + 400 mm clearance) for roads of classes L2, L3 and L4.
- When considering vehicular access requests, the actual height of the vehicle being investigated may be used in place of the 4.6 m maximum vehicle height.

The minimum overhead clearance at non-rigid overhead obstructions, such as wires and trees, is 500 mm above the height of the vehicle being investigated.

Where high voltage power lines cross the route, the minimum overhead clearance requirements must be checked with the local electricity authority. Contact details for the relevant network operators are as follows:

- Origin Energy: website: https://www.essentialenergy.com.au/partners/high-load-permit
- Ergon Energy: Tel: 13 74 66, e-mail: highloads2@ergon.com.au
  website: https://www.ergon.com.au/network/safety/industry-safety/high-loads-and-powerlines
- Energex: e-mail: HighLoadEscort@energex.com.au
  website: https://www.energex.com.au/contractors-And-service-providers/document-library/forms

Where electric overhead wiring exists at level crossings, height clearance requirements shall be checked with the relevant rail authority.

Table 4.14 shows the subsequent requirements on maximum vehicle heights for different road classes.

Table 4.14 - Maximum vehicle heights (Source: NTC (2007a))

Road class	Maximum vehicle height (m)	Comments
L1	4.3	Structures with less than 5 m clearance should be signed to show the clearance level to the nearest 0.1 m
L2 (B-doubles and PBS Level 2 vehicles)	4.6	
L3 (Type 1 Road Trains and PBS Level 3 vehicles)	4.6	
L4 (Type 2 Road Trains and PBS Level 4 vehicles)	4.6	

4.15 Off-street parking

In rural and remote areas, the route should have adequate off-road parking facilities suitable to allow the safe entry / exit and parking for heavy vehicles, at sufficient spacing along the route. In any one direction of travel, the desirable maximum spacing for off-road parking facilities is:

- 80 km (rural areas), and
- 120 km (remote areas).

An adequate off-road parking facility is defined as any service station or roadhouse, (or other commercial establishment), with provision for public truck parking; a signed parking bay, truck bay, rest area; or a designated road train assembly area. The length of the parking bays within the facility must provide for the length of the vehicle, plus areas to allow for manoeuvring. Heavy vehicles should not protrude onto the adjacent carriageway.

Depending on the frequency of heavy vehicles using the parking facilities, the requirement for other facilities such as rubbish bins, tables, chairs and toilets should be considered. Assessors should also consider the need for multiple parking bays for heavy vehicles, as guided by expected traffic volumes.

Sight distances to the entry points of the parking facilities for heavy vehicles travelling on the through road should be in accordance with the ASDs specified in Section 4.10. Recommended minimum clearances from the edge of the adjacent road vary with the speed limit and are shown in Table 4.15. Truck parking should be provided on both sides of a road to discourage drivers from performing U-turns.

Table 4.15 – Recommended minimum clearances from the edge of the adjacent road (Source: TMR 2013)

Speed limit (km/h)	Recommended minimum clearance (m)
60	5.0
70	5.7
80	6.2
90	7.6
100	8.8
110	11.0

Guidance on the appropriate layouts for truck parking signage should be obtained from relevant design guides and standards. Parking facilities can be identified using satellite imagery and some geometric aspects measured, but should be physically inspected so that their suitability can be judged.

4.16 Grades

The speed of heavy vehicles ascending long and steep grades can be reduced to the extent that the speed differential can present a hazard for approaching upstream vehicles. In some cases, the drivers of such vehicles may become frustrated and attempt unsafe overtaking manoeuvres. To mitigate this, steep ascending grades should have overtaking lanes where possible. A forced speed reduction to 40 km/h is considered the threshold point at which drivers will seek to overtake a slower vehicle, regardless of whether adequate sight distance is available or not.

The distances required for heavy vehicles on grades to slow to 40 km/h were previously investigated via simulation (TMR 2013). The results of that investigation are applicable to current as-of-right combinations and PBS vehicles, as the power-to-weight ratios are similar, with the exception of quad-trailer road trains, which are expected to have low acceleration performance, particularly for combinations with gross masses above 120 tonnes.

Table 4.16 shows the maximum distances of uphill travel before speeds are reduced to 40 km/h. Where no value is given, this indicates that the vehicle can maintain a speed higher than 40 km/h on that grade.

Table 4.16 – Maximum distances of uphill travel before speeds are reduced to 40 km/h (Source: TMR 2013)

Grade (%)	B-doubles and PBS Level 2 vehicles		Type 1 road trains and PBS Level 3 vehicles		Type 2 road trains and PBS Level 4 vehicles	
	80 km/h approach speed	100 km/h approach speed	80 km/h approach speed	100 km/h approach speed	80 km/h approach speed	100 km/h approach speed
3	–	–	–	–	1,080	1,650
4	950	1,410	900	1,350	690	1,110
5	640	980	610	960	520	840
6	480	760	470	750	410	680
7	390	630	380	620	340	570
8	330	530	320	530	290	490

For proposed routes where road sections have extended long downgrades of between 6% and 10%, safety ramps (comprising an upward sloping escape ramp or an arrester bed of sand / gravel) should be provided approximately 3.0 km downhill of the grade summit and every 3.0 km thereafter for longer grades.

Safety ramps should be located prior to or at the start of the smaller radius curve along the alignment. They should not require an out of control vehicle to cross oncoming traffic.

When upgrading a road classification, consideration should be given to the potential that an errant heavier vehicle may obtain a higher speed when descending a grade, and consideration should be given to the length, depth, grade or material of an arrester bed.

4.17 Additional considerations for errant vehicles and emergency situations

The ability of a heavy vehicle driver to safely pull off the carriageway should be assessed. Heavy vehicles may need to pull over and stop for various reasons, including to inspect equipment, change tyres, or undertake minor repairs. Long, continuous sections with narrow or no shoulders and/or deep drains should be noted and the safety impacts considered.

The shoulder condition should also be considered if it is likely that vehicles may need to use the shoulder. Shoulders should preferably be sealed and have minimal drop-off to the adjacent surface.

Steep batter slopes may induce the roll-over of errant vehicles. Batters with a slope greater than 1:4 have the potential to reduce the ability of drivers to recover if they run off the road (DTEI 2008). However, trucks will probably roll over on a 1:4 batter.

The maximum batter slope for trucks to traverse is 1:6, while the batter slope should desirably be 1:10 or flatter for trucks to recover. Such slopes are not always affordable or practical to achieve (Arndt 2018).

Batter slopes cannot be assessed via a desktop study and must be inspected in the field. When assessing batter slopes, the likelihood of errant vehicle should be considered, taking into account the speed environment, road alignment, clear zone width and road surface crossfall.

5 Infrastructure considerations

5.1 Pavements

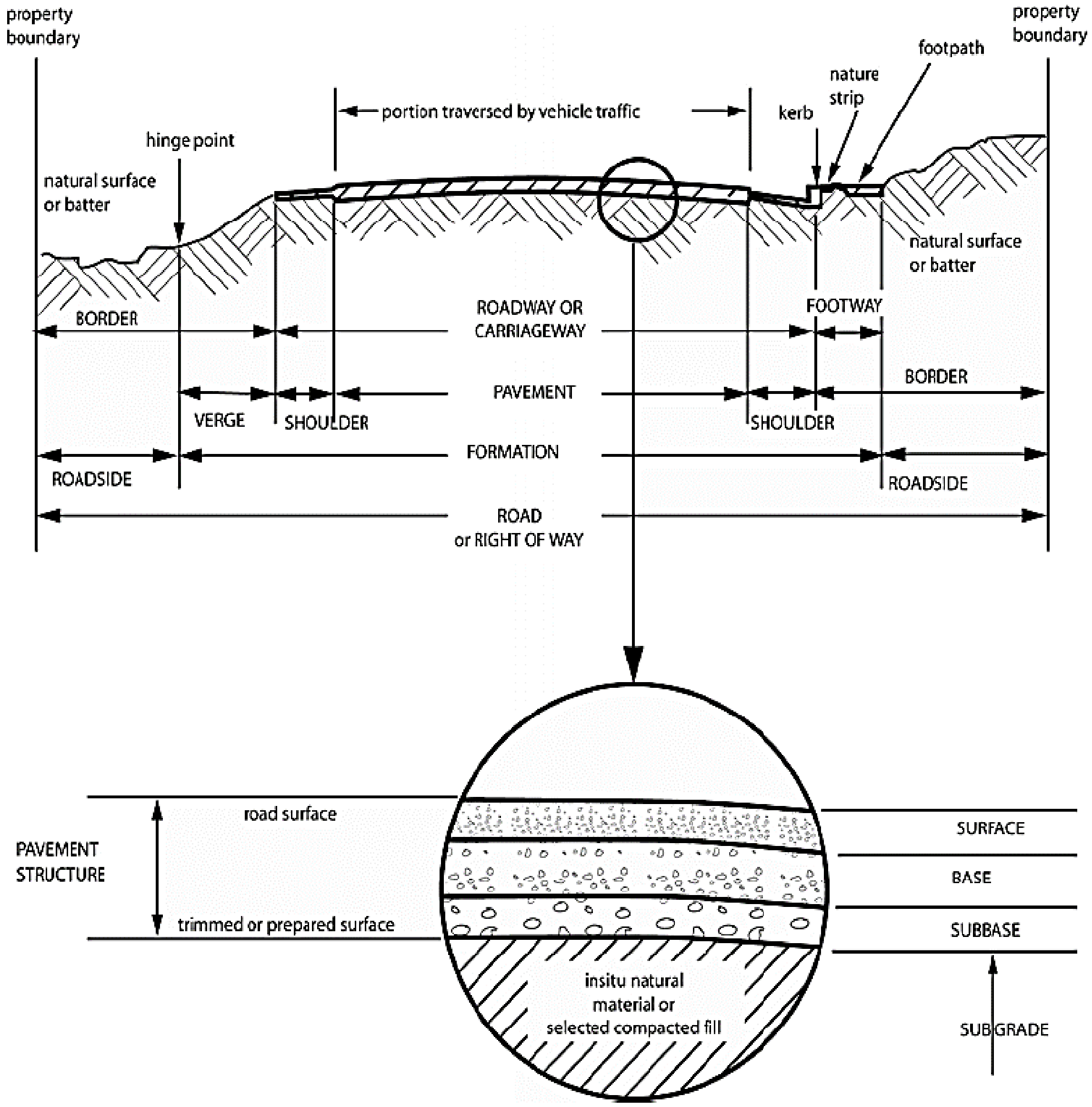
Consideration of pavement loading is required to ensure that the loads imparted by heavy vehicles to the pavement surface and underlying layers will not cause damage or premature wear.

Two types of pavement loading are of concern; vertical loading (the forces applied by the vehicle's mass, and their dynamic effects) and horizontal loading, which comprises the forces imparted when accelerating and braking, and the 'scrubbing' forces applied when turning.

Vertical loading typically impacts the underlying layers, and causes damage such as rutting, whereas horizontal loading typically impacts the surface itself, and can result in aggregate stripping, and in extreme cases, surface layer shifting.

The difference between surfaces and underlying layers is shown in Figure 5.1.

Figure 5.1 – Typical pavement structure within the context of road design (Source: Austroads 2009c)



Notwithstanding this, existing ‘as-of-right’ and PBS vehicles are permitted the same axle load limits as general access vehicles, so there is no reason to consider that their pavement loading forces would be any higher than for heavy rigid or articulated vehicles. In practice, the pavement vertical loading per tonne of payload generally decreases as vehicle mass and length increases, and particularly for PBS vehicles, due to their higher productivity.

In contrast, horizontal loading can be higher due to the increased tractive demands of heavier vehicles, and the higher tendency for axle groups to scrub the pavement when turning at intersections.

The pavement design process is extensive and well-documented in Australian guidelines (Austroads 2019), and covers pavement composition (surface, base, and subbase), layer depth and materials, and the consideration of traffic volumes, environmental conditions, and maintenance requirements.

Technical aspects of the pavement design are not required to be re-visited in the route assessment process, however, assessors should seek to determine if:

- the assumptions and parameters that were used to guide the pavement design regarding traffic volume and heavy vehicle composition remain valid under the proposed new route classification, and
- the likelihood that the new route classification will increase the chance of localised premature wear or damage at intersections and grades (due to high horizontal loading).

It is expected that accepted pavement design processes will have been employed in the design of Queensland roads, however the design parameters may not be documented. According to design guidelines (Austroads 2019), the heavy vehicle parameters include the average weight of heavy vehicles, the average number of axle groups, the weight distribution across axle groups, the average daily number of heavy vehicles, and the heavy vehicle traffic growth.

Increases in these parameters may accelerate the deterioration of a pavement and reduce its design life, and they should be reviewed to determine their validity under the new route classification. Irrespective of the available level of documentation, the assessor should seek input from pavement engineers or asset managers responsible for the road in question, and rely on their advice in the determination of the impacts.

Data on the pavement roughness may be available from the ARMIS system, and could be used to guide assessments. The department noted that surface irregularities arising from unevenness can result in instantaneous dynamic loads that greater than double the static axle load (TMR 2013). High dynamic loading can also arise from travel over surface level discontinuities at bridges and culverts. Consequently, road roughness can significantly increase further pavement wear and damage.

Intersections and grades are susceptible to wear and damage due to high horizontal loading. The tractive force exerted on the pavement by each drive tyre increases with vehicle mass, as heavier vehicles need extra tractive effort when starting and accelerating to overcome resistive forces of rolling resistance and gravity. This places additional shear / horizontal stresses on surfaces and the upper 100 mm pavement layers, and is most likely to be observed at intersections, on upgrades, and on new seals or reseals.

For those reasons, the department recommended that chip seals are acceptable for short sections of grades of less than 2%, whereas for grades greater than 5%, and asphalt surface should be used (TMR 2013). In some areas of low traffic, acceptable performance of chip seal surfacing on steep grades may be achieved using polymer-modified binders. Assessors should ensure that the pavement design considers the proportion and composition of traffic for climbing lanes.

Assessment of the suitability of surfacings at intersections should consider the potential for the increase in horizontal forces. High horizontal forces are more likely to be caused by longer multi-combination vehicles that have poor Low-Speed Swept Path (LSSP) performance, as the off-tracking of the trailers of those vehicles means that the axle groups are partially dragged sideways across the surface. In some instances, the effect of those forces may be beyond the capacity of a sprayed seal. Alternative seal types are listed below, in order from least to most effective at withstanding the effects of high horizontal forces (TMR 2013):

- single coat seal with polymer modification
- two-coat seal

- two-coat seal with polymer modification
- dense graded asphalt, and
- dense graded asphalt with polymer modification.

5.2 Bridges and culverts

Consideration of infrastructure capacity is required to ensure that the loads impacted onto bridge and culverts meet the criteria within the Transport and Main Roads assessment policy. Bridge assessments require specialised technical knowledge and all assessments are undertaken by the department's Structures section.

The load capacity of each bridge for a predetermined reference vehicle is expressed as a series of assessment ratios. The load effects of the vehicle being assessed are compared against the load effects of the reference vehicle to calculate its assessment ratios to determine if the bridge has sufficient capacity.

In addition, the assessed vehicle's load effects are directly compared with the load effects of the shortest, heaviest as-of-right freight vehicle permitted on the route. For culverts, only this latter check is carried out. Typically, both of these exercises are achieved using a line model analysis.

Some structures may be present on routes that are owned by third parties such as rail or utility operators, and they should be involved as required.

5.3 Floodways and causeways

Consideration of floodways and causeways is required to ensure that road safety and network operations are not compromised by routes that containing flood-prone sections.

When assessing a route that contains sections subject to flooding or is crossing floodways, the detours and alternative routes should be examined to determine whether they are suitable for the heavy vehicles in question. Consideration should be given to permanent flood traffic management schemes where available, and how they can accommodate such vehicles. Off-street parking areas, rest areas and lane closures can be used to address road closures due to flooding. In cases where alternative provisions cannot accommodate the heavy vehicles, a risk assessment should be conducted and used to guide the access decision.

5.4 Traffic interaction considerations

The interaction between heavy vehicles and other road users is an important road safety consideration. Whilst aspects of traffic interaction are covered in other areas of this guideline (for example, speed differential when merging, requirements for cycling lanes and so on) the traffic volume, composition and crash history of a route should be considered.

The daily and annual variation in traffic volumes on a proposed road (and the projected variation) should be considered. It may be prudent to restrict heavy vehicle operation during peak traffic hours in urban areas, or during certain periods of the year to accommodate seasonal fluctuations in traffic. On the other hand, higher heavy vehicle traffic may be permitted during certain periods of the year; for example, to cater for grain carting season.

The current and future traffic composition of the proposed route should be considered, in the context of assessing the likelihood that typical road users can safely integrate with heavy vehicles. On a route where there is presently high heavy vehicle traffic, or where local drivers are already familiar with similar heavy vehicles operating in the area, there is a greater likelihood of route acceptance.

In contrast, the possible risks to road safety should be considered for roads with high tourist traffic or vehicles towing caravans, or other road users not familiar with the area and inexperienced in encountering heavy vehicles. Appropriate signage advising motorists of heavy vehicle operation should be considered where significant amounts of slow-moving traffic or inexperienced drivers are likely to be encountered.

Heavy vehicles attempting to enter a through road from a junction may have trouble if there are insufficient gaps in the through traffic stream. Heavy vehicles require a greater time gap to enter or cross a traffic stream, which can have a significant effect on the capacity and delay at unsignalised intersections, and should be considered.

A detailed crash assessment of proposed roads is required to determine if there are any existing safety issues that may be exacerbated by the road reclassification. The assessment should comprise a review of crash data with the intent of identifying the presence of crash trends at particular locations, or for specific intersection manoeuvres or road users. Specific attention should be given to heavy vehicle crashes.

It is prudent to investigate whether particular risks are engendered at certain times of the day. In such cases, it may be warranted to recommend that heavy vehicles only use the route during the low-risk hours. Consultation with local authorities and the police should also be conducted. Other road users / vehicles to be considered include:

- vulnerable road users such as cyclists, and pedestrians (especially where there are school crossings)
- tourists (including cars towing caravans, who may be unfamiliar with the conditions)
- school buses (where the frequent stopping and turning by buses, and the presence of children on or adjacent to the road, can pose potential hazards)
- cattle and other stock, and
- farm machinery and implements.

To address safety concerns, the assessor should recommend that a formal road safety audit be conducted such that appropriate treatments can be identified. The assessor should use their judgement and input from road safety staff to determine if access can be permitted on the route while the feasibility of treatments is identified, and if the risks can be mitigated in the short-term via the application of special conditions such as speed reductions or curfews.

6 Amenity considerations

The primary amenity considerations relating to the impacts of heavy vehicles are noise, exhaust emissions, and airborne dust. It is desirable to minimise their occurrence, but also good practice to consider the use of land adjacent to heavy vehicle routes, to minimise the likelihood of amenity impacts on businesses or facilities that are on or near those routes. Such businesses or facilities include shopping strips or centres, schools, community buildings, sporting venues, hospitals, aged care facilities, sensitive farmland, wildlife corridors, and other recreational areas.

6.1 Adjacent land use

Land use planning is conducted throughout Australia by local and state governments to encourage and assist land users to choose options that increase their productivity, meet social needs, and are sustainable.

The Queensland Department of Infrastructure, Local Government and Planning (DILGP) coordinates land use planning throughout the state. The department's responsibilities include development and review of regional plans, planning and coordination of infrastructure provisions, economic infrastructure development, and the identification and acquisition of infrastructure corridors.

Local governments are primarily responsible for regional land use planning, and are required by legislation to produce planning schemes outlining the future development areas within their jurisdictions. The schemes incorporate community planning and aspirations, along with the needs of the state and regional community.

Assessors should liaise with both DILGP and local councils, and attempt to understand the impacts of heavy vehicles on current and future businesses and facilities that are present on or near the roads under assessment.

6.2 Noise

Heavy vehicles are known to generate more traffic noise than other vehicles, particularly when braking, accelerating, and travelling over rough roads. Heavy vehicle services brakes can squeal or whine when applied, and there is usually a sudden release of compressed air when the vehicle comes to a stop.

Heavy vehicle exhaust brakes can be particularly noisy, and are often noted by residents as intrusive when used in urban areas. Rough roads can cause vehicles, payloads, and restraining devices to shake and clatter, creating additional noise. The noise of refrigeration units can be intrusive, particularly when vehicles are parked at night.

In some cases, the noise generated by heavy vehicles is unavoidable. In some instances, it can be mitigated by the presence of natural noise barriers such as hills and vegetation, which should be confirmed via a physical site inspection. Sensitive facilities such as dwellings, schools, and hospitals should be located at least 1,500 metres away from road segments requiring heavy vehicles to accelerate or decelerate (for example, intersections and grades), or road segments that are particularly rough, and at least 300 metres away from other sections.

In both instances, the traffic noise may be acceptable for buildings located within the specified distances, and could be confirmed via further investigation and consultation. If warranted, the assessor could engage a suitably-qualified consultant to conduct a road traffic noise assessment.

If there are known problems with heavy vehicle noise, or experienced judgment indicates that noise problems are likely to occur, the assessor shall consider and make recommendations on all possible solutions, including:

- signs advising drivers to avoid using engine brakes
- a curfew for heavy vehicles to prohibit operation during night time hours
- the installation of noise barriers along the sides of the road, and
- the construction of noise attenuation treatments.

It should be noted that noise emissions from existing as-of-right and PBS vehicles is similar to those from conventional rigid and articulated heavy vehicles. Therefore, use of longer and heavier vehicles can decrease total noise emissions over a set period, as fewer heavy vehicles are required for a given freight task.

6.3 Exhaust emissions and odours

Heavy vehicles are considerable producers of exhaust emissions, and in the case of vehicle carrying livestock, can create unpleasant odours. This can be of concern to sensitive facilities such as dwellings and schools. The potential amenity impacts should be investigated.

The route should not be recommended for approval if there are known problems caused by odours and fumes, or if the assessor judges that such problems are likely to be created because of allowing specific vehicles to access the route.

6.4 Airborne dust, and water splash / spray

The effects of airborne dust, and the potential for splash and spray of rainwater from the pavement by heavy vehicles should be considered. These factors can adversely impact other vehicles, pedestrians, cyclists and nearby property.

The department advised that splash and spray emanating from a heavy vehicle is related to the number of wheels on the vehicle and becomes significant above 80 km/h (TMR 2013).

National guidelines (NTC 2007) provide advice regarding the likelihood that dust, splash and spray can become problematic, relating to the speed limit, AADT, and types of vehicles operating on the road, as shown in Table 6.4. The listed preferred provisions should be considered.

If there are known problems of dust, splash or spray caused by heavy vehicles or, experienced judgment indicates that these problems are likely to be significant if heavy vehicles are introduced to the route, the assessor shall recommend whether the heavy vehicles should be required to fit spray suppression equipment or the route not be recommended for approval.

Note that whilst spray suppression equipment has moderate effect, it does not stop all of the spray being thrown out the sides and rear of the vehicle.

Table 6.4 – Dust, splash and spray guidance (Source: NTC 2007)

Vehicle Classification	Speed limit (km/h)	AADT	Preferred provisions to reduce dust, splash and spray
B-double or PBS Level 2 vehicle	< 80	No limit	The road should be sealed, preferably with a sealed shoulder, though an unsealed shoulder is acceptable.
	> 80	< 10,000	
Type 1 road train or PBS Level 3 vehicle	< 80	No limit	The road should be sealed. Unsealed shoulders are acceptable.
	> 80	< 1,000	
Type 2 road train or PBS Level 4 vehicle	< 80	Any	Unsealed roads are acceptable; however, speeds should not exceed 80 km/h.

7 Related resources

Table 7 provides a list of the route assessment guidelines used by other jurisdictions.

Table 7 – List of route assessment guidelines used by other jurisdictions

Jurisdiction	Documents
Western Australia	*Standard Restricted Access Vehicle Route Assessment Guidelines* (MRWA 2014)
South Australia	*DTEI Route Assessment for Restricted Access Vehicles* (DTEI 2008) *Commodity Network Route Guidelines* (DTEI, 2009)
Northern Territory	N/A
New South Wales	*NSW Route Assessment Guide – 4.6 metre high vehicle routes* (RMS 2013) *NSW Route Assessment Guide for Restricted Access Vehicles* (RMS 2012a) *Freight Route Investigation Levels for Restricted Access Vehicles* (RMS 2012b) *Route assessment for 14.5 metre buses* (RTA 1998) *Performance-Based Standards Scheme – Network Classification Guidelines* (NTC 2007)
Australian Capital Territory	N/A
Victoria	N/A
Tasmania	*Review of Gazetted High Productivity Vehicle Route Network* (DIER 2011)

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Appendix A – Glossary of terms

Term	Description
AADT	Annual Average Daily Traffic. A measure of the daily number of vehicles travelling on a road, averaged over one year.
A-double	A heavy vehicle combination comprising a prime mover and two semi-trailers connected by a converter dolly.
AB-triple	A heavy vehicle combination comprising a prime mover and semi-trailer, towing a B-double trailer set connected to the first trailer by a converter dolly.
Approach Speed	The Operating Speed on the approach to a geometric feature, such as a curve, or change of gradient, or intersection, or roundabout.
Arrester Bed	Commonly found on severely descending grades, an arrester bed is a type of escape exit that decelerates out of control heavy vehicles. Often gravel and sand is used.
ARMIS	Transport and Main Road's road management and data information system.
As-of-right vehicles	Heavy vehicle combinations that are permitted to operate through gazettes or notices.
A-triple	A heavy vehicle combination comprising a prime mover and three semi-trailers connected by converter dollies.
Austroads	The association of Australian and New Zealand road agencies.
B-double	A heavy vehicle combination comprising a prime mover, lead trailer, and semi-trailer connected by a fifth-wheel coupling.
B-triple	A heavy vehicle combination comprising a prime mover, two lead trailers, and a semi-trailer connected by fifth-wheel couplings.
Carriageway width	The width between the outer shoulder edges (sealed and unsealed portions) or between the kerb faces, of undivided carriageways.
Crossfall	The slope, measured at right angles to the alignment, of the surface of any part of a carriageway.
Heavy Vehicle National Law (HVNL)	A set of prescriptive regulations applicable to heavy vehicle combinations above 4.5 tonnes, adopted by the Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania and Victoria.
High Speed Off-Tracking	The degree to which the rear unit of a combination vehicle tracks outboard of the hauling unit during high speed turns or when travelling straight under the influence of pavement crossfall.
Lane	A portion of the paved carriageway marked out by kerbs, painted lines or barriers, which carries a single line of vehicles in one direction.
Multi-Combination Vehicle (MCV)	Multi-Combination Vehicles (MCV) consists of all combinations of vehicles exceeding 19 metres in length or 42.5 tonnes gross mass including B-doubles, Road Trains, and PBS vehicles.
National Transport Commission (NTC)	An inter-governmental agency charged with improving the productivity, safety and environmental performance of Australia's road, rail and intermodal transport systems.
One-way road	A road or street on which all vehicular traffic travels in the same direction.
Operating Speed	The speed below which 85% of cars are observed to travel under free flowing conditions. i.e. When traffic volumes are low.
Overtaking Lane	An auxiliary lane provided to allow for slower vehicles to be overtaken. It is lined-marked so that all traffic is initially directed into the left lane, with the inner lane being used to overtake.
Pavement	The portion of a road designed for the support of, and to form the running surface for, vehicular traffic.

Term	Description
Performance Based Standards (PBS)	Australia's alternative regulatory scheme for heavy vehicles, where access is granted on the basis of the vehicle's performance in a set of safety and infrastructure standards.
Restricted access vehicles	Heavy vehicles that are restricted from operating on the general access network, in its entirety.
Remote Area	These areas are defined in ARMIS as an area with a population of < 40,000 people per area and a density of < 200 people / km^2 as sourced from the Australian Bureau of Statistics 2006 Census.
Road Friendly Suspension (RFS)	Vehicle suspensions that comply with the Performance Standard described in Vehicle Standards Bulletin No. 11 (Certification of Road Friendly Suspensions).
Road Furniture	A general term covering all signs, street lights and protective devices for the control, guidance and safety of traffic, and the convenience of road users
Rural Area	These areas are defined in ARMIS as an area with a population of < 40,000 people per area and/or a density of < 200 people / km^2 as sourced from the Australian Bureau of Statistics 2006 Census.
Seal Width	Width between edges of sealed surface or between edge lines (where installed on undivided carriageways), whichever is less.
Shoulder	The portion of formed carriageway that is adjacent to the traffic lane and flush with the surface of the pavement.
Stopping Sight Distance	The distance required for a MCV driver, travelling at a given speed, to perceive an object on the road and to stop before striking it.
Superelevation	A slope on a curved pavement selected so as to enhance forces assisting a vehicle to maintain a circular path.
Swept Path	The total road area defined by the outermost and innermost points of the vehicle at each increment along the steering path of a vehicle negotiating a corner at low speed. Swept path is the sum of the vehicle width and the off tracking.
Swept Width	A measure of trailing fidelity defined as the sum of vehicle width at the rear plus the lateral deviation of the rear of the last trailer, measured during normal straight-ahead travel at highway speed.
Tracking Ability on a Straight Path (TASP)	The ability of the trailers of a multi-unit heavy vehicle combination to remain within the path tracked by the prime mover. One of the performance measures assessed in PBS.
TMR	The Queensland Department of Transport and Main Roads.
Type 1 road train	A group of heavy vehicles that comprise two or three trailers, connected by a converter dolly, including A-doubles and B-triples, with a maximum overall length of 36.5 m.
Type 2 road train	A group of heavy vehicles that comprise three or more trailers, connected by a converter dolly, including A-triples, AB-triples, and various quad-trailer combinations, with a maximum overall length of 53.5 m.
Urban Area	These areas are defined in ARMIS as an area with a population of ≥ 40,000 people per area and a density of ≥ 200 people / km^2 as sourced from the Australian Bureau of Statistics 2006 Census.

Appendix B – Technical data

Figure B1 – The relationship between curve radius and superelevation (Source: TMR 2013)

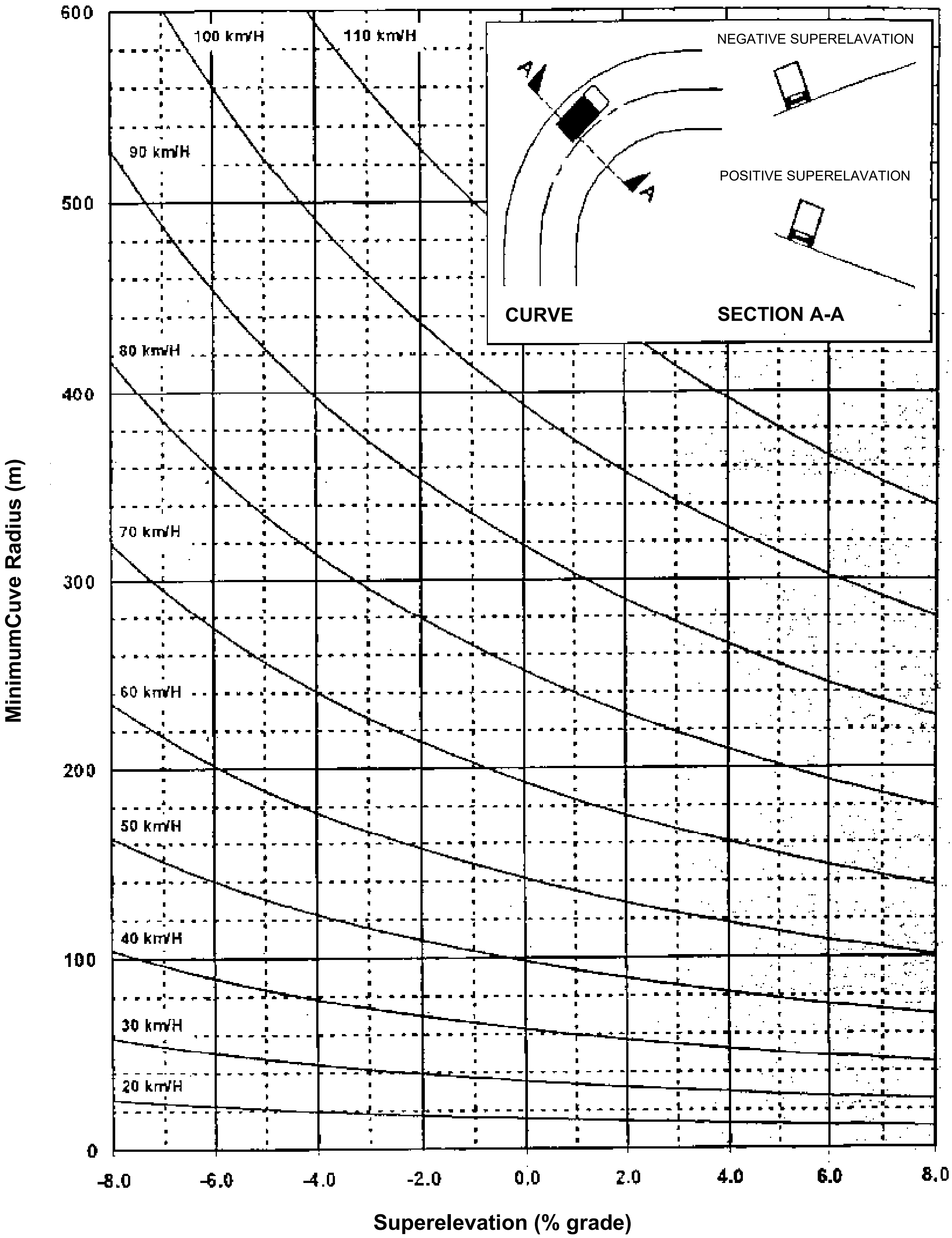
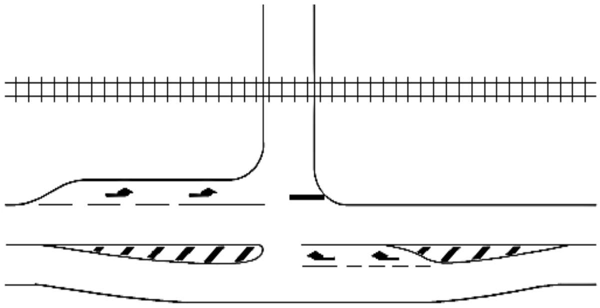
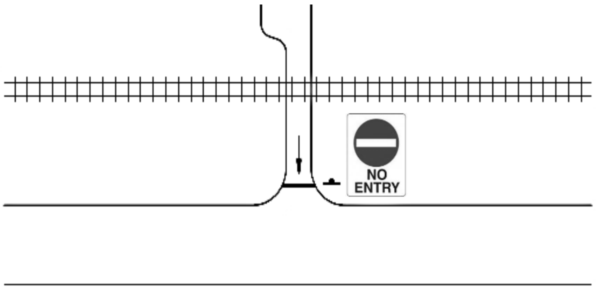


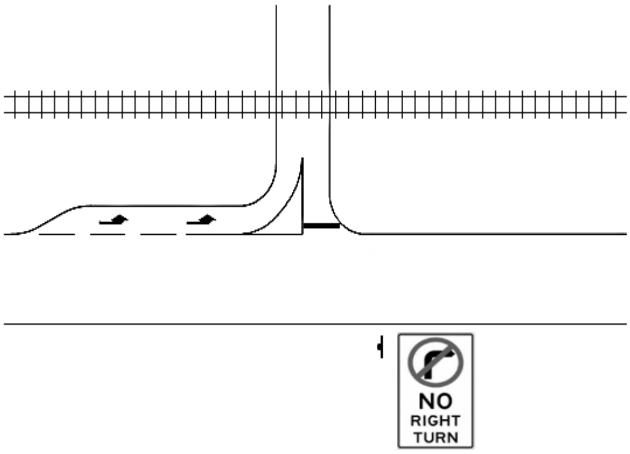
Figure B2 – Possible solutions for inadequate approach stacking distance (Source: TMR 2013)



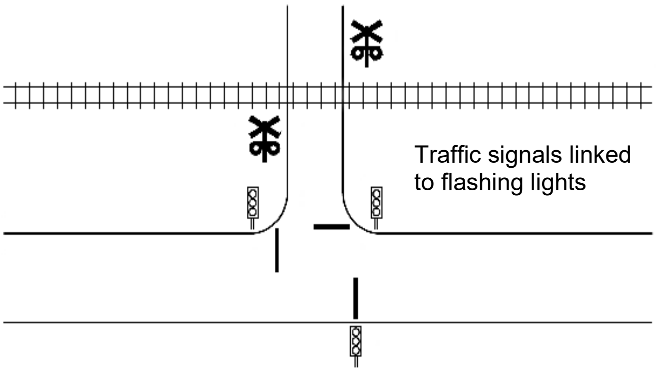
Left and Right Turn Lanes:
Unsuitable for crossing under passive control because train may approach from behind driver.



Partial Closure

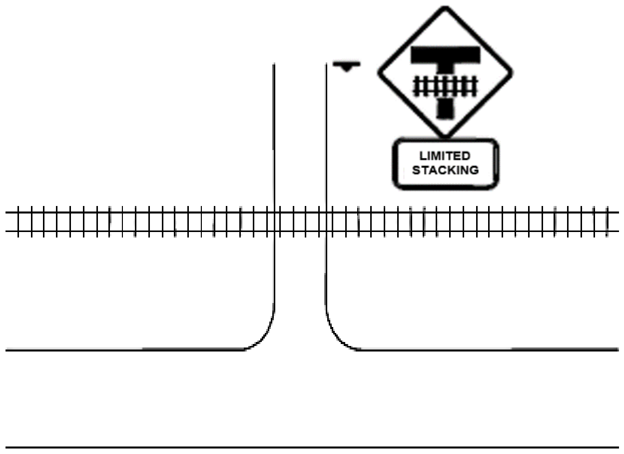


Right Turn Prohibition:
Unsuitable for crossings under passive control because train may approach from behind driver.

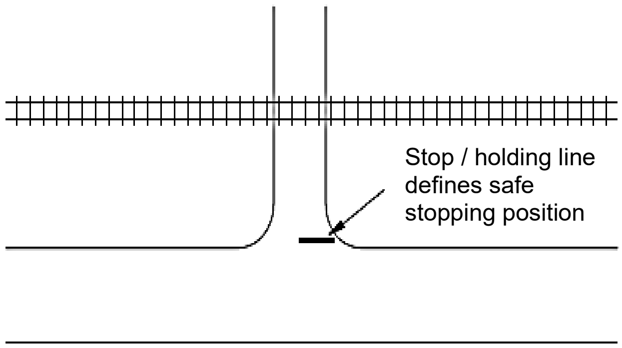


Traffic Signals:
For very short stacking distances, the stop line and signal display on the departure side of the crossing may be relocated to the approach side of the crossing.

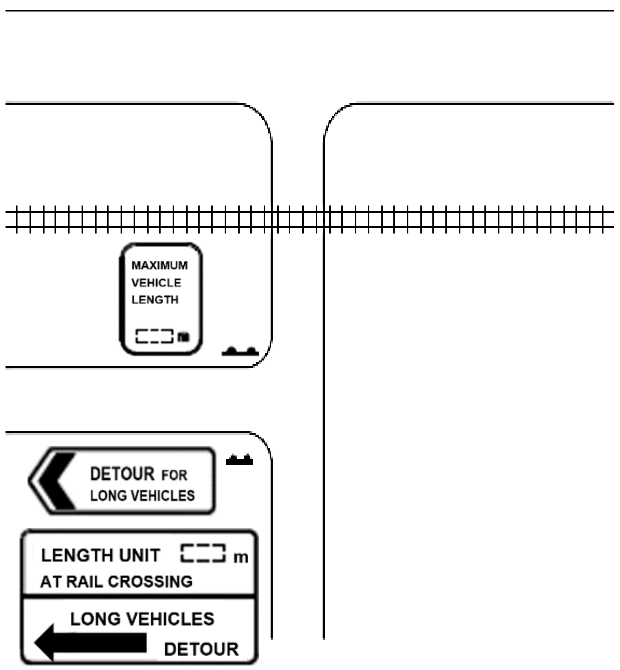
Figure B3 – Possible solutions for inadequate departure stacking distance (Source: TMR 2013)



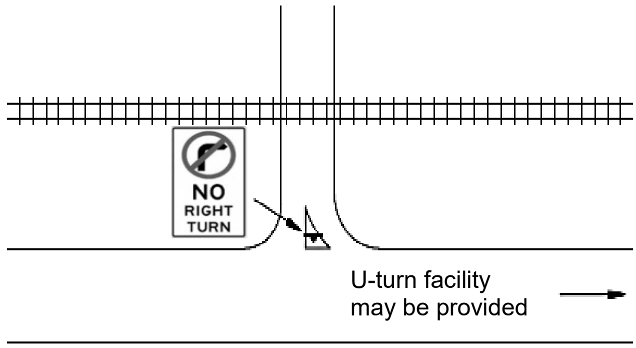
Advisory Signs



Add or Move Stop / Holding Line



Regulatory Signs



Right Turn Prohibition

Table B1 – Approach sight distances for heavy vehicles (Source: TMR 2013)

MCV Operating Speed (km/h)	Grade								
	Downhill				Level	Uphill			
	8%	6%	4%	2%		2%	4%	6%	8%
B-doubles and PBS Level 2 vehicles									
40	69	66	64	62	61	59	58	57	56
50	95	91	88	85	83	80	78	77	75
60	126	120	115	111	107	104	101	99	97
70	160	152	145	140	135	130	127	123	120
80	198	187	179	171	165	159	154	150	146
90	239	226	215	206	197	190	184	179	174
100	294	276	261	249	238	228	220	213	207
110	372	345	323	305	290	277	266	256	247
Type 1 road trains and PBS Level 3 vehicles									
40	74	72	70	68	66	65	64	62	61
50	102	98	95	92	89	87	85	84	82
60	134	128	123	119	116	112	110	107	105
70	170	162	155	149	144	140	136	133	130
80	209	198	190	182	176	170	165	161	157
90	252	239	228	218	210	203	197	191	186
100	308	290	275	263	252	242	234	227	220
110	387	360	339	321	305	292	281	271	262
Type 2 road trains and PBS Level 4 vehicles									
40	80	77	75	73	72	70	69	68	67
50	109	105	102	99	96	94	92	91	89
60	142	137	132	127	124	121	118	115	113
70	179	171	165	159	154	150	146	143	140
80	220	210	201	193	187	181	176	172	168
90	264	251	240	231	222	215	209	204	199
100	322	304	289	276	266	256	248	241	234
110	402	376	354	336	321	308	296	286	278

Table B2 – Safe Intersection sight distances for heavy vehicles (Source: TMR 2013)

MCV Operating Speed (km/h)	Grade								
	Downhill				Level	Uphill			
	-8%	-6%	-4%	-2%		2%	4%	6%	8%
B-doubles and PBS Level 2 vehicles									
40	97	94	92	90	88	87	86	85	84
50	130	126	123	120	117	115	113	111	110
60	167	162	157	152	149	146	143	140	138
70	209	201	194	188	183	179	175	172	169
80	253	243	234	227	220	215	210	205	201
90	302	289	278	268	260	253	247	241	236
100	364	346	331	318	307	298	290	282	276
110	448	422	400	382	367	353	342	332	323
Type 1 road trains and PBS Level 3 vehicles									
40	102	100	97	96	94	93	91	90	89
50	137	133	130	127	124	122	120	118	117
60	176	170	165	161	157	154	151	149	147
70	218	210	204	198	193	189	185	182	179
80	264	254	245	238	231	226	221	216	213
90	314	301	290	281	272	265	259	254	249
100	377	360	345	332	321	312	304	296	290
110	463	437	415	397	382	369	357	347	339
Type 2 road trains and PBS Level 4 vehicles									
40	108	105	103	101	99	98	97	96	95
50	144	140	137	134	131	129	127	125	124
60	184	178	173	169	166	162	160	157	155
70	228	220	213	208	203	198	195	191	188
80	276	265	256	249	242	237	232	228	224
90	327	314	303	293	285	278	272	266	261
100	391	373	358	346	335	326	317	310	304
110	479	452	430	412	397	384	373	363	354