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1 Scope and general

1.4 Definitions

1.4.3 Competent person

1.4.3-1 Competent person roles and tasks

The following table outlines the various temporary traffic management duties in relation to the selection, design, implementation, monitoring or modification of a Traffic Management Plan (TMP) or a Traffic Guidance Scheme (TGS) which may be performed based on the competent person definitions in Clause 1.4.3 and a few additional roles (RPEQ, lookout person, truck-mounted attenuator operator, event traffic marshal and pilot vehicle driver).

This table supersedes Tables K1 and K2 in Appendix K of the MUTCD Part 3 2016.

A person holding multiple competencies (qualifications) may apply all of the relevant sections for those competencies (or qualifications) as identified in the table following. If an activity is not listed for a given competency, then that activity cannot be conducted under that competency.

Note: All references to Clauses or Appendices in the following table are to MUTCD Part 3.
## Table 1.4.3-1 – Traffic management duties

<table>
<thead>
<tr>
<th>Competent Person</th>
<th>TGS task</th>
<th>Activity</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working in Proximity to Traffic Awareness – Part 1</td>
<td>Implementation</td>
<td>Install or remove signs and other devices included on a TGS under direct supervision and instruction by a TMI Competent Person</td>
<td>Direct supervision requires the supervising TMI to be present (in close proximity) and able to intervene if required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cover or uncover signs</td>
<td>Generally, at the end or start of a shift. Instruction must be included on the TGS that the signs can be covered or uncovered and at what times or under what conditions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Record Keeping</td>
<td>Daily record of installed traffic management signs and devices in accordance with Appendix A.</td>
</tr>
<tr>
<td></td>
<td>Modification</td>
<td>Modify the TGS on site in response to an emergency and unplanned event</td>
<td>In accordance with Appendix H, Clause H2, ‘Initial Response’ only.</td>
</tr>
</tbody>
</table>

### Working in Proximity to Traffic Awareness – Part 2

All of the Tasks and Activities for a Working in Proximity to Traffic Awareness Part 1 Competent Person, in addition to the following:

| Selection and Implementation | Select and implement a work method practice in accordance with the short-term low impact works in Clauses 4.3 and 4.4, and unsealed roads in Clause 4.5 | • With the appropriate risk assessments.  
  • Includes installing the relevant sign required under the specific clause.  
  • Excludes the following sub-clauses; 4.3.5, 4.3.6, 4.4.8 and 4.5.3 |
<table>
<thead>
<tr>
<th>Competent Person</th>
<th>TGS task</th>
<th>Activity</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Management Implement (TMI)</td>
<td>Selection and Implementation</td>
<td>Select and implement a work method practice in accordance with the short-term low impact works in Clauses 4.3 and 4.4, and unsealed roads in Clause 4.5</td>
<td>With the appropriate risk assessments. Includes all sub clauses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Select, determine site suitable and implement an appropriate Generic TGS</td>
<td>Selection and implementation must be performed in accordance with the established protocol or procedure as documented by the Traffic Management Design (TMD) Competent Person when developing the Generic TGS.</td>
</tr>
<tr>
<td></td>
<td>Implementation</td>
<td>Implement a Site Specific TGS</td>
<td>Implementation must be performed in accordance with the established protocol or procedure as documented by the TMD Competent Person when developing the Site Specific TGS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Install Portable Traffic Control Devices including: Portable Traffic Signal Systems (PTSS)(^<em>); Boom Barriers(^</em>); Rumble Strips; Speed Humps; and Speed Awareness Devices</td>
<td>Includes the configuration of PTSS Type 2 devices only when operated in timed or vehicle activated modes (as instructed by a TMD). Retail operation of PTSS or boom barriers shall only be performed by a Traffic Controller (TC). Only if competent (through training / experience) to do so and in accordance with manufacturer's specifications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provide direct supervision and instruction to a person without TMI competency to implement a TGS</td>
<td>The person under instruction must have at least the Working in Proximity to Traffic Awareness – Part 1 competency. Direct supervision requires the supervising TMI to be present (in close proximity) and able to intervene if required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Display text messages or electronic signs on VMS screens (both vehicle-mounted and trailer-mounted)</td>
<td>In accordance with requirements and instructions on the TGS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Display of direction arrow(s) on vehicle mounted arrow boards</td>
<td>In accordance with requirements and instructions on the TGS.</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>Monitor the performance (effectiveness) of the implemented TGS (this may include driver behaviour, vehicle speeds, queue lengths and so on)</td>
<td>Ensure all required traffic control devices remain in place. Monitoring of any specific item as identified in the TGS by the TMD. If the TGS is not effective, contact the TMD for modification instructions.</td>
</tr>
<tr>
<td></td>
<td>Adjustment</td>
<td>Move signs within tolerances</td>
<td>In accordance with the MUTCD Part 3 – Clause 4.1.6. If required to move signs beyond the tolerances given in this clause, contact the TMD for modification instructions.</td>
</tr>
<tr>
<td></td>
<td>Modification</td>
<td>In response to a long queue of traffic</td>
<td>Modifications to be as per the requirements of the TGS, prepared by a TMD for use with long traffic queues. If the TGS does not have provision for long queues and is not effective, contact the TMD for modification instructions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modify the TGS on site in response to an emergency and unplanned event</td>
<td>In accordance with Appendix H, Clause H2, 'Initial Response'. Implementation of an 'Interim Response' or 'Follow-up Protection' may be performed in accordance with designs or instructions from a TMD or authorised person.</td>
</tr>
<tr>
<td>Competent Person</td>
<td>TGS task</td>
<td>Activity</td>
<td>Additional information</td>
</tr>
<tr>
<td>------------------</td>
<td>----------</td>
<td>----------</td>
<td>------------------------</td>
</tr>
</tbody>
</table>
| Traffic Management Design (TMD) | Selection and Design | Select and design a work method practice in accordance with the short-term low impact works in Clauses 4.3 and 4.4, unsealed roads in Clause 4.5 and mobile works in Clause 4.6 | • With the appropriate risk assessments.  
• Includes all sub clauses. |
| | Prepare Traffic Management Plans (TMP) | Where the TGS is relatively simple, the TMP may be in the form of a short list of notes on the TGS. |
| | Select a Generic TGS | In accordance with the defined selection process. |
| | Design Generic or Site Specific TGS in accordance with the MUTCD and supplements | • Includes developing procedures and protocols for selection and implementation of a Generic TGS.  
• Including all notes required for implementation. |
| | Design a TGS without complying with a ‘should’ or ‘where practicable’ requirement of the MUTCD. | In accordance with Clause 2.2.5 with a supporting risk assessment. |
| | Design a TGS without complying with a ‘shall’ requirement of the MUTCD or outside the scope of the MUTCD (innovative treatment, devices and so on). | In accordance with Clause 2.2.5 with a supporting risk assessment and RPEQ signoff of relevant items. |
| | Design a TGS with Traffic Controllers using STOP / SLOW bats | • Ensure the site is suitable for STOP / SLOW bat operation and locations for the TC are defined.  
• Ensure TC locations meet all the requirements of TCASAP (for example, sight distance and escape path). |
| | Design a TGS * with Portable Traffic Control Devices including; Portable Traffic Signal Systems (PTSS)*; Boom Barriers; Rumble Strips; Speed Humps; Speed Awareness Devices | * Includes the design for the configuration (timing and operation) of PTSS |
| | Provide supervision and instruction to a person without a TMD competency preparing (designing) a TMP or TGS. | The TMD must sign off and take full responsibility for the plans prepared under their supervision and instruction. |
| | Modify the TGS Design | Modify a TGS designed by another TMD in accordance with the MUTCD | • If the original TGS was designed by another TMD, it is recommended that the original TMD be advised of the changes.  
• Ensure the changes are documented and traceable to the relevant TMD. |
<p>| | Changes to the TGS designs or devices outside a ‘should’ recommendation of the MUTCD | In accordance with Clause 2.2.5 with a supporting risk assessment. |
| | Changes to the TGS design or devices outside the scope or ‘shall’ requirements of the MUTCD | In accordance with Clause 2.2.5 with a supporting risk assessment and RPEQ signoff if required. |
| | Instruction of a person without a TMD competency to make on site changes to a TGS | The person with a TMD competency must sign off and take full responsibility for the changes made to the TGS under their instruction. |
| | Designs for Special Events | Identify circumstances in which Event Traffic Marshals (ETM) can be used | Specifically nominate on the TGS for a permitted Special Event the signs which may be installed by an ETM; traffic control positions which may be suitable for an ETM; and other instructions for the ETM. |</p>
<table>
<thead>
<tr>
<th>Competent Person</th>
<th>TGS task</th>
<th>Activity</th>
<th>Additional information</th>
</tr>
</thead>
</table>
| Event Traffic Marshal (ETM) for Special Events In accordance with the Traffic Marshal – Special Event Approved Procedure | Implement (ETMs are not to be used at roadworks or workplaces)          | Only the signs and devices specifically nominated by the TMD on the TGS (for a permitted Special Event) as able to be installed and removed by an ETM.                                                                                                                                                                                                                                                                                                                                                      | • Signs and devices to be installed by ETMs will be located in simple low speed, low risk traffic environments for the duration of a permitted Special Event.  
• A TC may also install devices nominated on the TGS for an ETM.                                                                                                                                     |
|                                          |                                                                          | Control traffic only at locations specifically nominated by the TMD on the TGS (for a permitted Special Event) as appropriate for an ETM.                                                                                                                                                                                                                                                                                                                                                     | • ETMs may control traffic in simple low speed, low risk traffic environments for the duration of a permitted Special Event.  
• A TC may also control traffic at a location nominated on the TGS for an ETM.                                                                                                                                      |
| Registered Professional Engineer of Queensland (RPEQ) | Design / Modify                                                         | TMP and TGS designs or the use of devices which are or have elements which are outside the scope or ‘shall’ requirements of the MUTCD (including designs with innovative devices or treatments). TMPs which require traffic modelling to support decision.                                                                                                                                                                                                                                     | In accordance with Clause 2.2.5 (including a risk assessment), an RPEQ within their area of competency may sign off (authorise the design under the Professional Engineers Act) the particular elements of the traffic management design which are outside the scope or ‘shall’ requirements of the MUTCD. |
| Traffic Controller (TC) In accordance with the Traffic Controller Accreditation Scheme Approved Procedure (Traffic Control for Special Events, also refer to Event Traffic Marshal – ETM) | Implement                                                                 | Only signs and devices for TC operations                                                                                                                                                                                                                                                                                                                                                                                                                                                        | • Refer Clause 4.10.2 for Traffic Controller equipment.  
• Also signs and devices for traffic signals (Clause 4.11) if operated in manual mode by TC and portable boom barriers.                                                                                                                                  |
|                                          |                                                                          | Install and operate portable traffic signals systems                                                                                      | Only if competent (through training / experience) to do so and in accordance with manufacturer’s specifications.                                                                                                                                                                                                                                                                                                                                                                           |
|                                          |                                                                          | Install and operate portable boom barrier                                                                                              | Only if competent (through training / experience) to do so and in accordance with manufacturer’s specifications.                                                                                                                                                                                                                                                                                                                                                                           |
|                                          |                                                                          | Install or remove signs and other devices included on a TGS under direct supervision and instruction by a TMI Competent Person                                                                                                    | Direct supervision requires the supervising TMI to be present (in close proximity) and able to intervene if required.                                                                                                                                                                                                                                                                                                                                                       |
| Monitor                                  | Monitor                                                                 | Monitor the performance (effectiveness) of the implemented TGS (this may include driver behaviour and vehicle speeds on the approach to the TC and queue lengths).                                                                                                                                                                                                                                                                                                                                 | • Ensure all required traffic control devices for the TC remain in place.  
• Monitor any specific item as identified in the TGS by the TMD.  
• If the TGS is not effective (for example approach speeds to the TC or traffic queues are extending to a point where end-of-queue protection measures should be considered), TC is to advise the site supervisor who will contact the TMD for modification options. |
<p>| Modify TGS on site                       | Modify TGS on site                                                       | In response to an emergency and unplanned event                                                                                           | In accordance with Appendix H, Clause H2, Initial Response only.                                                                                                                                                                                                                                                                                                                                                       |
|                                          |                                                                          | Only the signs and devices for TC operations.                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Install or remove, (cover or uncover) the signs or devices as required for TC operations.                                                                                                                                                                                                                                                                                                                                                       |
|                                          |                                                                          | If the assigned position of the TC is not in accordance with TCASAP (for example sight distance or escape path).                                                                 | TC is to advise the site supervisor who will contact the TMD for modification options.                                                                                                                                                                                                                                                                                                                                                       |
| Lookout Person                           | Perform lookout activity as required in the MUTCD                           | Must have good eyesight, hearing and be competent to perform lookout activities.                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                              |</p>
<table>
<thead>
<tr>
<th>Competent Person</th>
<th>TGS task</th>
<th>Activity</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadworks Pilot Vehicle Driver</td>
<td></td>
<td>Drive a pilot vehicle on a work site working with the Traffic Controllers in attendance for the purpose of traffic management at that work site only</td>
<td>Must have a current driver's licence and be competent to perform roadwork pilot vehicle driver duties. NOTE: This task is separate to and different from the requirements for pilot vehicles for heavy vehicles in general traffic situations.</td>
</tr>
</tbody>
</table>
| Truck Mounted Attenuator (TMA) Vehicle Driver | Drive a vehicle fitted with a Truck Mounted Attenuator (TMA) on a work site | • TMA driver must have a current and valid Heavy Vehicle drivers' licence of a suitable class to operate the TMA vehicle.  
• Completed specific training and is deemed competent in the operation of a TMA.  
• The TMA operator / driver must also hold the Traffic Management Implement competency. |                                                                                                                                                                                                                       |
|                                        | Implement                       | Display text messages or electronic signs on VMS screens mounted on the TMA vehicle.       | In accordance with requirements and instructions on the TGS.                                                                                                                                                           |
|                                        | Implement                       | Display of direction arrow(s) on arrow boards mounted on the TMA vehicle.                   | In accordance with requirements and instructions on the TGS.                                                                                                                                                           |
| Authorised Person                      | Install and remove              | Install and remove advance warning signs in accordance with procedures nominated in permits; for example, ‘Smoke Hazard’, ‘Stock’. | An example of a procedure would be Queensland Fire and Emergency Services gazette notice for cane burning.                                                                                                             |
1.4.21 Traffic Guidance Scheme

1.4.21-1 Traffic Guidance Scheme

The following outlines the various types of Traffic Guidance Scheme (TGS), which may be applicable dependant on the work and stage of TGS development (see Figure 1.4.21-1).

**Generic TGS**

TGS with no specific location information which may be applicable for use at a number of locations throughout the road network.

The development of a suite of Generic TGSs and a defined selection procedure must be completed by a TMD Competent Person (refer Supplement Clause 1.4.3-1). The defined selection procedure is to assist with the selection of the correct TGS for the road type (for example one / two-way, number of lanes), road environment (for example rural / urban and speed limit) and the type of works to be undertaken (for example on shoulder or in lane and any other requirements specific to the activity).

A Generic TGS may be selected by a TMD, RPEQ or a TMI Competent Person using the defined selection procedure.

A Generic TGS only exists in a suite of Generic TGSs (a library of TGSs) with a defined selection procedure and is never actually implemented on a site. A selected Generic TGS is required to be confirmed as Site Suitable (see following) prior to implementation.

**Site Suitable TGS**

A TGS is defined as ‘Site Suitable’ once a Generic TGS has been selected (by a TMD, RPEQ or a TMI Competent Person using the defined selection procedure) and a site visit or investigation of the site and the required works has confirmed that the selected TGS is appropriate for use for those works at that site.

Once the Generic TGS is confirmed as suitable for use, location information is added to the Generic TGS and the TGS is then considered ‘Site Suitable’.

While confirmation that a Generic TGS is ‘Site Suitable’ must be performed by a TMD, RPEQ or TMI Competent Person, there are no specific qualification requirements for the person adding the location information onto the Generic TGS.

**Site Specific TGS**

A Site Specific TGS is developed by a TMD Competent Person specifically for use at a specific location on the road network and to complete a specific type of work.

A Generic TGS which has been modified by (or the modifications have been approved by) a TMD Competent Person to suit a particular site or work type is also a Site Specific TGS.

The flowchart following outlines the various stages applicable to the selection of TGS for use at a site from the Generic TGS stage through to the adoption of a Site Suitable TGS or the design of a Site Specific TGS.
Figure 1.4.21-1 – Stages of Traffic Guidance Schemes

**Abbreviation Key:**
- TGS – Traffic Guidance Scheme
- TMI – Traffic Management Implementation
- TMD – Traffic Management Design

**Process Step Colour Key:**
- Green – TMI ok to proceed
- Yellow – TMI to consider options or make adjustments
- Red – TMI must get input from TMD

**Note 1:**
If a Generic TGS be selected using the established TMD approved selection procedure?

**Note 2:**
Is the Generic TGS suitable given the site conditions and work type?

**Note 3:**
Based on any new information, is there a suitable alternative Generic TGS available?

**Note 4:**
Yes, but requires adjustment or modification – Substantial Modifications

**OPTION 1**
Make Adjustments to Generic TGS under TMI competency

Add site location information to the Generic TGS

The Generic TGS is now Site Specific

**OPTION 2**
Consult with TMD who will Approve Modifications to the Generic TGS

Add site location information to the Adjusted Generic TGS

The Adjusted Generic TGS is now Site Suitable

**OPTION 3**
Consult with TMD who will design a Site Specific TGS

Add site location information to the Modified Generic TGS

The Modified Generic TGS is now Site Specific

**OPTION 4**
Record on the Generic TGS the details of the Modifications made and approved by TMD

Record on the Generic TGS the details of the Modifications made and approved by TMD

**Note 1:**
A checklist may be used to assist the TMI determine if the Generic TGS is:
- Suitable
- Not Suitable
- May be Suitable with Adjustment
- May be Suitable with Modification

**Note 2:**
“Adjustments” are alterations to the Generic TGS which are permitted to be made and recorded by a TMI qualified person.

**Note 3:**
“Modifications” are changes or additions to the Generic TGS which require design and approval by a TMD qualified person.

**Note 4:**
Where “Modifications” to the Generic TGS are substantial, the TMD may require that rather than the TMI record all of modifications on the Generic TGS, that a new Site Specific TGS is prepared.
Principles for the development, installation and operation of a Traffic Guidance Scheme

Planning

Use of permanent variable speed limit and lane control signs in construction and maintenance work areas on motorways

This supplement can be applied to permanent variable speed limit and lane control signs at static work sites on motorways only. It is not applied to variable speed limit and lane control signs at work sites in tunnels, at mobile works or frequently changing work areas on motorways.

Temporary variable speed limit signs used at construction zones are not controlled using practices from this document.

Definitions

Table 2.2-1(A) and Table 2.2-1(B) show relevant definitions and acronyms for this document.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer</td>
<td>A buffer is a speed zone, of minimal length, and intermediate value between two speed limits that differ by more than 20 km/h; for example, an 80 km/h buffer zone would generally be used as a transition between speed limits of 100 km/h and 60 km/h.</td>
</tr>
<tr>
<td>Critical fault</td>
<td>A critical fault of the variable speed limit system is a fault that may cause an unsafe situation for the site personnel.</td>
</tr>
<tr>
<td>Default speed limit</td>
<td>In case of failure of the variable speed limit system, it is necessary to specify a speed limit for motorists to travel at. This is called the default speed limit and will be set to normal posted speed limit (had the road been a static speed zone).</td>
</tr>
<tr>
<td>Non-critical fault</td>
<td>A non-critical fault of the variable speed limit system is a fault that does not affect the safety of the work site. A non-critical fault might be when a small number of LEDs fail.</td>
</tr>
<tr>
<td>Secondary contact</td>
<td>A person delegated by the Site Supervisor as the secondary contact person for onsite personnel. The TMC Supervisor or Operator will contact this person in the instance that the Site Supervisor is not able to be contacted.</td>
</tr>
<tr>
<td>Site Supervisor</td>
<td>The Site Supervisor is the person responsible for works. This person will be the primary contact for onsite personnel. The TMC Supervisor or Operator will contact this person to coordinate the activation, deactivation and management of the electronic signs.</td>
</tr>
<tr>
<td>STREAMS®</td>
<td>STREAMS® Integrated Intelligent Transport System is an enterprise traffic management system developed by the Department of Transport and Main Roads that applies information and communications technology to transport operations to reduce operating costs, improve safety and maximise the capacity of existing infrastructure. STREAMS® provides traffic signal management, incident management, motorway management, vehicle priority, traveller information, flood monitoring and parking guidance within a single integrated system.</td>
</tr>
<tr>
<td>TGS</td>
<td>The Traffic Guidance Scheme (TGS) is an arrangement of temporary signs and devices to warn traffic and guide it through or past a work area or temporary hazard.</td>
</tr>
</tbody>
</table>
Term | Definition
--- | ---
TMC Operator | This person in the Traffic Management Centre is responsible for activating, deactivating and managing the electronic signs. This person is responsible for communications with the Site Supervisor and other site personnel.
TMC Supervisor | This person is responsible in the Traffic Management Centre for overseeing operations and approvals.
Transition | Transitions are automatically implemented by the system and form the intermediate arrangement of signs to allow a smooth conversion between the current and the desired state of signs. Consider the following example of a sign which currently displays 100 km/h: before changing that specific sign to 60 km/h, this sign must transition through an 80 km/h speed limit for a minimal time.
Variable speed limit zone | A variable speed limit zone is defined as a length of road which is controlled by variable speed limit signs. Static speed limits are not used. A variable speed limit zone may also include lane control signs to open and close lanes.

Table 2.2-1(B) – Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITS</td>
<td>Intelligent Transport System</td>
</tr>
<tr>
<td>LCS</td>
<td>Lane control sign</td>
</tr>
<tr>
<td>TGS</td>
<td>Traffic Guidance Scheme</td>
</tr>
<tr>
<td>TMC</td>
<td>Traffic (or Transport) Management Centre</td>
</tr>
<tr>
<td>TMP</td>
<td>Traffic Management Plan</td>
</tr>
<tr>
<td>VSLS</td>
<td>Variable speed limit sign</td>
</tr>
<tr>
<td>VSL / LCS</td>
<td>Variable speed limit and lane control sign (integrated)</td>
</tr>
</tbody>
</table>

2 Background

A variable speed limit zone may be applied on a motorway, long bridge or in a tunnel to allow a reduction in the posted speed limit at times when road safety and performance are compromised, where full-time lower static speed limits are inappropriate. The variable speed limit zone is implemented through the use of variable speed limit signs and selected static signs.

Variable speed limits and lane control signs are integrated into a single set of signs as shown in Figure 2.2-1(A), where:

- the lane is open to all traffic at the indicated posted speed limit when a variable speed limit is displayed above the lane.
- the lane is soon to close to all traffic when a flashing red cross is displayed above the lane, and drivers must leave the marked lane as soon as it is safe to do so.
- the lane is closed to all traffic when a red cross is displayed above the lane and drivers must not drive in the marked lane past the signal, and
- a driver may enter a closed lane to exit the motorway if a diagonal up arrow (exit arrow) is displayed.
These signs are installed to increase efficiency and safety during times of congestion, incidents, inclement weather and planned events. These signs, when installed permanently, can be used to aid the control of traffic through work areas for maintenance or construction.

The variable speed limit and lane control signs are connected to a central software control system (STREAMS or similar) which allows operators to manage the operation of the signs in accordance with the MUTCD and other principles.

It should be noted that the spacing of signs along the mainline will vary according to the location of entrance and exit ramps, and in accordance with the Austroads Guide to Traffic Management and relevant supplements. Variable speed limit signs installed on motorways with more than three lanes are mounted overhead and integrated with lane control signs (Figure 2.2-1(A)).

Default static speed limit signs TC1568 are installed at entrance points to a variable speed limit zone and at changes of the default speed limit along the mainline carriageway.

### 3 Principles for using VSL / LCS during construction/maintenance

The use of special illuminated variable speed limit and overhead lane control signs to advise drivers of lane closures and associated reduced speed limits ahead on the motorway involves detailed planning involving complex traffic arrangements and liaison with motorway traffic management centre(s).

Planning will comprise a fully documented guidance scheme in accordance with Clause 2.2.1 of Part 3 of the MUTCD.

General principles applying to planned lane closures on motorways using integrated variable speed limits and overhead lane control signals at roadwork sites and for special events are set out in this section.

#### 3.1 General

The spacing of variable speed limit and lane control signs varies according to the location of entrance and exit ramps. Further, the location of the work site may vary between the variable speed limit signs. A number of typical arrangement figures have been developed to assist with the preparation of the Traffic Management Plans. Users should choose these drawings depending on the distance of the work site to the variable speed limit and lane control sign which is immediately upstream.
Figures are included in Section 5 for work in one lane where the distance between the work sites and the immediate upstream variable speed limit and lane control sign is:

- 0–150 m
- 150–300 m
- 300–500 m
- 500–750 m (60 km/h work area).

Figures are provided in Section 5 for work in two lanes where the distance between the work sites and the immediate upstream variable speed limit and lane control sign is:

- 0–150 m
- 150–300 m
- 300–500 m
- 500–750 m (60 km/h work area).

Figures are also provided in Section 5 for work on shoulder where the distance between the work sites and the immediate upstream variable speed limit and lane control sign is:

- 0–300 m
- 300–500 m
- 500–750 m.

These distances have been chosen based on the requirement of buffer speed limits in Table 4.7, Part 3 of the MUTCD; that is, a buffer zone in advance of a 40 km/h work site should be 150 m minimum length. A buffer zone in advance of a 60 km/h work site should be between 300 and 500 m in length.

In addition, figures are included for typical entry ramp and exit ramp arrangements:

- lane closed across an exit ramp
- lane closed across an entrance ramp
- variable speed limits at entrance ramp merge.

Note: These diagrams consider an activity where the entry and exit ramps are open, allowing traffic to enter and exit the motorway. If an activity requires the ramps to be closed, a solid red cross would replace the Lane Control (LC) symbols represented in these diagrams.

A special diagram is also included for side mounted variable speed limit signs along the mainline carriageway.

A diagram is also provided for staged implementation of the pre-approved Variable Speed Limit and Lane Control plan.

3.2 Speed management

Principle 1: Normal traffic control devices are required

All traffic management and control devices normally associated with work sites are to remain. This includes devices such as truck mounted attenuators, delineation and static signage. One Exception
exists for the buffer zone in advance of the work site; static buffer speed limits are not required as these signs will be displayed on the variable speed limit signs instead.

**Principle 2: One static speed limit is required at the work site**

The work area speed limit (that is, the last speed limit sign before the work area) must be a static sign. Therefore, in the instance that the electronic signs fail, the critical speed limit will be displayed. A back-up plan will need to be implemented in this case (refer to Section 4).

**Principle 3: Variable speed limit signs within the work area**

All variable speed limit signs within the work area should be set to the speed limit of the work area.

**Principle 4: Speed limit signs just prior to the work site**

Where one or more lanes are closed, delineation is specified in the MUTCD to close the lanes and vehicles need to merge into an open lane. These merging manoeuvres should occur at a maximum speed limit of 80 km/h.

**Principle 5: Buffer speed limits**

Speeds must be reduced in 20 km/h steps on the approach to a work site in accordance with the MUTCD even if they are displayed on variable speed limit signs. Minimum distances described in Table 4.7 of the MUTCD Part 3 apply. Note that due to the spacing of variable speed limit signs, the actual distances between variable speed limit signs may exceed the minimum distances. Note that (unless absolutely necessary), it is desirable to keep the buffer distances as close to the minimum as possible. This is likely to increase speed compliance.

The first variable speed limit signs beyond the work site will normally display the appropriate default speed limit for the road continuing beyond the works; that is, the speed does not need to be increased in 20 km/hr steps.

**Principle 6: Static speed limit sign at the end of the work site**

Static speed limit signs (R4-1 type) are to be placed at the end of the work site to indicate the speed limit beyond the end of the work site and until the next variable speed limit signs are passed. The END ROADWORK (T2-16, T2-17) sign is used together with the static speed limit sign.

**Principle 7: Entrance ramps**

The variable speed limit on the entrance ramp should be the same as that on the mainline on approach to the entrance ramp merge. This will ensure that vehicles merge at the same speed.

**Principle 8: Side mounted variable speed limit sign**

Side mounted variable speed limit signs (that is, without overhead lane control signs) along the mainline are used in a similar manner to integrated variable speed limit and lane control signs. A typical arrangement is shown in Section 6, Figure 2.2-1(R).

### 3.3 Lane control

**Principle 9: Lane closure on VSL / LCS**

Lane closures shall not be implemented on the integrated VSL / LCS until the variable speed limits have been reduced for the temporary roadworks.
Principle 10: Flashing red crosses and red crosses

A continuously flashing red cross must be shown as the first lane control device. One flashing red cross is the minimum amount of lane control.

Normally, the flashing red cross is followed by a continuous red cross at the next gantry. Refer to the figures in Section 6.

Principle 11: White arrows

A diagonally upwards white arrow (left or right) overhead lane control signal is used to indicate that an exit ramp from the motorway is open, where a lane closure extends past the exit ramp.

Principle 12: Speed limits in conjunction with lane control

At the introduction of lane control signs (flashing or continuous red cross); the speed limit shall be reduced to 80 km/hr (maximum). This reduced speed limit should assist merging.

Where it is necessary to close two lanes with a separation between the taper for each lane closure, a similar staggered warning shall be provided to drivers on the integrated VSL / LCS.

At no time shall flashing red crosses be displayed in adjacent lanes, except where a parallel lane type merge is closed adjacent to a closed main motorway traffic lane.

Principle 13: Closure of a central lane

Consistent with normal roadworks signing practice, a central traffic lane should not be closed in isolation. An adjacent lane(s) should also be closed.

Principle 14: Low flow conditions

In low flow conditions, extra lanes may be closed to provide sufficient space for worker safety and the method of work. This may increase lateral clearance and allow a higher work zone speed, reducing delays to drivers. This should be done in accordance with Table 4.7 and Section 4.2 of Part 3 of the MUTCD; however, the available trafficable lanes must be able to service the traffic capacity.

3.4 Other

Principle 15: Variable message signs

Where available, permanent variable message signs should be used to display a message about the road work: for example, ROAD WORK AHEAD / REDUCE SPEED; LEFT LANE CLOSED / MERGE RIGHT.

4 Planning

Detailed planning for the work will need to be commenced well in advance of construction to allow discussion with the Traffic Management Centre and Department of Transport and Main Roads Regional Director or his or her delegate or responsible authority and to allow for any refinements to the submitted Traffic Management Plan. This will ensure traffic operations are safe and efficient and will allow sufficient time for any system changes to be implemented by the Traffic Management Centre in an orderly manner.

The Department of Transport and Main Roads regional office and / or asset owner / manager gives the approval for the proposed traffic control methodology for the lane closures using the VSL / LCS. These approvals are the final part of a process which includes assessment of the impacts of the works on traffic flows, formulation of Traffic Management Plans, making an application and finally, execution.
of the plans. For projects on state-controlled roads, a pre-start meeting with the Road Operations business unit (or relevant area) may be necessary in order to assess how the VSL / LCS can assist with traffic management of the work site. A representative from the Traffic Management Centre should also attend to discuss operational detail of the VSL / LCS. Part of this discussion should include a brief formulation of a back-up plan if a critical error occurs with any aspect of the execution of the VSL / LCS assisted Traffic Management Plans. The level of traffic management needed for particular construction and maintenance activities will determine the degree of support to be provided by the VSL / LCS.

The suggested processes are summarised in Figure 4-A and Figure 4-B; with the development of a Traffic Management Plan, approval and review procedures and work site operations detailed in Sections 4.1, 4.2 and 4.3 of this supplement.
Figure 2.2-1(B) – Process for pre-approval of ITS component of the Traffic Management Plan

A pre-start meeting with representatives from TMC, Road Operations (or relevant area) and Project Manager for the works is conducted to discuss all traffic management elements (TMP) of proposed work activities.

- Traffic or Site Supervisor completes TMP and submits to Region.
- Region begins processing of application noting use of VSL/LCS.
- VSL/LCS Traffic Management Strategy is submitted for testing within the STREAMS Environment.
- Does the VSL/LCS strategy comply with STREAMS tests?
- No
  - Region to advise Site Personnel TMC that permit application is approved based on STREAMS testing of VSL/LCS strategy and other permit details.
- Yes
  - TMC operators are sent VSL/LCS plan to be implemented in STREAMS.
- Site Supervisor submits approved VSL/LCS plan to TMC.
  - (Optional) Site Supervisor previews the approved VSL/LCS plan as part of the overall TMP.
- Notification from TMC Manager to Region and Site Personnel that VSL/LCS plan is ready for activation.
- Operator gives final confirmation that VSL/LCS plan is ready for activation.
- Proceed to Figure 3 - Process for managing activated plans with site personnel.
Figure 2.2-1(C) – Process for managing activated plans with onsite personnel

- **Site Personnel**
  - Site supervisor calls TMC operator asking for plan activation
  - Site supervisor receives call from TMC operator to indicate that traffic personnel can begin to set up the work site
  - If a critical error is noticed, then TMC operator immediately calls site supervisor
  - Site supervisor advises TMC that all personnel are safe and asks TMC for plan deactivation
  - Site personnel confirms that plan is deactivated

- **TMC**
  - TMC operator confirms that the contact number for site personnel are still appropriate (not policy if necessary)
  - TMC activate plan and monitors transition phases
  - TMC operator notes when transition phases are complete
  - TMC operator continues to monitor signs for errors

- **Joint Implementation**
  - Both TMC operator and site supervisor implement back up plan from TMP
  - If an unplanned incident is observed, then site personnel immediately calls TMC operator
  - Site supervisor advises TMC that all personnel are safe and asks TMC for plan deactivation
  - TMC operator confirms that all construction personnel are safe and the construction work area is ready for reopening
  - TMC operator deactivates plan
  - TMC operator monitors the shut down transition phase
  - TMC operator monitors and ensures that normal operation has restarted
4.1 Preparation of Traffic Management Plans

Preparation of the Traffic Management Plan proposed for the works on the motorway includes a fully documented Traffic Guidance Scheme providing the following information:

- the limits of the work site
- defined lane closures
- types of signs and devices needed for the lane closure; for example, temporary static signs, bollards and so on
- proposals for lane closure and variable speed limits on integrated Variable Speed Limit / Lane Control Signals or Variable Speed Limit Signals only located on approach to, at, and departure from the work site. This will need to include consideration of the following:
  - ensuring that there is no conflict between static signs, or the static lane closed signs and the overhead lane control signals
  - ensuring that the principles described in Section 4 are applied; for example, variable speed limit sign(s) on the entrance ramp show the same speed limit as the main motorway traffic lanes, and
  - a staged implementation of the VSL / LC plan due to the work method or sign set out / retrieval
- a sketch of the location of the signs and devices, including the variable speed limit / lane control signals proposed at each gantry or pole mounted variable speed limit sign
- the time, day and date expected for the start and finish of the work, and
- contact details of the Site Supervisor (primary contact), secondary contact (for example, traffic supervisor) and Queensland Police Service representative where applicable. Mobile phone numbers or details of radio communications should be provided.

Submission of the plan to the Regional Director or his or her delegate for approval shall occur prior to installation.

4.2 Review of Traffic Management Plan by the Traffic Management Centre

Following approval of the Traffic Management Plan (by Regional Director or his or her delegate); it is then forwarded to the Traffic Management Centre. This is to allow assessment of the plan in relation to the VSL / LC components of the plan. This allows the Traffic Management Centre to preview the changes needed to the variable speed limit and lane control signals before, during and after the temporary roadworks; and to detect any errors or anomalies in the system and correct them well in advance of the commencement of the works.

Assessment of the plan by the Traffic Management Centre will also include preparation of strategies for managing the work site with variable speed limits and lane control signs with regard to:

- the communication process for activating and deactivating plans, and managing critical / non-critical faults, and
- procedures needed should the variable speed limit and lane control signs fail critically (for example, failure of the communications link or power supply) during the management of the
works in the event that an unplanned incident occurs near the roadworks, affecting traffic control at the temporary roadworks.

These issues and strategies proposed by the TMC should be discussed with and reviewed by the Site Supervisor prior to their finalisation.

Upon completion of the pre-approval process, the Site Supervisor and traffic supervisor are advised that the VSL / LC plan is ready for activation.

4.3 Operation

Good communication between site personnel and the Traffic Management Centre is essential before, during and upon completion of the works. It is important to note that only pre-approved VSL / LC plans that have been marked by the Traffic Management Centre as ‘Ready for Activation’ may be activated.

Before starting the work

Prior to the commencement of temporary works on the motorway, the Site Supervisor requests the Traffic Management Centre to:

**VSL/LC plan (Speed reductions only)**

i. Activate the speed reductions of the pre-approved plan.

Following activation of the plan, and when the transition from the normal speed limits to the pre-approved speed limits is completed, the Traffic Management Centre will then advise the Site Supervisor that the site traffic personnel can begin to set out advance roadwork signage and set up the work area. This shall ensure that Traffic Controllers are setting up in a safer, reduced speed environment.

**Full implementation of the VSL / LC plan (speed reduction and lane control)**

ii. Activate the pre-approved VSL / LC plan.

Following activation of the plan, and when the transition from open lanes and normal speed limits to closed lanes and work zone speed limits on the integrated VSL / LC signals is completed by the Traffic Management Centre, the Traffic Management Centre will then advise the Site Supervisor that site traffic personnel can begin to set up the work site with static signs, bollards and so on.

The reduced speeds and lane control signs should assist in creating a safer environment for Traffic Controllers to set up signing for the work site.

**Note:** Site personnel should not set up the traffic management devices for the work site (static signs, bollards and so on) until advised by the Traffic Management Centre that the VSL / LC plan is fully operational.

**Staged implementation of the VSL / LC plan* (speed reduction and lane control)**

iii. Activate the speed reductions of the VSL / LC pre-approved plan if a staged implementation is considered necessary.

Following activation of the plan, and when the transition from the normal speed limits to the pre-approved speed limits is completed, the Traffic Management Centre will then advise the Site Supervisor that the site traffic personnel can begin to set out advance signage only. This shall ensure that Traffic Controllers are setting up in a safer, reduced speed environment.
After all advance roadwork signage has been set out, the Site Supervisor shall request that the Traffic Management Centre activate the pre-approved lane control of the VSL / LC plan. Once lane control has been completed the site personnel may then begin setting up the work area with static signs, bollards and so on.

**Note**: A staged implementation of the VSL / LC plan may be necessary to safely support the set out of the advance roadwork signage. For example, if the VSL / LC plan contains a left lane closure, however, the advance signage being placed on the median closes the right lane, a staged implementation shall ensure that the left lane remains open to traffic whilst still providing a safe, low speed environment for set out.

**During the work**

The Traffic Management Centre continually monitors the activated plans. If there is an unplanned incident nearby, possibly requiring an even lower speed limit or closing an additional lane, the Traffic Management Centre will immediately contact the work site personnel to advise / discuss any changes needed to work site arrangements.

Should a failure occur in the communications link or power supply associated with the variable speed limit / lane control signals, resulting in the variable speed limit and lane control signals being blanked, the Traffic Management Centre will immediately contact the work site personnel. Site personnel would then implement the appropriate strategy from the traffic management and VSL / LC plans.

**At the end of the work**

At the end of the work – after all plant, equipment, workers and traffic management devices, for example, static signs, bollards and so on have been removed from the traffic lanes – the Site Supervisor, after verifying that all lanes are clear of obstacles, advises the Traffic Management Centre that the work has been completed and the motorway can be returned to normal operating conditions.

**Note**: All plant, equipment, workers and traffic management devices for the work site (static signs, bollards and so on) shall be removed from the traffic lanes before advising the Traffic Management Centre to re-open the lanes.

Consideration is required to determine if the VSL / LC plan is to be deactivated in a staged approach, that is, deactivate LC, and then deactivate speed reductions.

### 5 Planned events (other than roadworks)

Planned events other than roadworks are not normally permitted on motorways as they significantly adversely affect traffic flow and safety on such high speed, high volume roadways as well as on the adjacent road network.

Where a planned event, for example, major international bike race, is proposed to be allowed along a motorway where variable speed limit / lane control signals are installed, the procedures detailed in this supplement are to be followed.

However, there are a number of additional principles to be considered during the preparation of the traffic management and VSL / LC plans. These are:

i. Such an event would be considered as a mobile, or continually moving, event across all lanes of the motorway. Occupation of the sections of motorway should be limited to a short duration to minimise impacts on traffic using the motorway.
ii. A very high degree of safety would need to be provided, for example, police vehicles before and after the bike pack.

iii. Entry ramps would need to be closed (using police control) on a continually moving basis to limit impacts on general traffic.

iv. All lanes would need to remain open and be subject to the same speed for example, 60 km/hr.

v. Traffic management and VSL/LC plans are prepared and approved in accordance with this supplement.

vi. Preliminary approval of the proposed event is granted by police, local government, Department of Transport and Main Roads, fire and ambulance services, and so on.

vii. Final approval would be given only after all conditions by the agencies listed previously.

viii. The principles listed here have been met.

6 Example figures for VSL / LC signs used for roadworks

Typical arrangement figures which illustrate the application of variable speed limit and lane control signals to various work site situations are shown in Section 5. These figures indicate a nominal spacing of 750 m; however, the spacing between gantries may be larger or smaller depending on road geometry.

Work site situations which are not specifically covered by the figures should be signed by adopting the most appropriate figure according to the principles outlined in this supplement.
Figure 2.2-1(D) – Work in one lane – 0–150 m

Legend
- Red diagonal cross
- Flashing red diagonal cross

Notes:
(a) 1, 2, 3, 4, 5 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.

Where work zone speed limit is 40 km/h, the 60 km/h buffer zone is a minimum of 160 m. Where this is not able to be provided, 40 km/h variable speed limit is shown on VSL on gantry 1.

40 or 60

Subject to Section 4.2 and Table 4.7 clearances in Part 3 MUTCD

Note: Normal roadworks signing is provided, except for static speed signs.

Variable message sign

Variable speed limit to be reduced in 20 km/h steps
Figure 2.2-1(E) – Work in one lane – 150–300 m

Legend
- Red diagonal cross
- Flashing red diagonal cross

Notes:
(a) 1, 2, 3, 4, 8 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.

Subject to Section 4.2 and Table 4.7 clearances in Part 3 MUTCD

Note: Normal roadworks signing is provided, except for static speed signs.

Variable speed limit to be reduced in 20 km/h slope
**Figure 2.2-1(F) – Work in one lane – 300–500 m**

Legend:
- Red diagonal cross
- Flashing red diagonal cross

Notes:
(a) 1, 2, 3, 4, 5 – VSL/LCS gantry
(b) A, B, C – lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principle.

Variable speed limit to be reduced in 20 km/h steps

Note: Normal roadworks signing is provided, except for static speed signs.
Figure 2.2-1(G) – Work in one lane – 500–750 m

Legend
- Red diagonal cross
- Flashing red diagonal cross

Notes:
(a) 1, 2, 3, 4, 5 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.
(d) Dimension D=60 to 80 m, from Table 4.2 in Part 3 MUTCD.

Note: Sign is located 2D in advance of lower speed zone.

Note: Normal roadworks signing is provided, except for static speed signs.

Variable speed limit to be reduced in 20 km/h steps.
Figure 2.2-1(H) – Work in two lanes – 0–150 m

Legend
- Red diagonal cross
- Flashing red diagonal cross

Notes:
(a) 1, 2, 3, 4, 5 - VSULCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSULCS display to suit, in accordance with principles.

Variable message sign

Subject to Section 4.2 and Table 4.7 clearances in Part 3 MUTCD

Note: Normal roadworks signing is provided, except for static speed signs.

Variable speed limit to be reduced in 20 km/h steps
Figure 2.2-1(I) – Work in two lanes – 150–300 m

Legend
- Red diagonal cross
- Flashing red diagonal cross

Notes:
(a) 1, 2, 3, 4, 5 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.

Variable speed limit to be reduced in 20 km/h steps

Note: Normal roadworks signing is provided, except for static speed signs.
Figure 2.2-1(J) – Work in two lanes – 300–500 m

Legend
Red diagonal cross
Flashing red diagonal cross

Notes:
(a) 1, 2, 3, 4, 5 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.

Note: Normal roadworks signing is provided, except for static speed signs.

Variable speed limit to be reduced in 20 km/h steps
Supplement to Part 3: Traffic control for works on roads

Figure 2.2-1(K) – Work in two lanes – 500–750 m

Legend
- Red diagonal cross
- Flashing red diagonal cross

Notes:
(a) 1, 2, 3, 4, 5 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.
(d) Dimension D=60 to 90 m, from Table 4.2 in Part 3 MUTCD.
Figure 2.2-1(L) – Work on shoulder – 0–300 m

Notes:
(a) 1, 2, 3, 4, 5 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.
Figure 2.2-1(M) – Work on shoulder – 300–500 m

Notes:
(a) 1, 2, 3, 4, 5 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.

Variable speed limit to be reduced in 20 km/h steps

Note: Normal roadworks signing is provided, except for static speed signs.
Figure 2.2-1(N) – Work on shoulder – 500–750 m

Notes:
(a) 1, 2, 3, 4, 5 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.
(d) Dimension D=60 to 80 m, from Table 4.2 in Part 3 MUTCD.

Note: Sign is located 2D in advance of lower speed zone.
Variable speed limit to be reduced in 20 km/h steps.
Note: Normal roadworks signing is provided, except for static speed signs.
Figure 2.2-1(O) – Lane closed across an exit ramp

Legend

- Red diagonal cross
- White (angled) arrow

Notes:
(a) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.

Note: Static speed signs located in accordance with normal roadworks signing.

Note: This arrangement is used in conjunction with arrangements shown in other figures in this appendix (A1 to A8).

Note: For normal static roadworks signign for a closed exit ramp, refer to Clause 5.5, Diagram 38.
**Figure 2.2-1(P) – Lane closed across an entrance ramp**

Note: A flashing red diagonal cross is used where the gantry is located close to the merge.

A (non-flashing) red diagonal cross is used where it would be located about 400 m past the merge.

**Legend**
- Red diagonal cross
- Flashing red diagonal cross

**Notes:**
(a) A, B, C - lane designation
(b) Sign gantry locations may vary. Adjust VSL/ALCS displays to suit, in accordance with principles.
(c) This arrangement is used in conjunction with arrangements shown in other figures in this appendix (A1 to A8).
Figure 2.2-1(Q) – Variable speed limits at entrance ramp merge

Note: Normal roadworks signage is provided, except for static speed signs.

Note: This arrangement is used in conjunction with arrangements shown in other figures in this appendix (A1 to A8, A13).

Notes:
(a) A, B, C - lane designation
Figure 2.2-1(R) – Work in one lane – pole mounted VSL signs

Notes:
(a) 1, 2 - VSL pole mounted signs
(b) A, B, C - lane designation
(c) VSL pole mounted sign locations may vary. Adjust VSL displays to suit.

Variable speed limit to be reduced in 20 km/h steps

Subject to Section 4.2 and Table 4.7 clearances in Part 3 MUTCD

Note: Normal roadworks signing is provided, except for static speed signs.
Figure 2.2-1(S) – Staged implementation of pre-approved VSL / LC plan

Legend
- Red diagonal cross
- Flashing red diagonal cross

Note: Normal roadworks signing is omitted in this example.

Notes:
(a) 1, 2, 3 - VSL/LCS gantry
(b) A, B, C - lane designation
(c) Sign gantry locations may vary. Adjust VSL/LCS displays to suit, in accordance with principles.
2.2.3 Risk management

2.2.3-1 Risk management and Exception process for traffic control at road work sites

1 Purpose

This supplement provides guidance to practitioners for conducting risk assessment associated with the preparation, implementation and review of Traffic Management Plans and Traffic Guidance Schemes prepared in accordance with the principles of this manual. It also provides guidance on the processes to be followed when developing and accessing Exceptions to the requirements of this manual.

2 Backgrounds

Variations in traffic management practices at work sites in Queensland and in the application of traffic control devices occur when those preparing Traffic Management Plans design the Traffic Guidance Scheme outside the parameters set in the MUTCD Part 3 and related documents.

The department’s current culture is to encourage innovation in the design of Traffic Management Plans and Traffic Guidance Schemes where that innovation leads to an improvement in the value for money solutions which may involve impacts outside the specified requirements, without compromising safety.

Such treatments may include:

- planning for greater network impacts through reducing the level of service (LOS) for the road user which typically enables works to be undertaken in a more time efficient manner – Supplement to Part 3 of the MUTCD Clause 4.13-1 provides guidance on assessing acceptable LOS for roadworks sites: this may include changes to the scheduling / programming of the work to occur during periods of lower traffic demand
- treatments for the deployment of devices, and
- alternative device layouts using new / improved devices.

It is also recognised that, in some cases, conditions specific to the site and proposed traffic management layout may result in it not being possible to implement the requirements as outlined in the MUTCD Part 3 and related documents.

Traffic Guidance Schemes which provide a lesser level of protection and guidance may lead to additional safety risks to road workers and an increased risk of driver error. Schemes which do not meet the optimal requirements of the MUTCD Part 3 (Exceptions) can be considered but must be accompanied with a risk assessment and appropriate measures to ensure that the safety of workers and road users is not compromised.

Traffic Guidance Schemes with traffic management treatments in excess of that included in the MUTCD Part 3 are also considered as Exceptions and may potentially appear unnecessary to drivers and / or lead to increased driver frustration and reduced compliance with the regulatory requirements of the scheme. Traffic Guidance Schemes should not be developed with treatments in excess of that documented unless the risk assessment process identifies a clear need.

Where any alternative traffic management treatment or departure from standards is proposed, a risk assessment should be undertaken in accordance with this supplement. Both the risk assessment and Traffic Guidance Scheme shall be certified by a Registered Professional Engineer of Queensland (RPEQ).
3 Risk management

Risk Management shall generally be undertaken as per Section 2 – Risk Management, of Austroads Research Report AP-R403-12, Implementing National Best Practice or Traffic Control at Worksites – Risk Management, Audit and Field Operations.

The following additional provisions shall apply:

Use of standard and site-specific Traffic Management Plans

The MUTCD Part 3 contains a number of standard example diagrams for Traffic Guidance Schemes. While the application of these standard diagrams may be appropriate, they can be inappropriate if they are implemented without considering specific site conditions or the other requirements and options for deviation contained within the MUTCD Part 3.

When considering the application of standard diagrams, practitioners should consider:

- the notes accompanying the diagrams
- the need for a risk assessment
- the hierarchy of control to assess whether the highest practical level of protection or separation is being applied, and
- site-specific circumstances (for example, traffic characteristics, pedestrian facilities, public transport, vulnerable road users, road furniture, property access, crash history, probable weather conditions, site distance and so on) and adoptions of the plan as necessary to appropriately address these conditions.

Roles and responsibilities

Exceptions to requirements of the MUTCD Part 3 must be certified by a Registered Professional Engineer of Queensland (RPEQ), who must ensure that the use of the design Exception is appropriate, compliant with reasonable engineering principles and that departmental processes have been followed.

4 Exceptions process

This process for Exceptions to traffic control standards is adapted from the department’s design Exception process – Guidelines for Road Design on Brownfield Sites.

4.1 General

Traffic management officers must consider the following when contemplating Exceptions to traffic control standards:

- What is the safety performance of the standard arrangement?
- What is the expected safety performance of the arrangement that incorporates the Exception?
- What should the safety performance of the temporary traffic arrangement be?
- Is the difference acceptable?

The Exception process for traffic control standards is shown in Figure 4.3. The amount of work required to be put into each phase in the process will depend on the works and the extent of the proposed variations from the standards.
4.2 Development and evaluation of alternatives

An evaluation of the impacts of both the standard arrangement/s and that which incorporates the Exception/s must be undertaken. The evaluation should consider (and document) at least the following for all options:

- safety impact
- environmental impact
- community impact
- network impact (traffic operation and level of service), and
- value for money.

Other factors may also be considered depending on the particular circumstances of the site / project.

4.3 Mitigation

Specific treatments to mitigate identified risks associated with a proposed Exception must be considered and assessed on a case-by-case basis. An understanding of a site’s crash history and crash reducing treatments will assist in the development of risk mitigation strategies.
Figure 2.2.3-1(A) – Process for Exceptions to the MUTCD Part 3

1. Review background information
   - Review crash data operating speeds and other special considerations
2. Review the capability provided by each alternative
3. Assess cost & impacts
4. Conduct a risk analysis
5. Identify if there are other minima
6. Develop & evaluate alternatives
   - No
     - Consider construction sequencing, methods and redesign TMP
   - Can we retain the exception?
     - Yes
       - Are mitigation treatments required?
         - Mitigation of the specific exception or generally throughout the construction site
     - Review document and approve
4.4 Documentation

Elements of the Exception report may include:

- the location of the works
- the site characteristics such as sign posted speed limit, traffic volume and composition
- the standard to which the Exception applies, including full details of the document it is contained within
- the proposed Exception and the reasons for its proposal including site constraints
- the costs and impacts of both the standard solution and the Exception (including impacts to the environment, community, traffic network, safety and so on)
- other alternatives considered
- the risk assessment and control measures considered
- any safety and other performance information of similar Exceptions applied at other work sites, and
- all reference material used in the evaluation of the Exception.
**Figure 2.2.3-1(B) – Example risk assessment**

<table>
<thead>
<tr>
<th>Project Name / Job No.</th>
<th>XXX Road Shoulder Repairs</th>
<th>Workplace Location</th>
<th>Road XXX Chainage xx.xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>dd / mm / yyyy</td>
<td>Activity</td>
<td>Construction Works – Shoulder Repairs</td>
</tr>
</tbody>
</table>

**Step 1**

<table>
<thead>
<tr>
<th>Existing signposted speed</th>
<th>60 km/h</th>
<th>Lateral clearance between traffic lanes and workers</th>
<th>1.2–3 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road type / functional hierarchy</td>
<td>Arterial Road</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Step 2**

Level of planning required (generic / site specific): Site specific scheme required

**Steps 3, 4 and 5**

<table>
<thead>
<tr>
<th>No.</th>
<th>Activity</th>
<th>Hazard – Risk (What can harm you? – What could go wrong)</th>
<th>Likelihood (L)</th>
<th>Consequence (C)</th>
<th>Risk Level</th>
<th>Existing risk controls / treatments</th>
<th>Likelihood (L)</th>
<th>Consequence (C)</th>
<th>Residual Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Establishing, changing or removing traffic arrangements</td>
<td>Exposure of workers to traffic – risk of being struck by vehicle</td>
<td>Unlikely</td>
<td>Serious Injury</td>
<td>High</td>
<td>Undertake site set up and removal is in accordance with the MUTCD Part 3.</td>
<td>Very Unlikely</td>
<td>Serious Injury</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Note: Calculate the L, C, Risk Level using the risk calculator, for example, likely, severe, high.
<table>
<thead>
<tr>
<th>No.</th>
<th>Activity</th>
<th>Hazard – Risk (What can harm you? – What could go wrong)</th>
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<th>Consequence (C)</th>
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<th>Likelihood (L)</th>
<th>Consequence (C)</th>
<th>Residual Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Excavation and construction of new pavement adjacent to the travelled path including reduction to single, 2.9 m wide lane</td>
<td>Penetration of the work site by a vehicle possibly striking plant / equipment / workers in close proximity to the painted edge line during working hours</td>
<td>Unlikely</td>
<td>Serious Injury</td>
<td>High</td>
<td>Ensure advance signage is in accordance with the MUTCD Part 3 and correct for the works taking place Delineate with suitable bollards / hats to clearly identify locations Reduce the posted speed to 40 km/hr to reduce the likelihood, impact and severity of crashes and further ensure the safety of road workers Ensure speed signage arrangements are correct so police enforcement can be undertaken Monitor road user behaviour to determine if drivers are observing and responding to signs and devices – if not, review treatments</td>
<td>Very Unlikely</td>
<td>Serious Injury</td>
<td>Medium</td>
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<tr>
<td>No.</td>
<td>Activity</td>
<td>Hazard – Risk (What can harm you? – What could go wrong)</td>
<td>Likelihood (L)</td>
<td>Consequence (C)</td>
<td>Risk Level</td>
<td>Existing risk controls / treatments</td>
<td>Likelihood (L)</td>
<td>Consequence (C)</td>
<td>Residual Risk Level</td>
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<td>3</td>
<td></td>
<td>A difference in surface level between works and the existing travelled lane, with an edge drop ≤150 mm, posing a hazard to motorcyclists and the general public traversing the area</td>
<td>Unlikely</td>
<td>Serious Injury</td>
<td>High</td>
<td>Where practical, locate the difference in surface level (longitudinal edge drop) as far away from the known path used by motorcyclists and non-motored means of transport. Ensure adequate clearance is available for heavy vehicles that require additional width. Delineate the difference in surface level with suitable bollards / paint to clearly illuminate the potential hazard. Maintain acceptable minimal lateral separation from the trafficable path of 1.2 m. Ensure speed signage arrangements are correct so police enforcement can be undertaken.</td>
<td>Very Unlikely</td>
<td>Serious Injury</td>
<td>Medium</td>
</tr>
<tr>
<td>No.</td>
<td>Activity</td>
<td>Hazard – Risk (What can harm you? – What could go wrong)</td>
<td>Likelihood (L)</td>
<td>Consequence (C)</td>
<td>Risk Level</td>
<td>Existing risk controls / treatments</td>
<td>Likelihood (L)</td>
<td>Consequence (C)</td>
<td>Residual Risk Level</td>
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<td>4</td>
<td>Loose material, such as unsealed road base, may be present</td>
<td>Unlikely</td>
<td>Serious Injury</td>
<td>High</td>
<td>Delineate with suitable bollards / hats to clearly identify locations</td>
<td>Very Unlikely</td>
<td>Serious Injury</td>
<td>Medium</td>
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<td>Sweep the loose material away with bobcat broom at regular intervals</td>
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<td>Provide appropriate advance warning of chance of loose material</td>
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<td>Ensure speed arrangements are correct so police enforcement can be undertaken</td>
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<td>5</td>
<td>During shoulder widening works, the quality and smoothness of the surface is not uniform with that of the adjacent carriageway</td>
<td>Unlikely</td>
<td>Serious Injury</td>
<td>High</td>
<td>Delineate with suitable bollards / hats to clearly identify locations</td>
<td>Very Unlikely</td>
<td>Serious Injury</td>
<td>Medium</td>
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<td></td>
<td>In sections, the horizontal and vertical heights may not be in tolerance due to final trim requirements that cannot occur immediately</td>
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<td>Ensure speed signage arrangements are correct so police enforcement can be undertaken</td>
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</table>
### Steps 3, 4 and 5

<table>
<thead>
<tr>
<th>No.</th>
<th>Activity</th>
<th>Hazard – Risk (What can harm you? – What could go wrong)</th>
<th>Likelihood (L)</th>
<th>Consequence (C)</th>
<th>Risk Level</th>
<th>Existing risk controls / treatments</th>
<th>Likelihood (L)</th>
<th>Consequence (C)</th>
<th>Residual Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Worker strays onto live traffic or clear zone</td>
<td>Unlikely</td>
<td>Serious Injury</td>
<td>High</td>
<td>Delineate with suitable bollards / hats to clearly identify locations</td>
<td>Very Unlikely</td>
<td>Serious Injury</td>
<td>Medium</td>
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<td></td>
<td>Reduce the posted speed to 40 km/hr to reduce the likelihood, impact and severity of crashes and further ensure the safety of road workers</td>
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<td></td>
<td>Maintain acceptable minimal lateral separation from the trafficable path of 1.2 m</td>
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<td></td>
<td>Delineate work area with containment fence</td>
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<td></td>
<td>Include safe operating procedures in site inductions and reminders for workers in pre-start meetings</td>
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<tr>
<td>7</td>
<td>Over dimension vehicle / wide load using the road</td>
<td>Unlikely</td>
<td>Serious Injury</td>
<td>High</td>
<td>Advise appropriate authorities of width reduction so over dimension vehicles can be diverted</td>
<td>Very Unlikely</td>
<td>Serious Injury</td>
<td>Medium</td>
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<td></td>
<td>Also provide warning of diversion at closest decision point</td>
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</tbody>
</table>
### Steps 3, 4 and 5

<table>
<thead>
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<th>Risk Level</th>
<th>Existing risk controls / treatments</th>
<th>Likelihood (L)</th>
<th>Consequence (C)</th>
<th>Residual Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Construction vehicles entering and exiting the work site possible impacting on motorists</td>
<td>Unlikely, Serious Injury, High</td>
<td>Unlikely</td>
<td>Serious Injury</td>
<td>High</td>
<td>Design site access and egress to provide adequate acceleration, deceleration lengths and visibility. If acceleration and deceleration lengths cannot be achieved, provide Traffic Controller to control site access and egress. Include safe operating procedures for vehicle operators in site inductions and reminders in pre-start meetings. Provide advance signing for trucks entering.</td>
<td>Very Unlikely</td>
<td>Serious Injury</td>
<td>Medium</td>
</tr>
</tbody>
</table>

If any risk levels are very high, high, or medium, the Site Risk Rating is High, and a site-specific scheme is required.
**Risk Assessment Sheet**

Note: This risk assessment does not fulfill other WH&S requirements, such as the development of work procedures / method statements, hazard registers, and so on.

<table>
<thead>
<tr>
<th>Prepared by:</th>
<th>Date:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Approved by Project Manager (if required):</th>
<th>Date:</th>
</tr>
</thead>
</table>

This risk assessment and resulting control measures have been communicated and understood by all workers and contractors (must sign before starting work on this activity).

<table>
<thead>
<tr>
<th>Date</th>
<th>Name</th>
<th>Signed</th>
<th>Date</th>
<th>Name</th>
<th>Signed</th>
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</tbody>
</table>
The following road conditions are assumed for the following example. This information would be contained in the Traffic Management Plan / Guidance Scheme to which this Exception is attached.

- The road is a four lane, two-way urban arterial with 1 m wide central median. Only one direction of traffic will be affected.
- The existing lane width is 3.3 m with a 0.5 m shoulder.
- The sign posted speed limit is 60 km/h.
- The AADT is 28,000 vehicles per day with 4.9% heavy vehicles.
- There have been no recorded crashes at the site in the last five years.

**Note:** This is an example only. The level of risk associated with the Exception will determine the amount of documentation required to justify and support the Exception.

**Figure 2.2.3-1(C) – Example Exception decision record**

<table>
<thead>
<tr>
<th>Work Site Traffic Management Practice Exception Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location and Scheduled Dates</strong></td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>To:</td>
</tr>
</tbody>
</table>

**What is the standard that is to be departed from?**

MUTCD Part 3 Clause 4.13.3, Table 4.11 requires a minimum lane width of 3 m for road works speed zones of 60 km/h or less.

**What is the proposed departure?**

Only one lane will remain open in the affected direction while works are being undertaken. The proposed departure reduces the width of this lane to 2.9 m to allow a 1.2 m lateral clearance and avoid the use of barrier separation.

**What alternatives have been considered?**

Maintain the existing lane widths and install temporary barriers.

**What are the costs and impacts of the standard arrangement and Exception (including environmental, community, network and safety impacts along with any other relevant factors and constraints)?**

Due to the day time traffic demand, the works will be carried out between 9 pm and 5 am. A lane closure during day time peak period would result in considerable traffic congestion and the time and cost required to implement a full detour is not considered justifiable due to the short duration of the works.

The set-up and removal of barriers will add several hours to the duration of the works and prevent it from being completed in one nightshift. This will result in additional night time noise for surrounding residence, additional traffic impacts, and considerable additional costs in the supply and installation of barrier as well as additional traffic management and construction worker labour.

While a reduction in lane width is generally considered to be associated with reduced capacity and safety, this will be managed through the undertaking of works at night when volumes are low and adequate advance warning and speed restrictions at the work site. A 2.9 m lane provides adequate width for all heavy vehicles that have general access to the road. The road is not an over-dimension route.
### What mitigation treatments were identified in the risk assessment in relation to this Exception?

The following mitigation measures have been identified in relation to this Exception:

- Ensure advance signage is in accordance with MUTCD Part 3 and correct for the works taking place.
- Delineate with suitable bollards/hats to clearly identify locations.
- Reduce the posted speed to 40 km/hr to reduce the likelihood, impact and severity of crashes and further ensure the safety of road workers.
- Ensure speed signage arrangements are correct so police enforcement can be undertaken.
- Monitor road user behaviour to determine if drivers are observing and responding to signs and devices. If not, review treatments.
- Maintain acceptable minimal lateral separation from the trafficable path of 1.2 m.
- Advise appropriate authorities of width reduction so over dimension vehicles can be diverted.
- Provide warning of diversion at closest decision point.

### What is the safety performance of the standard arrangement?

The safety performance of the standard lane width applied in conjunction with MUTCD compliant signs and devices is considered to be very good.

### What is the expected safety performance of the arrangement that incorporates the Exception (including performance information from other sites where the Exception has been applied)?

All other arrangements are in accordance with the relevant standards. The 2.9 m lane has a 1 m concrete median providing clearance to opposing traffic on one side and a 1.2 m clearance to workers on the other side. For this reason, the safety performance of the arrangement incorporating the Exception is considered to be comparable to the standard arrangement incorporating a 3 m lane.

### Is the difference acceptable?

Yes.

### Will monitoring, and evaluation be carried out? Provide details.

Road user behaviour will be monitored to determine if drivers are observing and responding to signs and devices – if not, the treatments will be reviewed. Any incidents or near misses will be evaluated to determine if the Exception was a contributing factor.

### References/attachments

References: MUTCD Part 3
Attachments: Location Map and Risk Assessment attached to Traffic Guidance Scheme.

### Is the Exception considered to be acceptable (appropriate and compliant with reasonable engineering principles and departmental processes)?

Yes.
4.5 Roles and responsibilities

Exceptions to temporary traffic management standards must be certified by a Registered Professional Engineer of Queensland (RPEQ), who must verify that the Traffic Guidance Scheme is compliant with reasonable engineering principles and that the departmental Exception processes have been followed.

4.6 Monitoring and evaluation

Monitoring of road works sites where Exceptions have been implemented must be carried out for the duration of the works to ensure they are performing safely, effectively and with an acceptable level of service. This monitoring can be incorporated into the daily routine checks required by the MUTCD. Clear and complete records of the monitoring undertaken, analysis of results and any changes made to the TGS as a result must be kept.

Details of any incidents that occur at the site, whether the Exception contributed to the incident and the actions taken, are also essential.

2.6 Operation

2.6.1 Daily routine and worksite records

2.6.1-1 Frequency of after-hours inspections

The frequency of after-hours inspections and records are dependent on the type of traffic control devices left out at an unattended site, the length of time the site will be unattended, the general environment around the site and the likelihood that traffic control devices may be interfered with while workers are not present.

For example, sites at or near locations with high numbers of pedestrians (especially near licensed venues) may lead to greater risk that traffic control devices at an unattended site will be interfered with and require a greater level or frequency of inspection.
3 Description and use of signs and devices

3.5 Signs and devices for regulatory control of traffic

3.5.5 Temporary speed limits

3.5.5-1 Use of supplementary devices at roadworks to reduce speed

1 Purpose

The purpose of this document is to provide options and guidance on the use of supplementary traffic control devices at roadwork sites to reduce the incidence of speeding within roadwork zones.

2 Background

Traffic control devices are generally installed at roadwork sites in accordance with Part 3 of the MUTCD. The MUTCD provides for minimum signage and traffic control devices at roadworks sites; however, there is provision for alternative signage to be installed based on a risk assessment (Clauses 2.2.3 and 2.2.5).

The suite of signs and traffic control devices provided in the MUTCD has proved to be adequate and effective in achieving the desired result of reducing vehicle speeds at most roadworks sites in built-up areas; however, in rural (open road) areas where approach speeds are higher, speed compliance through the roadworks zone is low, resulting in elevated risk to the road workers and Traffic Controllers at these sites.

The following are intended to be used as supplementary traffic control devices at roadwork sites where the traffic control provisions of Part 3 of the MUTCD have been demonstrated to be inadequate in reducing the speed of traffic through the roadwork zone.

3 Current provisions within the MUTCD

3.1 Lane narrowing

Clause 4.13.3 of Part 3 of the MUTCD provides the requirements for lane widths at roadwork sites.

The width of traffic lanes can be reduced either through line marking or through the use of cones or bollards in accordance with Clause 3.9.1. Care should be taken to ensure that the cones or bollards remain in place and do not create a hazard to motorists.

Portable kerbs may be used to narrow the width of traffic lanes. These are not currently approved for use and will require approval for individual sites – see Section 4.4 Temporary kerb with delineator.

3.2 Flashing lamps on advance warning signs

The MUTCD permits the use of flashing lamps to be installed at roadwork sites to draw motorists’ attention to advance warning signs (see Clauses 2.4.3, 3.11, 4.7.5 and Figure 4.6). Flashing lamps shall not be used for delineation.

4 Supplementary traffic control devices

4.1 Speed indicator devices

4.1.1 General

Speed indicator devices use a radar unit which displays a vehicle's speed with messages requesting a driver to SLOW DOWN if they are exceeding the speed limit or thanking those who are observed to be...
complying with the speed limit. The speed display is set to not display a speed in excess of 10 km/h over the speed limit to avoid drivers trying to record a high reading.

Speed indicator devices are also capable of recording the speed of every vehicle that approaches the roadwork zone and can be used to determine speed characteristics through the roadwork zone.

Speed indicator devices may be installed at a roadwork site where speed compliance with the reduced roadwork speed limit is poor. The speed indicator device should be installed sufficiently in advance of the roadwork that motorists have adequate time to read, comprehend the message and react accordingly to reduce speed.

The speed indicator device should be programmed to display the speed and a SLOW DOWN message only to vehicles that are travelling over a set threshold.

4.1.2 Technical requirements
The speed indicator device should be capable of the following:

- ability to display speed and message for a minimum period of five seconds
- have a minimum 100 metre detection range and the ability to display a message every three seconds
- provide remote access to the signs for the purpose of programming and data collection; this feature is only required for signs that are permanently installed for the duration of the project
- provide adequate storage capacity to store data for up to one week
- ability to obtain speed data and prepare reports using proprietary software for export to Excel file
- ability to switch off the device remotely
- operate through the use of solar power with battery back-up, and
- be designed in accordance with TC1833 (other devices not conforming to TC1833 may be considered).

4.1.3 Speed display
The speed indicator device shall be set to activate as follows:

- Vehicles travelling less than or equal to speed limit: Display actual speed and THANK YOU message
- Vehicles exceeding speed limit by up to 10 km/h: Display actual speed and SLOW DOWN message, and
- Vehicles exceeding speed limit by more than 10 km/h: Display SLOW DOWN message only.
4.1.4 Site installation
The speed indicator device shall be installed in advance of where a Traffic Controller operates or where traffic signals or give way signs are installed within the 60 km/h speed zone. The device shall be installed:

- to face traffic approaching the roadwork zone
- on the shoulder of the road, a minimum of 1.5 m clear of the traffic lane, and
- radar should be angled to capture traffic approaching the roadwork zone and not traffic leaving the roadwork zone.

4.1.5 Data collection
If possible, data should be downloaded on a daily basis where traffic volumes are high to avoid loss of data through a full memory bank. The proprietary software available with the speed indicator device should be capable of data manipulation to determine average speed and 85th percentile speed of vehicles by time and day. The software should also be capable of filtering data by time and day. The software should also be capable of converting data to an Excel format for further analysis and reporting.

A record of traffic conditions, weather patterns, changes to signage, enforcement and other factors that may have an impact on driver behaviour should be kept.

4.2 Rumble strips/rumble mats

4.2.1 General
Rumble strips or rumble mats may be installed on the approach to the 60 km/h speed limit in a roadwork zone to make motorists aware of the reduced roadwork speed limit and to influence the driver to decrease speed.

4.2.2 Installation
Rumble strips shall only be installed where the following conditions are met:

- speed limit less than 80 km/h, and
- minimum visibility distance of 80 m to the rumble strips / rumble mats.

Note: A trial conducted in Queensland showed speed reduction was greatest when rumble strips were set up in sets of two with three rows of strips in each set. The two sets of rumble strips on the approach were separated by a distance of 200 m.

4.2.3 Technical requirements
Rumble strips or rumble mats should only be used at roadwork sites when the reduced speed limit in the roadwork zone is required for the safety of the road worker or for traffic safety. Rumble strips or rumble mats should comply with the following:

- rumble strips or rumble mats should not exceed 20 mm in thickness
- rumble strips or rumble mats should be yellow in colour
- should be installed without the need for tie down, and
- should be easy to handle onsite and quick to install.

4.2.4 Signage requirements
Where rumble strips are installed at roadwork sites, an advance warning sign shall be installed 2D in advance of the rumble strips to warn motorists of the rumble strip ahead (TC1991_1 or TC1991_2).
Rumble strip warning sign shall be installed adjacent to the rumble strip (TC1993_3). Dimension D is given in Table 4.2 of Part 3 of the MUTCD.

4.2.5 Removal from site
Rumble strips or rumble mats must only be used when the roadwork speed limit of 60 km/h is maintained. Rumble strips or rumble mats and all associated signage must be removed from site when the reduced speed limit is no longer required, and a higher speed limit is reinstated.

4.3 Not used

4.4 Temporary kerb with delineator
Temporary kerbs can be used at roadwork sites as a means of narrowing traffic lanes. The installation of a kerb changes the environment sufficiently to reduce vehicle speed. Temporary kerbs used at a roadwork site must be yellow in colour so that it can be easily seen by the motorist. Kerbs should be run-over type so that, in the event of an errant vehicle mounting the kerb, the driver is able to control the vehicle.

Delineators may be installed with temporary kerbs to guide traffic through the roadwork zone. Where delineators are used, these shall be black and yellow in colour. The bars shall be aligned to point down to the left if vehicles are to pass to the left and shall be aligned to point to the right if vehicles are to pass to the right of the kerb.

The width of the traffic lane shall be increased when roadwork is not in progress and the reduced speed limit is not required for traffic safety purpose.

4.5 UHF radio broadcast

4.5.1 General
This system allows vehicles that are fitted with UHF radios to receive pre-recorded voice messages warning of traffic conditions ahead (for example, SLOW DOWN warnings) which can be automated or set to run periodically. Typical applications include:

- SLOW DOWN notifications due to temporary road hazards ahead
- changed traffic conditions ahead for temporary traffic-controlled sites
- reduced speed ahead, and
- other applications approved by the Intelligent Transport Systems and Electrical Unit.

4.5.2 Technical requirements
The UHF broadcast device shall comply with the following requirements:

- The operating range of broadcast (km) of this type of system shall be up to 2 km; however, this will depend on the transmit power, type of antennae used (for example, directional Yagi / Omni Directional / Parabolic Dish antennae) as well as the usage of RF attenuators.
- The frequency (band) is to be 477 MHz within the UHF band (300 MHz–3 GHz).
- The RF equipment operating frequency shall not conflict with or cause interference to any other service within this band (such as Queensland Fire and Rescue Service, Queensland Police Service, Queensland Ambulance Service and other emergency services).
- The RF equipment shall conform to all the requirements of the Australian Communications and Media Authority.
• Pre-recorded messages shall be configured to play through external system activation (for example, induction loop detection, radar speed detection and other methods) or manual voice message on location.

• Voice messages can be recorded onsite using a CB radio microphone unit or pre-recorded messages stored on external memory card (for example, SDRAM card).

• All equipment shall be extra low voltage.

• All equipment shall be protected from water ingress (minimum IP rating of IP67) and suitably robust and protected against damage from the elements.

• All equipment shall be able to be easily handled by no more than two persons.

• The system should only to be installed in remote locations that minimise the reception of voice messages by parties not intended to receive the messages.

• Installed equipment shall not installed in positions so as to divert or catch driver attention.

• All messages shall be preceded by soft audible tones to alert drivers of an impending message or announcement.

• All pre-recorded messages to be submitted to a departmental representative for approval prior to installation of the system.

• All manual messages shall be approved by the onsite departmental representative or other Transport and Main Roads authorised representative.

4.5.3 Clearance from traffic lanes
The UHF broadcast device shall be installed outside the clear zone required for that site or shall be shielded by means of barrier so that it does not present a hazard to errant vehicles.

4.6 Portable speed humps

4.6.1 General
Speed humps may be used to increase compliance with the 40 km/h speed limit. The speed hump must be removed when the 40 km/h speed limit is no longer required (that is, when workers have left).

4.6.2 Application of a speed hump device
Prior to the use of any temporary speed hump device on a 40 km/h work site, a Traffic Guidance Scheme (TGS) shall be developed for the relevant work site. If higher order devices (such as safety barriers) are considered to be inappropriate temporary speed humps can be considered, subject to a risk assessment being undertaken.

These temporary speed humps shall only be used:

• on a short-term roadworks site with a construction posted speed limit of 40 km/hr

• as per the manufacturer’s specifications

• in daylight hours or under floodlighting at each temporary speed hump location point

• within the confines of the area defined by the relevant Traffic Guidance Scheme
• in conjunction with appropriate warning signs (refer Figures 4.6.4–A and 4.6.4–B in this supplement), and

• when the work site is attended (temporary speed humps shall be removed when no roadworks are being undertaken).

4.6.3 Number of temporary speed humps at a work site
Generally, a minimum of two temporary speed humps shall be used at a work site, one at each end of the road work area.

If the length of the work area is greater than 200 metres, or there is an interrupted line of sight between each end of the work zone, then intermediate temporary speed humps and their associated signing shall be installed at intervals of not less than 100 metres.

One temporary speed hump may be suitable for small work areas on local roads. The single temporary speed hump is to be located immediately prior to the work area.

In two directional arrangements, it may only be necessary to install temporary speed humps in the lane closest to the work site.

4.6.4 Speed hump warning signs
Temporary advance warning signs (TC1668) shall be installed in advance of the first temporary speed hump. TC1668 shall be included in a multi-message sign.

Warning signs (TC1667) shall be located at each of the temporary speed hump locations, including any intermediate temporary speed humps. These warning signs shall only be visible in the direction in which the hump is traversed (in the case of humps only being installed, in the lane closest to the work site).

Typical signing arrangements are shown in Figures 3.5.5-1(A) and 3.5.5-1(B).
Figure 3.5.5-1(A) – Typical one-lane temporary speed hump arrangement (100 km/h road)
Figure 3.5.5-1(B) – Typical two-way temporary speed hump arrangement with lane shift (100 km/h road)
4.6.5 Speed hump installation requirements
Speed humps shall be positioned to allow a bicycle rider to safely manoeuvre around the end of the hump without hitting any other object or hazard. A minimum clearance of 0.5 metres should be provided.

Installation, maintenance and removal of temporary speed humps are to be as per the relevant manufacturer’s specifications.

Traffic control, if required, shall be controlled by accredited Traffic Controllers during all installation, maintenance or removal activities.

4.6.6 Delineation
Where two-way traffic passes through the work area, there will be a need to ensure traffic does not attempt to bypass the temporary speed humps. Delineation may be required between each of the lanes to guide vehicles over the temporary speed humps.

Traffic cones and bollards should be considered for this purpose. Onsite procedures should be put in place to ensure traffic signs, cones and bollards are regularly inspected to ensure they are located in accordance with the Traffic Management Plan.

4.6.7 Approved profiles
Speed humps are official traffic devices. Devices approved for speed management purposes on roads in permanent applications are outlined in Appendix B of Part 13 of the MUTCD. The profile outlined in Figure 3.5.5-1(C) has been tested and the Department of Transport and Main Roads is satisfied that it is acceptable for the purpose of slowing vehicles without posing any driver control or behaviour concerns.

*Figure 3.5.5-1(C) – Speed hump profile*

4.7 Light emitting diodes STOP / SLOW bats
STOP / SLOW bats that have built-in light emitting diodes (LEDs) have been trialled successfully in Queensland.

They may be used where enhanced visibility is desirable, such as during night works or when weather conditions such as rain or fog may limit the effectiveness of the standard bats.

The bats replace the standard STOP / SLOW bats used by Traffic Controllers and incorporate a switch that the Traffic Controller can use to turn the LEDs on when required. It is not intended to develop operational guidelines for when Traffic Controllers can activate the LEDs.
3.9  **Devices for delineating and indicating the travelled path**

3.9.1  **Traffic cones and temporary bollards**

3.9.1-1  **Logos and marking on cones and bollards**

Logos and marking may be used on cones and bollards for identity purposes. When used, it shall be limited to the non-reflective surface areas of the device.

3.10  **Containment fences and road safety barrier systems**

3.10.3  **Road safety barrier systems**

3.10.3-1  **Road safety barrier systems**

The following table outlines the various temporary traffic management duties in relation to the selection, design and implementation of a temporary road safety barrier as part of a Traffic Guidance Scheme (TGS), which may be performed by competent persons.

Only temporary road safety barriers that have been assessed as accepted by Transport and Main Roads may be used on state-controlled roads. A list of these products is available on the Transport and Main Roads website in the document *Road Safety Barrier Systems, End Treatments and other related Road Safety Devices - Assessed as accepted for use on state-controlled roads in Queensland*.

**Table 3.10.3-1 – Temporary traffic management duties**

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Competent Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine the need for a temporary road safety barrier.</td>
<td>Works require the use of a temporary road safety barrier system due to worker or road user safety.</td>
<td>TMD</td>
</tr>
<tr>
<td>Selection of temporary road safety barrier system.</td>
<td>Compare various temporary road safety barrier system and select the most suitable for the specific site.</td>
<td>TMD with temporary road safety barrier design training.</td>
</tr>
<tr>
<td>Design of temporary road safety barrier in strict accordance with manufacturer’s supplied manuals / guidelines.</td>
<td>Complete the design of the barrier system including (but not limited to) the location / length of need / fixing / deflection limits and end treatment requirements.</td>
<td>TMD with temporary road safety barrier design training or Specialist temporary road safety barrier designer in consultation with the TMD.</td>
</tr>
<tr>
<td>Design of temporary road safety barrier which is outside the scope of the manufacturer’s supplied manuals / guidelines.</td>
<td>RPEQ certification is required for all areas of the design and installation which are outside the scope of (or not included in) the manufacturer’s supplied manuals / guidelines.</td>
<td>RPEQ, desirably with temporary road safety barrier design training.</td>
</tr>
<tr>
<td>Install a temporary road safety barrier system.</td>
<td>Install the temporary road safety barrier as nominated on the TGS, in accordance with the manufacturer’s supplied manuals / guidelines and instructions from the TMD or RPEQ.</td>
<td>TMI competent with the installation of the selected temporary road safety barrier or Specialist temporary road safety barrier installer.</td>
</tr>
</tbody>
</table>
### Temporary road safety barriers

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Competent Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certification of manufacturer’s supplied manuals / guidelines.</td>
<td>Temporary road safety barrier suppliers must ensure all manufacturers’ supplied manuals / guidelines are appropriately certified by an Engineer.</td>
<td>RPEQ or equivalent.</td>
</tr>
</tbody>
</table>

*This is part of Transport and Main Roads’ product assessment process and is not required when using assessed as accepted products.*

### 3.12 Vehicle-mounted signs and devices

#### 3.12.5 Truck-mounted crash attenuator

#### 3.12.5-1 Application and use of truck and trailer mounted attenuators (TMAs) at roadworks

#### 1 Purpose

The purpose of this supplement is to provide a set of technical specifications, operational procedures and the minimum training qualifications required by persons responsible for supervising and operating Truck Mounted Attenuators (TMAs) at road work sites in Queensland.

#### 2 Objectives

The primary objective of this supplement is to improve the safety of road workers through providing physical protection via TMAs when road closures or temporary safety barriers are not reasonably practical. TMAs also protect the occupants of errant vehicles through attenuating an impact.

The secondary objective is to provide guidance for training of TMA Operators, in order to achieve a consistent approach in the use of TMAs in Queensland.

#### 3 Terminology

This section provides abbreviations and definitions of terms used throughout the document.

**Table 3.12.5-1(A) – Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
</tr>
<tr>
<td>ADR</td>
<td>Australian Design Rule</td>
</tr>
<tr>
<td>AIB</td>
<td>Automatic Impact Braking</td>
</tr>
<tr>
<td>AS</td>
<td>Australian Standard</td>
</tr>
<tr>
<td>GVM</td>
<td>Gross Vehicle Mass</td>
</tr>
<tr>
<td>MASH</td>
<td>Manual for Assessing Safety Hardware</td>
</tr>
<tr>
<td>MUTCD Part 3</td>
<td>Queensland Manual of Uniform Traffic Control Devices Part 3: <em>Traffic control for works on roads</em></td>
</tr>
<tr>
<td>NCHRP</td>
<td>National Cooperative Highway Research Program</td>
</tr>
<tr>
<td>NHVR</td>
<td>National Heavy Vehicle Regulator</td>
</tr>
<tr>
<td>TGS</td>
<td>Traffic Guidance Scheme</td>
</tr>
<tr>
<td>TL</td>
<td>Test Level</td>
</tr>
</tbody>
</table>
Table 3.12.5-1(B) – Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIB</td>
<td>A system that, in the event of an impact with the rear of the Impact Attenuator Unit, will apply the brakes of the TMA host vehicle automatically; the system must apply brakes on all wheels of the rear axle/s of the host vehicle</td>
</tr>
<tr>
<td>Competent person</td>
<td>A person who has acquired through training, qualification and/or experience, knowledge and skills to carry out a particular task</td>
</tr>
<tr>
<td>GVM</td>
<td>Means the maximum loaded mass of a vehicle:</td>
</tr>
<tr>
<td></td>
<td>a) stated on the vehicle’s compliance plate, or</td>
</tr>
<tr>
<td></td>
<td>b) stated in a way prescribed under a regulation.</td>
</tr>
<tr>
<td>Host vehicle</td>
<td>A host vehicle is a vehicle that has an impact attenuator unit attached to it permanently or to which a trailer mounted impact attenuator unit can be attached</td>
</tr>
<tr>
<td>Impact</td>
<td>In mechanics, an impact is a high force or shock applied over a short time period when two or more bodies collide (such a force or acceleration usually has a greater effect than a lower force applied over a proportionally longer time period) / an impact that may affect the integrity or operation of the vehicle and / or Impact Attenuator Unit</td>
</tr>
<tr>
<td>Impact Attenuator Unit</td>
<td>(Also known as a ‘crash cushion’ or ‘crash attenuator’) A device intended to reduce the damage done to structures, vehicles and motorists resulting from a motor vehicle collision, designed to absorb the vehicles’ kinetic energy and / or redirect the vehicles away from the hazard, and from roadwork machinery or workers</td>
</tr>
<tr>
<td>TGS</td>
<td>A diagram that illustrates the layout, signs, devices and general arrangement to warn and guide traffic around, past, or, when necessary, through a work site or temporary hazard</td>
</tr>
<tr>
<td>TL2</td>
<td>Applies to Impact Attenuator Units that meet NCHRP Test Level 2 (basic) requirements (TL2) 70 km/h</td>
</tr>
<tr>
<td>TL3</td>
<td>Applies to Impact Attenuator Units that meet NCHRP Test Level 3 (basic) requirements (TL3) 100 km/h</td>
</tr>
<tr>
<td>TMA</td>
<td>A combination of Host Vehicle and Impact Attenuator Unit, either mounted to the Host Vehicle or towed by the Host Vehicle; the combination must meet the requirements of this document</td>
</tr>
<tr>
<td>TMA Operator</td>
<td>A person meeting the requirements of Part B of this document</td>
</tr>
</tbody>
</table>

4 Reference and applicable documents

- ISO 6487 *Road vehicles – Measurement techniques in impact tests – Instrumentation*.
- AS 4192-2006 *Illuminated flashing arrow signs*.
- AASHTO *Manual for Assessing Safety Hardware*.

### 5 Risk management

The Queensland Work Health and Safety Regulation 2011 classifies work on or adjacent to roads that is used by traffic other than pedestrians as high-risk work and prescribes the need to identify hazards and control risks.

The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest. This ranking is known as the ‘hierarchy of risk control’. The WHS Regulation requires duty holders to work through this hierarchy when managing risk under the WHS Regulation.

**Figure 3.12.5-1 – Hierarchy of risk control**

![Hierarchy of risk control diagram](image)

The Queensland *Manual of Uniform Traffic Control Devices* Part 3: *Traffic control for works on roads* provides guidance in relation to hazard identification and risk control as it relates to all applications of road works. This supplement embraces these requirements together with the principles as contained in AS/NZS ISO 31000 *Risk Management*. 
Following is an extract of Clause 2.2.3 from the MUTCD Part 3.

### 2.2.3 Risk Management

Risk management entails the identification and analysis of all safety risks likely to arise during works on roads including the setting up, operating, changing and ultimate dismantling of a Traffic Guidance Scheme, followed by the determination of appropriate measures to mitigate those risks. The process is appropriate at all levels of planning and operation including the following:

a) when preparing standardised plans and safe work method statements for the conduct of minor routine and mobile works

b) when preparing Traffic Guidance Schemes for more extensive or complex works where site specific risks will assume importance.

In each case the process should be carried out by first identifying all the hazards likely to arise, evaluating them in terms of likelihood of occurrence and determining adverse consequences using historical data, experience or other means. The proposed procedural statement or Traffic Guidance Scheme should then be checked in detail to ensure that adequate means of controlling or reducing those risks found to be significant, are in place.

This Part of the Manual sets out guidance and optimal treatments (see Clause 1.2.2). Variations to these optimal treatments shall only be made on the basis of a documented risk assessment undertaken in accordance with Supplement 2.2.3-1 and subject to Clause 2.2.5.

### 6 Technical specifications

This section provides technical specifications in the following areas:

1. Host vehicle.
2. Impact Attenuator Unit certification.
3. Truck Mounted Impact Attenuator unit.
5. TMA repairs, modifications and inspections.
6. Traffic control devices.

#### 6.1 Host vehicle

This section provides standard functional specifications for the host vehicle. This includes areas such as seating, seatbelt harnesses, masts, visibility of the host vehicle and standard control panel arrangement.

Individual state or territory authorities may have different or specific registration requirements; therefore, it is advisable that the relevant authorities be contacted prior to modifications being made to any vehicles.
The host vehicle shall conform to the following requirements:

a) Must comply with the applicable regulatory requirements, such as Australian Design Rules, registration requirements and applicable legislation, including the Transport Operations (Road Use Management – Vehicle Standards and Safety) Regulation 2010. In some cases, a full engineering analysis by a suitable qualified person, supported by testing where applicable, will be necessary before the modified vehicle is accepted. This testing may include determination of front axle loading when the impact attenuator unit is deployed.

b) Be approved for on-road use.

c) Be a minimum of 15 tonnes GVM (refer to Appendix A in Section 3.12-5 Application and use of truck and trailer mounted attenuators (TMAs) at roadworks).

d) Be a single cab truck with an automatic transmission.

e) The mounting of any fixtures is to be engineered to 20 times the weight of the fixture.

f) Be painted in accordance with the requirements of the MUTCD Part 3, Clause 3.12.4.

h) Be fitted with an Automatic Impact Brake (AIB) system that, in the event of an impact with the rear of the Impact Attenuator Unit, will apply the brakes of the TMA host vehicle automatically. In the event of such incidents, it is critical to have an isolation switch or system which will allow the AIB system to be deactivated: this will allow for the impacted TMA vehicle to be removed from positions or locations that could cause an unnecessary obstruction or blockage to the roadway.

As a minimum, the AIB System must apply the brakes on all wheels of the rear axle/s of the host vehicle. The AIB system must only be activated when the Impact Attenuator Unit is fully deployed, and the host vehicle speed is no greater than 40 km/h.

It is recommended that the AIB system be fitted so activation of the system is automatic when the Impact Attenuator Unit is fully deployed, and the host vehicle is travelling at a speed no greater than 40 km/h.

**Note:** Modification of the braking system may affect ADR compliance and require approval through the NHVR Code of Practice for the Approval of Heavy Vehicle Modifications.

g) Be fitted with an Automatic Impact Brake (AIB) system that, in the event of an impact with the rear of the Impact Attenuator Unit, will apply the brakes of the TMA host vehicle automatically. In the event of such incidents, it is critical to have an isolation switch or system which will allow the AIB system to be deactivated: this will allow for the impacted TMA vehicle to be removed from positions or locations that could cause an unnecessary obstruction or blockage to the roadway.

As a minimum, the AIB System must apply the brakes on all wheels of the rear axle/s of the host vehicle. The AIB system must only be activated when the Impact Attenuator Unit is fully deployed, and the host vehicle speed is no greater than 40 km/h.

**Note:** Modification of the braking system may affect ADR compliance and require approval through the NHVR Code of Practice for the Approval of Heavy Vehicle Modifications.

h) Be fitted with an AS/NZS 4192 Illuminated flashing arrow signs approved size ‘C’ arrow board. The arrow board assembly shall be positioned on the truck in accordance with the requirements of the MUTCD Part 3.

i) The arrow board and its mountings shall be engineered to a standard:

   i. that will allow for them to withstand the forces applied during forward travel motion based on maximum speed environment for heavy vehicles when travelling to site; that is, 100 km/h, and

   ii. to withstand a force of 20 times the total mass of the arrow board and its mountings, and

   iii. if the arrow board assembly is designed to lift and lower, it must lift or lower within 15 seconds.
j) Have an ‘in-cabin’ control panel placed in close proximity to the operator and illuminated at night. The panel shall include methods of control for, but not limited to, the following:

   i. activation of communication equipment
   ii. activation of warning lights
   iii. activation of arrow board
   iv. raising and lowering of arrow board if applicable
   v. activation of rear-view camera
   vi. raising and lowering of the Impact Attenuator Unit.

k) Be fitted with an approved four-point harness seat belts and mountings (a four-point harness seat belt is also required in the passenger seat if the vehicle is used for training or assessment purposes).

l) Prevention of rearward seat collapse.

   To reduce the likelihood of rearward seat collapse in the event of a substantial rear impact:

   The driver’s seat and seat mountings must be of sufficient strength to prevent rearward seat collapse when subjected to a loading of 740 ± 20 daN (daN – decanewton, a metric unit of force equal to 10 newtons), supplemented by a force equal to 6.6 times the mass of the complete seat, or

   **Note:** This loading must be applied horizontally rearward through the centre of mass of the seat / occupant combination and must be sustained for at least one second.

   An engineered and certified device designed to restrict rearward seat collapse when the driver’s seat and seat mountings are subjected to the loading described in this point l) must be installed behind the driver’s seat.

   **Note:** The device should not increase the likelihood of injury to the seat occupant.

   Reference Appendix B for further information on rearward seat collapse.

m) Be fitted with high strength headboards to prevent debris from crashing through the cabin in the event of an impact. The backs of these headboards are to be blacked out, so as to contrast / highlight the arrow board and other detailing of the vehicle when viewed from the rear.

n) Be fitted with a minimum of two flashing yellow lamps, positioned on the vehicle in accordance with the requirements of the MUTCD Part 3.

o) Have mounting facilities for signs to be mounted to the tailgate or headboard as required by relevant state / territory road authority technical publications.

p) As a minimum, be fitted with communication equipment that will enable simultaneous and independent communication to all relevant personnel, for example, two 5-watt 41 channel UHF radios, operating on separate channels.

q) Be equipped with a warning device of sufficient intensity and volume to be easily heard by workers carrying out their normal duties at least 30 metres from the TMA.
r) Have an independent power back-up system installed that will adequately cater for all auxiliary equipment associated with use of the host vehicle as a TMA; for example, this may include the installation of auxiliary batteries or power packs.

s) Be fitted with a camera to allow the TMA Operator to observe traffic approaching from the rear.

Note: Consideration should be given to the use of cameras suitable for both day and night operations, and installation of an associated data recording device to record vehicles approaching from potential impact areas.

t) Must have rear marker plates fitted to the rear of the vehicle.

6.2 Impact Attenuator Unit testing requirements

Impact Attenuators Units shall meet all mandatory testing requirements of the following:

- AASHTO Manual for Assessing Safety Hardware for all other Impact Attenuator Units (MASH).

Typical form of evidence for compliance would be, or may include, test specification report of that particular make and model.

6.3 Impact Attenuator Unit test level ratings

The following table indicates Impact Attenuator Unit ratings.

Table 3.12.5-1(C) – Impact Attenuator Unit ratings

<table>
<thead>
<tr>
<th>Rating</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL2</td>
<td>70 km/h</td>
</tr>
<tr>
<td>TL3</td>
<td>100 km/h</td>
</tr>
</tbody>
</table>

Impact Attenuators Units shall have their test level rating clearly displayed on both side panels of the unit. The display shall be made up of a panel with black lettering (for example, TL3) on a white 210 mm x 300 mm background.

6.4 Truck Mounted Impact Attenuator Unit

Host vehicle shall be as detailed in Section 6.1:

a) Impact Attenuator Units shall be assembled and fitted to the host vehicle in accordance with the manufacturer’s specifications.

b) Flashing yellow light/s shall be fitted to the rear of the Impact Attenuator Unit.

c) The rear surface of the Impact Attenuator Unit when deployed shall consist of Class 400 (1W) retroreflective red diagonal striping at least 100 mm wide on a white non-retroreflective background.
6.4.1 **Truck Mounted Impact Attenuator Unit configuration**

In addition to these requirements, the following shall apply:

a) dedicated yellow flashing light to automatically provide notice of the Impact Attenuator Unit being raised or lowered

b) Automatic Impact Brake micro-switch is to be fitted to the rear of the Impact Attenuator Unit to activate the host vehicle brakes in the event of an impact

c) In-cabin and external audible alarms to automatically provide notice of the Impact Attenuator Unit being raised or lowered

d) travel lock system installed that prevents inadvertent deployment of the Impact Attenuator Unit

e) when not deployed, an adhesive-type (black on yellow) warning sign stating: 'Caution: keep clear this unit may lower at any time' must be visible from the rear of the Impact Attenuator Unit.

6.5 **Trailer Mounted Impact Attenuator Unit (NOT APPLICABLE IN QUEENSLAND)**

Trailer Mounted Impact Attenuator Units must be equipped with anti-rotational damper systems (designed to restrict gating of the unit into adjacent traffic lanes). Breakaway cables shall also be used to ensure that the electronic braking system is activated, should the anti-rotational damper system fail.

The minimum recommended weight for the tow or host truck is 4536 kg Gross Vehicle Weight (GVM).

There is no specified maximum GVM for the tow or host vehicle (NCHRP report 350 conducted on Trailer Mounted Impact Attenuator Units with a TL3 rating).

It is important to note that, as the weight of the support or host truck is increased, the ‘roll ahead distance’ upon impact is reduced.

6.6 **TMA repairs, modifications and inspections**

a) All repairs and/or modifications to TMAs and attachments shall be carried out by a competent person.

b) Following repair or modification, TMAs and attachments must be inspected and have certification documentation prepared by a competent person.

c) TMAs and attachments must be inspected at least once each year and have certification documentation prepared by a competent person.

6.7 **Traffic control devices**

All traffic control devices are to conform to the requirements of and installed in accordance with the MUTCD Part 3.

6.7.1 **Vehicle mounted signs and devices**

All vehicle mounted warning devices shall be in accordance with the requirements contained in the MUTCD Part 3. This includes all signs, illuminated flashing arrow sign and flashing yellow lamps:

- illuminated flashing arrow sign
- flashing yellow lamps may be used in conjunction with this sign, provided that the lamps are either appropriately shielded or laterally or vertically displaced from the edge of the sign to avoid visually corrupting the arrow shape or its directional effect
- variable message sign
• all variable message sign boards shown in the Traffic Guidance Schemes and used in conjunction with attenuator operations as a minimum shall—
  – meet AS 4852.2;
  – have a display of 1600 mm wide x 1150 mm high as a minimum; and
  – display no more than two messages.

6.7.2 Advance warning vehicles
Advance warning vehicles warn and inform of changes to traffic conditions ahead and give motorists time to adjust their driving patterns.

Advance warning vehicles shall have ‘B’ size arrow board or variable message board.

7 Qualification criteria for operators
This section provides guidance in TMA Driver Training requirements.

Mandatory requirements for TMA Operators:

1. Hold a current and valid Heavy Vehicle licence of a suitable class to operate the TMA.
3. Traffic Control Qualifications. TMA Operators must be able to produce evidence that they have completed and maintained currency in traffic control training equivalent to RIIOHS302A ‘Implement Traffic Management Plan’.
4. Completed training and be deemed competent in the operation of a TMA equivalent to RIIRTM301D ‘Operate a Truck or Trailer Mounted Attenuator’.

Traffic Control Work Zone skill set ‘Implement traffic control guidance plan’ from the Resources and Infrastructure Training Package (RII09).

This skill-set outlines the key competencies for a person involved in the implementation of traffic control at a work site (for example, TMA Operator).

Following is an extract from the Austroads’ Report for Implementing National Best Practice for Traffic Control at Roadwork Sites – June 2011.

<table>
<thead>
<tr>
<th>Functional role</th>
<th>Profile functions / duties summary</th>
<th>Recommended skill-set (national training package competencies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement Traffic Control Guidance Scheme</td>
<td>Personnel are required to identify and select traffic control signs and devices and correctly position them in accordance with the approved TGS. It may be necessary for personnel to adjust the location of signs and devices within stated tolerances to suit the specific road environment. Personnel will be required to inspect and maintain signs and devices specified in the TGS during the work program.</td>
<td>RIIOHS201A – Work safely and follow WHS policies and work procedures. RIICOM201A – Communicate in the work place. RIIOHS302A – Implement Traffic Management Plan.</td>
</tr>
</tbody>
</table>
7.1 TMA Operator training – gained qualifications and experience through competency-based assessment

All TMA Operators must successfully complete TMA Operator Training before operating the TMA. When training has been successfully completed, a statement that clearly identifies the trainee’s name, when the training occurred (date of training), training content and trainer’s details must be provided.

The following elements of competency need to be covered and assessed for training of TMA Operators.

7.1.1 Plan and prepare
- Access, interpret and apply compliance documentation relevant to work activity.
- Obtain and discuss safety requirements for the site; for example, Traffic Guidance Scheme (TGS) and Vehicle Management Plan (VMP).
- Set up TMA signage as required by TGS.
- Select vehicles, plant and equipment consistent with requirements for the job.

7.1.2 Conduct truck and attenuator pre-operational checks
Check truck and attenuator (including TMA pre-start check and TMA Features and Functions).

7.1.3 Check TMA devices and identify positioning of TMA
- Position and check TMA signs and devices.
- Check TMA vehicle warning lights and displays.
- Identify TMA position according to TGS.

7.1.4 Use radio communication
- Check radio.
- Test and verify radio contact between all vehicles and handheld.
- Check radio contact periodically.
- Use radio communication between vehicles to confirm correct positioning of vehicle.

7.1.5 Operate TMA
- Identify site hazards associated with TMA operations.
- Identify and apply safe operating techniques for TMA.
- Operate TMA to work instructions, including closing lanes and working in a mobile/progressively moving work situation.
- Move TMA safely between work sites.

7.1.6 Carry out operator maintenance
Conduct inspection and fault finding.

In addition, all support staff working with a TMA must be inducted into the TMA, including the communication processes.

8 Operational procedures
This section provides guidance in the Operation of TMAs.
8.1 Operational requirements

The following shall be observed when operating a TMA:

a) At all times, the host vehicle’s seat belts shall be used.

b) After an impact or crash that may affect the integrity of the host vehicle and / or Impact Attenuator Unit, TMAs and attachments must be inspected (see Section 6.6).

c) No items to be carried in the back of a host vehicle while it is performing the duties of a TMA.

d) The mounting of any fixtures or equipment to the TMA shall be engineered to 20 times the weight of the fixture.

e) Only the operator shall be in the vehicle when the TMA is in use, except if the operator is undergoing training or assessment, in which case the trainer or assessor must occupy a seating position that has the same level of occupant protection as the driver’s seat (see Section 6.1 – Host Vehicle clauses ‘l’ and ‘m’).

f) On request, operators shall produce evidence of successful completion of an approved competency-based TMA training course.

g) When the Impact Attenuator Unit is in the deployed / lowered position, the vehicle may only travel within its own lane or carry out lane-changing manoeuvres in the same direction. The Impact Attenuator Unit must be raised when carrying out all other manoeuvres.

h) The Impact Attenuator Unit may only be in the deployed / lowered position when the TMA is engaged at an approved road work site. This may include the preparation and disassembly of an approved TGS.

i) The TMA operator shall remain in the vehicle while it is in operation which includes mobile works, progressively moving works, or setting up a static closure. Once a static closure is in place, the TMA operator should leave the vehicle and may assist with works being undertaken.

8.2 Use of TMAs

TMAs shall be used as prescribed in the MUTCD Part 3.

8.3 TMA work instructions

Work instructions shall be produced for the safe operation of TMAs.

Typically, these instructions should include information relating to the following:

- Using TMAs to undertake a static lane closure.
- Using TMAs in a mobile convoy situation or progressively moving work situation.
Appendix A – 15-tonne Gross Vehicle Mass rationale

15-tonne gross vehicle mass (GVM) requirement for TMA Host Vehicle

Critical to the development of a TMA that affords protection to the public, the road workers and the TMA Operator, is the selection of the host vehicle. The vehicle must be appropriate for the use intended and also comply with all legislative requirements.

There are a number of requirements that affect the selection of the host vehicle. A discussion of critical requirements follows.

Minimum tare mass

For acceptable impact performance, minimum tare mass requirements for host vehicles are set by the manufacturers of Impact Attenuator Units. The two currently available Impact Attenuator Units have minimum host vehicle tare mass requirements of 7.3 tonnes (Safe Stop) and approximately 9.07 tonnes (20 000 lbs) (Scorpion).

The host vehicle tare mass is the mass of the truck with all the components necessary for operation as a TMA.

Weight distribution

To enhance the effectiveness of the Automatic Impact Braking (AIB) system, the rear axle/s should carry a significant proportion of the total TMA mass.

Use of ballasting

The use of ballasting is discouraged. The mounting points of all attachments to a TMA host vehicle are required to withstand a force of 20 times the mass of the attachment. While the attachment of the ballasting to the truck body may meet this requirement, the attachment of the body with ballast to the chassis is unlikely to meet the 20 times mass requirement without significant modification to the mounting points on both the body and to the truck chassis.

Chassis size and strength for Impact Attenuator Unit mounting

Under impact, the loads imposed on an Impact Attenuator Unit are transferred through the mounting assembly into the chassis of the truck. The truck chassis shall be of a size that allows mounting of the Impact Attenuator Unit in accordance with the manufacturer’s specifications. The truck chassis shall also be of sufficient strength to absorb applied loads without significant failure or distortion.

Conclusion

It is recommended that TMA host vehicles with a manufacturer’s GVM rating of at least 15 tonnes will meet these critical requirements.

Vehicles with a lesser GVM rating are unlikely to meet all or possibly any of these critical requirements.
Appendix B – Rearward seat collapse

Prevention of rearward seat collapse

Background

The Queensland Department of Transport and Main Roads experienced a TMA incident where the driver’s seat failed in a rearward direction. The driver’s head hit the rear of the cabin and the driver also suffered back injuries, which have permanently prevented his return to work.

Rearward seat collapse

The purpose of this requirement is to reduce the likelihood of rearward seat collapse in the event of a substantial impact to the rear of a TMA. This will reduce the likelihood of injury to a TMA occupant.

The purpose of this requirement may be achieved by either of two methods:

1. By design or testing, determine that the seat and mountings are of sufficient strength to withstand, in the rearward direction, similar loading to that applied to the seat and seat mountings in a forward direction for ADR compliance.

2. By fitting a device behind the seat to restrict rearward seat collapse when the same loadings are applied in a rearward direction.

The rearward loading requirements are based on ADR 5/05 requirements.

ADR 5/05 relates to seat belt anchorage strength required to restrain an occupant in a frontal impact. In a rear impact, the seat belt has no effect and rearward movement of the occupant is restrained by the seat structure and seat mountings only.

The TMA requirement is intended to afford a seat occupant a similar level of protection in the event of a rear impact that the ADRs provide in a frontal impact.

ADR 5/05 requires that, for heavy goods vehicles (GVM >12 t) with lap belt anchorages located wholly within the seat structure, the seat and the belt anchorages must withstand the following loading in the forward direction:

A test load of 740 ± 20 daN supplemented by a force equal to 6.6 times the mass of the complete seat.

The TMA requirement imposes the same loading in a rearward direction to simulate the effects of a rear impact.

Evidence of compliance with these rearward loading requirements can be either by design verification or by representative test results. This evidence would give blanket cover (type approval) to that seat / vehicle combination and the vehicle / seat supplier or verifying engineer would supply certification of same.

If evidence of compliance with additional rearward loading requirements is not available, a device to prevent rearward seat collapse would be fitted.

Note: ADRs require that, to test seat and seat anchorage strength, a rearward longitudinal deceleration of 20 G is applied to the whole shell of the vehicle, without an occupant.

Given this requirement, and that the seat assembly is certified to withstand applied loads in a forward direction, the original equipment seats may meet the TMA requirements.
Appendix C – Traffic Guidance Schemes

The design, selection and implementation of traffic control measures should be based on the MUTCD Part 3 Traffic control for works on roads.

It is of paramount importance in ensuring the safety of all persons, including members of the public at work sites, that there is a high standard of traffic control around, past or through those work sites. This can only be undertaken with a systematic consideration of conditions to be encountered at each site and selecting or designing a specific plan for the control of traffic.
3.16 Other signs and devices

3.16-1 Anti-gawking screens

1 Background

Anti-gawking screens should be used at work sites to minimise visibility of construction activities to the travelling public where specified in the Department of Transport and Main Roads Technical Specification MRTS02.

Department of Transport and Main Roads Standard Drawing SD1473 provides typical details for a fabricated timber screen installed on a Single Slope Precast Concrete Barrier (PCB).

Use of anti-gawking screens constructed from other materials shall be as per the relevant manufacturer’s specifications and only used with the relevant Transport and Main Roads approved proprietary temporary barrier system.

Proprietary screens may be adopted, or other screens may be developed on a project-by-project basis. Such screens should be compliant with the principles set out in this supplement.

2 Considerations

2.1 General

When using anti-gawking screens at roadworks sites, the following characteristics should be considered:

- the screens are of adequate height and opacity to function as a screen
- installation does not adversely affect or alter the performance of the barrier system
- installation will not present an undue risk to workers and other traffic during an impact (for example, by spearing / penetrating the passenger compartment)
- performance will be in a suitable predictable manner should impact occur (for example, will not shatter or create debris which would become a hazard or projectile)
- resistance to vandalism and vehicle damage
- ease of repair, and
- potential to protrude or lean into vehicle path, especially when subject to wind loading.

2.2 Specific requirements

a) Crash testing / analysis barrier performance is tested against the requirements of AS 3845 and NCHRP350. It should be demonstrated by crash-testing or modelling / analysis that any anti-gawking screen does not modify the performance of the safety barrier system to which it is to be attached. These requirements notwithstanding, it is expected that anti-gawking screens will be independently mounted; that is, will not be connected together across couplings between barriers.
b) The Austroads *Guide to Road Design* and relevant supplements expressly prohibits the erection of fencing with horizontal rails within the clear zone or in any location where there is the possibility of impaling an impacting vehicle. In this regard, the principles applying to fencing also apply to anti-gawking screens; that is, anti-gawking screens erected within the clear zone shall not comprise horizontal rails.

c) Screens should be constructed from materials that are robust.

Screens should be demonstrated to be:

- resistant to impact: that is, materials are not brittle or prone to become brittle and do not create a hazard when hit, for example, by shattering or disintegration into sharp edged fragments which would be a hazard to adjacent parties
- durable: that is, resistant to ignition by cigarettes or similar, or defacement by sharp implements, and
- resistant to fatigue failure, for example, due to cyclic wind loading including buffeting from truck movements.

Subject to these, materials used should be appropriate for the design life of the screen.

**Stability**

Any anti-gawking screening should be designed to withstand design wind loads without toppling, displacing or becoming detached from the barrier system to which it is attached. The method of attachment to the barrier system should not compromise performance of the barrier system.

**Delineation**

It is recommended that anti-gawking screens do not compromise the capacity of a barrier system to display delineation. Consideration should be given to reflectivity of screen faces, with particular attention to headlight glare under wet conditions.

**Installation and maintenance**

Screens should be maintained, removed or replaced when damaged or deteriorated through prolonged use. Contractors should be encouraged to attend to damaged or deteriorated screens as soon as practicable. In this regard, manufacturers should give consideration to ease of handling and installation, and method of removal in an emergency.

Anti-gawking screens shall be in accordance with Standard Drawing SD1473 (if timber) and as per the manufacturer's specifications for other materials and be:

- a minimum of 2.2 m total height
- of sufficient extent to fully screen the work area from the public, and
- designed, installed and maintained to enable the safe and continuous passage of traffic through the construction site.

### 3.16-2 Project signage

This supplement is currently being reviewed and will be issued as a Technical Note. For enquiries about project signs, please email trafficengineering.support@tmr.qld.gov.au.
4 Procedures for the installation and operation of traffic control devices

4.7 Advance and termination warning signs

4.7.2 Advance sign selection

4.7.2-1 Quick reference guides

1 Introduction

The following quick reference guides have been developed to assist with the preparation and / or review of Traffic Management Plans. These quick reference guides are not designed to replace the MUTCD Part 3 and are to be used in conjunction with Part 3. Where possible references have been included in the quick reference guides to allow the relevant section of the MUTCD Part 3 to be viewed if greater detail is required.

The following Quick Reference Guides have been developed:

a) Temporary speed limits at roadwork sites for road worker safety

b) Temporary speed limits at roadwork sites for road user safety

c) Sign spacing or distances at roadwork sites

d) Typical speed signage arrangements for roadwork sites

   i. 110, 100 or 90 km/h to 40 km/h – with flagman and workers within 1.2 m of traffic

   ii. 80 or 70 km/h to 40 km/h – with flagman and workers within 1.2 m of traffic

   iii. 60 km/h to 40 km/h – with flagman and workers within 1.2 m of traffic

   iv. 110, 100 or 90 km/h to 60 km/h – with flagman and workers between 1.2 m and 3.0 m of traffic

   v. 80 km/h or 70 km/h – with flagman and workers between 1.2 m and 3.0 m of traffic

   vi. 110, 100 or 90 km/h to 40 km/h – with workers within 1.2 m of traffic

   vii. 80 or 70 km/h to 40 km/h – with workers within 1.2 m of traffic

   viii. 60 km/h to 40 km/h – with workers within 1.2 m of traffic

   ix. 110, 100 or 90 km/h to 60 km/h – with workers between 1.2 m and 3.0 m of traffic

   x. 80 or 70 km/h to 60 km/h – with workers between 1.2 m and 3.0 m of traffic.

All references in this Supplement regarding Clauses and Tables are to the MUTCD Part 3.
2 Temporary speed limits at roadworks for road worker safety

Table 4.7.2-1(A) – Temporary speed limits at roadworks for road worker safety

<table>
<thead>
<tr>
<th>Description</th>
<th>Speed Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Controller (Clause 4.2d))</td>
<td>60 km/h</td>
</tr>
<tr>
<td>Workers on foot or small items of plant within 1.2 m of Traffic and not protected by a Safety Barrier (Clause 4.2c)(iii)</td>
<td>40 km/h *</td>
</tr>
<tr>
<td>Workers on foot or small items of plant between 1.2 m and 3.0 m of Traffic or large plant within 3.0 m of Traffic and not protected by a Safety Barrier (Clause 4.2c)(ii))</td>
<td>60 km/h</td>
</tr>
<tr>
<td>Workers on foot or Plant between 3.0 m and 6.0 m of Traffic and not protected by a Safety Barrier (Clause 4.2b))</td>
<td>80 km/h</td>
</tr>
<tr>
<td>Workers on foot greater than 6.0 m from Traffic (Clause 4.2a))</td>
<td>No Temporary Speed Limit required</td>
</tr>
<tr>
<td>Workers within 3m of traffic and protected by a safety barrier (Clause 4.2c)(i))</td>
<td>No requirement to reduce traffic speeds for roadworker safety</td>
</tr>
<tr>
<td>Unusually Hazardous Site (Clause 4.2e))</td>
<td>Less than 40 km/h</td>
</tr>
<tr>
<td>In advance of temporary or portable traffic signals or boom barrier or when dust, smoke or fog limits visibility</td>
<td>60 km/h</td>
</tr>
</tbody>
</table>

NOTE: * Steps should always be taken in the first instance to avoid conditions requiring this limit (Table 4.7).

3 Temporary speed limits at roadworks for road user safety

Table 4.7.2-1(B) – Temporary speed limits at roadworks for road user safety

<table>
<thead>
<tr>
<th>Description</th>
<th>Speed Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is impracticable to separate pedestrians or cyclists from vehicular traffic in the work area.</td>
<td>&lt; 40 km/h</td>
</tr>
<tr>
<td>Very poor alignment and / or road surface. Steps should be taken to limit or negate the need to use this speed limit for road user safety purposes. There would be structural danger to bridges at higher speeds.</td>
<td>40 km/h</td>
</tr>
<tr>
<td>Traffic is subjected to a reduced standard alignment due to the works. The Pavement Surface has been degraded. A Bituminous Seal has just been laid.</td>
<td>60 km/h</td>
</tr>
<tr>
<td>The need for a lower limit does not exist, but there is some disturbance to alignment or pavement surface which makes unrestricted speeds undesirable on traffic safety grounds.</td>
<td>80 km/h</td>
</tr>
<tr>
<td>Lane Closure / Merge Taper (Clause 4.8.2 and Table 4.6).</td>
<td>No maximum or minimum speed limit is specified.</td>
</tr>
<tr>
<td>Workers protected by a safety barrier.</td>
<td>No requirement to reduce traffic speeds for road user safety unless the road geometry requirements above are met.</td>
</tr>
</tbody>
</table>

Refer to Table 4.7 and Clause 4.9.3.
4  Sign spacing or distances at roadworks sites

Table 4.7.2-1(C) – Sign spacing or distances at roadworks sites

<table>
<thead>
<tr>
<th>Description</th>
<th>Spacing or Distance Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Controller to Traffic Controller Sign</td>
<td>Minimum of 2D (where value of D is the greater value of the range of dimensions shown in Table 4.2) (Clause 4.10.3) Also, the Traffic Controller must be visible to a driver when passing the Traffic Controller sign</td>
</tr>
<tr>
<td>80 km/h Advance Warning (Buffer Zone) (Clause 4.9.5)</td>
<td>300 m minimum to 500 m maximum (Table 4.7)</td>
</tr>
<tr>
<td>60 km/h Advance Warning (Buffer Zone) (Clause 4.9.5)</td>
<td>150 m minimum to 300 m maximum (Table 4.7)</td>
</tr>
<tr>
<td>80 km/h Zone</td>
<td>500 m minimum (Table 4.7)</td>
</tr>
<tr>
<td>60 km/h Zone</td>
<td>150 m minimum (Table 4.7)</td>
</tr>
<tr>
<td>40 km/h Zone *</td>
<td>1000 m maximum for Road Worker Safety (Table 4.7).</td>
</tr>
<tr>
<td>Less than 40 km/h Zone</td>
<td>100 m minimum to 200 m maximum (Clause 4.2e)</td>
</tr>
<tr>
<td>Speed Limit Ahead Sign to Speed Limit Sign (Clause 4.9.5)</td>
<td>2D</td>
</tr>
<tr>
<td>Speed Limit Repeater Signs for general roadwork sites (Clause 4.9.8).</td>
<td>40 km/h and 60 km/h zones a maximum of 500 m and all other speed zones a maximum of 1 km</td>
</tr>
<tr>
<td>Minimum spacing between two Roadwork Signs</td>
<td>D if not specified elsewhere</td>
</tr>
<tr>
<td>ROADWORK 1 km AHEAD Sign</td>
<td>Installed 1000 m from the start of the taper (or the work area if no taper exists) (Clause 3.4.2)</td>
</tr>
<tr>
<td>END ROADWORK</td>
<td>Minimum D beyond last point on the roadway or verge affected by roadworks (Clause 4.7.9) Care needs to be taken when erected with a speed sign terminating the temporary limit that an offset speed zone is not created (Clause 4.9.9)</td>
</tr>
<tr>
<td>Taper lengths (Clause 4.8.2)</td>
<td>Refer Table 4.6</td>
</tr>
<tr>
<td>Taper spacing (Clause 4.8.2)</td>
<td>D between successive tapers 2D between successive merge tapers</td>
</tr>
<tr>
<td>Safety Buffer (Clause 4.1.4c))</td>
<td>20 m to 30 m. May be increased to 100 m on multi-lane roads.</td>
</tr>
</tbody>
</table>

NOTE: * Steps should always be taken in the first instance to avoid conditions requiring this limit (Table 4.7).

Refer Table 4.2 for the Value of D.

5  Example of speed signing arrangements for roadwork sites

Speed reductions at roadwork sites are to be minimised wherever practicable. Both the selected limit and the length of any speed reductions may be minimised through the adoption of work practices and schedules which may allow shorter and higher limits to be safely implemented.

It is important to avoid offset speed zones except at buffer zones (Clause 4.9.9) and to increase any temporary speed limit as soon as possible after the work area and reinstate the appropriate speed limit with a speed limit sign installed with the END ROADWORK sign.
The following sections detail possible ways of reducing the speed limit on approach to a work area and reinstating the speed limit after the work site.

The choice of speed signage is to be made based on site specific requirements. The sections do not show other signs which may be required.

*Figure 4.7.2-1(A) – 110, 100 or 90 km/h to 40 km/h – with Traffic Controller; and workers within 1.2 m of traffic*

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAD WORK AHEAD</td>
<td>60 AHEAD</td>
<td>REDUCE SPEED</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK</td>
</tr>
<tr>
<td>ROAD WORK AHEAD</td>
<td>60</td>
<td>REDUCE SPEED</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 AHEAD</td>
<td>REDUCE SPEED</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK</td>
</tr>
<tr>
<td>ROAD WORK AHEAD</td>
<td>60 AHEAD</td>
<td>REDUCE SPEED</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK</td>
</tr>
<tr>
<td>ROAD WORK AHEAD</td>
<td>80 AHEAD</td>
<td>REDUCE SPEED</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK</td>
</tr>
<tr>
<td>ROAD WORK AHEAD</td>
<td>80</td>
<td>REDUCE SPEED</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK</td>
</tr>
</tbody>
</table>
Figure 4.7.2-1(B) – 80 km/h or 70 km/h to 40 km/h – with Traffic Controller; and workers within 1.2 m of traffic.

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROADWORK AHEAD</td>
<td>Reduce Speed</td>
<td>Prepare To Stop</td>
<td>40</td>
<td>60</td>
<td>Drive Safely</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>Reduce Speed</td>
<td>Do Not Overtake</td>
<td>40</td>
<td>60</td>
<td>Drive Safely</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>Reduce Speed</td>
<td>Prepare To Stop</td>
<td>40</td>
<td>60</td>
<td>Drive Safely</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>Reduce Speed</td>
<td>Do Not Overtake</td>
<td>40</td>
<td>60</td>
<td>Drive Safely</td>
</tr>
</tbody>
</table>

Figure 4.7.2-1(C) – 60 km/h to 40 km/h – with Traffic Controller; and workers within 1.2 m of traffic.

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROADWORK AHEAD</td>
<td>Reduce Speed</td>
<td>Prepare To Stop</td>
<td>40</td>
<td>60</td>
<td>60 Drive Safely</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>Reduce Speed</td>
<td>Do Not Overtake</td>
<td>40</td>
<td>60</td>
<td>60 Drive Safely</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>Reduce Speed</td>
<td>Prepare To Stop</td>
<td>40</td>
<td>60</td>
<td>60 Drive Safely</td>
</tr>
</tbody>
</table>
Figure 4.7.2-1(D) – 110, 100 or 90 km/h to 60 km/h – with Traffic Controller; and workers between 1.2 m and 3.0 m of traffic

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 AHEAD REDUCE SPEED</td>
<td>60 PREPARE TO STOP</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 AHEAD REDUCE SPEED</td>
<td>60 DO NOT OVERTAKE</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 AHEAD REDUCE SPEED</td>
<td>60 PREPARE TO STOP</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>80 AHEAD REDUCE SPEED</td>
<td>60 PREPARE TO STOP</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>80 AHEAD REDUCE SPEED</td>
<td>60 DO NOT OVERTAKE</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
</tbody>
</table>

Figure 4.7.2-1(E) – 80 km/h or 70 km/h to 60 km/h – with Traffic Controller; and workers between 1.2 m and 3.0 m of traffic

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 AHEAD REDUCE SPEED</td>
<td>60 PREPARE TO STOP</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 AHEAD REDUCE SPEED</td>
<td>60 DO NOT OVERTAKE</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 AHEAD REDUCE SPEED</td>
<td>60 PREPARE TO STOP</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 AHEAD REDUCE SPEED</td>
<td>60 DO NOT OVERTAKE</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
</tbody>
</table>
**Figure 4.7.2-1(F) – 110, 100 or 90 km/h to 40 km/h – with workers within 1.2 m of traffic**

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>60 REDUCE SPEED</td>
<td>Not applicable</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROAD WORK AHEAD 80 AHEAD REDUCE SPEED</td>
<td>40 AHEAD REDUCE SPEED</td>
<td>Not applicable</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROAD WORK AHEAD 80 AHEAD REDUCE SPEED</td>
<td>60 REDUCE SPEED</td>
<td>Not applicable</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
</tbody>
</table>

**Figure 4.7.2-1(G) – 80 km/h or 70 km/h to 40 km/h – with workers within 1.2 m of traffic**

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAD WORK AHEAD 40 AHEAD REDUCE SPEED</td>
<td>60 REDUCE SPEED</td>
<td>Not applicable</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>60 REDUCE SPEED</td>
<td>Not applicable</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>60 REDUCE SPEED</td>
<td>Not applicable</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
</tbody>
</table>

**Figure 4.7.2-1(H) – 60 km/h to 40 km/h – with workers within 1.2 m of traffic**

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>40 AHEAD REDUCE SPEED</td>
<td>Not applicable</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK 60 DRIVE SAFELY</td>
</tr>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>60 REDUCE SPEED</td>
<td>Not applicable</td>
<td>40</td>
<td>60</td>
<td>END ROAD WORK 60 DRIVE SAFELY</td>
</tr>
</tbody>
</table>
**Figure 4.7.2-1(l) – 110, 100 or 90 km/h to 60 km/h – with workers between 1.2 m and 3.0 m of traffic**

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>60 REDUCE SPEED</td>
<td>Not applicable</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROAD WORK AHEAD 80 AHEAD REDUCE SPEED</td>
<td>Not applicable</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
<td></td>
</tr>
<tr>
<td>ROAD WORK AHEAD 80 AHEAD REDUCE SPEED</td>
<td>Not applicable</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
<td></td>
</tr>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>Not applicable</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4.7.2-1(J) – 80 km/h or 70 km/h to 60 km/h – with workers between 1.2 m and 3.0 m of traffic**

<table>
<thead>
<tr>
<th>Advance Sign</th>
<th>Worker Warning</th>
<th>Traffic Controller Warning</th>
<th>Work Area Start</th>
<th>Work Area End</th>
<th>End Roadwork Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROADWORK AHEAD</td>
<td>60 REDUCE SPEED</td>
<td>Not applicable</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
</tr>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>Not applicable</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
<td></td>
</tr>
<tr>
<td>ROAD WORK AHEAD 60 AHEAD REDUCE SPEED</td>
<td>Not applicable</td>
<td>60</td>
<td>60</td>
<td>END ROAD WORK DRIVE SAFELY</td>
<td></td>
</tr>
</tbody>
</table>
4.7.8 Avoiding end-of-queue collisions

4.7.8-1 Avoiding end-of-queue collisions

1 Use of hazard lights by last vehicle in queue

Section 221 of the Transport Operations (Road Use Management – Road Rules) Regulation 2009 permits the use of hazard warning lights on a vehicle to warn other road users under the following conditions:

a) The vehicle is stopped and is obstructing, or is likely to obstruct, the path of other vehicles or pedestrians, or

b) The vehicle is a slow-moving vehicle and is obstructing, or is likely to obstruct, the path of other vehicles or pedestrians.

A sign (TC1992_1) has been developed to encourage the driver of the last vehicle in the queue to activate the vehicles hazard warning lights. This draws upon experience in Europe where drivers routinely activate their hazard warning lights in hazardous situations. The sign is installed in advance of the roadwork site and may be repeated if the anticipated queue lengths are long during certain periods of the day and shorter queues form at other times. The TC1992_2 sign shall be installed past the traffic control point to remind drivers to turn off the hazard warning lights.

Where there is a risk that drivers approaching the last vehicle in the queue may try to overtake the last vehicle with hazard lights switched on, cones may be placed on the road centreline with a KEEP LEFT (R2-3-Q01) sign or the temporary hazard marker (T5-Q02) in accordance with Clause 3.9.3 of the MUTCD Part 3.

2 Use of enhanced queued traffic warning signs (TC2232)

At roadwork sites where stopping sight distance cannot be met due to road geometry and approach speeds to the roadwork site are high, or high-speed approaches to roadworks where there is potential that drivers would benefit from additional warning devices, an enhanced queued traffic warning sign may be installed to supplement the treatment provided in the MUTCD Part 3.

The Department of Transport and Main Roads has developed a suite of design drawings in TC2232 that provide sign design details, together with a typical site layout. A single sign is generally installed on the left-hand side of two-lane two-way roads, while a second sign may be installed on the right-hand side of multi-lane roads.

While there are a number of activation options, including activation when queued traffic is detected, manual activation by the Traffic Controller or continuous operation, it is recommended that activation by vehicle approach speeds be used as it provides the most appropriate means of conveying a targeted message to drivers who are fatigued or have failed to anticipate the presence of queued traffic ahead. Alternative enhanced or active queue warning signs and activation methods may be developed. These need to be approved by Transport and Main Roads prior to installation at any work site.
3 Signage options

*Figure 4.7.8-1(A) – Variable message sign (electronic version of the static queued traffic ahead sign)*

*Figure 4.7.8-1(B) – Variable message sign with alternating QUEUED TRAFFIC AHEAD and queued vehicle symbol*
Figure 4.7.8-1(C) – Static Queued traffic ahead sign supplemented with alternating wig-wag lights
4.10  Traffic Controllers

4.10.2  Equipment

4.10.2-1  Advance signs

1  General

The figure following indicates the signs which are to be used when traffic is being controlled using signals or a boom barrier.

*Figure 4.10.2-1 – Example multi-message signs for use with signals or boom barrier*

<table>
<thead>
<tr>
<th>TC2254</th>
<th>TC1217</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Sign Image]</td>
<td>![Sign Image]</td>
</tr>
<tr>
<td>TC1362</td>
<td>TC1362</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC1173</th>
<th>TC2254</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Sign Image]</td>
<td>![Sign Image]</td>
</tr>
<tr>
<td>TC1174</td>
<td>TC1174</td>
</tr>
</tbody>
</table>

2  Signals or Boom Barrier failure or malfunction

In the event of a signal system or boom barrier failure, the recommended traffic management response by the Traffic Controller operating these devices would entail:

1. The Traffic Controller who is operating the signals on the closed side of the road stops all traffic in this direction, using a STOP / SLOW bat (this is the critical approach which needs to be managed). It is recognised that this would entail the TC displaying a STOP sign without the use of the required Traffic Controller / PREPARE TO STOP sign being installed for a short period of time.

2. The signals of boom barrier should be switched off or rotated away from traffic to remove any conflicting message.

3. The advance signs for this approach should be changed from ‘signals’ (or boom barrier) to the Traffic Controller sign as soon as possible.

4. Traffic at the other end of the works may be managed in a similar way; however, it is not as critical in terms of response time, as traffic from this direction may continue to flow along the
open lane while the other direction is stopped. This approach should be treated as soon as possible after the other end and so that normal STOP / SLOW activities with bats may then proceed.

5. Following the commencement of STOP / SLOW bat control, the faulty devices may then be removed or fixed.
4.10.3 Sight distance

4.10.3-1 Location of the Traffic Controller

1 Controlling traffic with STOP / SLOW bat

In addition to the sight distance requirements in Clause 4.10.3, the Traffic Controller is to stand clear of the travel path on the road shoulder and operate in accordance with the provisions specified in the Traffic Controller Accreditation Scheme Approved Procedure.

2 Controlling traffic with a Portable Traffic Control Device (PTCD)

Traffic Controllers (TCs) operating PTCDs must do so from a safe location, and as such, the department encourages practitioners to adopt the following recommendations.

The key considerations in determining a safe location for TCs include site geometry, traffic control device position, sight distance, roadside terrain / vegetation, the type of PTCD used, vehicle mix and their approach speeds. Environmental factors (for example, fog, rain, dust or smoke) and time of day/night also need to be considered.

TCs should occupy a position which:

- Is clear of the travel path (the risk of being struck by passing vehicles is significantly reduced as the offset distance is increased).
- Has an escape path.
- Has sight distance of approaching traffic of at least 2D (where the value of D is the greater value of the range nominated in Table 4.2 of the MUTCD Part 3).
- Aims to ensure that drivers focus on the PTCD, and not take cues directly from the TC.
- Enables effective communication to both site workers and other TC (if applicable). If a single TC is operating two PTCDs, an added consideration is to ensure the operating range of the hand-held remote controller is not exceeded.
- Enables the TC to identify the last vehicle before changing to STOP.
- Is close enough to the PTCD to allow the TC to commence STOP/SLOW bat duties in the event of a system failure. In the case of a single TC operating two PTCDs, the TC should be located at the end which is on approach to the closed section of road (as this is the critical approach to control in the event of a failure).
- Has visibility of the PTCD (either the front face or rear indicator light) and traffic queues. In the case of a single TC operating two PTCDs, the TC should be located to have visibility of both devices and traffic queues for each approach.

In addition to these recommendations, other considerations include:

- Planning the site arrangements so that, where possible, one hand-held remote controller can be used to operate the PTCDs.
- Using an elevated location (to maximise sight distance).
- Positioning the TC behind safety barrier (clear of deflection zone).
• Parking vehicles clear of the traffic control station.
• Using shade to reduce sun exposure and heat stress wherever appropriate.
• Managing fatigue; for example, if a suitable position is available, the TC may be seated while performing TC duties.
4.11 Portable traffic signals

4.11-1 Portable traffic signals

1 Introduction

This supplement outlines the operational requirements for two different portable traffic signal systems (PTSS) that are approved for use in Queensland.

The requirements ensure that:

- PTSS are operated effectively and consistently by accredited Traffic Controllers trained and competent in their use, and
- the risk to road workers, Traffic Controllers and road users is minimised

PTSS can be used for three types of traffic control:

- shuttle control
- plant-crossing control
- gating control

There are four user selectable modes of operation:

- flashing yellow
- manual
- vehicle-actuated
- fixed time.

Commencing on 1 July 2018, PTSS should be used, in lieu of Traffic Controllers using STOP / SLOW bats, on roads with AADT exceeding 1000 veh/day and approach speed limit (prior to the works occurring) of 80 km/h or faster. Any decisions not to use PTSS or other equivalent systems (see Clause 3) in these situations will need to be supported by a risk assessment (the risk assessment must address why it is considered that the use of a Traffic Controller is acceptable at that site and the measures that will be implemented to reduce the potential risk to the Traffic Controller).
Commentary

Transport and Main Roads’ vision is that ‘there should never be an incident in which a Traffic Controller is killed or seriously injured at work’. This Supplement was developed to facilitate the deployment of light weight portable traffic signal systems that allow either a single Traffic Controller (or in some cases, two or more Traffic Controllers) to monitor and control systems deployed at roadworks from a safe location. The benefits of the technology are:

- significant workplace health and safety improvement (as well as being out of harm’s way, Traffic Controllers can locate themselves in the shade, where it is cooler, and they have reduced skin cancer risk)
- ability to manage traffic with one fewer Traffic Controller, in many cases, which will encourage rapid uptake as a result of labour cost savings and largely obviate the need to mandate circumstances in which portable traffic signals be deployed (the Supplement does however elevate TMR’s expectation that portable signals be used in high risk locations)
- ease of installation and operation, when compared with current trailer mounted systems that comply with AS4191

2 Definitions

Table 4.11-1(A) – Definitions

<table>
<thead>
<tr>
<th>Expression</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuation</td>
<td>The electrical action produced by a vehicle (on a vehicle detector) to enable the controller to recognise its presence.</td>
</tr>
<tr>
<td>All-red time</td>
<td>A period of time during which only red aspects are illuminated for all movements.</td>
</tr>
<tr>
<td>Approach</td>
<td>That section of road, consisting of one or more lanes, used by vehicles approaching an intersection or mid-block site.</td>
</tr>
<tr>
<td>Aspect</td>
<td>A single optical system (circular, arrow or symbolic) on a single face capable of being illuminated at any given time. Red, yellow and green aspects are used for vehicle movements.</td>
</tr>
<tr>
<td>Controller</td>
<td>The equipment (including the housing) that switches power to signal lanterns and controls the duration and sequence of signal displays.</td>
</tr>
<tr>
<td>Cycle length (cycle time)</td>
<td>Time required for one complete sequence of signal displays. For a given movement, cycle time is the sum of the durations of red, yellow and green signal displays.</td>
</tr>
<tr>
<td>Flow rate</td>
<td>Number of vehicles per unit time (normally per hour) passing (arriving or departing) a given reference point.</td>
</tr>
<tr>
<td>Green time</td>
<td>Duration of the green display for a phase or movement.</td>
</tr>
<tr>
<td>Hand-held Remote Controller (HRC)</td>
<td>A hand-held remote/device which can control and set the PTSS lanterns. This allows the Traffic Controller to control operations without being physically located at a PTS.</td>
</tr>
<tr>
<td>Long-term</td>
<td>The description which applies when a Traffic Guidance Scheme is required to operate both day and night and may be left unattended.</td>
</tr>
<tr>
<td>Maximum green time</td>
<td>The maximum duration of the green display that can continue to be illuminated after a demand for another phase had occurred.</td>
</tr>
<tr>
<td>Expression</td>
<td>Definition</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Phase</td>
<td>That part of a signal cycle during which one or more movements receive right-of-way subject to resolution of any vehicle conflicts by priority rules. A phase is identified by at least one movement gaining right-of-way at the start of it and at least one movement losing right-of-way at the end of it.</td>
</tr>
<tr>
<td>Portable Traffic Control Devices (PTCD)</td>
<td>Portable devices that can be used to control traffic; for example, portable traffic signals or boom barriers.</td>
</tr>
<tr>
<td>Portable Traffic Signal Unit(s) (PTSU)</td>
<td>An individual portable traffic signal that consists of the traffic signal lantern, battery, communications equipment, mounting assembly and base.</td>
</tr>
<tr>
<td>Portable Traffic Signal System(s) (PTSS)</td>
<td>Traffic light signals and associated equipment that provides signalling for temporary control of traffic at work sites.</td>
</tr>
<tr>
<td>Red time</td>
<td>Duration of the red signal for a phase or movement.</td>
</tr>
<tr>
<td>Short-term</td>
<td>The description which applies when a Traffic Guidance Scheme is required only while work personnel are in attendance. The time is generally limited to the duration of a single work shift or lesser period where road conditions are returned to normal when the shift or lesser period ends.</td>
</tr>
<tr>
<td>Signal lantern</td>
<td>A signal assembly of optical components (one or more aspects), together with the means of connecting them to power supply and facilities for mounting the complete assembly.</td>
</tr>
<tr>
<td>Stop line</td>
<td>A single continuous line marked across all or part of a road, behind which vehicles should stand when required to stop by traffic light signals or regulatory signs.</td>
</tr>
<tr>
<td>Temporary traffic signal system</td>
<td>An electrically operated signalling system that provides traffic signals for the temporary control of vehicular traffic at road works, bridge works or similar applications. The system is installed temporarily to the road using the same standard traffic signal equipment used at permanent sites.</td>
</tr>
<tr>
<td>Traffic Controller / flag person</td>
<td>A person who holds an appointment as an accredited person under section 21 of the Transport Operations (Road Use Management) Act 1995 to perform the functions of a Traffic Controller as prescribed by the Transport Operations (Road Use Management - Accreditation and Other Provisions) Regulation.</td>
</tr>
<tr>
<td>Unattended operation</td>
<td>Vehicle actuated operation and fixed time operation.</td>
</tr>
<tr>
<td>Yellow time</td>
<td>Duration of the yellow display for a phase or a movement.</td>
</tr>
</tbody>
</table>

3 Types of Portable Traffic Signal Systems

3.1 General

The technical requirements of Type-1 PTSS are defined in MRTS264 Type-1 Portable Traffic Signals and the requirements of Type-2 PTSS are defined in MRTS 265 Type-2 Portable Traffic Signals. The Type-1 PTSS provides a simpler, easy-to-deploy system with reduced functionality compared to the Type-2 PTSS. The Type-1 units only work in manual mode and can only be used for shuttle flow, plant crossing and gating control.

A PTSS operating under manual mode may be used to control traffic at the approach legs to an intersection (signalised or unsignalised) under the same procedures as Traffic Controllers using...
STOP / SLOW bats. If all approaches are controlled by PTSUs, each approach may be independently controlled by a Traffic Controller (one TC with one HRC controlling a PTSU).

There may be times where traffic control at a three- or four-leg intersection with a prominent traffic flow path may be managed using a PTSS (two PTSUs paired with a single HRC) under manual control for the prominent traffic flow path (normally the through-leg movements). A TC with a STOP / SLOW bat or a PTSU with an individual HRC is required to control traffic on the terminating or each minor approach legs.

PTSUs, when not in use, shall face away from traffic or be covered and all signs for the device shall be removed or covered.

Systems other than portable traffic signals that accomplish the same outcome of removing Traffic Controllers from the road (for example, boom barriers) may also be used in lieu of Traffic Controllers. These alternative systems shall be approved for use either by the Department of Transport and Main Roads (Engineering and Technology) or the ARRB Transport Infrastructure Product Evaluation Scheme.

3.2 Type-1 Portable Traffic Signal Systems

A Type-1 PTSS shall only be used instead of Traffic Controllers manually controlling with STOP / SLOW bats when single-lane operation is required. Type-1 PTSS shall consist of either one or two PTSUs paired with a single HRC operated by a Traffic Controller.

Where the PTSS consists of one HRC paired with two PTSUs:

- Visibility to the PTSUs and approaching traffic shall be assessed before confirming the number of controllers required, noting that visibility can vary with weather condition, day light, local lighting, road geometry and the presence of road side objects. Where visibility to both PTSUs and approaching traffic from both directions is available, traffic may be controlled using a single Traffic Controller.

- Visibility to both PTSUs and approaching traffic from both directions by one Traffic Controller is restricted:
  - two Traffic Controllers (one per PTSU) are required
  - the operating procedure is as per standard stop / slow arrangements
  - only one of the two Traffic Controllers will operate the PTSS with a fully functional HRC: the other Traffic Controller monitors the other PTSU and associated traffic and provides information to the operator
  - each Traffic Controller shall be equipped with radio communication.

A PTSS consisting of two or more PTSUs (not paired) with each PTU being controlled by a single HRC may be used under the following conditions:

- Where visibility to both PTSUs and approaching traffic from both directions by one traffic controller is restricted
- Where a single HRC cannot communicate effectively with both PTSUs
- Where traffic control is required at intersections or for plant crossing
In any of these cases the following will apply:

− traffic controllers (one per PTSU) are required
− each traffic controller has an HRC controlling a single PTSU
− the operating procedure is as per standard stop / slow arrangements.
− each traffic controller shall be equipped with radio communication.

3.3 **Type-2 Portable Traffic Signal Systems**

Type-2 PTSS comply with MRTS265 *Type-2 Portable Traffic Signals*.

A Type-2 PTSS has the following features:

- three modes of operation
  - manual
  - fixed time
  - vehicle-actuated
- adjustable time settings
- minimum battery life of seven days without recharging.

During manual operation, the Traffic Controller controls the sequence and time for which the green signals are displayed. The Traffic Controller cannot override the configured minimum green time and all-red time after initial configuration and operation has commenced.

Two Type-2 PTSUs shall be used for gating control on a two-lane one-way road (refer to Clause 4.3).

Vehicle-actuated mode shall be used when operating unattended shuttle control, except if the vehicle detectors fail.

A Type-2 PTSS can operate unattended. When operating unattended, a Type-2 PTSS shall be inspected at least once every 24 hours to confirm its correct operation or shall have remote error monitoring and reporting functionality.

When unattended, the contractor's after hours contact details shall be displayed prominently on all PTSUs.
3.4 Application Guideline

Table 4.11-1(B) – Application Guideline of Portable Traffic Signal Systems

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MANUAL OPERATION</th>
<th>VEHICLE-ACTUATED / FIXED-TIME OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>shuttle control</td>
<td>plant crossing control</td>
</tr>
<tr>
<td>TYPE-1</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>(independently operated PTSUs only)</td>
<td>(single lane only)</td>
</tr>
<tr>
<td>TYPE-2</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>(single &amp; two lanes)</td>
<td>(In vehicle-actuated mode, fixed-time mode as fall back mode only)</td>
</tr>
</tbody>
</table>

4 Control types

PTSS can be used in three forms of traffic control:

- shuttle control
- plant crossing
- gating control.

4.1 Shuttle control

PTSS may be used in lieu of Traffic Controllers for shuttle control operations. This type of control is generally used on a two-lane two-way road, where one lane is closed for maintenance and the other is shared by traffic from both approaches.

Shuttle control uses two PTSUs.

Each PTSU indicates which direction of the traffic flow may proceed past the roadworks site. A PTSU is used at each end of the work zone, and only one PTSU can be green at a time. When there is a need for complete access to the roadway for a short period, both PTSUs can be red.
4.2 Plant crossing control

One PTSU shall be used on each road approach to temporarily stop traffic at a road work site where plant needs to cross the roadway.

This control type allows the signals on both approaches to display the same signal (that is, green, yellow and red simultaneously).

Appropriate measures to control traffic on the plant crossing shall be implemented.

Manual operation is safer and more effective in preventing delays to vehicles on both the road and plant crossing.

Plant crossing control may be undertaken with unattended vehicle-actuated operation if the following conditions are met:

- A PTSU is used on each approach (both the road and the plant crossing).
- The PTSS used has the capability to hold a permanent call on the through road to allow the signals to dwell on green and the signals on the plant crossing are vehicle actuated as required.
- A site-specific risk assessment has been completed which addresses the operational details (for example, volumes of both the through road and plant crossing and vehicle types using the plant crossing).
4.3 Gating control

Gating control is the control of traffic from a single approach. Gating control is permitted in accordance with Table 4.11-1(C).

**Table 4.11-1(C) – Gating control on one-way roads**

<table>
<thead>
<tr>
<th>Approach</th>
<th>Type of PTSS</th>
<th>Number of PTSU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single lane operation</td>
<td>Type-1 or 2</td>
<td>1</td>
</tr>
<tr>
<td>Two-lane operation</td>
<td>Type-2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Figure 4.11-1(C) – Gating control**

![Gating control diagram](image-url)
5 Modes of operation

The permitted modes of operation for PTSS are outlined in Table 4.11–1(D).

Table 4.11-1(D) – Permitted modes of operation and control types

<table>
<thead>
<tr>
<th>Control Type</th>
<th>Shuttle Control</th>
<th>Plant crossing control</th>
<th>Gating control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle-actuated operation</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Fixed time operation</td>
<td></td>
<td>Fall-back mode only</td>
<td></td>
</tr>
<tr>
<td>Flashing yellow operation</td>
<td></td>
<td></td>
<td>See Clause 5.1</td>
</tr>
</tbody>
</table>

5.1 Flashing Yellow Operation

In flashing yellow mode of operation, the yellow aspects on all PTSUs continually flash.

This operation mode occurs in response to:

- start-up conditions
- faults or failure conditions
- manual selection of flashing yellow mode (Type-2 PTSS).

5.2 Manual Operation

In manual mode, the lantern signals are manually controlled remotely from a safe location.

Manual operation should be used when:

- traffic is required to be kept out of the live lane for an extended period (for example, to accommodate work vehicle movements)
- a vehicle detector fails when using vehicle-actuated operation, and it is not appropriate to switch to fixed-time operation
- other situations where optimal traffic flow is not being achieved by vehicle-actuated mode.

Where manual operation is used, the operator shall ensure that all-red times are sufficient to clear the control area of opposing traffic

5.3 Vehicle-Actuated Operation

Vehicle-actuated operation allows a variable sequence and variable duration of signal displays. In this mode, a PTSS operates automatically. It responds to actuations from vehicle detectors installed on each PTSU. For details of sequence and timing of signal displays, refer to AS4191 Portable Traffic Signal Systems.

Vehicle-actuated operation should be the normal mode of operation for Type-2 PTSS.
5.4 Fixed-Time Operation

In this mode, the duration of the greens and all-reds are fixed, and the PTSS cycles through a fixed sequence. The operator sets the green and all-red times at the PTSS controller. These time settings operate until the signals are switched off or the timer is reset.

Type-2 PTSS shall not be operated in fixed-time operation unless the vehicle detectors have failed.

6 Equipment installation

6.1 Safety considerations

Only a nominated trained and competent Traffic Controller may operate PTSS in manual mode.

It is the responsibility of the Traffic Management Designer to determine the location, operation mode and operation parameters of the PTSS. Operation parameters (including any on-site changes) shall be documented for record keeping purposes.

PTSS shall only be operated when all safety, operation and service instructions contained in the manufacturer's manuals are understood by the operator. Operators shall understand and comply with the manufacturer's instructions accompanying each PTSS (this supplement does not replace the field service manual and instructions accompanying each set of equipment).

PTSUs shall be located a safe distance from the traffic path, which would generally be not more than one metre from the travelled path; however, this may need to be increased in particular circumstances so that wide loads or turning vehicles will not impact the unit. PTSUs shall not be located within the taper and shall be installed so that their signal lanterns are approximately vertical (±5 degrees).

The location of PTSUs should also consider the impact of work vehicles and plant (including the impact of vehicle mounted warning devices and other lights at night) on the visibility of the signals, especially when they are located or parked in the background.

For unattended operation, weather conditions shall be monitored to ensure they do not exceed manufacturer’s specifications (for example, wind speed).

PTS using wireless communications are not to be used near blasting activities.

For shuttle control, the maximum operating distance should be based on the requirements outlined in MUTCD Part 3, Table 4.9.

The lantern faces, the vehicle detectors and solar panels (if used) shall be kept clean. PTSS batteries shall be fully charged before operating the unit.

6.2 Lanterns

Portable traffic signal lanterns shall be clearly visible to approaching traffic stopped behind the stop line or the STOP HERE ON RED SIGNAL sign.

Additional signal lanterns may be used on an approach, if appropriate for traffic or site conditions. A second signal lantern used on an approach provides redundancy – for example, one lantern may fail, or signals may be knocked or turned so that the signals are no longer facing traffic.
Before operating a PTSS, the visibility of each PTSU shall be assessed. To ensure visibility, these factors should be considered:

- deep shade
- the direction of the sunlight
- background conditions.

A PTSS with a target board may be required if visibility is compromised based on this assessment.

7 Time Settings

7.1 General

The time settings listed following are set to the time settings determined by the Traffic Management Designer when the signals are installed on site.

Table 4.11-1(E) – Time settings

<table>
<thead>
<tr>
<th>Time Setting</th>
<th>Controlling Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow time</td>
<td>The speed limit, gradient and vehicle types on the approach to the signals.</td>
</tr>
<tr>
<td>All-red time</td>
<td>The distance between the stop lines and the speed limit (refer to Table 4.11-1(F)).</td>
</tr>
<tr>
<td>Minimum green</td>
<td>Traffic volume (5 – 10 seconds)</td>
</tr>
<tr>
<td>Maximum green</td>
<td>Work zone length and traffic volume (refer to Table 4.11-1(A)).</td>
</tr>
</tbody>
</table>

In fixed-time and vehicle-actuated modes of operation, the times are selected manually for each site. In manual operation, the timings are manually controlled in each cycle.

7.2 Yellow time

The length of yellow time shall be four seconds for Type-1 PTSS. The length of yellow time for Type-2 PTSS may be increased from four seconds with consideration to the controlling factors. For guidance, refer to Austroads Guide to Traffic Management Part 9: Traffic Operations.

7.3 All-red time

The all-red time is the time period after one approach changes to red, and before the opposite approach changes to green.

The all-red time shall be long enough to allow a vehicle to pass the stop line, and safely clear the work zone while travelling at the speed limit. The all-red time varies according to the work zone length and the posted speed limit. (The work zone length is measured as the distance between the stop lines at each traffic signal unit.)

All-red times for various speeds and work zone lengths are shown in Table 4.11–1(E). The relationship between the all-red interval and travel distance for a range of vehicle speeds is also illustrated in AS4191.
### Table 4.11-1(F) – All-red time (to the nearest 0.5 second)

<table>
<thead>
<tr>
<th>Distance between stop lines (m)</th>
<th>Work Zone Speed Limit (km/h)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>9.0</td>
<td>4.5</td>
<td>3.5</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>18.0</td>
<td>9.0</td>
<td>7.0</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>27.0</td>
<td>13.5</td>
<td>11.0</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>36.0</td>
<td>18.0</td>
<td>14.5</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>45.0</td>
<td>22.5</td>
<td>18.0</td>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>54.0</td>
<td>27.0</td>
<td>21.5</td>
<td>18.0</td>
<td></td>
</tr>
<tr>
<td>350</td>
<td>63.0</td>
<td>31.5</td>
<td>25.0</td>
<td>21.0</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>72.0</td>
<td>36.0</td>
<td>29.0</td>
<td>24.0</td>
<td></td>
</tr>
<tr>
<td>450</td>
<td>81.0</td>
<td>40.5</td>
<td>32.5</td>
<td>27.0</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>90.0</td>
<td>45.0</td>
<td>36.0</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>99.0</td>
<td>49.5</td>
<td>39.5</td>
<td>33.0</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>108.0</td>
<td>54.0</td>
<td>43.0</td>
<td>36.0</td>
<td></td>
</tr>
<tr>
<td>650</td>
<td>117.0</td>
<td>58.5</td>
<td>47.0</td>
<td>39.0</td>
<td></td>
</tr>
<tr>
<td>700</td>
<td>126.0</td>
<td>63.0</td>
<td>50.0</td>
<td>42.0</td>
<td></td>
</tr>
<tr>
<td>750</td>
<td>135.0</td>
<td>67.5</td>
<td>54.0</td>
<td>45.0</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>144.0</td>
<td>72.0</td>
<td>57.5</td>
<td>48.0</td>
<td></td>
</tr>
</tbody>
</table>

For distances or speed limits other than those nominated in Table 4.11-1(F), the all-red time shall be calculated using the following formula:

\[
t_{ar} = \frac{3.6L_c}{V_d}
\]

where

\[
t_{ar} = \text{all red time – must be equal or greater than 1.0}
\]

\[
L_c = \text{distance between stop lines (m)}
\]

\[
V_d = \text{work zone speed limit}
\]

### 7.4 Maximum green time

The maximum green time varies with the two-way traffic flow and the work zone length.

Longer maximum green times may be used in vehicle-actuated operation, as the green time will only run to the maximum time where necessary. For fixed-time control, shorter green times are required. Unnecessary delays may occur if unsuitable green times are used.

Appropriate maximum green time values for both approaches may be selected from Table 4.11-1(G) (vehicle actuated operation) or Table 4.11-1(H) (fixed-time operation).
Table 4.11-1(G) – *Initial maximum green times for vehicle-actuated operation*

<table>
<thead>
<tr>
<th>Work Zone Length (m)</th>
<th>Two-way Traffic Flow (veh/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200</td>
</tr>
<tr>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>200</td>
<td>60</td>
</tr>
<tr>
<td>300</td>
<td>60</td>
</tr>
<tr>
<td>400</td>
<td>60</td>
</tr>
<tr>
<td>500</td>
<td>60</td>
</tr>
<tr>
<td>600</td>
<td>50</td>
</tr>
<tr>
<td>700</td>
<td>40</td>
</tr>
<tr>
<td>800</td>
<td>30</td>
</tr>
</tbody>
</table>

The maximum green times for vehicle-actuated operation allows for some variation in traffic flow while ensuring a reasonable maximum cycle time. The actual cycle time for any cycle is dependent on the traffic demand, but the maximum cycle time shall always be less than 240 seconds.

Table 4.11-1(H) – *Initial maximum green times for fixed-time operation*

<table>
<thead>
<tr>
<th>Work Zone Length (m)</th>
<th>Two-way Traffic Flow (veh/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200</td>
</tr>
<tr>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>300</td>
<td>20</td>
</tr>
<tr>
<td>400</td>
<td>20</td>
</tr>
<tr>
<td>500</td>
<td>20</td>
</tr>
<tr>
<td>600</td>
<td>20</td>
</tr>
<tr>
<td>700</td>
<td>20</td>
</tr>
<tr>
<td>800</td>
<td>20</td>
</tr>
</tbody>
</table>

The green times given in Table 4.11–1(H) were calculated (using aaSIDRA) to give the minimum practical cycle time with a degree of saturation less than 0.9. They assume traffic flows in each direction are equal. Allowance has been made for some peaking within the hourly volume and for 4% heavy vehicles. Inter-green times for each work zone length were calculated by adding four seconds yellow time to the 40 km/h all-red times from Table 4.11-1(F).

These values are given as a starting point only. They are appropriate if traffic flows are similar in both directions and the two-way flow is known. The initial settings may be adjusted in accordance with Clause 8.3. If long queues are regularly occurring on one approach, the maximum green time should
be increased for that approach only. Manual operation may be used to provide traffic control if vehicle-actuated operation is not sufficient to clear the traffic.

8 Operation

8.1 Monitoring portable traffic signal systems

The performance of the PTSS shall be monitored to ensure that the assumptions made for the system set-up are correct.

When monitoring and evaluating the operation of a site:

- Are traffic flows actually as predicted?
- Is traffic avoiding the signalised site, and creating congestion elsewhere?
- Is the equipment (controller) operating as designed?
- Are signal phasings and timings adequate?
- Are yellow times appropriate (in relation to vehicle stopping characteristics, and times provided between phases to clear traffic from the controlled area)?
- Is traffic being held for long periods of time at a red signal, when adequate gaps exist in a running movement?
- Are there delays to vehicles (and pedestrians) on each approach?
- Is the number of vehicles left in a queue at the termination of the green period, and the number of vehicles stopped more than once in each queue, at satisfactory levels?
- Are vehicle detectors appropriately located to detect traffic as intended, in both the passage and presence mode?
- Are unusual vehicles being missed by detectors, and are they in sufficient numbers to justify special detection techniques?

The following checks shall be made to ensure the correct operation of PTSS:

- When operating in unattended operation, Type-2 PTSS shall be inspected to confirm its correct operation at least once every 24 hours or shall have remote error monitoring and reporting functionality. Contact details of the relevant persons shall be available on the body of PTSS for reporting any fault with the PTSS.
- With Type-1 and Type-2 PTSS, an alternative control arrangement shall be available to be put in place if the PTSS fails.
- For Type-1 PTSS, Traffic Controllers and STOP/SLOW bats should be available in case of failure of the PTSS.
8.2 Trouble shooting vehicle-actuated operation

**Table 4.11-1(I) – Trouble shooting in vehicle-actuated operation (Type-2 PTSS)**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long queues</td>
<td>Green time too short</td>
<td>Increase maximum green time setting (do not exceed the value given in the right-hand column of Table 4.11-1(A))</td>
</tr>
<tr>
<td></td>
<td>Vehicle detector fault</td>
<td>Call service, and operate as fixed-time or manual operation until fixed</td>
</tr>
<tr>
<td></td>
<td>Capacity exceeded</td>
<td>Call supervisor</td>
</tr>
<tr>
<td>Signals do not change</td>
<td>Vehicle detector fault</td>
<td>Call service, and operate as fixed-time or manual operation until fixed</td>
</tr>
<tr>
<td>Green period is always the same length and longer than required</td>
<td>Vehicle detector fault</td>
<td>Call service, operate as fixed-time or manual operation until fixed</td>
</tr>
<tr>
<td>Traffic still in work zone at start of opposite green</td>
<td>All-red time too short</td>
<td>Increase all-red time setting</td>
</tr>
<tr>
<td>Long gap between last vehicle clearing and start of next green</td>
<td>All-red time too long</td>
<td>Decrease all-red time setting</td>
</tr>
<tr>
<td></td>
<td>Vehicle detector fault</td>
<td>Call service, and operate as fixed-time or manual operation until fixed</td>
</tr>
<tr>
<td>Signals do not dwell on all-red time in absence of traffic</td>
<td>Vehicle detector fault</td>
<td>Call service, and operate as fixed-time or manual operation until fixed</td>
</tr>
</tbody>
</table>

8.3 Adjusting green time for fixed-time operation

If the green times of Type-2 PTSS are too short (that is, the queue does not clear in the first cycle), they should be increased gradually by:

- Switching the signals to manual mode for one or two cycles to clear the queue
- Switching back to fixed-time mode and count how many vehicles do not get through in the first cycle
- Adding two seconds of green time for each vehicle that does not clear the work site
- Observing the signals over three cycles and subtract green time if the queue clears before the end of the green-time.

Vehicle-actuated operation shall be used if traffic volumes significantly change throughout the work shift (for example, if traffic volumes are considerably higher in the peak hour). If the signals are in fixed-time operation, the maximum green time shall be adjusted throughout the day to suit the prevailing traffic conditions.
4.13  **Maintaining traffic flow**

4.13-1  **Traffic operations level of service for roadworks sites**

1  **Purpose**

This supplement provides guidance for determining the appropriate traffic operations Level of Service (LOS) to be maintained through roadworks sites. This guidance is to be applied in the assessment of alternative construction and traffic management schemes on traffic operations.

2  **Background**

Most roadworks schemes invariably require a degree of interruption to the normal flow of traffic on a road. The acceptable level of impact is dependent on a range of factors including the urgency of the works, the scale of the works, the advance notice provided to the community and the availability of alternative routes or modes of transport.

In developing a Traffic Guidance Scheme, the primary objective is to ensure the safety of road workers and road users. The secondary objective is to balance the:

- safe and convenient movement of traffic (community costs), and
- construction and traffic management costs (project costs).

These elements must be carefully assessed to ensure that the most appropriate balance is found to ensure that cost effective solutions are being applied.

Examples of the inefficient application of a Traffic Guidance Scheme can include:

- The traffic operations principles behind a Traffic Guidance Scheme are based purely on maintaining traffic flow. In these cases, the minimum number of lanes to be retained in each direction on each road is usually defined. This can result in constraints on the construction process which may lead to the inefficient sequencing and conduct of the works which can potentially increase the project costs.

- A minimum Level of Service is specified based on maintaining existing traffic conditions. This can severely affect the times at which construction activity can be undertaken, which can result in an associated increase in project costs.

Alternatively, the most effective construction practice may result in extensive delays / detours to traffic with substantial community impact. In these cases, delays at roadworks sites can be a source of frustration for drivers which may potentially lead to an increased risk for road users and road workers.

This note, therefore, provides some guidance on determining the appropriate balance between traffic operations and construction process.
3 Discussion

The following principles for roadworks LOS shall apply:

1. In the following cases, the community cost will be considered to be NIL and the most efficient construction process which complies with these LOS parameters should be applied:
   a) If the existing LOS on the road is A, B or C, then a traffic management treatment which delivers no worse than LOS D.
   b) If the existing LOS on the road is D, then a traffic management treatment which delivers no worse than LOS E.
   c) If the existing LOS on the road is E or F, then a traffic management treatment which maintains the existing traffic operational performance.

2. An assessment of the community cost against the construction cost will be undertaken in all other circumstances

3. Travel time costs:
   a) Travel time costs are to be determined using the approach documented within Clause 3.2 of the Austroads Guide to Project Evaluation Part 4: Project Evaluation Data, 2012.
   b) Private travel time cost is adopted for a single occupant (A$13.17/hour) which, as per the Austroads Guide, was assumed to be 40% of average hourly earnings (A$32.93, as per quarter ending 31st May 2010).
   c) Business travel time for cars is assumed to be the average hourly earnings.
   d) These figures need to be increased by CPI to current day figures.

4. Traffic management costs and project costs should be provided by the contractor undertaking the works
5  Example diagrams

5-1  Collection of example diagrams

1  Application

The following collection of diagrams include examples of applications for short-term and long-term works, and for all types of roads; for example, multilane roadway and two-way roads. All references to Clauses on the diagrams or in the accompanying notes are to the MUTCD Part 3.

The collection of example diagrams is intended to provide guidance on the types of traffic management practice which could be considered during the development of a Traffic Guidance Scheme (TGS). TGSs for situations which are not specifically covered by the diagrams should be developed by applying the principles outlined in the MUTCD Part 3.

No one standard arrangement of signs and devices can operate for every work site, or for different work activities at a particular site. It may be necessary to vary warning signs and devices at a work site, not only from day to day, or from day to night operation, but also from hour to hour (see Clause 2.6.2).

Whenever it is necessary to undertake roadworks within an intersection, warning signs must be erected on each of the approaches on which traffic is affected by the works. It is also important to consider the needs of pedestrians and cyclists (see Clauses 2.3.7 and 3.14).

2  Diagram symbols

Symbols used in Figures 5-1.1 to 5-1.37 are as follows:

Table 5-1 – Symbols used in Figures 5-1.1 to 5-1.37

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Symbol" /></td>
<td>ANTIGLARE SCREEN</td>
<td><img src="image2" alt="Symbol" /></td>
<td>SINGLE TEMPORARY HAZARD MARKER</td>
</tr>
<tr>
<td><img src="image3" alt="Symbol" /></td>
<td>BARRIER</td>
<td><img src="image4" alt="Symbol" /></td>
<td>TRAFFIC CONES</td>
</tr>
<tr>
<td><img src="image5" alt="Symbol" /></td>
<td>DELINEATORS</td>
<td><img src="image6" alt="Symbol" /></td>
<td>TRAFFIC CONTROLLER</td>
</tr>
<tr>
<td><img src="image7" alt="Symbol" /></td>
<td>MESH FENCING</td>
<td><img src="image8" alt="Symbol" /></td>
<td>TRAFFIC SIGNAL HEAD</td>
</tr>
<tr>
<td><img src="image9" alt="Symbol" /></td>
<td>RAISED RETROREFLECTIVE PAVEMENT MARKERS</td>
<td><img src="image10" alt="Symbol" /></td>
<td>TRAFFIC SIGNAL LOCATION</td>
</tr>
<tr>
<td><img src="image11" alt="Symbol" /></td>
<td>SIGN, CAB-MOUNTED</td>
<td><img src="image12" alt="Symbol" /></td>
<td>VEHICLE</td>
</tr>
<tr>
<td><img src="image13" alt="Symbol" /></td>
<td>SIGN, LOCATION</td>
<td><img src="image14" alt="Symbol" /></td>
<td>WORK AREA</td>
</tr>
<tr>
<td><img src="image15" alt="Symbol" /></td>
<td>TEMPORARY HAZARD MARKER</td>
<td><img src="image16" alt="Symbol" /></td>
<td>MULTI TEMPORARY HAZARD MARKER</td>
</tr>
</tbody>
</table>
3 Example diagrams

The example diagrams included in this section are not generic Traffic Guidance Schemes for the purposes of traffic management. They must not be used as an actual TGS and must not be implemented. They incorporate the various requirements, recommendations and options from the MUTCD and are to be read together with the accompanying notes to the figures and any referenced text, table or figure in the MUTCD.

The example diagrams are divided into four main categories which are set out following, together with a brief description of the type of work site covered by each example diagram.

The example diagrams may be used to prepare generic or site specific TGS based on the conditions and work methods / practices to be adopted at specific sites.

Thus, an understanding of the underlying principles and options in the MUTCD is essential when using these example diagrams.

a) Short-term work

5-1.1A Short-term – frequently changing: clear of traffic lanes – workers on foot
5-1.1B Short-term – frequently changing: clear of traffic lanes – plant only
5-1.2 Short-term – full lane closure: residential street – low speed – 50 km/h maximum speed limit
5-1.3 Short-term – part lane closure: two-way road – low speed
5-1.4A Short-term – full lane closure: two-way road
5-1.4B Short term – full lane closure: two-way road using PTCD
5-1.5 Short-term – traffic through work area: two-way road
5-1.6 Short-term – lane closure: work in centre lane – multilane undivided road
5-1.7A Short-term – left lane closure: multilane divided road
5-1.7B Short-term – left lane closure: multilane undivided road
5-1.7C Short-term – median lane closure: multilane divided road
5-1.7D Short-term – median lane closure: multilane divided road
5-1.8 Short-term – occupation of centre of roadway: two-way road
5-1.9 Short-term – temporary closure of roadway: multilane divided road

b) Lane and roadway closures

5-1.10 Shoulder closure – two-way road
5-1.11 Short-term – part-lane closure: two-way road
5-1.12 Lane closure: two-way road or bridge
5-1.13 Long-term lane closure: two-way road
5-1.14 Long-term lane closure: multilane divided road
5-1.15 Long-term lane closure of 2 outer lanes: multilane undivided road
5-1.16 Long-term - closure of 2 central lanes: multilane undivided road
5-1.17 Short-term - closure of one side: multilane undivided road – low speed
5-1.18 Short-term – closure of one side: multilane undivided road – high speed
5-1.19 Lane closure: major roundabout
5-1.20 Part lane closure: minor roundabout
5-1.21 Haul road crossing: two-way road
5-1.22 Road closed: blasting
c) Detours and side tracks
5-1.23 High vehicle detour: two-way road
5-1.24 Long-term – heavy vehicle detour: two-way road
5-1.25 One-lane side track: two-way road
5-1.26 Two-way side track: two-way road
5-1.27 Contraflow crossing median (crossover): multilane, divided road
5-1.28 One direction detour: two-way road
5-1.29 Detour all traffic: two-way road
5-1.30 Exit closure: multilane, one-way roadway
d) Special work situations
5-1.31 Road temporarily closed: two-way road
5-1.32 Line marking: all roads
5-1.33 Kerbside work: intersection of minor roads
5-1.34 Kerbside work: intersection of a minor and a major road
5-1.35 Kerbside work: intersection of two major roads
5-1.36 Work occupying the full width of a footpath
5-1.37 Closure of two outer lanes: one direction – multilane road
Figure 5-1.1(A) – Short term – frequently changing: clear of traffic lanes – workers on foot

<table>
<thead>
<tr>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
</tr>
<tr>
<td>Road Type</td>
</tr>
<tr>
<td>Traffic Volume</td>
</tr>
<tr>
<td>Travelled Path</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Operation</td>
</tr>
<tr>
<td>D</td>
</tr>
</tbody>
</table>

See Notes

NOT TO SCALE
NOTES TO FIGURE 5-1.1(A):

1. Frequently changing work area involving workers on foot in open road areas with or without machinery on shoulders (see Clause 4.3.4 and 4.3.5). Job examples – grass mowing, shoulder work, table drain clearing. Advance warning signs may be omitted if the sight distance exceeds 150 m in a 60 km/h or lower zone, or 250 m elsewhere and a vehicle mounted warning device is displayed.

2. Where the shoulder material is soft or is to remain temporarily on the pavement, then the appropriate sign Slippery, Loose Stones, SOFT EDGES, and so on (see Clause 3.7.2) should be shown a minimum distance 2D (see Table 4.2) metres ahead of the hazard (see Clause 4.7.4). Where workers will be working on the shoulder the Workers (symbolic) sign should be repeated in this location. Workers (symbolic) signs shall be used when workers are actually working.

3. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2 and Clause 4.9). Remove when workers have left the work area.

4. Consider the need for cones alone the edge of the pavement in accordance with Table 3.7.

5. The distance D for signs spacing is given in Table 4.2.

6. Refer to Clauses 4.3.3 and 4.3.4.

7. For works on unsealed roads see Clause 4.5.

8. Consider use of ROADWORK 1 km AHEAD or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more: see Clause 4.7.2.

9. For a high-speed road, additional signs to control vehicle approach speeds will be required.

10. Road condition signs (see Clause 3.7.2), if required, are placed 2D distance from the hazard in both directions.
**Figure 5-1.1(B) – Short term – frequently changing: clear of traffic lanes – plant only**

### APPLICATION

<table>
<thead>
<tr>
<th>Term</th>
<th>Short (Clause 1.4.17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Type</td>
<td>All. See Note 6</td>
</tr>
<tr>
<td>Traffic Volume</td>
<td>All. See Note 5</td>
</tr>
<tr>
<td>Traveled Path</td>
<td>(a) Direction</td>
</tr>
<tr>
<td></td>
<td>Past</td>
</tr>
<tr>
<td></td>
<td>(b) Width Unaffected</td>
</tr>
<tr>
<td>Control</td>
<td>Nil</td>
</tr>
<tr>
<td>Operation</td>
<td>Shoulder grading</td>
</tr>
<tr>
<td>D</td>
<td>Table 4.2</td>
</tr>
</tbody>
</table>

See Notes

NOT TO SCALE
NOTES TO FIGURE 5-1.1(B):

1. Frequently changing work area involving machinery running on shoulders in open road areas (see Clauses 4.3.4 and 4.3.5). Job examples: grass mowing, shoulder grading, table drain clearing. Advance warning signs may be omitted if the sight distance exceeds 150 m in a 60 km/h or lower zone, or 250 m elsewhere and a vehicle mounted warning device is displayed and no windrow is present near the pavement edge.

2. Where a shoulder is being graded, and (for example) the shoulder material is soft or is temporarily on the pavement, then the appropriate sign Slippery, Loose Stones, SOFT EDGES, and so on (see Clause 3.7.2) should be shown a minimum distance 2D (see Table 4.2) metres ahead of the hazard (see Clause 4.7.4). Where workers will be working on the shoulder, the Workers (symbolic) sign should be repeated in this location. Workers (symbolic) signs shall be used when workers are actually working.

3. Temporary speed zone to meet workplace or traffic safety requirements (see Clauses 4.2 and 4.9). Remove when workers have left the work area.

4. The distance D for sign spacing is given in Table 4.2.

5. On sealed roads with traffic volumes less than 1500 vpd, where sight distance to the vehicle mounted warning device is greater than 250 m in both directions, the distance between signs at the limits of work may be increased to 10 km. Where this sight distance is not available, an additional sign, for example, GRADER Ahead must be placed in advance of work to warn motorists (Clause 4.3.5).

6. For works on unsealed roads, see Clause 4.5.

7. For a high-speed road, additional signs to control vehicle approach speeds will be required.

8. Road condition signs (see Clause 3.7.2), if required, are placed 2D distance from the hazard in both directions.
Figure 5-1.2 – Short term – full lane closure: residential street – low speed – 50 km/h maximum speed limit

<table>
<thead>
<tr>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
</tr>
<tr>
<td>Road Type</td>
</tr>
<tr>
<td>Traffic Volume</td>
</tr>
<tr>
<td>Travelled Path (a) Direction</td>
</tr>
<tr>
<td>(b) Width</td>
</tr>
<tr>
<td>Control</td>
</tr>
<tr>
<td>Operation</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>Taper</td>
</tr>
</tbody>
</table>
NOTES TO FIGURE 5-1.2:

1. If the remaining clear roadway width is 5.5 m or more, two-way operation should be maintained. If 5.5 m cannot be maintained, the width should be reduced to no more than 3.5 m (see Clause 4.13.5) to ensure vehicles operate in single file under shuttle working conditions.

2. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic. Placement of the sign should be in accordance with Clause 4.7.4.

3. Direct control of traffic may not be required if there is clear visibility past the work area and beyond if for at least 75 m, and length of shuttle lane does not exceed 60 m (see Clause 4.13.5(b)). If these conditions cannot be maintained, some form of traffic control will be required.

4. Refer to Table 4.6 for recommended taper lengths and Clause 4.13.5(c) for work in residential streets.

5. One T5-Q02 (or T5-5) sign shall be placed within the taper area (refer Clause 3.9.3). If the lateral shift is more than 2 m, consider the need for extra T5-Q02 (or T5-5) signs.
Figure 5-1.3 – Short term – part lane closure: two-way road – low speed

### APPLICATION

<table>
<thead>
<tr>
<th>Term</th>
<th>Short. See Note 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Type</td>
<td>Low speed urban e.g. business or shopping streets</td>
</tr>
<tr>
<td>Traffic Volume</td>
<td>All</td>
</tr>
<tr>
<td>Travelled Path</td>
<td></td>
</tr>
<tr>
<td>(a) Direction</td>
<td>Past</td>
</tr>
<tr>
<td>(b) Width</td>
<td>See Note 1</td>
</tr>
<tr>
<td>Control</td>
<td>Nil.</td>
</tr>
<tr>
<td>Operation</td>
<td>Maintenance. Part lane closure</td>
</tr>
<tr>
<td>D</td>
<td>Table 4.2</td>
</tr>
<tr>
<td>Taper</td>
<td>Table 4.6</td>
</tr>
<tr>
<td>Buffer zone</td>
<td>Table 4.7</td>
</tr>
</tbody>
</table>
NOTES TO FIGURE 5-1.3:

1. The minimum lane width shall be 3.0 m (see Clause 4.13.3) and the edge clearance shall be as determined in Clause 4.13.4. Where this remaining width is insufficient for a lane of traffic and vehicles need to cross the centreline to travel around the work area, Figure 5-1.11 should be used. Where Traffic Controllers are used to control traffic, use Figure 5-1.4.

2. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic. The Sign shall be placed at a distance 2D from the taper for speed limit 60 km/h or more (Clause 4.7.4).

3. Consider the need to prohibit parking along this kerb.

4. For short-term, low impact works (built-up area), see Clause 4.4.

5. Refer to Table 4.6 for recommended taper lengths.

6. One T5-Q02 (or T5-5) sign should be placed within the taper area (refer Clause 3.9.3). If the lateral shift is more than 2 m, consider the need for extra T5-Q02 (or T5-5) signs.
**Figure 5-1.4(A) – Short term – full lane closure: two-way road**

<table>
<thead>
<tr>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
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<tr>
<td>Road Type</td>
</tr>
<tr>
<td>Traffic Volume</td>
</tr>
<tr>
<td>Travelled Path</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Control</td>
</tr>
<tr>
<td>Operation</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>Taper</td>
</tr>
<tr>
<td>Buffer zone</td>
</tr>
</tbody>
</table>
NOTES TO FIGURE 5-1.4(A):

1. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path;
   b. to leave a clear escape path for workers; and
   c. where necessary, in advance of the work area to protect workers.

2. A Traffic Controller Ahead / PREPARE TO STOP sign may be required on the right-hand side of high-volume roads.

3. The minimum lane width including trafficable shoulder shall be 3.0m (see Clause 4.13.3). For widths of 6 m or more, see Figure 5-1.11. Where only one Traffic Controller is available, and high traffic volumes or barrier lines make it necessary to direct traffic through the work area, see Figure 5-1.5.

4. For traffic volumes of 40 vpd or less and posted speed during roadworks 70 km/h or less, where the length of single lane does not exceed 60 m, traffic control may not be required (see Clauses 4.13.1 and 4.13.5). Where the length of single lane is less than 100 m and the requirements of Clause 3.5.3a) are met, the GIVE WAY and ONE WAY sign assembly may be used (see Figure 5-1.12).

5. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area or are no longer visible to traffic.

6. May be omitted if continuous operations are in progress and vehicle has a vehicle-mounted warning device activated.

7. A maximum speed limit of 60 km/h shall be used on approach to the Traffic Controller (see Clause 4.10.4).

8. Consider use of ROADWORK 1 km Ahead or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more – see Clause 4.7.2.

9. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign; or
   b. a speed zone (see Table 4.7 for length of speed zone).

10. For works on unsealed roads, see Clause 4.5.

11. The distance D for sign spacing is given in Table 4.2.

12. Refer to Table 4.6 for recommended taper lengths.

13. Four cones installed on the centreline in advance of Traffic Controller position (see Clause 4.10.2).

14. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

15. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).
Figure 5-1.4(8) – Short term – full lane closure: two-way road using PTCD

<table>
<thead>
<tr>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
</tr>
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<td>Road Type</td>
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<tr>
<td>Traffic Volume</td>
</tr>
<tr>
<td>Travelled Path (a) Direction</td>
</tr>
<tr>
<td>(b) Width</td>
</tr>
<tr>
<td>Control</td>
</tr>
<tr>
<td>Operation</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
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<tr>
<td>Buffer zone</td>
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</table>
NOTES TO FIGURE 5-1.4(B):

1. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

2. A Boom barrier / PREPARE TO STOP sign may be required on the right-hand side of high-volume roads.

3. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3). For widths of 6 m or more, see Figure 5-1.11. Where only one Traffic Controller is available, and high traffic volumes or barrier lines make it necessary to direct traffic through the work area, see Figure 5-1.5.

4. For traffic volumes of 40 vpd or less and posted speed during roadworks 70 km/h or less, where the length of single lane does not exceed 60 m, traffic control may not be required (see Clauses 4.13.1 and 4.13.5). Where the length of single lane is less than 100 m and the requirements of Clause 3.5.3a) are met, the GIVE WAY and ONE WAY sign assembly may be used (see Figure 5-1.12).

5. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area or are no longer visible to traffic.

6. May be omitted if continuous operations are in progress and vehicle has a vehicle-mounted warning device activated.

7. A maximum speed limit of 60 km/h shall be used on approach to the portable traffic control device (see Clause 4.10.4) for boom barrier and Clause 4.11.3 for temporary or portable signals).

8. Consider use of ROADWORK 1 km AHEAD or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more – see Clause 4.7.2.

9. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

10. For works on unsealed roads see Clause 4.5.

11. The distance D for sign spacing is given in Table 4.2.

12. Refer to Table 4.6 for recommended taper lengths.

13. Four cones installed on the centreline in advance of Traffic Controller position (see Clause 4.10.2).

14. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

15. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).
Figure 5-1.5 – Short term – traffic through work area: two-way road

APPLICATION

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</tr>
</thead>
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<td>Control</td>
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<td>Operation</td>
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</tr>
<tr>
<td>D</td>
<td>Table 4.2</td>
</tr>
<tr>
<td>Buffer zone</td>
<td>Table 4.7</td>
</tr>
</tbody>
</table>
NOTES TO FIGURE 5-1.5:

1. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

2. A Traffic Controller Ahead / PREPARE TO STOP sign may be duplicated on the right-hand side of roads where the volume is 10,000 vpd or greater.

3. Work area should not extend beyond centreline.

4. Traffic Controller stops and holds all traffic in obstructed lane; then, when work area is temporarily clear, directs traffic to the left of the Temporary Hazard Marker and through the work area.

5. Traffic should not be held for longer than 5 min at any time.

6. This arrangement should be used where:
   a. the minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3)
   b. where only one Traffic Controller is available, and
   c. barrier lines are present.

7. For works on unsealed roads see Clause 4.5.

8. Consider the need for a temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area or are no longer visible to traffic. A maximum speed limit of 60 km/h shall be used on approach to the Traffic Controller (see Clause 4.10.4).

9. Consider use of ROAWORKS 1 km AHEAD or ROADWORKS 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more – see Clause 4.7.2.

10. The distance D for signs spacing is given in Table 4.2.

11. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. Speed Limit AHEAD sign; or
   b. a speed zone (see Table 4.7 for length of speed zone).

12. May be omitted if continuous operations are in progress and vehicle has vehicle-mounted warning device activated.

13. Four cones installed on the centreline is advance of Traffic Controller position (see Clause 4.10.2) unless delineation of lanes by cones is 4 m maximum.

14. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

15. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).
Figure 5-1.6 – Short term – lane closure: work in centre lane – multilane undivided road
NOTES TO FIGURE 5-1.6:

1. If traffic control is required, a Traffic Controller Ahead / PREPARE TO STOP sign is used 2D in advance of the Traffic Controller (see Clause 4.10.2).

2. A central traffic lane should not be closed in isolation.

3. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3)

4. The distance D for sign spacing is given in Table 4.2.

5. The vehicle should be parked:
   a. so it does not unduly obstruct motorist' vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

6. Consider use of ROADWORK 1 KM Ahead or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or more – see Clause 4.7.2.

7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

8. A vehicle-or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

9. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

10. A manoeuvre requiring the left-hand stream to shift laterally into the right-hand stream is to be preferred (see Clause 4.8.2).

11. Refer to Table 4.6 for recommended taper lengths.

12. Traffic control may be omitted if not required.

13. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4c)).

14. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

15. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).

16. A maximum speed limit of 60 km/h shall be used on approach to the Traffic Controller (see Clause 4.10.4)
**Figure 5-1.7(A) – Short term – left lane closure: multilane divided road**

- **APPLICATION**
  - Term: Short (Clause 1.4.17)
  - Road Type: Multilane
  - Traffic Volume: High
  - Travelled Path
    - (a) Direction: Past
    - (b) Width: 3 m min. See Note 11
  - Control: Nil
  - Operation: Maintenance
  - Left or median lane closure
  - D: Table 4.2
  - Taper: Table 4.6
  - Buffer zone: Table 4.7
NOTES TO FIGURE 5-1.7(A):

1. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

2. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

3. A vehicle or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

4. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

5. The distance D for sign spacing is given in Table 4.2.

6. May be omitted if continuous operations are in progress and vehicle has a vehicle-mounted warning device activated.

7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

8. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either;
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

9. For a median lane closure, a manoeuvre requiring the left-hand stream to shift laterally into the right-hand stream is to be preferred (see Clause 4.8.2 and Figure 5-1.7(C)).

10. Refer to Table 4.6 for recommended taper lengths.

11. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

12. On a multi-lane divided road, traffic travelling in the direction not affected by roadworks may not require signs.

13. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

14. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

15. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).
Figure 5-1.7(B) – Short term – left lane closure: multilane undivided road

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<tr>
<td>Buffer zone</td>
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</table>
NOTES TO FIGURE 5.1.7(B):

1. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway, where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

2. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

3. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

4. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

5. The distance D for sign spacing is given in Table 4.2.

6. May be omitted if continuous operations are in progress and vehicle has a vehicle mounted warning device activated.

7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

8. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

9. For a median lane closure, a manoeuvre requiring the left-hand stream to shift laterally into the right-hand stream is to be preferred – see Clause 4.8.2 and Figure 5.1.7(C).

10. Refer to Table 4.6 for recommended taper lengths.

11. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

12. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

13. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

14. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).
Figure 5-1.7(C) – Short term – median lane closure: multilane divided road
NOTES TO FIGURE 5-1.7(C):

1. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway, where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

2. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

3. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

4. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

5. The distance D for sign spacing is given in Table 4.2.

6. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

8. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   d. a Speed Limit AHEAD sign, or
   e. a speed zone (see Table 4.7 for length of speed zone).

9. Refer to Table 4.6 for recommended taper lengths.

10. On a multi-lane divided road, traffic travelling in the direction not affected by roadworks may not require signs.

11. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

12. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

13. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).

14. Distance between tapers (see Clause 4.8.2).
Figure 5-1.7(D) – Short term – median lane closure: multilane divided road

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<tr>
<td>Taper</td>
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<tr>
<td>Buffer zone</td>
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</table>
NOTES TO FIGURE 5-1.7(D):

1. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway, where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

2. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

3. A vehicle or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

4. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

5. The distance D for sign spacing is given in Table 4.2.

6. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

8. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

9. Refer to Table 4.6 for recommended taper lengths.

10. On a multi-lane divided road, traffic travelling in the direction not affected by roadworks may not require signs.

11. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

12. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

13. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).

14. May be omitted if continuous operations are in progress and vehicle has a vehicle-mounted warning device activated.
Figure 5-1.8 – Short term – occupation of centre of roadway: two-way road
NOTES TO FIGURE 5-1.8:

1. All vehicles should be parked off the roadway, beyond the work area. A vehicle so parked should not display vehicle-mounted warning devices.

2. Refer to Table 4.6 for recommended taper lengths.

3. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either;
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

4. The minimum lane width shall be 3.0 m (see Clause 4.13.3). If the width is less than this in one direction, consideration should be given to the use of traffic control.

5. For continuous operations such as paint spotting, the temporary hazard markers may be replaced with vehicles fitted with appropriate vehicle-mounted warning devices and the delineation traffic cones omitted.

6. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

7. For short-term, low-impact works in open road areas see Clause 4.3 and, in built-up areas, see Clause 4.4.

8. Barrier boards shall be installed in accordance with Clause 3.8.3. The bars should be aligned to point down the side which vehicles are required to pass (see TC9215_1 and TC9224_1).

9. The distance D for sign spacing is given in Table 4.2.

10. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

11. A vehicle or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).
Figure 5-1.9 – Short term – temporary closure of roadway: multilane divided road
NOTES TO FIGURE 5.1.9:

1. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

2. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, is advance of the work area to protect workers.

3. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

4. See Clause 3.8.2 if a special sign is required.

5. The distance D for sign spacing is given in Table 4.2.

6. A maximum speed limit of 60 km/h shall be used on approach to the Traffic Controller or boom barrier (see Clause 4.10.4).

7. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (for example, 100 km/h to 60 km/h) (see Clause 4.7.2).

8. Normally a Traffic Controller with boom barrier should be used; however, for work of short duration outside of peak period, a Traffic Controller with STOP / SLOW bat may be used.

9. The Traffic Controller Ahead / PREPARE TO STOP sign must only be used when Traffic Controller using a STOP / SLOW bat is on duty.

10. Use PROBABLE DELAY 15 MINUTES sign (T1-Q02) where expected delays are considerable. Also, consider the need for special signs to warn of delays at junctions with alternate routes.

11. Consider local traffic access. Parking restrictions should apply throughout the work site.

12. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

13. Refer to Table 4.6 for recommended taper lengths.

14. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

15. Consider the need for a temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

16. On a multi-lane divided road, traffic travelling in the direction not affected by roadworks may not require signing.

17. Minimum distance between successive merge tapers is 2D. Refer Clause 4.8.2.

18. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

19. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

20. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).
Figure 5-1.10 – Shoulder closure – two-way road
NOTES TO FIGURE 5-1.10:

1. In built-up areas, access for pedestrians should be considered together with appropriate signs.
2. In built-up areas, parking may need to be prohibited within the work site.
3. Access for local traffic should be considered.
4. The length of the 40 km/h speed zone may be subject to Clause 4.2(e).
5. At night, or when no work is being carried out, barricades may be erected along the work site at right angles to traffic flow (see Clause 3.8.3).
6. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).
7. May be omitted when work is less than 20 m in length, no truck or major plant item is in use and no excavation is involved.
8. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.
9. The distance D for sign spacing is given in Table 4.2.
10. Where traffic flow must be temporarily interrupted, Traffic Controllers with appropriate signs (see Figure 5-1.12) should be used.
11. The Workers (symbolic) sign shall be removed when workers have left the work area or are no longer visible to traffic.
12. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road.
13. Barrier boards shall be installed in accordance with Clause 3.8.3. The bars should be aligned to point down the side which vehicles are required to pass (see TC9215_1 and TC9224_1).
14. On a multi-lane divided road, traffic travelling in the direction not affected by roadworks may not require signing.
15. This diagram has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.
Figure 5-1.11 – Short term – part lane closure: two-way road

APPLICATION

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<td>Table 4.6</td>
</tr>
<tr>
<td>Buffer zone</td>
<td>Table 4.7</td>
</tr>
</tbody>
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NOTES TO FIGURE 5-1.11:

1. Where works are continuously moving, advance warning signs may be vehicle mounted.

2. If a barrier line is present for traffic in either direction, traffic control is required (see Figure 5-1.5).

3. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

4. The minimum lane widths including trafficable shoulder shall be 3.0 m (see Clause 4.13.3). A temporary hazard marker and cones may be required to separate opposing traffic.

5. May be omitted if continuous operations are in progress and vehicle has a vehicle-mounted warning device activated.

6. For works on unsealed roads, see Clause 4.5.

7. The distance D for sign spacing is given in Table 4.2.

8. Consider use of ROADWORKS 1 km Ahead or ROADWORKS 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (for example, 100 km/h to 60 km/h) (see Clause 4.7.2).

9. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

10. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
    a. a Speed Limit AHEAD sign, or
    b. a speed zone (see Table 4.7 for length of speed zone).

11. Refer to Table 4.6 for recommended taper lengths.

12. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

13. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).
Figure 5-1.12 – Lane closure: two-way road or bridge

For night and sometimes day operation of signals, signals will be required to direct traffic back to the correct side of the road.
NOTES TO FIGURE 5-1.12:

1. Local traffic access should be considered. Parking restriction should apply on both side of the roadway throughout the work site.

2. At bridgeworks, the sign ROADWORK Ahead should be replaced by BRIDGEWORK Ahead sign and the END ROADWORKS sign may be omitted where a temporary speed zone has not been implemented. Consider the need for a Narrow Bridge sign (W4-1) in conjunction with a ONE LANE sign (W8-16) (see Part 2 of this Manual).

3. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2).

4. If the work area is made available to traffic at night, remove or cover all inappropriate signs and erect signs advising of the road surface conditions (see Figure 5-1.31 and Clause 2.6.2). The Traffic Controller Ahead / PREPARE TO STOP sign should be only used when Traffic Controllers with STOP / SLOW bat are on duty. It should be covered or removed at all other times.

5. For long-term works where it is not intended to make the work area available to traffic at night, use traffic signals, stop line and associated sign or divert traffic (see Figure 5-1.25 or 5-1.28).

6. A GIVE WAY sign (see Clause 3.5.3) may be used where:
   a. the road has a traffic volume of 150 vpd or less and the posted speed limit during roadworks is 70 km/h or less
   b. each entry to the work area is visible from the other
   c. work area is less than 100 m in length, and
   d. there is sight distance to opposing traffic of desirably 200 m or more beyond the far end of the work area for traffic facing the GIVE WAY sign.

The GIVE WAY / ONE LANE sign assembly should be placed at the start of the taper to control traffic in the obstructed lane, the NO OVERTAKING OR PASSING signs should be erected in conjunction with the GIVE WAY / ONE LANE sign assembly (see Clause 3.5.3).

7. A maximum speed limit of 60 km/h shall be used where Traffic Controllers or signal control is employed and should be considered for give way control. Cover or alter if inappropriate at night.

8. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

9. Where work involves excavation or removal of bridge deck, barriers or some form of continuous fencing should be used. Delineators should be attached to the fence to delineate the edge of the travelled path (see Clause 3.9.2).

10. The distance D for sign spacing is given in Table 4.2.

11. When traffic signals are used, the sign STOP HERE ON RED SIGNAL (R6-6) shall be installed when STOP line is not marked on the pavement. It is also recommended to supplement the STOP line where one is provided (see Clause 3.5.4d)). The STOP line is positioned 6 m in advance of the signal unit (see Clause 4.11.3).

12. The Workers (symbolic) sign shall be removed when workers have left the work area or are no longer visible to traffic.

13. Where a secondary signal is not provided, the primary signal should consist of two sets of lanterns, particularly where signals are required to operate unattended.

14. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

15. Refer to Table 4.6 for recommended taper lengths.

16. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).
17. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner, for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

18. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

19. Four cones installed on the centreline in advance of Traffic Controller position (see Clause 4.10.2).

20. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

21. Distance between tapers (see Clause 4.8.2)
Figure 5-1.13 – Long term lane closure: two-way road
NOTES TO FIGURE 5-1.13:

1. The temporary island width should be a minimum of 1.2 m and formed with temporary kerbing.
2. Place double barrier lines and yellow raised retroreflective pavement markers at 12 m spacing (see Clause 3.9.5).
3. Consider local traffic access. Parking restrictions should apply within the worksite.
4. On sealed roads, the shoulder should also be sealed.
5. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2).
6. At night or when no work is being carried out, barriers may be erected along the work site at right angles to traffic flow (see Clause 3.8.3).
7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.
8. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).
9. The distance D for sign spacing is given in Table 4.2.
10. The Workers (symbolic) sign shall be removed when workers have left the work area or are no longer visible to traffic.
11. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).
12. Speed restriction signs may be duplicated on both sides of the roadway at the start of a zone.
13. Refer to Table 4.6 for recommended taper lengths.
14. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).
15. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner, for example, on posts sunk into the ground, and duplicated on the right-hand side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).
16. Misleading line marking should be temporarily erased, and lane edge lines marked as required (see Clause 3.9.4).
17. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.
Figure 5-1.14 – Long term lane closure: multilane divided road

See Notes
NOT TO SCALE

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NOTES TO FIGURE 5-1.14:

1. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway, where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided situation.

2. Misleading line marking should be temporarily erased, and an edge line marked (see Clause 3.9.4).

3. Barrier boards may be used at night or when no work is in progress (see Clause 3.8.3).

4. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

5. If work is being performed in one lane, an adjacent lane or shoulder should normally be closed to provide sufficient space for worker safety and the method of work. If the roadway has three or more lanes and two lanes are closed, then a staggered taper arrangement as shown in Figure 5-1.27 should be used.

6. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.

7. Consider use of ROADWORK 1 km Ahead or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

8. On a multi-lane divided road, traffic travelling in the direction not affected by roadworks may not require signing.

9. Adopt a similar treatment for a right lane closure. Use the Lane Status sign (with appropriate bars and arrows).

10. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic.

11. The distance D for sign spacing is given in Table 4.2.

12. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   
   a. a Speed Limit AHEAD sign, or
   
   b. a speed zone (see Table 4.7 for length of speed zone).

13. Refer to Table 4.6 for recommended taper lengths.

14. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right-hand side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

15. Mesh fencing may be installed in areas where pedestrian traffic requires separation/delineation from the work area.

16. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

17. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

18. For Termination area (see Clause 4.7.9).

19. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).
**Figure 5-1.15 – Long term lane closure of 2 outer lanes: multilane undivided road**

Diagram showing traffic control measures for long term lane closure of 2 outer lanes on a multilane undivided road. The diagram includes signs, lane markings, and traffic control devices to manage traffic during the work period.
NOTES TO FIGURE 5-1.15:

1. At night or when no work is being carried out, barrier boards may be erected along the work area at right angles to traffic flow (see Clause 3.8.3). Where excavation is involved, longitudinal delineation such as mesh fencing or closely spaced delineators should be used.

2. Misleading line marking should be temporarily erased, and lane and edge lines marked as required.

3. For traffic flow separation, use either:
   a. temporary barrier lines and raised retroreflective pavement markers, or
   b. a safety barrier (see Clause 3.10.2).

4. If work is only being performed in lane B, the left lane (Lane A) should normally be closed to provide sufficient space for worker safety and the method of work.

5. Consider local traffic access. Parking restrictions should apply adjacent to barrier lines.

6. An Antiglare Screen should be used where headlight glare may be a problem.

7. See Clause 3.8.2(a) if a special lane status sign is required.

8. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

9. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.

10. The distance D for sign spacing is given in Table 4.2.

11. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic.

12. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

13. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

14. Refer to Table 4.6 for recommended taper lengths.

15. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

16. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road.

17. Distance between tapers (see Clause 4.8.2).

18. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

19. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

20. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

21. Place double barrier lines and yellow raised retroreflective pavement markers at 12 m spacing (see Clause 3.9.5).
Figure 5-1.16 – Long term - closure of 2 central lanes: multilane undivided road

See Notes
NOT TO SCALE

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NOTES TO FIGURE 5.1.16:

1. At night or when work is being carried out, barrier boards may be erected along the work area at right angles to traffic flow (see Clause 3.8.3). Where excavation is involved, longitudinal delineation such as mesh fencing or closely spaced delineators should be used.

2. Misleading line marking should be temporarily erased, and lane and edge line marked as required (see Clause 3.9.4).

3. Consider local traffic access. Parking restrictions should apply throughout the work site.

4. If work is only being performed in lane C, an adjacent lane (D) should normally be closed to provide sufficient space for worker safety and the method of work.

5. If it is necessary to close lane B and C, an appropriate staggered taper similar (mirror imaged) to that show in Figure 5.1.15 should be used. A manoeuvre requiring the left-hand stream to shift laterally into the right-hand stream is to be preferred – see Clause 4.8.2.

6. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.

8. The distance D for sign spacing is given in Table 4.2.

9. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

10. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic.

11. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

12. Refer to Table 4.6 for recommended taper lengths.

13. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

14. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road.

15. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

16. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

17. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).
Figure 5-1.17 – Short term – closure of one side: multilane undivided road – low speed
NOTES TO FIGURE 5-1.17:

1. At night or when no work is being carried out, barrier boards may be erected along the work area at right angle to traffic flow (see Clause 3.8.3). Where excavation is involved, longitudinal delineation such as mesh fencing or closely spaced delineators should be used.

2. An Antiglare Screen should be used where headlight glare may be a problem.

3. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area or are no longer visible to traffic.

4. The distance D for sign spacing is given in Table 4.2.

5. Consider local traffic access. Parking restrictions should apply adjacent to barrier lines.

6. Refer to Table 4.6 for recommended taper lengths.

7. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

8. Misleading line marking should be temporarily erased, and lane and edge lines temporarily marked as required (Clause 3.9.4b)).

9. The safety buffer may be increase to 100 m on multi-lane roads (see Clause 4.1.4(c)).

10. Distance between tapers (see Clause 4.8.2).

11. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

12. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).
Figure 5-1.18 – Short term – closure of one side: multilane undivided road – high speed

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See Notes
NOT TO SCALE

Delineation (see Clause 3.9, 3.10.2)
NOTES TO FIGURE 5-1.18:

1. At night or when no work is being carried out, barrier boards may be erected along the work area at right angle to traffic flow (see Clause 3.8.3). Where excavation is involved, longitudinal delineation such as mesh fencing or closely spaced delineators should be used.

2. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

3. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

4. The distance D for sign spacing is given in Table 4.2.

5. Consider local traffic access. Parking restriction should apply adjacent to barrier lines.

6. An Antiglare Screen should be used where headlight glare may be a problem.

7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

8. Refer to Table 4.6 for recommended taper lengths.

9. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

10. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
    a. a Speed Limit AHEAD sign, or
    b. a speed zone (see Table 4.7 for length of speed zone).

11. Misleading line marking should be temporarily erased, and lane and edge lines temporarily marked as required (Clause 3.9.4b).

12. Consider use of ROADWORK 1 km Ahead and ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

13. The safety buffer may be increase to 100 m on multi-lane roads (see Clause 4.1.4(c)).

14. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

15. The ROADWORK AHEAD sign is required for long-term work site (see Clause 3.4.2).

16. Minimum D between tapers (see Clause 4.8.2).
Figure 5-1.19 – Lane closure: major roundabout
NOTES TO FIGURE 5-1.19:

1. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

2. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

3. A vehicle-or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

4. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

5. The distance D for sign spacing is given in Table 4.2.

6. Cover pavement arrows to allow all turns from single lane entry.

7. Refer to Table 4.6 for recommended taper lengths.

8. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

9. If installed, advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).
Figure 5-1.20 – Part lane closure: minor roundabout
NOTES TO FIGURE 5-1.20:

1. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

2. The distance D for sign spacing is given in Table 4.2.

3. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

4. Cones may be omitted if continuous operations are in progress and vehicle has a vehicle-mounted warning device activated.

5. Traffic Controllers may be used where larger vehicles, for example, buses, are unable to negotiate the remaining clear roadway width on the roundabout.

6. Four cones installed on the centreline in advance of Traffic Controller position (see Clause 4.10.2).
Figure 5-1.21 – Haul road crossing: two-way road

Application Table

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NOTES TO FIGURE 5-1.21:

1. If traffic signal lights cannot be seen from the Signal Ahead sign, install additional advance warning sign with a 1 km distance plate. To draw attention to these signs, flashing yellow lamps may need to be used (Clause 3.5.4c).

2. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2).

3. Traffic Controllers with Traffic Controller Ahead / PREPARE TO STOP signs or boom barriers with appropriate signs (see Figure 5-1.31) may be used instead of traffic signals on each approach.

4. If work continues into darkness, the haul road crossing will need to be suitably illuminated (see Clause 2.3.6).

5. If construction operations affect the condition of the through road pavement, the appropriate road condition signs should be used (see Figure 5-1.31 and Clause 3.7).

6. Consider use ROADWORK 1 km Ahead sign 1 km in advance of the haul road crossing for approach speeds greater than 80 km/h and sight distance less than 150 m (Clause 3.4.2).

7. The distance D for sign spacing is given in Table 4.2.

8. This arrangement is not to be used where normal road traffic uses the crossing.

9. The sign PREPARE TO STOP (T1-18) shall be used subject to the conditions in Clause 3.5.4e).

10. These signal lanterns may be mounted on signal standards supporting the lanterns directed along the normal roadway.

11. A maximum speed limit of 60 km/h shall be used (see Clause 4.11.3).

12. STOP HERE ON RED SIGNAL (R6-6) sign to be used in accordance with Clause 3.5.4d).

13. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

14. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

15. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

16. When traffic signals are used, the sign STOP HERE ON RED SIGNAL (R6-6) shall be installed when STOP line is not marked on the pavement. It is also recommended to supplement the STOP line where one is provided (see Clause 3.5.4d)). The STOP line is positioned 6 m in advance of the signal unit (see Clause 4.11.3).
**Figure 5-1.22 – Road closed: blasting**

NOTE: Same signing arrangement to be used at all other approaches to the work area.

For blasting works the temporary barrier should also block pedestrian access.

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**APPLICATION**

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NOTES TO FIGURE 5-1.22:

1. For general road closures, use ROAD CLOSED at the barrier.
2. Vehicle and pedestrian barriers should always be used where blasting is in progress. For other closures of short duration, barriers may be omitted.
3. At blasting works where flyrock and other debris is not controlled the temporary barrier should be erected not less than 500 m from the blasting area.
4. Prior to the start of blasting operations on or near a trafficked road, the following precautions should be taken to minimise traffic problems in the event of an accident or misfire that required a lengthy closure of the road reserve:
   a. The route of a detour should be planned so that it will carry traffic a safe distance away from the blasting area (see Figure 5-1.29)
   b. Sufficient signs and devices to mark and delineate the planned detour day and night should be available for immediate use.
5. Any temporary barrier should NOT be removed until the ALL Clear has been given at the end of blasting operations.
6. These signs are required only where electric detonators are handled and / or used (see Clause 3.13.2).
7. Reference should also be made to appropriate Acts and Regulations regarding blasting operations.
8. Consider use of ROADWORK 1 km Ahead or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).
9. A maximum speed limit of 60 km/h shall be used (see Clause 4.10.4).
10. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic.
11. Use PROBABLE DELAY 15 MINUTES sign where expected delays are considerable (see Clause 3.16.9a)).
12. The Traffic Controller Ahead / PREPARE TO STOP sign should only be used when Traffic Controllers are on duty. It should be covered or removed at all other times.
13. The distance D for sign spacing is given in Table 4.2.
14. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).
15. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Sings continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road.
16. Four cones installed on the centreline in advance of Traffic Controller position (see Clause 4.10.2).
17. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.
18. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2)
Figure 5-1.23 – High vehicle detour: two-way road
NOTES TO FIGURE 5-1.23:

1. For structures where the vertical clearance is more than 4.6 m but less than 5.3 m, the sign CLEARANCE …m (R6-12) (see Clause 3.15.4) is used. Where clearance is less than 4.6 m, the sign LOW CLEARANCE … m (R6-11) (see Clause 3.15.3) is used in conjunction with the (W4-8) sign (see Clause 3.15.3). The clearance in metres shown on this sign should be 0.15 m less than the temporary clearance of structures, scaffolding, falsework or temporary low clearance warning gauges, and should be shown to the nearest lower 0.1 m. On multi-lane roads, the LOW CLEARANCE …m (Ahead) (W4-8) sign shall be duplicated on the right-hand side of the roadway approaching the structure.

2. Low Clearance Warning Gauges (see Clause 3.15.6) should be used in advance of a temporary reduction of clearance to 5.3 m or less at an overhead structure. The desirable clearance should be not less than 4.6 m. The clearance provided under the gauges would be a minimum of 0.1 m less than the clearance of the structure. At locations of greater hazard, two low clearance warning gauges, a distance of 2D apart, should be used on each approach. The gauge nearest the structure should be rigid construction and provide a physical height restraint.

3. Any closure of part of the roadway during the bridge repairs should be signed in an appropriate manner to separate traffic from the work area (see another relevant example diagram for the situation). Also, the BRIDGEWORK Ahead sign should be erected in lieu of the ROADWORK Ahead sign. In addition, a further BRIDGEWORK Ahead sign should be erected a distance of 2D in advance of the LOW BRIDGE Ahead sign.

4. The detour should be signed at intersections along the route by sign G9-5-1 (see Clause 3.6.7 and Figure 5-1.29).

5. Means of regulated access for high vehicles beyond the Low Clearance Gauges should be provided if practicable and required by local traffic.

6. Relevant authority should be informed of the restriction (see Clause 2.4.6).

7. The distance D for sign spacing is given in Table 4.2.

8. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

9. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner, for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

10. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2).
Figure 5-1.24 – Long term – heavy vehicle detour: two-way road

See Notes
NOT TO SCALE

| APPLICATION |
|-------------|-----------|
| Term        | Long. See Note 8 |
| Road Type   | Two-way |
| Traffic Volume | All |
| Traveled Path | Around |
| (a) Direction | |
| (b) Width | 3 m min. See Note 7 |
| Control | Nil |
| Operation | Heavy vehicle detour |
| D | Table 4.2 |
NOTES TO FIGURE 5-1.24:

1. The detour should be indicated at intersections along the route by the DETOUR FOR HEAVY VEHICLES sign (G9-5-2) (see Clause 3.6.7 and Figure 5-1.29).

2. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2).

3. Any closure of part of the roadway during bridge repairs should be signed in an appropriate manner to separate traffic from the work area (see another relevant example diagram for the situation). Also, the BRIDGEWORK Ahead sign should be erected in lieu of the ROADWORK Ahead sign. In addition, a further BRIDGEWORK Ahead sign should be erected a distance of 2D in advance of the LOAD LIMIT ON BRIDGE sign.

4. Relevant authority should be informed of the restriction (see Clause 2.4.6).

5. On multi-lane roads, the BRIDGE LOAD LIMIT ...t GROSS sign shall be duplicated on the right-hand side of the roadway approaching the structure.

6. The distance D for sign spacing is given in Table 4.2.

7. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

8. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).
Figure 5-1.25 – One-lane side track: two-way road

Supplement to Part 3: Traffic control for works on roads
NOTES TO FIGURE 5-1.25:

1. The side track lane width should be NOT less than 3 m (see Clause 4.13.3). Curves should be constructed to suit the approach speed; however, if this is not practicable appropriate curve and advisory speed signs should be placed.

2. If existing road is sealed and the side track is to be used for an extended period, it should be sealed (see Clause 4.14.3) and appropriate temporary line marking placed. Misleading line marking should be temporarily erased, and for use over an extended period, edge lines marked.

3. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2). On multi-lane or one-way roadways where practicable, signs shall be duplicated on the right-hand side where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

4. Consider whether parking should be prohibited on the approach to the side track.

5. An Antiglare Screen may be necessary on short side tracks on straight roads (see Clause 3.16.7).

6. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.

7. The distance D for sign spacing is given in Table 4.2.

8. Consider use of ROADWORK 1 km AHEAD or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

9. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

10. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

11. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign; or
   b. a speed zone (see Table 4.7 for length of speed zone).

12. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

13. Consider local traffic access.

14. At night or when no work is being carried out, barrier boards may be erected along the work area at right angles to traffic flow (see Clause 3.8.3). Where excavation is involved, longitudinal delineation such as mesh fencing or closely spaced delineators should be used.

15. Consider the need for lighting the length of the side track (see Clause 2.3.6) and the side track departure points.
Figure 5-1.26 – Two-way side track: two-way road
NOTES TO FIGURE 5-1.26:

1. The width of side track for traffic lanes should be not less than 6 m (see Clause 4.13.3). Curves should be constructed to suit the approach speed; however, if this is not practicable, appropriate curve and advisory speed signs should be placed.

2. If this existing road is sealed and the side track is to be used for an extended period, it and the approaches should be sealed (see Clause 4.13.3) and appropriate temporary line marking placed. Misleading line marking should be temporarily erased, and for use over an extended period, edge lines marked.

3. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2). On multi-lane or one-way roadways where practicable, signs shall be duplicated on the right-hand side where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

4. Means of access past temporary barriers should be provided for local traffic if necessary.

5. Because of the nature of the two-way operation, consider whether means should be provided to exclude pedestrians and prohibit parking over the length of the side track.

6. An Antiglare Screen may be necessary on short side tracks on straight roads (see Clause 3.16.7).

7. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.

8. Consider use of ROADWORK 1 km AHEAD or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).

9. The distance D for sign spacing is given in Table 4.2.

10. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

11. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

12. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

13. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

14. Consider the need for lighting the length of the side track (see Clause 2.3.6) and the side track departure points.
Figure 5-1.27 – Contraflow crossing median (crossover): multilane, divided road
NOTES TO FIGURE 5-1.27:
1. Side track pavement width should be not less than 3 m (see Clause 4.13.3). Curves should be constructed to suit the approach speed; however, if this is not practicable appropriate signing should be placed to warn and guide traffic.
2. Misleading line marking should be temporarily erased, and for use over an extended period, edge lines marked.
3. The temporary dividing line on the single open roadway shall be treated with extra delineation as appropriate (see Clause 4.14.6). Depending on traffic volumes and speeds, the following additional delineation should be considered:
   a. conversion of the dividing line to double unbroken
   b. reducing spacing of RRPMs to one-half or one-quarter of normal spacing and/or
   c. use of lane dividers (see Clause 3.9.5).
   Alternatively, provision of a safety barrier, appropriately delineated should be considered.
4. An Antiglare Screen should be used where headlight glare may be a problem (see Clause 3.16.7).
5. Depending on length of the contraflow section, repeat Two-way Traffic sign (W4-11) as required (see Clause 3.6.8). Two-way Traffic signs are not required if a safety barrier is used to separate opposing traffic.
6. Means should be provided to exclude pedestrians or warn them of the two-way traffic operation (see Clause 4.14.8). Parking should be prohibited over length of the contraflow.
7. Means of access past temporary barriers should be provided for local traffic if necessary.
8. The distance D for sign spacing is given in Table 4.2.
9. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).
10. The maximum length of two-way operations on a one-way roadway is to be 2 km (desirably 1 km).
11. Temporary speed zone to meet workplace or traffic safety requirement (see Clause 4.2). Cover or alter if inappropriate at night.
12. Consider use of ROADWORK 1 km AHEAD or ROADWORK 500 m Ahead signs in advance of the taper at the work site for approach speeds of 90 km/h or greater, especially when the work site requires a reduction in speed of 40 km/h or more (see Clause 4.7.2).
13. Refer to Table 4.6 for recommended taper lengths.
14. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).
15. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).
16. 40 km/h speed zone only required if road geometry or surface condition of crossover requires this reduced limit.
17. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.
18. Distance between tapers (see Clause 4.8.2)
19. Consider the need for lighting the length of the contraflow section (see Clause 2.3.6) and the crossover points.
Figure 5-1.28 – One direction detour: two-way road

APPLICATION

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See Notes NOT TO SCALE
NOTES TO FIGURE 5-1.28:

1. Direction and reassurance signs may be required for through traffic that is required to detour. A Reassurance DETOUR sign (T5-1A) (see Clause 3.6.4) should be used where the route of the detour is not clear.

2. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2). On multi-lane or one-way roadways where practicable, signs shall be duplicated on the right-hand side where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

3. Means of access for local traffic and pedestrians across the work area should be provided if practicable and suitable signs erected (see Clauses 2.3.7, 4.14.4 and 4.14.5).

4. Consider whether parking should be prohibited adjacent to the work area.

5. Consider the use of temporary barrier lines to prevent overtaking on the approaches to the work area (normally a distance 2D in advance of the start of the detour). Where barrier lines are not used, traffic cones at 5–25 m spacing along the centreline should be used. Traffic cones are not suitable for night operation.

6. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.

7. The NO ENTRY sign should be erected in accordance with Clause 3.16.9b).

8. Traffic arrangements should be set out in accordance with the requirements of other relevant diagrams.

9. The distance D for sign spacing is given in Table 4.2.

10. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic.

11. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

12. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner, for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

13. See Clause 3.4.8 for END DETOUR signs.
**Figure 5-1.29 – Detour all traffic: two-way road**

### APPLICATION

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NOTES TO FIGURE 5-1.29:

1. Destination signs may be required for through traffic required to detour. A reassurance DETOUR sign (T5-1A) (see Clause 3.6.4) should be used where the route of the detour is not clear.

2. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2). On multi-lane or one-way roadways where practicable, signs shall be duplicated on the right-hand side where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

3. Means of access for local traffic and pedestrians across the work area should be provided if practicable and suitable signs erected (see Clauses 2.3.7, 4.14.4 and 4.14.5).

4. Consider the use of temporary barrier lines to prevent overtaking on the approaches to the work area (normally a distance 2D in advance of the start of the detour). Where barrier lines are not used, traffic cones at 5–25 m spacing along the centreline should be used. Traffic cones are not suitable for night operation.

5. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.

6. The distance D for sign spacing is given in Table 4.2.

7. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner, for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

8. This sign may be required where local access to property in advance of the road closure is required to be maintained.

9. See Clause 3.4.8 for END DETOUR signs.
Figure 5-1.30 – Exit closure: multilane, one-way roadway
NOTES TO FIGURE 5-1.30:

1. The distance D for sign spacing is given in Table 4.2.
2. Barrier and the ROAD CLOSED sign (T2-4-Q01) (see Clause 3.8.2b)) should be placed at right angles to exit ramp direction.
3. The destination from which traffic has been diverted may need to be added to the alternative exit advance direction signs.
4. Warning of the exit closure should be given in advance of the preceding off-ramp when the associated exit is the alternative route.
5. A suitable route should be signed (as Jones St detour) to guide diverted traffic to its original destination (Jones St exit).
6. The … EXIT CLOSED – ALTERNATIVE sign may need to be repeated a distance 3D in advance of the alternative exit to advise vehicles in the right-hand lane(s) to change lanes.
7. Where the alternative exit is beyond the closed exit, the … EXIT CLOSED – ALTERNATIVE signs are omitted, and the EXIT CLOSED sign should be supplemented with a specially designed temporary alternative exit sign.
8. Temporary warning signs (black and yellow) with the destination name(s) of the closed exit should be mounted in conjunction with exit direction and advance exit direction signs (see Clause 4.14.9).
9. Existing exit signing to the destination should be covered.
Figure 5-1.31 – Road temporarily closed: two-way road

See Notes
NOT TO SCALE

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<td>Control</td>
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<tr>
<td>Operation</td>
</tr>
<tr>
<td>D</td>
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</table>
NOTES TO FIGURE 5-1.31:

1. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

2. Portable or temporary traffic signals (with appropriate signs) may be used in lieu of a Traffic Controller or a boom barrier.

3. Appropriate road condition signs (see Clause 3.7.2) are used and spaced as required and covered when not appropriate. Advisory Speed signs may be used in conjunction with these signs (see Clause 3.7.3). Where traffic is approaching a haul road crossing (see Figure 5-1.21).

4. For works on unsealed roads see Clause 4.5.

5. Where works is confined to a single lane only, traffic operating in the unobstructed lane may be controlled by using a Workers (symbolic) sign and Speed Limit sign on the approach to the works. At the other end of works an END ROADWORK sign and appropriate Speed Limit sign would be needed at a distance 2D beyond the work area.

6. Use PROBABLE DELAY 15 MINUTES sign where expected delays are considerable.

7. The distance D for sign spacing is given in Table 4.2.

8. The Traffic Controller Ahead / PREPARE TO STOP sign should only be used where Traffic Controllers using STOP / SLOW bats are on duty. It should be covered or removed at all other times.

9. Consider use of ROADWORK 1 km Ahead sign 1 km in advance of the work area for approach speed greater than 80 km/h and sight distance less than 150 m (see Clause 3.4.2).

10. A maximum speed limit of 60 km/h on approach to the Traffic Controller or boom barrier shall be used (see Clause 4.10.4).

11. All machinery operating on the roadway under traffic must be equipped with appropriate devices (see Clause 3.12).

12. Four cones installed on the centreline in advance of Traffic Controller position (see Clause 4.10.2).

13. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

14. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2).

15. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than two weeks should be erected in a permanent manner; for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).
Figure 5-1.32 – Line marking: all roads
NOTES TO FIGURE 5-1.32:

1. The cab-mounted sign (T6-Q06) should have the chevron panel correctly adjusted depending on operation (see Clause 3.12.3). An illuminated flashing arrow sign may be used in lieu of a chevron panel (see Figure 4.3).

2. Work vehicle should operate with headlights illuminated.

3. For edge lining right-hand side of pavement of a one-way roadway, use LINE MARKING sign T6-Q06 (L). This sign should also be used for lane lining where appropriate.

4. Static line marking operations such as intersection painting should be regarded as the same as other works areas and treated in a similar way to the relevant short-term works arrangement given in Figures 5-1.4, 5-1.6, 5-1.7, 5-1.8 and 5-1.11.

5. The location of the work vehicles and associated signing may need to be adjusted depending on the configuration and/or operation of the line marking machine. Such adjustments may be necessary where the shoulder is unsealed or where the edge line is marked from the centre line using an outrigger.

6. A lead vehicle shall be used where an outrigger is used off the centre line.

7. An arrow board may be cab-mounted below the LINE MARKING (T6-Q07) sign or mounted on the vehicle body facing to the rear (see Clause 3.12.3).

8. Consideration should be given to the fitting of CB radios in work vehicles to give heavy vehicles prior warning of line marking operations and to advise the safe passage through the work.

9. This signing arrangement may also be used for laying pavement markers. In this case, the LINE MARKING sign is replaced by Workers (symbolic) signs on the vehicles (see Clause 3.12.3).

10. Lead vehicle distance should be 200–400 m in open road and 30–100 m in built-up areas (see Clause 4.6.3f)).

11. Tail vehicle distance should be 300–500 m in open road and 200–300 in built-up areas (see Clause 4.6.3f)).
Figure 5-1.33 – Kerbside work: intersection of minor roads

APPLICATION

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<tr>
<td>(b) Width</td>
<td>3 m min. See Note 4</td>
</tr>
<tr>
<td>Control</td>
<td>Nil. See Note 1</td>
</tr>
<tr>
<td>Operation</td>
<td>Maintenance, Full lane closure</td>
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<tr>
<td>D</td>
<td>Table 4.2</td>
</tr>
<tr>
<td>Taper</td>
<td>Table 4.6</td>
</tr>
</tbody>
</table>
NOTES TO FIGURE 5-1.33:

1. If traffic control at the intersection is a problem, Traffic Controllers or a Police officer may be needed. In this case of a Traffic Controller (see Clause 4.10), a Traffic Controller Ahead / PREPARE TO STOP sign should be erected 2D in advance of the work area (see Clause 4.10.2). In the case of a Police control, appropriate signs may also be required.

2. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic.

3. Refer to Table 4.6 for recommended taper lengths.

4. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

5. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

6. The distance D for signs spacing is given in Table 4.2.
Figure 5-1.34 – Kerbside work: intersection of a minor and a major road
NOTES TO FIGURE 5-1.34:

1. Leave sufficient space here for a vehicle to wait when another vehicle is coming out of the street.
2. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater.
3. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2). On multi-lane or one-way roadways where practicable, signs shall be duplicated on the right-hand side where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.
4. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night. Remove when workers have left the work area.
5. The distance D for sign spacing is given in Table 4.2.
6. Refer to Table 4.6 for recommended taper lengths.
7. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).
8. The Workers (symbolic) sign shall be removed when workers have left the area or are no longer visible to traffic.
9. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).
10. The vehicle should be parked:
    a. so it does not unduly obstruct motorists’ vision of the travelled path
    b. to leave a clear escape path for workers, and
    c. where necessary, in advance of the work area to protect workers.
Figure 5-1.35 – Kerbside work: intersection of two major roads
NOTES TO FIGURE 5-1.35:

1. Consider local traffic access. Parking restrictions should apply adjacent to barrier lines. Provision should be made for pedestrians.

2. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

3. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2). On multi-lane or one-way roadways where practicable, signs shall be duplicated on the right-hand side where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.

4. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

5. The distance D for sign spacing is given in Table 4.2.

6. Refer to Table 4.6 for recommended taper lengths.

7. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

8. Temporarily remove barrier lines as necessary.

9. Antiglare Screen may be required.

10. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

11. The vehicle should be parked:
   a. so it does not unduly obstruct motorists’ vision of the travelled path
   b. to leave a clear escape path for workers, and
   c. where necessary, in advance of the work area to protect workers.

12. Distance between tapers (see Clause 4.8.2).
Figure 5-1.36 – Work occupying the full width of a footpath

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<tr>
<td>Traffic Volume</td>
<td>All</td>
<td></td>
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<tr>
<td>Travelled Path</td>
<td>(a) Direction</td>
<td>Past</td>
</tr>
<tr>
<td></td>
<td>(b) Width</td>
<td>3 m min. each direction See Note 14</td>
</tr>
<tr>
<td>Control</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Work wholly or principally on the sealed footpath area</td>
<td></td>
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<tr>
<td>D</td>
<td>Table 4.2</td>
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</tr>
<tr>
<td>Taper</td>
<td>Table 4.6</td>
<td></td>
</tr>
</tbody>
</table>
NOTES TO FIGURE 5-1.36:

1. Provide a full width temporary ramp for prams and all-weather surface on unpaved pedestrian areas (see Clause 2.3.8).
2. Prohibit vehicles stopping along length of narrowed roadway.
3. Where pedestrians will be required to divert onto the roadway for an extended period, consider the use of a safety barrier.
4. A clear width of not less than 2 m should be provided for pedestrian traffic (see Clause 2.3.8).
5. Separate trees and other facilities from the work area where damage may otherwise occur.
6. Arrange vehicular access to the work site, for example, by using movable barriers or sections of mesh fencing, so that pedestrians are not able to enter the work site inadvertently.
7. The distance D for sign spacing is given in Table 4.2.
8. Advance warning signs and all other signs may be required on the right-hand side of roads where the volume is 10,000 vpd or greater (see Clause 2.5.2). On multi-lane or one-way roadways where practicable, signs shall be duplicated on the right-hand side where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.
9. The remaining width of the lane affected by the works should be in accordance with Clause 4.13.3.
10. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Cover or alter if inappropriate at night.
11. The Worker (symbolic) sign shall be removed when workers have left the work area or are no longer visible to traffic.
12. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).
13. Refer to Table 4.6 for recommended taper lengths.
14. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).
15. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner, for example, on posts sunk into the ground, and duplicated on the right side of the road.
16. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).
17. Consider use of ROADWORK 1 km Ahead sign 1 km in advance of the work area for approach speeds greater than 80 km/h and sight distance less than 150 m (see Clause 3.4.2.).
18. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.
Figure 5-1.37 – Closure of two outer lanes: one direction – multilane road

<table>
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<tr>
<th>APPLICATION</th>
<th>Term</th>
<th>Road Type</th>
<th>Traffic Volume</th>
<th>Travelled Path</th>
<th>Control</th>
<th>Operation</th>
<th>D</th>
<th>Taper</th>
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<td>Long/Short. See Note 7 and Note 12</td>
<td>Multilane, undivided</td>
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<td>Past</td>
<td>Nil</td>
<td>Closure over two adjacent lanes</td>
<td>Table 4.2</td>
<td>Table 4.6</td>
</tr>
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</table>
NOTES TO FIGURE 5-1.37:

1. Where excavation is involved, longitudinal delineation such as mesh fencing or closely spaced delineators should be used. Safety barriers may also be considered.

2. Consider local traffic access requirements.

3. The distance D for sign spacing is given in Table 4.2.

4. Consider use of ROADWORK 1 km Ahead sign 1 km in advance of the first taper at the work site for approach speeds greater than 80 km/h.

5. Temporary speed zone to meet workplace or traffic safety requirements (see Clause 4.2). Remove when workers have left the work area.

6. A vehicle- or trailer-mounted illuminated flashing arrow sign shall be used where the traffic volume is 1,500 vpd or greater and the temporary speed limit during roadworks on approach to the taper is 70 km/h or greater (see Clause 4.8.3).

7. For works of long-term duration, adapt Figure 5-1.15 and replace traffic cones with temporary edge line and use barrier line along centreline of road.

8. Adopt a similar treatment for closure of right lanes. Use the Lane Status sign (with appropriate bars and arrows). Also, consider the need for parking restrictions in the vicinity of the work site.

9. Advance warning (see Clause 4.9.5) shall be provided by a buffer zone comprising either:
   a. a Speed Limit AHEAD sign, or
   b. a speed zone (see Table 4.7 for length of speed zone).

10. Refer to Table 4.6 for recommended taper lengths.

11. The minimum lane width including trafficable shoulder shall be 3.0 m (see Clause 4.13.3).

12. Advance signs shall be displayed as prominently as possible by selecting the longitudinal location of the sign for best sight distance for approaching traffic. Signs continuously required for works which will be in progress for periods longer than 2 weeks should be erected in a permanent manner, for example, on posts sunk into the ground, and duplicated on the right side of the road. Flashing lamps may be used to draw attention to advance signs (see Clause 3.11).

13. The safety buffer may be increased to 100 m on multi-lane roads (see Clause 4.1.4(c)).

14. This figure has advance and departure speed signage for 100 km/h speed zone. MUTCD Part 3 Supplement Section 4.7.2-1 (Clause 5) illustrates the typical options available for speed signage at roadworks sites for a number of different speed environments. The advance signing options given in Supplement Section 4.7.2-1 may be used when work is being undertaken on roads with other posted speed limits.

15. The distance between successive merge tapers on a multilane road is given in Clause 4.8.2.

16. Where practicable, signs shall be duplicated on the right-hand side of a one-way roadway where the volume is 10,000 vpd or greater (see Clause 2.5.2). These signs may be required for the multi-lane undivided road situation.