

Guideline

Traffic management procedures for tunnel closures

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1 Introduction

The purpose of this guideline is to describe the traffic management practices to be used on the approaches to a tunnel when the occurrence of an incident (planned or unplanned) requires full closure of the tunnel carriageway.

This guideline is issued under the authority of Section 166 of the *Transport Operations (Road Use Management) Act 1995*. The contents of this guideline are issued as an 'approved notice' under Section 166(2) of said Act.

The requirements of this guideline apply only to tunnel ramps that are located directly off a motorway or freeway (that is, a high-flow, high-speed environment) or off arterials operating under motorway / freeway conditions.

These practices, and the processes in which they are applied, are to be further articulated in the incident management and subsequent traffic control plans for both planned and unplanned incidents during the daily operation of the tunnel.

The full operational plan and risk assessments for the tunnel will be required to be developed separately by each Tunnel Operator. The following requirements are to be considered as a minimum only and each situation should be individually assessed to determine if any additional devices are required. Planned closures will also necessitate additional traffic control devices in accordance with the Queensland *Manual of Uniform Traffic Control Devices Part 3 Traffic control for works on roads*.

Table 1(a) – Abbreviations

Abbreviation	Full title
CCTV	Closed Circuit Television
CMS	Changeable Message Sign
IPL	In-pavement Lighting
LED	Light Emitting Diode
MUTCD	Queensland Manual of Uniform Traffic Control Devices
PA system	Public Address system
MRTS	(Transport and) Main Roads Technical Specifications
TMC	Traffic Management Centre
TRUM manual	Traffic and Road Use Management manual
UPS	Uninterruptible Power Supply
VMS	Variable Message Sign
VSL	Variable Speed Limit Sign

Table 1(b) – Definition of terms

Term	Definition
Changeable message sign	Signs capable of displaying several messages that can be flipped manually or automatically to display the desired information
Decision point	An exit off a motorway or freeway that is likely to provide a motorist with an alternative route to that of the motorway or freeway
Jog switch	A mechanism used to lower a boom gate in controlled, partial movements
Mainline	The running lanes of the through carriageway, excluding entry ramps, exit ramps, shoulders, stopping bays and emergency vehicle crossovers
Tunnel portal	The entrance to the tunnel where a physical structure is used to control entry
Turn-around facility	A dedicated break in the barrier or central median used to turn tunnel-bound vehicles around prior to the tunnel portal
Uninterruptable power supply	A system designed to provide power, without delay, during any period when the normal power supply is incapable of performing acceptably
Variable speed limit sign	A sign used to indicate the posted speed limit that has the ability to alter the regularly speed according to the operational conditions of the road

2 Background

When the occurrence of an incident (planned or unplanned) requires full closure of a tunnel carriageway, it is essential that the traffic is managed in a way that will minimise the safety and operational effects on the surrounding road network as a result of the closure.

In particular, where the entry ramp to a tunnel diverges off a motorway or freeway, the traffic management processes employed should not create secondary safety issues (for example, vehicles queuing onto the motorway or freeway) nor should they impede the operation of the mainline.

3 Description and use of closure devices

The traffic management requirements for a tunnel closure, herein called closure, are divided into three stages:

1. warning
2. physical closure, and
3. re-opening.

In the case of an unplanned closure, Stage 2 shall be enacted as soon as practical after Stage 1. The time between the initiations of the two stages will be dependent upon each situation and as specified / agreed by the road network owner/s.

In the case of a planned closure, the time between the initiations of Stage 1 and Stage 2 will generally be the time for a vehicle to travel from the first warning device on the motorway / freeway to the tunnel portal.

3.1 Stage 1 – Warning

Stage 1 consists of the following components:

- a) variable message signs (VMS)
- b) warning signs
- c) LED in-pavement lights
- d) variable speed limits signs
- e) audible alarm, and
- f) public address system.

These warning devices are located on the mainline, at the diverge, and on the ramp to the tunnel itself and are to be activated simultaneously in the event of a closure. Refer to the [Standard Drawings](#) for a comprehensive layout of these devices.

3.1.1 Variable message signs

As a minimum, a VMS is to be provided prior to the last decision point before the tunnel exit. This sign is to be used to inform motorists of the closure and to encourage the use of alternative routes. A VMS is to also be provided at the tunnel portal, directly above the entrance. In the event of a closure, this VMS will display the text TUNNEL CLOSED / ALL VEHICLES STOP / WAIT FOR / EMERGENCY SERVICES. All VMSs shall comply with the requirements of the Austroads [Guide to Traffic Management](#), the Queensland Manual of Uniform Traffic Control Devices (MUTCD), and Technical Specification MRTS202 *Variable Message Signs*.

3.1.2 Warning signs

The following warning signs are to be provided both on the mainline and at the diverge:

- a) Advance warning signs in the form of changeable message signs (CMSs) are to be used in conjunction with any tunnel advance static direction signs on the motorway, typically 1 km and 500 m prior to the exit. The CMS panels are to be incorporated into the static direction signs such that the text 'TUNNEL CLOSED' can be displayed in the event of a closure (see Standard Drawings). Additionally, two alternately-flashing yellow lights, each complying with the requirements of [Australian Standard](#) AS 2144 *Traffic signal lanterns*, are to be positioned on either side of the CMS panel and will be activated when the CMS displays the closure message. All CMS shall comply with the requirements of the Queensland MUTCD and Technical Specification MRTS227 *Changeable Message Signs*. The locations of all advance direction signs shall comply with the requirements of the Queensland MUTCD.
- b) Additionally, a flashing static warning sign is to be provided on the approach side of the diverge from the motorway or freeway to the tunnel ramp. The sign is to display the text TUNNEL CLOSED WHEN FLASHING, DO NOT EXIT. Two alternately-flashing yellow lights, each complying with the requirements of AS 2144, are to be provided in both top corners of the sign and will be activated in the event of a closure. The static sign shall comply with the requirements of the Queensland MUTCD.

3.1.3 LED in-pavement lights

Red Light Emitting Diode (LED) in-pavement lighting (IPL) is to be installed in the pavement along the full length of the continuity line at the diverge from the motorway to the tunnel ramp. The lights shall

have dimensions that comply with the requirements of Australian Standard AS/NZS 1906.3 *Retroreflective materials and devices for road traffic control purposes, Part 3: Raised pavement markers (retroreflective and non-retroreflective)*. The lights are to be spaced in accordance with the Queensland MUTCD Part 2 *Traffic Control Devices for General Use*. The IPL will only be activated during the event of a closure, that is, no IPL will be used during normal operating conditions. When activated, the IPL is to remain fully lit.

3.1.4 Variable speed limit signs

Variable speed limit signs (VSLS) are to be provided on the tunnel ramp to reduce the speed in the event of a closure. The signs shall be located as close to the diverge as possible while still being apparent to motorway traffic that the speed applies to the ramp only. In the event of a closure, these signs shall reduce the ramp regulatory speed limit. The maximum posted speed limit on the ramp during a closure shall be 60 km/hr. All VSLS shall comply with the requirements of the Austroads *Guide to Traffic Management*, the Queensland MUTCD, and Technical Specification MRTS206 *Provision of Variable Speed Limit and Lane Control Signs*.

3.1.5 Audible alarm

An audible alarm is to be located at the tunnel portal to provide an audible warning of the closure where use of the tunnel by people walking or riding bikes is permitted.

3.1.6 Public address system

A PA system shall be used at the tunnel portal where use of the tunnel by people walking or riding bikes is permitted.

3.2 Stage 2 – Physical closure

A physical barrier must be installed to prevent traffic driving into the tunnel when the occurrence of an incident requires full closure of the tunnel carriageway. The physical barrier must incorporate the following components:

- a) boom gate/s, and
- b) dual-aspect traffic signals.

Where a turnaround facility is not provided within 200 m of the tunnel portal, the traffic management measures for Stage 2 shall be duplicated just prior to the turnaround facility.

Stage 2 may be activated automatically after a predetermined period of time after the initiation of Stage 1, or manually by an operator at the Tunnel Traffic Management Centre (TMC).

3.2.1 Traffic signals

Dual-aspect traffic signals are to be mounted and operated as follows:

- a) For carriageways with two or more lanes, one set of signals is to be provided on each side of the carriageway. For single-lane carriageways, one set of signals is to be provided on the left-hand-side of the carriageway only.
- b) Each set of signals must be mounted horizontally on the side of the carriageway, just prior to the boom gate/s.
- c) They shall be used in conjunction with an R6-6 STOP HERE ON RED SIGNAL sign.
- d) Each set of signals must be housed in a single mounting enclosure and consist of dual red aspects.
- e) When activated, the dual red aspect signals in each set must flash alternately with an adjustable mark space ratio of 1.1:1, a cycle period of 1.1 seconds and must be adjustable in the range 0.5 to 3.0 seconds in 0.1 second increments. The flash controller must provide an overlap in ON time so that, at any instant in the cycle, at least one aspect is energised.
- f) A white stop bar is to be painted on the pavement at the same physical location as the signals.

The signals must comply with the requirements of AS 2144, the Queensland MUTCD, and Technical Specification MRTS93 *Traffic Signals*. All signs and pavement markings must comply with the requirements of the Queensland MUTCD.

3.2.2 Boom gate/s

A boom gate is to be provided at the tunnel portal. Where there are two or more lanes at the portal, two boom gates are to be used with a maximum clearance of 2 m between booms. The boom gate/s must incorporate the following features:

- a) the boom arm is to move from a vertical to a horizontal position; when in the 'closure' position, the boom gate is to always remain perpendicular to the traffic stream
- b) the boom arm is to be red-and-white striped and is to be fitted with high visual impact red flashing lanterns that are activated when the boom gate arm starts to lower; the boom arm design is to comply with the requirements of the Queensland MUTCD Part 7 *Railway Crossings*
- c) there is to be a panelled section that extends from the boom gate arm to the road surface when the gate is in the closure position
- d) the gates are to lower via a jog switch mechanism which allows the boom to be lowered in partial movements to increase visibility, and
- e) there is breakaway of the boom gate arms at vehicle speeds of greater than 10 km/hr or bends and distortion at lower-speed impacts.

The boom gate may be lowered automatically after some period of time after the initiation of the flashing red signals or manually by an operator at the Tunnel TMC. Where pedestrian and/or cyclist use of the tunnel is permitted, separate gates are to be provided on these paths.

3.3 Stage 3 – Re-opening

The re-opening procedure will be dependent upon each situation and shall be outlined in the tunnel's operational plans. Generally, once all physical closure devices have been removed, warning devices shall not be switched off until it is safe to do so as determined by the Tunnel Operator.

4 Additional requirements

4.1 CCTV coverage

In addition to the requirements set out in the previous sections, full CCTV coverage of the following areas is to be provided and shall be able to be viewed directly from both the Tunnel TMC and the Transport and Main Roads' Regional TMC to allow manual assistance / intervention during a closure:

- a) section/s of the mainline affected by the tunnel warning devices
- b) the diverge from the mainline to the tunnel ramp
- c) entire length of the tunnel ramp from the diverge to the tunnel portal
- d) turnaround facility, and
- e) tunnel portal.

4.2 Uninterruptible power supply

All traffic management systems and devices outlined in this guideline are considered by Transport and Main Roads to be critical tunnel infrastructure. As such, these systems and devices shall be backed up by a UPS system/s to allow full operation of all critical infrastructure (including VMS display) for the greater of the time nominated by the *Fire Engineering Design Brief* and two hours. The UPS may be fed by a diesel generator.

5 Drawings

See attached drawings.

Figure 5(a) – Tunnel advance direction sign (normal use) – example only



Figure 5(b) – Tunnel advance direction sign (tunnel closure) – example only



Figure 5(c) – Traffic management practice for tunnel closure – motorway to diverge

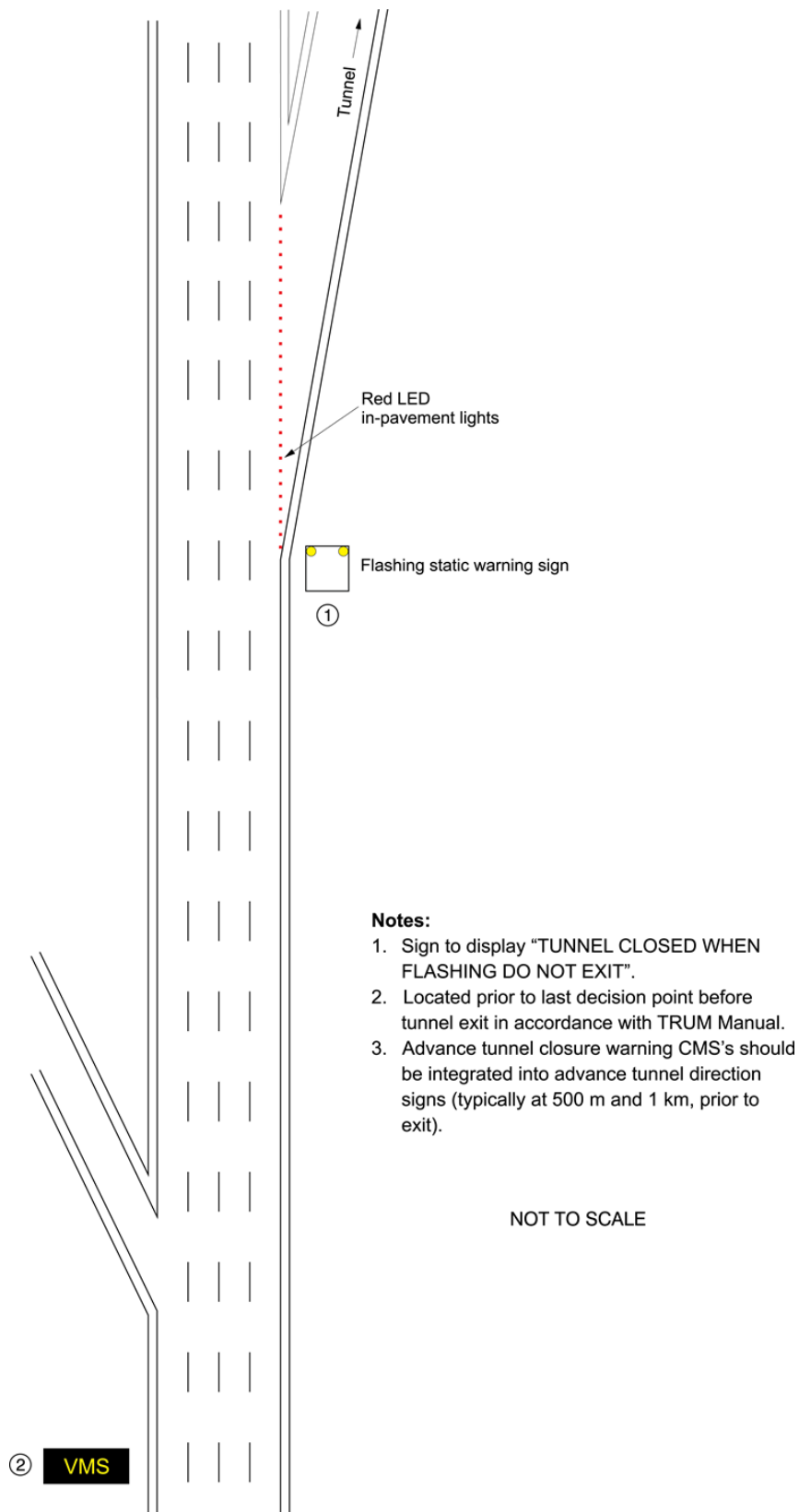


Figure 5(d) – Traffic management practice for tunnel closure – diverge to tunnel portal

