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Guidelines for Variable Message Signs

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Guidelines for Variable Message Signs

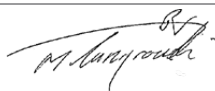

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Variable Message Signs Guidelines

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Foreword

Main Roads policy and guidelines

Main Roads Western Australia's (Main Roads) Smart Freeways policy and various guidelines influence overall planning, project development, delivery and ongoing operation of Smart Freeways and routes in Western Australia.

The Smart Freeways documents were originally developed as part of the Managed Freeways Policy Framework in 2012. At that time Main Roads used the term 'Managed Freeways', which was changed to 'Smart Freeways' at the time of the first Smart Freeways project on Kwinana Freeway northbound. The 2020 updated documents supersede the previous Managed Freeways documents.

Historically, Intelligent Transport Systems (ITS) on freeways were typically case-by-case. Our current approach is outlined in the Smart Freeways Policy, which states that all freeways are considered for ITS provision at either foundation or higher order standard according to these guidelines.

The Main Roads' Smart Freeways policy and guidelines comprise the documents listed in the table below. This document is shown highlighted.

Document	Description
Smart Freeways Policy	One page high-level policy statement setting out Smart Freeways objectives and principles.
Smart Freeways Policy Framework Overview	Smart Freeways context, principles, corporate governance, processes and intended outcomes to achieve policy objectives.
Smart Freeways Provision Guidelines	Guidelines and warrants for application of Smart Freeways traffic management treatments and ITS devices.
Smart Freeways Operational Efficiency Audit Guidelines	Guidelines for formal examination of traffic analysis and design of all freeway projects.
Guidelines for Variable Message Signs	Guidelines for the design and use of variable message signs for traveller information for safe and efficient travel for road users.
Supplement to Victoria's Managed Motorway Design Guide, Volume 2: Design Practice, Parts 2 and 3	Main Roads' Supplement relating to: <ul style="list-style-type: none"> • Network optimisation tools (benefits and operation of coordinated ramp signals). • Planning and design for mainline, entry ramps (including ramp signals), exit ramps and interchanges.
Supplement to Victoria's Managed Freeways Handbook for Lane Use Management and Variable Speed Limits	Main Roads' Supplement relating to: <ul style="list-style-type: none"> • Lane use management system (LUMS). • Variable speed limits (VSL).

Smart Freeways concept

Smart Freeways make the best use of the existing freeway network, particularly during times of high demand and traffic incidents. We use ITS and operational strategies that enable dynamic network management and operation in real-time. Smart Freeways traffic management initiatives, complemented by appropriate mainline and ramp geometric improvements, work together as an integrated system to achieve and maintain optimal freeway traffic conditions, with minimal delays and congestion.

Over recent years, Victoria's approach to managed motorways in Melbourne has achieved unparalleled, sustainable benefits to freeway operations for safety, productivity, efficiency and reliability. We have applied the same holistic principles and learnings, while also working towards national consistency.

Guidelines for Variable Message Signs

These guidelines are based on, and supersede the previous 'Guidelines for Variable Message Signs' (VMS) dated October 2015. They apply to the wider freeway network (including high standard arterial routes being progressively upgraded to freeways) and to arterial roads. They also include a section on portable VMS (pVMS) for use at roadworks and events.

Using VMS to provide up-to-date information for travellers optimises road network operations and safety performance. Travellers improve their transport choices using VMS details such as travel times, traffic conditions, congestion and incident information. The benefits include:

- Influencing road user route choices (during an incident, roadworks, planned event or congestion).
- Improving safety in changing road conditions (lane closures, reduced visibility or an incident, which may reduce the likelihood of crashes particularly rear-end crashes).
- Providing road user journey information (travel time, delays, speed limit changes) and other relevant information, such as the reason for a speed limit reduction.

This guide provides an overview of the various types of VMS that can be used to display traveller information including freeway VMS on the mainline, tactical VMS (used as part of a lane use management scheme (LUMS)) and arterial road VMS (used on arterial road approaches to the freeway interchanges).

This guide also includes information to guide the design and installation of other signs.

The guidelines outline methods to calculate and display travel time and traffic condition information, as well as the rationale for choosing travel time destinations. They also provide travel time destinations on Perth's strategic transport routes.

This guide can also be used to assist in project design, operations and functions of traveller information devices for the integrated Smart Freeways control system.

Abbreviations

ALR	All lane running
AADT	Annual average daily traffic
AAWDT	Annual average week day traffic
ALR	All lane running
ANPR	Automatic number plate recognition
AID	Automatic incident detection
AS	Australian Standard
CCTV	Closed circuit television
CIC	Customer Information Centre
CRS	Coordinated ramp signals
ELR	Emergency lane running
ESB	Emergency stopping bay
ESL	Emergency stopping lane
ETT	Estimated travel time
FCS	Freeway control system
GPS	Global positioning system
HERO	Heuristic ramp metering coordination
ICT	Information and communications technology
ITS	Intelligent transport systems
LED	Light emitting diode
LUMS	Lane use management system
LUS	Lane use sign
MOU	Memorandum of Understanding
MM	Managed motorway
MMDG	Managed Motorway Design Guide
NTT	Nominal travel time

OSOM	Over size over mass
PTA	Public Transport Authority
PTZ	Pan, tilt and zoom (camera)
RC1	Ramp control sign 1
RC2	Ramp control sign 2
RC3	Ramp control sign 3
ROSMA	<u>R</u> oad <u>s</u> afety <u>m</u> anagement
RO&DS	Recognising opportunity and developing solutions
pVMS	Portable variable message sign
RNOC	Road Network Operations Centre
RTMT	Real-time monitoring team
SCATS	Sydney Coordinated Adaptive Traffic System
STREAMS	The central control system used by Main Roads
SF	Smart Freeway
TCSN	Traffic control system network
TIRTL	The Infra-Red Traffic Logger
TCS	Trip condition sign
TIS	Trip information sign
TVMS	Tactical variable message signs
VMS	Variable message sign or signs. This generic term may include dynamic message signs (DMS) and changeable message signs (CMS)
VSL	Variable speed limit
WA	Western Australia
WAPOL	Western Australia Police
WIM	Weigh-in-motion

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1 Introduction

1.1 Purpose

Variable Message Signs (VMS) are critical to providing traveller information, particularly in real-time, to road users during their journey. Real-time traveller information assists road users to make informed travel decisions and enables road operators to manage the road network efficiently.

Traveller information systems use traffic data and other information to provide road users with information including current travel times, timely and relevant details about congestion, traffic incidents, roadworks, special events and severe weather conditions.

A comprehensive automated traveller information system can also contribute to other online information systems such as third party websites.

The VMS guidelines have been developed to:

- Recommend VMS road user information for Perth's wider freeway network and key arterial roads.
- Define travel time destinations on freeway VMS.
- Provide a guide for operating VMS, the types of signs and sign locations for the wider freeway network and key arterial roads in Perth, and the design of detailed signing schemes and locations.
- Inform the functionality requirements of a freeway control system (FCS).
- Provide an overview of potential future enhancements for inclusion in a traveller information system.

At this time, while VMS and data are not available on all our freeway routes, these guidelines provide a framework for future road user information needs that can be applied as freeways and arterial roads are upgraded.

This guide provides an overview of the VMS that can be used to display traveller information including freeway VMS, tactical VMS (used as part of a lane use management scheme (LUMS) and arterial road VMS on relevant approaches to the freeway interchanges).

VMS is a generic term for electronic signs that may include dynamic message signs (DMS) and changeable message signs (CMS).

1.2 Benefits of providing traveller information

The provision of traveller information assists in optimising road network operations, efficiency and safety performance across the road network. This is achieved by providing travel times, congestion and incident information to enable road users to make informed travel choices. The benefits include:


- Influencing road user route choices (during an incident, roadworks, planned event or congestion).

- Improving safety in changing road conditions (lane closures, reduced visibility or an incident, which may reduce the likelihood of crashes particularly rear-end crashes).
- Providing road users with travel time information to key destinations as well as expected delays.
- Providing road user journey information (travel time, delays, speed limit changes) and other relevant information, such as the reason for a speed limit reduction or road safety messages.

1.3 Typical traveller information signing

Traveller information for road users is typically real-time information displayed on VMS at strategic locations on freeways and arterial roads. Examples of sign types referenced in these guidelines are shown in Table 1.1. Signs indicated for freeway use may also be used elsewhere on the road network where sign size or functionality is appropriate.

Table 1.1 VMS traveller information sign types and messages

Sign type	Example
Freeway VMS (refer Section 2)	 <p>Incident management</p>  <p>Travel time (Kwinana Freeway mainline)</p> <p>Note: Due to system limitations, interim use of freeway VMS may provide the travel times in the pictogram panel of a composite sign.</p>
Tactical VMS (refer Section 3)	 <p>Lane status and warning information used as part of a Lane Use Management System</p>
Freeway-to-freeway VMS (RC3-C) (refer Section 4)	 <p>VMS prior to a freeway exit for traveller information or incident management on the intersecting freeway, and warning if freeway ramp signals are operating on the ramp</p>
Arterial road VMS (RC3-A and RC3-B) (refer Section 5)	 <p>RC3 Travel time and incident information on arterial roads entering the freeway</p>



Sign type	Example
AS Type A and Type B VMS (refer Section 5.7)	 <p>Other arterial road traffic management applications (non-freeway)</p>
Portable VMS (refer Section 8)	 <p>Construction and event management</p>

Table 1.2 Summary of Typical VMS sign details

Type	Operating speeds (km/h) (see note 1)	Typical text size (mm)	Typical No. lines of text	Pictograms	Colours
Freeway VMS	80 to 100	400	3	Yes	Yellow, white, green, red
Tactical VMS	80 to 100	320 or 400	Up to 3	No	Yellow, white, green, red
Freeway-to-Freeway VMS (RC3-C)	80 to 100	320	Up to 4	No	Yellow, white, green, red
Arterial Road VMS (RC3-A)	Up to 60	120	3	No	Yellow, white, green, red
Arterial Road VMS (RC3-B)	70 and 80	200 to 250	3	No	Yellow, white, green, red
AS Type A (see note 2)	Up to 60	200	4	No	Yellow
AS Type B (see note 2)	Up to 90	320	3	No	Yellow
AS Type C (see note 2)	80 to 100	400	3	No	Yellow
Portable VMS	Various	Various	4	Yes	Yellow, white, green, red

Note 1: The speed environment shall be considered when determining the sign text size.

Note 2: Type A, B and C Australian Standard VMS may also be used on the Main Roads' arterial network.

1.4 General guidance

In applying these guidelines, consideration shall also be given to broader signage selection matters including site selection, sight distance and visibility factors (e.g. sign clutter, sun glare), legibility / reading distance, spacing between adjacent signs, overhead clearances, placement in relation to a driver's line of sight, use of signs on curves, maintenance access and use of overhead bridges or other structures for mounting signs.

In general, good and consistent messages should:

- Be appropriate to the location, time of day, road environment and prevailing road conditions.
- Be written in a directive tone.
- Use appropriate font cases, as outlined in these guidelines. This includes fonts consistent with general static signing principles, e.g. destination information on freeway and arterial road VMS using the upper/lowercase fonts as used on direction signs. Lowercase fonts may also be considered for campaign or promotion (Priority 4) messages. Research suggests that lowercase fonts are more legible because they have more pronounced contours.
- Be as brief as possible and be considered 'glance appreciative' to promote quick comprehension by road users.
- Generally, use eight-words to match the processing capability of an average road user.
- Have words of no more than eight characters, except location names.
- Contain no single line with more than two units of information, and not allow a unit of information to be split across two lines, unless logical, as shown in Figure 1-1.



Figure 1-1 Example of incorrect and correct combination of units of information

- Use the minimum number of words necessary, example shown in Figure 1-2.



Figure 1-2 Example of minimising number of words

- Avoid excessive use of full stops (see Figure 2-4), except where information needs to be separated to avoid confusion.
- Limit filler messages (campaigns / promotions) to no more than a single screen.
- Allow screen-timing of no less than three seconds per screen, where two-screen messages are to be used.
- Avoid the use of inappropriate language, which is likely to offend the public.

1.5 Australian standards

Australian Standard 4852.1-2009 defines fixed VMS in three sizes as Type A, B and C which relates 85th percentile speed to legibility and character height as shown in Table 1.3.

Table 1.3 Australian Standard VMS types and display requirements (Source: AS 4852.1-2009 Table 3.1)

Size type	85th percentile approach speed (km/h)	Minimum legibility distance (m)	Minimum equivalent character height (mm)
A	≥50 and ≤60	100	200
B	>60 and ≤90	200	320
C	>90	300	400

The various types of VMS in these guidelines generally enhance the Australian Standard (AS) sign requirements or provide appropriate standards relative to the use and application.

1.6 Providing freeway traveller information

Valuable traveller information is provided on the freeway mainline as well as near freeway interchanges on the adjacent arterial or local road network to enable road users to make informed choices about their journey.

These guidelines provide information regarding:

- Types of information provided on VMS and typical messages, etc.
- Estimated travel time to destinations.
- Freeway operating conditions (quality of traffic flow) compared to free-flow travel conditions, i.e. levels of congestion, including escalating messages related to the extent of congestion using colour coded displays in green, yellow or red.
- Location and direction information related to incidents or roadworks and events (planned or unplanned) including road closures.
- Other information as applicable, such as community safety or promotion messages.

Real-time information allows road users to make informed travel choices and has the potential to reduce the impact of an incident or event by reducing the demand on the main traffic flow.

Traveller information signage locations can include:

- on-freeway signs, and
- off-freeway signs to provide road users with information before entering the freeway, this includes signs at ramp entrances and the arterial road approaches to interchanges.

1.7 Freeway central control system

A comprehensive central control system is essential to implement and manage integrated and consistent information and devices for traffic operations, such as ramp signalling, VMS, lane-use management and variable speed limits.

Perth's freeways are currently managed by a central control system (STREAMS) that incorporates various sub-systems to manage ramp signals, lane-use management, variable speed limits, VMS, CCTV and performance reporting.

This guide details the on-road traveller information requirements (such as functionality, type and standards) that need to be incorporated into the design and operation of a system. This guide also outlines how to manage expanding traveller information systems to ensure data is in a form that can be interfaced with the existing freeway central control system.

If additional devices are needed these also need to be compatible with the existing central control system. Where new devices require connection to the existing central control system, compatibility with an appropriate system driver shall be demonstrated at the time of tendering / purchasing. Alternatively, suitable timeframes shall be allowed for to ensure relevant development and testing can be undertaken to integrate additional devices with the existing central control system.

Fundamental to a Smart Freeway is that all aspects of the freeway system, including devices, power, communications and the central control system operate in a manner that will ensure high reliability and integrity of the system.

To achieve an optimised road network the system and any devices shall be designed to minimise faults, and expedite fault rectification to meet tight intervention levels. Faults in critical control elements such as a Lane Use Management System (LUMS) (safety critical) and vehicle detectors (performance critical) need to be repaired within short timeframes.

On-road and real-time traveller information for road users is provided using various types of VMS that display a range of messages appropriate to the travel conditions being experienced. VMS can operate in default mode or provide special information during incidents, congestion or events. These systems need to be integrated for efficient and consistent operations and messaging using standard message libraries, graphics and abbreviations.

The role of the STREAMS VMS management sub-system is to provide capability for automated (default) message posting, with capability for the operator to modify messages before or after they are posted.

The posting of VMS messages shall be based on all available data, from both automated sensors and human sources.

1.8 Context and complementary material

This VMS guide, in conjunction with the Policy Framework Overview, Provision Guidelines and other Smart Freeways design guidelines have been developed to provide the requirements for planning, design and implementation of Smart Freeways across Western Australia's freeway network.

This guideline shall be read in conjunction with other Main Roads' design guides as well as functional and technical specifications for ITS elements. If there are any differences in practice between these guidelines and other complementary material, this guideline will apply. Other complementary documents include:

- Smart Freeways Provision Guidelines.
- Smart Freeways Operational Efficiency Audit Guidelines.

- Main Roads' Supplements to Victoria's Managed Motorway Design Guide.
- Victoria's Managed Motorway Design Guide.
- Victoria's Managed Motorway Design Guide Volume 2: Part 4 Lane Use Management, Variable Speed Limits, Traveller Information.

Other guidelines and standards may also be relevant including:

- Austroads Guide to Traffic Management Part 10: Traffic Control and Communication Devices. However, it is noted that Trip Condition Signs (TCS) and Trip Information Signs (TIS) are not used in Western Australia (refer Section 2.3.6).
- Australian Standard AS 4852.1-2009: Variable Message Signs Part 1: Fixed signs.

2 Freeway VMS

2.1 Overview

Freeway VMS are permanent signs that provide real-time, integrated and consistent traffic condition information to road users. These VMS which are sometimes referred to as dynamic message signs (DMS) are also used for incident and event management, and to support a lane use management system operation where this is provided.

In general, VMS shall be multi-purpose rather than single-purpose, and the number of different VMS types minimised for ease of system and maintenance management. VMS shall be able to display incident warnings as well as real-time traffic and travel time information.

The freeway VMS consists of a single full matrix display area as shown in Figure 2-1. A typical display includes:

- A message in an alphanumeric format with up to three lines of text (generally up to 18 characters per line). Text has a typical height of 400 mm on 100 km/h roads and a minimum 320 mm on 80 or 90 km/h roads. The displays are generally consistent with AS 4852.1-2009.
- A colour pictogram, symbol or travel time information as part of the display.



Figure 2-1 Freeway VMS example layouts

2.2 Message hierarchy and priority

The primary purpose of a freeway VMS is to display real-time travel information relevant to a road users current trip. A secondary function is to display information relevant to trips for that freeway in the near future, for example future roadworks. Other relevant road safety messages (campaigns or promotions) may also be displayed when appropriate, but are usually of a lower priority and shall only be used when there are no other higher priority road user messages to display.

Various types of messages can be displayed on a VMS and a hierarchy of control is essential to ensure that the VMS is used for the most appropriate need at the time. The message priorities are outlined in Table 2.1.

The VMS 'default' mode display is current traffic conditions and travel times. These messages are particularly useful to road users during peak periods or other times when freeway conditions may affect a road user's trip, for example during incidents. Traffic conditions and travel times shall be displayed unless a higher priority message needs to be displayed as outlined in Table 2.1. The following general principles also apply:

- STREAMS is a priority based system and priorities determine what is displayed on a device when there are competing requests. Therefore, different priority messages are unable to be displayed on alternating frames (pages). For example, alternating a message with default travel time displays is not possible, when a higher priority message is required to be displayed.

- Generally the messages should be single frame. In the rare event of two-frame messages, i.e. inserting a second frame when a message cannot be accommodated in single display frame, (Priority 1 only), the message in each frame shall be independent of the message on the other frame and read as a complete message on its own, so that a reader does not have to necessarily read messages on both frames to understand the message on each frame.
- In determining the priority of message displays, consideration may also need to be given to the incident severity as outlined in Section 2.4.4.

Non-standard messages shall be approved for display by Manager Real Time Traffic Operations.

Table 2.1 Mainline VMS and arterial road VMS message hierarchy and purpose

Priority	Message type	Purpose / Description
Default display	Traffic condition and travel time	Dynamic information about real-time traffic conditions, including travel time information.
1	Incidents, Current roadworks, Current events	<p>Incident messages provide details to road users about an incident, roadworks underway or an event (e.g. CITY TO SURF) underway, an unplanned event (e.g. BREAKDOWN or SPILLED LOAD) and other unplanned road or traffic conditions (e.g. OIL SPILL requiring immediate unplanned maintenance or severe congestion to warn road users of slow moving traffic).</p> <p>Priorities for incident severity may also exist within this message type (refer Section 2.4.3) or for strategic messages (e.g. PORT CLOSED).</p> <p>Messages relating to changed speed limits or lane availability on Smart Freeways as part of LUMS are considered incident messages.</p> <p>Two frames may be needed for a Priority 1 incident message (refer Section 2.4.3) if additional information needs to be manually provided (not automated). Priority 1 main messages are not alternated with a default message or any other priority category.</p> <p>General unplanned events such as major storms, fires and floods are considered to be community safety messages (refer Priority 2), unless they are not related to the road users targeted by the VMS. In this case they shall be regarded as Priority 4 messages.</p>
2	Community safety	<p>Important information for road users about a significant event such as a major storm, fire, fog or flood affecting travel on that roadway. The impact of the event shall be of significant importance for road users passing / reading the sign.</p> <p>'TOTAL FIRE BAN TODAY' is also regarded as a Priority 2 message, aligned with the Memorandum of Understanding (MOU) with the Department of Fire and Emergency Services.</p> <p>Community safety messages may be displayed on every other VMS along a route with planned works/events messages on other VMS along the route, where doing so is likely to maximise message impact and therefore the expected outcome/s.</p> <p>Messages to change road user behaviour or improve road safety as well as general 'filler' messages unrelated to road conditions are considered to be campaign / promotion messages (refer Priority 4).</p>

Priority	Message type	Purpose / Description
3	Planned works or events	<p>Messages about significant future road works or lane closures and events that will have a significant impact on traffic conditions. In some instances the message could relate to a major intersecting road (e.g. at an interchange exit), where a significant proportion of road users may be exiting.</p> <p>Generally, mainline VMS signs are not a substitute for normal roadwork and traffic management signs, particularly long-term works, as the VMS may need to be used for other higher priority purposes (e.g. an incident). The traffic management plan for works or events will set out how the information will be communicated to road users assuming that the permanent VMS is being used for default or other higher priority messages. The mainline VMS can be used to supplement / complement traffic management signing when not needed for a higher priority purpose, but planning shall not be reliant upon the use or availability of the mainline VMS.</p> <p>Messages shall only relate to the impact of the event on traffic (e.g. a lane closure), not promote or raise awareness of an event or campaign.</p> <p>The consequence of the planned works or event would have a significant impact on road users passing / reading this sign.</p> <p>Planned works or events messages may be displayed from three days prior to the works/events. Depending on the event, some planned works/events messages may need to be displayed one week prior to capture the target audience; for example, a major event on a Sunday may require planned event messages displayed on the previous Sunday to capture road users who may use the road only on the weekend.</p> <p>Planned works/events messages and travel times may be displayed on alternate signs along a route, where planned works/events messages are required to be displayed during peak periods and enough signs are available on the route.</p> <p>Planned works or events messages may transition into incident (Priority 1) messages when the works/event commences (e.g. ROAD CLOSURE may become ROAD CLOSED).</p>
4	Campaigns or promotions	<p>Messages that promote road safety as part of an approved safety campaign and other general 'filler' type messages unrelated to road conditions. Typical messages are listed in Appendix B. General community safety messages not related to the road users targeted by the VMS (refer Priority 2), would be regarded as Priority 4 messages.</p> <p>Messages shall be brief, preferably single frame, to facilitate road users receiving and comprehending the information. Such messages shall avoid the potential to distract road users from their primary driving tasks.</p> <p>Campaign and promotion messages shall only be displayed outside peak periods and when there are no other higher priority messages.</p> <p>No commercial or advertising information, logos, or organisation names shall be used.</p>

2.3 Display messages

2.3.1 General

To ensure road users read and act on VMS messages, appropriate sign usage and message credibility is important to maintain. At Main Roads, VMS usage and messaging is approved using operational procedures at our Road Network Operations Centre (RNOc).

Using VMS messages that do not reflect appropriate purposes and priorities reduces the effectiveness of the information they display. Our incident message wording is generally an automated standard message within the control system, with operator confirmation and over-ride available as required.

2.3.2 Single and multiple frames

In general, message displays shall use a single frame. This typically shows a message over a maximum of three lines in the text section of the VMS.

Where necessary, as outlined in Table 2.1 and Section 2.4.3, a maximum of two frames may be selected for use by the automated system or by the operator. When using two frames, messages shall generally be a maximum of two lines per frame with the changes between frames blanking one display and simultaneously generating the next display, meaning there is no blank time between frames.

2.3.3 Use of abbreviations

Abbreviations can be used for VMS for long road names and other terminology. Authorised standard abbreviations shall be used to ensure messages can be understood independently of their context, or when they are used combined with certain prompt words.

A standard list of abbreviations is provided in Appendix E. Further abbreviations may be identified and added to the list as specific messages are considered within the sign size capabilities. No scrolling of messages is permitted.

2.3.4 Use of conspicuity devices

The conspicuity devices in each corner of older VMS (refer Section 5.8 and Figure 5-9) may be activated for incident and community safety messages (Priority 1 and 2). They are not to be activated for traffic condition / travel time (default displays), planned works / events (Priority 3) or campaigns / promotions messages (Priority 4). They shall not be activated if no messages are being displayed.

Conspicuity devices are not generally used on current standard freeway VMS, particularly when using a pictogram.

2.3.5 Message displays for traffic conditions and travel times

Consistent with national practice, message displays and format for destinations shall be based on how the message display would be read by road users, which usually from the top down. This layout provides:

- Consistency with other messages displayed on the VMS, for example incident messages.
- Destinations in the order they will be encountered when driving along the route, with the closest being considered the most important by most road users as it relates to the section of freeway ahead, as well as the most relevant information where the sign is not read in full.

- Consistency with the order of destinations on arterial road VMS and reassurance direction signs.

VMS will provide travel time and freeway conditions at downstream on-freeway destinations at various interchanges along the freeway route (refer Section 7). An example is shown in Figure 2-2.

These messages include:

- Estimated travel time to each destination in minutes.
- Colour coding of the travel time to indicate the freeway operating condition relative to normal travel time (refer Section 6).
- A display that is consistent with the arterial road VMS format (refer Section 5) that road users will see on arterial roads prior to entering the freeway.

Roe Hwy	10 min
Leach Hwy	14 min
G. Farmer Fwy	32 min

Figure 2-2 Freeway VMS travel time display

For consistency with static direction signing principles, destination information on freeway and arterial road VMS uses combined upper and lowercase fonts.

2.3.6 Superseded options for providing travel time information

The VMS displaying travel time information perform the same function as the trip information signs (TIS) and trip condition signs (TCS) described in the Austroads' Guide to Traffic Management Part 10: Traffic Control and Communication Devices (Austroads, 2019). TIS and TCS represent superseded practice and shall not be used in Western Australia.

Multi-purpose VMS increase message flexibility as they can be used for other purposes when higher priority messages are necessary. Multi-purpose VMS also reduce the number of different types of variable message signs, which assists with system and maintenance management.

2.3.7 Existing VMS

In general, existing VMS as of June 2020 on Perth's freeways have been limited to mainline VMS which are able to display incident and planned roadworks or event information, while some of them display travel times during specific periods, for example at peak times.

Old freeway mainline VMS are full matrix single colour signs, however, more recently signs have the capacity to display colour-coded travel times. VMS are also now provided on arterial roads, some with specific purpose, for example the South Street bus lane. Section 5 outlines use of VMS on arterial roads.

2.4 Message displays for incidents

2.4.1 Message structure

VMS incident messages shall generally be structured as shown in Table 2.2 using problem, location, effect and action statements as a guide.

Table 2.2 VMS Incident message structure

Problem statement	Defines the situation or type of incident that will affect traffic operations, for example incident, roadworks, high winds
Location statement	Describes the location of the incident, for example distance to incident, interchange name, exit name or number or a landmark
Effect statement	Describes the state of the road or the effect the problem will have on traffic, for example, left lane closed, major delays, freeway closed
Action statement	Provides guidance and describes what the road user is required to do, for example, proceed with caution, prepare to stop, consider alternate route
Attention statement (special case)	Identifies specific road users the message is directed to if the message does not apply to all traffic, for example trucks

A message with a pictogram and text over three lines illustrates the display of four information elements as shown in Figure 2-3. The pictogram generally represents the 'Problem statement' and the remaining information elements are displayed with text, on separate lines, arranged from the top to the bottom of the sign.



Figure 2-3 VMS pictogram and text displays – problem, location, effect, action

Examples of VMS messages and pictograms within the freeway control system message library are shown in Appendix A. Perception testing research carried out in other jurisdictions has confirmed road user understanding of the pictograms alone and in conjunction with a text message. Pictograms on their own were well comprehended, and when combined with a text message, fully understood.

Generally, no pictogram is used for community safety (Priority 2), planned works / events (Priority 3), or campaign / promotion messages (Priority 4).

Different sequences may be appropriate for campaign / promotion messages where a lasting (take home) message is intended, for example the action 'Buckle Up' may be the top line of the message, as shown in Figure 2-4.



Figure 2-4 VMS text displays – campaign/promotion messages

2.4.2 Interim use of older VMS

Tactical incident messaging generally follows the problem, location, effect and action guide. However, in some situations, such as using older VMS with no pictogram display area, there may be strategic reasons for providing the location first, for example prior to an exit for an event or closure on another road. In this case, the strategic message guide may use location, effect and action only. Indicating the location first may be appropriate as the problem is not immediate and impacts a smaller number of road users. For example, a VMS on Kwinana Freeway could be used to warn road users of a problem on Roe Highway as shown in Figure 2-5.

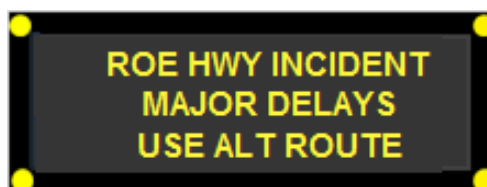


Figure 2-5 Example - VMS incident display

2.4.3 Main and supplementary messages during incidents

Initiating an incident response plan generates an automated VMS message, with a manual override available before and after implementation. The automated VMS generates one or two varied messages for display on different sections of the freeway. The nature of the incident will determine if an alternating main or supplementary message may be required as indicated below or at Table 2.1.

Main Message (first VMS upstream of the incident) - A main text message together with an appropriate pictogram will be displayed on the VMS upstream of the incident, or the start of the LUMS, as applicable. Tactical VMS may also be provided within the LUMS area (refer Section 3).



Figure 2-6 VMS example of a main message upstream of an incident

Supplementary Message (other upstream VMS) - A supplementary message with a pictogram, is displayed on the VMS in the freeway sections upstream of the incident within the default length of freeway based on the incident severity (refer Section 2.4.4 and Table 2.3), if VMS exist within these upstream sections of freeway. The supplementary message is required for major, severe and freeway closure incidents



Figure 2-7 VMS example of a supplementary message upstream of an incident

As outlined in Table 2.1, traffic condition / travel time is the default message for all capable freeway VMS. If an incident occurs, other priority messages may be alternated as follows:

- Main message VMS
 - Priority 1 - Incident message only
 - Priority 2 - Travel Time alternating with Community Safety messages
 - Priority 3 - Travel Time alternating with Planned Works and Events messages
 - Priority 4 - Travel Time alternating with Campaign / Promotional messages
- Supplementary message VMS
 - Priority 1 - Travel Time alternating with Incident message, subject to RNOC approved operational procedures
 - Priority 2 - Travel Time alternating with Community Safety messages
 - Priority 3 - Travel Time alternating with Planned Works and Events messages
 - Priority 4 - Travel Time alternating with Campaign / Promotional messages

2.4.4 Incident severity

The severity of a freeway incident as indicated in Table 2.3 determines the upstream length that messages are displayed on freeway VMS and arterial road VMS.

A high severity incident may have a significant impact on freeway flow. Therefore, the information shall generally be displayed over a longer distance upstream of the incident to advise road users of the issue and provide opportunities for alternative route choices. Providing advanced information recognises the importance of managing large traffic volumes, and facilitates choices to exit and to facilitate 'unloading' of the freeway, for example traffic exiting over a large number of interchanges. Providing information upstream of the incident creates opportunities for traffic to divert and be distributed to a number of alternative routes rather than creating a major impact on one exit or on the freeway network. Upstream incident advice may also be provided on intersecting downstream freeway routes using the Freeway VMS and/or the Freeway-to-Freeway VMS (see Section 4).

The incident severity criteria and the freeway distances over which traveller information is generally provided are shown in Table 2.3. The default distances are configurable, and an operator may adjust the distance for a specific incident, when necessary.

Table 2.3 Incident severity / upstream extent of message displays

Incident Severity		Criteria	Freeway VMS	Arterial Road VMS
1	Minor	Emergency stopping lane affected, or other hazard without a reduction in lane usage, for example high winds, sun glare, surface debris (sand)	Warning message may be provided at the discretion of the operator	Generally, no message
2	Major	One traffic lane affected	Upstream for 5 km	
3	Severe	Two or more traffic lanes affected	Upstream for 8 km	
4	Freeway closure	All lanes affected or the freeway needs to be closed	Upstream for 15 km or more	

2.5 Design principles for locating freeway VMS

2.5.1 General principles

Freeway VMS are to be placed where displayed messages for an incident or event are relevant to a significant proportion of road users on the freeway. The location of signs also needs to be consistent with incident management plans, e.g. prior to nominated exits to the arterial road network that would have strategic importance for diverting traffic.

The positioning of all types of signs during design sequence needs to consider the hierarchy of various sign types, generally in the following order:

1. Static directional signs
2. LUMS gantries and signs
3. VMS

All VMS shall be placed with clear sight distance so that they are legible to road users. Every effort shall be made to reduce competition between VMS and other traffic signs or roadside furniture and vegetation.

2.5.2 VMS spacing and location

The desirable spacing of successive VMS is between three and five km, subject to the spacing of significant interchanges and presence of a LUMS environment. VMS also need to be located clear of structures or other sight distance restrictions.

The longitudinal placement of VMS signs is typically:

- 900 m to 1,200 m prior to major decision points to provide adequate time for road users to respond. Major decision points include:
 - Significant exit ramps, for example likely to be used for trip diversion.
 - Freeway-to-freeway (system) interchanges.
- Prior to a LUMS environment to support and advise of lane closures or reduced speed limits.

When locating a freeway VMS prior to a freeway-to-freeway interchange it is for the purpose of providing traveller information on the continuing route and should be positioned prior to the freeway-to-freeway VMS (see section 4).

Detailed design needs to ensure VMS locations are separated from other signs and typically no closer than:

- 200 m to static direction signs or LUMS signs.
- 300 m off an exit ramp (start of taper).
- 350 m beyond an entry ramp (nose), for example install beyond the merging area.

VMS should not be located in decision-making areas, for example areas of merging, high weaving and exiting.

2.5.3 Co-location of signs

Separation guidance provided in Section 2.5.2 is preferred for the positioning of VMS, relative to direction signs and LUMS signs in a LUMS environment. It is undesirable to locate VMS at the same location as other traffic management devices. However, VMS may need to be installed on the same gantry as LUMS signs or direction signs where location constraints exist.

While co-location of signs may operate satisfactorily under normal conditions, during incidents when clear messaging is critical, care is needed to ensure that the amount of information likely to be displayed at the same location will not exceed the road users capacity to comprehend and act on the information. This may be a particular consideration in complex road environments.

It has been shown in research and practice in other jurisdictions that dual co-location of VMS with LUMS and/or direction signs is a practical arrangement. However, the co-location of VMS is undesirable with complex direction signs and inappropriate as a cost saving measure if separated locations are feasible.

Triple co-location of VMS with lane-use and direction signs is also practised in some jurisdictions, however this arrangement should be viewed with caution. Further evaluation of triple co-location in real-life settings is necessary, and shall only be used in situations where other separated arrangements for displaying essential sign information are impractical. If this is necessary, driver behaviour shall be monitored closely following installation.

Guidelines relating to the co-location of tactical VMS are provided in Section 3.

2.6 Sign installation

Overhead mounting of VMS on gantries provides good visibility on wide carriageways and is the most effective way of conveying important information to road users on a high-volume, high-speed freeway.

Where there are less than four lanes, VMS are generally mounted on a cantilevered structure. However, where a VMS is combined with LUMS traffic management, it is recommended to be gantry-mounted if feasible.

3 Tactical VMS

3.1 Overview

Tactical VMS (TVMS) provide real-time warnings and instructions to road users as part of LUMS.

TVMS are generally installed on the LUMS gantries as shown in Figure 3-1 and are used to help road users understand the reasons for lane closures or lower speed limits.

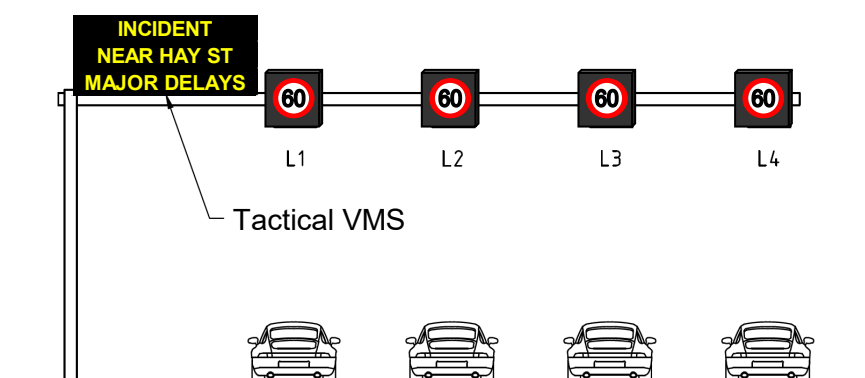


Figure 3-1 Tactical VMS used as part of a LUMS scheme

3.2 Sign size, location and displays

TVMS typically have yellow font (as a warning message) and are able to display messages in up to three lines of text. They are smaller than freeway VMS and have limited display message functionality. In association with a LUMS scheme they are generally installed on every second gantry, and in advance of emergency stopping bays in ALR sections. They are positioned to provide more frequent messages relevant to the traffic situation.

When combining TVMS and LUMS signs on the same gantry, consideration shall be given to the amount of information displayed in one place. For example, there may be a lane closed (or merging), a reduced speed limit and an explanation. This may result in messages being missed or create a safety issue as road users take their focus off the road for longer than desirable to read and comprehend the displayed information. Therefore, it is preferred that the TVMS displays one screen of text only. The display of two alternating screens may be acceptable if the LUMS displays are in default mode, that shows no changes to lane use or speed limits.

Typically, TVMS are used for incident messages only (Priority 1 as defined in Table 2.1). For example, incident messages that complement a lane closure, reinforce a reduced speed limit or advise of a specific downstream hazard. In some circumstances, for example if mainline VMS are not available, Priority 2 messages may be displayed.

When freeway operations do not require the use of Priority 1 or 2 messages, the TVMS default shall be blank, as lower priority messages are not shown on these signs. This maximises the potential for road users to notice messages on TVMS when important real-time safety information is displayed.

4 Freeway-to-freeway VMS

4.1 Purpose and use

Freeway-to-freeway VMS (sign No. RC3-C) are provided for road users exiting at a freeway-to-freeway interchange. They provide road users with travel time and traffic condition information reached from the intersecting freeway, i.e. destinations that are not on the route currently being travelled. In some instances an RC3-C can also be installed on arterial roads where a sign larger than RC3-B is warranted (e.g. on Leach Highway eastbound approach to Kwinana Freeway northbound).

Freeway-to-freeway VMS provide valuable information for road users intending to leave the freeway and facilitate route choice decisions, such as whether to use the intersecting freeway or other roads to reach their destinations. Where relevant, when entering exit ramps, the VMS can also indicate if entry ramp signals for the intersecting freeway are operating. A freeway-to-freeway VMS installation is shown in Figure 4-1.

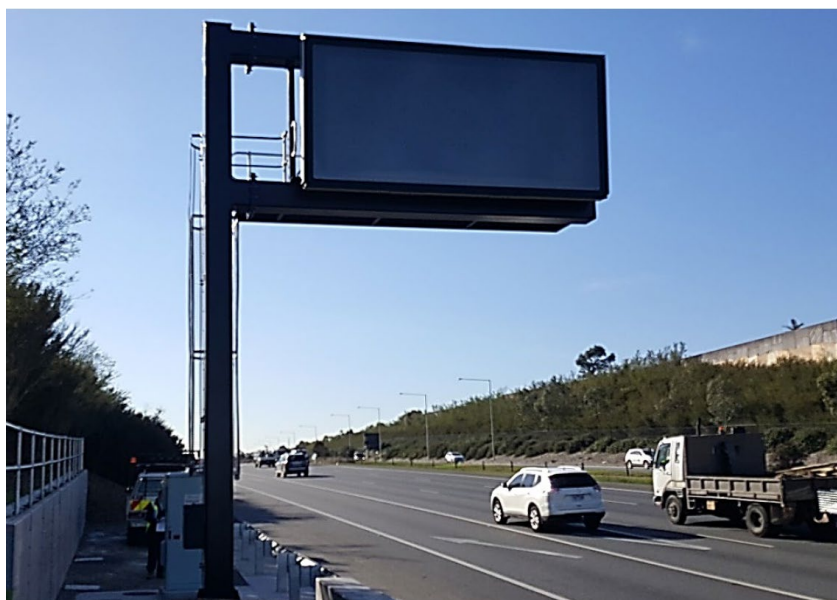


Figure 4-1 Example of freeway-to-freeway VMS on cantilever structure

Source: VicRoads

4.2 Sign displays

The freeway-to-freeway VMS providing information for road users in the left lane exiting the freeway, can display up to four lines of text with a text height of 320 mm. This is generally satisfactory in a 100 km/h speed environment where lower left lane speeds are generally applicable. The size, shape and installation position of the VMS is to reinforce differences and help avoid confusion relative to freeway VMS for traveller information on the continuing freeway.

If appropriate, the freeway-to-freeway VMS indicates colour coded travel time and traffic conditions to key destinations on the intersecting freeway that road users would be entering. The VMS is also capable of providing traveller information to assist with ramp operation and network optimisation and management, for example during incidents, lane or ramp closures and roadworks. When ramp signals are off (or there are no ramp signals on the ramp), the freeway-to-freeway VMS default display is either blank or displays travel times and traffic conditions.

Example freeway-to-freeway VMS messages are shown in Figure 4-2 and Figure 4-4. The sign header (first line) shows the intersecting freeway direction and is colour coded according to traffic condition categories outlined in Section 6. The purpose of the escalating messages is to provide general advice, as well as give information that could lead to road users choosing to divert to other routes, if feasible. When the sign is being used for a travel time message, the abbreviation 'Min' is shown on the first line above the travel times if sufficient space is available (abbreviate freeway name as appropriate – see Appendix E).

Lines two and three provide colour coded traffic condition and travel time information, if appropriate. In setting message options, care is needed to avoid information overload with complex messages, particularly if the VMS is co-located at an exit direction sign or LUMS gantry location (which is generally undesirable – see Section 4.3). A maximum of two destinations on the intersecting freeway are provided.

The bottom line will indicate 'Ramp Signals On' if appropriate, but may also be used for other warning messages if necessary.

The priority of freeway-to-freeway VMS messages is determined in a similar way to that used for freeway VMS as outlined in Section 2.2 and Table 2.1, but Priority 4 messages (campaigns and promotions) are generally not appropriate.



Figure 4-2 Examples of freeway-to-freeway VMS messages for signs on Roe Highway east of Kwinana Freeway

4.3 Design locations and installation

The design of a freeway-to-freeway VMS location before a freeway exit needs to consider the spacing requirements relative to other signs, particularly the exit direction signs, the exiting lane arrangements (one or two lane exit), and LUMS gantries, if provided.

The longitudinal position of the freeway-to-freeway VMS before the ramp exit shall be in accordance with the following general design principles:

- Install on a dedicated support structure with separation from other signs as shown in Figure 4-3, which is preferred to minimise signing complexity. In general, the sign would be installed about mid-way between the one km and 500 m advance exit direction signs, with a desirable minimum separation distance from other signs of 200 m. This location relates the sign information to the direction sign exit information and provides sufficient distance for road users to read the sign and make a decision about exiting the freeway. If a freeway VMS is also provided prior to a freeway-to-freeway interchange for traveller information on the continuing route, it should be positioned prior to the freeway-to-freeway VMS (see section 2).

- For a long exit lane arrangement (e.g. a two-lane exit), the freeway-to-freeway VMS shall generally be positioned after the initial advance exit direction sign and before the start of the exit lanes, with a general maximum of 1200 m prior to the related freeway exit. This is subject to design constraints such as curves and / or high lane changing manoeuvres where driver distraction is to be avoided
- For exits where design constraints prevent separate installation, the freeway-to-freeway VMS may be co-located with:
 - LUMS signs on the same gantry if no tactical VMS are installed, or
 - a simple advance exit sign ('Exit 1km') or direction sign ('Exit left Lane'). It would generally be undesirable to co-locate the freeway-to-freeway VMS with complex signage, for example lane allocation signs or exit signs with more than one destination.
- As the sign is intended for exiting traffic, the freeway-to-freeway VMS shall generally be installed near the side of the carriageway in the direction the traffic is leaving (usually the left), over the emergency stopping lane or over the left lane for a two lane exit. This position reinforces the purpose of the message for exiting traffic.

Further guidance relating to design locations and use of freeway-to-freeway VMS is available in the Main Roads' Supplement to Victoria's Managed Motorway Design Guide Volume 2: Part 3.

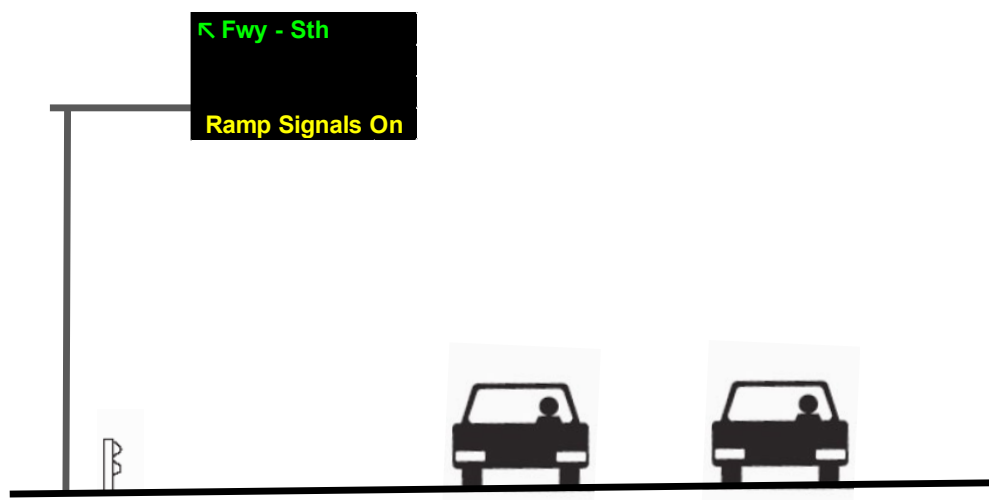


Figure 4-3 Example of freeway-to-freeway VMS installation

4.4 Indicative network locations

Freeway-to-freeway VMS are only for use on, and for, freeway standard roads. Travel destinations provided are generally for longer distance travel on the intersecting freeway (refer Section 7), and indicative locations for consideration are shown in Table 4.1 and the map in Figure 4-4.

Table 4.1 Indicative freeway-to-freeway VMS locations

RC3-C VMS Location	Traffic condition on	Destinations signed
Mitchell Freeway – Southbound		
North of Reid Highway	Reid Highway	Tonkin Highway
North of Graham Farmer Freeway	Graham Farmer Freeway	Great Eastern Highway
Kwinana Freeway – Northbound		
South of Roe Highway	Roe Highway	Willeri Drive
		Kenwick Link
Roe Highway – Westbound		
East of Kwinana Freeway	Kwinana - north	Graham Farmer Freeway
	Kwinana - south	Thomas Road
Roe Highway – Northbound		
West of Tonkin Highway	Tonkin Highway	Airport
		Great Eastern Highway
Tonkin Highway – Southbound		
North of Roe Highway	Roe Highway	Kenwick Link
		Willeri Drive
Tonkin Highway – Northbound		
South of Reid Hwy	Reid Highway	Mitchell Freeway
Reid Highway – Eastbound		
West of Tonkin Hwy	Tonkin Highway	Great Eastern Highway
		Airport
Tonkin Highway – Southbound		
North of Reid Highway	Reid Highway – west	Mitchell Freeway
	Reid Highway – east	Roe Highway

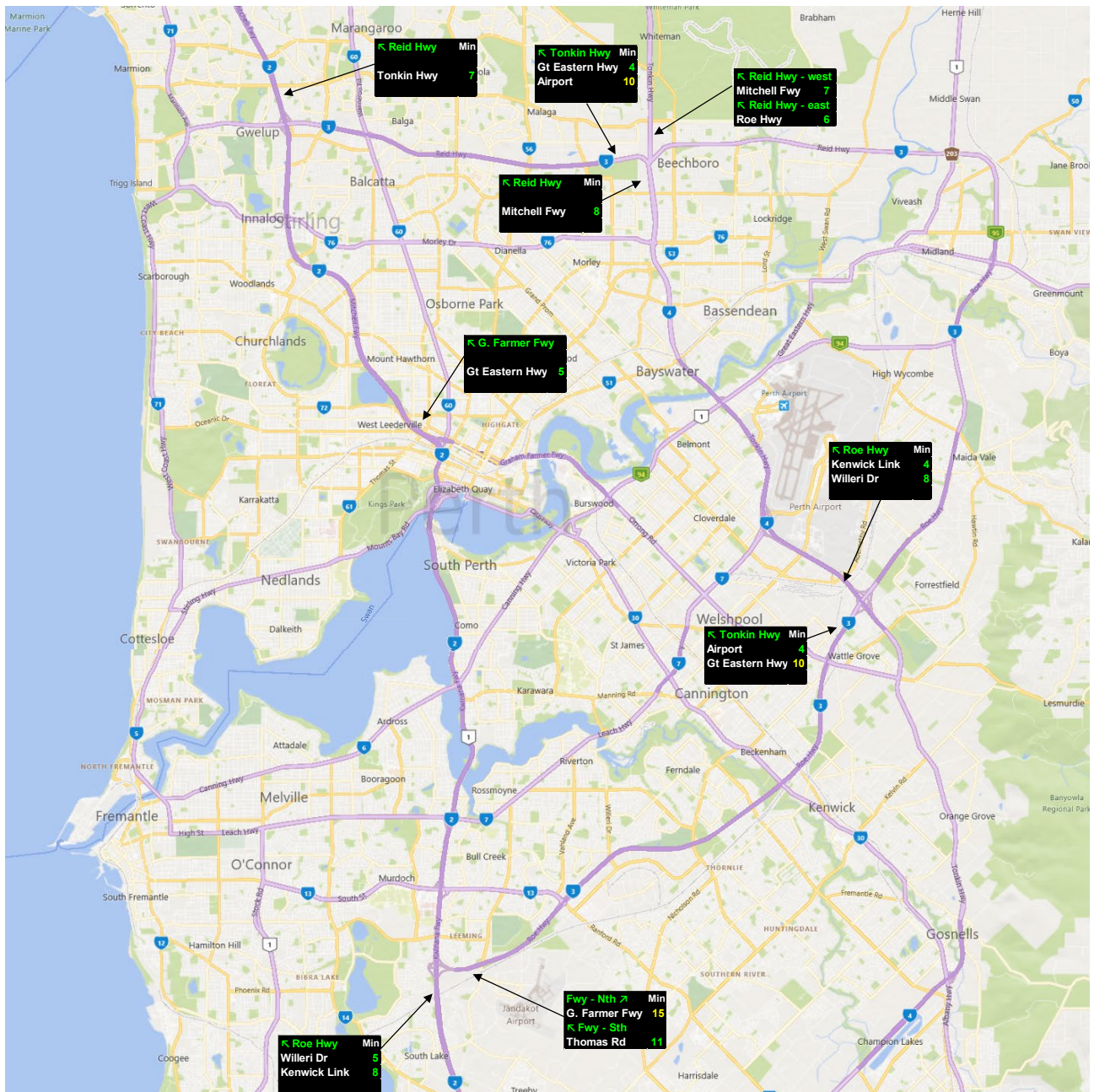


Figure 4-4 Indicative locations for freeway-to-freeway VMS

5 Arterial road VMS

5.1 Overview

Arterial road VMS (sign Nos. RC3-A and RC3-B) provide real-time traveller information and warning messages to road users on the arterial road network. The arterial road VMS for ramp control are generally provided as part of the ramp signal design. They may also be used in locations remote from a freeway interchange (see Section 5.6), or other applications where a colour display or message flexibility is advantageous.

The arterial road VMS display real-time traveller information to provide traffic condition and travel time information before road users enter the freeway as shown in Figure 5-1. The arterial road VMS also support ramp management during ramp signal operation, incidents, roadworks or congestion.

Fwy - Nth	Min
Roe Hwy	11
Leach Hwy	15

Figure 5-1 Example of arterial road VMS with traffic condition and travel time information

Arterial road VMS are generally installed on arterial roads near a freeway interchange prior to the left and right-turn lanes. Separate signs are installed for each travel direction for road users entering the freeway.

Where LUMS and/or freeway VMS are provided, the signs also integrate with the central control system (STREAMS) to provide consistent messaging. Messages consistent with the guideline hierarchy may also be displayed by a system operator, if required.

Arterial road VMS are available in two sizes which generally enhance the Australian Standard (AS) Type A and B signs:

- RC3-A for lower speed arterial road environments (up to 60 km/h), and
- RC3-B for higher speed arterial roads (70 and 80 km/h).

The use of the RC3-A sign on lower speed arterial roads recognises that road users are slowing down when entering the turning lane. The development process and sign size also recognises the balance required between available space for sign mounting, installation cost, display impact relative to static signs and legibility for the likely arterial road approach speeds. Although the font size used is less than the AS 4852.1 standard, the sign functions well for legibility of non safety-critical messages by using a combination of uppercase and lowercase lettering and with letter, word and line spacings greater than the AS 4852.1 standard.

For ramp signals on freeway-to-freeway ramps, a larger RC3-C freeway-to-freeway VMS is available for use on the freeway carriageway prior to interchange (see Section 4).

5.2 Display messages

The arterial road VMS displays travel time information as the default message for the freeway route/s downstream from the interchange. VMS messages relating to events and incidents shall complement and be compatible with the freeway VMS operation. The types of messages include:

- Traveller information relating to:
 - Travel time (default)
 - Freeway condition, such as level of congestion
 - Incidents and events
- Freeway closure information

Examples of arterial road VMS incident and roadworks messages are shown in Figure 5-2.



Figure 5-2 Examples of arterial road VMS incident and roadwork messages

Abbreviations will need to be used to display some long freeway names, like Graham Farmer Freeway, and also when freeway names are combined with other information in the header line, for example, traffic condition and event details. Abbreviations may also be needed when using names on smaller signs. While considered, the use of larger signs to accommodate longer names would result in significant disadvantages for installation, as well as system and maintenance management.

A standard list of abbreviations for general terminology is provided in Appendix E.

5.3 Travel time messages

The arterial road VMS displays travel time information for the freeway route/s downstream from an interchange. The information provides estimated travel times to:

- Two destinations at most sites in each travel direction on the freeway.
- Four key destinations (two destinations per route) for locations close to a downstream freeway fork, such as where the traffic entering the freeway at the interchange can travel in different downstream directions. Separate signs are displayed on each pole to provide information for each of the downstream directions (also see Section 5.5).

Various freeway sections are used for advising road users about travel times and congestion as outlined in Chapter 7. The central freeway control system (STREAMS) enables operators to provide the displayed destinations used to calculate travel times for each VMS.

5.4 Message priorities

Travel time and freeway traffic condition information are the default messages usually displayed.

The priority of other messages is determined in a similar way to that used for freeway VMS as outlined in Section 2.2. The hierarchy of message priorities are outlined in Table 2.1 with the following variations relating to arterial road VMS:

- Priority 2 messages (community safety) are generally not appropriate
- Priority 4 messages (campaigns and promotions) are not appropriate

5.5 Design locations for arterial road VMS near interchanges

Arterial road VMS provide warning and other information to road users before they enter the freeway. The signs are installed on arterial roads near freeway interchanges prior to the left and right-turn lanes as shown in Figure 5-3. To minimise confusion, separate poles / signs are provided for each travel direction entering the freeway.

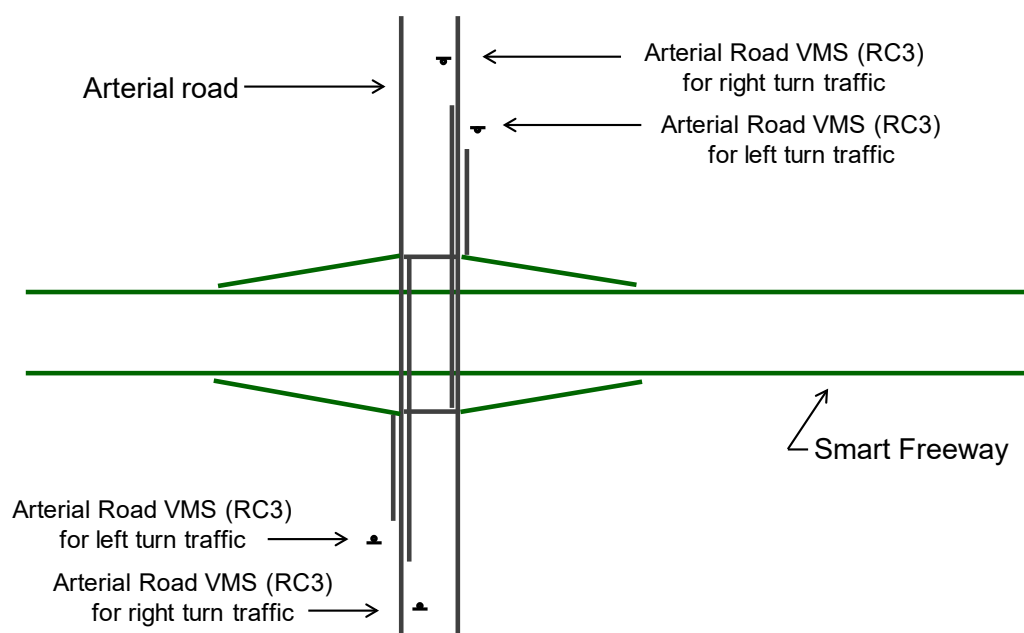


Figure 5-3 Typical locations for remote arterial road VMS

Guidelines for positioning RC3 signs before the start of turning lanes and relative to other signs are provided in Table 5.1. The following principles also apply:

- Provide separate signs for all turning movements onto the freeway at interchanges where ramp signals are provided. Provide signs in advance of the indented left and right-turn lanes (if divided carriageway and/or if turn lanes are provided).
- Where practicable, position the signs on the same side of the road as the movement that is being signed, such as on the left side of the road for left-turn movement and right side (in the median) for right-turn movement.

Where arterial road interchanges are close to a downstream freeway fork, i.e. the freeway divides into different downstream routes to create a route choice, two separate arterial road VMS shall generally be provided on the same pole on each arterial road approach. This enables separate travel information messages to be displayed for each downstream route (see Section 5.3). For example, when entering Roe Highway at Karel Avenue to travel west, two signs would be provided, i.e. one for Kwinana Freeway northbound and one for Kwinana Freeway southbound.

Arterial road VMS are generally installed on special poles designed to accommodate wind and sign loadings. When installed, the sign poles shall not create a hazard and appropriate measures including offsets to the roadway or shielding with a safety barrier should be considered according to roadside design practice. In some instances, shielding may not be an option due to various factors related to sign location or barrier installation. Road safety risks may need to be assessed, however, risks are generally similar to those associated with other poles on arterial roads, for example, traffic signal poles.

The mounting height to the bottom of the sign is generally a minimum of 2.5 metres to provide clearance over footpaths and minimise potential for vandalism.

The arterial road VMS shall be located at an adequate distance before the action point (where a road user makes a decision), so that road users have time to respond to the messages displayed.

The desirable minimum distances for sign installation before the action point are provided in Table 5.1. The desirable separation distance relative to other signs is also provided.

Table 5.1 Arterial road VMS location prior to action point and spacing relative to other signs

Installation	Speed Environment (km/h)	
	60 and 70	80
Distance prior to action point	60 to 80 m	80 to 120 m
Spacing to other signs	50 m	60 m
	Minimum $0.6V$ m (where V is the 85th percentile speed in km/h)	

Note: Based on Appendix C of AS 1742.2-2009

5.6 Remote arterial road VMS

The principles for considering remote arterial road VMS is that they are used to provide freeway condition information at travel decision points prior to a road user being committed to using the freeway. This enables road users to choose whether to take an alternative route if they so desire. Typically, remote arterial road VMS are only installed where alternative 'parallel' routes can provide travel to similar end-destinations when compared with travel on the freeway

Remote arterial road VMS are generally located some distance away from the freeway where route choices are available and generally before a major arterial road intersection as shown in Figure 5-4. In this example, the arterial road VMS would be useful for city-bound travel for the morning peak period, but could also be beneficial at other times when the use of alternative routes may be desirable, e.g. during an incident.

An example of a remote arterial road VMS traveller information message is in Figure 5-5. If arterial road travel time data is available, they can also be used to display comparative travel times via the freeway and an alternative route as shown in the example in Figure 5-6.

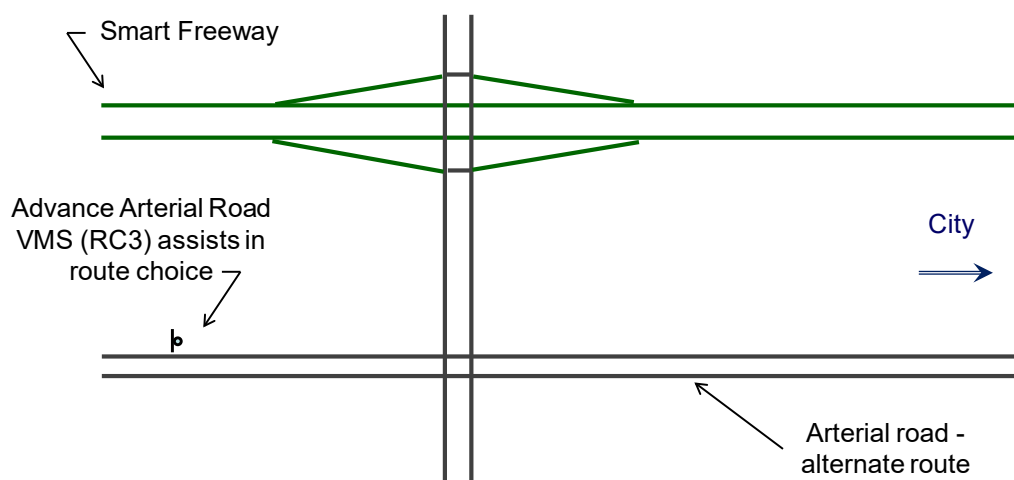


Figure 5-4 Typical remote location for an Arterial Road VMS

Fwy - Sth	Min
Reid Hwy	11
Hutton St	15

Figure 5-5 Example of remote arterial road VMS traveller information message

City via:	Min
Mitchell Fwy	15
Wanneroo Rd	20

Figure 5-6 Example of remote arterial road VMS message if arterial road data is available

Due to the importance of the messages used, the typical speed environment and the legibility and time needed to read and understand the information, RC3-B size signs would generally be the minimum size considered for remote arterial road VMS.

Examples of a remote arterial road VMS include when approaching Perth from the north. Wanneroo Road and Marmion Avenue are both alternative southbound routes to the Mitchell Freeway. Remote arterial road VMS could include the following locations (also see Figure 5-7):

- Wanneroo Road north of Hester Avenue and/or Burns Beach Road
- Burns Beach Road east of Wanneroo Road, and
- Marmion Avenue north of Hester Avenue and/or Burns Beach Road.

When approaching Perth from the south, an alternative to the Kwinana Freeway northbound is Rockingham Road / Stock Road and then Stirling Highway via Leach Highway / High Street. Remote arterial road VMS could be installed at the following locations (also see Figure 5-8):

- Rockingham Road south of Thomas Road, and
- Stock Road south of South Street.

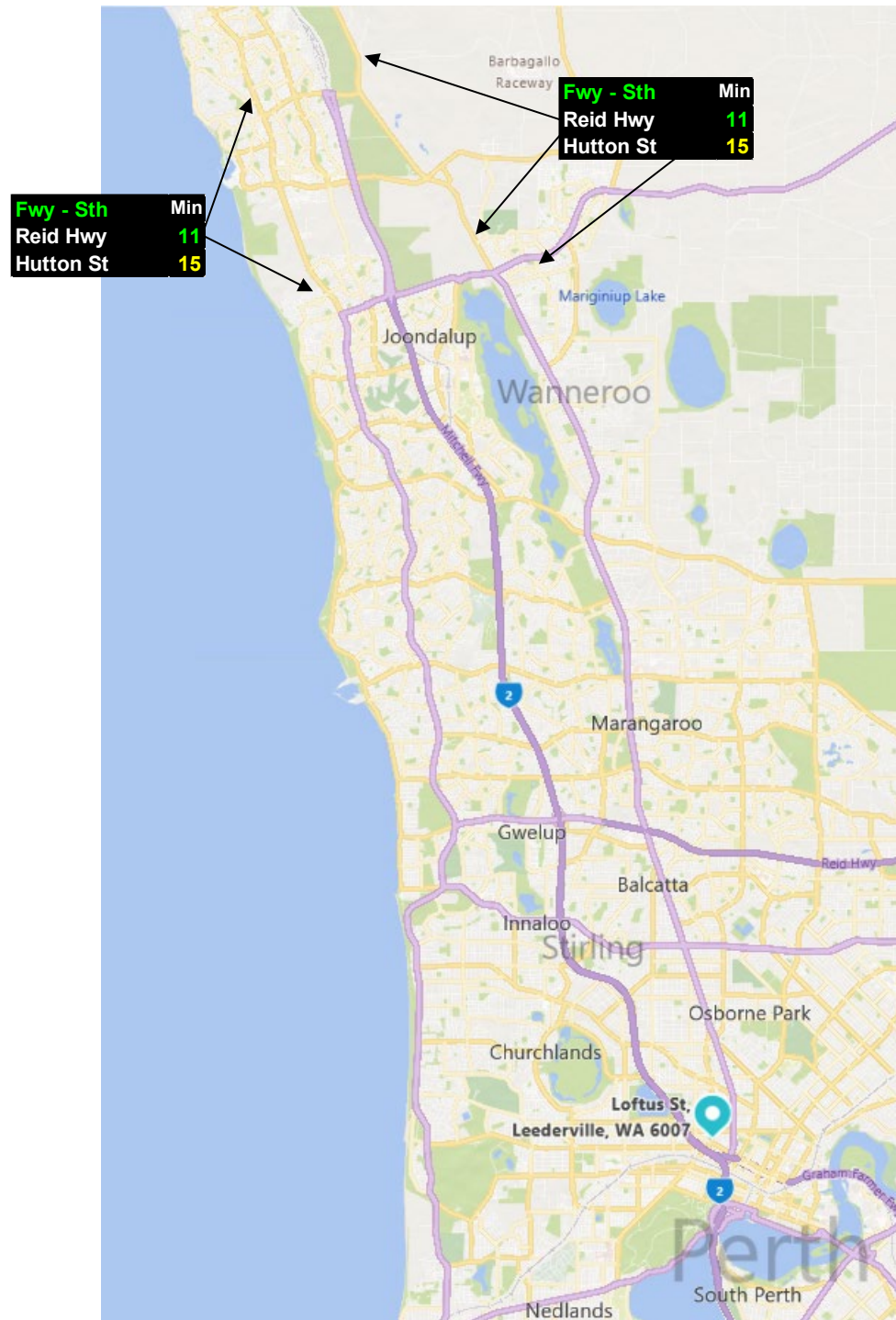


Figure 5-7 Options for remote arterial road VMS messages – southbound towards Perth

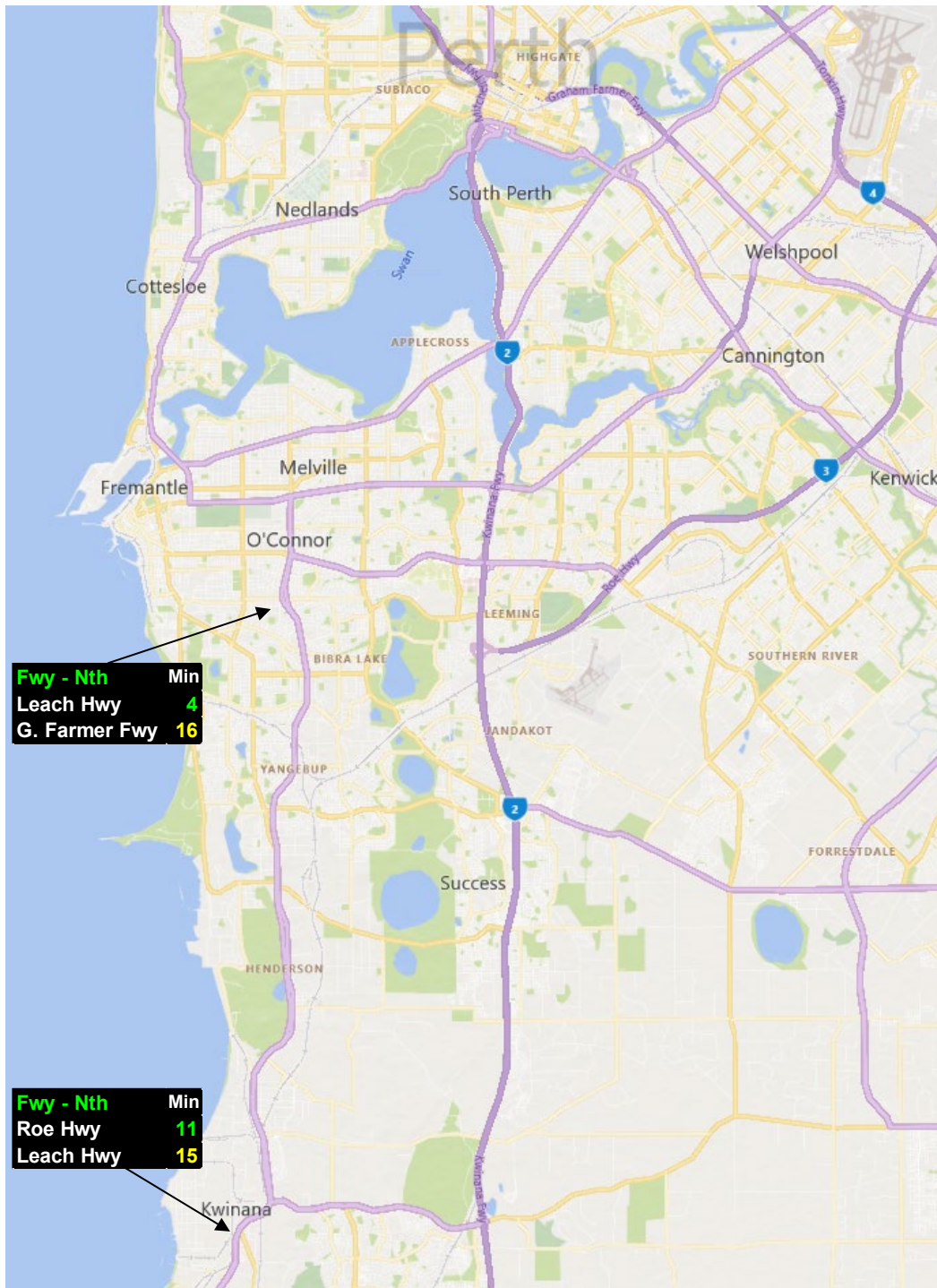


Figure 5-8 Options for remote arterial Road VMS messages – northbound towards Perth

5.7 Australian standard type A and B VMS on arterial roads

Historically, Main Roads has used Australian standard VMS on the road network and an example is shown in Figure 5-9. Type A and Type B VMS have been installed on the arterial road network as part of a network-wide traveller information system, or for specific purposes applicable to a particular road, for example operation of a part-time bus lane.



Figure 5-9 Example of Australian Standard arterial road VMS

5.8 Other arterial road VMS

Other VMS may be used in various traffic management situations and may also be required on the arterial road network. An example of a hybrid sign where a VMS is combined within a static sign is shown in Figure 5-10.

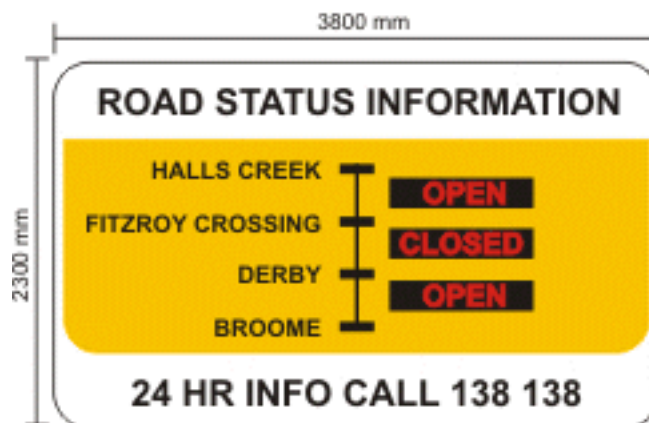


Figure 5-10 Example of arterial road VMS with specific application

6 Travel time and traffic conditions

6.1 Overview

Travel time information provides a 'snapshot' of travel time along the freeway based on the mainline speed data from each detector location. This traveller information can provide confidence to road users for their current trip, or alternatively, information on delays that may impact their journey time may enable them to plan accordingly, e.g. detour to another route or advise others that they are delayed.

6.2 Calculations

Detectors spaced along the freeway mainline calculate travel times that are then amalgamated to calculate the following values between the sign location and the signed destinations:

- Nominal travel time (NTT) in minutes along the freeway for travel to the exit destinations based on the speed limit.
- Estimated travel time (ETT) in minutes along the freeway to the exit destinations based on current traffic conditions. These values are displayed on the mainline VMS. For travel conditions corresponding to 'Major Delays' and 'Seek Alt Route' the system shall provide an option for the travel time to be flashed. If ramp signalling is operating, the vehicle queuing delay on the ramp prior to entering the freeway is calculated by the ramp signal algorithm. This delay value is added to the ETT for inclusion on RC3 sign displays.

The freeway condition (light, medium, heavy, 'Major Delays' or 'Seek Alt Route') is based on the ETT to NTT ratio for the first nominated travel time destination downstream of the ramp. The freeway condition messages (configurable within the system) are shown in Table 6.1..

Table 6.1The purpose of the 'Major Delays' and 'Seek Alt Route' messages is to divert traffic from the freeway during heavy congestion (see Section 6.3 and the Policy Framework Overview). These messages are generally only used on the arterial road VMS at the interchange or at remote locations.

The colours (green, yellow or red) display the freeway conditions and travel times that reflect the mainline travel conditions for those destinations relative to travel conditions without delays (ETT / NTT ratio). This snapshot of how the freeway is performing is based on thresholds in Table 6.1.

Table 6.1 Freeway condition travel thresholds

Travel Time Colour	Freeway Condition	ETT / NTT Ratio	Speed Range for 100 km/h Speed Limit	Speed Range for 80 km/h Speed Limit
Green	Light	< 1.5	> 67	> 53
Yellow	Medium	1.5 to < 2.0	50 to 67	40 to 53
Red	Heavy (Steady red message)	2.0 to < 2.5	40 to 50	32 to 40
Red	Major Delays (Flashing red message)	2.5 to 4.0	25 to 40	20 to 32
Red	Seek Alt Route (Flashing red message)	> 4.0	< 25	< 20

6.3 Heavy congestion management

Management of the freeway during very heavy congestion, during an incident or recovery from an incident, requires special traveller NTT information messages of 'Major Delays' and 'Seek Alt Route' as outlined above. Additional strategies associated with the operation of the ramp signalling may also be considered (see Policy Framework Overview).

7 Freeway sections for travel time

7.1 Rationale for choosing destinations

Travel time information has most benefit when provided to significant arterial roads that are strategic intersecting routes within the road network, including system (freeway-to-freeway) interchanges. Typically, it is not necessary to provide travel time signing to all freeway exits. The signing of strategic interchanges focuses on:

- Significant destinations for high volume movements that benefit a large number of road users
- High capacity routes that facilitate route choice for deviation of traffic, for example during periods of high congestion or incidents
- Routes with good connectivity within the network.

Other less significant interchanges may need to be used on the outer limits of a Smart Freeway where data stations are available, for example Thomas Road on the Kwinana Freeway.

Off-freeway destinations may also include significant locations that are close to the freeway but are reached after leaving the freeway, for example the airport, if data is available for the calculations.

7.2 Destination signing principles

Generally, all downstream travel time destinations cannot be shown unless the sign or freeway entry is near the end of the route. Therefore, destinations for each location are a subset of the overall list of input into the system for the freeway route.

The following principles generally apply to the use of destination signing:

- Travel time destinations are consistent with names on freeway directional signage to facilitate understanding and navigation by road users.
- The first displayed destination is typically two interchanges or more downstream from the mainline VMS location or the interchange entry ramp being entered. This provides reasonable accuracy and credibility of travel time within the data available.
- The mainline VMS displays one frame with a maximum of three destinations.
- RC3 signs display the nearest key destination and second nearest key destination (close destinations are shown rather than distant destinations), and further destinations would be shown on the mainline VMS that can display up to three destinations.
- When close to the end of the freeway or a freeway fork where the freeway diverts into two routes of similar importance (e.g. Roe Highway approaching Kwinana Freeway):
 - Upstream freeway VMS will only display travel time to the freeway interchange (i.e. destinations on each continuing route will not be displayed to avoid alternating frames on the VMS, for example, on freeway VMS on Roe Highway for westbound traffic will only indicate travel time to the Kwinana Freeway interchange, but not travel time destinations to the north or south).
 - Upstream freeway-to-freeway VMS (see Section 4), if provided, may display destinations on each of the downstream routes.

- Two RC3 signs are desirable at each signing location on upstream arterial roads so that separate signs and destinations are provided for each route, including destinations downstream of the interchange, if applicable. Installation of two signs avoids the distraction of alternating frames in the default (travel time) situation. Destination names on the same frame shall be on the same route.
- When close to other system interchanges (generally a crossing freeway):
 - Upstream mainline VMS will only display on-freeway destinations on the continuing route.
 - Upstream mainline exit traffic condition VMS (if provided) will display off-freeway destinations on the intersecting route(s).
 - RC3 VMS at upstream freeway interchanges may display destinations on the continuing route and an intersecting route (two signs required at each signing location).
- If a key destination name is longer than the available space on the sign (freeway VMS and arterial road VMS may differ), it shall be abbreviated (see Appendix E). There is to be no scrolling of messages.

7.3 Travel time destinations

Destinations signed for travel time are generally locations on the freeway where road users would be leaving the network. They are typically:

- **On-freeway destinations** - these locations are on the freeway the road user is currently travelling on, or on the freeway being entered from an arterial or local road.
- **Off-freeway destinations** - these are locations that are reached from another downstream freeway, including after leaving the current freeway being used. Generally, these destinations are only signed when close to the freeway exit (refer Section 4).

The suggested on-freeway travel time destinations for the strategic transport routes (inbound (towards the city) and outbound (away from the city)) are shown in Table 7.1. As more VMS are added to the network, other significant destinations may be signed with approval from the Manager Real Time Traffic Operations.

Table 7.1 Travel time destinations

Freeway	Travel Time Destinations	
	Inbound	Outbound
Mitchell Freeway	Burns Beach Road Ocean Reef Road Reid Highway Karrinyup Road Graham Farmer Freeway Mounts Bay Road Canning Highway	Hay Street Powis Street Karrinyup Road Reid Highway Hepburn Avenue Ocean Reef Road Burns Beach Road Neerabup Road Hester Avenue

Freeway	Travel Time Destinations	
	Inbound	Outbound
Graham Farmer Freeway	East Parade Loftus Street Mitchell Freeway	Great Eastern Highway
Reid Highway	Alexander Drive Tonkin Highway Great Northern Highway	Tonkin Highway Alexander Driver Mitchell Freeway
Tonkin Highway (north of Great Eastern Highway)	Reid Highway Great Eastern Highway Dunreath Drive (T3 T4) Airport Drive (T1 T2) Roe Highway	Morley Drive Reid Highway Wanneroo Road via Reid Highway Gnangara Road Great Northern Highway (Mucnea)
Tonkin Highway (south of Great Eastern Highway)	Orrong Road via Leach Highway Albany Highway via Leach Highway Airport Drive (T1 T2) Dunreath Drive (T3 T4) Great Eastern Highway Guildford Road Morley Drive Reid Highway	Great Eastern Highway Dunreath Drive (T3 T4) Airport Drive (T1 T2) Roe Highway Welshpool Road East Kelvin Road Albany Highway Thomas Road
Kwinana Freeway	Armada Road Roe Highway Leach Highway Canning Highway Mounts Bay Road Graham Farmer Freeway Karrinyup Road	Canning Highway Leach Highway Roe Highway Armada Road Thomas Road Safety Bay Road Mandjoogordap Drive Lakes Road Pinjarra Road Old Coast Road
Roe Highway	Great Eastern Highway Great Eastern Highway Bypass Tonkin Highway Leach Highway via Tonkin Highway Orrong Road Albany Highway (via Kenwick Link) South Street Kwinana Freeway	South Street Albany Highway (via Kenwick Link) Tonkin Highway (Airport) Great Eastern Highway Great Northern Highway Tonkin Highway

Notes: On Tonkin Highway detailed signing is provided in the vicinity of the Airport

The travel destinations are freeway or arterial road interchanges on the route(s) travelled. Where a freeway changes names but can be driven as a 'continuing' route, for example, Mitchell Freeway to / from Kwinana Freeway, travel time destinations on the downstream route are signed.

Some important off-freeway destinations have been considered for signing that are used by significant number of travellers, such as Perth City and Perth Airport. Rather than sign 'City', this off-freeway destination is signed at the freeway interchanges that travellers would use to reach them. For example on the Mitchell Freeway and Kwinana Freeway travel times are located at the Graham Farmer Freeway and Mounts Bay Road interchanges that service the city. Signing to the Airport (with terminal numbers) may be appropriate as it can be identified as a single point destination, if the tools are available to measure travel times to that single point destination.

8 Portable VMS for roadworks or events

8.1 General

Portable VMS (pVMS) can be moved around and used across many formats including road construction projects or events. They are appropriate for use at strategic locations to provide road and traffic condition information for road users, and are able to be moved around on a major road construction projects as work progresses. The portable signs may also be appropriate for significant events to provide traveller information as part of an overall traffic management plan. An example of a pVMS is shown in Figure 8-1.



Figure 8-1 An example of portable VMS displaying travel time on a construction project

On a road construction project the pVMS will generally display messages relating to current roadworks, incidents affecting traffic and future roadworks. As pVMS have the potential for multiple uses, the signs may also provide 'real-time' travel-time and traffic information. They may also be used to display roadwork-related messages, for example planned lane closures, detours and safety messages.

While pVMS are controlled locally as part of construction projects or events, it is also desirable that pVMS have communications with RNOG via the central control system in case of emergency, particularly outside work hours, in consultation with the relevant project or event managers. The pVMS shall generally comply with AS 4852.2-2009.

8.2 Message hierarchy for construction sites

The order of priority for pVMS messages in a construction project is indicated in Table 8.1.

Table 8.1 Hierarchy of messages for pVMS

Priority	Message Type	Description
1	Incidents	<p>Incident messages take precedence over other messages. Details may include messages advising of any incidents impacting traffic such as a crash, stalled vehicle or spilled load. They may also include imminent major disruption such as lane / road closures or detours, and community safety messages on severe weather events such as a bushfire, storm or flooding affecting traffic. Example:</p> <p>CRASH AHEAD SLOW DOWN</p>
2	Current roadworks	<p>Most pVMS will be used for messages on 'current roadworks'. This includes standard signs in AS 1742.4, where appropriate. Examples:</p> <p>LEFT LANE CLOSED. MERGE RIGHT TRAFFIC CONTROL. PREPARE TO STOP</p>
3	Current traffic condition or travel times	<p>Dynamic traffic condition information including travel times. Example:</p> <p style="text-align: right;">Min</p> <p>Leach Hwy 9 H. Miller Dr 14</p> <p>Note the use of mixed case (mix of upper and lower case font) for travel times. Guidance on the use of colours for travel times is provided in Section 8.9</p>
4	Planned roadworks	<p>Messages about future roadworks. Example:</p> <p>NIGHT WORK LEACH TO KEWDALE FROM 24 APR</p>
5	Individual vehicle speeds	<p>These messages can be displayed when connected with a speed measuring device. They will advise if a vehicle is travelling over the speed limit. They could be useful if speeding is found to be a problem at the site. Example:</p> <p>Your Speed 64 km/h Your Speed 59 km/h Slow Down ☹ Thank You ☺</p> <p>The line 'Slow Down' shall flash to provide additional warning if the speed is too high, say, 10 km/h above the posted speed limit (no need to flash the emoticon).</p>
6	Safety messages (related to worksite safety only)	<p>The pVMS may be used for safety messages (worksite related only) when they are not required for higher priority messages. They shall be limited to a single screen and only be displayed when the worksite is in operation and outside peak periods. Example:</p> <p>Slow Down for Workers' Safety. They Work for U</p> <p>Note the use of mixed-case letters for safety messages, and also the use of 'U' for 'You', which shall only be used in safety messages (filler messages)</p>

At construction sites, during work hours the default display for pVMS is the current roadwork message (Priority 2), or the current traffic condition or travel-time message (Priority 3) when there are no relevant roadwork messages. For Priority 3 messages (current traffic condition / travel times) the message would generally include two or three destinations plus the header row. Incident messages (Priority 1) will always take priority.

When traffic conditions are normal, for example outside normal work hours, Priority 4 or lower messages may be displayed.

For all displayed messages, but particularly when using multi-frame messages, consideration shall be given to the amount of information that road users can comprehend. This will ensure legibility and minimise unnecessary driver distraction.

8.3 Display colour and dimension requirements

The multifunction pVMS can display graphics using four colours (yellow, red, green and white) with up to four lines per frame and 14 characters per line.

The character height for Priority 1 and Priority 2 messages is generally 320 mm (which will limit the number of characters to 10 per line) with a legibility distance of 200 m. Priority 3 and Priority 6 messages shall have 200 mm high characters (to accommodate up to 14 characters per line) with a legibility distance of 100 m. The character height for Priority 3 messages can be either 320 mm or 200 mm if the number of characters per line is more than 10. For priority 5 messages, 200 mm high characters may be used.

The pVMS will also have flashing conspicuous lights at its four corners, which are only to be used for Priority 1 messages. If the message involves two frames, flashing conspicuous lights may not be used (assuming that the changing frames will be adequate to draw attention to the sign).

8.4 Using multi-frame and alternating messages

Due to the limited space available on pVMS, the use of multiple frames may be required for important messages. However, this is generally undesirable and shall only be considered if other options are not available. The use of multiple frames is not recommended for Priority 3 and lower messages.

When multiple frames have to be used (for Priority 1 or Priority 2 messages), they shall be limited to two frames. Multi-frame messages may include a symbol and text combination or only text as shown in Figure 8-2. Each of the two frames shall comprise complete units of information, forming a stand-alone message. The screen timing shall be no less than three seconds per screen (frame). Scrolling messages are not permitted.

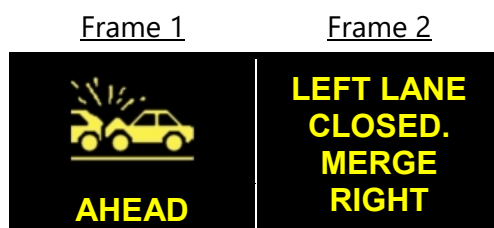


Figure 8-2 Multiple screens including a symbolic pictogram

Alternating two messages of the same type, for example a symbol or a text message or two symbols is permitted but only in Priority 2 messages, subject to a maximum of two frames as shown in Figure 8-3.

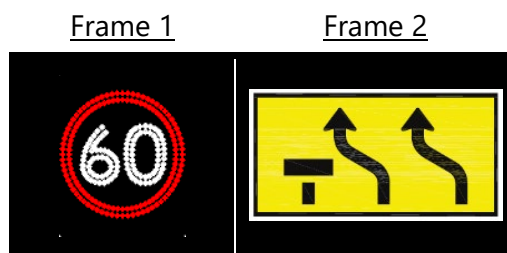


Figure 8-3 Alternating symbol Priority 2 (roadwork) signs

8.5 Message design

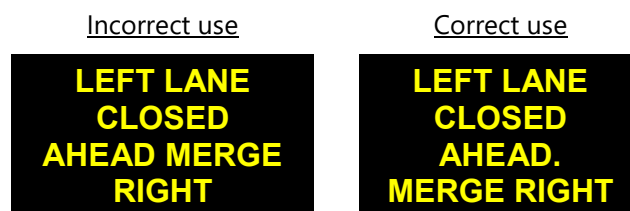
In general, the credibility and effectiveness of VMS messages depends on how the messages are designed and used. Messages that are poorly designed, irrelevant or displayed at the wrong time are less effective and may even confuse road users.

Designing pVMS incident messages follows the same guidelines as outlined in Section 2.4.1. As the pVMS does not have a separate pictogram panel, messages shall generally have a problem and action statement as a minimum. As space is limited on a pVMS, a message may take two lines.

Commercial or advertising messages shall not be displayed on worksite pVMS.

Guidelines for the development of new messages are provided below based on good signing practice:

- Where needed, only approved / standard abbreviations shall be used. pVMS may require the use of more abbreviations because of space limits. A list of approved abbreviations is provided in Appendix E.
- Messages shall be appropriate to the location, time of day, road environment and prevailing road conditions.
- Messages shall be clear, concise and unambiguous, and written in a directive tone.
- Messages shall be as brief as possible and be considered 'glance appreciative', to promote quick comprehension of the message by the road user.
- Generally, an eight word message approaches the processing capability of an average road user.
- A single message shall not contain more than seven units of information.
- No single line shall contain more than two units of information.
- A single space shall be left between a number and its unit.
- No units of information shall be illogically split or combined. An example is shown in Figure 8-4.
- A full stop may be used to separate information where necessary to avoid confusion. However, excessive use of full stops shall be avoided (refer Figure 8-2 and Figure 8-5).



(NOTE: For demonstration of the argument only. The above message may not be able to be displayed on a pVMS due to space limitations)

Figure 8-4 Example of incorrect and correct combination of units of information

- Use the minimum number of words necessary to convey message, an example is shown in Figure 8-5.



Figure 8-5 Example of incorrect and correct combination of minimum number of words

- Appropriate case shall be used for the messages as follows:
 - Except for travel times and safety (filler) messages, use upper case.
 - For travel times and safety messages, use mixed-case with the first letter of each word in upper case, except in words such as 'to', 'with' or 'for' unless they are used as the first word in a line.
- Inappropriate language, which is likely to offend the public, shall not be used.

To minimise confusion noted around messages using 'ROAD CLOSED' on the days prior to the proposed closure date the following principle is applied. The advanced notice ('ROAD CLOSURE' message) leading up to the road closure shall be a Priority 3 message (planned roadworks) with 200 mm characters, while the 'ROAD CLOSED' message on the days of closure is a Priority 2 message with 320 mm characters (refer Figure 8-6). This should assist with road user understanding of terms, particularly if they have not read the closure dates.

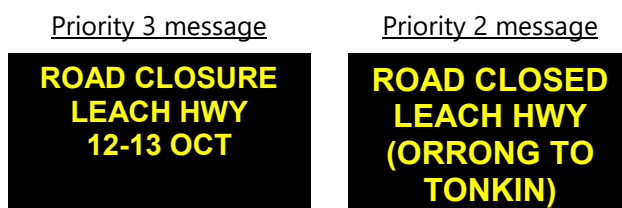


Figure 8-6 Message priorities and correct use of 'ROAD CLOSURE' and 'ROAD CLOSED' messages

8.6 Message approvals

An approved message library is attached at Appendix C, while approved pictograms and approved abbreviations are provided at Appendix D and Appendix E.

Any road sign in AS1742 is also deemed approved for use on pVMS as appropriate. Any new message, pictogram, abbreviation or road sign not in this guide shall be approved by the Manager Real Time Traffic Operations.

8.7 pVMS placement

The longitudinal placement of pVMS shall be as shown in Table 8.2.

Table 8.2 Portable VMS location prior to a problem and spacing relative to other signs

Installation	Speed Environment (km/h)	
	60 to 90	< 60
Distance prior to the subject of the message (no complex manoeuvres)	80 to 180 m	30 to 100 m
Distance prior to the subject of the message (complex manoeuvres)	400 to 500 m	300 – 400 m
Spacing to static signs	50 to 60 m	30 m

When being used to give advance warning of worksites, the pVMS shall be placed 300 m in advance of the worksite.

When aiming the pVMS, the point aimed shall be in the middle of the lanes travelling towards the pVMS at a point on the road that is:

- 65 m from the pVMS having a legibility distance of 100 m; and
- 140 m from the pVMS having a legibility distance of 200 m.

8.8 Construction site message posting and operator control

The pVMS should generally have remote and local control at a construction worksite. Although RNOC is not expected to be involved in the day-to-day control of the pVMS at a worksite, it is desirable that RNOC have the ability to control the pVMS remotely for network management purposes, for example in the case of an incident.

In the event of a major incident, the local (site-based) operator shall liaise with RNOC regarding pVMS messages. If RNOC operators want to take over the control of project-based pVMS, they may do so after discussing with the local operator. This may mean either deploying messages decided by RNOC through the local operator, or in an extreme case, full direct control of pVMS by RNOC until the operation is handed back to the local operator.

All projects on state controlled roads in the metropolitan area, with a duration greater than three weeks, are required to develop (in consultation with RNOC – Road Planned Interventions Section) a project specific Remote Access to pVMS Procedure. As a minimum, the procedure will address the requirements outlined in this section of the VMS Guidelines. Contact RNOC (Road Planned Interventions Manager) for a sample Remote Access to pVMS Procedure.

Except for the travel-time displays (refer Section 8.9), all other pVMS messages are to be posted manually by an authorised operator. There shall be at least one designated operator at all times with a backup operator also available. A list of authorised pVMS operators shall be approved for each worksite.

Traffic management implementers at the work site shall have a map of current pVMS locations and their unique identification numbers. They shall be aware of the status of all pVMS at the site and maintain an accurate record of changes to the messages at each pVMS, with the details of new message, date and time of change (unless such details are logged in automatically by the control system associated with the pVMS).

8.9 Travel-time displays

The display of near real-time travel information on pVMS may also be implemented with the use of appropriate data.

An application needs to be available for the pVMS in consultation with the data supplier, so that the travel time data can be automatically uploaded via an appropriate communication link to the relevant pVMS. This data would generally be refreshed every five minutes. Travel times to the destination shall be provided to the nearest minute.

A pVMS with a travel time display is illustrated in Figure 8-1 and in Figure 8-7.

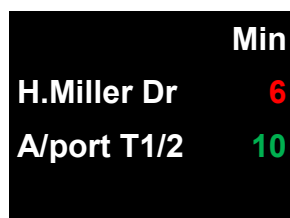


Figure 8-7 An example pVMS with real-time travel-time information

Colour coding will be used as in Table 8.3 to indicate the Estimated or Actual Travel-Time (ETT) relative to Nominal Travel Time (NTT). NTT is based on posted speed prior to roadworks.

Table 8.3 Travel time (or speed) thresholds for travel-time colour display

Travel Time Colour	ETT / NTT Ratio	Equivalent Speed Range (km/h)			
		100	90	80	70
Green	< 1.5	> 66	> 60	> 53	> 46
Yellow	1.5 to < 2.0	50 to 66	45 to 60	40 to 53	to 46
Red	> 2.0	< 50	< 45	< 40	< 35

Travel times can be overridden by an authorised operator with a higher priority message if needed.

Travel time destinations are usually the key intersections within the project area, unless key intersections and destinations, for example the airport, are outside the project area and are within the agreed project scope.

Destinations shall be in top to bottom order with the closest destination at the top and the furthest last. A project destinations strategy shall be developed. Focus group testing may be needed to confirm comprehension of sign messages.

Where travel times are not available for a short duration due to a breakdown in the communication link or other reasons, the screens can move to a default safety message.

8.10 Event management message posting and operator control

For the use of pVMS before or during significant events, the sign locations and proposed messages shall be determined as part of an overall traffic management plan for the event. The RNOC would generally manage and control the pVMS remotely as part of the event management.

9 References

Austroads 2019, Guide to Traffic Management Part 10: Traffic Control and Communication Devices, AGTM10-19, Austroads, Sydney, NSW.

Standards Australia 2009, Variable message signs Part 1: Fixed signs, AS 4852.1—2009, Sydney, NSW.

Standards Australia 2009, Manual of uniform traffic control devices, Part 2: Traffic control devices for general use, AS 1742.2-2009, Sydney, NSW.

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Standards Australia 2010, Australian Standard AS 1742 Set – 2009 Manual of uniform traffic control devices Set, Standards Australia, Sydney.

VicRoads 2019, Managed Motorway Design Guide Volume 2: Part 3, Motorway Planning and Design, Ministry of Transport, Melbourne, Victoria.



VicRoads 2020, Managed Motorway Design Guide Volume 2: Part 4, Lane Use Management, Variable Speed Limits and Traveller Information, Ministry of Transport, Melbourne, Victoria.



Appendix A VMS Message Library


– Incidents and Events




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Table A.1 VMS message library – incidents and events. Source: Adapted from VicRoads and STREAMS




No.	Pictogram	Event Type	Location	Effect	Action	Comment
1		HIGH WINDS	- ON ____	- ____CLOSED - FREEWAY CLOSED	- CAUTION - REDUCE SPEED - DRIVE SAFELY - USE ALT ROUTE - USE EXIT "number" - USE "name" EXIT - USE NEXT EXIT	<i>This symbol shall be used to represent high winds. This will be used at bridges during winds greater than the prescribed threshold</i>
2		CONGESTION QUEUES	- AHEAD - AT ____ - ____ TO ____ - IN TUNNEL - ON ____ - NEAR ____ - AFTER ____	- EXPECT DELAYS	- PREPARE TO STOP - CAUTION - DRIVE SAFELY - USE ALT ROUTE	<i>This pictogram shall be used for congestion and queuing</i> <i>The event type is to be displayed in the text message section of the sign or beneath the pictogram</i>
3	No Symbol used for Planned (future) Event	SPECIAL ROAD EVENT	- ____ TO ____ - IN TUNNEL - ON ____	- EXPECT DELAYS - SEEK ALT ROUTE (NON ACTIVE)	SCHEDULED DAY/DATES - "Day" – "Day" - "No." "Month" - "No." "Month" - "No." "Month" - "No." AM – "No." PM	<i>No pictogram shall be used when information for planned events is displayed (future roadworks or special road events etc)</i>

No.	Pictogram	Event Type	Location	Effect	Action	Comment
		PLANNED ROADWORK	<ul style="list-style-type: none"> - AT ____ - ____ TO ____ - IN TUNNEL - ON ____ 	<ul style="list-style-type: none"> - EXPECT DELAYS - NIGHT WORKS - SEEK ALT ROUTE (NON ACTIVE) 	SCHEDULED DAY/DATES <ul style="list-style-type: none"> - "Day" – "Day" - "No." "Month" - "No." "Month" - "No." "Month" - "No." AM – "No." PM 	<i>The effects shown in red are only used in planned event messages</i>
4		BREAKDOWN	<ul style="list-style-type: none"> - AHEAD - AT ____ - IN TUNNEL - ON ____ - NEAR ____ - ____ AHEAD - AFTER ____ 	- LEFT LANE(S) CLOSED	- MERGE RIGHT	<i>This pictogram shall be used to represent a broken down vehicle</i>
				- RIGHT LANE(S) CLOSED	- MERGE LEFT	
				- ON SHOULDER	- REDUCE SPEED	
				<ul style="list-style-type: none"> - ____ CLOSED - FREEWAY CLOSED 	<ul style="list-style-type: none"> - USE ALT ROUTE - USE EXIT "number" - USE "name" EXIT - USE NEXT EXIT 	
				- EXPECT DELAYS	<ul style="list-style-type: none"> - PREPARE TO STOP - CAUTION - REDUCE SPEED - DRIVE SAFELY 	
5		ROADWORKS	<ul style="list-style-type: none"> - AHEAD - AT ____ - ____ TO ____ - IN TUNNEL - ON ____ - NEXT ____ - ____ AHEAD - AFTER ____ 	- LEFT LANE(S) CLOSED	- MERGE RIGHT	<i>This pictogram shall be used for any active roadworks.</i>
				- LEFT LANE(S) CLOSED	- MERGE LEFT	
				<ul style="list-style-type: none"> - LEFT SHOULDER CLOSED - RIGHT SHOULDER CLOSED 		
				<ul style="list-style-type: none"> - ____ CLOSED - FREEWAY CLOSED 	<ul style="list-style-type: none"> - USE ALT ROUTE - USE EXIT "number" - USE "name" EXIT - USE NEXT EXIT 	

No.	Pictogram	Event Type	Location	Effect	Action	Comment
				<ul style="list-style-type: none"> - MAJOR DELAYS - MINOR DELAYS - EXPECT DELAYS 	<ul style="list-style-type: none"> - PREPARE TO STOP - CAUTION - REDUCE SPEED - DRIVE SAFELY 	
6		TRAFFIC CONTROLLER	<ul style="list-style-type: none"> - AHEAD - AT ____ - ____ TO ____ - IN TUNNEL - ON ____ - NEXT ____ - ____ AHEAD - AFTER ____ 	<ul style="list-style-type: none"> - LEFT LANE(S) CLOSED - RIGHT LANE(S) CLOSED - LEFT SHOULDER CLOSED - RIGHT SHOULDER CLOSED - MAJOR DELAYS - MINOR DELAYS - EXPECT DELAYS 	<ul style="list-style-type: none"> - MERGE RIGHT - MERGE LEFT - PREPARE TO STOP - CAUTION - REDUCE SPEED - DRIVE SAFELY 	<p><i>The traffic controller sign shall be used to give advance warning of a traffic controller.</i></p> <p><i>PREPARE TO STOP shall be used in conjunction with this sign if traffic is required to stop at the traffic controller position</i></p>
7		FLOODING	<ul style="list-style-type: none"> - AHEAD - AT ____ - ON ____ - NEXT ____ - ____ AHEAD - AFTER ____ 	<ul style="list-style-type: none"> - ____CLOSED - FREEWAY CLOSED 	<ul style="list-style-type: none"> - USE ALT ROUTE - USE EXIT "number" - USE "name" EXIT - USE NEXT EXIT 	<p><i>This pictogram shall be used to represent water over road</i></p> <p><i>The event type is to be displayed in the text message</i></p>

No.	Pictogram	Event Type	Location	Effect	Action	Comment
				<ul style="list-style-type: none"> - MAJOR DELAYS - MINOR DELAYS - EXPECT DELAYS 	<ul style="list-style-type: none"> - PREPARE TO STOP - CAUTION - REDUCE SPEED - DRIVE SAFELY 	section of the sign or beneath the pictogram
8		EMERGENCY VEHICLE		- LEFT LANE CLOSED	- MERGE RIGHT	This pictogram shall be used when a lane closure is implemented solely for use by an emergency vehicle
				- RIGHT LANE CLOSED	- MERGE LEFT	
					- CAUTION	
9		CYCLING EVENT RUNNING EVENT	<ul style="list-style-type: none"> - ____ TO ____ - IN TUNNEL - ON ____ 	- LEFT LANE(S) CLOSED	- MERGE RIGHT	This pictogram shall be used for an active cycling event
				- RIGHT LANE(S) CLOSED	- MERGE LEFT	
				<ul style="list-style-type: none"> - LEFT SHOULDER CLOSED - RIGHT SHOULDER CLOSED 		The type of cycling event is to be displayed in the text message section of the sign or beneath the pictogram
				<ul style="list-style-type: none"> - _____CLOSED - FREEWAY CLOSED 	<ul style="list-style-type: none"> - USE ALT ROUTE - USE EXIT "number" - USE "name" EXIT - USE NEXT EXIT 	This pictogram shall be used for an active running event

No.	Pictogram	Event Type	Location	Effect	Action	Comment
				<ul style="list-style-type: none"> - MAJOR DELAYS - MINOR DELAYS - EXPECT DELAYS 	<ul style="list-style-type: none"> - PREPARE TO STOP - CAUTION - REDUCE SPEED - DRIVE SAFELY 	<i>The type of running event is to be displayed in the text message section of the sign or beneath the pictogram</i>
10		OIL SPILL DEBRIS CHEMICAL SPILL FOG SMOKE ANIMAL	<ul style="list-style-type: none"> - AHEAD - AT ____ - IN TUNNEL - ON ____ - NEAR ____ - AFTER ____ 	- LEFT LANE(S) CLOSED	- MERGE RIGHT	<i>This pictogram shall only be used when there is not a more specific pictogram available.</i>
				- RIGHT LANE(S) CLOSED	- MERGE LEFT	
				<ul style="list-style-type: none"> - ____ CLOSED - FREEWAY CLOSED 	<ul style="list-style-type: none"> - USE ALT ROUTE - USE EXIT "number" - USE "name" EXIT - USE NEXT EXIT 	<i>It shall be used individually or in conjunction with words indicating the event type</i>
				<ul style="list-style-type: none"> - MAJOR DELAYS - MINOR DELAYS - EXPECT DELAYS 	<ul style="list-style-type: none"> - PREPARE TO STOP - CAUTION - REDUCE SPEED - STAY IN VEHICLE - DRIVE SAFELY 	<i>The event type is to be displayed in the text message section of the sign or beneath the pictogram</i>
11		INCIDENT	<ul style="list-style-type: none"> - AHEAD - AT ____ - IN TUNNEL 	- LEFT LANE(S) CLOSED	- MERGE RIGHT	<i>This pictogram shall be used to for an incident or a crash</i>
				- RIGHT LANE(S) CLOSED	- MERGE LEFT	

No.	Pictogram	Event Type	Location	Effect	Action	Comment
			<ul style="list-style-type: none"> - ON ____ - NEAR ____ - AFTER ____ 	<ul style="list-style-type: none"> - ____CLOSED - FREEWAY CLOSED 	<ul style="list-style-type: none"> - USE ALT ROUTE - USE EXIT "number" - USE "name" EXIT - USE NEXT EXIT 	
				<ul style="list-style-type: none"> - LEFT SHOULDER CLOSED - RIGHT SHOULDER CLOSED 		
				<ul style="list-style-type: none"> - MAJOR DELAYS - MINOR DELAYS - EXPECT DELAYS 	<ul style="list-style-type: none"> - CAUTION - REDUCE SPEED - STAY IN VEHICLE - DRIVE SAFELY 	
				<ul style="list-style-type: none"> - RIGHT LANE(S) CLOSED 	<ul style="list-style-type: none"> - MERGE LEFT 	
12		(Used as part of a LUMS response only)		<ul style="list-style-type: none"> - LEFT LANE(S) CLOSED 	<ul style="list-style-type: none"> - MERGE RIGHT 	This pictogram shall only be used prior to the start of a LUMS environment to display advance warning of a reduced speed limit to 40km/h and lane closure at the 1 st LUMS gantry, i.e., when there is no other upstream gantry to indicate a lane change is required
				<ul style="list-style-type: none"> - RIGHT LANE(S) CLOSED 	<ul style="list-style-type: none"> - MERGE LEFT 	
13		EXIT		<ul style="list-style-type: none"> - FREEWAY CLOSED 	<ul style="list-style-type: none"> - USE EXIT "number" - USE "name" EXIT - USE NEXT EXIT 	This pictogram shall be used only on the VMS upstream of a full freeway closure and upstream of an off ramp informing road users that they must exit at the next exit

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Appendix B VMS Message Library

– Campaigns and Promotions

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Table B.1 VMS Message Library – Campaigns and Promotions

No.	Message	Purpose
C1	Buckle Up. Seat Belts Save Lives	Safe road users
C2	Drink Driving is Never OK	Drink driving behaviour / road safety
C3	Stick to Speed Limit	Road safety
C4	Speed Can Kill. Slow Down	Road safety
C5	Don't be Distracted By Mobile Phone	Safe road users
C6	Bike Week Date to Date Cycle Instead	Campaign
C7	Walk Safely To School Day Fri Date May	Campaign
C8	Spinal Injury Awareness Week Date to Date Nov	Campaign
C9	Double Demerits Date to Date Drive Safely	Campaign
C10	Keep Left Unless Overtaking	Driver behaviour
C11	Charity Ride Ahead Expect Delays	Awareness and warning
C12	Back to School 40 km/h In School Zones	Public awareness / road safety
C13	Total Fire Ban Today	Public awareness

Note: This VMS library is not an exhaustive list; rather it provides a sample of approved messages. Contact Manager Real Time Traffic Operations for use of messages not presented within this appendix.

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Appendix C VMS Message Library

– Portable VMS

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Table C.1 Incident (Priority 1) pVMS messages

Sign ID	Message	Other combinations ¹				
		Problem	Location	Effect	Attention	Action
PV1-01a	CRASH AHEAD. RIGHT LANE CLOSED	CONGESTION DEBRIS EMERGENCY FLOOD	LEFT LANE MID LANE NEXT (number) KM NEXT (number) M	(name of road) CLOSED (number) MINS DELAY DELAYS LEFT LANE CLOSED	(destination) TRAFFIC ALL TRAFFIC BUSES CARS	DRIVE SAFELY DRIVE WITH CARE DRIVE WITH CAUTION EXIT TO (name of road)
PV1-01b		FOG HAZARD	ON (name of road) RIGHT LANE	MAJOR DELAY(S) MID LANE CLOSED	EMERGENCY VEHICLE LOCAL TRAFFIC	MERGE RIGHT PREPARE TO STOP
	ALL TRAFFIC MERGE RIGHT	INCIDENT OIL SPILL OVERSIZE LOAD OVERSIZE VEHICLE POLICE CONTROL POOR VISIBILITY QUEUES SMOKE SURFACE WATER TRAFFIC CONTROL VIP CONVOY WATER ON ROAD		MINOR DELAY(S) NO SHOULDER (S) QUEUES ROAD CLOSED	OVERSIZE VEHICLE THROUGH TRAFFIC TRANSIT VEHICLE TRUCKS	REDUCE SPEED SLOW DOWN STAY IN CAR STAY IN VEHICLE TURN LEFT TURN RIGHT USE ALT ROUTE USE DETOUR DO NOT OVERTAKE MERGE LEFT USE OTHER ROUTE USE (name of road) KEEP LEFT

¹ Some statements may need to be split into two lines and approved abbreviations may be required for some words due to space limitations.

Table C.2 Current roadwork (Priority 2) messages²

Sign ID	Message	Other combinations				
		Problem	Location	Effect	Attention	Action
PV2-01	ROADWORKS AHEAD. REDUCE SPEED	FLAGMAN TRAFFIC CONTROLLER	(same as in PV1-01)	(same as in PV1-01)	(same as in PV1-01)	(same as in PV1-01)

Table C.3 Planned roadwork (Priority 4) messages³

Sign ID	Message	Other combinations				
		Problem	Location	Effect	Attention	Action
PV4-01	NIGHT WORK XXXX RD FROM XX					

² Generally use AS1742 road signs

³ This table needs to be populated in consultation with roadworks traffic management team as construction proceeds

Table C.4 Safety (Priority 6) messages for pVMS (at roadworks sites)










Sign ID	Message	Uses
PV6-01	Slow Down for Workers' Safety. They Work for U	When workers work close to live traffic, and speeding through the worksite is an issue. Shall not be used when the worksite is not in operation. Refer note 1
PV6-02	Slow Down For Your & Others Safety	When speeding through the worksite is an issue. Refer note 1
PV6-03	Obey Road Signs For Your & Others Safety	Road signs are ignored.
PV6-04	Changed Road Alignment. Drive with Extra Caution	Road alignment is changed.
PV6-05	Changed Road Surface. Drive with Extra Caution	Road surface conditions have changed to a poor condition than before.
PV6-06	Heavy Machinery Close to Road. Drive with Extra Caution	When heavy machinery work close to traffic, particularly for prolonged periods.

Note 1: where appropriate or necessary, use directive tone and omit 'Please' or 'Pls'

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Appendix D Portable VMS Pictograms

Table D.1 Pictograms library

ID ⁴	Pictogram	Uses
PVP-01		CONGESTION QUEUES
PVP-02		INCIDENT (Vehicle breakdown)
T1-5		ROADWORKS
T1-34		TRAFFIC CONTROL
PVP-05		FLOODING Water on road
PVP-06		CRASH
PVP-07		EXIT
T3-3		SLIPPERY SURFACE
T3-9		LOOSE MATERIAL ON ROAD SURFACE

Source: Adapted from VicRoads and STREAMS

⁴ The sign IDs starting with T are Australian Standard sign numbers. Other IDs are temporary IDs assigned in this document. All signs shall conform to Australian Standards in size, colour and other parameters.

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Appendix E VMS Abbreviations

The following abbreviations are acceptable on VMS signs:

Table E.1 Abbreviations – Road Names

Road Name	Abbreviation
Horrie-Miller Drive	H. Miller Dr
Graham Farmer Freeway	G. Farmer Fwy
Great Eastern Highway	Gt Eastern Hwy
Great Northern Highway	Gt Northern Hwy

Table E.2 Abbreviations – General Terminology

Word	Abbreviation
ALTERNATE	ALT
AVENUE	AVE
BOULEVARD	BLVD
CORNER	CNR
EAST BOUND	EAST-BND
ESPLANADE	ESP
FREEWAY	FWY
HIGHWAY	HWY
HOURS	HRS
INFORMATION	INFO
JUNCTION	JNC
KILOMETRE	KM
NORTH BOUND	NTH-BND
MINUTES	MIN
ROAD	RD
SHOULDER	SHLDR
SOUTH BOUND	STH-BND
STREET	ST
VEHICLE	VEH
WEST BOUND	WEST-BND

Table E.3 Abbreviations – Times and Dates

Word	Abbreviation
Time duration	'number' Min
	'number' HRS
	'number' DAYS
	'number' WEEKS
Time of day	'number' AM
	'number' PM
Time period	'number' AM – 'number' PM
Days of week	SUN
	MON
	TUE
	WED
	THU
	FRI
	SAT
Day period	MON - FRI
Months of year	JAN
	FEB
	MAR
	APR
	MAY
	JUN
	JUL
	AUG
	SEP
	OCT
	NOV
	DEC

Word	Abbreviation
Date	'number' JAN
Date period	'number' JAN – 'number' FEB

Table E.4 Other abbreviations for pVMS safety (filler) messages only

Word	Abbreviation
AND	& (or) n
FOR	4
TO	2
YOU	U

NOTE: These abbreviations shall not be used in any other message type, except in filler messages in pVMS where they may be used only if necessary (for lack of space) and in appropriate context.

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