TRANSPORT FOR NSW (TfNSW)

TfNSW SPECIFICATION D&C TS912

MOTORWAY SYSTEMS – TRAFFIC MANAGEMENT AND CONTROL SYSTEM

REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		First issue as "OMCS Requirements – Traffic Management and Control System".	A/GM, CS (J Staugas)	14.06.17
Ed 1/Rev 1	1.4.2 & 5	Updates to Communication and Radio Re-Transmission Systems Requirements	DCS	29.03.18
Ed 1/Rev 2		Spec title changed. Clauses rearranged and reworded to improve clarity. Global "RMS Technical Note for vehicle loop detectors" changed to "RMS Smart Motorway Design Guide – Vehicle Detectors". 1.2 Related specs and Figure updated. 1.4.1 Definitions updated. 1.4.2 Acronyms updated. 2.3.4 (c) Requirement for AVID video recording to be accessible via OMCS GUI added. 2.4.2 (c) (iv) Reworded to improve clarity. 2.4.2 (e) & (f) Types of egress passages clarified. Requirement for CCTV system to provide continuous coverage to entrances to substations, motorist evaluation/muster points and roadside cabinets added. Requirement for sign face/device setting to be clearly visible/legible from CCEV cameras added.	DCS	10.06.20

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 2 (cont'd)	2.5 (d)	Requirement for TMCS to implement TIMP to notify motorists about emergency bay having been occupied added.		
		TIMP configuration options specified.		
	3.6.2	Requirement for each set of signals to comprise two red aspects in single enclosure deleted.		
	3.6.6	Requirement for CMS display to be conditionally blanked deleted.		
	3.6.7 (e) to (h)	Movable median requirements added for bifurcations in tunnels.		
	3.7.2 (b) (vii) & (c)	Requirement for smoky vehicle camera system to comply with Smoky Vehicle Camera Specification added.		
		RMS approval required for location of smoky vehicle camera system within tunnel.		
	4.3.1 (e)	Requirement for refresh rate for travel time calculation to be agreed with TMC added.		
	4.3.2	Previous sub-clause 4.3.2 "(Not Used)" deleted. Subsequent sub-clauses renumbered.		
	5.1	Heading title added to form new clause. Subsequent clauses renumbered.		
	5.11	Hold Point – submission details updated.		
	7.2	Hold Point – submission details updated.		
	Annex C	Schedule of Hold Points updated.		
Ed 1/Rev 3	Global	References to "Roads and Maritime Services" or "RMS" changed to "Transport for NSW" or "TfNSW" respectively.	DCS	22.06.20
		References to "RMS Representative" changed to "Principal".		

Transport for NSW SPECIFICATION D&C TS912

MOTORWAY SYSTEMS - TRAFFIC MANAGEMENT AND CONTROL SYSTEM

IC-DC-TS912

VERSION FOR:
DATE:

CONTENTS

CLAUSE PAGE

FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW D&C TS912 Edition 1 Revision 2.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

TfNSW SPECIFICATION D&C TS912

MOTORWAY SYSTEMS - TRAFFIC MANAGEMENT AND CONTROL SYSTEM

1 GENERAL

1.1 SCOPE

This Specification sets out the functional and performance requirements for the supply, installation and commissioning of a Traffic Management and Control System (TMCS) for an independently operated motorway.

The TMCS facilitates the safe and effective management of traffic on the Motorway through the integrated control of various motorway traffic systems, and is to be designed to allow for Smart Motorway operations in accordance with TfNSW Smart Motorway Design Guidelines.

1.2 RELATED SPECIFICATIONS

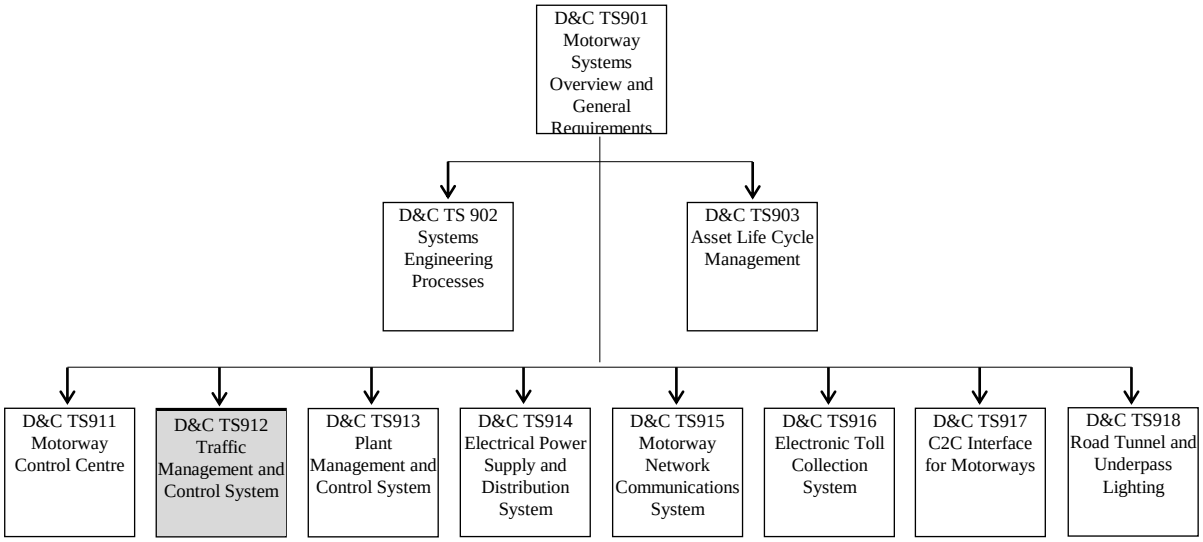
This Specification is a Level 2 document which forms part of the suite of TfNSW specification documents for Motorway Systems (see figure below). Other documents within the suite are:

Level 1

- D&C TS901 “Motorway Systems Overview and General Requirements”;

Level 2

- D&C TS902 “Systems Engineering Processes”;
- D&C TS911 “Motorway Systems - Motorway Control Centre”;
- D&C TS913 “Motorway Systems - Plant Management and Control System”;
- D&C TS914 “Motorway Systems - Electrical Power Supply and Distribution System”;
- D&C TS915 “Motorway Systems - Motorway Network Communications System”;
- D&C TS916 “Motorway Systems - Electronic Toll Collection System”;
- D&C TS917 “Motorway Systems - C2C Interface for Motorways”;
- D&C TS918 “Motorway Systems - Road Tunnel and Underpass Lighting”.



1.3 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.3.1 (Not Used)

1.3.2 (Not Used)

1.3.3 Schedules of HOLD POINTS and Identified Records

The schedules in Annexure TS912/C list the **HOLD POINTS** that must be observed. Refer to Specification TfNSW D&C Q6 for the definition of **HOLD POINTS**.

The records listed in Annexure TS912/C are **Identified Records** for the purposes of TfNSW D&C Q6 Annexure Q/E.

1.3.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure TS912/D and must be implemented.

1.3.5 (Not Used)

1.3.6 Referenced Documents

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 2350). For convenience, the full titles are given in Annexure TS912/M.

1.4 DEFINITIONS AND ACRONYMS

1.4.1 Definitions

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The following definitions apply to this Specification:

Alarm

Discrete change of data resulting in an audio/visual annunciation in the control room or the OMCS GUI display, requiring operator acknowledgement as well as input to alarm list.

The following categories are defined (not shown in order of priority or criticality of the alarm):

Action alarm: Alarm feature including blocking facilities intended for automatic safeguarding actions in order to protect people, equipment and environment.

Warning alarm: Alarm without blocking facilities intended for abnormal conditions enabling operator intervention in order to prevent further escalation.

Fault alarm: Alarm associated to fault or failure in the instrument and/or control device.

Availability

The time the OMCS is available. Availability is defined as the ratio of actual time for which the OMCS is able to perform a given task over total time the OMCS is expected to perform this task.

The availability A is calculated as follows:

A = MTBF / (MTBF + MOT)

Where:

MTBF (Mean Time Between Failure) indicates reliability for the given task.

MOT (Mean Outage Time) indicates the time required to restore performance of the given task from failure:
MOT = MTTD + MTTR

MTTD (Mean Time To Detection) is the elapsed time from the occurrence of a failure until detection.

MTTR (Mean Time To Repair) is the elapsed time to repair the fault. Must include the time between the system or device failure and the successful return to service including any mobilisation of repair crews and spares.

Backup control system

Comprises all hardware and software necessary to maintain control when the main control systems have either failed, malfunctioned or have been shut down during maintenance.

Congestion

In general, congestion occurs when the number of vehicles using the road is greater than the capacity of the available road space, impeding the efficient movement of traffic [(1)].

Contractor

The Project Company delivering the requirements of the SWTC, or the Company that is either the owner of the Motorway asset under a NSW Government concession or responsible for operating the asset.

[(1)] Managing Traffic Congestion Audit Report, PP No 221, Session 2010-13, Victorian Government Printer

Control Centre An operational centre for activities related to the management and maintenance of a transport infrastructure asset. Primarily, they refer to the TMC and private motorways MCC, but could include those of other transport modes.

Device All roadside equipment and plant equipment controlled by the OMCS.

Error The product state or incorrect information in the system which is liable to lead to a failure. In terms of consequences, error can be classified as:

- internal;
- external;
- transient;
- intermittent;
- persistent;
- permanent.

Failure Effect of an error. It is the nonconformity of behaviour of a component, subsystem or system.

Fault A defect either in hardware, software or in the design. Fault is an identified or potential cause of an error.

Incident An event or issue (both planned and unplanned) that has or may have an adverse impact on the traffic flow of the road network or to road user safety, requiring a response from Motorway traffic operations staff.

An incident is described in the C2C Interface by a set of data defining the type of the event, the position in the network, the severity and impact on traffic and other information.

For the purposes of the IMS, an incident includes:

- obstruction of one or more traffic lanes, including breakdown lanes, shoulders and ramps;
- any event or circumstance (e.g. congestion) which impacts the flow of traffic on the Motorway, ramps and approaches;
- closure of a Motorway carriageway;
- closure of the Motorway;
- evacuation of carriageways in tunnels;
- call out of any emergency service;
- activation of the deluge systems in tunnels;
- activation of the emergency ventilation systems;
- fire incident;
- air quality incident;
- flooding;
- planned works (e.g. road/tunnel maintenance activities);
- major/special events (e.g. sporting or cultural events);
- an incident notified via the C2C Interface.

Incident management	All operational activities designed to maintain or restore conditions of road use that are as close as possible to the normal situation.
Incident Response Plan	A prepared response to an incident or planned event, which covers predefined operator actions, including implementation of the Traffic Incident Management Plan (TIMP) and field resources management.
Motorway	The road including all: • open roadway sections; • tunnel sections; • approaches/entry ramps; • exits/exit ramps; • buildings, substations, and other structures; within the Motorway lease area.
Lane occupancy	The proportion of time, over a given time interval, that there is a vehicle present at a specified point in the lane [(2)].
Planned event	A scheduled traffic incident anticipated to impact traffic operations, that has been planned for and the response prepared in advance.
Ramp metering	The control of traffic entering a Motorway by means of traffic signals on the entry ramps [(3)].
Redundancy	A system with redundancy is one with duplication which prevents failure of the entire system in the event of failure of a single component.
Response	A set of actions taken by the System, with or without direct initiation from an Operator, to deal with an incident. Responses may consist of coordinated sets of conscription of field resources and /or device settings under a Traffic Incident Management Plan or individual device settings.
Road Network Operations	All traffic management and user support activities intended to permit, improve, or facilitate the use of an existing Motorway or tunnel, whatever its condition of use.
Sydney Motorway Network	The Motorway network comprising: • Eastern Distributor • Southern Cross Drive • General Holmes Drive • M5 Motorway East • M5 South Western Motorway • Westlink M7 • M2 Hills Motorway

[(2)] Austroads Glossary of Terms (2015 Edition), AP-C87-15, Austroads
[(3)] Same as for footnote (2).

- Lane Cove Tunnel
- Gore Hill Freeway
- Warringah Freeway
- Sydney Harbour Tunnel
- Sydney Harbour Bridge
- Cahill Expressway
- M1 Pacific Motorway (formerly F3 Freeway)
- M1 Princes Motorway (formerly F6 Southern Freeway)
- M31 Hume Highway (formerly F5 Freeway)

and any other Motorways which may be added in the future.

Traffic flow management	Automated system response to optimise the live flow of traffic on a Motorway based on data received, and the interactive management of traffic control equipment.
Traffic Incident Management Plan (TIMP)	Traffic management plans which are location specific and either can be generated automatically by the system or were programmed into the system using prior prepared and approved plans.
Traffic management	All measures, with respect to predetermined objectives, aimed at distributing and controlling traffic flows, in order to avoid the onset of disturbances or to reduce their impact. Traffic management is carried out in coordination with or under the control of the TfNSW and TfNSW TMC.
Traveller Information or Driver Advisory	All measures to disseminate predictive or current information on traffic conditions and improve general conditions of Motorway or tunnel use. Its general aim is safety and user comfort.
Traffic (platoon) speed	The arithmetic mean of individual spot speeds that are recorded for vehicles passing an observation point over a selected time period [(4)]. Also termed "time mean speed".
Tunnel	An underground or covered roadway which is continuously enclosed for a length of 120 m or greater measured parallel to the road alignment.

1.4.2 Acronyms

The following acronyms apply to this Specification:

ACMA	Australia Communications and Media Authority
ANSI	American National Standards Institute
ATID	Automatic Traffic Incident Detection
AVID	Automatic Video Incident Detection
AWS	Advanced warning sign(s)
C2C	Centre to Centre

[(4)] Detection Technology for Intelligent Vehicle Highway Systems (IVHS), Federal Highway Administration, FHWA-RD-95-100 (Dec 1996)

CCTV	Closed circuit television
CMS	Changeable message sign(s)
DAS	Distributed Antenna System
DRS	Disaster Recovery Site
EPSD	Electrical Power Supply and Distribution
GNSS	Global Navigation Satellite System
GRN	Government Radio Network
GUI	Graphical user interface
Hi-Occ	High Occupancy Algorithm
HV	High voltage
IMS	Incident Management System
IOCS	Internal Operations Communication System
IP	Internet protocol
ISLUS	Integrated Speed Limit and Lane Use Sign(s)
ITS	Intelligent Transport System
LED	Light emitting diode
MCC	Motorway Control Centre
METS	Motorist Emergency Telephone System
MMS	Motorway Management System
MNCS	Motorway Network Communications System
MOT	Mean Outage Time
MTBF	Mean Time between Failures
MTTD	Mean Time To Detection
MTTR	Mean Time To Repair
MTTS	Motorway Travel Time Service
NSW	New South Wales
NSWPFRN	New South Wales Police Force Radio Network
NTP	Network Time Protocol
O&M	Operations and Maintenance
OMCS	Operations Management and Control System
OHD	Over-height detectors
PA	Public Address
PABX	Private Automatic Branch Exchange
PTZ	Pan tilt zoom (in relation to CCTV)
QMS	Queue Management System
TfNSW	Transport for NSW

RRB	Radio Re-broadcast
SCATS	Sydney Coordinated Adaptive Traffic System
SEMP	Systems Engineering Management Plan
SWTC	Project Deed Scope of Works and Technical Criteria
TfNSW	Transport for New South Wales
TIDS	Traffic Incident Detection System
TIMP	Traffic Incident Management Plan
TMC	Transport Management Centre
TMCS	Traffic Monitoring and Control System for the Motorway
TMS	Tunnel Message Sign(s)
TTS	Travel Time System
UPS	Uninterruptible power supply
VCS	Video Control System
VMS	Variable message signs, incorporating LED sign facia, support, structure, VMS controller processor system and communications interface equipment
VSLS	Variable Speed Limit Signs. Refer also ISLUS.
WAE	Work-As-Executed (drawings)

1.5 OVERVIEW OF TMCS AND FUNCTIONAL REQUIREMENTS

1.5.1 Objectives and TMCS Features

The TMCS must meet the following objectives:

(a) respond safely and effectively to emergency situations on the Motorway in the shortest possible time frame;

(b) integrate control of all traffic devices and electronic signs on the Motorway to optimise the traffic flow to maximise safety and traffic throughput;

(c) integrate with the Incident Management System (IMS) to manage traffic incidents effectively and safely, and to mitigate the impacts of incidents and prevent secondary incidents occurring;

(d) provide accurate and timely driver information about traffic conditions and incident situations.

The TMCS must incorporate TfNSW's traffic management control philosophies (including Smart Motorways) and must be integrated with the TfNSW Traffic Flow and Incident Management System at the TfNSW Transport Management Centre (TMC).

The TMCS must operate as a high availability system in accordance with the Operations Management and Control System (OMCS) availability requirements specified in Specification TfNSW D&C TS911.

The TMCS must incorporate fault tolerant and fail-safe functions as part of an integrated OMCS.

1.5.2 Functional Capability

The TMCS must perform the following functions:

(a) Use detection and traffic monitoring systems to manage traffic flow and detect potential traffic incidents.

(b) Provide traffic flow, speed, occupancy and classification reporting for various types of vehicles.

(c) Detect potential incidents (including the detection of any over-height vehicles) automatically and enter the data describing the incident into the OMCS IMS, TfNSW and TfNSW TMC's systems.

(d) Implement ad hoc and planned Traffic Incident Management Plan (TIMP) responses that are coordinated with TfNSW TMC and/or NSW Police Force.

(e) Provide advice to motorists about traffic and incident conditions on the Motorway.

(f) Allow surveillance of the Motorway using closed circuit television (CCTV) cameras and a central Motorway Video Control System (VCS).

(g) Control all driver advisory devices and traffic lane control devices on the Motorway, including as a minimum:

(i) Variable Message Signs (VMS);

(ii) Integrated Speed Limit and Lane Use Signs (ISLUS);

(iii) Variable Speed Limit Signs (VSLS);

(iv) Tunnel Message Signs (TMS);

(v) Movable physical barriers and in-pavement lights;

(vi) Movable medians;

(vii) Changeable Message Signs (CMS).

(h) Control voice communications to motorists in the tunnels over a Radio Re-broadcast (RRB) System and a Public Address (PA) System.

(i) Provide Centre to Centre (C2C) Interface with TfNSW, TfNSW TMC and other Control Centres so that traffic flow data, the state of all roadside devices (including driver advisory devices), equipment status data and current incident management information is continuously supplied to TfNSW, TfNSW TMC and other Control Centres.

Data from roadside devices must include, but not be limited to, traffic data, device status and settings and environmental data. The C2C Interface requirements are described in Specification TfNSW D&C TS917.

(j) Enable TMC, TfNSW and other Control Centres shared control of motorway driver advisory devices, traffic flow management devices, and traffic lane control devices via the TMCS priority control system to optimise traffic flow and in critical incident and other emergency circumstances in accordance with agreed operational interface protocols.

(k) Provide comprehensive computer based control facilities through workstations with schematics and map-based Graphic User Interface (GUI) to monitor, command, control and report every functional component of the TMCS.

2 TRAFFIC SURVEILLANCE AND MONITORING REQUIREMENTS

2.1 GENERAL

(a) Traffic monitoring within the TMCS must provide measured traffic data to support incident management, traffic optimisation and analysis functions.

(b) Traffic monitoring relies upon accurate, timely and reliable input from vehicle detection systems that must operate at performance levels that are equal to or better than those detailed under this Clause.

2.2 VEHICLE DETECTION/TRAFFIC MONITORING REQUIREMENTS

2.2.1 Vehicle Detection Functional Output

(a) The vehicle detector systems must produce accurate, timely and reliable traffic data from the traffic monitoring sites on the Motorway.

(b) The vehicle detector systems must record and store traffic data for:

(i) automatic incident detection;

(ii) congestion detection;

(iii) displaying and visualising traffic information on the OMCS.

2.2.2 Traffic Monitoring Site Data Variables

(a) The vehicle detection system must continuously supply the following traffic data variables from all traffic monitoring sites on the Motorway, under all climatic, environmental, and both free flowing (> 30 kph) and lane constrained traffic conditions that will be encountered on the Motorway, to the levels of accuracy and reliability shown in Table TS912.1.

Table TS912.1 – Required Levels of Accuracy

Traffic Data Variable	Unit of Measurement	Required Level of Accuracy
Traffic volume	Number of vehicles in total per lane	Less than 1% error when measured over all fifteen minute time intervals
Traffic (platoon) speed	kph per lane	Less than 1% error when measured over all traffic monitoring time intervals
Lane occupancy	Percentage per lane	Less than 2% error when measured over all traffic monitoring time intervals
Classified vehicle volume	Number of vehicles per lane in accordance with the classification shown in Table TS912.2	Less than 5% error when measured over all fifteen minute time intervals

Table TS912.2 – Vehicle Classification

Classification [(1)]	Description
Short vehicles	Less than 6 m
Medium vehicles	6 m to 13 m
Long vehicles	13 m to 21 m
Combination	Longer than 21 m

Note:

[(1)] In accordance with Austroads 4-bin system by vehicle length (AP-T60/06) as shown in table above.

(b) If achievable with the selected vehicle detection system, vehicle classification may be extended to support Austroads Levels 2 and 3 vehicle classifications.

(c) Vehicle detector systems must be calibrated to the accuracy shown in Table TS912.1, at least once per year or whenever detectors are installed or replaced.

2.2.3 Traffic Monitoring Time Interval

(a) The traffic monitoring time interval (or data aggregation period) for traffic monitoring sites must be 10 seconds.

(b) Time intervals must be time synchronised to the start of the minute according to OMCS time (synchronised to a common OMCS/TfNSW Network Time Protocol (NTP) server).

(c) Time intervals must meet the following criteria:

(i) the real-time traffic data must be made available by the vehicle detection equipment's TfNSW Motorway Management System (MMS) interface in periods of 10 seconds;

(ii) the 10 second aggregation period must be aligned to the usual 10 second boundaries of OMCS time (as synchronised to a common OMCS/TfNSW NTP Server);

(iii) the field communications delay and the validation delay must jointly not exceed (see Figure TS912.1):

- 4 seconds for speed events;
- 1 second for occupancy and flow events;

(iv) the vehicle detection equipment's TfNSW MMS interface network delay to the TfNSW MMS must not exceed 2 seconds (see Figure TS912.1);

(v) the vehicle detection equipment's TfNSW MMS interface network delay to the other applications must not exceed 5 seconds (see Figure TS912.1);

(vi) the 10 second real-time traffic data package must contain a time-stamp of the end of the aggregation period and the traffic data of all detectors requested by the TfNSW MMS;

(vii) the data, sent to the TfNSW MMS for each detector, must include the time-stamp of the first road event and the time-stamp of the last road-event.

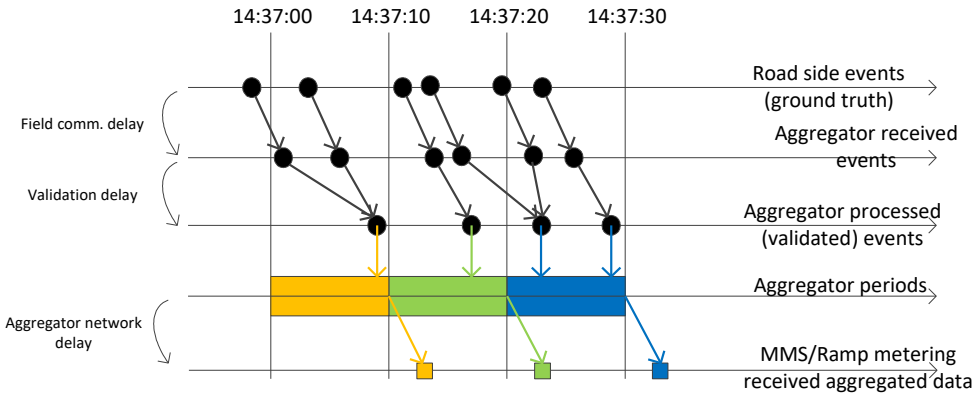


Figure 1 - Different types of delay that exist between road-side events and the MMS. The vertical lines are the 10 second clock boundaries. The horizontal time lines represent the events shifted according to the different levels of delay.

Figure TS912.1 - Types of Delays

2.2.4 Management of Traffic Data Streams

(a) The field and central architecture of the vehicle detection system must accommodate the data rate and data processing capacity and performance requirements to accurately and reliably manage the traffic data streams from all traffic monitoring sites on the Motorway to the OMCS and the TfNSW MMS.

(b) The TMCS must report detector station fault data via the C2C Interface.

2.2.5 Vehicle Detection Equipment Requirements

(a) Vehicle detection equipment must be based on in-pavement vehicle loop detection techniques, or an equivalent technology with performance levels of accuracy and reliability that are equal to or better than those specified in Clause 2.2.2.

(b) To satisfy Clause 2.2.4 requirements, the vehicle detection equipment must support at least 2 real time traffic data sessions simultaneously.

(c) Where vehicle loop detection systems are proposed, they must comply with Specification TfNSW TSI-SP-038 and the following requirements.

(i) Vehicle detection loops must be installed in the pavement without damage to the pavement substructure and without affecting pavement life, while providing for a long life of the detection loop itself.

(ii) Feeder cable inductance must be matched to the design requirements of the traffic loop detection module.

(iii) Installation of loop detectors at traffic monitoring sites must comply with Drawing VC005-33, relevant sections of AS 2276 and Specification TfNSW D&C TS101.

(d) The vehicle detection equipment must provide two independent interfaces in accordance with TfNSW TSI-SP-026 such that accurate traffic data may be independently collected by two different master systems (TMCS and TfNSW MMS), noting that:

(i) the first interface is to be used by the TMCS in accordance with this Specification;

(ii) the second interface is to be used by the TfNSW MMS and must not permit device configuration commands to affect the operation of the traffic monitoring equipment.

(e) The second interface for use by the TfNSW MMS must be connected to the TfNSW Traffic Data Network. The connection(s) must be in accordance with Specification TfNSW D&C TS915 with the fibre termination and splicing schedules approved by the Principal.

(f) Alternative means of providing the traffic data to the TfNSW MMS may be proposed for approval by the Principal. Any alternative proposal to the Principal must ensure that the provision of traffic data to the TfNSW MMS meets accuracy, timing and reliability requirements and is in a compatible interface/format.

2.2.6 Traffic Monitoring Sites

(a) Traffic monitoring sites must be provided along the entire Motorway in accordance with:

(i) TfNSW Smart Motorway Design Guidelines;

(ii) TfNSW Smart Motorway Design Guide – Vehicle Detectors;

and at the following locations generally:

- near the gore of both entry and exit ramps at all intersections on the Motorway;
- in each main carriageway lane;
- on each entry and exit ramp lane;
- before and after each entry ramp;
- before and after each exit ramp;
- before and after each lane configuration change.

(b) With reference to the TfNSW Smart Motorway Design Guidelines and TfNSW Smart Motorway Design Guide – Vehicle Detectors, after specific traffic monitoring sites have been installed at the required locations relative to existing infrastructure or geometric features, the remaining traffic monitoring sites must be placed in between these sites, using a nominal spacing of:

(i) 480 m in the Motorway entry/exit ramps for both inside tunnels and open road sections;

(ii) 120 m in the Motorway mainline tunnels noting that where an Automatic Video Incident Detection (AVID) system is used in conjunction with a sensor based vehicle detection system, this nominal 120 m spacing may be increased up to 500 m;

(iii) 500 m on the open road Motorway mainline.

(c) The spacing of the traffic monitoring sites may be varied by ±10% to suit the distances between the fixed traffic monitoring sites at adjacent intersections.

(d) The placement of the traffic monitoring sites must prevent "leakage" of traffic data on the Motorway. "Leakage" occurs when vehicles are able to enter or exit the Motorway without passing a traffic monitoring site.

(e) The distances between traffic monitoring sites must be configured in the TMCS to enable the correct presentation of traffic data and use of the traffic data in incident and other computational operations.

2.3 AUTOMATIC TRAFFIC INCIDENT DETECTION REQUIREMENTS

(a) Automatic Traffic Incident Detection (ATID) must be provided, using algorithmic Traffic Incident Detection System (TIDS) and Automatic Video Incident Detection (AVID) system as follows:

ATID System	Open Road Sections of Motorway	Tunnel Sections of Motorway
TIDS	Mandatory	Mandatory
AVID	Optional if AVID can achieve specified performance requirements.	Mandatory

(b) ATID must be provided in accordance with TfNSW Smart Motorway Design Guidelines.

2.3.1 Traffic Incident Detection System (TIDS)

(a) The TIDS must employ High Occupancy Algorithm (Hi-Occ), APID and McMaster incident detection algorithms. Licences must be obtained, where applicable, to operate these algorithms.

(b) The incident detection algorithms' parameters and settings must be controlled centrally in the TMCS and must be determined for each traffic monitoring site. Global settings covering all traffic monitoring sites are not acceptable and must not be used.

(c) The TIDS must be commissioned and tuned to reliably detect incidents, minimise false alarms and to declare incident detections within the detection time in order to comply with ATID performance requirements.

(d) Prior to opening of the Motorway to traffic:

(i) The performance of the traffic monitoring sites and vehicle detection system specified in Clause 2.2 must be validated to ensure that vehicle detector sensors are correctly aligned, sensor identification is correctly set up in each corresponding lane and end to end tests on the vehicle detection system confirm that true data is delivered for each lane at every traffic monitoring site location to the TMCS.

(ii) TIDS performance must be validated and base parameters established for the TIDS algorithms. End-to-end tests must confirm valid incident data and traffic data, if applicable, must be collected for each lane at every TIDS location.

(e) Within 3 months of the opening of the Motorway to traffic:

(i) The base parameters must be adjusted, tuned and optimised based on actual TIDS performance to establish recommended parameters for the TIDS algorithms.

(ii) A TIDS performance report must be provided which details the level of incident detection achieved, the percentage of false alarms occurring and the average time achieved by the TIDS to declare incidents.

2.3.2 Automatic Video Incident Detection (AVID) System

(a) The AVID system must provide full Motorway coverage for incident detection and must immediately detect and report an incident at any location on the Motorway.

(b) The shoulder lanes, breakdown stopping bays and non-trafficable areas must be configured as separate monitoring zones within the AVID system and must provide for event and incident detection at these locations of the Motorway.

(c) The AVID cameras must:

(i) produce full colour images;

(ii) be digital cameras;

(iii) utilise video over internet protocol (IP) communications;

(iv) utilise open (i.e. non-proprietary) industry standard video compression formats and communications protocols.

(d) Where ambient conditions, such as high contrast or low light, prevent visible light cameras from meeting performance requirements, additional cameras utilising alternative detection technology, such as thermal imaging, may be used.

(e) The AVID system must:

(i) allow for viewing of the AVID camera video at Motorway operator OMCS workstations.

(ii) include digital video recording for pre-incident and post-incident video with the recording interval configurable by the Motorway operator. Defaults intervals must be configured as 30 seconds for pre-incident video and 150 seconds for post-incident video.

(iii) include configuration and analysis tools to:

- program and analyse the various detection settings;
- examine the recorded video, including any system generated metadata.

(iv) utilise the Motorway Network Communications System (MNCS) network for all AVID communications (refer TfNSW D&C TS915 for details of the MNCS).

(v) detect and generate alarms for the following incidents:

(1) Traffic Incidents:

- stopped vehicles on the carriageway and in breakdown stopping bays;
- wrong way vehicle – opposite direction of travel;
- speed drop – sudden step change in average vehicle speed;
- traffic congestion – queue length measurement;
- under speed;
- over speed;
- vehicle presence.

(2) Non-traffic Incidents:

- smoke and fire detection;
- pedestrians and cyclists on the Motorway;
- fallen or random objects, cargo, debris or animals on the Motorway.

(e) Where the AVID system is used to provide traffic data, it must comply with the vehicle detection requirements specified in Clause 2.2 above.

(f) The AVID system must be commissioned and tuned to reliably detect incidents and minimise false alarms to comply with ATID performance requirements, in accordance with the process described below and must be implemented and fully operational within 3 months of the opening of the Motorway to traffic.

(g) Prior to opening of the Motorway to traffic, AVID performance must be validated and base parameters established for the AVID algorithms. This ensures that cameras are correctly aligned, detection zones set up, parameters tuned. End-to-end tests must confirm valid incident data and traffic data, if applicable, must be collected for each lane at every AVID camera location.

(h) Within 3 months of the opening of the Motorway to traffic:

(i) The base parameters must be adjusted, tuned and optimised based on actual AVID performance to establish recommended parameters for the AVID algorithms.

(ii) Provide an AVID performance report covering this period, which details the level of incident detection achieved, the percentage of false alarms occurring and the average time achieved by the AVID to declare incidents.

2.3.3 ATID Performance Requirements

(a) Incident detection triggers from TIDS and AVID system must generate an incident alert on the OMCS IMS.

(b) Congestion based incidents (called "Queue" type incidents) and normal incidents must be tracked in terms of the extent of congestion and must be displayed on the Motorway Status Display.

(c) The traffic monitoring time interval for incident detection algorithms processing must be 30 seconds.

(d) The performance of the TIDS and AVID system must be equal to or better than that shown in Table TS912.3 below.

Table TS912.3 – TIDS and AVID System Performance Requirements

Parameter	TIDS	AVID System
Percentage of incidents detected	> 98%	> 98%
Percentage of false alarms raised	< 2%	< 5%
Time to detect an incident	2 minutes or less	30 seconds or less

2.3.4 Integration with Other Traffic Management Systems

(a) Detected incidents must be presented on the OMCS IMS.

(b) Detected incidents must include the following minimum data for creation of an incident in the OMCS IMS:

(i) unique identifier or name for the incident;

(ii) source of the incident;

(iii) date and time when the incident occurred;

(iv) carriageway direction where the incident occurred;

(v) location where the incident occurred;

(vi) identification of the lane(s) where the incident occurred.

(c) The AVID video recording for pre-incident and post-incident video must be accessible for export and playback via the OMCS GUI.

2.4 CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM REQUIREMENTS

2.4.1 General

(a) A colour CCTV system must be designed and installed to provide full coverage of the Motorway, including all carriageways, ramps, approaches and intersecting local roads in accordance with TfNSW Smart Motorway Design Guidelines.

(b) The CCTV system must consist of a Digital VCS installed at the MCC and Disaster Recovery Site (DRS), and at CCTV camera sites with digital IP CCTV cameras, including both pan tilt zoom (PTZ) and fixed cameras.

(c) The Motorway Digital VCS must be integrated with the TfNSW TMC VCS (which uses Genetec Security Center system).

(d) The CCTV system must be interconnected via the MNCS to provide data communications between the VCS and the CCTV camera sites.

(e) The CCTV system must be configured on the MNCS such that any single point of failure on the PTZ or fixed camera network does not lead to any loss in CCTV coverage of the Motorway.

(f) The CCTV system must comply with Specification TfNSW TSI-SP-006-TMC.

2.4.2 Views and Coverage

(a) Motorway approaches must be viewable from the Motorway CCTV cameras. Motorway approaches include carriageways within 1 km of the Motorway.

(b) Intersecting roads must be viewable from the Motorway CCTV cameras for a minimum distance of 200 m from any Motorway entry ramp or exit ramp. For the purpose of this Clause, intersecting roads are defined as roads intersecting any Motorway entry ramps or exit ramp.

(c) With camera lenses at the maximum zoom setting, the CCTV system must comply with the following requirements:

(i) The views displayed must be of sufficient clarity to enable the Motorway operators to discern all vehicles within the viewable range, to categorise the vehicles by body type as motorbikes, sedans, hatchbacks, station wagons, panel vans, light commercial vehicles or trucks of all sizes and identify the vehicle registration details.

(ii) The views displayed must enable the Motorway operator to clearly discern the carriageway lane delineators, the carriageway edge line marking, local static signposting and pedestrians at the side of the carriageways.

(iii) The Motorway operators must be able to positively identify, using only the CCTV system, the Motorway segment within the Motorway in which an incident has occurred. Motorway segment identification must be aided by segment identifier data being displayed through text insertion on MCC monitors or the video wall.

(iv) All Motorist Emergency Telephone locations and motorists using the telephones must be observable using the CCTV system. The VCS must automatically switch (including any applicable PTZ/preset control) to display the associated CCTV camera viewing the Motorist Emergency Telephone System (METS) phone on the METS phone activation.

(v) At the farthest point of the viewable range, the width of a medium size vehicle, as displayed on CCTV monitor, must not be less than 5.0% of the monitor screen width.

(vi) All images must be in focus within the whole of the zoom range.

(vii) The maximum distance viewable from any CCTV camera location must not be greater than 1.5 km.

(d) In addition to providing views of the Motorway, the views detailed in the Project Deed Scope of Works and Technical Criteria (SWTC) must be provided by the CCTV system along the surrounding local road network.

(e) The CCTV system must also provide continuous coverage to:

(i) all egress passages, including cross passages, long egress passages and emergency egress passages and their doors;

(ii) plant and equipment rooms;

(iii) entrances to Motorway service buildings and substations;

(iv) entrances to the MCC building;

(v) entrances to the DRS;

(vi) high voltage (HV) equipment rooms;

(vii) motorist evacuation/muster points;

(viii) any other views required for Motorway operations.

(f) The CCTV system must also provide coverage of all motorway and tunnel closure devices, including:

(i) VMS/TMS;

(ii) ISLUS/VSLS;

(iii) moveable medians;

(iv) in-pavement lights;

(v) traffic signals;

(vi) physical barriers;

(vii) AWS;

(viii) CMS;

(ix) ramp metering stop lines and signals;

(x) roadside cabinets.

For the purpose of this requirement, the sign face or device setting must be clearly visible/legible from the CCTV camera.

(g) The CCTV system must provide a sufficient number of "tours" to meet Motorway operational requirements, with sufficient spare capacity to create additional "tours".

(h) For CCTV system "tours", cameras must be switched on each tour for a nominal 2 second period, but with the ability for the tour switching time interval to be configured by the Motorway operator.

2.4.3 Digital VCS Graphical User Interface (GUI)

(a) The VCS GUI must provide each Motorway operator access up to 16 concurrent live video streams at 720p resolution (at 25 frames per second) on their dedicated CCTV screen..

(b) Motorway operators must be able to select and control the CCTV camera's entire PTZ functionality from the VCS GUI and CCTV controller.

(c) For each PTZ CCTV camera, a minimum of 32 PTZ preset positions must be selectable and configurable from the VCS GUI.

(d) The VCS GUI must enable Motorway operators to select any "tours" to start/stop and configure the tour switching time interval.

(e) The VCS GUI must be integrated with the Video Wall to allow Motorway operators to configure the CCTV displays on the Video Wall.

(f) CCTV displays on the Video Wall must be displayed at 720p resolution (at 25 frames per second).

(g) The VCS GUI must allow for a Motorway operator to select which display(s) on their dedicated CCTV screen and Video Wall to be used for automatic camera switching.

2.4.4 CCTV Control

(a) The TMCS must allow any CCTV camera image to be displayed on any CCTV monitor installed within the MCC and DRS.

(b) CCTV camera PTZ functions must be controlled by the Motorway operator through the CCTV Controller (which would be a console equipped with a joystick style controller) and the VCS GUI.

(c) The CCTV system must:

(i) support camera presets for all CCTV cameras, composed of position, zoom and focus;

(ii) enable the Motorway operator to create, replace and delete stored camera presets and tours;

(iii) enable the Motorway operator to search for stored camera presets and tours.

(d) The OMCS GUI must indicate when a camera is exclusively locked by another Motorway operator or TIMP.

(e) Operators at TMC must be able to remotely control and access video from any camera in the Motorway CCTV system via the TMC VCS, as detailed further in Clause 6.2.

(f) In addition to the text insertion requirement detailed in TfNSW TSI-SP-006-TMC, the CCTV system must display the following text on each CCTV video image:

(i) observed Motorway segment identifier(s);

(ii) observed deluge zone(s);

(iii) nearest access/egress point upstream of the CCTV camera location;

(iv) summarised/abbreviated description of the camera view/location (the intent is to allow viewers to understand what they are looking at without having to have detailed knowledge of the Motorway segment identifiers).

(g) The CCTV system must provide priority-based control for PTZ cameras whereby Motorway operators have higher priority over other external users (e.g. TMC and other entities that may be sharing the CCTV feeds).

2.4.5 Camera Locations

(a) Within all Motorway tunnel sections, fixed CCTV cameras must be installed at a maximum of 60 m intervals and view the traffic from the rear. The fixed camera can be utilised for the AVID system, noting that additional rear or front facing cameras may be required to satisfy AVID requirements.

(b) PTZ CCTV cameras must also be installed to provide 100% redundant coverage of the Motorway.

(c) Dedicated CCTV cameras must also be installed to provide coverage of the following:

(i) egress passages;

(ii) cross-passage doors;

(iii) crossover points;

(iv) emergency equipment cabinets;

(v) movable medians;

(vi) tunnel closure facilities;

(vii) breakdown/emergency stopping bay facilities.

(d) A minimum of 2 cameras must be provided at each tunnel portal to provide dedicated redundancy of CCTV coverage.

(e) The positioning and locations of CCTV cameras and deluge zones must ensure that each deluge zone within the Motorway tunnel is completely observable, using only one CCTV camera located upstream of the deluge zone.

(f) In addition, CCTV cameras, mounted on remote controlled pan-tilt heads, must be provided at the required locations detailed in the SWTC.

(g) At interchanges and interfaces with local road network, additional CCTV cameras must be provided external to the Motorway. CCTV cameras located external to the Motorway must monitor dedicated approach carriageways, intersections/interchanges with local road network and also approaches and departures on the local road network.

(h) CCTV cameras must be positioned such that they view the entire ITS infrastructure installed on the Motorway, including VMS, TMS, ISLUS, CMS, AWS, moveable medians, in-pavement-lights and over-height detectors (OHD).

2.4.6 CCTV Recording

(a) The CCTV system must comply with the following:

(i) simultaneously record all CCTV cameras;

(ii) playback any recorded CCTV video on the OMCS workstations;

(iii) provide secure remote access for live viewing of CCTV video via remote computers and smart phone/tablet devices for up to 20 users concurrently;

(iv) enable Motorway operators to select and export live CCTV footage from any of the video streams;

(v) allow Motorway operators to select any two OMCS displays to be continuously recorded as if they were a CCTV camera site at any one time;

(vi) store all CCTV recordings for a period of not less than one calendar month;

(vii) allow the Motorway operator to mark a recording segment as permanent so that it cannot be overwritten;

(viii) permanently time stamp all recordings to OMCS time;

(ix) store all recordings in 720p resolution (at 25 frames per second) or an equivalent or superior recording format which provides a superior image quality and storage life.

(b) Where CCTV cameras are located in equipment rooms or indoor areas which are not normally illuminated (i.e. the room is normally dark), the CCTV system is only required to record these cameras when the rooms become illuminated or are accessed. In such cases, the CCTV recording must commence within 1 second of the room becoming illuminated or when the entrance to the room is opened (whichever occurs first).

2.4.7 Project Works and Temporary Works CCTV System During Construction

(a) A fully operational CCTV system must be provided during the construction of the Project Works and temporary works in accordance with the SWTC.

(b) The Project Works and temporary works CCTV system must be designed and fully installed in accordance with TfNSW D&C TS911, TfNSW D&C TS912, TfNSW D&C TS914 and TfNSW D&C TS915, including cabling, telecommunications between the sites, central video management system and video monitors.

(c) The Project Works and temporary works CCTV system must be installed and operational before the start of the construction of any of the Project Works and directly interfaced with the TfNSW TMC and not via the Motorways OMCS.

(d) The installations are permanent and are to remain after the completion of construction in accordance with the SWTC.

2.5 EMERGENCY BAY MONITORING

(a) The TMCS must monitor emergency bays for vehicle entry and presence.

(b) The TMCS must raise an alarm to the operator when a vehicle enters the emergency bay.

(c) The TMCS must automatically switch the CCTV display to the emergency bay when a vehicle enters the emergency bay.

(d) The TMCS must implement a TIMP to notify motorists that the emergency bay is occupied. The implementation of this TIMP must be configurable as either automatic or manual by the operator.

2.6 HOLD POINT

HOLD POINT	
Process Held:	Procurement and installation of traffic surveillance and monitoring systems.
Submission Details:	Complete design documentation in accordance with D&C TS901 Clause 5 in relation to: (a) Vehicle detection and traffic monitoring; (b) Automatic traffic incident detection; (c) Closed circuit television surveillance.
Release of Hold Point:	The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.

3 TRAFFIC MANAGEMENT REQUIREMENTS

3.1 GENERAL

(a) Traffic is managed by the TMCS by using traffic monitoring systems to determine and implement controls. TMCS optimises traffic flow on the Motorway by setting various traffic management systems and devices.

3.2 VARIABLE SPEED AND LANE CONTROL SYSTEM REQUIREMENTS

3.2.1 Overview

(a) ISLUS must be installed on the Motorway in accordance with TfNSW Smart Motorway Design Guidelines.

(b) ISLUS must comply with Specification TfNSW TSI-SP-011 and AS 5156.

(c) A single group controller must control the ISLUS at each location to synchronise the aspect control of the set of ISLUS, including interlocks/conflict detection.

(d) The ISLUS must incorporate:

(i) centralised control of each ISLUS from the TMCS;

(ii) ISLUS failure detection;

(iii) ISLUS conflict detection logic;

(iv) confirmation of the correct ISLUS aspect setting at all times to the TMCS;

(v) “Failure to set as expected” alerts to the TMCS;

(vi) synchronised flashing of annulus for all signs within a row and between adjacent rows.

(e) ISLUS must be installed with Military Standard screw lock IP67 plug and socket power and communications connections to facilitate maintenance replacement.

3.2.2 Operational Requirements

(a) The entire Motorway must operate as a variable speed control zone through the deployment of ISLUS and static signage along the Motorway in accordance with TfNSW Smart Motorway Design Guidelines.

(b) The start and end of each variable speed control zone must be signposted by a “Start Variable Speed Zone” and “End Variable Speed Zone” sign, together with a default sign to set a regulatory speed in the event of a failure of the ISLUS controls or when the ISLUS are blank. Signs must comply with Drawings G6-315, G6-316 and G6-317.

(c) ISLUS must display the regulatory speed limits that are operational throughout the Motorway, including speed limit variations that are required by the TMCS in response to incidents and congestion.

(d) ISLUS must display the speed limit display with steady red annulus when the lane is open at the normal speed limit. When a reduced speed limit is applicable, the ISLUS must flash the inner part of the red annulus.

(e) ISLUS must indicate to motorists whether a lane is open (speed limit displayed), merge directions (arrow showing direction of merge), exit directions (arrow directing to exit ramp displayed), advice to leave lane as soon as it is safe to do so (i.e. when the flashing red cross is displayed) or lane is closed (i.e. when the red cross is displayed without flashing).

3.2.3 Locations

(a) Separate ISLUS must be mounted over each carriageway lane for the entire Motorway.

(b) The spacing between ISLUS must be in accordance with TfNSW Smart Motorway Design Guidelines, as follows:

(i) ISLUS must be located at the start of the Motorway and at each entry point.

(ii) ISLUS must be located at each Motorway interchange and positioned appropriately depending on the entry ramp merge and exit ramp diverge arrangements.

(iii) Outside tunnels, the ISLUS must be located on all motorway carriageways at intervals of 500 m to 800 m, depending on the speed, roadway design and other roadside infrastructure for those sections of the Motorway.

(iv) At approaches to the tunnels, a row of ISLUS must be located within 200 m of the tunnel portal before entry into the tunnel and one row of ISLUS must be located on the tunnel portal.

(v) Inside tunnel sections of the Motorway, the ISLUS must be located at intervals of 120 m to enable drivers to always have visibility of the ISLUS.

(vi) A row of ISLUS must be located immediately before any exit from the tunnel

(c) The size of ISLUS is governed by the speed limit and must be able to generate speed limit display in accordance with TfNSW Smart Motorway Design Guidelines and AS 1743 for R4-1 signs.

(d) ISLUS mounted over carriageway lanes inside the Motorway tunnels with height limitations can be designed to a size equivalent to Type B speed limit signs as defined in AS 1742.2 and comply with TfNSW TSI-SP-011. The smaller size may result in additional signs being required due to reduced visibility distance.

3.2.4 TMCS Monitoring and Management

(a) The TMCS must provide an operator interface on the OMCS GUI to monitor and control ISLUS.

(b) The TMCS must display and log all ISLUS alarms, faults and device states changes.

(c) The TMCS must log all messages displayed on ISLUS, including date/time stamp, message and source/Motorway operator.

(d) The ISLUS must be connected to the MNCS network for data communications with the TMCS.

(e) The TMCS must coordinate the speed and lane control status between consecutive rows of ISLUS to ensure consistent and safe operation.

(f) The TMCS must ensure that the speed limit difference displayed between consecutive rows of ISLUS does not exceed allowable limits.

3.2.5 Integration with Other Traffic Management Systems

(a) The Speed and Lane Use Management System must be integrated with the OMCS IMS as part of TIMPs to safely manage speed and lane usage during incidents.

3.3 RAMP MANAGEMENT AND CONTROL SYSTEM

(a) Traffic management also requires the implementation of measures that actively manage traffic demand by effectively controlling entering vehicle volumes with traffic signals at one or a number of entry ramps to the Motorway. The ramp metering strategy helps to keep the traffic density below the critical level, maintain smooth safe traffic flow along the Motorway and prevent flow breakdown.

3.3.1 Overview

(a) The TMCS must support the ramp metering functionality provided by the TfNSW MMS in accordance with TfNSW Smart Motorway Design Guidelines.

(b) The TfNSW MMS will be the primary control system that will manage Motorway ramp traffic flow onto the Motorway mainline from the arterial road network and the adjoining Motorway network where designated.

(c) The TfNSW MMS will provide ramp metering functionality that will control ramp metering signals to regulate traffic access to the Motorway mainline to optimise Motorway operation.

(d) The following devices must be installed and commissioned by the Contractor but will be controlled by the TfNSW MMS (and associated SCATS ramp metering signal controllers) for the implementation and operation of Smart Motorway coordinated ramp metering functionality:

(i) SCATS ramp metering signal controllers and ramp signals;

(ii) traffic signal controllers and traffic signals in accordance with the SWTC;

(iii) Sydney Coordinated Adaptive Traffic System (SCATS) detectors/loops in accordance with TfNSW Smart Motorway Design Guide – Vehicle Detectors and TfNSW Traffic Signal Design Manual Section 15.14 “Ramp Metering Traffic Signals”. All SCATS detectors/loops for a ramp metering site must be connected to the respective SCATS ramp metering signal controller for that ramp metering site;

(iv) AWS to provide regulatory information, warnings and real time information regarding the status of the ramp and associated ramp metering operations. These AWS must be capable of displaying the messages of RC1, RC2 and RC3 signs, and must comply with the specification or drawing shown in the table below.

Sign Message Type	Advanced Warning Signs Compliance
RC1	Specification TfNSW TSI-SP-051
RC2	As per TfNSW Smart Motorway Guidelines
RC3	Specification TfNSW TSI-SP-008

AWS must be controllable by ramp metering/traffic signal controllers (via local control using external switch inputs) and by TfNSW MMS (via remote control using Ethernet/IP);

(v) other static signage required to support ramp metering operation including but not limited to "STOP HERE ON RED SIGNAL" (TfNSW Drawing R6-6) and "ONE VEHICLE ONLY PER LANE ON GREEN SIGNAL" (TfNSW Drawing G9-333-1);

(vi) all power, communications cabling/equipment and cabinets/housing infrastructure required for these devices, including connection to the TfNSW MMS.

(e) All devices to be controlled by the TfNSW MMS must be connected to the TfNSW Traffic Data Network. The connections must be in accordance with TfNSW D&C TS915 with the fibre termination and splicing schedules approved by the Principal.

(f) The locations and placement of all these devices and signs must be in accordance with the TfNSW Smart Motorway Design Guidelines and TfNSW Traffic Signal Design Manual Section 15.14 "Ramp Metering Traffic Signals".

(g) Traffic signal equipment provided for ramp metering purposes must be Type Approved in accordance with Specification TfNSW TS200.

(h) Traffic signals provided at new intersections for the Motorway must comply with Specification TfNSW D&C TS101 and SWTC.

3.3.2 Operational Requirements

(a) The TMCS vehicle detection equipment must provide the required traffic data in real time to allow TfNSW MMS to monitor available capacity on the motorway and queue lengths at the entry ramps and exit ramps and use these measurements to regulate traffic entering the Motorway through the operation of traffic signals at the entry ramps, including entry ramps from adjoining Motorways.

(b) The TfNSW MMS will provide status of the ramp metering operations to the TMCS (or OMCS) via the C2C Interface.

(c) Without limiting the TMCS's ability to detect incidents, the TfNSW MMS may provide the TMCS with status (notification or alert) on the formation and detection of queuing and congestion.

(d) The TfNSW MMS may request mainline speed limit changes to the TMCS (or OMCS) via the C2C Interface. In turn, the TMCS must:

(i) set the mainline speed limits according to the TfNSW MMS request, subject to business rules (including priority and safety interlocks);

(ii) provide notification to the Motorway operator if the TfNSW MMS request is in conflict with the business rules;

(iii) provide notification to the TfNSW MMS if any TfNSW MMS request is in conflict with the business rules;

(iv) provide the ability for the Motorway operator to override any request from the TfNSW MMS.

(e) The TMCS must be able to request the TfNSW MMS to perform exit ramp flushing on appropriate exit ramps to assist with:

(i) clearing of congestion on the Motorway;

(ii) maintaining acceptable exit ramp queue lengths for safety reasons;

(iii) clearing of exit ramps where exit ramp traffic falls back onto the Motorway mainline.

(g) The TMCS must be able to request the TfNSW MMS to set ramp metering signage and signals to close and clear ("flush") the selected entry ramps in response to incidents on the Motorway.

(h) The TMCS must be able to request the TfNSW MMS to implement complementary traffic management plans to assist with incidents on the Motorway. The TfNSW MMS complementary traffic management plans are complementary to TIMP implemented by the OMCS in response to incidents on the Motorway.

(i) The TMCS must be able to request the TfNSW MMS to clear complementary traffic management plans once the incident on the Motorway has been cleared.

(j) The TMCS must notify the Motorway operator if any request is rejected by the TfNSW MMS.

3.3.3 Locations

(a) The motorway vehicle detectors and SCATS detectors required for ramp metering operations must be installed in accordance with the TfNSW Smart Motorway Design Guidelines, TfNSW Smart Motorway Design Guide – Vehicle Detectors and TfNSW Traffic Signal Design Manual Section 15.14 "Ramp Metering Traffic Signals".

(b) AWS related to ramp management and control must be located in accordance with TfNSW Smart Motorway Design Guidelines, including consideration of the following:

(i) For arterial roads feeding into the entry ramp, the AWS must be installed at a position that is clear to all motorists intending to use the ramp.

(ii) For each lane of the entry ramp, the location of the AWS must provide sufficient time for the driver to halt the vehicle at the stop line of the entry ramp.

(c) The ramp signals must be installed in accordance with TfNSW Traffic Signal Design Manual Section 15.14 "Ramp Metering Traffic Signals".

(d) The stop line must be in accordance with the TfNSW Delineation Manual and Specification TfNSW D&C R145.

(e) For underground ramp management within a Motorway tunnel section, ITS devices such as TMS, ISLUS, etc must be used to display advanced warning and management information.

(f) For Motorway to Motorway connections, advanced warning signs related to ramp management and control must be located in accordance with TfNSW Smart Motorway Design Guidelines to display advanced warning and management information.

3.3.4 TMCS Monitoring and Management

(a) The TMCS must provide an operator interface on the OMCS GUI to monitor the TfNSW MMS ramp metering operations on the Motorway, including:

(i) status of ramp meters;

(ii) status of ramp meters traffic signals;

(iii) status of advance warning signs.

(b) The TMCS must provide an operator interface on the OMCS GUI to monitor and manage the interface to the TfNSW MMS.

(c) The TMCS must display and log all TfNSW MMS interface alarms, faults and operating states.

3.3.5 Integration with Other Traffic Management Systems

(a) The TMCS (via the OMCS) must be integrated with the TfNSW MMS to:

(i) provide traffic data collection and analysis systems for the TfNSW MMS;

(ii) display the status of ramp metering operations received from the TfNSW MMS;

(iii) provide variable speed limit control to implement speed limit changes requested by the TfNSW MMS;

(iv) request the TfNSW MMS to flush entry and exit ramps in response to certain Motorway conditions;

(v) request the TfNSW MMS to set ramp metering signage and signals to close selected entry ramps in response to incidents on the Motorway;

(vi) request the TfNSW MMS to implement/clear complementary traffic management plans to assist with incidents on the Motorway.

3.4 QUEUE MANAGEMENT SYSTEM

3.4.1 Overview

(a) The Queue Management System (QMS) must detect traffic congestion on the Motorway.

(b) Upon detection of traffic congestion, the QMS must automatically implement responses to safely improve the traffic flow, including but not be limited to:

(i) adjusting speed limits on ISLUS;

(ii) advising drivers via Driver Advisory Signs (e.g. VMS, TMS);

(iii) advising drivers via RRB break-in messages.

(c) In addition to any QMS response(s), the TfNSW MMS may provide ramp management operation in support (refer Clause 3.3).

(d) The QMS must constantly monitor the traffic congestion and adjust the traffic flow management response accordingly.

(e) The QMS may take inputs from other TMCS systems (e.g. Traffic Monitoring and ATID) as well as other external systems to effectively identify and respond to traffic congestion.

3.4.2 Operational Requirements

(a) The QMS must be able to:

(i) automatically detect queues and track congestion, continually updating the location, extent and severity of the congestion.

(ii) respond to congestion incidents with predefined driver advisory messages on VMS, TMS and RRB break-in. The response must include VMS on the approach to the congestion location, on both the upstream Motorway mainline and intersecting roads within a

configurable distance from the tail of the congestion. The messages to be employed must be developed with, and approved by TfNSW and TMC.

(iii) respond to congestion incidents with predefined ISLUS speed limits on approach to the congestion and for traffic within the congestion. The settings must be developed with, and approved by the TfNSW and TMC.

(iv) alter the VMS, TMS, RRB and ISLUS messages to display the changes in location, travel time impact and extent of the congestion.

(v) automatically remove all VMS, TMS, RRB and ISLUS responses when the TMCS clears an incident.

(vi) provide a manual override for any of these response functions to enable an operator to both deploy and remove any of the responses.

3.4.3 TMCS Monitoring and Management

(a) The TMCS must provide an operator interface at the OMCS GUI with:

(i) functions to monitor, control and manage QMS systems and devices;

(ii) a graphical representation on the Motorway Status Display of the location, extent and severity of congestion.

(b) The TMCS must display and log all QMS alerts, faults and device states.

(c) The TMCS must provide functions to configure QMS algorithms and decision logic in determining queue levels and the thresholds for operation of QMS roadside devices.

(d) The TMCS must only allow authorised personnel to have access to QMS configuration functions, including:

(i) setting of queue levels and thresholds;

(ii) settings for QMS roadside device operations.

3.4.4 Integration with Other Traffic Management Systems

(a) The QMS must be integrated with:

(i) other traffic monitoring systems to avoid unnecessary duplication of devices and systems with similar or related functions;

(ii) the OMCS IMS to record all congestion incidents, including records of:

- date and time the congestion started and finished;
- location, extent and severity of the congestion;
- all traffic flow management responses implemented (with time stamp);
- all Motorway operator actions with the QMS.

3.5 OVER-HEIGHT DETECTION AND RESPONSE SYSTEM

3.5.1 Overview

(a) The TMCS must provide an over-height vehicle detection and response system in accordance with TfNSW Smart Motorway Design Guidelines.

(b) Vehicles higher than the specified Motorway tunnel traffic envelope must be:

(i) warned of the need to divert, and the alternative route definition provided, by means of advance fixed warning signs. The Motorway tunnel entry portals must be appropriately signposted in accordance with AS 1742.2;

(ii) provided with safe lane guidance and speed management to the alternative route via ISLUS displays;

(iii) automatically detected and warned against entering Motorway tunnels;

(iv) physically prevented from entering the Motorway tunnels. Prevention devices must be set at levels no lower than the height limit above the road surface.

(c) Automatic responses to over-height vehicle detection must be generated and implemented in a timely manner to ensure that roadside devices are activated and produce safe effective advice to over-height vehicle drivers and other vehicles on the Motorway.

3.5.2 Over-height Detection

(a) Over-height detectors (OHD) must be provided with at least two stage detection at suitable locations for each approach to detect over-height vehicles before their entry to any of the Motorway tunnels.

(b) OHD must be positioned before the final diversion to the tunnel and immediately after the final diversion where:

(i) the first detector must trigger a warning to the over-height vehicle to divert;

(ii) the second detector must trigger a tunnel closure to prevent entry into the tunnel.

(c) The Motorway operators must be warned of all over-height vehicle detected by alarms and CCTV displays automatically switching to the over-height vehicle.

(d) The OHD system must utilise modulated light beams to detect over-height vehicles, or another technology with better performance.

(e) Vehicle presence detection must be provided at the detection point, using inductive loops or other acceptable vehicle detectors.

(f) The outputs from both of the detectors must be combined to identify the over-height vehicle detection event.

3.5.3 Over-height Warnings

(a) High visual impact warning signs dedicated to advising drivers of vehicles that they have been detected as over-height must be erected at suitable locations at all approaches to Motorway tunnels to give the drivers adequate space to stop before entering the tunnels and opportunities to detour by alternative routes.

(b) The warning signs must advise drivers of over-height vehicles not to enter the tunnels and to detour via alternative routes.

(c) Conspicuity roundels on the warning signs must be activated when an over-height vehicle is detected.

(d) Red/amber/green traffic signals located at boom gates must signal “red”/“stop” when the second detector has been triggered.

(e) Physical over-height barriers must be erected at the approaches to all tunnel portals to:

(i) impact on the over-height sections of over-height vehicles;

(ii) prevent damage to the Motorway tunnel structures.

3.5.4 TMCS Monitoring and Management

(a) The over-height detection system must initiate and place an appropriate message on the VMS at approaches and portal entrances.

(b) VMS located immediately downstream of OHD must be directly activated during the over-height detection event.

3.5.5 Integration with Other Traffic Management Systems

(a) Over-height detection must raise an alarm in the OMCS IMS for the Motorway operators to manage the over-height vehicle incident.

(b) All over-height vehicle incidents that are detected must be logged in detail in the OMCS IMS, including:

(i) date and time of the over-height vehicle detection;

(ii) location of the over-height vehicle detection;

(iii) all automated responses to manage the over-height vehicle detection (with time stamp);

(iv) any other Motorway operator actions to manage the over-height vehicle detection.

(c) Where over-height detection proposes to use a traffic signal as an additional means of stopping an over-height vehicle (e.g. over-height vehicle detected in lane turning into a motorway entry ramp), the over-height detection must be interfaced with SCATS Traffic Signal Controllers to request appropriate and safe traffic signal operation. This requirement does not replace the requirement for over-height warnings.

3.6 MOTORWAY CLOSURE SYSTEM

3.6.1 Overview

(a) The TMCS must include a Motorway Closure System, in accordance with TfNSW Smart Motorway Design Guidelines, which provides for the automatic closure and subsequent opening of the Motorway carriageways using sequenced and automatically controlled infrastructure and operations, and which:

(i) stops and diverts traffic at suitable locations in advance of the Motorway, using movable medians and in-pavement lights;

(ii) alerts approaching motorists of the stops, diversions and changed conditions ahead;

(iii) closes one or all carriageway lanes approaching the Motorway;

(iv) incorporates lane guidance and delineation devices that are activated when a carriageway is closed to divert traffic from the normal lane configurations, including movable medians, CMS and in-pavement lighting to delineate the altered lane configurations and to guide motorists out of the carriageway lanes;

(v) incorporates driver advisory devices and other devices or systems to accommodate automated Motorway closures, including traffic signals immediately in advance of

diverge points and advanced warning signs, with conspicuity flashers, advising motorists that the traffic signals ahead are set to "red" and to "prepare to stop";

(vi) incorporates functions to request entry ramps to be closed or opened by the TfNSW MMS (where applicable);

(vii) is operated by the Motorway operator via the OMCS GUI;

(viii) opens the closed carriageway lanes in reverse sequences to closing sequences.

(b) The automatic closure and opening of the Motorway carriageways must be controlled by the TMCS that integrates and sequences all of the infrastructure and other operations, including the ramps controlled by TfNSW MMS (where applicable).

(c) The TMCS must operate to achieve full or partial Motorway closure of either direction by automatic control of the closure devices and related driver advisory systems within 60 seconds of the Motorway operator ordering the closure on the OMCS GUI screen or operation of the carriageway emergency close buttons.

(d) The TMCS must provide the Motorway operator with the option to abort the tunnel closure. This option must be configurable in terms of whether it is enabled/disabled and how the abort is implemented for various scenarios, such as automatic closure due to over-height vehicle.

(e) Carriageway emergency close buttons must be provided on the Motorway operator workstation desks for each carriageway of the Motorway to initiate automatic closure of the Motorway carriageway.

(f) Each carriageway emergency close button must be shrouded with a protective hinged cover flap to prevent unintentional operation.

(g) The carriageway emergency close buttons must be clearly labelled and appropriately positioned to minimise the possibility of unintentional closure of the wrong Motorway carriageway.

(h) The carriageway emergency close button must illuminate when the TMCS commences the programmed closure routine (as defined in the corresponding TIMP).

(i) When the carriageway emergency close button is activated, the OMCS IMS must implement the corresponding TIMP for automatic, safe and orderly closure of Motorway carriageway, including setting:

(i) closure traffic signals;

(ii) CMS;

(iii) driver advisory signs;

(iv) physical barriers;

(v) in-pavement lighting;

(vi) ISLUS;

(vii) ramp closures to be performed by the TfNSW MMS (where applicable).

(j) Deployment of physical barriers will require specific Operator confirmation before being safely deployed.

(k) The OMCS IMS must provide a "clearing" function to return the closed carriageway to the open condition from the emergency closed state.

(l) Carriageway emergency closure equipment must have individual local controls which must override remote control from the Motorway operator using OMCS.

(m) Motorway closure traffic devices such as movable medians, associated CMS, and other carriageway emergency closure equipment must be configured as multi-state devices.

3.6.2 Physical Barriers at Motorway Entry Points

(a) Physical barriers must be installed to prevent traffic from entering a tunnel section of the Motorway entry points.

(b) Physical barriers must be used in conjunction with other devices, including but not limited to ISLUS, VMS, TMS, CMS, traffic lights and in-pavement lights to achieve orderly and safe diversion of traffic away from the Motorway.

(c) The physical barriers must be able to be operated as part of an automated closure sequence (with Motorway operator confirmation before deployment) and manually by a Motorway operator through the OMCS GUI.

(d) As a minimum, physical barrier must incorporate a vertically lowered boom gate or equivalent (e.g. swing gate) and a red/amber/green traffic aspect signal mounted at the stop line in advance of the boom gate above each of the lanes closed by the boom gates.

(e) The vertically lowered boom gate must:

(i) be installed at right angles to the traffic flow at a maximum distance of 2 m between pairs of boom gates;

(ii) incorporate panelled sections that extend from the boom gate arms to road surfaces when the gates are closed;

(iii) be fitted with high visual impact red flasher lanterns that are activated immediately when the boom gate arms have started to move to their lane closure positions;

(iv) incorporate breakaway of the boom gate arms at vehicle impact speeds of greater than 10 kph or bend and distort at lower speed impacts;

(v) incorporate stop lines painted on each carriageway lane at each boom gate position.

(f) The red/amber/green traffic aspect signals must be mounted and operated as follows:

(i) Each set of the signals must be housed in a single mounting enclosure, conforming to AS 2144 and have 300 mm diameter aspects.

(ii) The red/amber/green traffic aspect signals must be controlled to sequence the stopping of the traffic in accordance with normal timing practice for such events. This may include:

- signals are normally off;
- when closing a lane, the amber aspect is turned on for 6 seconds and then the red aspect is turned on continuously;
- when reopening a lane, the red aspect is turned off and the green aspect is turned on for 60 seconds, then all aspects are turned off.

3.6.3 In-pavement Lights

(a) In-pavement lights must be installed to provide lane guidance to motorists of carriageway closure.

(b) In-pavement lights must be activated whenever a Motorway carriageway is closed.

(c) In-pavement lights must be of a similar standard of design and performance as airport in-pavement lights with:

(i) bright amber coloured lens;

(ii) luminous output intensity of not less than 50,000 Cd/m^2;

(iii) aspect window apertures positioned to prevent them from being obscured by the build-up and accumulation of road debris.

(d) Lamp failure for in-pavement lighting must be automatically detected by the TMCS and alerted to Motorway operators via the OMCS GUI.

(e) Light emitting diode (LED)-based in-pavement lights is recommended to minimise maintenance access.

3.6.4 Movable Medians

(a) The TMCS must include an arrangement of movable medians to support full or partial Motorway closures.

(b) Movable median devices must be designed, manufactured and installed to provide control over the use of traffic lanes.

(c) The dimensions of movable medians must be suitable for the traffic merge required to divert traffic from the lane and must approximate a typical traffic median.

(d) Means must be provided to ensure that the movable median travel within their design travel limits and are prevented from travelling beyond these limits.

(e) The movable median must reach its destination position in less than 12 seconds, for travel across one carriageway lane or 24 seconds for travel across more than one carriageway lane.

(f) The sides of the movable median facing oncoming traffic must have conspicuity flasher lights or raised retroreflective marker panels to alert oncoming drivers of the positions of the movable median.

(g) Control of the movable median must be provided by the TMCS through the OMCS GUI, including the following:

(i) A graphical display overlaid on the Motorway roadway schematic must provide the Motorway operator with a clear and unambiguous view and the option to move the median from its present position to a new position.

(ii) Confirmation must be received from the Motorway operator before the TMCS orders the movable median to be moved to a new position.

(iii) The OMCS GUI must show the movable median in the transition state as distinct from any parked states.

(iv) If a movable median is moved from its designated park position by external forces, the OMCS GUI must alert the Motorway operator, who must be able to restore the movable median to its position by the use of jog controls provided on the OMCS GUI.

(v) The OMCS GUI must provide a crash stop control button on the OMCS GUI which, when operated, stops the movable median within 300 milliseconds of the crash stop being ordered by the Motorway operator.

(h) The movable median control system must be safely interlocked with other Motorway devices, including CMS and VMS, to advise motorists of the merge requirements ahead.

(i) Movable medians must be of robust design, capable of absorbing impacts from vehicle tyres at speed and provide reliable and durable service.

(j) Movable medians must include provisions to accommodate and allow for manual movement in the event of drive mechanism failure.

(k) Moveable medians must be interfaced with SCATS Traffic Signal Controllers to request appropriate and safe traffic signal operation, based on current MM state/operation, including but not be limited to, open, moving and closed positions.

3.6.5 Stop Traffic Signals

(a) Traffic control signals must be installed and located in advance of diverge points to halt approaching traffic and to enable the safe deployment of diversion infrastructure, including movable medians and boom gates.

(b) Traffic control signals must be mounted above each lane to be halted and must only have 300 mm diameter aspects that conform to AS 2144.

(c) The red/amber/green traffic aspect signals must be controlled to sequence the stopping of traffic in accordance with normal timing practice for such events.

(d) A white stop line must be provided on the carriageway surface at traffic control signals in accordance with the TfNSW Delineation Manual and Specification TfNSW D&C R145.

(e) A static sign with corner mounted warning flashers must be installed 200 m in advance of the tunnel closure traffic control signals to advise motorists when they are activated and to prepare to stop ahead.

(f) The corner mounted warning flashers must be amber coloured signals of minimum size 150 mm.

(g) The AWS must be energised by the traffic control signal controller and must have a flash rate that complies with traffic signal practice and is synchronised with traffic control signal aspects.

3.6.6 Changeable Message Signs (CMS) for Movable Medians

(a) At distances of approximately 100 m to 200 m in advance of movable medians or other carriageway lane changing configuration devices, CMS must be installed to display the changed lane configuration to oncoming motorists whenever the movable medians have been moved from their normal or detente positions.

(Normal or detente position is the position of the movable median where the lane is operating in its normal configuration and the movable median has not been moved to control or divert traffic.)

(b) CMS must provide an unambiguous graphical representation of the approaching lane configuration change to inform motorists fully of the approaching lane merging and/or diversion manoeuvres. CMS must comply with AS 1743 Fig A1 in relation to sign dimensions.

(c) CMS must comply with:

(i) Specification TfNSW TSI-SP-034 for Prismatic or “Trivision” style CMS;

(ii) Specification TfNSW TSI-SP-067 for Electronic style CMS.

(d) CMS must have a matt/non reflective black background with white or amber graphic symbols. Dimming controls must be provided to automatically adjust the luminous output intensity from full daylight to night time ambient light conditions.

(e) Flashing conspicuity lamps must be provided in all the corners of the CMS, which must operate when the movable medians are about to change locations and until they return to their normal positions.

(f) CMS control must be interlocked with the movable median control systems for failsafe operation to prevent any dangerous situations from occurring.

(g) CMS control systems must include monitoring for any fault and raising of corresponding alerts to Motorway operators via the OMCS GUI.

3.6.7 Physical Barriers Within Tunnels

(a) The TMCS must provide for the automatic closure and subsequent opening of the tunnel sections using sequenced and automatically controlled infrastructure and operations that stops and diverts traffic at suitable locations within the tunnels, and as a minimum at traffic bifurcations, as specified in the Project Deed.

(b) Physical barriers must be installed at the specified locations within tunnels to prevent traffic from entering a section of tunnel where an incident requires it to be closed, and in conjunction with ISLUS, TMS and RRB, to achieve an orderly diversion of traffic away from the closed section of tunnel.

(c) Physical barriers are required to provide a capability to close each of the tunnel sections downstream of the diverge point.

(d) Physical barriers must comply with the requirements of Clause 3.6.2 (c) to (f).

(e) Moveable medians must also be provided to divert traffic at traffic bifurcations within the tunnels.

(f) Moveable medians must comply with the requirements of Clause 3.6.4.

(g) Stop traffic signals and stop lines must also be provided in order to stop vehicles prior to the deployment of physical barriers and moveable medians.

(h) Automated sequences must be developed to coordinate the safe operation of these physical barriers and moveable medians in conjunction with other tunnel signage and equipment.

3.7 DANGEROUS GOODS CARRYING VEHICLES AND SMOKY VEHICLES

3.7.1 Dangerous Goods Carrying Vehicles

(a) Vehicles carrying dangerous goods (as defined by the *Dangerous Goods (Road and Rail Transport) Act 2008 (NSW), Dangerous Goods (Road and Rail Transport) Regulation 2014 (NSW)* and the Australian Dangerous Goods Code), must be automatically detected and warned of the need to divert, and the alternative route definition provided, by means of advanced fixed warning signs with flashing conspicuity lamps.

3.7.2 Smoky Vehicles

(a) A smoky vehicle camera system capable of reliably detecting, identifying and recording the entry of smoky vehicles into the Motorway tunnels must be provided by the Contractor to deter smoky vehicles from entering the Motorway tunnels.

(b) The smoky vehicle camera system must:

(i) be capable of detecting, identifying and recording smoky vehicles in tunnels;

(ii) have at least 20 second video capture of vehicle progression once smoky vehicles are detected;

(iii) comply with "Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales" by the EPA;

(iv) perform digital image capturing of vehicle registration number plate and video recording to satisfy the requirements of TM31 as prescribed by the EPA;

(v) identify correct lane usage for detection purposes;

(vi) have a minimum of 45 days storage for potential offence file from the smoky vehicle detection system;

(vii) comply with the TfNSW Vehicle Emissions Enforcement System – Smoky Vehicle Camera Technical Specification (provided by TfNSW).

(c) The location of the smoky vehicle camera system within the tunnel must be approved by the Principal.

3.8 HOLD POINT

HOLD POINT

Process Held:	Procurement and installation of traffic management systems.
Submission Details:	Complete design documentation in accordance with D&C TS901 Clause 5 in relation to: (a) Variable Speed and Lane Control System; (b) Ramp Management and Control System; (c) Over-height Detection and Response System; (d) Motorway Closure System; (e) dangerous goods carrying vehicles and smoky vehicles detection and warning system.
Release of Hold Point:	The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.

4 DRIVER ADVISORY SIGNS AND TRAVELLER INFORMATION REQUIREMENTS

4.1 VARIABLE MESSAGE SIGNS (VMS)

4.1.1 Overview

(a) Colour VMS must be installed and operated to provide information messages to motorists driving on the Motorway and local roads approaching the Motorway in accordance with TfNSW Smart Motorway Design Guidelines.

(b) Colour VMS must comply with Specification TfNSW TSI-SP-008.

4.1.2 Locations

(a) Colour VMS must be located in accordance with TfNSW Smart Motorway Design Guidelines and must be:

(i) sufficiently in advance of all Motorway entry and exit ramps to enable safe diversion of traffic away from incidents;

(ii) for tunnel incidents, sufficiently further upstream to divert traffic from the tunnel.

(b) In addition, Colour VMS must be provided at locations detailed in the SWTC.

(c) The type (size) of Colour VMS installed at each location must comply with TfNSW Smart Motorway Design Guidelines and take into consideration the nominal speed limit at the location.

4.1.3 Operational Requirements

(a) Colour VMS must be used to advise motorists of traffic conditions that include, but are not limited to, the following:

(i) route information and alternative routes;

(ii) stopping of vehicles suspected of carrying dangerous goods;

(iii) closure of lanes on the Motorway;

(iv) closure of ramps on the Motorway;

(v) traffic congestion;

(vi) expected delays;

(vii) advisory speed;

(viii) detour requirements;

(ix) information to prevent vehicles from entering the tunnels during major incidents;

(x) information to advise drivers of over-height vehicles not to enter tunnels;

(xi) travel time from the TMCS Travel Time System (TTS) and TfNSW Motorway Travel Time Service (MTTS);

(xii) safety messages;

(xiii) special event messages;

(xiv) ramp metering operations.

(b) When displaying messages for incidents, VMS must operate conspicuity devices to attract driver attention.

(c) Operation of VMS must be in accordance with TfNSW Smart Motorway Design Guidelines, including display of:

(i) pictogram symbols in conjunction with and without text messages;

(ii) text messages with multiple colours.

4.1.4 TMCS Monitoring and Management

(a) The TMCS must provide an operator interface on the OMCS GUI to monitor and control VMS.

(b) The TMCS must display and log all VMS alarms, faults and device state changes.

(c) The TMCS must display and log all messages displayed on VMS, including date/time stamp, message and source/Motorway operator.

(d) VMS must be connected to the MNCS network for data communications with the TMCS.

4.1.5 Integration with Other Traffic Management Systems

(a) VMS must be controllable by external TfNSW/TMC systems via the C2C Interface, using VMS message priorities.

(b) The priority of different types of messages displayed on the VMS must be in accordance with TfNSW D&C TS917.

(c) VMS messages displayed as part of TIMP must use the correctly configured VMS Message priority.

4.2 TUNNEL MESSAGE SIGNS (TMS)

4.2.1 Overview

(a) TMS must be provided along the lengths of all the carriageways in tunnels in accordance with TfNSW Smart Motorway Design Guidelines.

(b) TMS must be a single line VMS (200 mm character height and 18 characters long).

(c) TMS must comply with TfNSW TSI-SP-008, except for dimming requirements.

(d) TMS must be able to withstand normal Motorway cleaning operations and maintain an enclosure rating of IP67.

(e) TMS must be provided with conspicuity roundels with minimum diameter of 150 mm.

(f) TMS must be installed with Military Standard IP67 screw lock plug and socket power and communications connections to facilitate maintenance swap outs.

4.2.2 Locations

(a) TMS must be located between the ISLUS along the length of the tunnels in such a way that drivers can always see at least one TMS at all times.

(b) TMS must be mounted above the carriageways in tunnel ceilings.

(c) Separation of TMS must be such that it gives an unobstructed view of the trailing TMS to motorists when within the viewing zone of both TMS.

4.2.3 Operational Requirements

(a) TMS must be used to advise motorists of traffic conditions that include, but are not limited to, the following:

(i) fire;

(ii) life safety;

(iii) incidents;

(iv) traffic information (including congestion, ramp metering operations and travel time).

(b) Where two or more TMS are set with a common message or frame, they must be synchronised for display to minimise driver distraction.

(c) Flashing of conspicuity roundels must be synchronised between adjacent and consecutive TMS.

(d) TMS on entry ramps must be able to be controlled by TfNSW MMS via the C2C Interface to allow them to be used as RC2 Warning Sign for ramp metering operations. Where TMS are used as RC2 warning signs, they must also be controllable by ramp metering/traffic signal controllers (via local control using external switch inputs).

4.2.4 TMCS Monitoring and Management

(a) The TMCS must provide an operator interface on the OMCS GUI to monitor and control the TMS.

(b) The TMCS must display and log all TMS alarms, faults and device states changes.

(c) The TMCS must display and log all messages displayed on TMS, including date/time stamp, message and source/Motorway operator.

(d) TMS must be connected to the MNCS network for data communications with the TMCS.

4.2.5 Integration with Other Traffic Management Systems

(a) TMS must be integrated with the OMCS IMS as part of TIMPs to safely manage speed and lane usage during incidents.

4.3 TRAVEL TIME SYSTEM (TTS)

4.3.1 Overview

(a) The TTS provides travel time information for road users on the Motorway. The purpose of this system is to display travel time on VMS and TMS controlled by the TMCS. This information allows road users to make travel decisions and set expectations of the likely journey time.

(b) Operation and display of travel time information on VMS and TMS must be in accordance with TfNSW Smart Motorway Design Guidelines.

(c) The TMCS must include the TTS, which advises drivers via Motorway VMS and TMS of the travel time to key destinations, taking into account current Motorway conditions.

(d) The TTS must calculate the travel times along the entire Motorway, to any destination, to the nearest minute.

(e) The calculation of travel time must be based on inputs from traffic monitoring and traffic management subsystems within the TMCS, which provides parameters such as regulatory speed limits and time adjustments for incidents. The refresh rate for travel time calculation must be agreed with TMC.

(f) The TTS must also cater for the display of travel time from the TfNSW MTTS via the C2C Interface.

4.3.2 Operational Requirements

4.3.2.1 Operation with Motorway VMS and TMSs

(a) All VMS and TMS controlled by the TMCS must be capable of displaying travel time information. However, under normal conditions, only nominated VMS and TMS must display travel times.

(b) VMS and TMS on the Motorway that are nominated to display travel times must be configurable.

(c) Travel time must be the default display on VMS and TMS used for the TTS.

(d) Higher priority messages must override travel time as the display on VMS and TMS.

4.3.2.2 Travel Time Messages

(a) Motorway VMS and TMS must display formatted text to indicate the travel time in minutes for up to three downstream Motorway intersections in one frame, and have the capability to report up to three destinations in another frame for the reported time.

(b) If two frames are used, the display time of each frame must be configurable in seconds, with a minimum display time of 3 seconds. For each frame, the travel time must be displayed in the following format on VMS (where TMS are limited to only one destination):

DESTINATION1 X min

DESTINATION2 Y min

DESTINATION3 Z min

Where:

(i) "DESTINATION1", "DESTINATION2" and "DESTINATION3" are selectable destinations;

(ii) "X min", "Y min" and "Z min" are the calculated travel times which may be coloured coded consistent with current traffic conditions in accordance with TfNSW Smart Motorway Design Guidelines.

(c) Destination text displayed on VMS and TMS must be agreed with the Principal.

(d) VMS and TMS may display a travel time message together with another message (e.g. planned maintenance work) as a multi-frame/interleaved message.

4.3.2.3 TTS Destinations

(a) Destinations must include Motorway end points and any other destinations to be advised by the Principal and the TMC.

(b) Selection of destinations to be displayed must be configurable from the TMC©(c) All VMS and TMS used to display travel time must be able to display all downstream destinations.

(c) For destinations external to the Motorway, TfNSW MTTS will provide relevant travel time data via the C2C Interface.

4.3.2.4 Travel Time Calculation by TTS

(a) Travel time calculation for the TMCS must take into account the following:

(i) different regulatory speed limits displayed in different variable speed limit zones;

(ii) impacts on travel time from incidents and congestion;

(iii) if a reported travel time for a destination represents a travel speed exceeding that of the posted speed limit, then that travel time must be reported as the calculated travel time of a vehicle travelling at the speed limit.

4.3.2.5 Validation of Travel Time Calculation by TTS

(a) The Contractor must maintain and develop the TTS to ensure that calculation algorithms produce accurate results in order to maintain credibility of travel time displays.

(b) The Contractor must conduct tests and surveys to validate the travel times reported by the system and, within one month after the opening of the Motorway to traffic, the Contractor must submit a report to the TfNSW with these details.

4.3.2.6 Travel Time Calculation by TfNSW MTTS

(a) The TMCS must also take as input the travel time calculated and provided by TfNSW MTTS via the C2C Interface and VMS message priority queue.

(b) The TfNSW MTTS uses multiple system elements working together, as shown in Figure TS912.2.

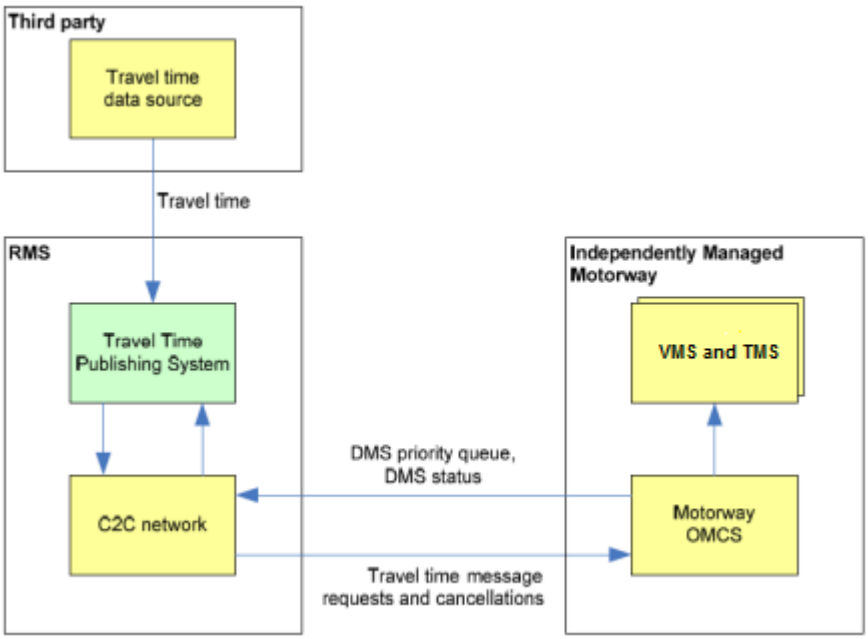


Figure TS912.2 - TfNSW Provided Travel Time

4.3.3 TMCS Monitoring and Management

(a) The TMCS must provide an operator interface on the OMCS GUI to monitor, control and manage TTS and associated devices.

(b) The TMCS must provide an operator interface on the OMCS GUI with a graphical TTS representation of VMS/TMS signs, destinations and travel times.

(c) The TMCS must display and log all TTS alarms, faults and device states.

(d) The TMCS must provide functions to configure TTS algorithms in determining travel times and VMS/TMS travel time message display formats.

(e) The TMCS must only allow authorised personnel to have access to TTS configuration functions.

(f) The TMCS must display and log all TfNSW MTTS alarms, faults and device states.

4.3.4 Integration with Other Traffic Management Systems

(a) The TTS must be integrated with the following systems to obtain input parameters affecting travel time calculations:

(i) Traffic monitoring systems;

(ii) QMS;

(iii) IMS.

(b) The TMCS must also be integrated with the TfNSW MTTS via the C2C Interface to allow display of TfNSW calculated travel times on Motorway VMS and TMS.

4.4 ELECTRONIC SIGNS MAINTENANCE AND DESIGN LIFE REQUIREMENTS

(a) Worker accessible gantries with walkway lighting must be installed for all VMS that are external to Motorway tunnels.

(b) All firmware/software for electronic signs must be remotely upgradable via the MNCS.

(c) The design life for all electronic signs that operate using LEDs must be not less than 10 years.

(d) Maintenance of electronic signs must be in accordance with the methodology and process specified in Specification TfNSW R300.

4.5 HOLD POINT

HOLD POINT

Process Held:	Procurement and installation of driver advisory signs and traveller information systems.
Submission Details:	Complete design documentation in accordance with D&C TS901 Clause 5 in relation to: (a) VMS and TMS; (b) Message priority via the C2C Interface and OMCS; (c) TTS.
Release of Hold Point:	The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.

5 VOICE COMMUNICATION AND RADIO RE-TRANSMISSION SYSTEMS REQUIREMENTS

5.1 GENERAL

(a) Voice communications and radio re-transmission systems must be provided on Motorways to service the needs and requirements of Motorway users, including emergency service organisations, the general public and Motorway Operations and Maintenance (O&M) personnel.

5.2 MOTORISTS EMERGENCY TELEPHONE SYSTEM (METS)

5.2.1 Design and Installation

(a) METS telephones must be provided in accordance with TfNSW Smart Motorway Design Guidelines.

(b) METS telephones must be supplied and installed by the Contractor, and must be purpose designed and built roadside telephones, and free standing. Instructions on the use of METS telephones must be provided in clearly legible signage on the METS telephones.

(c) METS telephones must be designed to operate under extreme weather conditions likely to be experienced on the Motorway and must comply with the requirements of Specification TfNSW TSI-SP-016.

(d) The METS in the tunnels must be suitable for use in a tunnel environment and must comply with the design and construction requirements for telephone communications equipment set out in AS 1670.4 and AS 4428.4.

(e) Notwithstanding the functional and operational requirements of AS 1670 and AS 4428, the METS must conform to the following functional and operational requirements:

(i) METS answering panels and control facilities must be supplied and configured at each of the Motorway operator workstations to enable each Motorway operator to independently and simultaneously answer calls from METS users on the Motorway.

(ii) METS answering panels must display current calls and queued calls on both the Motorway operator METS panel and the OMCS GUI to each Motorway operator. Additional information must also be provided to display the METS phone locations of the active callers, and queued callers, duration of the current call and waiting time for each queued call. Active and queued calls must be indicated by icon representation on the Motorway Status Display.

(iii) Upon initiation of a METS call, the respective CCTV camera must immediately zoom in to the METS location, using presets.

(iv) The METS must give confidence to METS users that the call is being progressed, prior to being answered, and if the call is queued, a confidence tone and automatic voice messages must be provided to the user.

(v) Motorway operators must be able to call any METS telephone on the Motorway from the Motorway operator METS panel.

(vi) The METS must have in-built self-test functions that are monitored by the TMCS.

(vii) The METS must be connected to the Motorway's Electrical Power Supply and Distribution (EPSD) network and must not rely on solar panels.

5.2.2 Connection of METS Telephones

(a) METS telephones must directly call the Motorway operator upon a user lifting the handset or pushing a button.

(b) METS telephones must be located in accordance with the requirements for emergency equipment as detailed in the SWTC.

(c) METS telephones must be connected to the MCC and DRS via the optical fibre cable network of the MNCS.

5.2.3 Enclosure for METS Telephones

(a) Emergency telephones must be contained in an enclosure rated to IP65, to withstand the conditions during tunnel cleaning operations and conditions normally expected for outdoor equipment.

(b) The METS telephones must be built to withstand vandalism and to protect the sensitive components from malicious damage.

5.2.4 Calling Number Location Reference Data in METS

(a) The METS must provide calling number location reference data to the TMCS and the OMCS GUI. Calling number location reference data must be linked to Motorway segment identifiers, CCTV camera number and preset view reference number. The requirements for preset view operation are specified in TfNSW TSI-SP-006-TMC.

5.2.5 Audible Clarity

(a) METS telephones must provide audible clarity for high ambient noise levels in the order of 95 dBA.

(b) Noise cancelling microphones and other techniques must be employed in the handsets and speakers must have sufficient output volume, with minimal distortion, and high clarity to ensure that conversation with Motorway operators is possible under all circumstances.

(c) METS telephone audible clarity performance must achieve an articulation index of 0.456 or better when subjected to objective machine based test based on ANSI S3.5-1997, with a Motorway operator at the MCC or DRS and the user in a tunnel environment, with an A-weighted background noise level for the LA10 equivalent to that given in Appendix D of Richard Heggie and Associates report ref: 10-2318 for the Westbound carriageway of the M5 East Motorway.

(d) METS telephones must incorporate hearing aid loop facilities in the handset for the benefit of persons with hearing disabilities.

5.2.6 Integration with Other Traffic Management Systems

(a) The METS must interface with OMCS IMS to:

(i) automatically raise an incident in OMCS IMS arising from a METS call;

(ii) locate the METS call/incident on the OMCS GUI.

(b) The TMCS must display and log all METS calls, including date/time stamp information, METS telephone ID and the Motorway operator who received or made the METS call.

(c) The TMCS must display and log all METS alarms, faults and device states.

5.3 INTERNAL OPERATIONS COMMUNICATION SYSTEM (IOCS)

(a) A Motorway Internal Operations Communication System consisting of, as a minimum, a Private Automatic Branch Exchange (PABX) telephone system and a secure mobile voice radio network, must be provided.

(b) The PABX telephone system must provide communications between:

(i) cross and egress passages in the tunnel;

(ii) plant and equipment locations, including toll equipment locations and communications hubs;

(iii) MCC and DRS;

(iv) equipment and plant rooms;

(v) other essential areas.

(c) The internal operations telephone communication network must be separate from the METS network.

(d) The secure mobile voice radio communication network must provide communication along the entire length of the Motorway, including:

(i) unrestricted 2-way communications at any point in the tunnel, access and ventilation tunnels, ramps and ancillary areas;

(ii) external carriageways;

(iii) along sections of adjoining motorways up to their first interchanges beyond the Motorway end points;

(iv) all roads within 2 km of the Motorway boundary.

(e) The secure mobile voice radio communication network must consist of at least 4 dedicated independently licensed UHF repeater channels, operating in half duplex (2 frequencies system) mode.

(f) The secure mobile voice radio communication network must provide adequate radio coverage (RF signal level strength of -95 dBm or better) along the entire length of the Motorway.

(g) The secure mobile voice radio communication network inside the Motorway tunnel must include a 2-way radio repeater system. This 2-way radio repeater system must be designed and installed in a manner which allows for radio maintenance activities to be undertaken without lane closure (i.e. no disruption to traffic).

(h) The secure mobile voice radio communication network must conform to the relevant requirements and standards of the Australia Communications and Media Authority (ACMA).

(i) The secure mobile voice radio communication network must be used exclusively to facilitate Motorway Operations and Maintenance (O&M) activities.

(j) The TMCS must display and log all IOCS alarms, faults and device states.

5.4 PUBLIC ADDRESS (PA) SYSTEM

(a) PA functions must be provided in accordance with TfNSW D&C TS913.

5.5 RADIO RE-BROADCAST (RRB) AND BREAK-IN SYSTEM

5.5.1 General

(a) RRB facilities must be provided to receive and re-transmit the following radio station broadcasts to motorists in tunnels:

(i) 12 AM stations;

(ii) 12 FM stations;

(iii) all DAB+ services defined in:

- 9A Sydney Multiplex (DAB+ Sydney 1);
- 9B Sydney Multiplex (DAB+ Sydney 2);
- 9C National Multiplex for Sydney (SY abc&SBS RADIO).

(b) The AM and FM radio stations that are re-broadcast must be the 12 most popular stations in each band.

(c) The RRB system must be provided with the capacity to re-broadcast at least an additional 10 AM, 10 FM radio stations and one DAB+ multiplex/ensemble in the future.

(d) For every radio station re-broadcast in a tunnel, the quality of the radio reception must be equivalent to the reception outside the tunnel. This requirement excludes radio reception disruption effects due to heterodyning caused by dual signal reception at tunnel entrance and exit transition zones.

5.5.2 RRB Infrastructure

(a) The Contractor must supply, install, commission, operate, maintain and upgrade all the equipment, plant, facilities and services required to provide RRB services (including "break-in" facility) for all of the AM, FM and DAB+ radio stations/services, including:

(i) input signal interfaces for each station/service;

(ii) signal transmission equipment for each station/service;

(iii) antenna systems to propagate radio signals in tunnels;

(iv) power supplies;

(v) all associated cabling.

5.5.3 RRB Break-In Facility

(a) The RRB system must be equipped with a "break-in" facility that enables the TMCS to override all normal radio reception in tunnels with voice instructions for traffic management from Motorway operators during tunnel operations, emergencies and major incidents.

(b) The RRB system "break-in" facility must allow "break-in" via pre-recorded message selected by a Motorway operator from a message library and live message as spoken by a Motorway operator.

(c) The RRB system must provide a minimum number of "break-in" zones covering the entire tunnel. The zone configuration must take into consideration the tunnel roadway layout (including entry/exit ramps and any tunnel bifurcations) and safety/operational requirements.

As a minimum, the following "break-in" zones must be provided:

(i) one zone for each tunnel mainline carriageway direction;

(ii) one zone for each tunnel entry ramp > 500 m in length;

(iii) one zone for each tunnel exit ramp > 500 m in length;

(iv) one zone for each tunnel segment > 500 m resulting from a bifurcation.

Any entry, exit or bifurcation segment < 500 m must be incorporated into other zones to ensure full tunnel coverage of RRB "break-in" facility.

Logical groupings of RRB zones must also be provided to assist Motorway operators to perform break-in announcements over larger sections of the Motorway. This may include, but not be limited to, entire carriageway groups covering all zones in one direction of travel, or grouping of ramp zones where the ramp includes bifurcations.

(d) The RRB system must be configured so that the operation of break-in communications to a selected tunnel zone does not affect radio re-broadcast in any other tunnel zone and different break-ins can be operated simultaneously in different tunnel zones.

(e) The RRB break-in facility must comply with the following requirements:

(i) Microphone and control panel equipment must be provided on every Motorway operator desk in the MCC and DRS.

(ii) The break-in facility must be able to be controlled and monitored by the TMCS via the OMCS GUI.

(iii) The Motorway operator must be able to select discreet tunnel zones for radio re-broadcast “break-in”.

(iv) A break- in tone/chime must precede all break-in messages.

(v) The break-in facility must automatically record and permanently store all live messages spoken by the Motorway operators on the TMCS.

(vi) Voice signal levels must be adjusted in the break-in facility and tested to ensure that the Motorway operators’ instructions are audible across the general range of in-vehicle radio settings.

(vii) The Motorway operator must be able to record new pre-recorded messages for inclusion in the message library.

(viii) The Motorway operator must be able to adjust the frequency (duration between repeats) of pre-recorded messages used for break-in.

(ix) The OMCS IMS must be able to automatically playback a pre-recorded message as part of a TIMP.

5.5.4 RRB Monitoring Functions

(a) The RRB system must confirm the correct operation of the radio re-broadcasts and “break-in” facility in each tunnel zone via an in-tunnel off-air monitoring system. Motorway operators must be able to select and independently monitor by listening to the AM, FM and DAB+ broadcasts in each tunnel zone.

(b) The RRB system must include facilities to enable the monitoring of system status and faults by TMCS. This must include active equipment such as transmitters, receivers, transceivers and power supplies.

(c) The RRB system must monitor received donor signals and re-transmitted radio signals for any degradation or loss of a station/service and raise alarms to the operator via the OMCS GUI. These alarms must have sufficient detail to identify the degradation or loss of a specific station/service.

5.5.5 TMCS Monitoring and Management

(a) The TMCS must display and log all RRB system alarms, faults and device states.

(b) The TMCS must log all usage of RRB break-in functions, including details identifying:

(i) date/time stamp information;

(ii) RRB zones used;

(iii) pre-recorded message selected by the Motorway operator;

(iv) live recording made by the Motorway operator;

(v) the Motorway operator who used RRB break-in;

(vi) the TIMP that used the RRB break-in.

5.6 NSW GOVERNMENT RADIO NETWORK (GRN)

5.6.1 Description of Network

(a) The NSW Government Radio Network (GRN) was established in 1993 to provide a common platform for NSW Government agencies and authorities which use mobile radio communications.

(b) Operation and maintenance of the GRN is provided by an external service provider under the oversight and assurance of the NSW Telco Authority.

5.6.2 General

(a) The Contractor must design, supply, install, test and commission the GRN system on the Motorway in accordance with the NSW Telco Authority GRN Site Specification (provided by the NSW Telco Authority). For the purposes of this Specification, the GRN system to be provided on the Motorway is considered to be a new P25 base station and not a repeater site.

(b) The Contractor must provide access to and support, cooperate and assist the NSW Telco Authority or its agents with the operation, maintenance and upgrading of the GRN system on the Motorway.

(c) The Contractor is responsible for payment of all capital and recurring costs and charges associated with the supply, installation, testing, commissioning, provisioning of communication links, operation and maintenance of the GRN system, including the costs, charges and fees incurred and charged by the NSW Telco Authority in accordance with the GRN Site License Agreement.

General information relating to the GRN can be obtained from the NSW Telco Authority website: http://telco.nsw.gov.au/.

(d) The NSW Telco Authority or its agents will operate, maintain and upgrade the GRN system on the Motorway (excluding any shared radio infrastructure that is common to other radio services) in accordance with the GRN Site License Agreement.

5.6.3 GRN Provisions

(a) The Contractor must provide, at no cost to the NSW Telco Authority, the space, access and supporting infrastructure on the Motorway to accommodate the GRN system, including, but not be limited to:

(i) rooms and associated services for GRN equipment, including lighting, ventilation, temperature control, power and ceiling and floor fit-out;

(ii) space for GRN radio transmission and receiver equipment and control system and battery cabinets for a minimum of 3 voice channels and 1 control channel;

(iii) floor space for 2 future equipment racks: one for Public Safety Mobile Broadband and one for associated batteries;

(iv) antenna systems and equipment distributed throughout the Motorway tunnels for propagation of GRN transmissions and connections to transceiver equipment;

(v) space for miscellaneous equipment, fittings and enclosures, both on the Motorway and in equipment rooms, conduits, power supplies, and cabling;

(vi) integration with all related communications systems on the Motorway;

(vii) Uninterruptible Power Supply (UPS) for GRN equipment rated for a minimum of 10 hour autonomy time.

(b) The Contractor must provide electrical power to operate the GRN system at no cost to the NSW Telco Authority.

(c) The Contractor must ensure that all standard GRN equipment alarms and faults are able to be monitored and logged by NSW Telco Authority or its agents through back to base monitoring.

(d) The NSW Telco Authority will provide the communications links from GRN equipment on the Motorway to the GRN network operations centre that is external to the Motorway.

5.6.4 GRN Design

(a) The NSW Telco Authority will assign the spectrum licensing for the GRN system on the Motorway.

(b) The NSW Telco Authority will review and approve the GRN system design for the Motorway.

(c) Prior to the procurement and installation of the GRN system, the Contractor must submit to the Principal complete design documentation of the GRN system for the Motorway in accordance with Clause 5 of TfNSW D&C TS901, and approval from the NSW Telco Authority of the GRN design for the Motorway.

HOLD POINT

Process Held:	Procurement and installation of GRN system.
Submission Details:	Details of the following: (a) Complete design documentation in accordance with D&C TS901 Clause 5 in relation to NSW GRN; (b) Approval from the NSW Telco Authority of the GRN system design for the Motorway.
Release of Hold Point:	The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.

5.6.5 GRN Acceptance

(a) The NSW Telco Authority or its agents will formally accept the GRN system only if the GRN system is built in accordance with the GRN Site Specification and approved GRN system design.

If the NSW Telco Authority or its agents identify any minor nonconformities, the GRN system may be Conditionally Accepted, provided that the minor nonconformities is rectified within one month of the date of issue of the Defects List. Any GRN system with nonconformity which has not been rectified will not be accepted.

(b) Prior to the handover of the GRN system to the NSW Telco Authority, the Contractor must submit to the Principal the following:

(i) Work-as-executed (WAE) drawings of the GRN system;

(ii) Records of rectification of all nonconformities associated with the GRN system;

(iii) Confirmation from the NSW Telco Authority that the Motorway GRN site commissioning was successful.

HOLD POINT

Process Held:	Handover of GRN system to NSW Telco Authority.
Submission Details:	Details of the following: (a) Work-as-executed (WAE) drawings of the GRN system; (b) Records of rectification of all nonconformities associated with GRN system; (c) Confirmation from the NSW Telco Authority that the Motorway GRN commissioning was successful.
Release of Hold Point:	The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.

(c) The Contractor must transfer ownership of the GRN system to the NSW Telco Authority upon Formal Acceptance.

(d) The NSW Telco Authority will retain ownership of the GRN assets and will be responsible for the insurance of these assets and the repairs of any assets that are damaged (excluding any shared radio infrastructure that is common to other radio services).

5.7 NSW POLICE FORCE RADIO NETWORK (NSWPFRN)

5.7.1 Description of Network

(a) The NSW Police Force Operational Communications and Information Command operates and maintains the NSW Police Force Radio Network (NSWPFRN).

(b) The NSWPFRN operates in the 450 to 470 MHz UHF band. Future data radio channels may occupy the 380 to 420 MHz band.

(c) A minimum of 4 NSWPFRN radio channels must be provided. The NSW Police Force will confirm which NSWPFRN radio channels must be provided throughout the Motorway.

(d) The Contractor must provide spare capacity for 2 more unspecified channels allocated to the NSWPFRN.

(e) The NSW Police Force operates portable belt type radios on the NSWPFRN and these radios must operate on all sections of the Motorway.

5.7.2 Installation of NSW Police Force Radio Network

(a) The Contractor must provide the NSW Police Force with all things necessary to accommodate, install, operate and maintain the NSWPFRN, at no cost to the NSW Police Force. These include, but are not limited to:

(i) equipment rooms and associated services to and in the rooms, including lighting, ventilation, temperature control, power and ceiling and floor fit-out;

(ii) space for NSWPFRN radio transmission and receiver equipment and control system plus battery cabinets;

(iii) antenna systems and equipment distributed throughout the Motorway tunnels for propagation of NSWPFRN transmissions and connections to transceiver equipment;

(iv) space for miscellaneous equipment, fittings and enclosures both in tunnels and equipment rooms, conduits, power supplies, and cabling;

(v) integration with all related communications systems on the Motorway;

(vi) a communications link from the NSWPFRN equipment on the Motorway to the NSWPFRN operations centre that is external to the Motorway.

(b) The Contractor must provide the electrical power infrastructure to operate the NSWPFRN system, at no cost to the NSW Police Force.

(c) The Contractor must provide access to and must support, cooperate, assist and liaise with the NSW Police Force when the Contractor undertakes the installation, testing, and commissioning of the NSWPFRN infrastructure, systems and services on the Motorway.

(d) The NSW Police Force will take ownership of the NSWPFRN after it is installed, tested and commissioned and will be responsible for the ongoing routine and breakdown maintenance and upgrading of the NSWPFRN.

(e) The Contractor must provide access to and must support, cooperate and assist the NSW Police Force or its agents with the maintenance and upgrading of the NSWPFRN infrastructure, systems and services on the Motorway.

(f) Specific information on the NSWPFRN channels and other detailed requirements for the NSWPFRN can be obtained from the NSW Police Force Communications Group on 02 9265 4502.

(g) The TMCS must display and log all NSWPFRN equipment alarms and faults.

5.8 MOBILE TELEPHONES AND OTHER RELATED MOBILE COMMUNICATION SERVICES

(a) The Contractor must do all things necessary to enable the installation, commissioning, operation and maintenance of all mobile telephone and all other related mobile communication services on the Motorway.

(b) Mobile telephone and other related mobile communication services must include sufficient capacity to service the number of voice and data channels required for the usage factors experienced by mobile telephone carriers for heavily traffic road corridors. Capacity requirements of the services must allow for peak loading that may occur during incidents on the Motorway.

(c) The Contractor must do all things necessary to enable it to enter into commercial agreements with all mobile telephone communication carriers for the provision of the infrastructure and services that are necessary to support the installation, operation and maintenance of the carriers' equipment. These provisions must include:

(i) all spaces and excavations required to house the plant, equipment and services, including those required in cross passages and in tunnel niches;

(ii) equipment rooms to house all communications and computer equipment, including adequate lighting, ventilation, temperature control, electrical power and distribution, cabling access, access security and specific finishes to suit the installed equipment;

(iii) accommodation of fibre optic repeater and transceiver equipment located in tunnels;

(iv) conduits and cables to link all the elements of mobile telephones and communication services equipment;

(v) accommodation for antennas mounted internally and externally to tunnels;

(vi) an essential service power supply, including earthing arrangements as applicable for communications;

(vii) accommodation of communication trunk links to wired services or microwave links for connection to general external communications networks of the communications carriers;

(viii) restricted access to authorised personnel, controlled by the Contractor.

(d) The Contractor must meet the requirements of the lead mobile telephone carrier and, as a minimum, provide:

(i) a Distributed Antenna System (DAS) that complies with lead mobile telephone carrier requirements and covering the entire tunnel;

(ii) a multi-carrier combiner for at least 4 carriers (or as otherwise specified by the lead mobile telephone carrier);

(iii) a system that is suitable for multi-carrier deployment across all the carriers' operating bands;

(iv) portal antennas to provide handover coverage to and from the outdoor networks.

(e) The Contractor must provide all mobile telephone communication carriers with sufficient access to enable them to install, test, commission, operate, maintain and upgrade their equipment.

(f) The Contractor must do all things necessary to enable the operation of all mobile telephony and other related mobile communication services when the Motorway is opened for public use.

(g) The installation, operation and maintenance of mobile telephone communications equipment and services must comply with the requirements of the Environmental Documentation and the Contractor must assist and facilitate the process for acquiring the required approvals.

5.9 LOCATION SERVICES

(a) The Motorway must be provided with Location Services capability within Motorway tunnel sections.

(b) The Tunnel Location Services technology, including but not limited to Global Navigation Satellite System (GNSS) retransmission, WiFi and Bluetooth, must utilise open standards to allow multiple vendors/systems to utilise this capability.

(c) The performance and accuracy of the Tunnel Location Services must be sufficient for safe navigation and way-finding applications.

(d) As a minimum, the Tunnel Location Services must provide location accuracy to within 1 m.

(e) The Tunnel Location Services must comply with ACMA and NSW Telco Authority requirements and all licenses/approvals must be obtained.

(f) The TMCS must display and log all Tunnel Location Services alarms, faults and device states.

5.10 RE-BROADCAST OF TFNSW UHF RADIO SERVICE

(a) TfNSW operates and maintains TfNSW UHF Radio Service in NSW.

(b) The Contractor must provide all equipment, services and facilities to enable the TfNSW UHF service to operate on the Motorway.

(c) The Contractor must supply, install, test, commission, operate, maintain and upgrade the TfNSW UHF RRB Service infrastructure, systems and services on the Motorway.

(d) The Contractor must provide capacity for up to 4 TfNSW UHF channels to be re-broadcast on the Motorway.

(e) The Principal will confirm the frequencies of these channels.

(f) The TMCS must display and log all TfNSW UHF RRB Service equipment alarms and faults.

5.11 HOLD POINT

HOLD POINT

Process Held:	Procurement and installation of voice communication and radio re-transmission systems.
Submission Details:	Complete design documentation in accordance with D&C TS901 Clause 5 in relation to: (a) Motorway emergency telephone system; (b) Internal operations communication system; (c) Public Address system; (d) Radio Re-broadcast and break-in system; (e) NSW Police Force radio network (f) Other mobile telecommunications carrier systems; (g) Location Services; (h) Re-broadcast of TfNSW UHF Radio Service.
Release of Hold Point:	The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.

6 INTERFACE REQUIREMENTS WITH TFNSW AND TFNSW TMC

6.1 CENTRE TO CENTRE (C2C) INTERFACE

6.1.1 General

(a) C2C Interface must be designed, constructed, installed, commissioned, operated and maintained as part of the TMCS to:

(i) exchange traffic and traffic management data between the TfNSW, other agreed OMCSs and the OMCS;

(ii) facilitate the coordination of incidents on the Motorway with the TfNSW and other agreed OMCSs;

(iii) provide remote monitoring of traffic systems and traffic movements on the Motorway, including approach roads and ramps to TfNSW controlled sections;

(iv) provide shared, priority control of Motorway traffic devices to TfNSW as agreed.

(b) The TMCS must be configured to receive and process incident and device messages sent from TfNSW or another Motorway OMCS over the C2C Interface.

(c) The services to be provided as part of the C2C interface between the Contractor and the TfNSW are detailed in TfNSW D&C TS917.

(d) The Contractor must provide all engineering services to support TfNSW in the design, installation, testing and commissioning of the end-to-end C2C Interface.

6.1.2 Data Communications Protocol for the C2C Interface

(a) The Data Communications Protocol between the TMCS and TfNSW must conform to the following:

(i) The interface must utilise a non-proprietary, industry standard extensible message structure protocol (XML) and data transportation mechanisms delivering XML over Ethernet (HTTPS).

(ii) The data communications protocol between the OMCS and TfNSW must conform to the requirements and message set definitions for C2C Interfaces published by transportation authorities, as per NTCIP 2306 and ITE/AASHTO TMDD Standard and IEEE 1512 and their corresponding XML schemas.

(iii) The interface data object definitions and the required messages interchange criteria and rules must conform to TfNSW D&C TS917.

(iv) All aspects of the protocols in the respective TMCS and TfNSW systems must be implemented and the protocol functionality must be supported in the TMCS.

(v) The interface must be capable of providing authentication services via X509 Binary Security Token and WS-Security Username Token in accordance with Oasis 200401 and TfNSW A3410742 Security Implementation Guide.

6.1.3 Requirements to Implement Data Communications Protocol

(a) The implementation of the data communications protocol between the TMCS and the TfNSW will result in the integration of the Motorway into the Sydney Road Network IMS operating in the TMC.

(b) Suitably qualified and experienced technical support personnel must be deployed to ensure that the requirements for implementation of the data communications protocol are understood and that the design and architecture of the TMCS are harmonised with the data communication protocol application.

6.1.4 Testing and Commissioning of the Data Communications Protocol

(a) The testing, commissioning and acceptance of the data communications protocol must be completed concurrently with the commissioning of the TMCS and prior to the opening of the Motorway to traffic.

(b) Scheduling of testing activity must be agreed with the TfNSW and TfNSW TMC to ensure successful end-to-end testing.

(c) C2C Interface test plans and test specifications must be prepared and submitted to the TfNSW for approval 60 days prior to the commencement of testing.

6.2 CCTV INTERFACE

(a) TfNSW TMC must have access to all CCTV cameras installed on the Motorway.

(b) The Motorway CCTV system must be integrated with the TMC Genetec Video Management System in accordance with TfNSW TSI-SP-006-TMC. To ensure compatibility, the Contractor must confirm with TfNSW TMC as to the version of TMC Genetec Video Management System.

(c) TfNSW TMC must be able to access up to 16 CCTV cameras at full motion rate and at any one point in time.

(d) TfNSW TMC must be able to control the pan, tilt and zoom for each Motorway CCTV PTZ camera from the TMC's video control consoles and TMC's Genetec Video Management System.

(e) If the Motorway CCTV system is able to access the TMC CCTV video feeds, the Motorway CCTV system must comply with the TMC Policy for Using TfNSW Traffic Management CCTV Cameras (TMC-POL-402002).

(f) The Contractor must provide to TfNSW TMC a listing of all CCTV cameras installed on the Motorway including latitude/longitude positional references and user friendly description of the camera location/view for each CCTV camera.

6.3 TFNSW MOTORWAY MANAGEMENT SYSTEM

(a) An interface to the TfNSW MMS must be provided via the C2C Interface in accordance with TfNSW D&C TS917.

6.4 HOLD POINT

HOLD POINT	
Process Held:	Installation and integration with TMCS interfaces.
Submission Details:	Complete design documentation in accordance with D&C TS901 Clause 5 in relation to: (a) C2C Interface to TfNSW/TfNSW TMC; (b) CCTV Interface to TfNSW TMC.
Release of Hold Point:	The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.

7 TMCS TESTING AND COMMISSIONING

7.1 GENERAL

(a) The TMCS comprises several subsystems that must be tested both individually and when integrated with the OMCS.

(b) The testing and commissioning of the TMCS must satisfy the requirements of the overall OMCS integration and testing detailed in TfNSW D&C TS911.

(c) The testing and commissioning of the TMCS must also adhere to the process, methodologies and documentation requirements specified in TfNSW D&C TS901 Clause 5 and TfNSW D&C TS911 Clause 9.

7.2 HOLD POINT

HOLD POINT	
Process Held:	Commencement of testing.
Submission Details:	Complete test documentation (including Test Plans and Test Specifications) in accordance with D&C TS901 Clause 5 and D&C TS911 Clause 9.
Release of Hold Point:	The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.

ANNEXURES TS912/A TO TS912/B – (NOT USED)

ANNEXURE TS912/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.3.3.

C1 SCHEDULE OF HOLD POINTS

Clause	Description
2.6	Procurement and installation of traffic surveillance and monitoring systems.
3.8	Procurement and installation of traffic management systems.
4.5	Procurement and installation of driver advisory signs and traveller information systems.
5.6.4	Procurement and installation of GRN system.
5.6.5	Handover of GRN system.
5.11	Procurement and installation of voice communication and radio re-transmission systems.
6.4	Installation and integration with TMCS interfaces.
7.2	Commencement of testing.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW D&C Q6 Annexure Q/E.

Clause	Description of Identified Record
	Systems Engineering Management Plan (SEMP), Systems Requirements Specification, Design Documentation, Equipment Documentation, Test Plans, Test Specifications, and WAE Documentation for OMCS complying with D&C TS901 Clause 5.
7	Test documentation, including test reports, for all OMCS installation, testing and commissioning activities carried out.

ANNEXURE TS912/D – PLANNING DOCUMENTS

Refer to Clause 1.3.4.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. The requirements of this Specification and others included in the Contract must be reviewed to determine additional documentation requirements.

Clause	Description of Document
	SEMP, Design/Development Plan(s) and Inspection and Test Plan(s) developed in accordance with D&C TS901 and D&C TS902.

ANNEXURES TS912/E TO TS912/L – (NOT USED)

ANNEXURE TS912/M – REFERENCED DOCUMENTS

Refer to Clause 1.3.6.

TfNSW Specifications

TfNSW D&C Q6	Quality Management System (Type 6)
TfNSW D&C R145	Pavement Marking (Performance Based)
TfNSW R300	ITS Maintenance Services – General Requirements
TfNSW TS200	Register of ITS Field Equipment
TfNSW D&C TS101	Traffic Control Signals – New Installation and Reconstruction
TfNSW D&C TS901	Motorway Systems Overview and General Requirements
TfNSW D&C TS902	Systems Engineering Processes
TfNSW D&C TS911	Motorway Systems - Motorway Control Centre
TfNSW D&C TS913	Motorway Systems - Plant Management and Control System
TfNSW D&C TS914	Motorway Systems - Electrical Power Supply and Distribution System
TfNSW D&C TS915	Motorway Systems - Motorway Network Communications System
TfNSW D&C TS916	Motorway Systems - Electronic Toll Collection System
TfNSW D&C TS917	Motorway Systems - C2C Interface for Motorways
TfNSW D&C TS918	Motorway Systems - Road Tunnel and Underpass Lighting
TfNSW TSI-SP-006-TMC	General Specification for the Design, Supply, Installation, Testing and Commissioning of Closed Circuit Television Systems for Motorways
TfNSW TSI-SP-008	Specification for Variable Message Signs
TfNSW TSI-SP-011	Specification for Integrated Speed Limit and Lane Use Signs
TfNSW TSI-SP-016	General Requirements for Outdoor Electronic Equipment
TfNSW TSI-SP-026	Communications Protocol for Vehicle Detection Systems
TfNSW TSI-SP-034	Changeable Message Signs - Prismatic
TfNSW TSI-SP-038	General Requirements for Vehicle Loop Detector Equipment
TfNSW TSI-SP-051	Electronic Message Sign Type EMS1
TfNSW TSI-SP-067	Changeable Message Signs – Electronic
TfNSW TSI-SP-069	Control Equipment for Road Traffic Signals
TfNSW A3410742	Security Implementation Guide.

TfNSW Guides and Manuals

TfNSW Delineation Manual

TfNSW Smart Motorway Design Guidelines

TfNSW Smart Motorway Supplement for Traveller Information

TfNSW Smart Motorway Supplement for Ramp Signals

TfNSW Smart Motorway Supplement for LUMS including VSL

TfNSW Smart Motorway Design Guide Capacity and Flow Analysis

TfNSW Smart Motorway Design Guide Tunnel Traffic Management

TfNSW Smart Motorway Design Guide Traffic Monitoring and Surveillance

TfNSW Smart Motorway Design Guide – Vehicle Detectors

TfNSW Guidelines for Priority Vehicle Access on Entry Ramps for Managed Motorways

TfNSW Traffic Signal Design Manual

TfNSW Drawings

G6-315	Start Variable Speed Limit Zone
G6-316	End Variable Speed Limit Zone
G6-317	If Variable Speed Limit Sign is Blacked Out
G9-333-1	One Vehicle Only Per Lane On Green Signal
R6-6	Stop Here On Red Signal
VC005-33	Installation of Loop Detectors at Traffic Detector Stations
W3-204-1	Warning Sign W3-204-1

Australian Standards

AS 1670.4	Fire detection, warning, control and intercom systems - System design, installation and commissioning - Emergency warning and intercom systems
AS 1742.2	Manual of uniform traffic control device - Traffic control devices for general use
AS 1743	Road signs - Specifications
AS 2144	Traffic signal lanterns
AS 2276	Cables for Traffic Signal Installations
AS 4428.4	Fire detection, warning, control and intercom systems - Control and indicating equipment - Emergency intercom control and indicating equipment
AS 5156	Electronic speed limit signs

Austroads Publication

AP-C87-15	Austroads Glossary of Terms
AP-T60/06	Austroads Technical Report - Automatic Vehicle Classification by Vehicle Length

EPA Publication

Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales

NSW Legislation

Dangerous Goods (Road and Rail Transport) Act 2008

Dangerous Goods (Road and Rail Transport) Regulation 2014

National Code

National Transport Commission	Australian Dangerous Goods Code

International Standards and Other Documents

ANSI S3.5-1997	Methods for Calculation of the Speech Intelligibility Index
IEEE 1512	Space Communications - Disaster Communications
NTCIP 2306	Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications
FHWA-RD-95-100	Detection Technology for Intelligent Vehicle Highway Systems (IVHS)