WAKA KOTAHI
NZ TRANSPORT AGENCY

RAMP METER SYSTEMS

ITS Delivery Specification

30 JUNE 2020
1.0

New Zealand Government

More information
If you have further queries, contact the ITS S&S Coordinator via email: itsspec@nzta.govt.nz

More information about intelligent transport systems (ITS) is available on the Waka Kotahi website at https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/intelligent-transport-systems/

This document is available on the Waka Kotahi website at https://www.nzta.govt.nz/resources/intelligent-transport-systems/its-standards-and-specifications/

Template version
1.9, 25/06/2020

Contents

1 DOCUMENT CONTROL

1.1 Document information

Document number	ITS-02-003-202006-SPEC-RMS
Previous document number/s (if applicable)	ITS-05-02
Document status DRAFT | PENDING | RATIFIED | RETIRED	**DRAFT (Interim):** This version is pending reauthoring and is published as an indication of what is required when installing ITS equipment or systems. Some of the content is outdated, eg references to external industry standards. To confirm suitability, always contact Waka Kotahi to verify the application of an interim standard or specification at itsspec@nzta.govt.nz
[IF RETIRED] New document details	
Online ISBN number	
Document availability	The controlled version of this document can be accessed from https://www.nzta.govt.nz/resources/intelligent-transport-systems/its-standards-and-specifications/

1.2 Document owner

Role	ITS Document Review Panel
Organisation	Waka Kotahi

1.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation
DD/MM/YY		Design Engineer	Waka Kotahi
		Product Manager	Waka Kotahi
		Asset Manager	Waka Kotahi
		Safety Engineer	Waka Kotahi
		Security Specialist	Waka Kotahi
		Procurement Advisor	Waka Kotahi
		Manager, Technical Specialists (Technology Operations)	Waka Kotahi
		Senior Manager, Journey Management (Transport Operations)	Waka Kotahi

1.4 Version history

This table shows a record of all changes to this document:

Version	Date	Author	Role and organisation	Reason
0.1	01/09/15	Kirill Yushenko	Consultant, AECOM	Fundamental update, split into requirements and layout parts
0.2	01/05/20	Final Word	Editorial services	Transferring the draft document to the latest ITS delivery specification template
0.3	11/05/20	ITS Document Review Panel	Waka Kotahi	Checking this draft in the new template, redirecting content, addressing queries
1.0	30/06/20	ITS Document Review Panel	Waka Kotahi	Interim draft issued

2 TERMINOLOGY USED IN THIS DOCUMENT

Term	Definition
DRAFT	The document is being written and cannot be used outside of Waka Kotahi
PENDING	The document has been approved and is pending ratification by Waka Kotahi. It can be used for procurement at this status
RATIFIED	The document is an official Waka Kotahi document. Road controlling authorities are obliged to follow a document with this status
RETIRED	The document is obsolete, and/or superseded
AS/NZS	Australian and New Zealand standard
AWS	Advanced warning signs
BIT	Built-in test
EN	European standard
EQT	Environmental qualification test
EMIQT	Electromagnetic qualification test
FAT	Factory acceptance test
m/s	Metres per second
MOTSAM	Manual of traffic signs and markings
RCA	Road controlling authority
RSS	Ramp signalling system
SCATS	Sydney Coordinated Adaptive Traffic System
SCATS RMS	SCATS ramp metering system
TCD	Traffic Control Devices Rule
TCP/IP	Transmission Control Protocol/Internet Protocol
TOC	Transport operations centre

3 OVERVIEW AND OUTCOMES

This section defines the purpose of the equipment within the operational system.

3.1 ITS delivery specification definition

Delivery assurance is managed through delivery specifications which support procurement and systems integration. The key risks that specifications address are to ensure the correct equipment is being procured, that it will integrate with operational systems, and it will deliver the correct functionality and performance requirements.

3.2 Overview

This document outlines a formal methodology to be followed when implementing ramp signalling systems (RSS); the ITS equipment that contributes to improved efficiency and safety both in the local area and the wider motorway network. With so much at stake, the processes recommended in the following sections will ensure that the implementation of all ramp signalling equipment is consistent and continues to provide strong value for money.

Ramp signalling is a tool used around the world to regulate the flow of vehicles entering a motorway according to existing traffic conditions in order to smooth and optimise traffic flows.

In a typical RSS, vehicle detectors report the flow of vehicles to a computerised system which then uses the data, in conjunction with algorithms and stored plans, to control the flow of traffic entering the motorway.

Standard traffic signals are generally installed at the intersection of the arterial road and the start of the motorway on-ramps to control the flow of vehicles. Typically, the ramp signals operate a short cycle allowing one vehicle per lane to join the motorway traffic at each green period. The duration of the red period within the signal cycle varies depending on the density of traffic in the adjacent motorway lanes. As the flow on the motorway becomes denser, the red period increases, thus reducing the incoming flow rate from the on-ramp.

Ideally, a successful ramp signalling implementation can be described as follows:

- installed minimally, only in places where real benefits identified prior to design can be demonstrated after commissioning
- highly efficient in terms of operational energy use and information delivery
- low maintenance with ready access when maintenance is required
- equipped with automated fault reporting to enhance availability and reduce the need for physical checks
- interoperable, plug and play, regardless of vendor, enabled by excellent object-oriented specification.

In New Zealand, Waka Kotahi has standardised on SCATS for the overall control and coordination of traffic signals at intersections and has standardised on the SCATS ramp metering system (SRMS) for ramp signals on motorway on-ramps. SRMS may use arterial road SCATS detectors for queue and count purposes.

3.2.1 Definition

A ramp meter is tactical traffic demand management system. They are used to manage or regulate a traffic flow, in response to measured local traffic conditions, at a merge point where the traffic flow enters the main line traffic of a motorway or express way. A typical ramp meter site will have a set of detection devices, signalling equipment and a local controller associated with each site. A group of sites can be coordinated to provide corridor level demand management. This requires a back office supervisory system, to which each coordinated site is connected. An example of this is SCATS.

3.2.1.1 Ramp signalling major subsystems

In order to perform the major functions defined below, the RSS shall comprise of at least the following major subsystems:

- ramp control subsystem
- traffic signal subsystem
- traffic detection subsystem
- advanced warning signs (AWS) subsystem
- communications subsystem
- cabling subsystem
- power subsystem
- accessories subsystem.

3.2.1.2 Ramp signalling functional block diagram

A block diagram representation of the RSS functionalities is shown below.

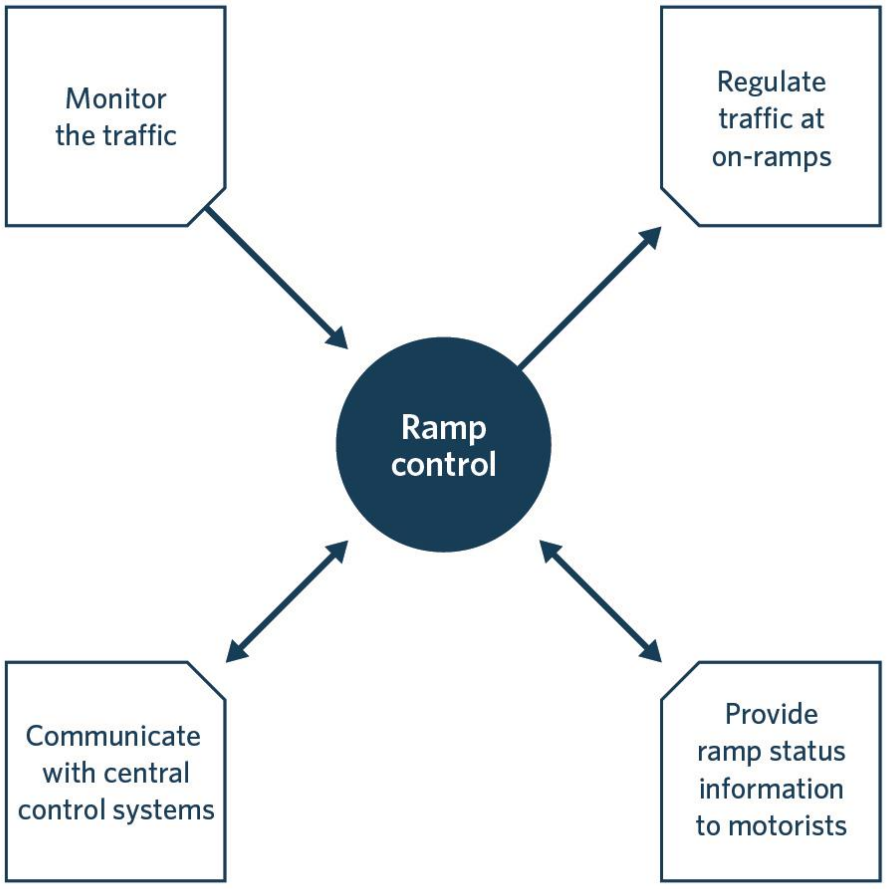

Figure 1. RSS functional diagram.

3.2.2 Class

003 Signals.

3.3 Scope

This delivery specification sets the requirements for the establishment of an RSS. This specification document is intended for designers, manufacturers, RSS installation contractors and suppliers while being sufficiently comprehensive to define the standards against which to perform design, selection and installation of equipment, and final acceptance testing.

It applies to all new or reconstructed sites. The requirements of this specification are not intended to be retrospectively applied to existing ramp signal sites until that site is modified or replaced.

3.4 Applicable legislation

All ITS equipment must be capable of being installed and maintained in accordance with the Health and Safety at Work Act 2015.

3.5 Outcomes

To be defined.

3.5.1 Operational

To be defined.

3.5.2 For road users

To be defined.

3.5.3 For road controlling authorities

To be defined.

4 FUNCTIONAL REQUIREMENTS

This section outlines the dynamic components of equipment which can be tested and configured.

Ramp signalling is an established traffic management technique that is used to regulate the number of vehicles using a motorway at peak periods. The fundamental concept of ramp signalling is to prevent potential breakdowns in the flow of traffic on the main carriageway by a combination of:

- controlling the traffic flow at all on-ramps to avoid vehicles entering the main carriageway in groups and causing a breakdown in flow
- restricting the rate of vehicle flow onto the motorway of traffic volumes that, if unrestricted, would trigger a flow breakdown
- aiding the recovery of the motorway system after the flow breakdown has occurred.

4.1 Ramp control

The RSS shall be capable of controlling the operations of a ramp signal site locally via a controller unit and distributing necessary information and commands to the subsystems.

4.2 Traffic monitoring

The RSS shall:

- be capable of monitoring the traffic flow rates of all vehicles travelling on, exiting, or waiting to join the motorway within the boundaries of where an RSS is deployed
- determine both vehicle count and occupancy information on the main line, on-ramps and off-ramps
- have queue and/or SCATS traffic detectors installed to determine the queue lengths of vehicles on the on-ramps and arterial roads approaching the on-ramps.

4.3 Traffic regulation

The RSS shall have traffic signals on each on-ramp positioned such that a vehicle can accelerate to the operating speed of the left lane by the time the merge lane is 3.5m wide. It is recommended that the limit line is at least 100m before the physical nose to allow acceleration. Where there are two lanes at the limit line, a minimum 100m of two-to-one lane merge taper shall be provided before the physical nose. A merge length between 75m and 100m shall only be permitted with the written sign-off from the relevant Waka Kotahi Safety Engineer.

The cycle timing of the stop/go signals shall be variable by changing the timing of the red period only and related to traffic demand from an on-ramp and main line. The red period will be no less than two seconds. The green period is fixed at 1.3 seconds and the yellow period is fixed at 0.7 seconds.

4.4 Ramp status information

The RSS shall be capable of:

- providing the motorist with advanced warning of the ramp status to allow the choice of an alternative route when the ramp signals are in operation or when there is an incident on the motorway
- providing the motorist with advanced warning of the motorway status (incident, queue etc) to allow the choice of an alternative route when approaching on-ramp entrance on an arterial road
- informing the motorist of the status of the ramp signals once on the ramp.

4.5 Communications

The RSS shall be capable of communicating in real time with the SCATS central control system in order that the following functions can be successfully fulfilled:

- transmit back the detected traffic information obtained by the traffic detection subsystem
- relay the received traffic signal timing information to the traffic signal subsystem
- relay ramp status information to the AWS so that corresponding messages are displayed
- monitoring of and manual intervention to the system by an operator in a traffic operations centre (TOC).

4.6 Power

All the RSS power requirements shall be obtained from a Waka Kotahi-approved metered 240V AC power source.

All power installations shall be undertaken according to the New Zealand prevalent electricity standards.

4.7 Cabling

Supply and installation of cabling (copper and fibre) shall conform to the communications infrastructure sections of the following:

- Copper: To be defined.
- ITS design standard: Optical fibre.

4.8 Accessories

Guardrail layout design and installation shall be in accordance with the latest version of Specifications and notes for road safety barrier systems on state highways (NZTA M23).

Static signage layout design and installation shall be in accordance with the latest relevant Waka Kotahi standards.

The design and installation of RSS mechanical structures and components, including ducting, chambers, poles, lanterns, gantries and cabinets, shall be in accordance with the relevant portions of section 5.3.28 Major subsystem characteristics in this document.

4.9 System interfaces

4.9.1 External interfaces

The accessories subsystem shall interface with motorists by either providing information (static signs) or safety (barriers).

The AWS subsystem shall interface with motorists by providing real-time information about on-ramp status (ramp signal on or off) or motorway status (incidents, queues etc).

The traffic signal subsystem shall interface with motorists by displaying green and red signals to advise motorists that access to motorway is allowed or not allowed.

The cabling subsystem shall physically interface with the Waka Kotahi data network to enable real-time communications with the SCATS central control system.

The power subsystem shall interface with the country's power reticulation system to provide a 220v AC power source for the operation of all equipment.

The communications subsystem shall interface with the SCATS central control system via the Waka Kotahi Ethernet network (preferred) or SCATS arterial signal system network to send traffic data and receive control commands to regulate traffic flow.

4.9.2 Internal interfaces

The ramp control subsystem shall interface with the traffic detection, traffic signal, communications and AWS subsystems in order to control the complete RSS operations.

The traffic detection subsystem shall interface with the ramp control subsystem to pass on the traffic flow data, which is analysed at the SCATS central control system.

The traffic signal subsystem shall interface with the ramp control subsystem to obtain the signal timing information sent from the SCATS central control system, which is the timing used to regulate the ramp signals.

The AWS subsystem shall interface with the ramp control subsystem to obtain continual ramp status information in order to display relevant information to motorists.

Provision will be made to establish a communication connection between the SCATS central control system and the ramp meter controller at the roadside to enable information exchange and supervisory control.

The power supply subsystem shall interface with the traffic detection, traffic signal, communications, ramp control and AWS subsystems to supply the required power for operation.

The cabling subsystem shall interface with the traffic detection, traffic signal, communications, ramp control and AWS subsystems to enable the required wired communications (copper or fibre).

4.10 Testing and compliance

To be defined.

5 PERFORMANCE REQUIREMENTS

This section outlines the non-dynamic components of equipment which may require independent certification.

5.1 Reliability

The RSS at any one site shall have a total operational availability of 99.72 per cent per annum (unavailable for a total of 24 hours in a year).

All RSS equipment shall be designed and selected for a usable lifetime of at least 15 years.

The mean time between failures (MTBF) of the RSS at any site shall be >27,000 hours (approximately three years).

The MTBF values for each equipment module (replacement item) making up the RSS, scientifically derived, shall be provided by the installer along with method and calculation details.

5.2 Maintainability

Design, selection and installation of RSS equipment shall be undertaken with maintenance as a primary requirement.

Paved (asphalt, chipseal or concrete) parking and unobstructed safe access shall be provided for a service team to work on ITS equipment and carry out maintenance on RSS communications cabinets. Unobstructed parking provided shall be within 100m of cabinets.

No RSS equipment shall require scheduled maintenance at intervals shorter than six months.

The RSS shall be capable of being restored to a fully operational state within a maximum of two hours during any scheduled maintenance.

The ramp signals shall be designed to be maintained at their original levels of performance through life.

The design and installation of all RSS equipment shall generally conform to a maintenance concept of replacement of modules to resolve faults onsite.

All RSS equipment shall comprise adequate built-in test (BIT) to ensure quick automated identification of faults. BIT functionality is required to enable remote management and monitoring of field assets.

Maintenance guidelines shall be provided by RSS equipment suppliers, before final acceptance of the RSS, to be included in the regular maintenance schedule.

All RSS structures shall be designed and implemented:

- to ensure no aesthetic defects
- to minimise the need for continually cleaning bird and animal waste products, sand, debris and vegetation

- in such a way that the equipment can easily be kept clean and where appropriate, clearly visible to traffic.

Cabinets and any item of RSS equipment vulnerable to graffiti attack such as AWS should have an approved graffiti protective coating applied.

All reasonable measures shall be taken to prevent infestation by ants, rodents or other pests in the design of the RSS.

5.3 Environmental conditions

The RSS shall:

- suffer no degradation of performance or reliability when subjected to the worse possible environmental conditions of temperature, UV radiation, wind, sandstorms and humidity that can be expected in New Zealand
- be designed and installed in such a way that it minimises any negative impact to the nature conservation value of natural habitats
- be designed and installed in a manner so as not to interfere with the health and safety of motorists or the operation and maintenance of the motorway.

RSS equipment shall:

- be designed and installed in such a way that it minimises any negative impact on adjacent properties (ie to minimise light and noise pollution)
- suffer no degradation of performance or reliability when subjected to the shock and vibration conditions that can be expected along any New Zealand motorways.

5.3.1 Temperatures

RSS equipment shall operate without degradation in ambient air temperatures from –10°C to +50°C.

5.3.2 Humidity

RSS equipment shall suffer no damage and operate without degradation of performance when subjected to an environment of 90 per cent humidity.

5.3.3 Atmospheric pollutants

All RSS equipment shall:

- be designed and manufactured for use in fume and salt-laden atmospheres over a minimum service life of 15 years
- operate without degradation of performance while being continuously exposed to the minimum levels of pollutants defined in table 1 below.

All metallic parts including screws, nuts, and washers shall be suitably protected by plating or be manufactured of non-corrosive material to prevent corrosion when exposed to the minimum levels of pollutants defined in table 1 below.

All dissimilar metals in contact shall have an electrochemical potential difference not exceeding 0.5V.

Pollutant	Level
Total suspended particles 30–50µm	23–300µm/m^3
Dust deposit >30µm	0.5–5g/m^2/month
Sulphur dioxide	0.005–0.05ppm (vol)
Nitrogen dioxide	0.001–0.3ppm (vol)
Hydrogen sulphide	0.001–0.02ppm (vol)
Airborne salt (NaCl) deposited	2–30g/m^2/month

Table 1. Pollutants

5.3.4 Immersion

RSS assets which may be subject to immersion (such as ducting, foundations and cables etc) shall be designed so that they will not be damaged.

RSS assets which will not be subject to immersion (such as cabinets, power supplies, AWS etc) shall take all practicable measures during the design to avoid this occurring.

5.3.5 Rainfall

RSS equipment shall not exhibit water penetration when subjected to driving rain of up to 1.7mm per minute accompanied by winds of up to 40km/h (11.1m/s).

5.3.6 Hail

RSS equipment shall not suffer physical damage and shall maintain its specified performance when subjected to hail diameters of up to 11mm and a wind velocity of 79km/h (22m/s).

5.3.7 Wind conditions

RSS equipment shall remain safe and meet the requirements specified herein when exposed to steady state wind conditions of 86km/h (24m/s) and gusts up to 144km/h (40m/s) on any vertical face.

5.3.8 Lightning

RSS equipment structures shall be protected against lightning as specified in AS/NZS 1768:2007 Lightning protection and AS/NZS 3100 Approval and test specification – General requirements for electrical equipment.

5.3.9 Fungus

All RSS equipment shall be appropriately treated and protected to minimise fungus growth and shall withstand and maintain its specified performance, in both operating and non-operating conditions, when exposed to the roadside environment anywhere in New Zealand.

5.3.10 Corrosion, sand and dust

All RSS materials and parts used shall be inherently corrosion resistant.

The RSS shall remain safe and continue to operate with no degradation when subjected to the continuous blowing of sand and dust.

RSS enclosures shall be rated to a minimum of IP65, excluding AWS and roadside cabinets which shall be IP55, and fibre, detector and electrical cable joints which shall be a minimum of IP67.

5.3.11 Resistance to contamination by fluids

RSS equipment shall continue to operate as specified when exposed to contamination by the following fluids:

- insect repellent
- cleaner, white spirit, solvents
- diesel fuel, gasoline, kerosene
- lubricant; grease, automotive, graphite
- lubricating oil, GP, petroleum light
- paint.

5.3.12 Solar radiation

The RSS asset which has surfaces designed to be exposed to prolonged solar radiation during the lifetime of the asset shall withstand exposure to the radiation of up to 1100W/m^2, at an ambient air temperature of 35°C, without suffering damage and shall maintain its specified performance.

Where a surface is required to be repainted (ie following damage occurring) during the lifetime of the asset, a suitable paint for the conditions shall be used.

5.3.13 UV radiation

The surface coatings of all RSS equipment shall be capable of withstanding prolonged exposure to the levels of UV radiation expected in the New Zealand environment.

All RSS equipment shall withstand prolonged exposure to New Zealand levels of UV radiation without degradation of performance.

5.3.14 Shock and vibration

The RSS shall:

- be designed, constructed and installed such as to minimise the effects of shock and vibration.
- remain operable without any reduction in performance related to the effects of shock and vibration during the periods between maintenance visits. All equipment shall not fail, and connections shall not become loose as a result of vibration.

5.3.15 Seismic effects

All RSS equipment, as well as their foundations and holding-down assemblies, shall be designed to withstand seismic forces equal to 0.6 times the self-weight of the equipment.

5.3.16 Materials, processes and parts

All RSS equipment shall be manufactured from materials selected to operate in a roadside environment anywhere in New Zealand.

RSS equipment shall not incorporate any prohibited materials such as asbestos or heavy metals unless specifically approved.

RSS equipment shall incorporate materials which:

- minimise combustion and smoke or toxic fumes when subjected to fire
- are not a hazard to health during installation, operation or maintenance.

Electrical power and network reticulation between RSS external components shall be contained in ducting or conduit to prevent personnel injury or equipment damage. See latest versions of ITS design standard: Ducts and ITS design standard: Jointing chambers and pull pits, for the relevant requirements. Seals shall be fitted to enclosure doors to prevent dust, water or hail ingress and a means employed to minimise dust, water or hail ingress when the doors are opened.

The paint finish shall be capable of withstanding the environmental requirements of this specification for 15 years without significant discolouring, fading or paint peeling.

Known ozone-depleting substances shall not be used.

RSS materials and parts containing mercury shall not be used.

Beryllium shall not be used except where sealed as an alloying element in electronic equipment and devices.

Polychlorinated biphenyls shall not be used.

Grounding, bonding and shielding of equipment shall be conducted where required.

5.3.17 Electromagnetic compatibility

5.3.17.1 Radiated emission

The equipment making up the RSS and its installation shall meet the limits of AS/NZS 4251.1 Electromagnetic compatibility – Generic emission standard – Residential, commercial and light industrial.

5.3.17.2 Radiated susceptibility

The equipment making up the RSS and its installation shall be such that the RSS will not suffer any degradation of performance from any reasonably expected electromagnetic interference caused from other equipment used in the vicinity of the ramps.

5.3.17.3 Electrostatic discharge

The equipment making up the RSS and its installation shall be such that there will no risk of electrostatic discharge to personnel carrying out maintenance duties.

5.3.18 Nameplates and product marking

All equipment shall be clearly labelled with permanent labels providing at least the following information, in English:

- manufacturer
- part number
- serial number
- version number
- date of manufacture
- any safety warning labels
- compliance labels, such as radio spectrum management labelling on electronic or radio products.

5.3.19 Workmanship

All RSS equipment shall be designed, installed, tested and commissioned in accordance with Waka Kotahi standards.

Particular attention shall be given to:

- neatness and thoroughness of wiring
- making of parts and assemblies
- plating, painting and riveting
- machine screw assembly
- welding and brazing
- cleanliness and freedom of parts from burrs and sharp edges.

5.3.20 Human performance / human engineering

All RSS equipment designs shall follow the guidance of human engineering (ergonomics) principles. As per SAA HB59—1994: Ergonomics—The human factor, the design philosophy shall consider three-way interactions between people, the equipment they use at their workplaces, and the environment within which the people and equipment are placed. The purpose is to design both workplace and the environment in such a way that the most efficient use is made of human capabilities, without exceeding human capacities.

The RSS equipment shall be fitted with handles and/or eye bolts to facilitate the transportation and lifting during installation and replacement.

5.3.21 Softcopy

The RSS installation contractor shall supply the following softcopy documentation:

- operator manuals in .pdf format
- system drawings in an agreed editable electronic format, such as MS Visio or AutoCAD
- maintenance and installation manuals in MS Word, including all planned maintenance and procedures for identification and verification of faulty units
- configuration information, including full equipment and performance baseline down to line replaceable unit level, in MS Word
- setting to work procedures in MS Word

- interface document defining connectivity between all subsystems in MS Word. This shall include hardware, software and electrical interfaces, protocols and messages where applicable
- all controller software files
- as-built drawings and documentation.

5.3.22 Hardcopy

The RSS installation contractor shall supply the following hardcopy documentation:

- operator manual
- maintenance and installation manual.

5.3.22.1 Operator manual

The operator manual shall contain a full description of the RSS with functional block diagrams. Every aspect concerning the operation of the RSS shall be addressed in the manual.

5.3.22.2 Maintenance and installation manual

The maintenance and installation manual shall comprehensively address every aspect of the installation and first line maintenance of the RSS. At least the following shall be provided:

- installation procedures
- equipment setup procedures
- system test procedures
- first line maintenance procedures
- system block diagrams
- system description
- major subsystem block diagrams
- major subsystem descriptions
- wiring diagrams
- spare parts list (first line maintenance replaceable spares)
- self-testing procedures.

5.3.23 Documentation standards

All documentation shall:

- be in English.
- contained in an A4 size, hardcover booklet which allows removal and insertion of sheets for updating purposes.
- correspond in exact detail with the equipment supplied.

Drawings shall be A4 or A3 size.

All documentation and drawings shall be provided with document and revision numbers.

Waka Kotahi shall be advised in writing of any updates and changes in the documentation during the guarantee period of the equipment.

5.3.24 Performance

Onsite RSS repairs shall consist only of unit replacement to ensure maximum availability.

Waka Kotahi shall have designated personnel carry out first-line RSS maintenance, ie perform fault identification and replacement of modules where relevant.

Repairs of all complex RSS equipment shall be outsourced to the equipment specialists.

The RSS installation contractor shall retain the technical expertise for the RSS equipment that they provided and installed within agreed maintenance contract period, for the lifetime of that equipment.

The suppliers shall retain the technical expertise and spares for the RSS equipment that they provided, for the lifetime of that equipment.

A support agreement for all RSS software and hardware shall be entered upon at procurement time for the life of the RSS.

5.3.25 Maintenance

The RSS shall be:

- configured in such a way that maintenance carried out on any subsystem shall only have minimal effect on the performance or functionality of another
- capable of recording faults and make the data available for analysis
- capable of immediately alerting an operator of all significant failures.

A full set of maintenance schedules for the RSS shall be provided by the RSS installation contractor.

5.3.26 Guarantee

All RSS hardware equipment and installations shall be guaranteed against faulty materials and workmanship for a period of at least one year from the date of commissioning.

5.3.27 Personnel and training

5.3.27.1 Personnel

The RSS installation contractor shall define the competency level of personnel and the training required for maintainers.

5.3.27.2 Training

For installations where there was no previous working knowledge of ramp signals, an agreed competent organisation (the consultant or RSS installation contractor) shall be able to provide operator and maintainer training courses as required, including the ability to repeat courses as necessary for a nominated period.

For installations where there was no previous working knowledge of ramp signals, an agreed competent organisation (the consultant or RSS installation contractor) shall also be capable of providing operator and

maintainer ‘train the trainer’ type courses as required, including the ability to repeat these as necessary for a nominated period.

Where a ramp signal installation is being added to an existing system, the necessary maintenance and operational expertise will already be in place, therefore additional training will not normally be required unless a new or unfamiliar type of equipment is being installed.

The maintainer will be responsible for all training requirements of new staff where an existing RSS is in place.

5.3.28 Major subsystems characteristics

5.3.28.1 Ramp control subsystem

5.3.28.1.1 Ramp controller unit

The general requirements, installation and commissioning of the ramp controller unit (which is a part of the ramp control subsystem) shall comply with section 2.3 of the National Traffic Signal Specification 2013 Revision 1.

The ramp controller provides the control functionalities for the operation of vehicle detection, traffic signalling and AWS at the motorway on-ramp. Its location shall be selected according to the latest version of ITS design standard: Ramp meter systems.

5.3.28.1.2 Ramp controller identification

Every ramp of an RSS shall be assigned with a unique identification number by Waka Kotahi, which shall be referred to as a SCATS identifier number.

The ramp controller unit shall be programmed with the assigned site SCATS ID number.

Every controller attached to the SRMS system is given a unique SCATS ID number by Waka Kotahi, whether controlling ramp signals themselves or whether it’s a mid-block RSS count site.

5.3.28.1.3 Signal control cabinet

The signal control cabinet shall comply with relevant requirements of the National Traffic Signal Specification 2013 Revision 1, as well as with the following requirements:

- The cabinet shall have an AWS fibre box installed on the internal left-hand side wall.
- At completion, the cabinet shall have a plate fitted at the bottom which is gas and insect proof.
- Unless specified, the cabinet colour shall be beige.
- The cabinet shall be fitted with a permanent label to indicate the ramp identification number and the direction of the ramp signal.
- The switchboard shall have one 10A circuit breaker controlling power to each AWS.

5.3.29 Traffic signals subsystem

5.3.29.1 Signal heads

In the case of single and two-lane on-ramps without any priority bypass lanes, the traffic signal heads shall be pole mounted, two per pole. For dimensions, refer to the latest version of ITS standard drawing 000-0000-0-7104-16-RX.

Three-lane on-ramps shall have an overhead gantry with one traffic signal head centrally positioned above each lane and one on both the right and left-hand gantry legs. The minimum clearance from the carriageway to the lowest part of the gantry or any signal head or sign attached to the gantry shall be 6m. For dimensions, refer to the latest versions of ITS standard drawing 000-0000-0-7104-16-RX.

On-ramps with a priority bypass lane shall have an overhead gantry with one traffic signal head centrally positioned above each controlled lane and one on the gantry leg opposite to the bypass lane (right-hand gantry leg when the bypass lane is on the left). The minimum clearance from the carriageway to the lowest part of the gantry or any signal head or sign attached to the gantry shall be 6m. For dimensions, refer to the latest version of ITS standard drawing 000-0000-0-7104-16-RX.

RSS traffic signal heads shall be located 6m downstream of the limit line.

The signals shall be aimed in the following way:

- Lower pole or gantry-mounted signal heads shall be aimed to a point 3m in advance of the limit line in the direction of travel.
- Upper pole or gantry-mounted signal heads shall be aimed as far down the ramp as is practicably possible in order to maximise visibility.

5.3.29.2 Signal lanterns

The general requirements, installation and commissioning of RSS traffic signal lanterns including cowls, visors and louvres shall comply with sections 2.4 and 3.10 of the National Traffic Signal Specification 2013 Revision 1.

The RSS signal lanterns shall comply with these standards:

- AS/NZS 3000 Electrical installations
- AS 3147 Approval and test specification – Electric cables – Thermoplastic insulated for voltages up to and including 0.6/1 kV
- AS/NZS 4251.1 Electromagnetic compatibility – Generic emission standard – Residential, commercial and light industrial.

Traffic signal lanterns shall comply with AS/NZS 2144:2002 Traffic signal lanterns. Signals shall be 200mm diameter aspects when installed on poles or gantry legs and shall have 300mm diameter when located above the lanes on gantries. Signals used on high-speed approaches shall have 300mm aspects installed on both traffic pole and traffic gantries.

5.3.29.3 Visors and louvres

Visors used at all RSS shall be one of the following types:

- Open-type visor: used on primary signal lanterns and extend a minimum of 200mm from the lantern face to shield it from sunlight without unduly obstructing the driver's view of the aspect from the stop line.
- Closed-type visor: used in close proximity to the motorway mainline which is highly visible to the motorist. They extend a minimum of 300mm from the lantern face and enclose the whole of the circumference of the lantern lens except for an opening at the bottom.

All visors shall be of cylindrical construction to facilitate the fitting of louvres.

Louvres shall be fitted to visors only where specified by Waka Kotahi.

5.3.29.4 Traffic signal poles

Traffic signal poles shall be used to mount signal lanterns at all single and two-lane (without priority bypass lane) RSS on-ramps.

All traffic signal poles shall be constructed from hot-dip galvanized steel.

All traffic signal poles shall be 5.4m long, with 4.1m height above the ground. They shall comply with all other requirements in the National Traffic Signal Specification 2013 Revision 1. For shear-base pole dimensions and installation details, see latest version of ITS standard drawing 000-0000-0-7104-19-RX. The same drawing shall be used for foundation installation details of a ground-plant pole.

5.3.29.5 Ramp signal gantry

Three-lane on-ramps shall have a gantry installed with overhead-mounted traffic signal lanterns.

On-ramps with a priority bypass lane shall have a gantry installed with overhead-mounted traffic signal lanterns.

All gantry design details and traffic signal lantern alignment shall comply with dimensions and requirements specified on the latest versions of ITS standard drawings 000-0000-0-7104-11-RX, 000-0000-0-7104-13-RX and 000-0000-0-7104-16-RX.

5.3.30 Traffic detection subsystem

5.3.30.1 Detector types

An RSS shall be capable of operating correctly from vehicle information obtained from a range of vehicle detectors.

Any detector used shall be able to provide the operating system with reliable count, flow and occupancy data. Vehicle detectors shall be based on but not limited by the following technologies:

- inductive loops
- wireless in-road sensors
- radars
- fibre cabling sensors
- video.

RSS operation shall require vehicle detectors to be installed as mainline, count and occupancy detectors to monitor the traffic flow rates on the motorway.

Count and mainline detectors shall be physically identical, even though they perform slightly different functions.

Vehicle queue detectors shall be installed at on-ramps and where necessary on arterial roads to monitor traffic volumes at the on-ramps. To date, virtually all detectors have been inductive loops. For inductive loops, either a 4.5m standard SCATS configuration (creating a 4.5m detection zone) or two 1.75m loops with 1m gap between (also a 4.5m detection zone) shall be used.

5.3.30.2 Detector standards

Only inductive loop detectors shall be installed for purposes of ramp signalling. If any other detector type is to be used, it shall be demonstrated to Waka Kotahi that it performs satisfactorily.

The installation procedure of all RSS vehicle detectors shall comply fully with the latest installation standards published by Waka Kotahi.

With the exception of dual queue loops, single loops shall be installed. See the latest version of ITS standard drawing 000-0000-0-7104-08-RX. SRMS only relies on count and occupancy information, but does not require speed as an input to determine on/off thresholds or ramp signal timing.

Where speed measurement is required by Waka Kotahi and is to be derived from the signal controller itself, double loops may be used.

For detector loop numbering and layout information, see the latest version of ITS design standard: Ramp meter systems.

5.3.31 AWS subsystem

5.3.31.1 Design requirements for AWS

The design requirements for all AWS shall be as follows:

- Have a minimum operating life expectancy of 15 years.
- AWS shall be compliant with requirements set out in the latest Traffic Control Devices Rule 54002 and its addendums.
- All displays shall use LED technology.
- All display colour shall be in accordance with EN 12966-1 Road vertical signs. Variable message traffic signs (EN 12966), class C1.
- Luminance from all displays shall be in accordance with EN 12966, class L3.
- The luminance ratio shall be in accordance with EN 12966, class R3.
- All AWS shall have a 10-level display intensity capability, controlled automatically according to ambient light conditions.
- The display LED's beam width shall be in accordance EN 12966, class B2 minimum angle of 14 degrees.
- The communication protocol to external devices is to be TCP/IP.
- All AWS shall have the capability of being mounted using brackets:
  - on a gantry
  - on a post
- AWS enclosure dimensions for 175mm and 250mm character height shall be the same as for journey time signs, as specified on the latest version of ITS standard drawing 000-0000-0-7104-18-RX.
- The enclosure doors shall be fitted with a stay to limit their opening to a maximum of 100 degrees.
- The ingress protection shall be in accordance with the following:
- Water: EN 12966, class P2 (minimum of IP55).

- Dust and other pollutants: EN 12966, class D3.
- The environmental protection shall be in accordance with EN 12966, class T1.
- AWS operating temperatures shall be –15°C (minimum) to +60°C (maximum).
- The full functionality of AWS shall not degrade if connected by the fibre-optic cable over a distance of up to 1km.

5.3.31.2 AWS communications

See section 5.3.32.6 AWS communications in this document for details.

See the latest version of ITS design standard: Optical fibre.

5.3.31.3 AWS power

All AWS shall be operated from 240V AC power.

The 240V AC power to the AWS shall be supplied from the local RSS signal control cabinet.

All AWS installations shall include a capability to isolate power at the sign.

When AWS power is supplied from an RSS signal control cabinet, the cabinet shall have a capability to isolate the AWS power.

AWS may have a battery mounted in the enclosure to provide power backup capability.

Backup power shall be sufficient to allow the AWS to communicate a power fail message to the control system.

5.3.31.4 AWS text display

The height of all AWS text characters shall be as follows:

- In an urban environment — 175mm minimum.
- Where approach speeds are likely to exceed 70kph and in a motorway-to-motorway environment — 250mm minimum.

All AWS shall have a minimum of three lines of text.

Each AWS line of text shall have a minimum of eight characters.

All AWS shall be capable of displaying alphanumeric messages.

5.3.31.5 AWS status messages

AWS are typically connected to the ramp signal controller, which outputs message bits to the sign in order to display fixed messages. See the latest version of ITS design standard: Ramp meter systems.

However, it is preferred that type A and B AWS signs are also capable of communicating via an Ethernet link with an external system, such as a traffic control system or a fault management system, for improved functionality and fault-finding capability.

- As a minimum, all AWS shall be capable of communicating with the RSS signal control cabinet.
- All AWS shall be capable of relaying to the SCATS central control system, via the RSS signal control cabinet, the following fault messages:
  - general equipment failure
  - power failure
  - display failure
  - heartbeat signal failure.
- As a minimum, all AWS shall be capable of relaying, via an Ethernet connection to a fault management system, the following fault messages:
  - general equipment failure
  - power failure
  - display failure
  - pixel failure as an X-Y coordinate
  - communications failure.

5.3.31.6 Brackets

All AWS shall be mounted on brackets that are installed on poles.

AWS brackets shall be of F type or C type, depending on the site design.

The F type bracket shall be used when the AWS is flagged from one side of the pole. It shall be installed on the left or right side of the sign as required.

The C type bracket shall be used where the sign is centrally mounted on the pole.

All AWS brackets and mounting parts shall be manufactured from mild steel and hot-dipped galvanised.

The AWS shall be mounted on brackets prior to installation onsite.

All AWS bracket attachments shall be waterproof to prevent moisture getting into the sign once installed onsite.

All AWS brackets shall conform to the latest version of ITS standard drawings 000-0000-0-7104-22-RX and 000-0000-0-7104-23-RX.

5.3.31.7 Protective coatings

All AWS poles and brackets shall be hot-dipped galvanised in accordance with the following standards:

- AS 1650-1989 Hot-dipped galvanised coatings on ferrous articles
- AS/NZS 4680:2006 Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
- AS/NZS 4791:2006 Hot-dip galvanised (zinc) coatings on ferrous open sections, applied by an in-line process
- AS/NZS 4792:2006 Hot-dip galvanised (zinc) coatings on ferrous hollow sections, applied by a continuous or specialised process
- The protective coatings shall be either: messages:
  - zinc with a dry film build-up of 0.350mm

- hot-dipped galvanised with the minimum thickness of zinc coating in accordance with table 1 of 2 of AS/NZS 4680:2006 Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.

5.3.32 Communications subsystem

5.3.32.1 General

Ethernet shall be used as the data communications protocol by the Waka Kotahi network.

All the on-ramp sites of an RSS shall be fitted with a layer 3 switch and equipment with layer 2/3/4+ intelligence.

The on-ramp switches shall all be connected to the fibre backbone using GBIC modules allowing full-duplex gigabit Ethernet connectivity between the sites and the SCATS central control system.

5.3.32.2 External communications

External communications shall comprise of communications between the ramp controller and the RSS SCATS central control system.

The ramp controller shall have a capability to connect to Ethernet via a CAT5 cable for external communications.

The ramp controller Ethernet communications to the RSS SCATS central control system shall be via a connection to the on-ramp network switch in the communications cabinet.

The ramp controller communications capability shall include support for additional IP-based peripherals.

The ramp controller communications shall have high bandwidth capability, at least 100Mbps.

The ramp controller shall have the capability to enable online communications firmware upgrades.

5.3.32.3 Communications cabinet

Each RSS site shall be connected to a communications cabinet at the same interchange. Multiple adjacent RSS sites at one interchange may be connected to a single communications cabinet located at the same interchange.

Where possible, the communications cabinets shall be installed adjacent to the on-ramp control cabinet. The network switch and all associated equipment relating to communications external to the RSS shall be housed in the communications cabinet.

The network switch shall be connected to the ramp controller in the signal control cabinet, either via a CAT5 Ethernet cable when the cabinets are installed adjacent to each other or via fibre cabling.

The communications cabinet shall conform to the requirements of the latest version of ITS design standard: Roadside cabinets.

5.3.32.4 Internal communications

All RSS internal communications equipment shall be housed in the signal control cabinet.

Internal communications shall comprise of communications at the on-ramp between the ramp controller and the vehicle detectors, traffic signals, AWS and the Ethernet on-ramp network switch installed in the adjacent communications cabinet.

The ramp controller shall be connected to the Ethernet network switch via CAT5 or CAT6 cable.

5.3.32.5 Vehicle detector communications

All vehicle loop detector circuitry shall be hard wired inside the signal control cabinet. External loop detectors are permitted but not preferred and the designer shall endeavour to avoid using them. All other vehicle detector types shall be able to communicate with the SCATS system in real time.

Vehicle detector cables from the signal control cabinet to the vehicle detector shall be one continuous unjointed length of cable.

All vehicle detector cabling shall be installed in ducting.

5.3.32.6 AWS communications

All AWS shall be capable of being communicated with, via the following medium types:

- fibre-optic cable
- copper cable
- wireless.

All communications between the ramp controller and the type A and B AWS at all on-ramps shall be via multimode fibre-optic cabling with no intermediate joints (the Waka Kotahi preferred method). All other alternative methods of communications shall obtain Waka Kotahi approval before the implementations.

Communications between the ramp controller and the type A and B AWS at all on-ramps shall be via an interface unit.

The links between the ramp controller and the AWS interface unit shall be opto-isolated to protect the signal controller input circuitry from accidental power damage.

The AWS shall be capable of Ethernet communication.

5.3.33 Cabling subsystem

5.3.33.1 Fibre-optic cabling and the Waka Kotahi network

Data communications between the RSS sites and the SCATS central control system shall be via a Waka Kotahi fibre backbone cable.

Four fibre cores from the backbone cable shall be used to carry the Ethernet communications between all RSS sites and the SCATS central control system.

5.3.33.2 On-ramp backbone fibre connections

RSS fibre cable supply, connections and testing shall comply with the latest versions of ITS design standard: Optical fibre and ITS design standard: Roadside cabinets.

5.3.33.3 AWS fibre cabling and connections

AWS fibre cable supply, connections and testing shall comply with the latest version of ITS design standard: Optical fibre.

5.3.34 Power subsystem

5.3.34.1 Power supply

Power to all RSS sites shall be supplied from standard AC mains reticulated from the nearest convenient source.

The RSS installation contractor shall establish that adequate power capacity is available to supply the RSS equipment.

5.3.34.2 Material

The RSS installation contractor shall select electrical materials such as to exclude the possibility of galvanic or other corrosion.

5.3.34.3 Workmanship

The RSS installation contractor shall:

- employ skilled, competent electrical personnel, qualified and registered or licensed at the time of carrying out the work
- use industry-approved electrical processes and equipment to complete the works in accordance with best trade practice.

5.3.34.4 Electrical terminations

All electrical terminals shall:

- be made from self-extinguishing materials, be rail mounted, and of the self-locking screwed pressure plate type
- be adequately sized to take the conductor which they connect
- have a current rating of not less than 20A, with the smallest terminals being capable of taking stranded conductors up to 2.5mm^2 cross-sectional area.

All earth terminals shall be green or green/yellow; no other terminals shall be the same colour.

All electrical terminals carrying power shall be appropriately labelled, shielded and segregated from control signal terminals.

All electrical cables shall be glanded at the point of entry into equipment.

All electrical cable glands shall be selected to correctly match the size of the cable.

5.3.34.5 Cable wiring

All panel cable wiring shall use the following stranded copper conductors and conform with AS 3147 Approval and test specification – Electric cables – Thermoplastic insulated for voltages up to and including 0.6/1 kV:

- minimum 30/0.25 PVC 600/1000V grade size on 400/230V circuits
- minimum 24/0.2 PVC 250V grade on extra low voltage circuits.

All control cable wiring shall be run in PVC open-slotted cable trunking sized to provide 30 per cent spare space within, once all conductors are installed.

Cable wiring to panel doors shall be neatly loomed and supported with nylon cable ties at every 100mm.

Cable wiring to hinged doors shall be of sufficient length to enable the door to swing fully open.

Flexible mechanical protection shall be installed around the cable wiring loom of each hinged door.

All cable wiring shall be bunched to give a tidy appearance while taking care of preventing overheating.

All wires shall be number ferruled at each end according to the designated numbering system.

Wires shall not be joined or connected between terminals.

All wiring shall use stranded conductors.

5.3.34.6 Marking and labelling

All electrical cables shall be labelled.

Labels shall be installed at both ends of the cable.

The text of all labels shall be black lettering on a white background.

Write-on or Dymo labels shall not be acceptable.

All labels shall be correctly sized for each cable, ensuring no movement.

5.3.34.7 Electrical cables

All cable conductors shall be copper.

All power supply cables shall be PVC/SWA/PVC or XLPE/SWA/PVC 600/1000V in accordance with AS/NZS AS/NZS 5000.1:2005 Electric cables – Polymeric insulated – For working voltages up to and including 0.6/1 (1.2) kV or AS 3147 Approval and test specification – Electric cables – Thermoplastic insulated for voltages up to and including 0.6/1 kV.

All underground electrical cables shall be installed inside ducts.

5.3.34.8 Underground electrical cables

All underground electrical cables shall be laid inside ducts in a trench as follows:

- to a minimum depth of 600mm below finished ground level in non-trafficked areas
- to a minimum depth of 900mm below finished ground level in trafficked areas.

The RSS installation contractor shall:

- locate the position of all services in the vicinity of the proposed works prior to excavation
- pilot for and precisely locate the position of any services close to excavations prior to commencing those excavations
- obtain approval from the Engineer prior to relocating any conflicting services
- supply accurate drawings of all new cable routes at the completion of installation works.

5.3.34.9 Earthing and bonding

Earthing shall be in accordance with AS/NZS 3000 Electrical installations.

All metalwork, including equipment panels, screens, glands, conduits, sheaths, structural members, access doors and access platforms not normally expected to carry current, shall be bonded to earth.

5.3.34.10 Electrical noise

The effects of generated or radiated electrical noise shall be minimised at all RSS sites by using the following installation practices:

- All DC power and electronic signal cables shall not run parallel or in close proximity to AC power cables.
- Good grounding techniques shall be utilised at each installation.
- Proper cable shielding shall be utilised.
- Power filters shall be installed to mitigate the effects of noise from AC power supplies.

5.4 Quality assurance provisions

5.4.1 General

The RSS equipment shall be subjected to formal verification in accordance with the stipulations of this section to demonstrate compliance with this specification.

Compliance with the requirements of section 3 shall be verified by test, analysis, demonstration, inspection, certification, similarity or a combination thereof as defined below:

- Demonstration [D]: A verification method that relies on observable functional operation not requiring the use of instrumentation, special test equipment or subsequent analysis.
- Test [T]: A verification method that uses instrumentation or other special test equipment to collect data for later analysis.
- Analysis [A]: A theoretical analysis or simulation of a design to prove conformance to a requirement.
- Inspection [I]: The visual examination of an item or documentation to prove conformance to a requirement.
- Certification [C]: A verification record by an independent certification authority.

- Similarity [S]: A verification method which refers to the results of verification performed on the same or similar equipment.

5.4.1.1 Responsibility for tests

The RSS installation contractor shall be responsible for all factory acceptance tests (FAT), site acceptance testing (SAT), environmental qualification tests (EQT) and electrical safety and electromagnetic (EMI and EMC) qualification tests (EMIQT).

5.4.1.2 Test categories

Verification of requirements shall apply to section 3 of this document. The test categories shall be as follows:

- The requirements specified in section 3.3.2 shall be classified as test category EMIQT.
- The requirements specified in section 3.2.4 shall be classified as test category EQT.
- All the other requirements of section 3 shall be classified as test category FAT.

5.4.2 Quality conformance inspections

5.4.2.1 Inspection of design

With regards to specification requirements to be subjected to the inspection test method, the RSS installation contractor shall supply to Waka Kotahi all the detailed data required to verify conformance of the design.

Peer reviews shall be employed as a procedure for conducting inspections of design.

5.4.2.2 Reliability calculations

Equipment reliability calculations shall use a parts count method with associated failure rates based upon known or estimated values of components used.

Reliability values shall be expressed as number of failures per 1000 hours.

5.4.2.3 Maintainability calculations

Calculations shall be conducted only for equipment with known relatively high failure rates.

The RSS installation contractor shall supply a list of activities with time of execution for each activity.

All calculations shall assume a realistic timeframe for spares availability.

5.4.2.4 Vibration calculations

The RSS installation contractor shall submit all the calculations performed to show that the RSS equipment will not be affected by sustained roadside vibrations.

5.4.2.5 Rain penetration testing

During rain penetration testing, all enclosure doors shall be closed.

The rain penetration test shall:

- consist of using a water hose to spray the top and sides of the enclosures at the specified rate of rain for 15 minutes per face
- be deemed passed if there is no evidence of water in the enclosure at the end of the spraying time.

5.4.2.6 Hail damage

The RSS installation contractor shall demonstrate that the enclosures of all RSS equipment will not be permanently damaged when subjected to the specified hail environment.

5.4.2.7 Wind conditions

The RSS installation contractor shall submit all the calculations performed to show that the RSS equipment will not move or topple when subjected to the specified wind conditions.

5.4.2.8 Verification of safety

The RSS installation contractor shall conduct all relevant calculations and analyses required to prove that the system conforms to specified safety requirements.

6 TECHNICAL REQUIREMENTS

This section outlines specific technical and technology constraints for the equipment.

6.1 Electrical safety

All ITS equipment must comply with and be installed in accordance with the Electricity (Safety) Regulations 2010 (SR 2010/36).

7 APPENDIX A – <TITLE>

8 APPENDIX B – <TITLE>

9 REFERENCES

This section lists all external and Waka Kotahi references included in this document.

9.1 Industry standards

Standard number / name	Source	Licence type and conditions
AS 1650-1989 Hot-dipped galvanised coatings on ferrous articles		
AS/NZS 1768:2007 Lightning protection		
AS 1939 Degrees of protection provided by enclosures for electrical equipment (IP code)		
AS/NZS 2053 Conduits and fittings for electrical installations		
AS/NZS 2144:2002 Traffic signal lanterns		
AS/NZS 3000 Electrical installations		
AS/NZS 3100 Approval and test specification – General requirements for electrical equipment		
AS/NZS 3101.1&2:2006 Concrete structures standard		
AS 3147 Approval and test specification – Electric cables – Thermoplastic insulated for voltages up to and including 0.6/1 kV		
AS/NZS 3845.1:2015 Road safety barrier systems		
NZS 4203 General structural design and design loadings for buildings		
AS/NZS 4251.1 Electromagnetic compatibility – Generic emission standard – Residential, commercial and light industrial		
AS/NZS 4680:2006 Hot-dip galvanised (zinc) coatings on fabricated ferrous articles		
AS/NZS 4791:2006 Hot-dip galvanised (zinc) coatings on ferrous open sections, applied by an in-line process		
AS/NZS 4792:2006 Hot-dip galvanised (zinc) coatings on ferrous hollow sections, applied by a continuous or specialised process		
AS/NZS 5000.1:2005 Electric cables – Polymeric insulated – For working voltages up to and including 0.6/1 (1.2) kV		
CP 33:1996 Code of Practice for Lightning Protection		

Standard number / name	Source	Licence type and conditions
EN 12966-1 Road vertical signs. Variable message traffic signs		
National Traffic Signal Specification 2013 Revision 1		
SAA HB59—1994: Ergonomics—The human factor		
SR 2010/36 Electricity (Safety) Regulations 2010	NZ Legislation website	Public
Health and Safety at Work Act 2015	NZ Legislation website	Public

9.2 Waka Kotahi standards, specifications and resources

9.2.1 Standards and specifications

See the Waka Kotahi website for the latest versions of the ITS design standards, delivery specifications and core requirements listed below.

Document name
ITS design standard: Ducts
ITS design standard: Jointing chambers and pull pits
ITS design standard: Optical fibre
ITS design standard: Ramp meter systems
ITS design standard: Roadside cabinets

9.2.2 Resources

Document name / code	Waka Kotahi website link
Manual of traffic signs and markings (MOTSAM)	https://www.nzta.govt.nz/resources/motsam/part-1/
Specifications and notes for road safety barrier systems on state highways (NZTA M23)	https://www.nzta.govt.nz/resources/road-safety-barrier-systems/index.html

9.3 Drawings

See the Waka Kotahi website for the latest versions of the ITS standard drawings listed below.

Drawing number
000-0000-0-7104-08-RX
000-0000-0-7104-11-RX
000-0000-0-7104-13-RX

Drawing number
000-0000-0-7104-16-RX
000-0000-0-7104-18-RX
000-0000-0-7104-19-RX
000-0000-0-7104-22-RX
000-0000-0-7104-23-RX

10 CONTENT TO BE REDIRECTED

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document	Class
5.2	Maintainability	Ramp meter systems design standard, design for operation section	003 Signals
5.3	Environmental conditions, including the subsections under here 5.3.1 – 5.3.15	Environmental core standard	000 Core requirements
5.3.19	Workmanship	General core standard	000 Core requirements
5.3.20	Human performance / human engineering	Ramp meter systems design standard	003 Signals
5.3.23	Documentation standards	General core standard	000 Core requirements
5.3.25	Maintenance	Ramp meter systems design standard, design for maintainability section	003 Signals
5.3.27	Personnel and training, including the subsections under here 5.3.27.1 – 5.3.27.2	N/A – remove from this document	
5.3.28.1.1	Ramp controller unit	Ramp signal controller delivery specification	005 Controllers
5.3.28.1.2	Ramp controller identification	Ramp signal controller delivery specification	005 Controllers
5.4.1	Paragraph under the functional requirements section, before section 4.1 starts	Ramp meter systems design standard, design for operation section	003 Signals