Technical Specification

Transport and Main Roads Specifications
MRTS203 Provision of Weigh-in-Motion System

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Queensland
Government

Contents

1 Introduction

This Technical Specification applies to the design, supply, installation, testing and commissioning, performance, documentation, training, maintenance and handover requirements for a high-speed Weigh-in-Motion system (WiM system).

A high-speed WiM system is used for collecting traffic flow data, weight and classification data of individual heavy vehicles travelling at highway speed.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications,* MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads *Specifications Manual*.

2 Definition of terms

The terms defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 below.

Table 2 – Definitions

Term	Definition
4G	Fourth generation mobile phone technology.
ANPR	Automatic Number Plate Recognition.
ASCII	American Standard Code for Information Interchange.
Axle	The axis oriented transversely to the nominal direction of vehicle motion, and extending the full width of the vehicle, about which the wheel(s) at both ends rotate.
Axle Group Load	The sum of all loads of the wheels on a group of adjacent axles, a portion of the gross vehicle weight. (An axle group can be defined in terms of the number of axles included in the group and their respective interspaces).
Axle Weight	The sum of all loads of the wheels on an axle, a portion of the gross vehicle weight.
Calibration	Adjustment to a reference level of values from any measuring device.
Calibration Factor	Numerical factor by which the raw result of a measurement is multiplied to compensate for systematic error.
CAT	Customer Acceptance Test.
CT	Commissioning Test.
FAT	Factory Acceptance Test.
FTP	FTP – File Transfer Protocol.
ELV	Extra Low Voltage – not exceeding 50V a.c or 120V ripple-free d.c.
Gross Vehicle Weight	The total weight of the vehicle or the vehicle combination including all connected components, also, the sum of the tyre loads of all wheels on the vehicle.
HTTPS	Hypertext Transfer Protocol Secure.
IAT	Installation Acceptance Testing.

Term	Definition
ICMP	Internet Control Message Protocol.
IPRT	Internet Protocol Remote Telemetry (the department's core ITS Network supplied by Telstra).
Piezo Sensor	A piezo sensor (also known as piezoelectric sensor) is a device that uses the piezoelectric effect, to measure changes in pressure, strain or force by converting them to an electrical signal. Piezo sensors used in high-speed WiM applications can be based on piezo-ceramic sensors, piezo-polymer sensors, brass linguine or piezo-quartz crystal strip sensors.
POS	Point of electrical supply.
QTDF	Queensland Traffic Data Format.
ROAR	Road Operations Asset Register.
SCP	Secure Copy Protocol.
SFTP	SSH File Transfer Protocol.
SNMP	Simple Network Management Protocol.
SSH	Secure Shell (Protocol).
TCP/IP	Transmission Control Protocol/Internet Protocol.
Weigh-in-Motion (WiM)	The process of estimating a moving vehicle's gross weight and the portion of that weight that is carried by each wheel, axle, or axle group, or combination thereof.
WiM Logger	A local electronic device(s) designed to collect signals from various field sensors, processing of signals, performing calculations, storing data, and transmission locally and remotely of the required traffic data. This includes all electronic component(s) that together provide the required functionality.
WiM system	The WiM system includes a set of sensors, supporting instruments and WiM Logger process and store data locally and allow transmission of this information to a locally connected laptop computer and/or remote computer via a telecommunications network such as 4G and/or Ethernet.

3   Reference documents

The requirements of the referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements* and Table 3 apply to this Technical Specification. Where there are inconsistencies between this Technical Specification and the referenced MRTS (including those referenced in MRTS201 *General Equipment Requirements*), the requirements specified in this Technical Specification shall take precedence.

Table 3 – Referenced documents

Reference	Title
AGTM03-20	*Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis Methods*
AS 60529	*Degrees of Protection Provided by Enclosures (IP Code)*
MRTS01	*Introduction to Technical Specifications*

Reference	Title
MRTS14	*Road Furniture*
MRTS30	*Asphalt Pavements*
MRTS50	*Specific Quality System Requirements*
MRTS91	*Conduits and Pits*
MRTS92	*Traffic Signal and Road Lighting Footings*
MRTS97	*Mounting Structures for Roadside Equipment*
MRTS200	*General Requirements for Intelligent Transport Systems (ITS) Infrastructure*
MRTS201	*General Equipment Requirements*
MRTS207	*Traffic Monitoring Foundation Equipment*
MRTS210	*Provision of Mains Power*
MRTS226	*Telecommunications Field Cabinets*
MRTS263	*Standalone Solar (PV) Power Systems*
QTDF V1.04	*Queensland Traffic Data Format (Version 1.04)*
SD 1905	*ITS – Traffic Monitoring Cabinet Typical Details*
SD1906	*ITS – WiM Piezo Sensor Installation Details*
SD1908	*ITS – WiM Sensor Configuration Piezo-Loop-Piezo*
SD1909	*ITS – WiM Sensor Configuration Piezo-Piezo-Loop-Piezo-Piezo*
SD1910	*ITS – WiM Sensor Configuration Piezo-Piezo*
SD1911	*ITS – WiM Sensor Configuration Strain Gauge Sensor*
TRUM Vol 4, Part 5	*Traffic and Road Use Management Volume 4, Part 5 – Configuration and placement of traffic sensors*

4 Quality system requirements

The quality system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional quality system requirements relevant to this Technical Specification are defined in Table 4.

There are no Milestones defined in the document.

Table 4 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
10	1. The telecommunications network connection shall be confirmed by the Contractor with the Principal prior to procurement.		

Clause	Hold Point	Witness Point	Milestone
11.2	2. Site selection, final location and site conditions confirmed by the Contractor to the Principal.	1. The roughness and rutting shall comply with Clause 8.1.5 of TRUM Vol 4 Part 5.	
12.1	3. The Contractor shall supply a certificate showing that each supplied weight sensor has met the FAT requirements.		
12.3		2. The IAT shall be conducted on site by the Contractor immediately after the WiM system has been installed and calibrated to the manufacturer's specification.	
13	4. Documentation including Operations and maintenance manual and Asset data.		

5 Functional requirements

The WiM system shall detect, collect, process, store, and transmit traffic information related to the counting, classifying and speed monitoring of all vehicles and the weighing of heavy vehicles at highway speeds.

The WiM system shall be able to accommodate vehicles and vehicle combinations with up to 25 axles and shall automatically determine for each vehicle, by lane of travel: vehicle classification, vehicle speed, axle spacing, and individual axle weight (for the estimation of axle group weight and gross vehicle weight).

The WiM system shall process data in real time in the field in a WiM Logger and provide a connection for the purposes of configuration and data retrieval. The WiM system shall also allow data to be viewed in real time, both locally and remotely.

The WiM system shall provide a system integration interface allowing real-time identification of vehicle classifications. The Interface may be system-to-system or through the use of voltage free contacts. A desirable feature for the WiM system is for the user to be able to configure over length and weight thresholds which triggers voltage free contacts or digital outputs in real time.

The WiM system shall be capable of interfacing locally with a co-located ANPR system to reliably and accurately identify the vehicles being weighed by the WiM system, if requested by Transport and Main Roads.

5.1 Site components

A WiM site includes the following components in general:

- weight sensors for each lane to be instrumented

- axle sensors per lane to determine vehicle speed and axle spacings

- inductive loop to detect individual vehicle events

- a WiM Logger for data processing

- interconnecting cables and miscellaneous materials to make an operational system

- all other associated supporting infrastructure including equipment enclosures, power supplies, communications hardware, POS connection, pits, conduits, solar poles, footings, mounting brackets, and

- traffic lane with proper pavement where sensors are installed.

The selection of the weighing technology shall be determined by considering the location of the WiM site, the purposes of the site, and the accuracies required to achieve the purposes.

6 Mechanical and physical requirements

6.1 General

Pits and conduits to accommodate power and communication cables shall be supplied and installed according to the requirements of MRTS91 *Conduits and Pits*. The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Unless otherwise specified the pole footing, typically for the installation of solar panel, shall be as per MRTS92 *Traffic Signal and Road Lighting Footings* and its referenced documents. Poles and footings shall be designed in accordance with the requirements of MRTS97 *Mounting Structures for Roadside Equipment* and approved by a structural RPEQ.

The equipment and enclosures shall be of suitable design to protect against vandalism and prevent infestation by vermin. Ingress protection (IP) rating for enclosures shall be no less than IP55 as defined in AS 60529 *Degrees of protection provided by enclosures (IP Code)*. This includes all cable penetrations and equipment that may be located external to the enclosure.

6.2 WiM equipment

The equipment shall be established, reliable and have been used successfully in applications equivalent to those required by the Contract. Equipment of experimental or unproven design is prohibited.

The WiM system shall include all necessary sensor, electrical, electronic, electro-mechanical hardware and software required to process, store and transmit all data specified in this Technical Specification.

6.3 Environmental requirements

The Contractor shall supply evidence that the offered WiM System has previously performed satisfactorily (within accuracy tolerances specified in Clause 7.2) throughout the specified ambient air temperature range specified in MRTS201 *General Equipment Requirements*.

6.4 Design life

Unless otherwise specified, the design life of all WiM System equipment shall comply with MRTS200 *General Requirements for Intelligent Transport Systems (ITS) Infrastructure* Table 6.2 – ITS design life requirements.

7 Operational requirements

The operational requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional operational requirements for equipment provided under this Technical Specification are described below.

7.1 General

Installed equipment shall meet the accuracy requirements for the categories specified in Clause 7.2 in terms of individual axle weights, axle group weights, gross vehicle weights, speeds, and axle spacings.

The WiM system must provide for single threshold weighing, and operate over a speed range of 16 km/h to 130 km/h.

Single threshold weighing will be performed by weight sensors in each lane of measurement. The weight sensors shall cover the entire lane width.

7.2 Accuracy

WiM systems are categorised by accuracy tolerance that the systems can achieve, as shown in Table 7.2, for specific site applications.

The WiM system must be capable of performing within the accuracy tolerances described in Table 7.2 with a minimum 95% confidence when measured with data points produced by each sensor in the system.

Table 7.2 – WiM system types by accuracy tolerance

Function	Accuracy Tolerance		
	Type A	Type B	Type C
Axle Load	± 15%	± 20%	± 30%
Axle Group Load*	± 10%	± 15%	± 20%
Gross-Vehicle Weight	± 6%	± 10%	± 15%
Speed	±2 km/h		
Axle-Spacing and wheelbase	±150 mm		

* applicable to axle groups that have more than one-axle.

Type A sites are intended to support enforcement activities by providing more accurate weight data, usually in real-time, for transport inspectors to screen overloaded vehicles for formal inspection. Type B and Type C sites are suitable for general traffic and loading survey applications. If the Contract does not specify the accuracy requirement of the site, then Type B shall be delivered.

Factors determining WiM site accuracy include sensor technology, workmanship of sensor installation, road geometry and pavement condition. Refer to Clause 11 of this Technical Specification.

The WiM system shall provide calibration features such that the required accuracy can be met and maintained over the design life and for the conditions installed.

7.3 Recorded data

Each vehicle record shall include, as a minimum, the following data:

- Date and Time (to a resolution of at least two decimal places of a second)
- Lane Number
- Vehicle Speed
- Vehicle Classification
- Axle Load
- Axle Group Load
- Gross Vehicle Weight, and
- Spacings in between each sequentially numbered axle.

7.4 Vehicle classification

Classification parameters shall be programmable by the trained Transport and Main Roads personnel.

Vehicle classification shall be accomplished by the WiM system using the following data by default:

- number of axles
- axle spacing, and
- number of axle groups.

The WiM system shall use the axle count and axle spacing information to classify the Austroads vehicle types as described briefly below. Refer to *Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis Methods* (in particular, Table A.8) for the complete description of vehicle types. The axle spacing values used for this process shall be associated with each vehicle type as listed in Table 7.5. These values shall be able to be retrieved, viewed, and updated by trained Transport and Main Roads personnel. The classified vehicle type shall be indicated by the 2-digit code shown in Table 7.5.

Table 7.5 – Austroads vehicle types

2-digit code (Austroads Class)	Brief description
01	Short Vehicle
02	Short Vehicle Towing
03	Two-axle Truck or Bus
04	Three-axle Truck or Bus
05	Four-axle Truck
06	Three-axle Articulated Vehicle
07	Four-axle Articulated Vehicle
08	Five-axle Articulated Vehicle
09	Six-axle Articulated Vehicle

2-digit code (Austroads Class)	Brief description
10	B Double
11	Double Road Train
12	Triple Road Train

7.5   Data processing

The WiM Logger shall process and store all specified data with the capacity to store a minimum of three months of vehicle count data and individual vehicle records. The logger shall be capable of flagging an alarm signal when the data capacity reaches 90%. When memory is full, the oldest data is to be overwritten.

The WiM Logger shall continue to process and store data for all vehicles passing through the WiM site during periods of local or remote access for purposes of configuration, real time view or data transfer.

The WiM Logger shall produce data files which are compliant with Transport and Main Roads Queensland Traffic Data Format (QTDF) which is text-based allowing data users intuitively to interpret the data without needing to decode. Details of this data format can be obtained from the Principal.

8   System communication and user interface

The WiM Logger shall be capable of communicating with a locally connected computer and remote computer(s) over an IP network, to enable access to any logged data, configuration parameters, alarms, and system status.

The WiM Logger shall process data to generate the specific ASCII files required by the QTDF specification generally, and specifically for vehicle classification and weigh-in-motion. It shall be possible to perform all configurations and data transfer tasks locally from a laptop computer running Microsoft Windows 10. Capability for remote configuration of all configurable variables described in this Technical Specification shall also be provided.

8.1   Communications

The WiM Logger shall provide secure communications facilities for remote log in for real time view and system configuration, data transfer and firmware upgrade. Acceptable communications protocols are specified in Clause 8.2 of this Technical Specification.

8.1.1   Real time view

The WiM System shall provide a real time view (via the manufacturer's application or, preferably, a HTML-based interface with common browser support) on-line monitoring of traffic. The real time view shall be able to be used locally at site or remotely over a network.

The real time view shall depict the axle configuration of each vehicle passing through the site. The user shall have the options of displaying either all traffic or any selected Austroads vehicle types, the weight violation table, as well as the option of displaying a selected individual lane or all lanes.

8.1.2   System configuration parameters

The WiM Logger shall support on-line (local and remote) modification to the data logging configuration parameters such as speed and weight calibration factors, vehicle classification parameters, weight violation table parameters, and front axle weight threshold. The WiM Logger shall retain all system configuration parameters in non-volatile memory. The logger shall be able to recover in the event of a power failure.

8.1.3   Data transfer

The WiM Logger shall support the transfer of data log files to a local or remote computer via FTP or similar. The WiM Logger shall provide for the transfer of the current day's data stored as of the time of transfer.

8.1.4   Firmware upgrade

The WiM Logger must support both local and remote firmware upgrade. Provision of firmware rollback mechanism is preferable.

8.2   Data security

Data security shall be provided via user login and password as a minimum.

Industry standard secure shell protocol used for TCP/IP, SSH, shall be used for remote communication via the Ethernet port of the logger. Should proprietary software be used, Contractor shall provide proof to demonstrate that the software has a security level equal to or higher than that of the SSH protocol. In addition, all protocols and ports used in the proprietary software shall be disclosed to the Principal to allow appropriate independent security checking to be performed.

Industry standard secure file transfer protocol shall be used for data file transfer. While FTP is an acceptable secure protocol for file transfer, SFTP, FTPS or SCP which provides additional security features are preferred. WiM Logger shall not initiate data transfer process to 'push' data to any remote host.

Acceptable communications protocols are limited to the following: SSH, FTP, SFTP, FTPS, SCP, SNMP, ICMP, HTTPS or as approved by the Principal.

9   Electrical requirements

The WiM site shall be provided with either a permanent mains electrical supply to the site cabinet, or, from a local solar powered supply. For mains power the requirements of MRTS210 *Provision of Mains Power* apply. For a solar powered installation, the requirements of MRTS263 *Standalone Solar (PV) Power Systems* apply. The WiM system shall be powered by an ELV power supply. Battery backup is required at all sites.

10   Telecommunications requirements

The telecommunication requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. The connection of the WiM system to a STREAMS Field Processor is optional.

The WiM Logger shall be equipped with at least one dedicated local serial access port and one Ethernet port for dedicated remote communications.

The WiM Logger shall support remote connectivity via Cellular 4G network, IPRT and the Principal's private telecommunications network. The WiM Logger shall have session management or a similar method to protect the system against unauthorised access.

During the design stage the Contractor shall arrange with the Principal the connection of the WiM system to the Principal's telecommunications network as described in MRTS201 *General Equipment Requirements*.

Prior to procurement, the Contractor shall confirm the details of the required telecommunications network connection and reach agreement with the Principal. The telecommunications network connection shall be confirmed by the Contractor with the Principal prior to procurement. **Hold Point 1**

11   Installation requirements

The installation requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. Additional testing and commissioning requirements relevant to work provided under this Technical Specification are described below.

11.1   General

The Contractor shall provide full-time on-site supervision during weigh-in-motion system installation and system start-up. The Contractor shall use an installer who is accredited to perform the installation by the WiM System manufacturer.

11.2   WiM site selection

The site selection requirements shall be in accordance with Clause 8.1 of TRUM Vol 4 Part 5 *Site selection*.

The roughness and rutting shall comply with Clause 8.1.5 of TRUM Vol 4 Part 5. **Witness Point 1**

The final location and site conditions shall be confirmed by the Contractor to the Principal. **Hold Point 2**

11.3   Field cabinet

All electronics associated with the WiM system with the exception of sensors shall be housed in a field cabinet that complies with MRTS201 *General Equipment Requirements,*
MRTS226 *Telecommunications Field Cabinets,* MRTS207 *Traffic Monitoring Foundation Equipment,* and Standard Drawing SD1905.

11.4   Sensor installation

WiM sensor installation shall be in accordance with SD1906 ITS – *WIM Piezo Sensor Installation Details,* SD1908 *ITS – WIM Sensor Configuration Piezo-Loop-Piezo,* SD1909 *ITS – WiM Sensor Configuration Piezo-Piezo-Loop-Piezo-Piezo,* SD1910 *ITS – WiM Sensor Configuration Piezo-Piezo* and SD1911 *ITS – WiM Sensor Configuration Strain Sensor*, and Clause 8.4 of TRUM Vol 4 Part 5, unless the Contractor is able to prove otherwise with better performance based on the manufacturer's detailed installation guidelines.

12   Testing and commissioning

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification.

Additional testing and commissioning requirements relevant under this Technical Specification are described below.

12.1 Factory Acceptance Test (FAT)

The Factory Acceptance Test shall meet the following requirements:

- Prior to installation, the Contractor shall provide a manufacturer supplied certificate showing that each supplied weight sensor has been factory tested with output voltage being linearly proportional to the applied load of range between zero load and 15 tonnes, and

- Additionally, the contractor shall visually inspect the weight sensor for visible damage and perform an electrical characteristics test to the Principal's satisfaction measuring against the manufacturer's specification and test reports for each individual sensor as appropriate.

The Contractor shall supply a certificate showing that each supplied weight sensor has met the FAT requirements. **Hold Point 3**

12.2 Installation Acceptance Test (IAT)

All tests and measurements associated with Installations Acceptance are to be recorded on the appropriate Form. The Contractor shall request from the Principal any additional forms required for recording the testing and commissioning results.

Note that the Contractor is required to perform electrical characteristics test again, as described in FAT, on all sensors after a minimum 72 hours of the installation, to ensure the installed sensors are within specification after installation. Any fail sensor must be replaced.

12.3 Initial calibration

Initial calibration of the WiM system shall be performed only after the confirmation of the performance of all sensors and proof that the logger is compensating for temperature. **Witness Point 2**

All calibration associated with WiM Installations are to be recorded on the appropriate Form. The Contractor shall request from the Principal any additional forms required for recording the calibration results.

12.4 Commissioning Test (CT)

The CT requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additionally, the equipment shall be commissioned by integrating the operation, monitoring and control with other equipment and/or systems as appropriate. This shall include initialising performance parameters to suit the site-specific function of operation. Commissioning shall prove the correct operation, monitoring and control as required to meet the requirements of the Contract. Additionally, the Contractor shall demonstrate that the WiM system is connected to the Principal's communications network and can reconnect successfully upon restarting in the event of a power failure.

12.5 Customer Acceptance Test (CAT)

With the exception to the requirement of STREAMS integration, the CAT requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

13   Documentation

The documentation requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. Additional minimum documentation requirements to be provided by the contractor and relevant under this Technical Specification are described below.

Hold Point 4

13.1   *Operations manual and maintenance manual*

The WiM system sections in the operations manuals and the maintenance manuals shall detail all WiM system assets including the sensor units, WiM Logger and software.

The manuals shall include, as a minimum, the following items:

- specifications
- design characteristics
- operation theory
- function of all controls
- signal responses and acceptable thresholds
- maintenance activities, including on the pavement. Refer to Clause 15 of this Technical Specification.
- list of component parts with stock numbers
- Certificates of compliance
- documentation for the control system
- documentation for the WiM Logger including all protocols used for communications, data formats used, and all initial calibration / configuration settings, and
- detailed calibration processes including frequency and methods.

13.2   *Asset Data*

Once each ITS asset type being installed is known, this shall be communicated to the Principal at first opportunity. This is required to ensure assets are recorded in ROAR and have appropriate asset IDs and site IDs.

14   Training

The training requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. In addition, onsite training for at least three operations personnel nominated by the Principal shall be provided.

The training shall generally cover the elements contained within MRTS201, this Technical Specification and not less than the following:

- how the site is accessed
- tools required
- installation
- system configuration

- confirmation of system accuracy

- system testing to confirm – vehicle classification, speed, lane, direction, temperature compensation, weight

- calibration with known control vehicles

- preventative maintenance actions, and

- spare parts required.

15   Maintenance

The Principal will nominate the ongoing WiM maintenance support period, if required. The maintenance requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. Additional maintenance requirements relevant under this Technical Specification are described below.

15.1   Pavement

The surface of the paved roadway at each WiM site shall be maintained in a condition that meets or exceeds the surface evenness requirements specified in Clause 8.1.5 of TRUM Vol 4 Part 5, *Surface evenness*. Verification of the pavement smoothness following any significant pavement maintenance shall be performed, no less frequently than annually. The maintenance plan produced by the Contractor shall incorporate full details of such tests.

15.2   Recalibration

The Contractor shall document the requirements for recalibrating the WiM system following any significant maintenance. Recalibration shall be performed no less frequently than annually. Recalibration shall be performed in a manner similar to the calibration process in Clause 12.3.

15.3   Culvert-based strain gauge WiM systems

Additional to the Clauses 15.1 and 15.2, the Contractor shall document how to undertake annual inspections of the road condition around the sensors, the culvert and the WiM system equipment. Care should be taken to ensure the culvert is kept clean and free of flammable debris, to reduce the possibility of damage occurring to the strain-gauge sensors should a bushfire at the site occur.

The Contractor shall also document how to measure and record the electrical properties of each road sensor and strain gauge of the WiM system.

The maintenance plan for culvert-based strain gauge WiM systems shall include these details and inspection response times to significant weather events local to the site.

15.4   Embedded in-road WiM systems

Additional to the Clauses 15.1 and 15.2, the Contractor shall document how to undertake annual inspections and measurements of the road condition around the sensors and the WiM system.

The Contractor shall also document how to measure and record the electrical properties of each embedded in road sensor of the WiM system.

The maintenance plan for embedded in road WiM systems shall include these details and inspection response times to significant weather events local to the site.

16   Handover

The handover requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification.

17   Product approval checklist

The checklist for the product approval evaluation is published as Appendix A to this Technical Specification.

Appendix A – Product Approval Compliance Checklist

Product Approval Compliance Checklist

Product Approval Compliance Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NATA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records/ other documents	
Functional Requirements								
1	The WiM system shall detect, collect, process, store, and transmit traffic information related to the counting, classifying and speed monitoring of all vehicles and the weighing of heavy vehicles at highway speeds.	5			X		X	
2	The WiM system shall be able to accommodate vehicles and vehicle combinations with up to 25 axles and shall automatically determine for each vehicle, by lane of travel: vehicle classification, vehicle speed, axle spacing, and individual axle weight (for the estimation of axle group weight and gross vehicle weight).	5			X		X	
3	The WiM system shall process data in real time in the field in a WiM Logger and provide a connection for the purposes of configuration and data retrieval.	5	X		X		X	
4	The WiM system shall also allow data to be viewed in real time, both locally and remotely.	5	X		X		X	
5	The WiM system shall provide a system integration interface allowing real-time identification of vehicle classifications.	5	X				X	
6	The Interface may be system to system or through the use of voltage free contacts.	5			X	X	X	
7	A desirable feature for the WiM system is for the user to be able to configure over length and weight thresholds which triggers voltage free contacts or digital outputs in real time.	5			X		X	
8	The WiM system shall be capable of interfacing locally with a co located ANPR system to reliably and accurately identify the vehicles being weighed by the WiM system, if requested by Transport and Main Roads.	5			X	X	X	
Mechanical and physical requirements								
9	Pits and conduits to accommodate power and communication cables shall be supplied and installed according to the requirements of MRTS91 *Conduits and Pits.*	6.1	X			X		

Product Approval Compliance Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NATA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records/ other documents	
10	The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.	6.1	X			X		
11	Unless otherwise specified the pole footing, typically for the installation of solar panel, shall be as per MRTS92 *Traffic Signal and Road Lighting Footings* and its referenced documents.	6.1	X			X	X	
12	Poles and footings shall be designed in accordance with the requirements of MRTS97 *Mounting Structures for Roadside Equipment* and approved by a structural RPEQ.	6.1	X			X	X	
13	The equipment and enclosures shall be of suitable design to protect against vandalism and prevent infestation by vermin. Ingress protection (IP) rating for enclosures shall be no less than IP55 as defined in AS 60529 *Degrees of protection provided by enclosures (IP)*. This includes all cable penetrations and equipment that may be located external to the enclosure.	6.1	X	X		X	X	
14	The equipment shall be established, reliable and have been used successfully in applications equivalent to those required by the Contract.	6.2			X		X	
15	The WiM system shall include all necessary sensor, electrical, electronic, electro-mechanical hardware and software required to process, store and transmit all data specified in this Technical Specification.	6.2	X				X	
16	The Contractor shall supply evidence that the offered WiM System has previously performed satisfactorily (within accuracy tolerances specified in Clause 7.2) throughout the specified ambient air temperature range specified in MRTS201 *General Equipment Requirements*.	6.3	X		X		X	
17	Unless otherwise specified, the design life of all WiM System equipment shall comply with MRTS200 *General Requirements for Intelligent Transport Systems (ITS) Infrastructure* Table 6.2 – ITS design life requirements.	6.4					X	
Operational Requirements								
18	The operational requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.	7	X				X	

Product Approval Compliance Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NATA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records/ other documents	
19	Installed equipment shall meet the accuracy requirements for the categories specified in Clause 7.2 in terms of individual axle weights, axle group weights, gross vehicle weights, speeds and axle spacings.	7.1			X		X	
20	The WiM system must provide for single threshold weighing, and operate over a speed range of 16 km/h to 130 km/h.	7.1			X		X	
21	Single threshold weighing will be performed by weight sensors in each lane of measurement. The weight sensors shall cover the entire lane width.	7.1				X	X	
22	The WiM system must be capable of performing within the accuracy tolerances described in Table 7.2 with a minimum 95% confidence when measured with data points produced by each sensor in the system.	7.2	X		X		X	
23	The WiM system shall provide calibration features such that the required accuracy can be met and maintained over the design life and for the conditions installed.	7.2			X		X	
24	Each vehicle record shall include, as a minimum, the following data: Date and Time (to a resolution of at least two decimal places of a second), Lane Number, Vehicle Speed, Vehicle Classification, Axle Load, Axle Group Load, Gross Vehicle Weight, and Spacings in between each sequentially numbered axle.	7.3			X		X	
25	Classification parameters shall be programmable by the trained Transport and Main Roads personnel.	7.4			X		X	
26	Vehicle classification shall be accomplished by the WiM system using the following data by default: number of axles, axle spacing, and number of axle groups.	7.4			X		X	
27	The WiM system shall use the axle count and axle spacing information to classify the Austroads vehicle types as described briefly in Table 7.5. Refer to Austroads *Guide to Traffic Management Part 3: Traffic Studies and Analysis Methods* (in particular, Table A.8) for the complete description of vehicle types.	7.4			X		X	
28	The axle spacing values used for this process shall be associated with each vehicle type as listed in Table 7.5.	7.4					X	

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29	These values shall be able to be retrieved, viewed, and updated by trained Transport and Main Roads personnel.	7.4						
30	The classified vehicle type shall be indicated by the 2-digit code shown in Table 7.5.	7.4			X		X	
31	The WiM Logger shall process and store all specified data with the capacity to store a minimum of three months of vehicle count data and individual vehicle records.	7.5			X		X	
32	The logger shall be capable of flagging an alarm signal when the data capacity reaches 90%.	7.5			X		X	
33	When memory is full, the oldest data is to be overwritten.	7.5			X		X	
34	The WiM Logger shall continue to process and store data for all vehicles passing through the WiM site during periods of local or remote access for purposes of configuration, real time view or data transfer.	7.5			X		X	
35	The WiM Logger shall produce data files which are compliant with Transport and Main Roads Queensland Traffic Data Format (QTDF) which is text-based allowing data users intuitively to interpret the data without needing to decode.	7.5					X	
System communication and user interface								
36	The WiM Logger shall be capable of communicating with a locally connected computer and remote computer(s) over an IP network, to enable access to any logged data, configuration parameters, alarms, and system status.	8			X		X	
37	The WiM Logger shall process data to generate the specific ASCII files required by the QTDF specification generally, and specifically for vehicle classification and weigh in motion.	8			X		X	
38	It shall be possible to perform all configurations and data transfer tasks locally from a laptop computer running Microsoft Windows 10.	8			X		X	
39	Capability for remote configuration of all configurable variables described in this Technical Specification shall also be provided.	8			X		X	

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40	The WiM Logger shall provide secure communications facilities for remote log in for real time view and system configuration, data transfer and firmware upgrade.	8.1					X	
41	The WiM System shall provide a real time view (via the manufacturer's application or, preferably, a HTML based interface with common browser support) on line monitoring of traffic.	8.1.1	X		X		X	
42	The real time view shall be able to be used locally at site or remotely over a network.	8.1.1	X		X		X	
43	The real time view shall depict the axle configuration of each vehicle passing through the site.	8.1.1	X		X		X	
44	The user shall have the options of displaying either all traffic or any selected Austroads vehicle types, the weight violation table, as well as the option of displaying a selected individual lane or all lanes.	8.1.1	X		X		X	
45	The WiM Logger shall support on line (local and remote) modification to the data logging configuration parameters such as speed and weight calibration factors, vehicle classification parameters, weight violation table parameters, and front axle weight threshold.	8.1.2	X		X		X	
46	The WiM Logger shall retain all system configuration parameters in non-volatile memory. The logger shall be able to recover in the event of a power failure.	8.1.2	X		X		X	
47	The WiM Logger shall support the transfer of data log files to a local or remote computer via FTP or similar.	8.1.3			X	X	X	
48	The WiM Logger shall provide for the transfer of the current day's data stored as of the time of transfer.	8.1.3	X		X		X	
49	The WiM Logger must support both local and remote firmware upgrade. Provision of firmware rollback mechanism is preferable.	8.1.4			X		X	
50	Data security shall be provided via user login and password as a minimum.	8.2			X		X	
51	Industry standard secure shell protocol used for TCP/IP, SSH, shall be used for remote communication via the Ethernet port of the logger.	8.2			X		X	
52	Should proprietary software be used, Contractor shall provide proof to demonstrate that the software has a security level equal to or higher than that of the SSH protocol.	8.2			X		X	

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53	In addition, all protocols and ports used in the proprietary software shall be disclosed to the Principal to allow appropriate independent security checking to be performed.	8.2				X	X	
54	Industry standard secure file transfer protocol shall be used for data file transfer.	8.2					X	
55	While FTP is an acceptable secure protocol for file transfer, SFTP, FTPS or SCP which provides additional security features are preferred.	8.2					X	
56	WiM Logger shall not initiate data transfer process to 'push' data to any remote host.	8.2					X	
57	Acceptable communications protocols are limited to the following: SSH, FTP, SFTP, FTPS, SCP, SNMP, ICMP, HTTPS or as approved by the Principal.	8.2					X	
Electrical requirements								
58	The WiM site shall be provided with either a permanent mains electrical supply to the site cabinet, or, from a local solar powered supply.	9	X		X		X	
59	For mains power the requirements of MRTS210 *Provision of Mains Power* apply.	9	X			X	X	
60	For a solar powered installation, the requirements of MRTS263 *Standalone Solar (PV) Power Systems* apply.	9	X			X	X	
61	The WiM system shall be powered by an ELV power supply.	9	X		X	X	X	
62	Battery backup is required at all sites.	9				X	X	
Telecommunications requirements								
63	The telecommunication requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification.	10			X		X	
64	The connection of the WiM system to a STREAMS Field Processor is optional.	10			X		X	
65	The WiM Logger shall be equipped with at least one dedicated local serial access port and one Ethernet port for dedicated remote communications.	10			X	X	X	
66	The WiM Logger shall support remote connectivity via Cellular 4G network, IPRT and the Principal's private telecommunications network.	10			X	X	X	

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67	The WiM Logger shall have session management or a similar method to protect the system against unauthorised access.	10	X		X		X	
68	During the design stage the Contractor shall arrange with the Principal the connection of the WiM system to the Principal's telecommunications network as described in MRTS201 *General Equipment Requirements*.	10				X	X	
69	The Contractor shall confirm the details of the required telecommunications network connection and reach agreement with the Principal.	10				X	X	

Note: It is an expectation that a request for a new WiM system product approval will suitably demonstrate field test results against the compliance requirements. The submission of only bench test results without field testing will not be adequate for product approval acceptance.