

Technical Specification

**Transport and Main Roads Specifications
MRTS233 Roadway Flood Monitoring Systems**

May 2026

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1 Introduction

This Technical Specification defines the design, supply, installation, Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT) and commissioning, performance, documentation, training, and maintenance requirements for Roadway Flood Monitoring Systems (RFMS).

The RFMS is intended to supplement an overall weather monitoring system strategy to improve incident response and driver safety.

The basic RFMS is an electrically powered system consisting of a water level sensor, data logger / controller, antenna and communications equipment, and support structure. The RFMS will communicate (usually wireless) with the Traffic Management System (TMS) STREAMS used by Transport and Main Roads' Transport Management Centres (TMCs). The TMS enables near real time monitoring of roadway water height data, with optional roadway flood monitoring imaging provided via centralised closed-circuit television (CCTV) management software system. Optional imaging solutions are used by TMC operators to confirm onsite conditions once alerted to an issue by a water level sensor.

Auxiliary devices or systems connected to the basic RFMS include Active Advanced Warning Signs (AAWS), Road Condition Information Signs (RCIS) and CCTV cameras with or without infrared illumination for night viewing.

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 Definitions of terms

The terms defined in Clause 2 of MRTS01 *Introduction to Technical Specifications* and MRTS01 *Introduction to Technical Specifications* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 below.

Table 2 – Definitions of terms

Term	Definition
AAWS	Active Advanced Warning Signs
m AHD	Metres Australian Height Datum
API	Application Programming Interface
BoM	Bureau of Metrology

Term	Definition
CCTV	Closed Circuit Television
FAT	Factory Acceptance Test
FLIR	Principal's video management system
FP	Field Processor
GIS	Geographical Information System
GUI	Graphical User Interface
IP	Internet Protocol
IPRT	Internet Protocol Remote Telemetry (the department's core ITS network)
ITS	Intelligent Transport System
LAN	Local Area Network
LiDAR	Laser imaging, Detection, and Ranging
NTU	Network Termination Unit
PLC	Programmable Logic Controller
RCIS	Road Condition Information Sign
RFMS	Roadway Flood Monitoring System(s)
ROAR	Road Operations Asset Register
RPEQ	Registered Professional Engineer of Queensland
SAT	Site Acceptance Test
SDI	Serial Digital Interface
STREAMS	The Principal's traffic management system and primary user interface to ITS field devices
TMC	Traffic Management Centre
TMS	Traffic Management System (STREAMS)
TRUM	Traffic Road Use Management

3 Referenced documents

The requirements of the referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements* and Table 3 below 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
AS/NZS 3000	<i>Electrical installations (known as the Australian / New Zealand Wiring Rules)</i>
AS 60529	<i>Degrees of protection provided by enclosures (IP Code)</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS61	<i>Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices</i>
MRTS91	<i>Conduits and Pits</i>
MRTS201	<i>General Equipment Requirements</i>
MRTS225	<i>Imaging</i>
MRTS231	<i>Road Weather Monitor (RWM) Systems</i>
MRTS232	<i>Provision of Field Processors</i>
MRTS263	<i>Standalone Solar (PV) Power Systems</i>
TRUM Volume 3 Part 5	<i>Design Guide for Roadside Signs</i>
Queensland MUTCD	<i>Queensland Manual of Uniform Traffic Control Devices</i>
QRA AFWI	<i>QRA Alternative Flood Working Infrastructure (Rain and Level Gauges): Guideline for Minimum Requirements (August 2023)</i>

4 Quality system requirements

4.1 Hold Points, Witness Points, and Milestones

General requirements for Hold Points, Witness Points, and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

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 4.1. There are no Milestones defined.

Table 4.1 – Hold Points, Witness Points, and Milestones

Clause	Hold Point	Witness Point	Milestone
15	1. Inspection of mounting surfaces	After installation of the cables, the conduits shall be sealed to prevent vermin entry.	
16	2. Testing and commissioning		
17	3. Documentation prior to commencement of manufacturing works		
	4. Documentation prior to delivery and acceptance of the RFMS site		
	5. Documentation prior to issue of practical completion		

5 Functional requirements

The RFMS shall transmit water level information to stations designated by the Principal, for the purpose of incident management and monitoring.

RFMSs are used to measure the relative water surface level with respect to a roadway crossing or a known flood location. To ensure accurate readings, offsets must be applied to raw sensor measurements following the guidelines detailed in Appendix A.

The RFMS shall also be able to send signals to local roadway signage such as AAWS, to alert motorists of water over the road. Operational status of this signage shall be reported back to the TMS (STREAMS).

Where a weather monitor system is already installed at the site, the RFMS may be installed as part of the weather monitor system as described in MRTS231 *Road Weather Monitor (RWM) Systems*.

6 Roadway flood monitoring system components

A typical RFMS shall include:

- a) water level sensor (Clause 8)
- b) RFMS controller (Clause 11)
- c) RFMS communication equipment (Clauses 11, 14)

- d) imaging equipment, where required (Clause 10)
- e) co-located STREAMS field processor, where required
- f) enclosures (complying with MRTS201 *General Equipment Requirements*) to house all control and communications equipment associated with the RFMS
- g) column / mounting support and footings (Clause 12)
- h) power supply, including solar power (Clause 13)
- i) roadway warning signals and displays, where required (Clause 9), and
- j) where the warning signals and display enclosure is located above the road surface, a maintenance gantry or designated work platform that complies with MRTS201 *General Equipment Requirements*.

7 Operational requirements

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

The RFMS shall transmit water height data to Transport and Main Roads TMS (STREAMS) to enable departmental operators to centrally monitor RFMS sites directly via STREAMS.

Communications between the RFMS sites and the TMCs should be provided by the department's Intelligent Transport Systems (ITS) communication network (Internet Protocol Remote Telemetry (IPRT) or Transport and Main Roads 'private' wireless networks) unless another technology is approved by the Principal.

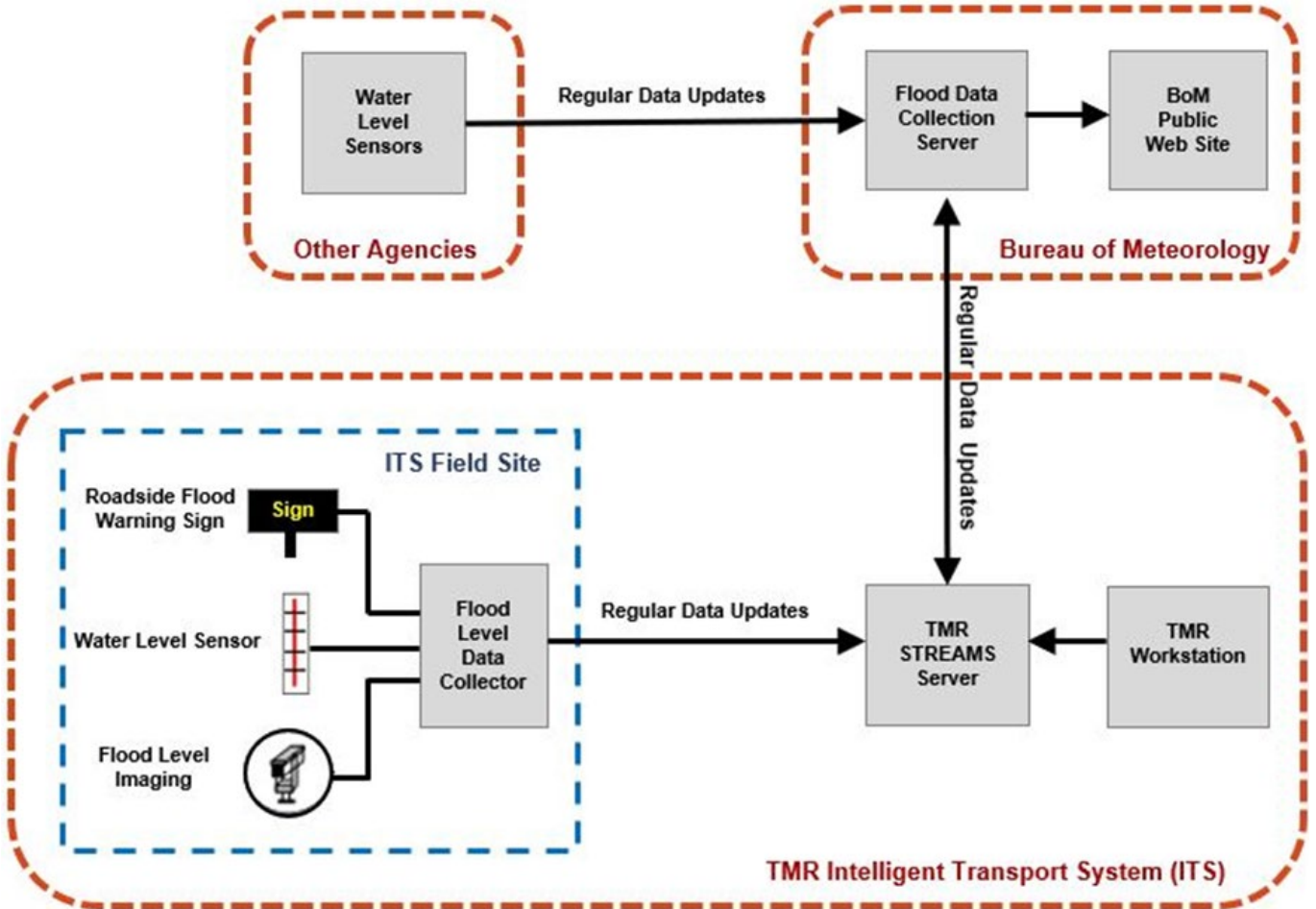
For RFMS sites supporting remote water level backhaul data and monitoring via STREAMS, but also requiring low speed flood monitoring images, these images should be integrated within STREAMS via the department's default video management system (FLIR) or purpose-built image server as informed by the Principal.

The department will send some roadway water level data collected from the RFMS to the Bureau of Metrology (BoM) as shown in the diagram below and will also receive selected relevant flood data from BoM.

The departmental roadway flood data captured in STREAMS is transferred to BoM for use in the BoM public database and website. Reciprocal flood data sharing arrangements of data collected directly by BoM (and other agencies supplying data to BoM) is of direct benefit to the department for roadway flood height measurement and prediction.

The department’s flood data captured in STREAMS has the advantage of the normal STREAMS full support and maintenance arrangements.

Figure 7 – Transport and Main Roads STREAMS to Bureau of Meteorology Roadway Flood Monitoring Systems data transfer schematic



Where the integration of potential departmental RFMS sites directly into STREAMS or the department’s existing ITS communication network is not technically possible, a number of third party RFMS solutions are available which provide tested and mature flood monitoring solutions, including satellite backhaul capability where mobile coverage is not available at the RFMS site.

The third-party RFMS shall not be used unless those systems have been integrated with STREAMS through a system-to-system interface (access to data via a secure Application Programming Interface (API)) and be able to access using a simple device driver interface of STREAMS.

7.1 Security requirements

Physical security of the equipment and equipment shelter will be in accordance with MRTS201 *General Equipment Requirements*. RFMSs shall have controls over accessing the system through authentication and authorisation of users for system configuration management.

8 Flood level sensor requirements

The RFMS shall have the ability to support a diversity of water level sensor technologies including the following which have been successfully used in RFMS sites:

- a) radar type sensor
- b) LiDAR sensor
- c) ultrasonic type sensor
- d) conductive probe tube sensor
- e) gas bubbler sensor (widely used throughout Queensland), or
- f) pressure transducer.

The sensors for the RFMS shall be easy to install and maintain. All sensors shall meet the environmental, performance, and technical requirements as outlined below.

The choice of appropriate flood water level sensors should be carefully selected, depending on the specific flood monitoring site's physical environment.

8.1 Environmental requirements

The sensor (or system of sensors) shall:

- operate normally at temperatures of -5–50°C
- have ability to operate without an air-drying unit
- be suitable for use in very contaminated waters, and
- withstand extended periods of exposure to dry riverbed conditions (for sensors that measure water level insitu).

8.2 Performance requirements

The sensor (or system of sensors) shall:

- have a measurement range from 0 m to a minimum of 10 m H₂O
- be accurate to within 0.25% of full scale

- have a current output of 4–20 mA or a Serial Digital Interface (SDI) output, and
- drift stabilisation to be at most 0.2% per annum.

8.3 Electrical requirements

The sensor (or system of sensors) shall:

- operate normally for voltage variation of between 10–30V DC. System voltage shall be 12V or 24V DC
- have reverse polarity protection
- have zero offset of no more than 0.1 mA, and
- withstand voltage spike of up to 600V.

8.4 Mechanical / material requirements

The sensor (or system of sensors) shall:

- have a minimum rating of IP68 if installed outside the equipment enclosure
- have a minimum 10-year life span
- be made of corrosion resistant material, and
- be a design with minimal moving parts.

9 Road signage

Where specified in the contract, the RFMS roadway sign face shall be as outlined in Section 4.10 of the Queensland MUTCD Part 2. The sign face G9-21-1 should be used with alternate flashing yellow lights, designed to TC1768 (Figure 9(a)) when installed at a ford, floodway or low-level bridge as defined in the Queensland MUTCD. Full drawings for TC1768 (including the G9-21-1 sign) are attached in Appendix B.

When signage is required on other roadway flood points that are not defined as a ford, floodway or low-level bridge, the sign TC2316 (Figure 9(b)) should be used to replace the G9-21-1 sign face. Full drawings for TC2316 are in Appendix B.

Where electronic signage is to be used, the signage shall comply with any of the following signs:

- TC-2204 – Regulator Sign (Road Closed – No Entry)
- TC-2205 – Warning Sign (Road Closed Ahead)
- T1-Q26-1 – Warning Sign (Road Closed Ahead due to flooding), and/or
- T2-4-Q03 – Warning Sign (*Road name Rd* Closed due to Flooding).

The flash rate for the flashing lights shall be configurable locally or remotely by the user and shall initially be set to 50% duty cycle with a 1 Hz cycle.

Frangible post or slip base construction shall be used in high-speed environments for mounting the signs. The decision to use slip base or frangible posts shall be made by an engineer with the appropriate Registered Professional Engineer of Queensland (RPEQ) qualification.

Figure 9(a) – Roadway flood monitoring system signage showing advanced warning flooding warning lights – TC1768 and G9-21-1



Figure 9(b) – Roadway flood monitoring system signage showing advanced warning flooding warning lights – TC1768 and TC2316



10 Imaging equipment

Where specified in the contract, the provision of imaging equipment shall be as per the requirements detailed in MRTS225 *Imaging*.

11 Control system

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

11.1 General

The RFMS control system shall, as a minimum:

- a) have provision for one or more water level sensors, 3 digital or analogue inputs for interfacing the water level sensor, equipment monitoring, and power supply monitoring
- b) retrieve and communicate, automatically or on demand, in near real-time, the flood levels and other related system information, including images, system status and/or faults, from multiple flood monitoring stations / sensors to STREAMS and/or a server nominated by the Principal
- c) where it performs local calculations based on sensor inputs, transmit both raw data and calculated data to STREAMS and/or a webserver nominated by the Principal
- d) have 3 digital outputs to activate other ITS devices such as road signage or other monitoring devices, as required
- e) provide capability for both local and remote fault diagnostics, system monitoring, and configuration of the flood monitoring system components
- f) respond to operator commands (either from STREAMS or a server nominated by the Principal) within 200 ms, and
- g) be housed in an enclosure with IP rating as specified in Clause 12 of this Technical Specification.

11.2 STREAMS device driver

RFMSs shall be interfaced with STREAMS using any of the following protocols:

- Modbus TCP / Modbus Serial
- HTTP (JSON data format preferred)
- SNMP, and
- DNP3.

Any other protocol that can interface with STREAMS shall be presented to the Principal for acceptance.

11.3 System local control

The RFMS shall allow local control via a maintenance communications port using a laptop. Local control shall be gained using the diagnostic software. The system shall provide secure access to the RFMS equipment and prevent unauthorised access.

All system diagnostics and configuration parameters able to be changed in the field shall be accessible when the RFMS is selected for local control. Remote control of the RFMS shall be disabled when the RFMS is selected for local control.

Disconnection of a laptop or timeout of the local control session shall cause the controller to revert to autonomous operation. The timeout period shall generally be one minute.

Ending of the maintenance session shall not require further interaction from the user, nor in any way interrupt operation or require rebooting of the RFMS but immediately let the RFMS revert to autonomous operation.

11.4 System remote control

A remote management system must be provided. The remote sign management software shall:

- detail the location and current status of all RFMS sites (operational, idle, fault condition)
- show the RFMS on an interactive Geographical Information System (GIS) enabled Graphical User Interface (GUI)
- request passwords as part of the access and configuration authorisation process
- implement multiple levels of user access such as:
 - Administrator
 - Maintenance
 - Standard user, and
 - Read only.
- allow querying of events according to set criteria such as by site, time, date, event type, or by duration
- poll the RFMS in the field every 24 hours to verify the communications link and that the system has not failed; failure of the remote management system to gain a response from the sign shall result in an event being logged in the system that highlights that the sign status is unknown and possibly failed or damaged
- be compatible with the department's standard operating environment, Microsoft Windows® operating system environment, or industry standard system at the time of delivery – any software provided shall be capable of operating on all such operating systems, and
- support remote connectivity to the RFMS via satellite, 4G/5G, ADSL, Cat-M1, NB-(IoT), fixed broadband, or another telecommunications network nominated by the Principal.

11.5 Internal clock

An internal clock shall be provided in accordance with MRTS201 *General Equipment Requirements*.

11.6 Communication protocol

Communication with the RFMS shall be in accordance with a protocol accepted by the Principal's Representative and the requirements of MRTS201 *General Equipment Requirements*. The RFMS controller shall connect to STREAMS using the protocols specified in this Technical Specification.

12 Mechanical and physical requirements

The mechanical and physical requirements of the RFMS equipment shall be as defined in MRTS201 *General Equipment Requirements*.

The enclosures used for housing any of the RFMS equipment, including the controller, shall be in accordance with MRTS201 *General Equipment Requirements* and IP rated in accordance with AS 60529 *Degrees of protection provided by enclosures (IP Code)* as follows:

1. IP68 – if installed below the maximum known flood level, or if the flood level is not known.
2. IP56 – if installed above maximum known flood level.

Mounting structures shall be as per the applicable requirements defined in MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices* and/or TRUM Volume 3 Part 5. Frangible post or slip base construction may be used in high-speed environments for mounting the RFMS equipment and the signage.

The decision to use slip base or frangible posts shall be made by an engineer with the appropriate RPEQ qualification.

13 Electrical requirements

13.1 Mains power

Where mains power is required, the relevant electrical requirements defined in Clause 10 of MRTS201 *General Equipment Requirements* apply to this Technical Specification.

13.2 Battery power

Where mains power is required, a backup battery power supply in accordance with Clause 10 of MRTS201 *General Equipment Requirements* shall also be supplied as part of the RFMS.

13.3 Solar power

Where solar power is specified, the requirements defined in MRTS263 *Standalone Solar (PV) Power Systems* apply to this Technical Specification.

13.4 Protection against electrical transients and over voltage

Provision of protection against electrical transients and over voltage shall be in accordance with Clause 10 of MRTS201 *General Equipment Requirements*.

14 Telecommunications requirements

The telecommunications requirements defined in MRTS201 *General Equipment Requirements* apply under this Technical Specification. Additional requirements are as shown below.

RFMSs shall have a Local Area Network (LAN) ethernet port to connect with the department's supplied Network Termination Unit (NTU).

In the areas where the department network coverage is not available, the following connectivity options should be used:

1. connection via third party provided satellite link backhails from RFMS sites where no telco-provided mobile coverage is available, or
2. connection via third party provided Telstra Cellular LPWAN NB-IOT backhaul solution with provision of a secure API for data connection using STREAMS simple device driver.

15 Installation requirements

The sensors and associated infrastructure shall be installed at locations shown on the design documentation, and in accordance with the manufacturer's recommendations. The Contractor shall allow access for inspection of all mounting surfaces by the Administrator prior to installation. **Hold Point 1**

After installation of the cables, the conduits shall be sealed to prevent vermin entry.

Witness Point 1

16 Testing and commissioning

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. In addition, test sheets shall demonstrate compliance with the technical requirements of this Technical Specification prior to the delivery of the equipment to site. **Hold Point 2**

17 Documentation

The documentation requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Additional documentation requirements relevant to this Technical Specification are defined below.

Prior to the commencement of manufacturing works, the Contractor shall prepare and request approval of the Principal / Administrator of 3 copies of the following documents:

- a) fabrication and assembly drawings, detailing all the components to be installed
- b) the control systems configuration program files associated with the system
- c) manufacturer's specifications of the RFMS and of all major components detailing ratings and performance characteristics
- d) a schematic layout of components, building details and interconnection diagrams, and
- e) system operating manual, including:
 - i. operation instructions
 - ii. added interface details
 - iii. recommendations for routine maintenance tasks, and
 - iv. recommendations on spare parts holdings. **Hold Point 3**

The Contractor shall provide, to the satisfaction of the Principal / Administrator, the following documents prior to the delivery and acceptance of the RFMS to site:

- a statement confirming the warranty provisions associated with the RFMS and associated equipment
- full set of installation As Constructed drawings
- compliance details of all components as required or implied under this document
- records of tests conducted by the Contractor to demonstrate compliance with this Technical Specification, and
- project asset data types in a format suitable for entry to the department's Road Operations Asset Register (ROAR). The Contractor shall contact the Principal / Administrator to obtain the relevant spreadsheet / template.

Hold Point 4

Prior to issue of Practical Completion, the Contractor shall provide a laminated A3-sized copy of the As Constructed telecommunications and electrical schematics and wiring diagrams, together with all FATs, commissioning, and operating / maintenance documentation, as appropriate, to the satisfaction of the Administrator. **Hold Point 5**

18 Training

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

19 Maintenance

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

20 Handover

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

21 Product approval checklist

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

Appendix A – RFMS offset guidelines

RFMSs are used to measure the relative water surface level with respect to a roadway crossing or a known flood location. To ensure accurate readings, the following offsets must be applied to raw sensor measurements.

Road Level Offset

When an RFMS is installed, a calculated offset is required so that:

- 0 m represents the lowest road surface level at overtopping location
- negative values indicate the water level is below the road surface level, and
- positive values indicate the water depth above the roadway.

m AHD offset

An additional offset should be collected at the completion of construction to correct raw sensor readings to Australian Height Datum (m AHD) for future use as required.

Data collection for offsets

Offsets can be determined using:

- *TMR Surveying Standards*, and
- localised measurements (e.g. levels and tape measures), depending on the RFMS type and location.

Survey requirements for non-direct installations

For installations where:

- the sensor is near, but not at, the known flood point, or
- the exact flood point is unknown.

Survey measurements must be taken to determine the local offset of the lowest roadway point within 200 m on either side of the waterway, including any crossing point. These points should be referenced to the sensor measurement point (e.g. bubbler outlet or radar base).

Survey requirements for direct installations

Where the RFMS is installed directly adjacent to a known flood point:

- local offsets can be measured using levels and tape measures, and
- this method is suitable only for low-cost installations where m AHD correction is not required.

Example calculations

Example calculations below illustrate the above definitions and methodology further. The calculations refer to the surveyed values shown in the following measured data table.

Table A – Example calculations

Reduced level (m)	m AHD (m)	Level measurement location
6.274	7.422	Bridge – Permanent Survey Mark 150842
0	1.148	Flood Level Sensor Orifice
7.903	9.051	Survey Mark on path corner of Progress and Station Roads
5.915	7.063	Bridge, southern end, upstream side
5.713	6.861	Bridge, middle, upstream side
5.403	6.551	Bridge, northern end, upstream side
6.393	7.541	Bench Mark – Tower Permanent Survey Mark

Note:

GDA2020 latitude and longitude to be provided at each of these locations.

Level accuracy ± 0.1 m

Road level offset

Where local reference correction to the roadway flood point is required:

- apply the reduced level value at the lowest road point measured as a negative offset
- lowest roadway point (refer to Reduced Level column): 5.403 m
- flood level sensor orifice level (refer to Reduced Level column): 0 m, and
- road level offset: -5.403 m. This ensures the adjusted reading equals 0 m at the road surface

m AHD offset

If m AHD correction is required:

- apply the m AHD value at the sensor measurement point as a positive offset
- flood level sensor orifice m AHD value (refer to m AHD column): 1.148 m
- m AHD offset: 1.148 m, and
- all subsequent sensor measurements will then be relative to m AHD, not the road level or the local sensor outlet.

Appendix B – Road signage

2150
520
520
400
r100
2 x 180 or 200 dia. alternate flashing yellow lights.

ROAD SUBJECT TO FLOODING INDICATORS SHOW DEPTH G9-21

Typical set up example

Colour Legend

- Retroreflective white
- Black
- Yellow flashing lights

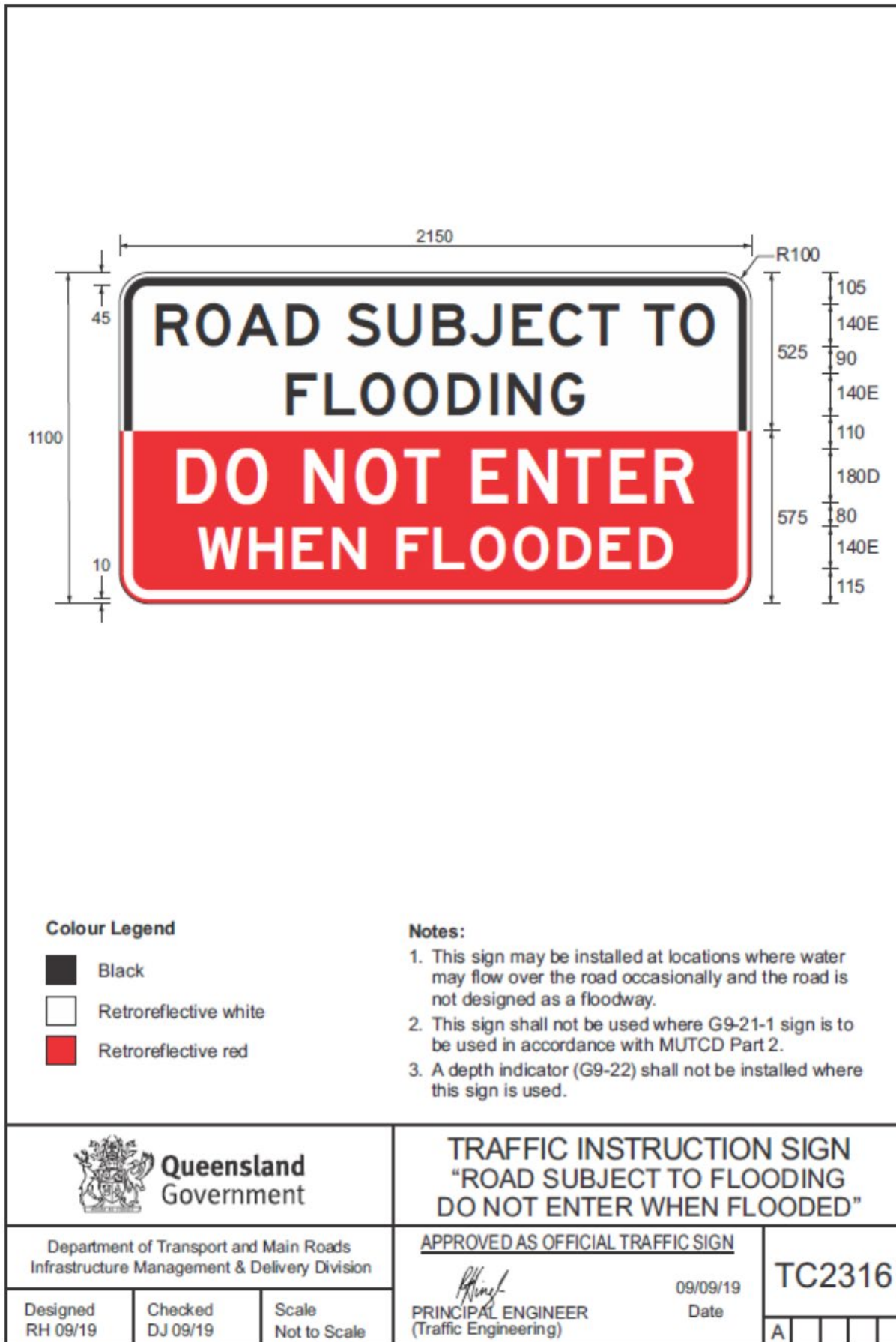
Notes

1. This warning light panel may be used in conjunction with advanced guide sign G9-21 when particular attention will be required to notify the possibility of the road ahead being subject to flooding.
2. The conspicuity devices (flashing lights) shall meet the requirements of AS2144 for 200mm diameter signal lanterns.
3. Stiffener rails used on the light panel should be "Type 1" and spaced so as not to interfere with light assembly.
4. Flashing light separation is designed to suit 2 x 65 NB posts spaced at 1290mm (non slip base - 1500 mm to underside of sign) or 2 x 80NB posts spaced at 1520mm (slip base - 2200 mm to underside of sign).
5. For the post design example details of non slip and slip base options see page 2 and page 3 respectively.

Queensland Government		ADVANCED WARNING FLOODING WARNING LIGHTS	
Network Operations & Road Safety Division Traffic Engineering & Road Safety Section		APPROVED AS OFFICIAL TRAFFIC SIGN	
Designed TV 06/09	Checked DJ 06/09	Scale Not to Scale	24/06/09 Date
		PRINCIPAL ENGINEER (Traffic Engineering)	TC1768 Page 1 of 3
		A	[] [] [] []

24/06/2009		Traffic Sign Structures - Design Form		Page 1
Job : Flood		Section : Lights		Sign Pos : 1
Location Details		Slope Details		
Wind Region	Region C	<u>Segment</u>	<u>Length</u>	<u>Height</u>
Exposed Terrain	No	1	5000	0
Risk Category	Low Impact Risk			
Foundation Soil	Firm to Stiff Clay Soil			
Side of Road	Left			
Distance from carriageway	1000			
Road Height	1500			
Sign Face Details				
<u>Detail</u>	<u>Front Lower</u>	<u>Front Upper</u>		
Sign Code	11	12		
Sign Width	2150	2150		
Sign Depth	800	400		
Legend Class	Various	Various		
Legend Colour	Various	Various		
Background Class	Various	Various		
Background Colour	White	Brown		
Sign Separation	0	0		
Sign Stiffener Details				
<u>Detail</u>	<u>Front Lower</u>	<u>Front Upper</u>		
Stiffener Type	1	1		
Number of Stiffeners	3	2		
Stiffener Spacing	375	350		
Number of Brackets	6	4		
CHS Steel Design Details				
<u>Support Details</u>				
Number	2			
Spacing	1290, Standard			
Kerb Post Length	3400			
Post 2 Length	3400			
Post 3 Length	0			
Post 4 Length	0			
Stub Length	0			
Post Dimensions	65 NB			
Post Wall Thickness	3.2			
Post Grade	C350			
Slip Base Required	No			
<u>Footing Details</u>				
Diameter of Hole	300			
Depth of Hole	700			
		ADVANCED WARNING SUPPORT DESIGNS - NON SLIP BASE		
Network Operations & Road Safety Division Traffic Engineering & Road Safety Section		<u>APPROVED AS OFFICIAL TRAFFIC SIGN</u> PRINCIPAL ENGINEER (Traffic Engineering)		24/06/09 Date
Designed TV 06/09	Checked DJ 06/09	Scale Not to Scale	TC1768 Page 2 of 3	
			A	

24/06/2009		Traffic Sign Structures - Design Form		Page 2
Job : Flood		Section : Lights		Sign Pos : 2
Location Details		Slope Details		
Wind Region	Region C	<u>Segment</u>	<u>Length</u>	<u>Height</u>
Exposed Terrain	No	1	5000	0
Risk Category	High Impact Risk			
Foundation Soil	Firm to Stiff Clay Soil			
Side of Road	Left			
Distance from carriageway	1000			
Road Height	2200			
Sign Face Details				
<u>Detail</u>	<u>Front Lower</u>	<u>Front Upper</u>		
Sign Code	11	12		
Sign Width	2150	2150		
Sign Depth	800	400		
Legend Class	Various	Various		
Legend Colour	Various	Various		
Background Class	Various	Various		
Background Colour	White	Brown		
Sign Separation	0	0		
Sign Stiffener Details				
<u>Detail</u>	<u>Front Lower</u>	<u>Front Upper</u>		
Stiffener Type	1	1		
Number of Stiffeners	3	2		
Stiffener Spacing	375	350		
Number of Brackets	6	4		
CHS Steel Design Details				
<u>Support Details</u>				
Number	2			
Spacing	1520, Variable			
Kerb Post Length	3400			
Post 2 Length	3400			
Post 3 Length	0			
Post 4 Length	0			
Stub Length	825			
Post Dimensions	80 NB			
Post Wall Thickness	3.2			
Post Grade	C350			
Slip Base Required	Yes			
<u>Footing Details</u>				
Diameter of Hole	300			
Depth of Hole	900			
		ADVANCED WARNING SUPPORT DESIGNS - SLIP BASE		
Network Operations & Road Safety Division Traffic Engineering & Road Safety Section		<u>APPROVED AS OFFICIAL TRAFFIC SIGN</u> PRINCIPAL ENGINEER (Traffic Engineering)		24/06/09 Date
Designed TV 06/09	Checked DJ 06/09	Scale Not to Scale	TC1768 Page 3 of 3	
			A	



Appendix C – Product approval compliance checklist

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
5. Functional requirements								
1	The RFMS shall transmit water level information to stations designated by the Principal, for the purpose of incident management and monitoring.	5					X	
2	RFMSs are used to measure the relative water surface level with respect to a roadway crossing or a known flood location. To ensure accurate readings, offsets must be applied to raw sensor measurements following the guidelines detailed in the Appendix A.	5					X	
3	The RFMS shall also be able to send signals to local roadway signage such as Active Advance Warning Signs (AAWS) to alert motorists of water over the road.	5					X	
4	Operational status of this signage shall be reported back to the TMS (STREAMS).	5			X		X	
5	Where a weather monitor system is already installed at the site, the RFMS may be installed as part of the weather monitor system as described in MRTS231 Road Weather Monitor (RWM) Systems.	5					X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
6. Roadway flood monitoring system components								
6	A typical RFMS shall include: a) a water level sensor (Clause 8)	6					X	
7	b) RFMS controller (Clause 11)	6					X	
8	c) RFM communication equipment (Clauses 11, 14)	6					X	
9	d) imaging equipment, where required (Clause 10)	6					X	
10	e) co-located STREAMS field processor, where required	6					X	
11	f) enclosures (complying with MRTS201 <i>General Equipment Requirements</i>) to house all control and communications equipment associated with the RFMS	6					X	
12	g) column / mounting support and footings (Clause 12)	6				X	X	
13	h) power supply, including solar power (Clause 13)	6					X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
14	i) roadway warning signals and displays, where required (Clause 9), and	6				X		
15	j) where the warning signals and display enclosure is located above the road surface, a maintenance gantry or designated work platform that complies with MRTS201 <i>General Equipment Requirements</i> .	6					X	
7. Operational requirements								
16	The operational requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to equipment provided under this Technical Specification.	7					X	
17	The RFMS shall transmit water height data to the Transport and Main Roads TMS (STREAMS) to enable departmental operators to centrally monitor RFMS sites directly via STREAMS.	7					X	
18	Communications between the RFMS sites and the TMCs should be provided by the department's ITS communication network (Internet Protocol Remote Telemetry (IPRT) or Transport and Main Roads 'private' wireless networks) unless another technology is approved by the Principal.	7					X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
19	For RFMS sites supporting remote water level backhaul data and monitoring via STREAMS, but also requiring low-speed flood monitoring images, these images should be integrated within STREAMS via the department's default video management system (FLIR) or purpose-built image server as informed by the Principal.	7					X	
20	Where the integration of potential departmental RFMS sites directly into STREAMS or the department's existing Intelligent Transport Systems (ITS) communications network is not technically possible, a number of third-party RFMS solutions are available which provide tested and mature flood monitoring solutions, including satellite backhaul capability where mobile coverage is not available at the RFMS site.	7			X		X	
21	The third-party RFMS shall not be used unless those systems have been integrated with STREAMS through a system-to-system interface (access to data via a secure Application Programming Interface (API)) and be able to access using a simple device driver interface of STREAMS.	7			X		X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
22	Physical security of the equipment and equipment shelter will be in accordance with MRTS201 <i>General Equipment Requirements</i> .	7.1					X	
23	RFMSs shall have controls over accessing the system through authentication and authorisation of users for the system configuration management	7.7			X		X	
8. Flood level sensor requirements								
24	The RFMS shall have the ability to support a diversity of water level sensor technologies including the following which have been successfully used in departmental RFMS sites: a) Radar type sensor b) LiDAR sensor c) Ultrasonic type sensor d) Conductive probe tube sensor e) Gas bubbler sensor (widely used throughout Queensland), or f) Pressure transducer.	8					X	
25	The sensors for the RFMS shall be easy to install and maintain.	8			X		X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
26	All sensors shall meet the environmental, performance, and technical requirements as outlined below.	8					X	
27	The choice of appropriate flood water level sensors should be carefully selected, depending on the specific flood monitoring site's physical environment.	8					X	
28	The sensor (or system of sensors) shall: <ul style="list-style-type: none"> operate normally at temperatures of -5-50°C. 	8.1					X	
29	<ul style="list-style-type: none"> have ability to operate without an air-drying unit 	8.1					X	
30	<ul style="list-style-type: none"> be suitable for use in very contaminated waters, and 	8.1					X	
31	<ul style="list-style-type: none"> withstand extended periods of exposure to dry riverbed conditions (for sensors that measure water level insitu). 	8.1			X		X	
32	The sensor (or system of sensors) shall: <ul style="list-style-type: none"> have a measurement range of 0-10 m H₂O 	8.2					X	
33	<ul style="list-style-type: none"> be accurate to within 0.25% of full scale 	8.2					X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
34	<ul style="list-style-type: none"> have a current output of 4–20 mA or a Serial Digital Interface (SDI) output, and 	8.2					X	
35	<ul style="list-style-type: none"> drift stabilisation to be at most 0.2% per annum. 	8.2			X		X	
36	The sensor (or system of sensors) shall: <ul style="list-style-type: none"> operate normally for voltage variation of between 10–30V DC. System voltage shall be 12V or 24V DC 	8.3					X	
37	<ul style="list-style-type: none"> have reverse polarity protection 	8.3					X	
38	<ul style="list-style-type: none"> have zero offset of no more than 0.1 mA, and 	8.3					X	
39	<ul style="list-style-type: none"> withstand voltage spike of up to 600V. 	8.3					X	
40	The sensor (or system of sensors) shall: <ul style="list-style-type: none"> have a minimum rating of IP68 if installed outside the equipment enclosure 	8.4		X				
41	<ul style="list-style-type: none"> have a minimum 10-year life span 	8.4					X	
42	<ul style="list-style-type: none"> be made of corrosion-resistant material, and 	8.4					X	
43	<ul style="list-style-type: none"> be a design with minimal moving parts. 	8.4	X				X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
9. Road signage								
44	Where specified in the contract, the RFMS roadway sign face shall be as outlined in Section 4.10 of the Queensland MUTCD Part 2.	9				X		
45	The sign face G9-21-1 should be used with alternate flashing yellow lights, designed to TC1768 (Figure 9(a)) when installed at a ford, floodway, or low-level bridge as defined in the Queensland MUTCD.	9				X		
46	When signage is required on other roadway flood points that are not defined as a ford, floodway, or low-level bridge, the sign TC2316 (Figure 9(b)) should be used to replace the G9-21-1 sign face.	9				X		

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
47	Where electronic signage is to be used, the signage shall comply with any of the following signs: <ul style="list-style-type: none"> • TC2204 – Regulator Sign (Road Closed – No Entry) • TC2205 – Warning Sign (Road Closed Ahead) • T1-Q26_1 – Warning Sign (Road Closed Ahead due to flooding), or • T2-4-Q03 – Warning Sign (Road name Rd Closed due to Flooding). 	9				X		
48	The flash rate for the flashing lights shall be configurable locally or remotely by the user and shall initially be set to 50% duty cycle with a 1 Hz cycle.	9	X				X	
49	Frangible post or slip base construction shall be used in high-speed environments for mounting the signs.	9				X	X	
50	The decision to use slip base or frangible posts shall be made by an engineer with the appropriate Registered Professional Engineer (RPEQ) qualification.	9					X	
10. Imaging equipment								
51	Where specified in the contract, the provision of imaging equipment shall be as per the requirements detailed in MRTS225 <i>Imaging</i> .	10					X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
11. Control system								
52	The control system requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to equipment provided under this Technical Specification.	11					X	
53	The RFMS control system shall, as a minimum: a) have provision for one or more water level sensors, 3 digital or analogue inputs for interfacing the water level sensor, equipment monitoring, and power supply monitoring	11.1	X				X	
54	b) retrieve and communicate, automatically or on-demand, in near real-time, the flood levels and other related system information, including images, system status and/or faults, from multiple flood monitoring stations / sensors to STREAMS and/or a server nominated by the Principal	11.1			X		X	
55	c) where it performs local calculations based on sensor inputs, transmit both raw data and calculated data to STREAMS and/or a webserver nominated by the Principal	11.1			X		X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
56	d) have 3 digital outputs to activate other ITS devices such as road signage or other monitoring devices, as required	11.1			X		X	
57	e) provide capability for both local and remote fault diagnostics, system monitoring and configuration of the flood monitoring system components	11.1			X		X	
58	f) respond to operator commands (either from STREAMS or a server nominated by the Principal) within 200 ms, and	11.1			X		X	
59	g) be housed in an enclosure with suitable IP rating as specified in this Technical Specification.	11.1		X				
60	RFMSs shall be interfaced with STREAMS simple devices interface using any of the following protocols: <ul style="list-style-type: none"> • Modbus TCP / Modbus Serial • HTTP (JSON data format preferred) • SNMP, or • DNP3. 	11.2					X	
61	Any other protocol that can interface with STREAMS shall be presented to the Principal for acceptance.	11.2					X	
62	The RFMS shall allow local control via a maintenance communications port using a laptop.	11.3			X		X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
63	Local control shall be gained using the diagnostic software.	11.3			X		X	
64	The system shall provide secure access to the RFMS equipment and prevent unauthorised access.	11.3			X		X	
65	All system diagnostics and configuration parameters able to be changed in the field shall be accessible when the RFMS is selected for local control.	11.3			X		X	
66	Remote control of the RFMS shall be disabled when the RFMS is selected for local control.	11.3			X			
67	Disconnection of a laptop or timeout of the local control session shall cause the controller to revert to autonomous operation.	11.3			X			
68	The timeout period shall generally be one minute.	11.3			X		X	
69	Ending of the maintenance session shall not require further interaction from the user, nor in any way interrupt operation or require rebooting of the RFMS but immediately let the RFMS revert to autonomous operation.	11.3			X			
70	A remote management system must be provided.	11.4					X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
71	The remote sign management software shall: <ul style="list-style-type: none"> detail the location and current status of all RFMS sites (operational, idle, fault condition) 	11.4			X		X	
72	<ul style="list-style-type: none"> show the RFMS on an interactive GIS-enabled Graphical User Interface (GUI) 	11.4			X		X	
73	<ul style="list-style-type: none"> request passwords as part of the access and configuration authorisation process 	11.4			X		X	
74	<ul style="list-style-type: none"> implement multiple levels of user access such as: <ul style="list-style-type: none"> Administrator Maintenance Standard user, and Read only. 	11.4			X		X	
75	<ul style="list-style-type: none"> allow querying of events according to set criteria such as by site, time, date, event type, or by duration 	11.4			X		X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
76	<ul style="list-style-type: none"> poll the RFMS in the field every 24 hours to verify the communications link and that the system has not failed; failure of the remote management system to gain a response from the sign shall result in an event being logged in the system that highlights that the sign status is unknown and possibly failed or damaged 	11.4			X		X	
77	<ul style="list-style-type: none"> be compatible with the department's standard operating environment, Microsoft Windows® operating system environment, or industry standard system at the time of delivery – any software provided shall be capable of operating on all such operating systems, and 	11.4			X		X	
78	<ul style="list-style-type: none"> support remote connectivity to the RFMS via satellite, 4G/5G, ADSL, Cat-M1, NB-(IoT), fixed broadband or another telecommunications network nominated by the Principal. 	11.4			X		X	
79	An internal clock shall be provided in accordance with MRTS201 <i>General Equipment Requirements</i> .	11.5					X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
80	Communication with the RFMS shall be in accordance with a protocol accepted by the Principal's Representative and the requirements of MRTS201 <i>General Equipment Requirements</i> .	11.6					X	
81	The RFMS controller shall connect to STREAMS through the simple device interface using the protocols specified in this Technical Specification.	11.6					X	See 60
12. Mechanical and physical requirements								
82	The mechanical and physical requirements of the RFMS equipment shall be as defined in MRTS201 <i>General Equipment Requirements</i> .	12					X	
83	The enclosures used for housing any of the RFMS equipment, including the controller, shall be in accordance with MRTS201 <i>General Equipment Requirements</i> and IP rated in accordance with AS 60529 <i>Degrees of protection provided by enclosures (IP Code)</i> as follows:	12		X				
84	1. IP68 – if installed below the maximum known flood level.	12		X				
85	2. IP56 – if installed above and up to 1.0 m of maximum known flood level.	12		X				

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
86	3. IP55 – if installed at least 1.0 m above the maximum known flood level.	12		X				
87	Mounting structures shall be as per the applicable requirements defined in MRTS61 <i>Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices</i> and/or TRUM Volume 3 Part 5.	12				X	X	
88	Frangible post or slip base construction may be used in high-speed environments for mounting the RFMS equipment and the signage.	12				X		
89	The decision to use slip base or frangible posts shall be made by an engineer with the appropriate RPEQ qualification.	12					X	
13. Electrical requirements								
90	Where mains power is required, the relevant electrical requirements defined in Clause 10 of MRTS201 <i>General Equipment Requirements</i> apply to this Technical Specification.	13.1					X	
91	Where mains power is required, a backup battery power supply in accordance with Clause 10 of MRTS201 <i>General Equipment Requirements</i> shall also be supplied as part of the RFMS.	13.2					X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
92	Where solar power is specified, the requirements defined in MRTS263 <i>Standalone Solar (PV) Power Systems</i> apply to this Technical Specification.	13.3					X	
93	Provision of protection against electrical transients and over-voltage shall be in accordance with Clause 10 of MRTS201 <i>General Equipment Requirements</i> .	13.4					X	
14. Telecommunications requirements								
94	The telecommunications requirements defined in MRTS201 <i>General Equipment Requirements</i> apply under this Technical Specification.	14					X	
95	RFMSs shall have a Local Area Network (LAN) ethernet port to connect with the department's supplied Network Termination Unit (NTU).	14				X		
96	In the areas where the department network coverage is not available, the following connectivity options should be used:	14					X	
97	1. connection via third-party provided satellite link backhauls from RFMS sites where no telco-provided mobile coverage is available, or	14					X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
98	2. connection via third-party provided Telstra Cellular LPWAN NB-IOT backhaul solution with	14					X	
99	provision of a secure API for data connection using STREAMS simple device driver.	14					X	
15. Installation requirements								
100	The sensors and associated infrastructure shall be installed at locations shown on the design documentation, and in accordance with the manufacturer's recommendations.	15					X	
101	The Contractor shall allow access for inspection of all mounting surfaces by the Administrator prior to installation.	15					X	
102	After installation of the cables, the conduits shall be sealed to prevent vermin entry.	15					X	
16. Testing and commissioning								
103	The testing and commissioning requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to this Technical Specification.	6					X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
104	In addition, test sheets shall demonstrate compliance with the technical requirements of this Technical Specification prior to the delivery of the equipment to site.	16					X	
17. Documentation								
105	The documentation requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to this Technical Specification. Additional documentation requirements relevant to this Technical Specification are defined below.	17					X	

Item #	MRTS233 Roadway Flood Monitoring Systems	MRTS clause	Verification Method					Compliance (Y, TBC, N, N/A)
			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
106	<p>Prior to the commencement of manufacturing works, the Contractor shall prepare and request approval of the Principal / Administrator of 3 copies of the following documents:</p> <ul style="list-style-type: none"> a) fabrication and assembly drawings, detailing all the components to be installed b) the control systems configuration program files associated with the system c) manufacturer's specifications of the RFMS and of all major components detailing ratings and performance characteristics d) a schematic layout of components, building details and interconnection diagrams, and e) system operating manual, including: <ul style="list-style-type: none"> i. operation instructions ii. misadded interface details iii. recommendations for routine maintenance tasks, and iv. recommendations on spare parts holdings. 	17				X	X	

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
107	<p>The Contractor shall provide, to the satisfaction of the Principal / Administrator, the following documents prior to the delivery and acceptance of the RFMS to site:</p> <ul style="list-style-type: none"> • a statement confirming the warranty provisions associated with the RFMS and associated equipment • full set of installation As Constructed drawings • compliance details of all components as required or implied under this document • records of tests conducted by the Contractor to demonstrate compliance with this Technical Specification, and • project asset data types in a format suitable for entry to the department’s Road Operations Asset Register (ROAR). 	17					X	
108	<p>The Contractor shall contact the Principal / Administrator to obtain the relevant spreadsheet / template.</p>	17						

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			Visual inspection	NATA certification	Field OR bench test	Detailed drawings	Other records (datasheets, internal testing, RPEQ)	
109	Prior to issue of Practical Completion, the Contractor shall provide a laminated A3-sized copy of the As Constructed telecommunications and electrical schematics and wiring diagrams, together with all FATs, commissioning and operating / maintenance documentation, as appropriate, to the satisfaction of the Administrator.	17					X	
18. Training								
110	The training requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work under this Technical Specification.	18					X	
19. Maintenance								
111	The maintenance requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work under this Technical Specification.	19					X	
20. Handover								
112	The handover requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work under this Technical Specification.	20					X	

