Managed Freeways
Ramp Signal Technical Requirements

Document No.: 12/8007-REQ-101
April 2013
1. DOCUMENT HISTORY AND PREAMBLE

This document is a draft for discussion to seek feedback from industry. It has been developed by Main Roads WA as a part of development activities for potential Managed Freeways installations in Perth, particularly on the Perth Urban Transport and Freight Corridor. This document should be read in conjunction with the other documents in this series including the Managed Freeways Acronyms and Terminology document.

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<tr>
<th>Version</th>
<th>Author</th>
<th>Reviewer</th>
<th>Date</th>
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<tr>
<td>1.0 (draft for web release)</td>
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<td>April 2013</td>
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2. PURPOSE

2.1 Introduction

This document outlines the technical requirements for the Ramp Signal system to be provided as part of Managed Freeway projects in Western Australia. The system will allow for the control of the Ramp Signalling sites along the freeway and highway network.

This document should be read in conjunction with the Managed Freeways Technology Functional Requirements document (document no. 12/8007-REQ-001), the VicRoads Freeway Ramp Signals handbook, the Main Roads jurisdictional supplement, the Managed Freeways Provision Guidelines and other supporting documentation.

Main Roads has entered into a negotiation process for the procurement of an ITS Control System with Transmax. This negotiation process is the extent of current commitments, however for simplicity the use of STREAMS has been included in the Managed Freeways technical requirement documents.

2.2 Terminology

A full list of the terms used throughout this document and other supporting documentation can be found in the Managed Freeways Acronyms and Terminology, document no.: 12/8007-GEN-001.

2.3 Acronyms

A full list of the acronyms used throughout this document and other supporting documentation can be found in the Managed Freeways Acronyms and Terminology document.

2.4 Link between Services and ITS Elements

Table 1 sets out the foundation and future ITS services with respect to those technologies that are part of the managed freeway toolkit. A dark blue box with a tick indicates that the technology is essential to the service, a light blue box with a tick means that the technology is useful to the service.
### Table 1: ITS Services and ITS Elements

<table>
<thead>
<tr>
<th>ITS Service</th>
<th>Service Type</th>
<th>ITS Elements Required</th>
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<tbody>
<tr>
<td><strong>Ramp Signals – Corridor Management</strong></td>
<td>Real Time Control</td>
<td>Control System Comms</td>
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<td></td>
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<td>Power VDS FRS CCTV</td>
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<tr>
<td><strong>Ramp Signals – Local Merge and Bottleneck Management</strong></td>
<td>Real Time Control</td>
<td>Control System Comms</td>
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<td>Power VDS FRS CCTV</td>
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<tr>
<td><strong>Travel Time Calculation</strong></td>
<td>Real Time intelligence</td>
<td>Control System Comms</td>
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<td></td>
<td></td>
<td>Power VDS FRS CCTV</td>
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<tr>
<td><strong>Roadside Travel Time and Other Message Display</strong></td>
<td>Real Time Information</td>
<td>Control System Comms</td>
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<td>Power VDS FRS CCTV</td>
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<tr>
<td><strong>Incident Detection</strong></td>
<td>Real Time intelligence</td>
<td>Control System Comms</td>
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<td></td>
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<td>Power VDS FRS CCTV</td>
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<tr>
<td><strong>Incident Verification</strong></td>
<td>Real Time intelligence</td>
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<td>Power VDS FRS CCTV</td>
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<tr>
<td><strong>System Performance Management</strong></td>
<td>Real Time System Management</td>
<td>Control System Comms</td>
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<td>Power VDS FRS CCTV</td>
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<tr>
<td><strong>Freeway Performance Evaluation</strong></td>
<td>Historical Intelligence</td>
<td>Control System Comms</td>
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<td></td>
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<td>Power VDS FRS CCTV</td>
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This matrix is based around the example performance measurements in this document and other services and technologies may be applicable for different scenarios.
3. FUNCTIONAL REQUIREMENTS

3.1 General

The Ramp Signals for Managed Freeways shall be supplied in accordance with this document. The Contractor should also consider the requirements of the RC1 and RC2 Technical Requirements (document no.: 12/8007-REQ-102), the VicRoads Freeway Ramp Signals handbook and the Main Roads jurisdictional supplement to the handbook.

The Ramp Signal lanterns shall meet the requirements of this document and shall comply with AS2144 and where possible Main Roads Specification 712 Traffic Signals.

3.2 Placement

The Ramp Signals consist of the following elements:

- Ramp Signal Controller (RSC) and cabinet,
- Ramp Signal Lanterns and support structure,
- RC1 and RC2 signs – covered in the RC1 and RC2 Technical Requirements,
- Vehicle Detection Station for on ramp sensors – covered in the Managed Freeways Vehicle Detection Station Technical Requirements (document no.: 12/8007-REQ-105), and
- All required power and communications cabling and infrastructure – to be determined as part of the detailed design.

The location of the stop line shall be determined based on the storage requirements for the ramp and in accordance with the VicRoads Freeway Ramp Signalling handbook and the Main Roads jurisdictional supplement to the handbook.

The storage requirements and therefore the stop line location should be agreed with the Main Roads Traffic Engineering Standards Manager (TESM) during the design period.

The ramp signal lanterns are located 10m downstream of the stop line location in accordance with the VicRoads Freeway Ramp Signalling handbook and the Main Road jurisdictional supplement.

The ramp signals at sites with more than two lanes at the stop line shall be mounted on a gantry structure.

At all other locations the ramp signal will be mounted on a mast arm structure. The structure shall be in accordance with Main Roads Standard Drawing 0330-1944, included in Appendix A, modified to accommodate lanterns heads mounted above the on ramp as shown in the VicRoads Freeway Ramp Signalling handbook and the Main Roads jurisdictional supplement to the handbook. The mast arm shall also comply with AS2979 where applicable.
3.3 Ramp Signals

3.3.1 Ramp Signal Controller

The TOC Control System Replacement Team will procure the RSCs under their common use arrangement with the Control System provider. A data sheet for the RSC can be found in Appendix B of this document.

The Contractor should make the TOC Control System Replacement Team aware of their requirements for RSCs at the earliest opportunity.

Each Ramp Signal site shall be supplied with a dedicated RSC.

The RSC shall be 19" rack mountable, either directly or on a shelf, and housed in a roadside local cabinet adjacent to the ramp signal site.

The RSC shall be connected to the network via a Field Processor (FP), this FP will typically be installed in the RSC cabinet.

The RSC shall utilise traffic signal copper cable to connect to the ramp signals. Refer to Main Roads Specification 712 Traffic Signals for the cable requirements.

The RSC will include a communications port to connect the RSC internal PLC.

The RSC will support LED type lanterns outputs.

The RSC shall be housed in a cabinet that provides a minimum of 24RU available rack space, an appropriate power distribution board and is IP55 rated.

The RSC will be a hardened device able to operate in the environmental conditions experienced in the Perth Metropolitan area with no degradation in performance.

3.3.2 Ramp Signal Lanterns

The ramp signal lanterns shall be three (3) aspect 200mm LED lanterns and shall meet the requirements of Main Roads Specification 712.

The ramp signal mounting arrangement shall allow for the signals to be adjusted in the horizontal and vertical plane to allow the viewing angle for road users to be optimised based on the specific, road geometry.

3.3.3 RC1 & RC2 Signs

RC1 signs are required to be placed at the entrance to the on ramp in accordance with the VicRoads Freeway Ramp Signalling handbook.

RC2 signs are required at sites where the Ramp Signals are not visible from the entrance to the ramp.

All RC1 and RC2 sign locations should be approved by the Main Roads TESM.

For further details on the signs please refer to the following:
- RC1 and RC2 Technical Requirements, and
- VicRoads Freeway Ramp Signals handbook and Main Roads jurisdictional supplement.

### 3.3.4 Ramp Signal Vehicle Detection

Each Ramp Signal site will rely on the input of traffic data from a number of VDS.

Each Ramp Signal site has two key VDS locations, these are covered in further detail in the VDS Technical Requirements:

- At the on ramp with up to five detector sites required along the on ramp:
  - Ramp Entry,
  - Mid Ramp,
  - Stop Line,
  - Ramp Exit, and
  - Extra Queue – these are only provided where the ramp storage exceeds 4 minutes
- Near the downstream bottleneck or merge from the on ramp

The Contractor will be required to develop VDS design based on the VDS Technical Requirements, the project requirements and the constraints of the VDS technology selected.

VDS are required to be installed along the freeway and highways, and at the ramps, in accordance with the VDS Technical Requirements.

The locations of these detection stations chosen by the Contractor shall be approved by the Main Roads TESM.

### 3.4 Communications

The RSC requires a connection to the Traffic Control Systems (TCS) Network to allow the Traffic Operations Centre (TOC) to communicate with the Ramp Signal site.

A fibre optic connection shall be provided by the Contractor in the local cabinet to connect the RSC to the local Access Node in accordance with the TCS Network requirements.

A wireless communications path from the RSC to the local Access Node may be utilised following acceptance of the proposed design by the Asset Manager Traffic Systems (AMTS) providing the Contractor can demonstrate this will meet all performance and availability requirements.

The RSC supplied will be capable of communicating with the TOC using the STREAMS software platform by utilising an existing STREAMS device driver.

All communications for the Ramp Signal site shall be via the RSC cabinet, with the Ramp Signal elements listed in Section 2.2 all sharing a common FP at this point with the exception of the VDS.
Where, due to the length of the on-ramp, a minimum of two roadside cabinets are likely to be required all Ramp Signal elements for this ramp, besides the VDS, will still be required to share a common FP. The Contractor is to determine the most efficient communications solution for this location.

3.5 Fault Management

The Network Management System (NMS) shall be responsible for the monitoring of the communications network, connected devices and other alarms.

The Control System will be used to provide notifications when devices are in a faulty, intermittent or unavailable state.

The TOC operators and operations and maintenance personnel shall be immediately alerted to faults occurring in devices, even when idle.

This shall include but not limited to the following:

- Power Failures,
- Communications Failures,
- Pixel Failures,
- Dim/Bright Errors, and
- Overheat alarms.

3.6 Power

Each Ramp Signal site shall be provided with a power connection by the Contractor.

The power connection to the cabinet shall be a 240vAC 50Hz single phase mains connection from a Western Power metered supply. The Contractor shall determine if an existing supply can be utilised or if a new supply is required.

3.7 UPS

The Contractor should assess the requirement for a UPS at Ramp Signal sites based on the availability requirements of the project.

The UPS shall be adequately sized and should take into consideration the UPS used at other Main Roads traffic signal sites and UPS for other equipment types. Main Roads Specification 713 specifies the UPS requirements for traffic signal sites.

Any UPS implementation shall be discussed and agreed with the Asset Manager for Traffic Systems.

3.8 Environmental

The Ramp Signal system shall be designed to operate in the environmental conditions experienced in the Perth Metropolitan area with no degradation in performance.
4. OTHER REQUIREMENTS

4.1 Asset Management Traffic Systems

The Contractor shall liaise with the Asset Management Traffic Systems (AMTS) team during the procurement of the Ramp Signal System to ensure wider Main Roads interests are considered.

Engagement with AMTS is required throughout the design, implementation and commissioning stages. This process is outlined in the Traffic Control System Network and Asset Management Processes.

4.2 Availability

The Contractor shall review the existing network in the project area and determine the availability requirements of end equipment in order to meet the overall availability requirements of each user service as defined in the Managed Freeway Technology Functional Requirements (document no.: 12/8007-REQ-001). The availability requirements of end equipment should be agreed with the Main Roads Asset Manager for Traffic Systems.

4.3 Maintenance

The Ramp Signal system must not require routine maintenance visits at an interval shorter than 12 months.
5. INSTALLATION

5.1 Schedule

The Contractor shall be responsible for the installation of the Ramp Signal System.

The RSC or any other supporting infrastructure should not be installed until a power supply is available at the site.

All ramp signals should be fitted with a suitable cover following installation that clearly states; ‘SIGNALS NOT IN USE’ to road users prior to operation.

5.2 Testing and Commissioning

The Contractor shall test the Ramp Signal system rigorously prior, during and following installation in accordance with the Testing and Commissioning Strategy.

All test results should be captured on an appropriate pro-forma and provided as part of the Operation & Maintenance handover documentation.

The AMTS and the Metro Integrated Service Arrangement Electrical Service Senior Project Manager shall be provided with a minimum of 7 days' notice prior to installation of each Ramp Signal site to provide witness at the installation and testing if desired.
6. DOCUMENTATION

6.1 Drawings

For each Ramp Signal site the Contractor shall provide a full suite of drawings that detail, as a minimum, the following:

- The specific site layout,
- The construction and mounting arrangements,
- Mast arm foundation and structural drawings,
- The internal component arrangement,
- The external wiring arrangement, and
- The internal wiring arrangement.

6.2 Manuals

An O&M manual shall be supplied with the Ramp Signal system that details all elements of system.

A quick reference troubleshooting guide shall also be provided with the documentation.

All test results as detailed in Section 5 shall be supplied as part of the signs documentation.
Appendix A – Main Roads Standard Drawing for a Traffic Signal Mast Arm
Appendix B – Ramp Signal Controller Data Sheet
The STREAMS Ramp Signal Controller (RSC) manages the most demanding ramp metering sites by providing an advanced and co-ordinated ramp metering capability through the centralised STREAMS platform.

The RSC is used in conjunction with a STREAMS Field Processor (FP) to provide lamp signal switching with inbuilt AC lamp current monitoring and remote reporting functionality.

Sites requiring ramp metering signs can be accommodated for using the Field Processor’s RS232/422 serial ports with the option of vehicle detectors to meet the needs of ramp metering site configurations.

Support is provided for Extra Low Voltage (ELV) LED lanterns which provide greater safety for both maintenance personnel and motorists.

The RSC is a durable controller that is designed to operate reliably 24/7 with IP55 dust and water ingress protection and can operate in a variety of modes including metered, unmetered, “Freeway Ramp Closed” and (optionally) in pre-designated cycles of six and nine seconds.

**STREAMS Support**

**Supported in STREAMS versions**
- v2008.1 partial functionality supported
- v2009.1 and onwards – fully supported

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**Technical Specifications**

**Signal Outputs**
- 1 Signal Group
- Advance Amber Warning Signals - nonflashing.
  (for flashing warning signals connect External Flasher Unit)
- Programmable start up & shutdown sequences for Lamp Displays

**Signal Output Relay Contact Ratings**
- 2.5A continuous @ AC Voltages

**Sign Control**
- Control of CMS and VMS ramp metering signs (consult with Transmax for compatible signs)

**Max Total Lamp Power Current**
- 20A continuous @ AC Voltages

**Controller Power Supply Voltage**
- 240VAC (-15%, +10%), 50Hz

**Controller Inrush Current**
- 40A for 4 ms (240VAC)

**Controller Power Consumption**
- 60VA (not including lamp power)

**Lamp Types Supported**
- LED
- Quartz Halogen
- Incandescent
- ELV LED (contact Transmax for specific details)

**Lamp Monitoring**
- The STREAMS Ramp Signal Controller provides lamp fault and last red reporting to STREAMS

**Communications**
- RS-232 DB9-MF Serial to a STREAMS Field Processor (3m cable included)
- RJ45 Network Interface/LAN Port for local access to PLC

**Environmental**
- -20 C to +65 C (Operation)
- -40 to +85 C (Storage)

**Ingress Protection Rating**
- IP55

**Lamp Relearn Switch**
- Yes
**Connection Diagram**

![Connection Diagram](image)

**Ordering Information**

When placing your order please specify part number:

- TM10110 - Ramp Signal Controller, Unit, Gen-2
- C-1048 - Facility Switch, 3 Position
- C-1049 - Facility Switch, 5 Position

Both kits include power cable and 3m Serial Cable

**Facility Switch**

3 or 5 position security keyed Control Switch.

- 3 way position – Off, Auto, Flash
- 5 way position – Off, Auto, Flash, 6 second, 9 second

**Physical Specifications**

**Dimensions**

- 380mm x 270mm x 170mm (W x H x D)

**Weight**

- 4kg

**Mounting Options**

- 19" rack mount
- Direct mount
- Shelf Mount

**Warranty**

- 1 Year (return to base)

**Further Information**

The information contained in this brochure is subject to change. Transmax Pty Ltd recommends you discuss your specific requirements with us prior to placing your order.

**Transmax**

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