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WHEN MEASUREMENTS MATTER

Integration of Roadway Flood Information into an ITS Traffic Management System – An Example from Queensland, Australia

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Outline

- The problem - why it floods in Queensland – 2010/2011 floods
- Existing policy and the need for centralised monitoring and control
- STREAMS ITS Traffic Management System
- Case Study Roadway Flood Monitoring System
- Benefits of STREAMS Integrated Environmental Monitoring Systems

TMR Statistics show that…

“More than half of flood-related deaths in Queensland are a result of driving through floodwater”

(Department of Transport and Main Roads)

When it Rains, it Pours!

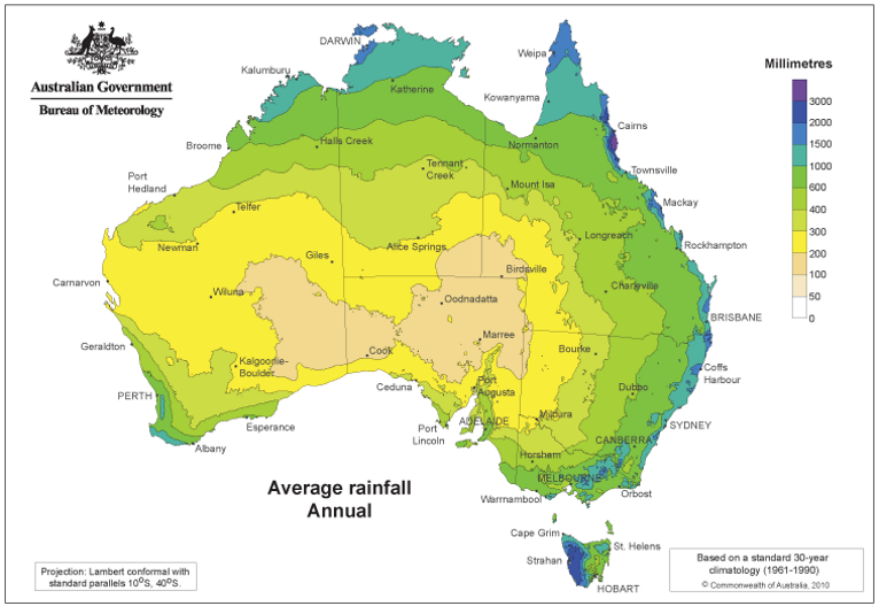

Figure 1: Average annual rainfall, Australia. (Bureau of Meteorology, 2016b).

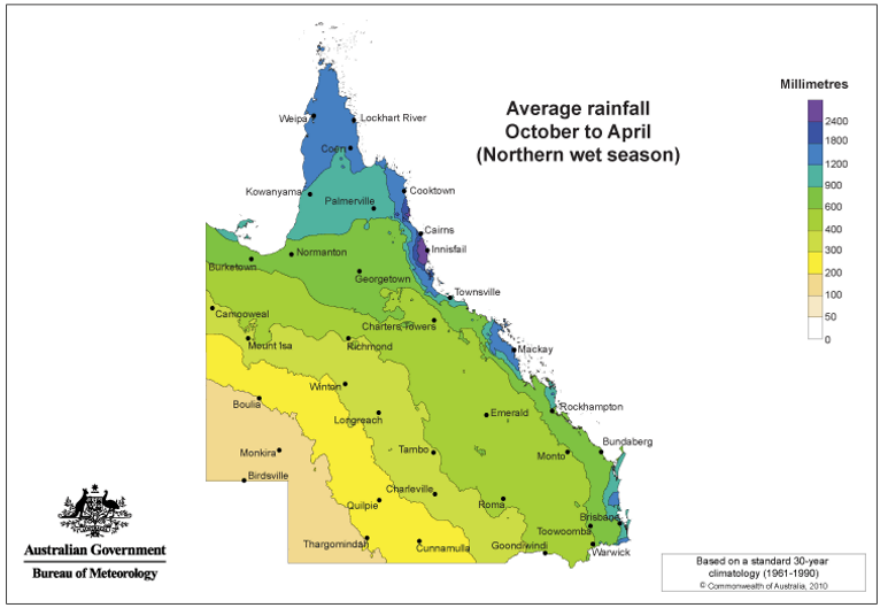

Figure 2: Average rainfall October to April, Queensland. (Bureau of Meteorology, 2016b).

- Parts of N.Qld average over 3,000 mm annually (12,400 mm record)
- La Niña events bring increased probability of wetter conditions over much of Australia

Queensland Floods 2010/2011

- Highest SOI values ever recorded
- 33 flood-related deaths
- Many due to people driving through floodwaters
- Lack of information about road conditions ahead was a contributing factor
- Department of Transport & Main Roads (TMR) tasked with improving the accuracy and timeliness of road condition information given to the public

Existing Road Closure Process

- Rely on cameras, public notification or third party roadway flood monitoring services
- Road is assessed by transport department officers or local police
- Officer closes road only after consultation with police, TMR website operators and affected residents
- Road access information submitted to the transport department and published on website

A Change in Policy

Previously:

- Proprietary software and communications protocols
- No integration with STREAMS ITS Traffic Management System used by TMR
- TMCs have no visibility of these systems within STREAMS

Going Forward:

- New Technical Specification for Roadway Flood Monitoring Systems (MRTS 233) – Requires monitoring systems to interface with STREAMS ITS System
- TMC operators can centrally monitor and control Roadway Flood Monitoring Systems

What is STREAMS?

- Integration Platform for Traffic Management Operations

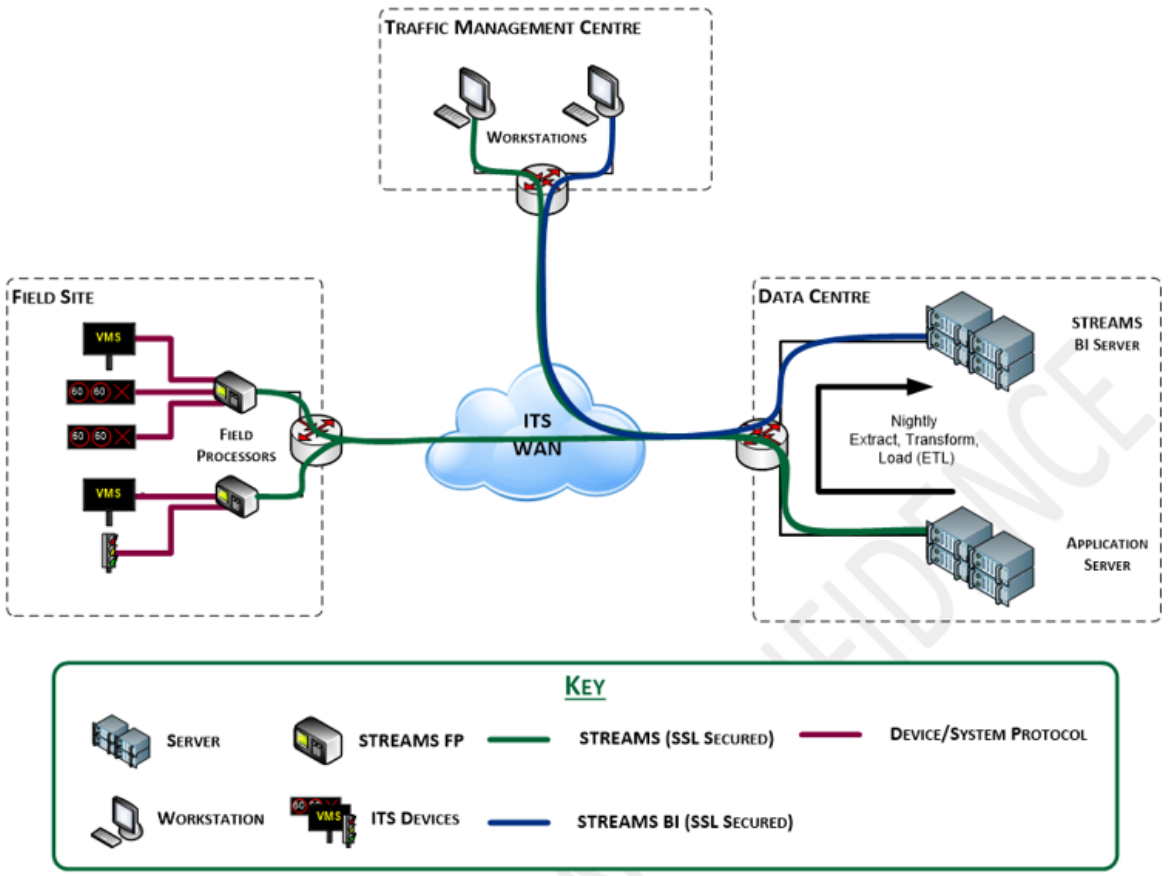

Figure 3: STREAMS distributed computing architecture.

What is STREAMS?

- Connect layer is key to the flexibility of STREAMS
- Supports multiple vendors for devices of a specific type through use of a device driver model

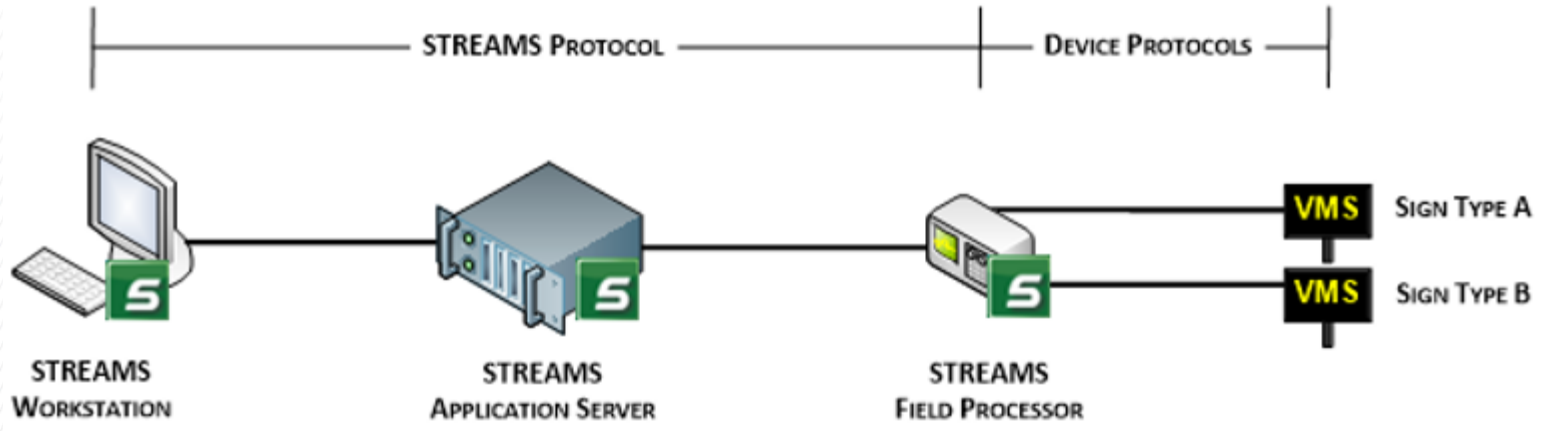

Figure 4: STREAMS Connect Layer

Benefits of Integrated Traffic Management Functions

- Synergy between existing systems and equipment – no vendor lock -in
- Secure, flexible data communications
- Reduced training and resourcing costs with a single ITS platform
- Single UI – optimised road network management
- Modular, scalable architecture allowing streamlined migrations and upgrades
- Efficient data management

Case Study – STREAMS Integrated Roadway Flood Monitoring System

Figure 5: Location of the Glendale Drive floodway in the suburb of Annandale, Townsville, North Queensland. (Google Maps, 2016).

Glendale Drive Floodway System

Figure 6: Radar Roadway Flood Monitoring System installed at the Glendale Drive floodway in Townsville.

- Non-invasive CS475 radar sensor
- Solar powered with RF comms to nearby CR800 datalogger
- IP connection into TMR private network via Telstra UC-372SP3GE modem
- CR800 – Modbus to STREAMS Communications Processor (CP) located in TMC
- Data sent from CP to Application Server and presented as a Simple Device Value
- Allows any semantically similar device to be ingested and displayed

Glendale Drive Floodway System

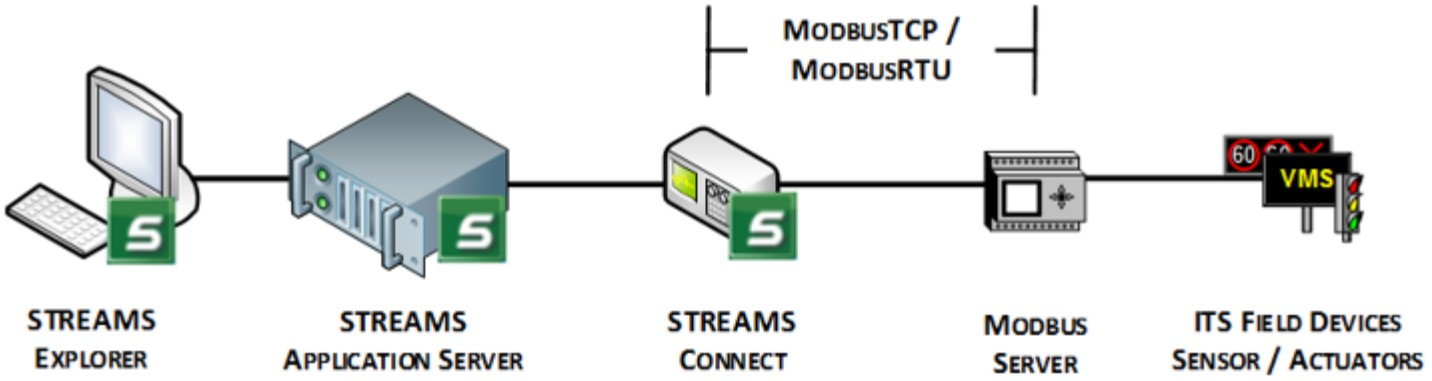

Figure 7: Communications schematic for the Glendale Drive Floodway in Townsville

Glendale Drive Floodway System

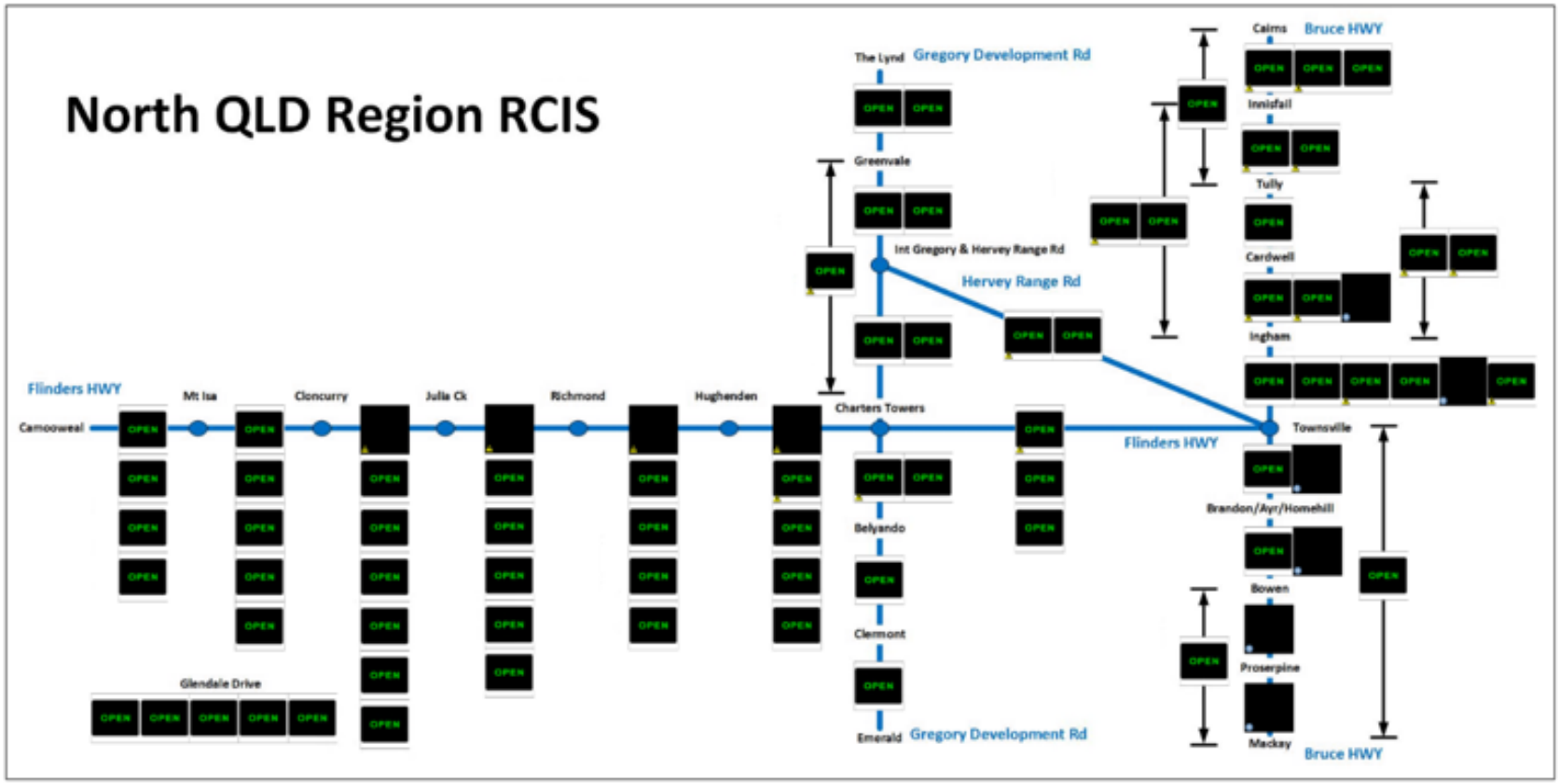

Figure 8: Example STREAMS user interface for a Roadway Flood Monitoring System.


orth QLD Region RCIS

Automated Responses

STREAMS Stimulus/Response Engine:

- TMC Operators select thresholds/conditions for alarming
- Once met, the software automatically sets a response on any actuator device (e.g. Road Condition Information Sign (RCIS)).

- 5 RCIS within Glendale Drive system
- Water Level automated response:

Less than 0.03m	OPEN
Between 0.03m and 0.09m	CAUTION
Greater than 0.09m	CLOSED

Sample Flood Event – 16/03/16

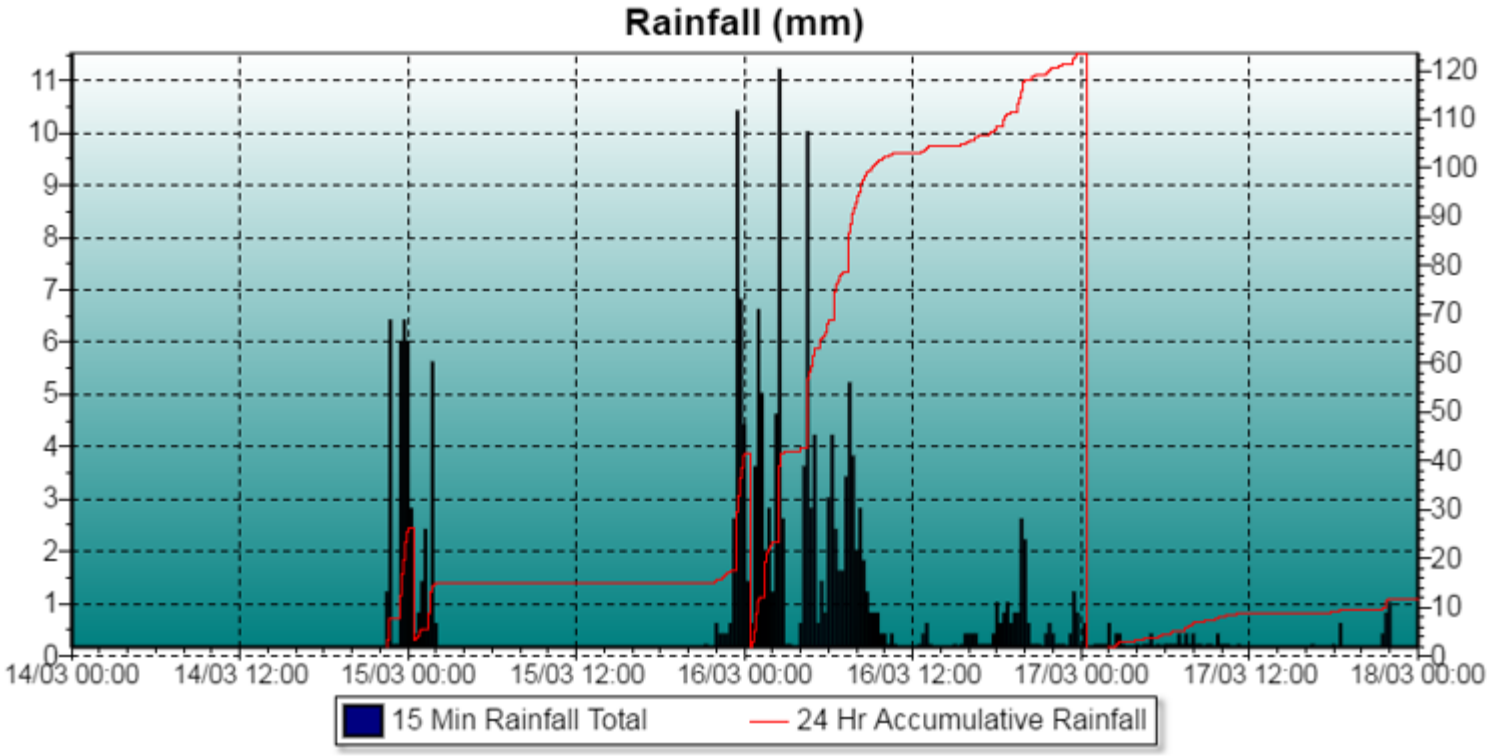

Figure 9: Rainfall data (14/03/16 00:00 to 18/03/16 00:00) from a weather station located 5.6 km North West of the Glendale Drive Roadway Flood Monitoring System. Right axis indicates 24 Hour Accumulative Rainfall totals. (Campbell Scientific Australia, 2016).

Sample Flood Event – 16/03/16

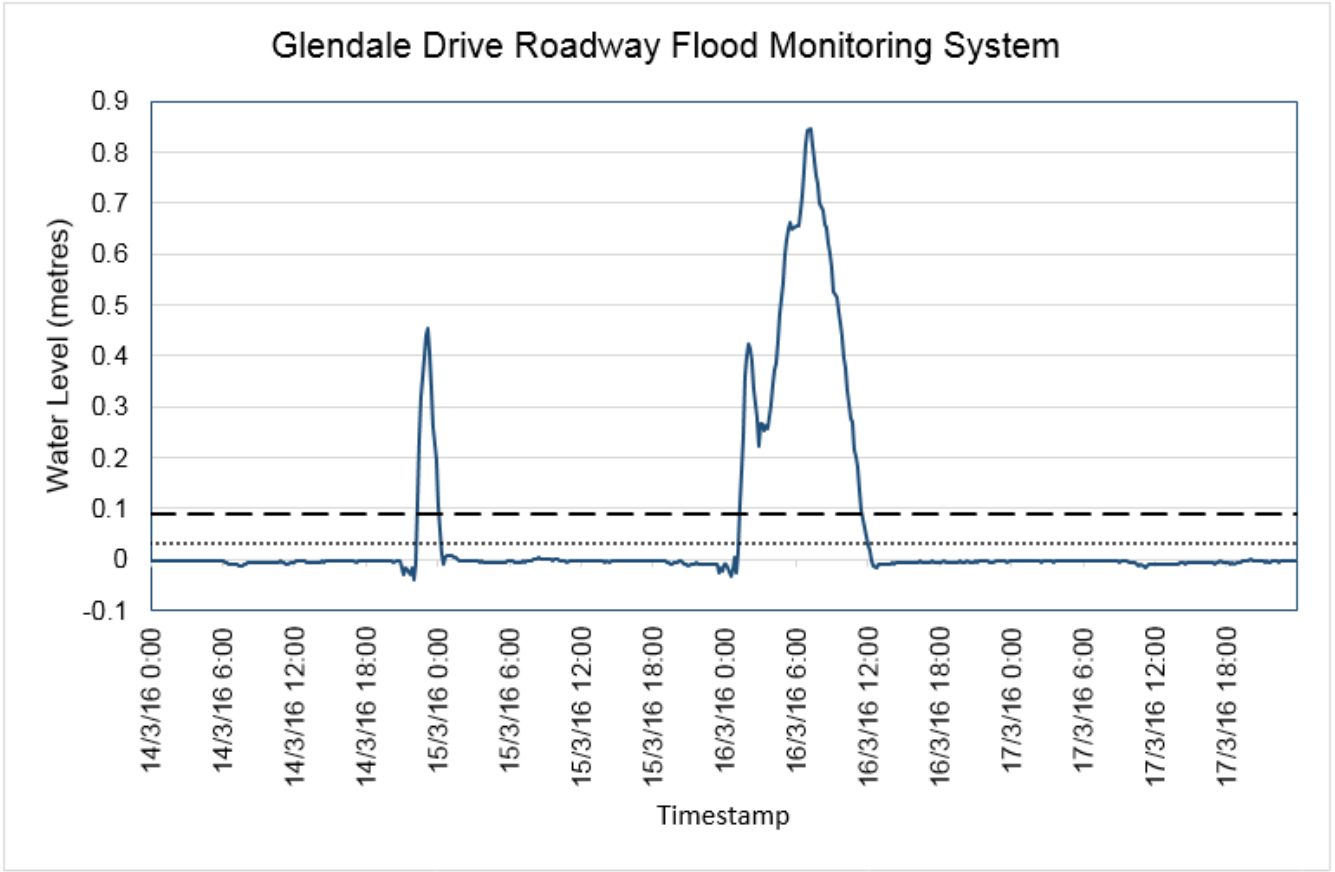

Figure 10: Radar water level data (14/03/16 00:00 to 18/03/16 00:00) measured by the Glendale Drive Roadway Flood Monitoring System.

Sample Flood Event – 16/03/16

Figure 11: Glendale Drive floodway on 16th March 2016 under road closed conditions.

Main Benefits of a ITS Integrated RMFS

- Full visibility of flood conditions within a TMC with automated response engines
- Ensures timely distribution of road condition information to commuters (instantaneous)
- Allows for automated road closures during flood events
- Operational efficiency with re-opening of roads and bridges
- Reduced inconvenience to commuters whilst maintaining safety standards
- Optimised road network management and future cost savings through reduced training and resourcing costs and efficient data management

Other Road Weather Data

- Visibility
- Temp/RH
- Wind Speed/Direction
- Rainfall
- Ice Detection
- Surface Friction
- Surface Temp

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Questions

An extended version of this paper is available at the following web address:
https://s.campbellsci.com/documents/au/technical-papers/road_flood_monitoring_systems.pdf