Asia-Pacific
Economic Cooperation

2017/TPTWG/WKSP1/007

Overview of Technology Responses to Overloading

Submitted by: Australia

Workshop on Regulating High Mass Heavy Road Vehicles for Safety, Productivity and Infrastructure Outcomes
Brisbane, Australia
3-6 April 2017

Overview of Technology Responses to Overloading

APEC Transportation Working Group Workshop – 3 April 2017

Geoff Smith Manager (TSDM)

Our values, our diversity

Customers first

Unleash potential

Be courageous

Ideas into action

Empower people

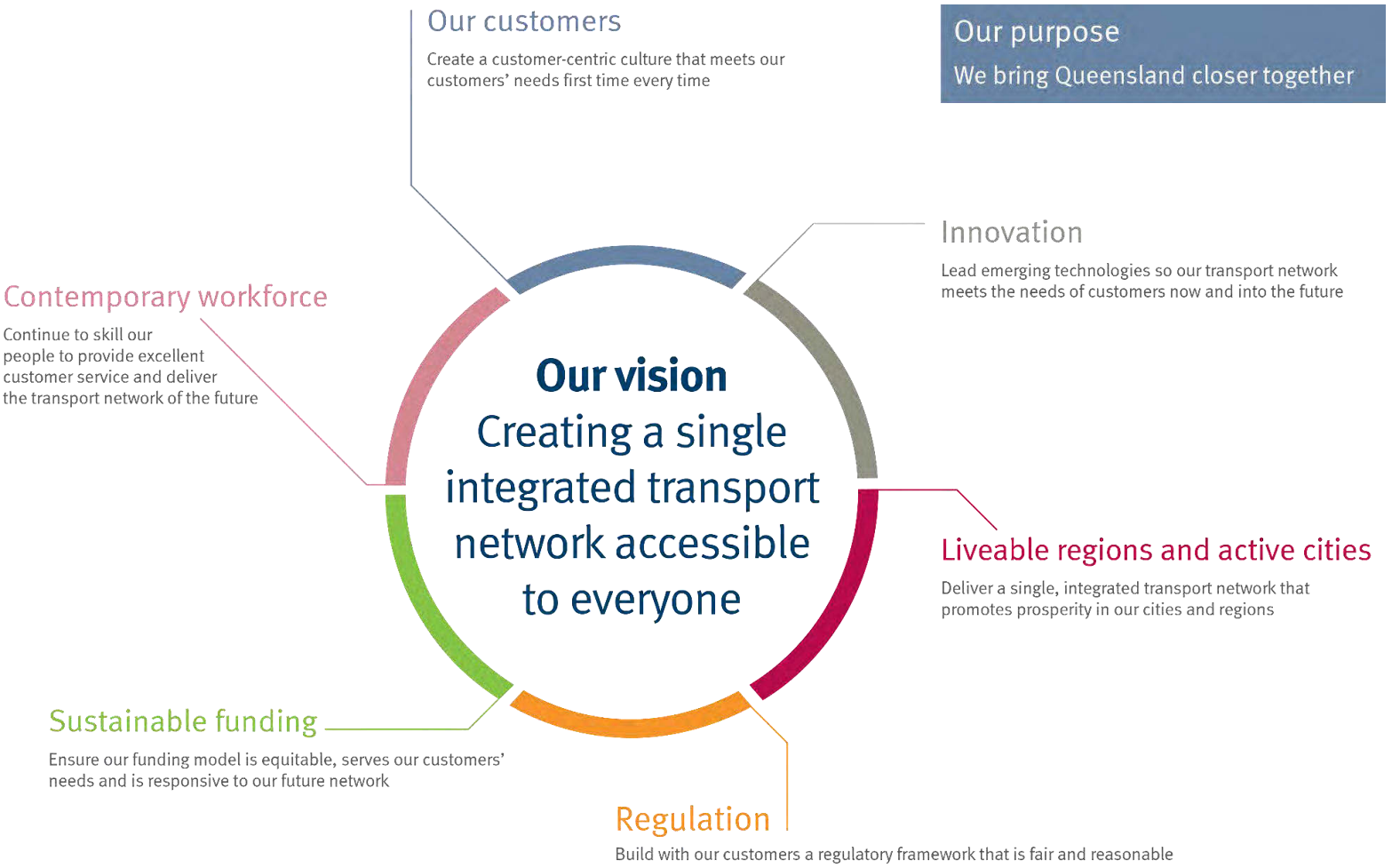
diversity

inspire create innovate

Queensland Government's objectives for the community

Advance Queensland

Our strategic plan



About us…

Creating a single integrated transport network accessible to everyone

As at 30 June 2016 we manage:

33,343km
state-controlled roads

3,029
bridges

20
ports

As at 30 June 2016:

3.5m
drivers licensed

5m
vehicles registered

3,260
taxis licensed

256,151
recreational vessel registrations

997,289
boat licenses

3.63m
customers served face-to-face at
59
Customer Service Centres

Our customers conducted
6.68m
online services

As at 30 June 2016 there were:

180m
in SEQ

12.1m
outside SEQ

trips taken annually on bus, rail, ferry and light rail

2.5m
go cards in use

Over 490,000
passengers travel on the south-east Queensland network on average each day

Heavy Vehicle Compliance

Cost of Overloading

- An assessment of the impact of overloading on the road asset was estimated as an extra $30m-$45m per annum (in 1999$). It was also noted that the estimated efficiency gains for new works for that year was $80m.

- In effect half of the network efficiency gains were being lost to accelerated asset damage

Cost of Overloading

- As a general rule, a 1 year reduction in pavement life (from a 20 year design life) can be expected for every 1% increase in overloading

- Current industry design and load/damage calculations indicate that:
  - For unbound pavements – a 20% overload is 2 times more damaging than the legal load
  - For asphalt pavements – a 20% overload is between 3 – 4 times more damaging than the legal load
  - For cement pavements – a 20% overload is between 9 – 10 times more damaging than the legal load

Key Technologies

Weigh in Motion (WiM)

Weighbridge

ANPR Camera

Weigh in Motion (WiM)

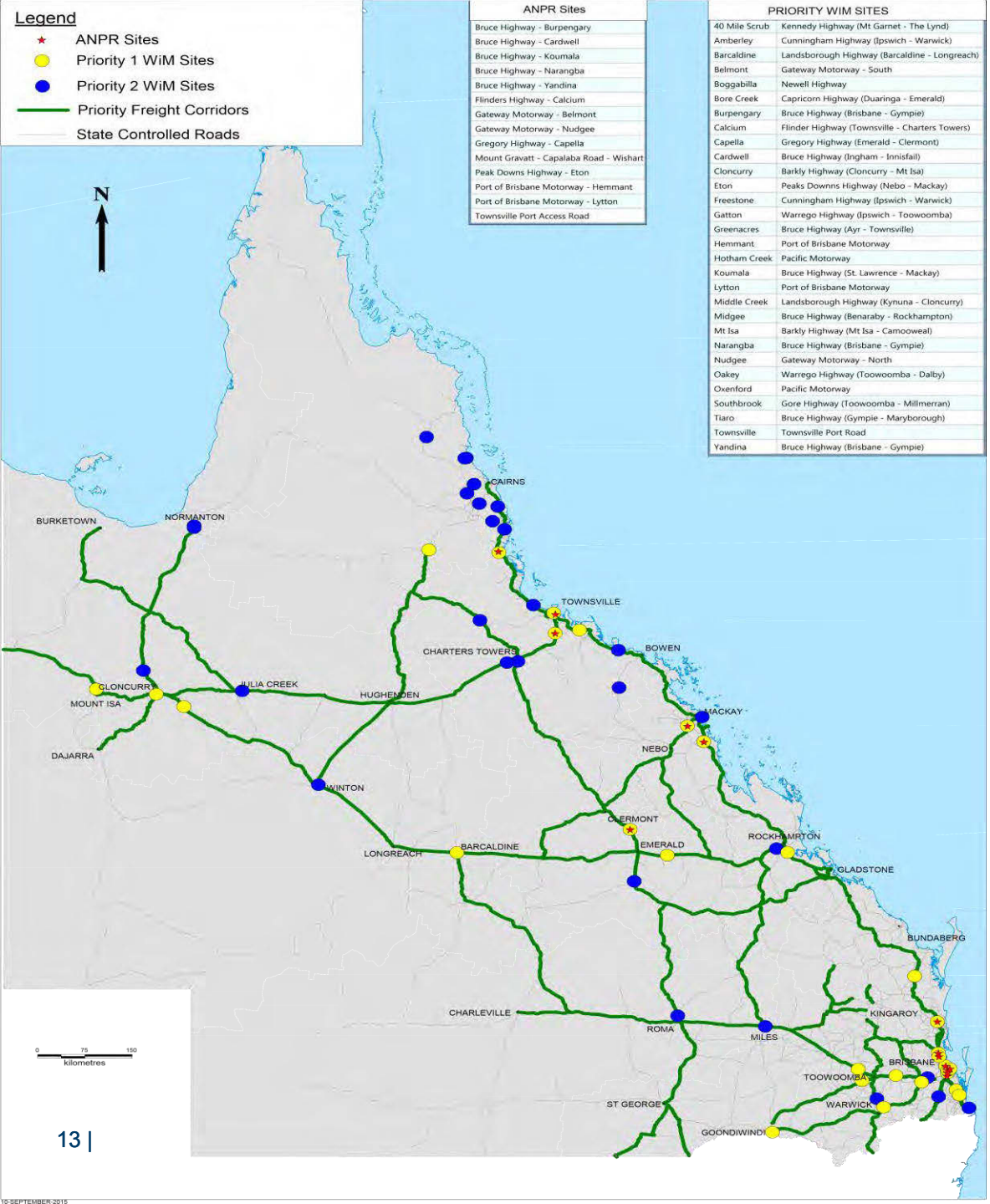
- Austroads (2000) defined Weigh in Motion (WiM) as a device that measures the dynamic axle mass of a moving vehicle to estimate the corresponding static axle mass

Weigh in Motion (WiM) Site Strategy

- Key freight routes
- Cordon lines around freight generators or hubs such as ports, freight depots and mines
- Entry/exits to adjacent state borders
- Supporting interception sites as a pre-selection tool
- Protection of susceptible pavements and bridges
- Sites delivered under major projects to inform a pavement maintenance contract

Key Freight Routes

Location of WiM Sites

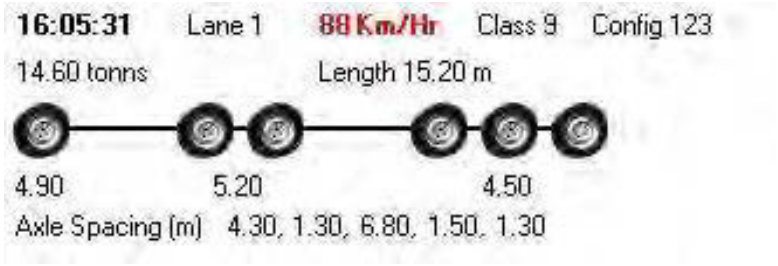


Heavy Vehicle Interception Site


Entrance to Weigh Station
WiM Site
TMR Weigh Station
20. 2. 2004

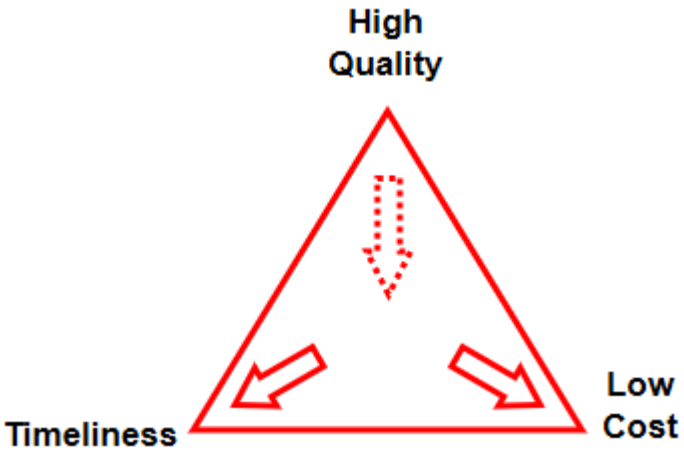
WiM Data Types

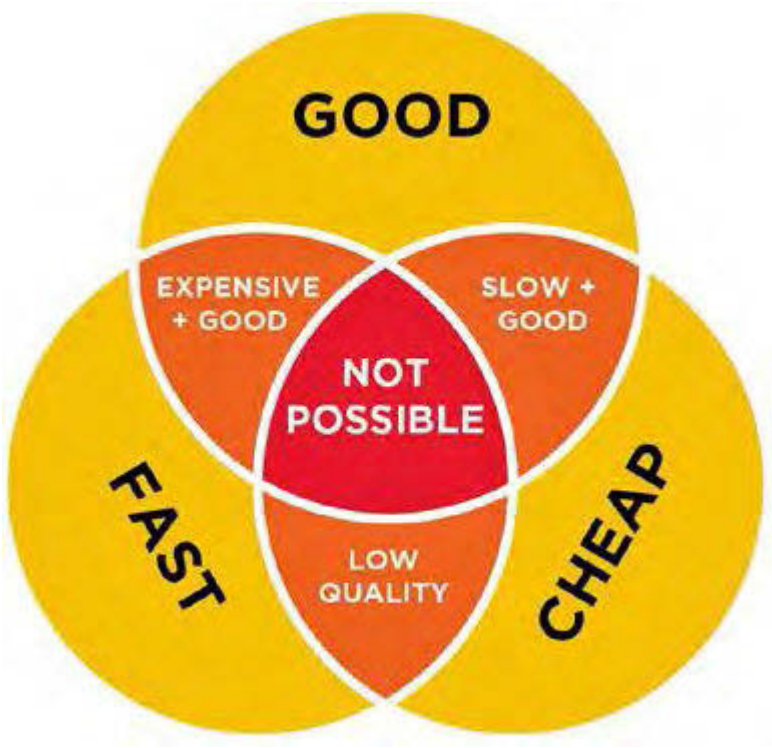
- Vehicle Configuration
- Austroads Vehicle Class
- Speed
- Axle Spacings
- Axle Group Mass
- Gross Vehicle Mass



Data Strategy

- Choose from:
  - High quality
  - Low cost
  - Timely to implement





WiM - Data Utilisation

1. Asset Preservation
   - Compliance programming
   - Vehicle selection
2. Asset Management
   - Heavy vehicle access
   - Freight management

WiM - Data Utilisation

3. Asset Maintenance

- Capital and maintenance funding
- Pavement and bridge design

4. Asset Operations

- Traffic management & network operations (traffic data)

5. Road Safety e.g. fatigue management

ANPR Camera – Data Utilisation

- Overload Management
- Heavy vehicle route enforcement
- Driver fatigue management
- Time over distance speed
- Traffic Planning
  - Origin Destination (OD) Surveys
  - Travel Time Surveys

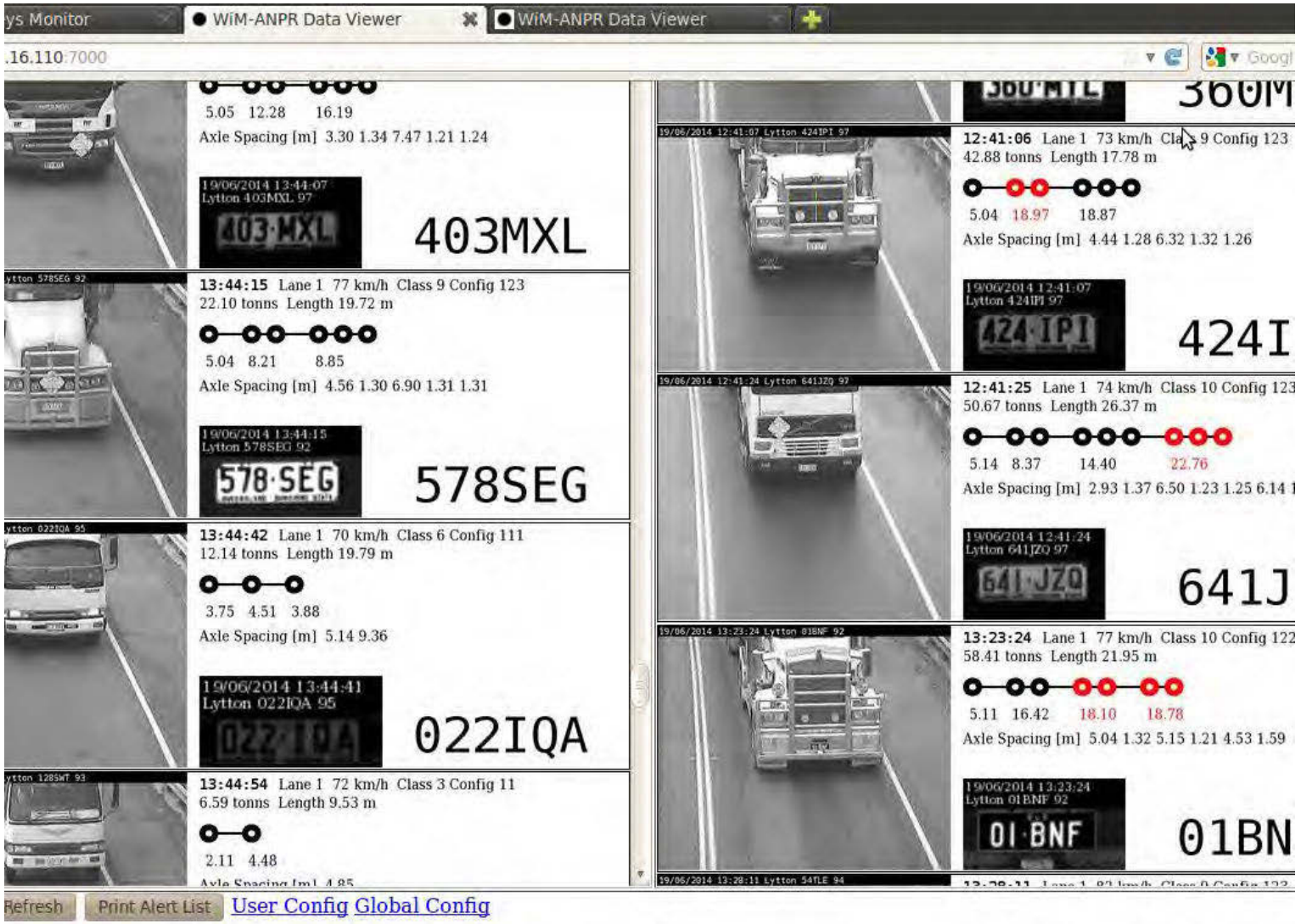
Co-location of WiM/ANPR

- Provides intelligence for compliance activities
  - Targeted education campaign to peak industry groups
  - Supports Chain of Responsibility investigations
  - Targeted enforcement (repeat offenders)
  - Select overloaded heavy vehicles from the traffic stream without inconveniencing responsible operators

Co-location of WiM/ANPR

- Road Safety Benefits
  - Reduced on-road activities by TMR compliance officers
  - Reduced incidence and severity of overloaded heavy vehicles
  - Reduce potential for traffic incidents by limiting the extraction of heavy vehicles from the traffic stream

Vehicle Display



Thank you and stay connected

Twitter @TMRQld

Facebook @TMRQld

LinkedIn Department of Transport and Main Roads

Blog blog.tmr.qld.gov.au

Technology Solutions

APEC Transportation Working Group Workshop – 4 April 2017

Geoff Smith Manager (TSDM)

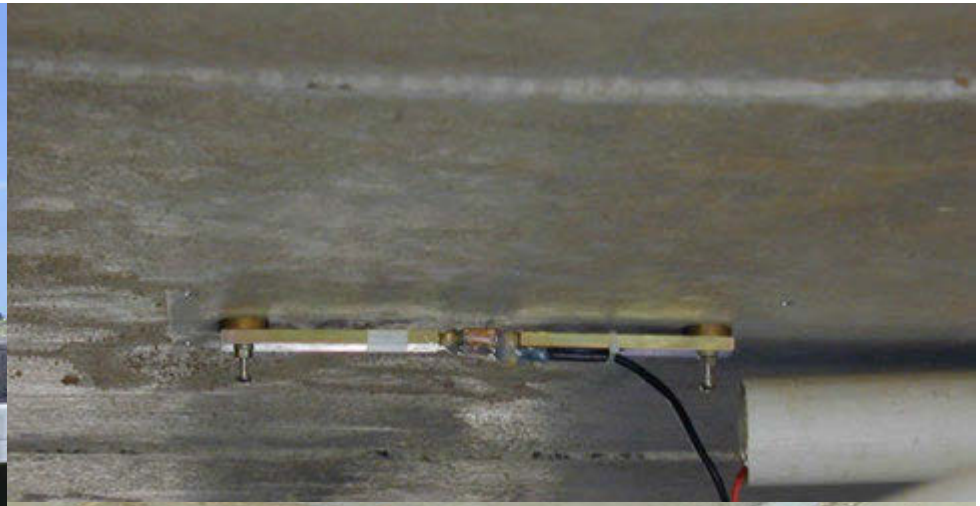
WiM System Components

- Mass sensor
- Vehicle/axle detectors
- Field processor
- Communications

WiM Sensor Technology

- Strain gauge - Culway
- Piezoelectric Sensor
- Kistler Lineas Sensor – Quartz piezo
- Capacitive Pad
- Bending Plate

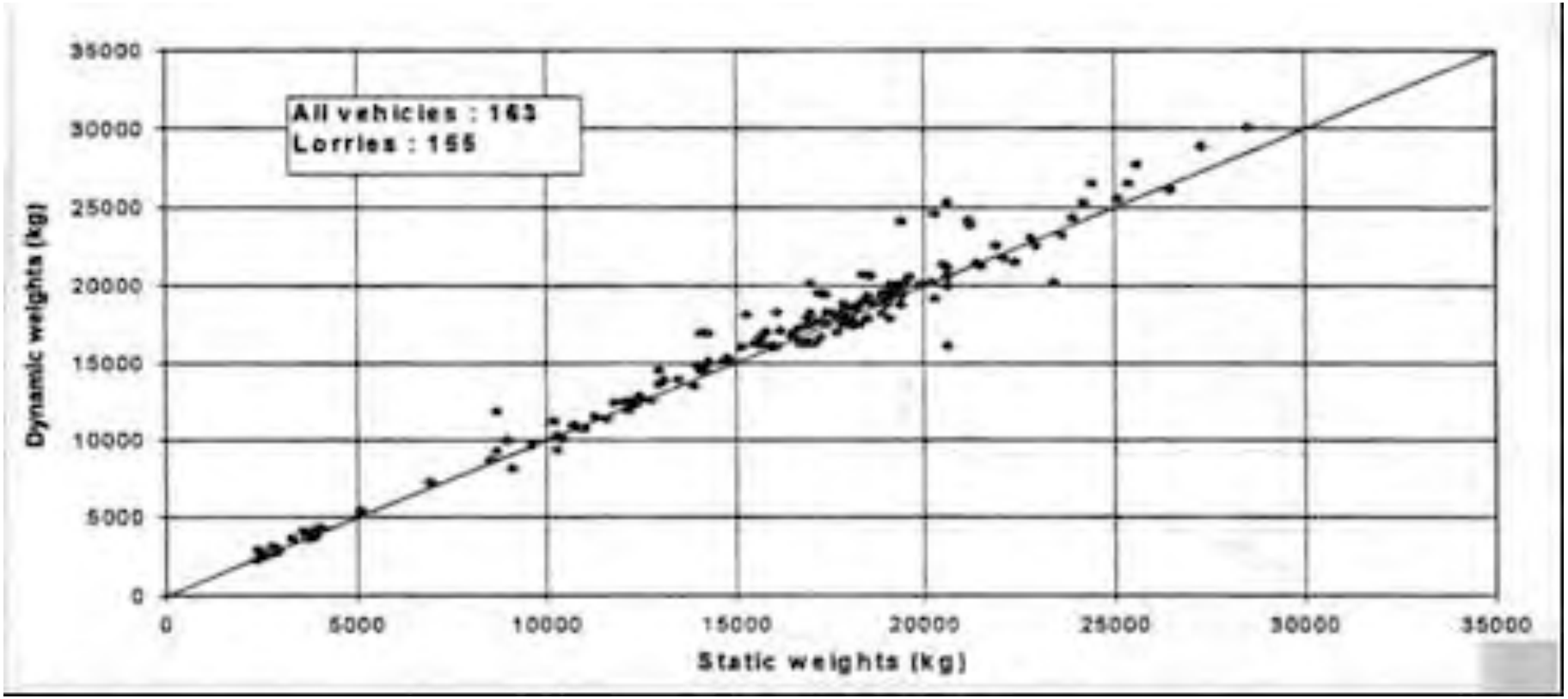
Culway Installation



Why Piezo Based WiM?

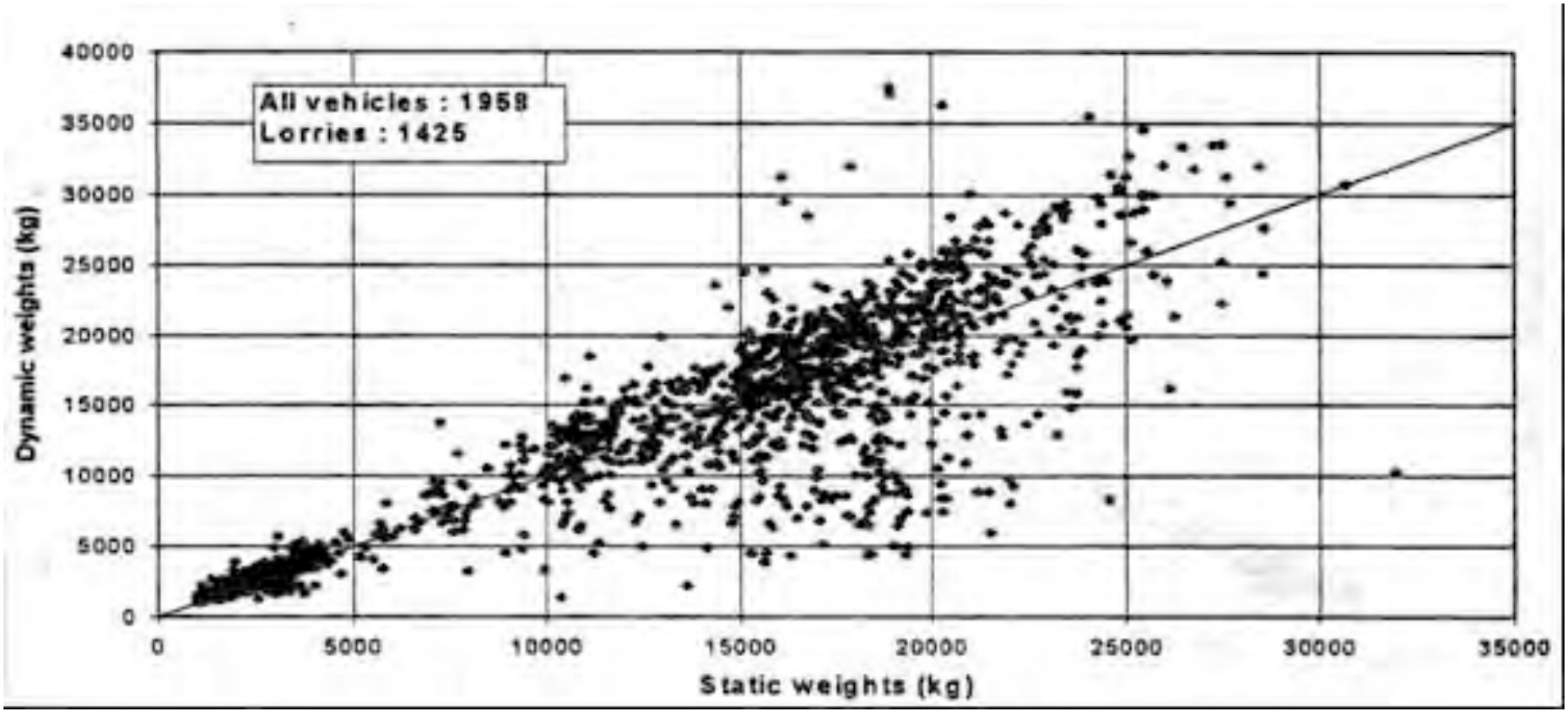
- Absence of suitable culverts
- Lower sensor cost and the ease of installation
- The expense of concrete or deep lift asphalt pavement for plate solutions
- Superior multi-lane solution

Scatter of Typical Dual Pad System



Source Mikros Systems

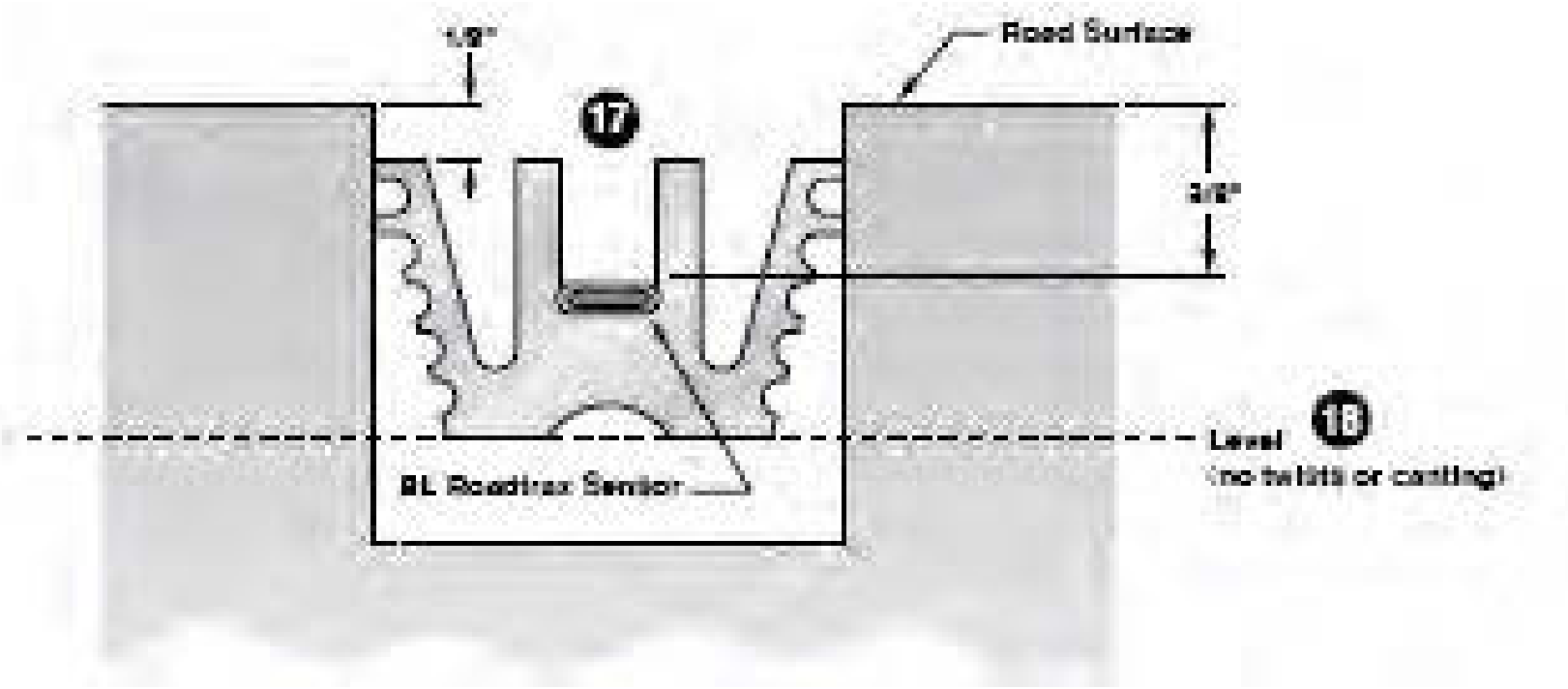
Scatter of Typical Piezo Sensor System



Source Mikros Systems

BL Piezo Installation

BL Piezo Installation



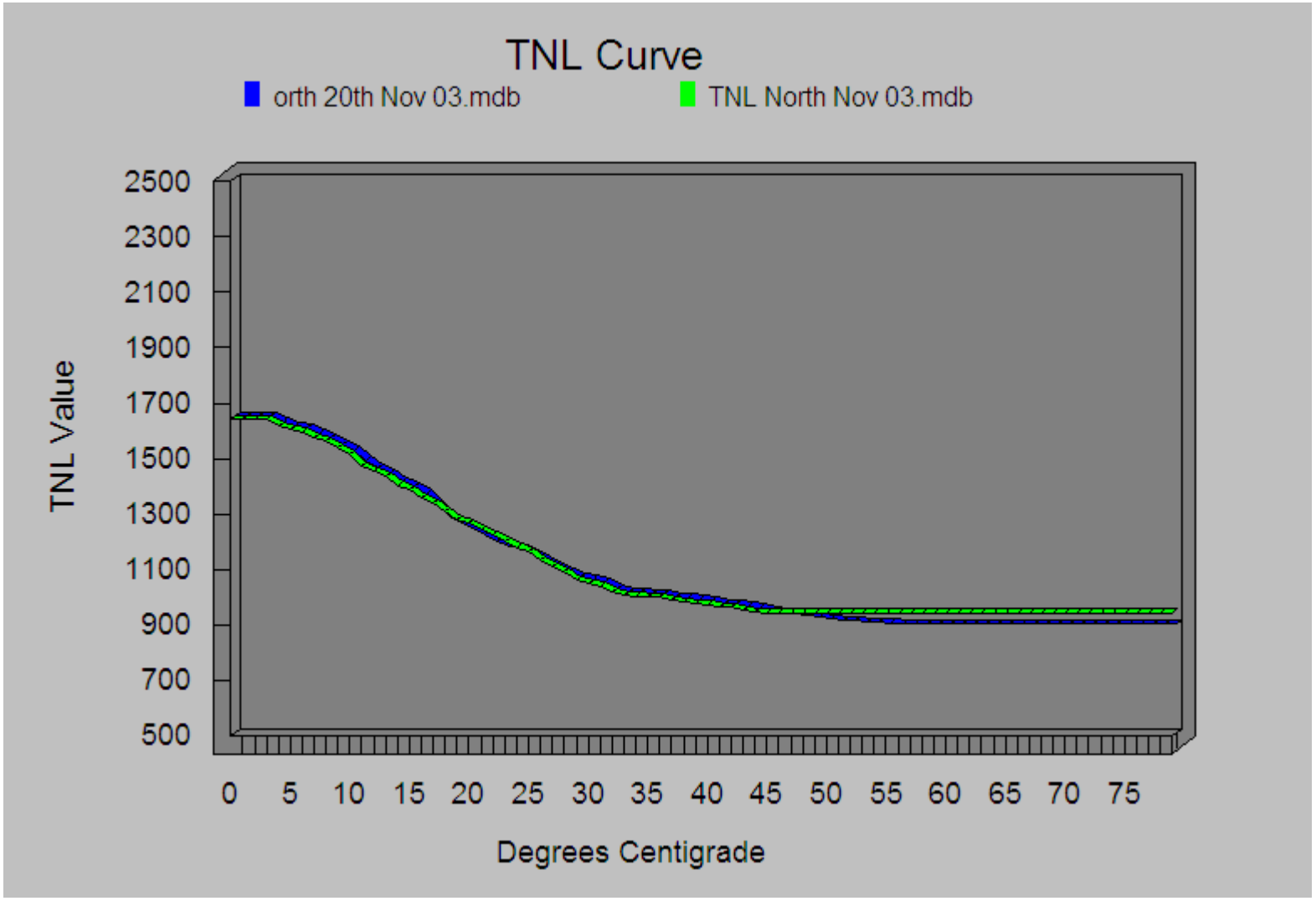
Source MSI Sensors

BL Piezo Installation

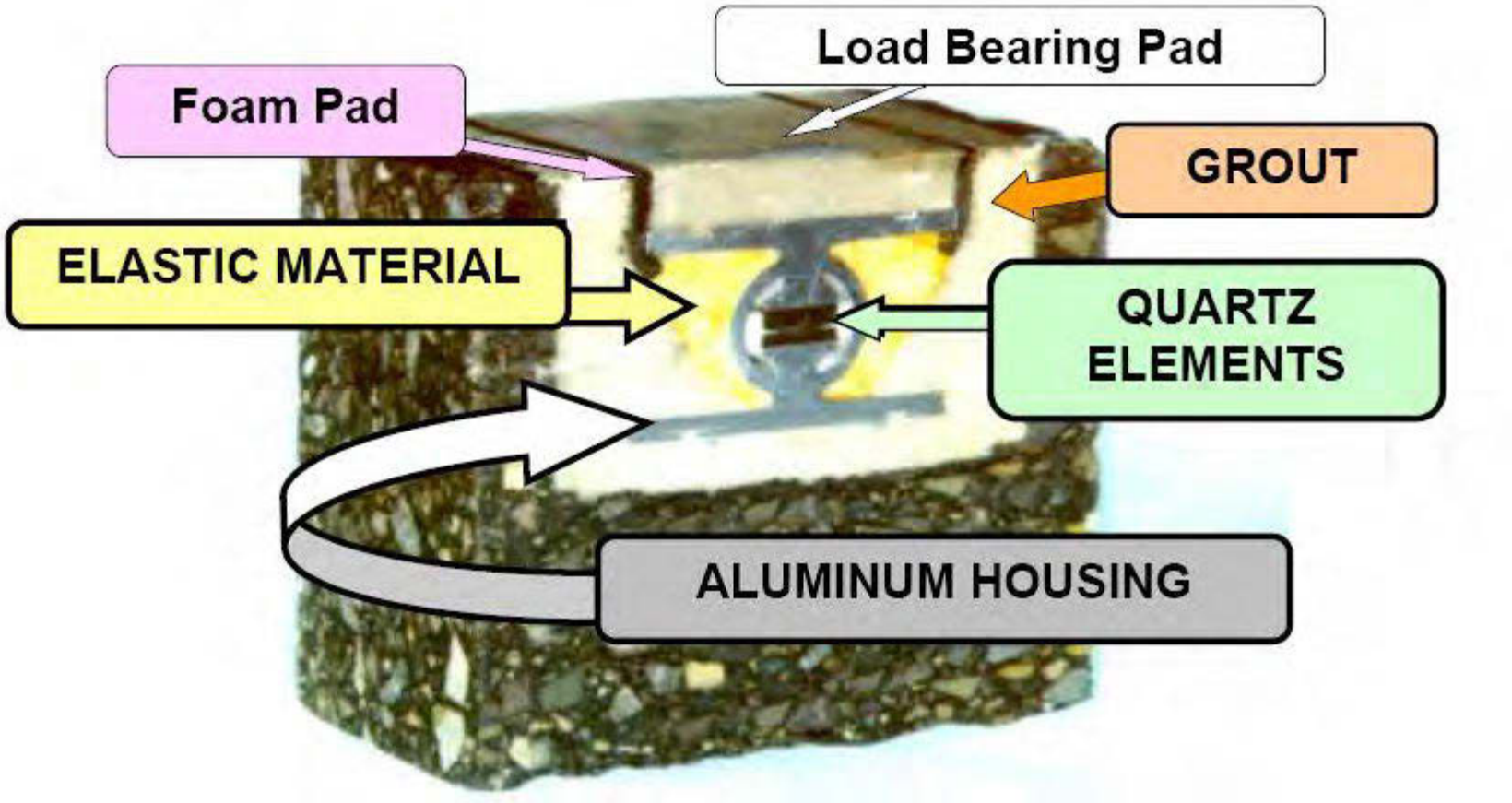
Qld Experience Piezo WiM

- First site installed in 1999
- Temperature compensation is essential
  - Without temperature correction, mass recorded in afternoon could more than double that recorded in the morning (same vehicle and load)
- Piezo sensors are not only very sensitive to temperature changes but also sensitive to the rate at which the temperature changes

Typical Temperature Compensation



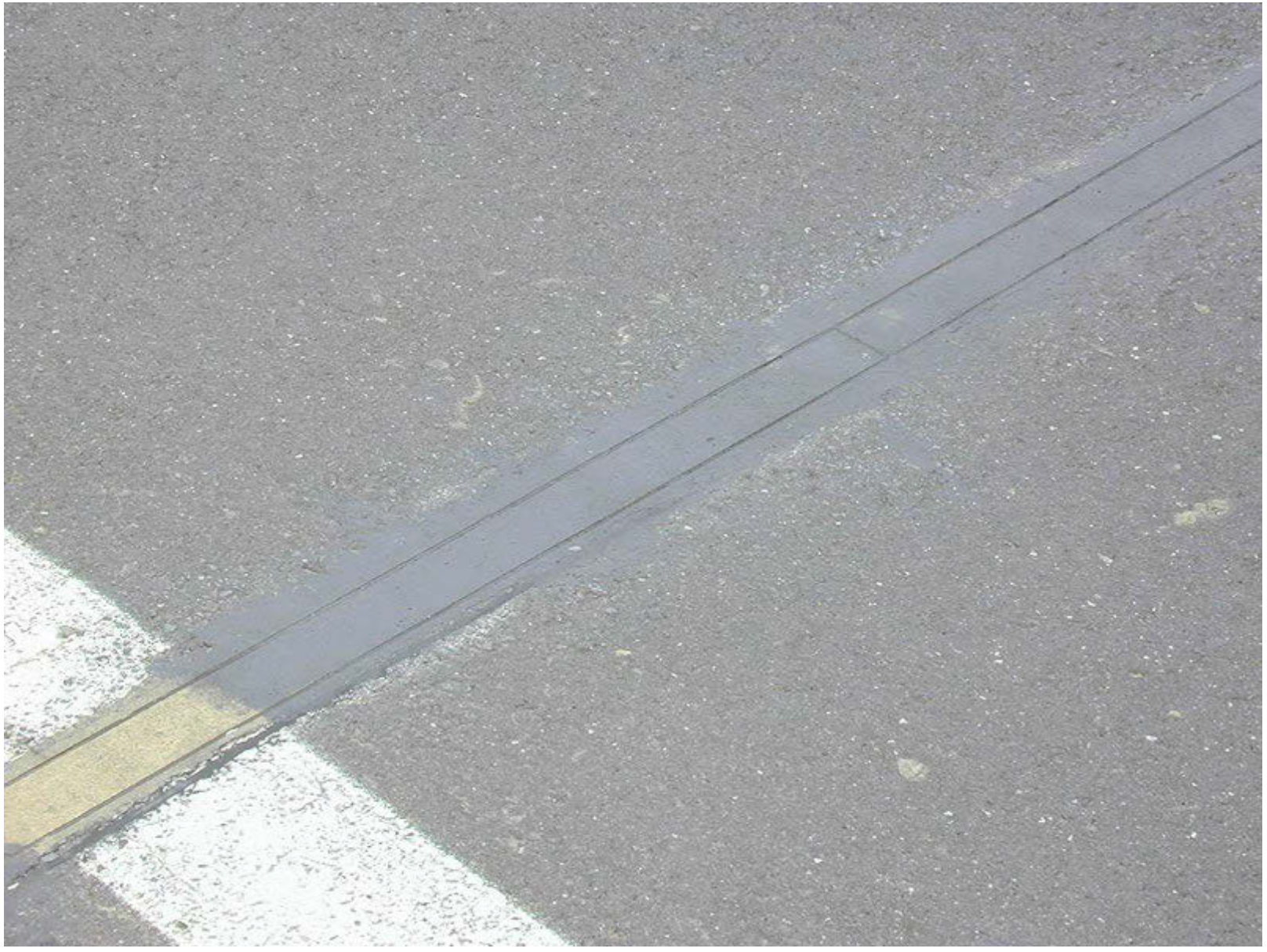
Cross Section of Kistler Piezo



Kistler Piezo

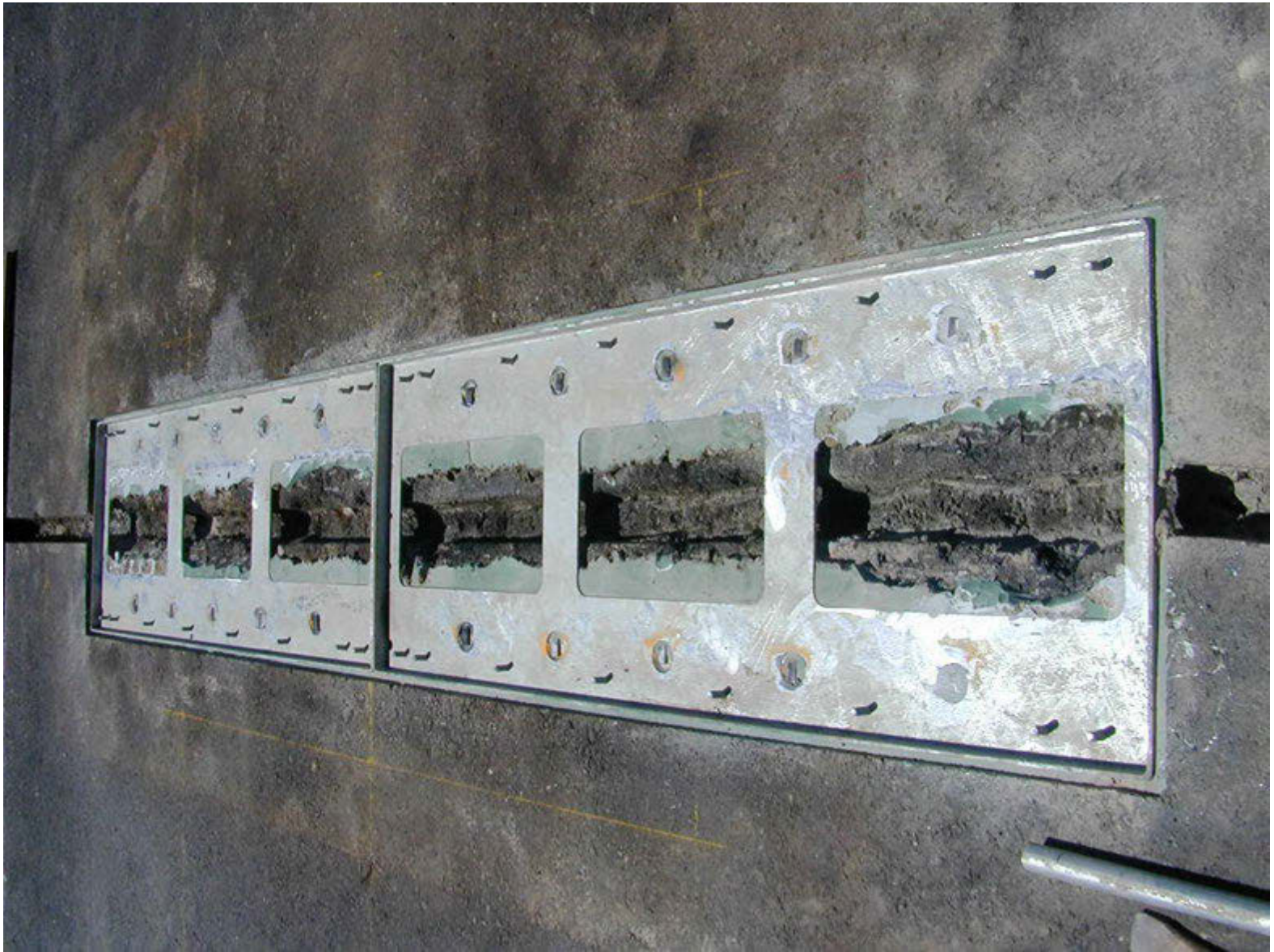
Kistler Piezo

Kistler Piezo



Bending Plate

Bending Plate



Bending Plate

WiM Accuracy Classes – TMR

- Class A
  - For legal purposes such as enforcement of legal weight limits for example, IAP audit. None of the existing WiM sites in Queensland currently achieve this level of accuracy
- Class B
  - For infrastructure design, pre-selection of overloaded vehicles
- Class C
  - Detailed statistical analysis, infrastructure planning, freight planning and regulation and targeted enforcement
- Class D
  - Binary level of accuracy that is, loaded or unloaded only - essentially an intelligent vehicle classifier. Suitable for traffic studies plus limited freight planning and regulation

WiM Accuracy Classes

	A_1	B_2	C_3	D_4
	Tolerance for 95% Probability of Conformity			
Gross	±6%	±10%	±15%	±25%
Axle Group	±10%	±15%	±20%	
Single Axle	±15%	±20%	±30%	

1 - equivalent of ASTM Type III (6%)
2 - equivalent of ASTM Type I (10%)
3 - equivalent of ASTM Type II (15%)
4 - equivalent of Euro Type D (25%)

WiM Accuracy – Contributing Factors

- Sensor configuration and type
- Pavement quality and smoothness – key component
- Calibration procedure and frequency
- Condition of sensors
- Vehicle behaviour

Pavement Condition

- Site considered unacceptable for WiM if any of the levels of pavement smoothness exceeded
- Site assigned an accuracy class of "D" – binary WiM site.

Site Class	Excellent	Good	Acceptable
Rutting (3m straightedge)	≤ 4mm	≤ 7mm	≤ 10mm
Roughness (NRM)	0 – 33	33 – 68	68 – 105

WiM Site Availability

- Goal is for WiM sites to fully operation 24/7
- Equipment malfunctions, telemetry outages and pavement failures will impact on availability and reliability of data
- Realistic goal is 80% availability

Good	Fair	Poor
>= 90%	>= 80% < 90%	< 80%

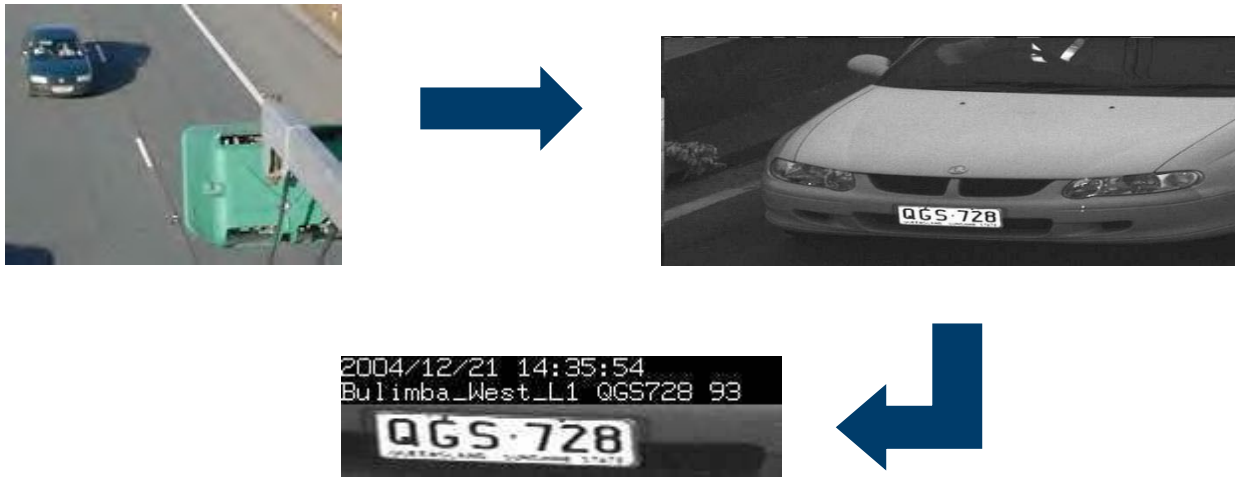

MIDDLE CREEK

WiM Site Maintenance

In most instances the source of an outage to a WiM site is related to the condition of the pavement

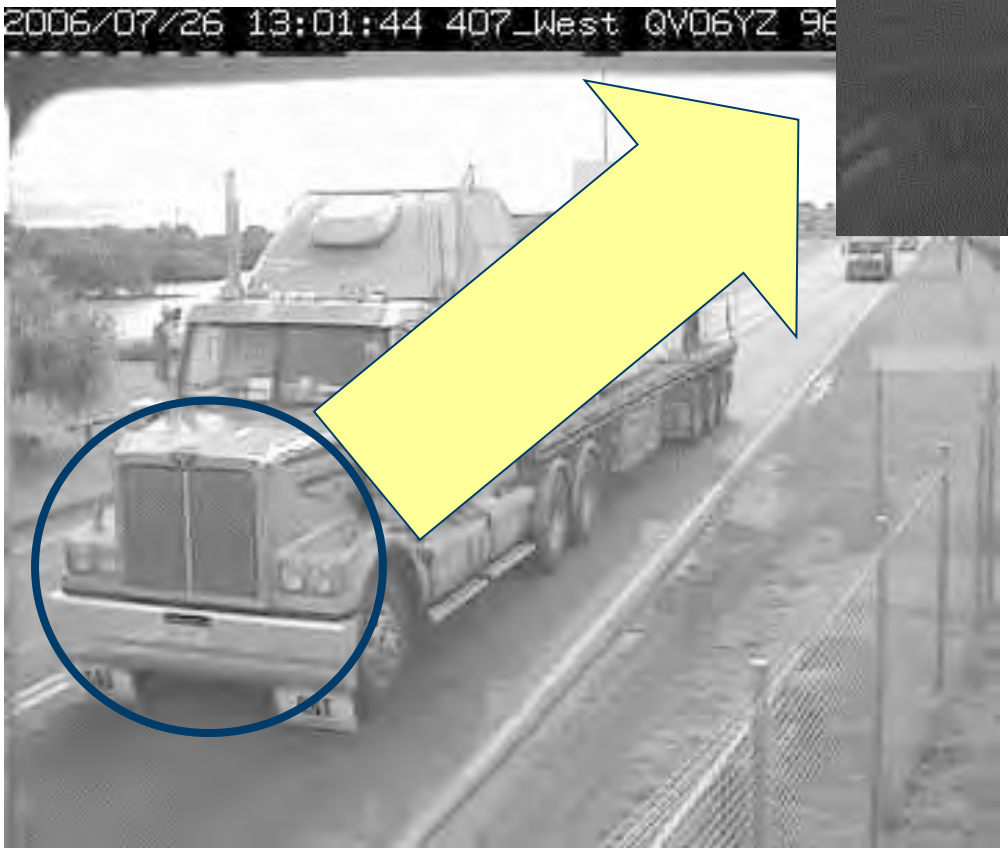
Automatic Number Plate Recognition (ANPR) Technology

- Utilises infra-red cameras to automatically capture images of vehicle number plates and record registration number, date and time



Day Capture

Scene Image

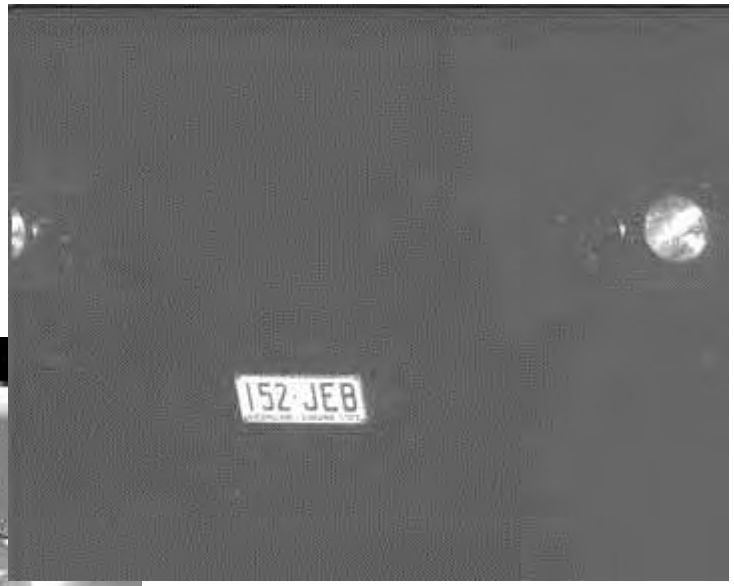


Infrared Image

Plate Capture

Night Capture

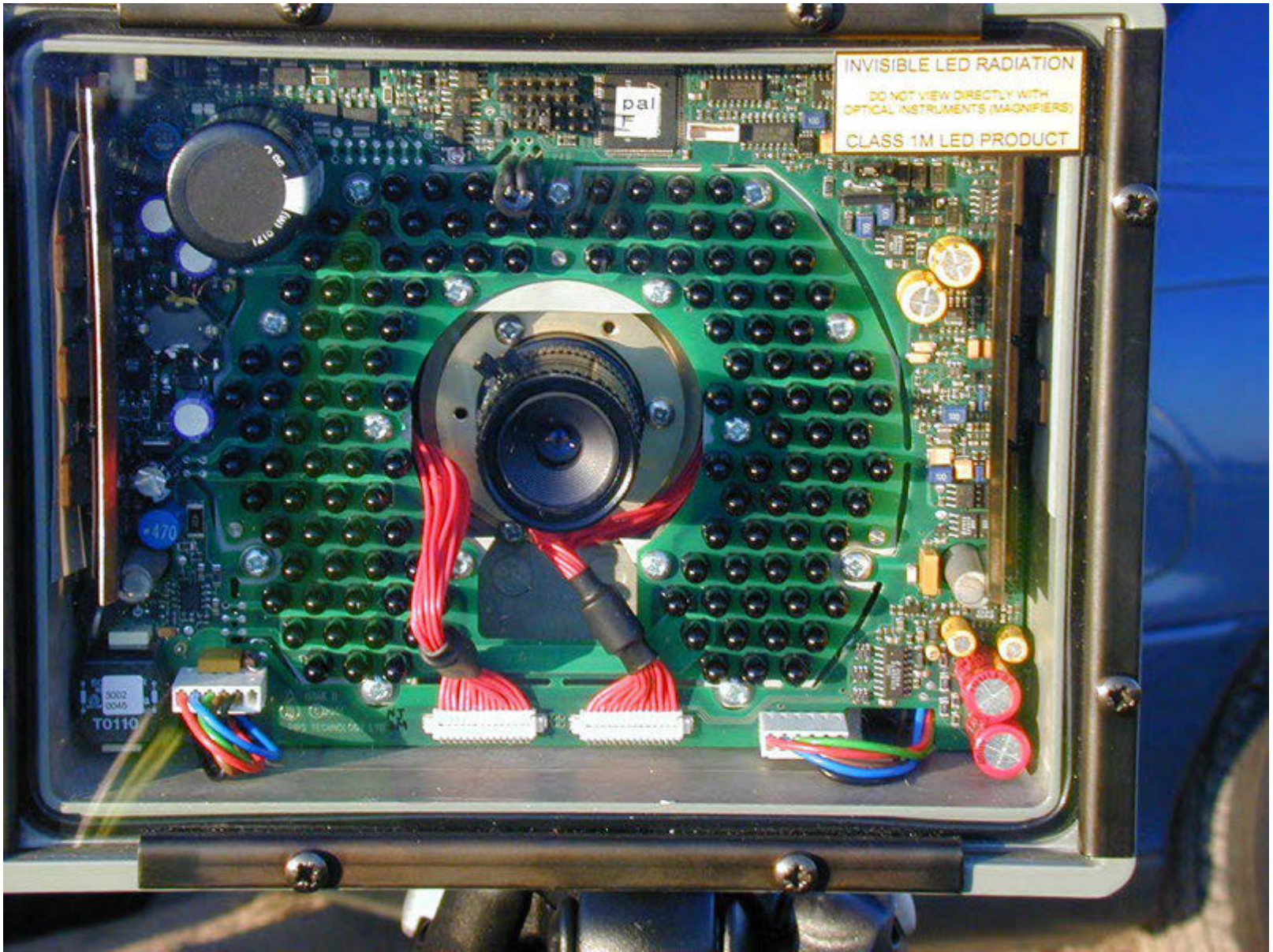
Scene Image



Infrared Image

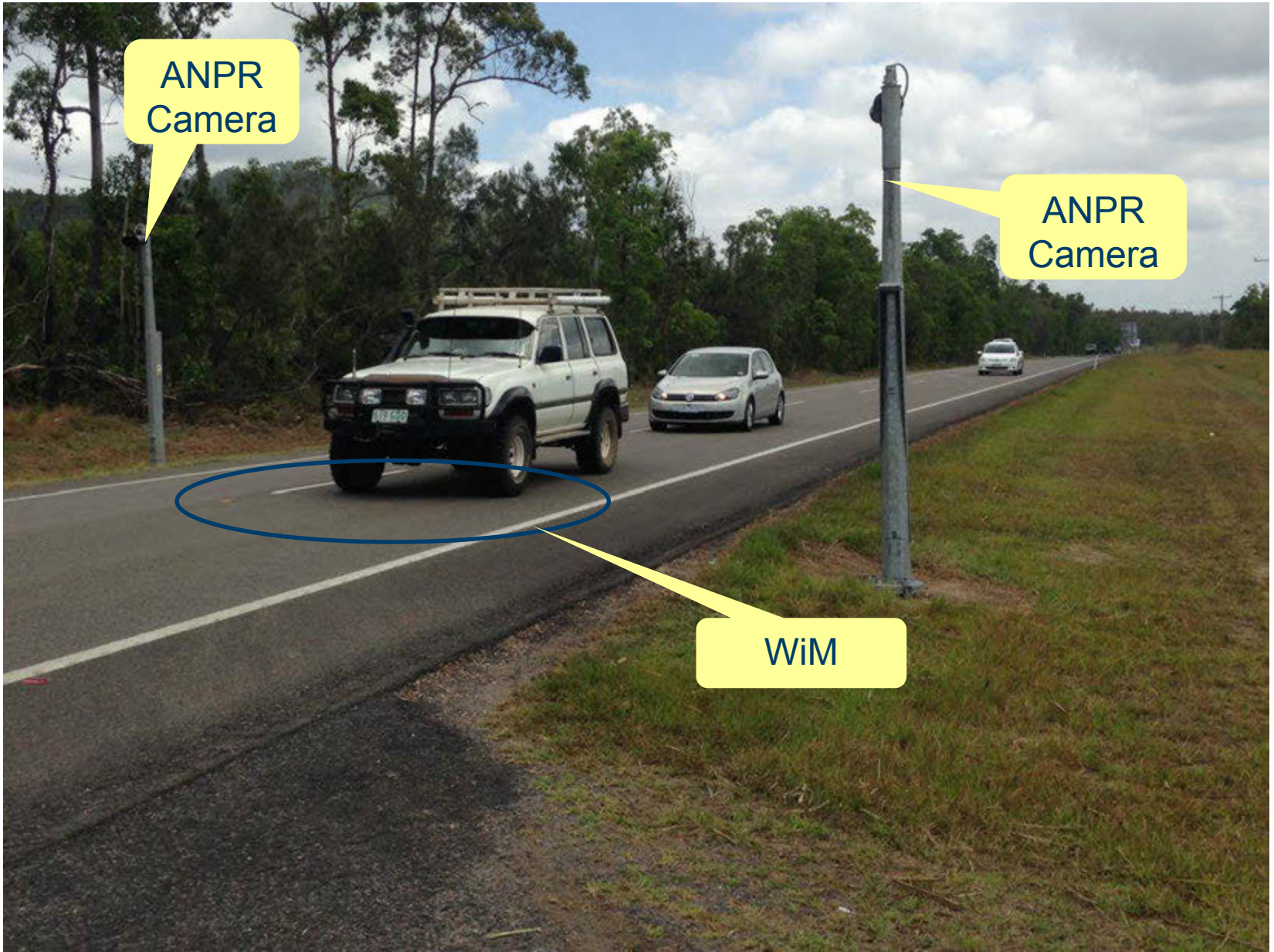
Plate Capture

Typical ANPR Camera



ANPR & WiM - Motorway

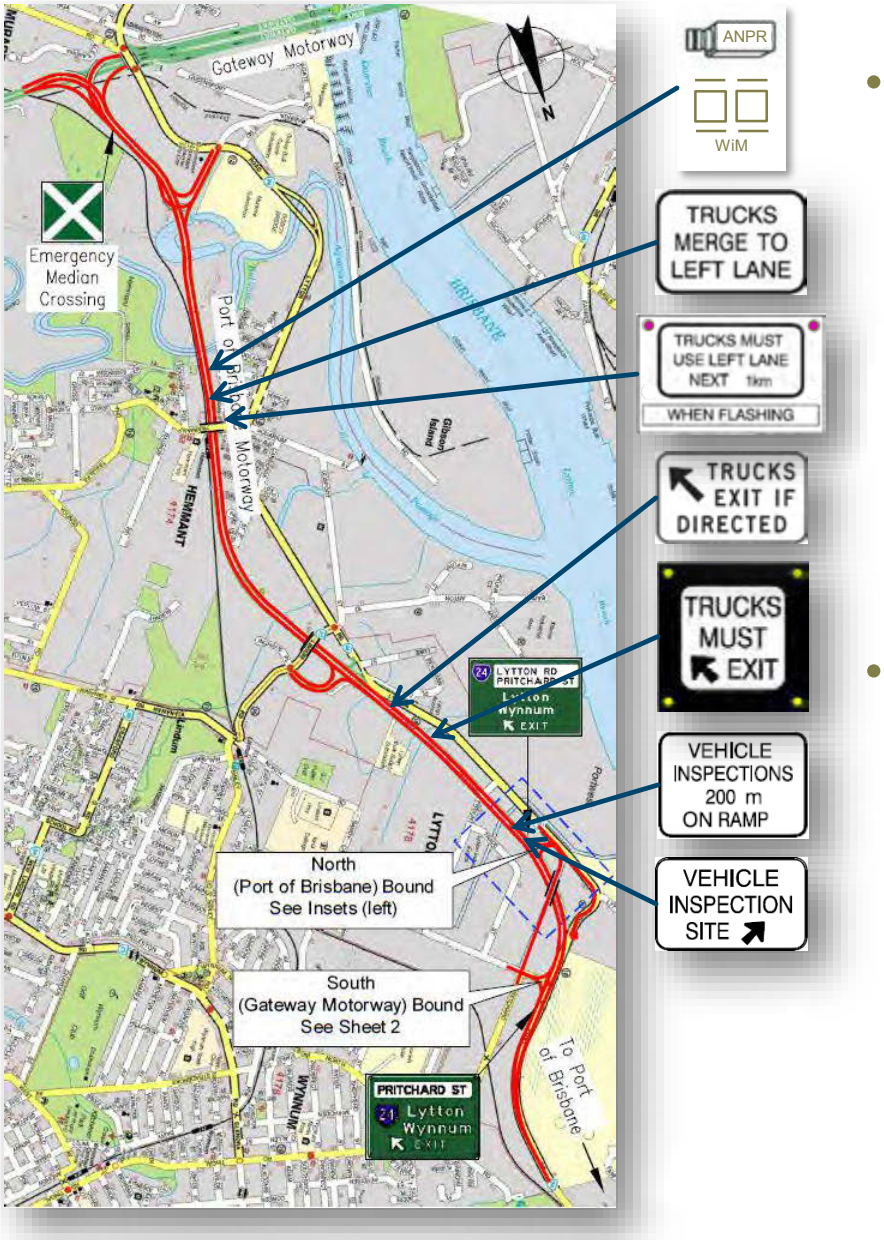
ANPR & WiM - Rural Environment



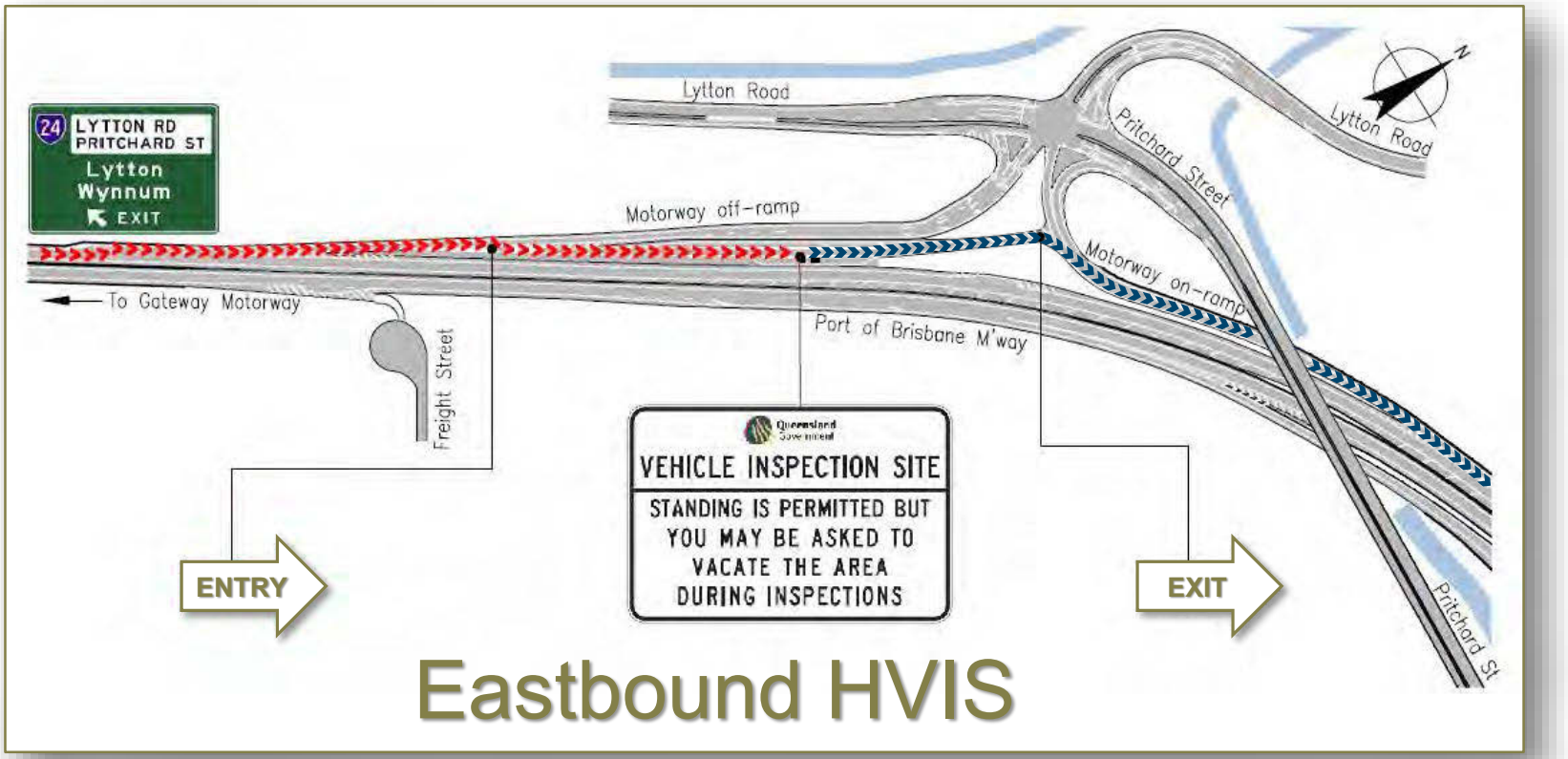
Heavy Vehicle Interception Sites

- Pull Over – where enforcement personnel pull over a suspect vehicle or driver encountered during their journey
- Short duration – where enforcement personnel spend less than two hours at a time
- Long duration – where enforcement personnel spend more than two hours at a time
- Long duration including weighing facilities – these are located on motorways or other high speed divided roads

Typical Motorway Site Layout



- Automatic Number Plate Recognition (ANPR) and Weigh-in-Motion (WiM)
- Changeable Message Sign (CMS)



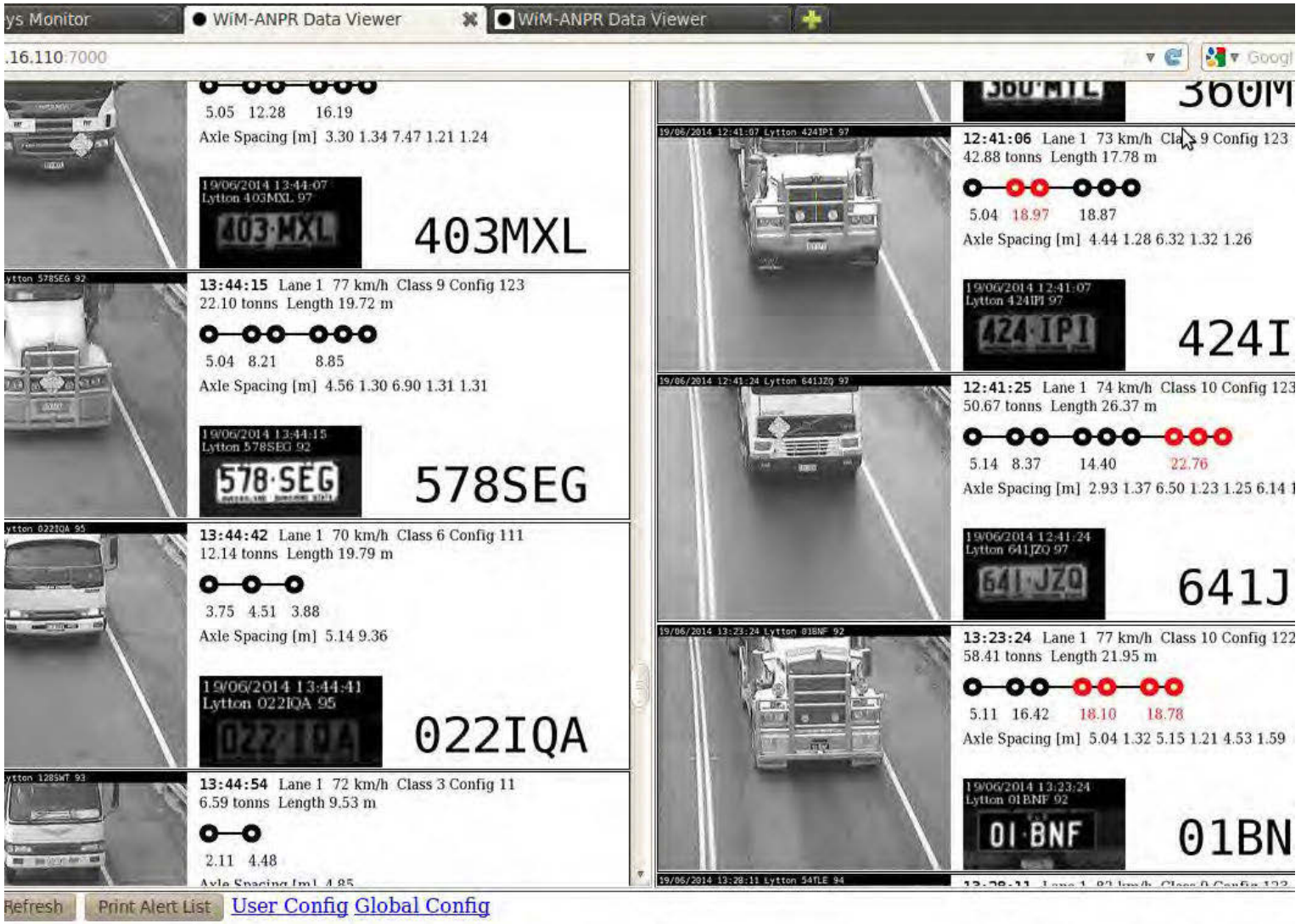
- **Entry** from Motorway off-ramp
- **Exit** onto Motorway on-ramp
  - allows sufficient acceleration length before re-entering Motorway
  - causes inspected local traffic to ‘go around’

Heavy Vehicle Interception Site (HVIS)

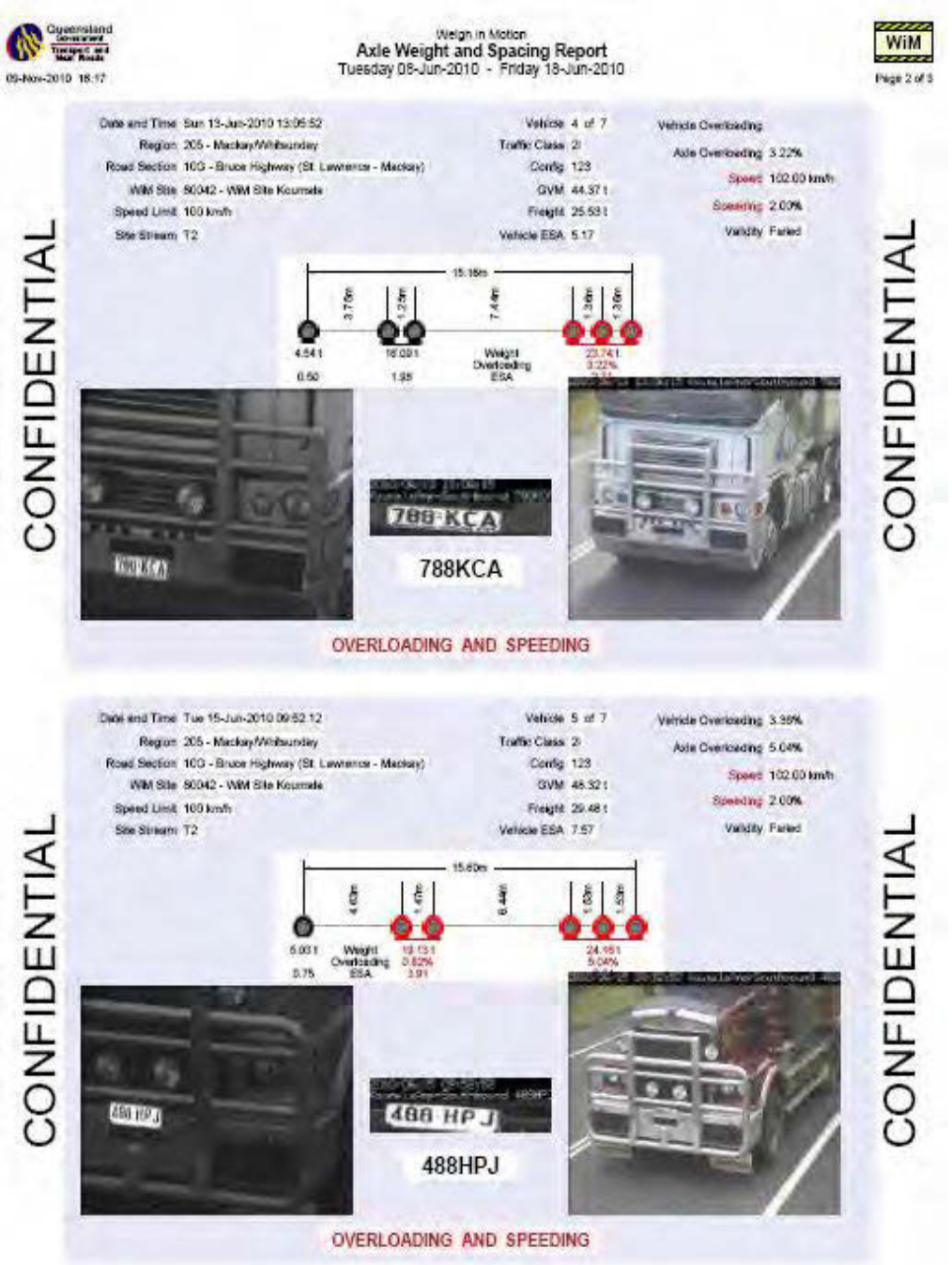
HVIS Operations

Monitoring Heavy Vehicles

Vehicle Display



Database Reporting



Thank you and stay connected

Twitter @TMRQld

Facebook @TMRQld

LinkedIn Department of Transport and Main Roads

Blog blog.tmr.qld.gov.au