ROAD INFRASTRUCTURE
MANAGEMENT FORUM

Our Carbon Equation

New Zealand
IPWEA
INSTITUTE OF PUBLIC WORKS
ENGINEERING AUSTRALASIA

To maintain or rehabilitate? That is the question

Stephen Wormald| GeoSolve Limited

RIMS
Roading Infrastructure Management Support

in association with
IDS
Infrastructure
Decision Support

To Maintain or Manage

- Maintenance Management Systems:
  - **Reactive:** measures are taken based mainly on the surface condition monitoring results (=symptoms)
- Pavement Management Systems
  - **Proactive:** Monitoring is made to detect the root causes of the surface condition (=diagnostics) and measures are taken before damages appear

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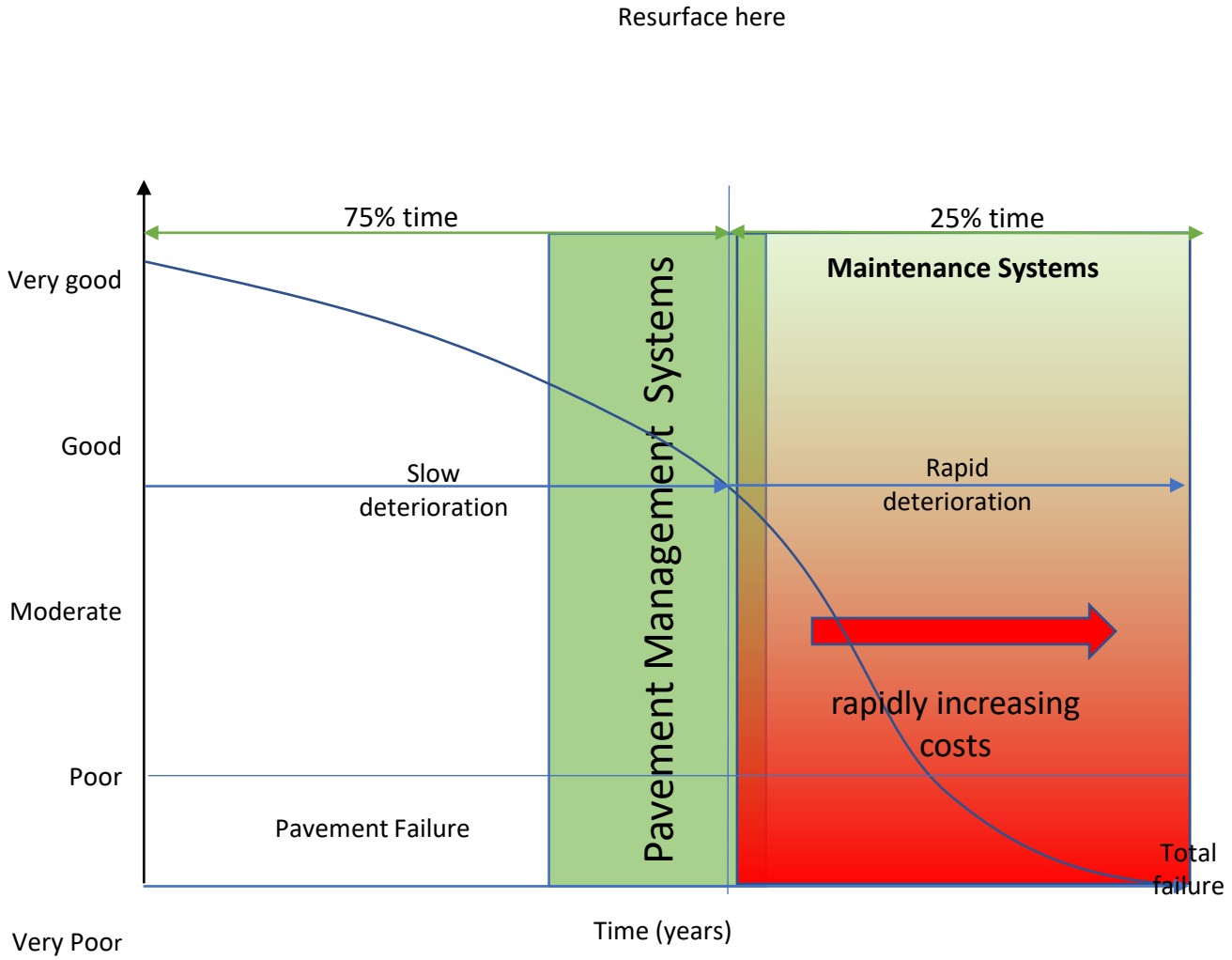
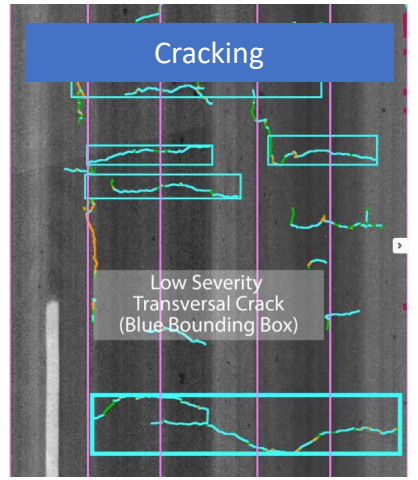
Maintenance or Management

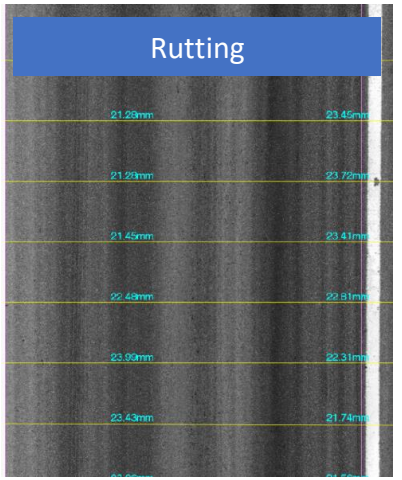


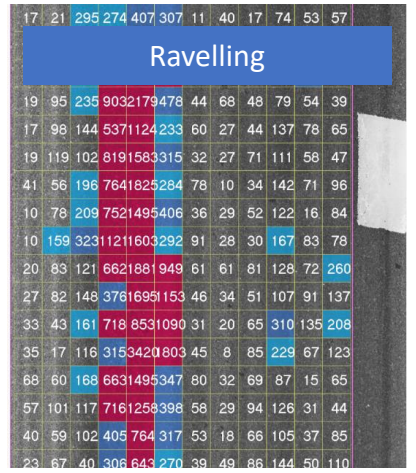
Road Pavement Deterioration Vs Time

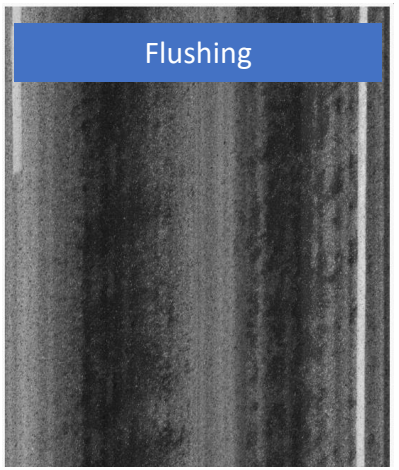
Our Carbon Equation

Profile and Visual data = High Quality and Sampling Rate









Our Carbon Equation

What's Needed to Manage Pavements?

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Structural Data & Models

Our Carbon Equation

What's Needed to Manage Pavements?

RIMS
Roading Infrastructure Management Support

Structural Data & Models

Falling Weight Deflectometer

- Typical Network Sampling Frequency
  - 200m – 400m is this sufficient?
  - every year, 2 or 3?
- Whole Network surveys?

Traffic Speed Deflectometer

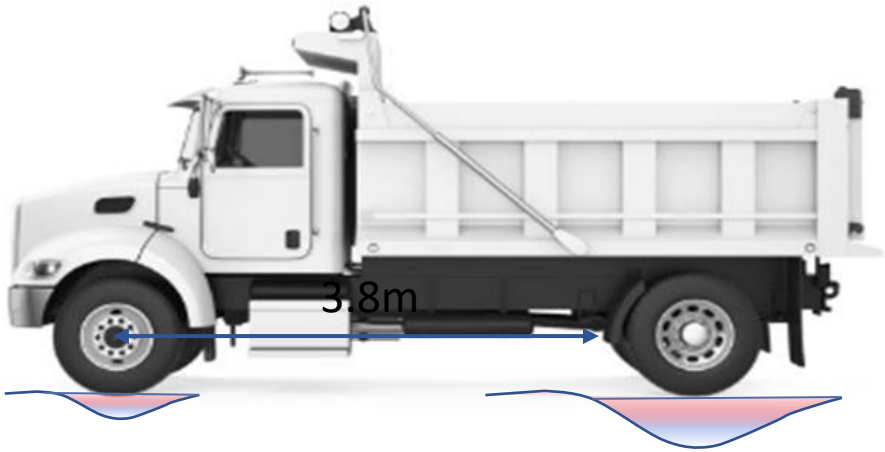
- Summer months

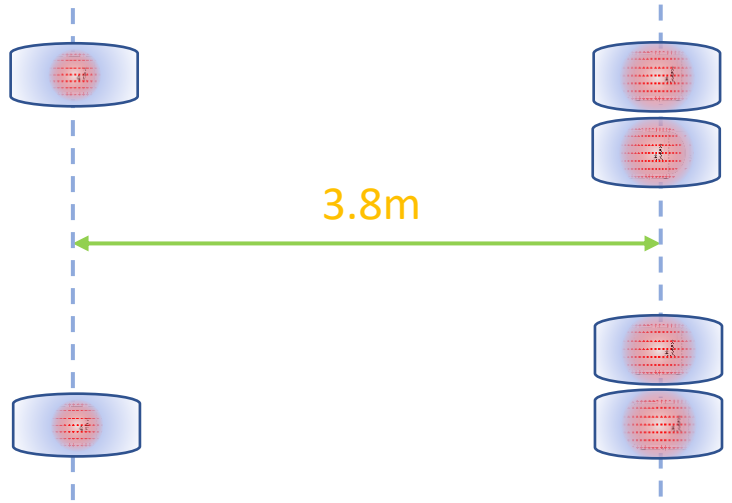
Traditional Structural Models are too standard

Our Carbon Equation

Multi Speed Deflectometer

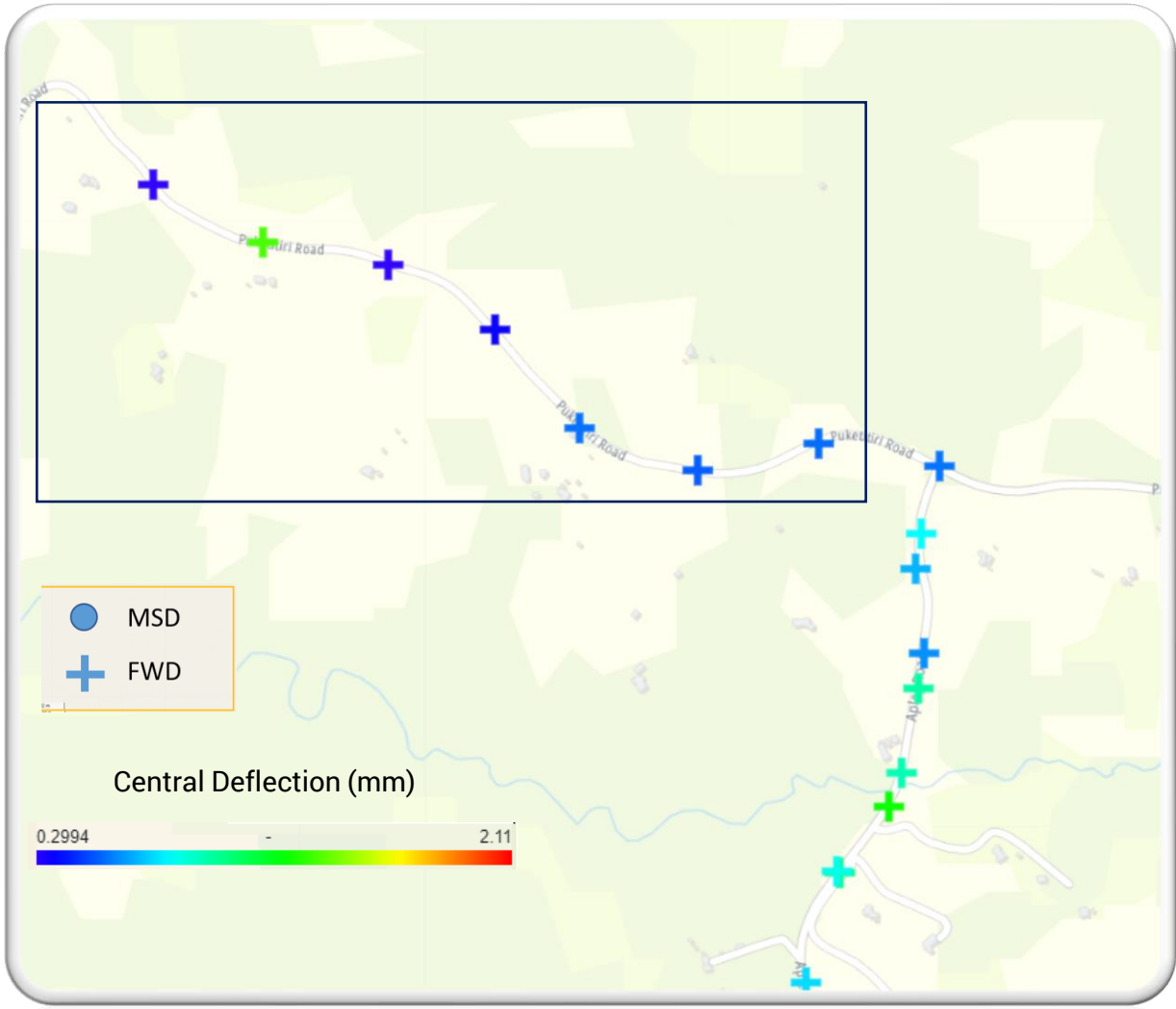
- Used on most roads
- Structural surveys at traffic speed
- 1 or 2 wheel paths
- Surveying in any weather condition any time of year
- Identification weak section for further investigation
- Network surveys of 25 RCA





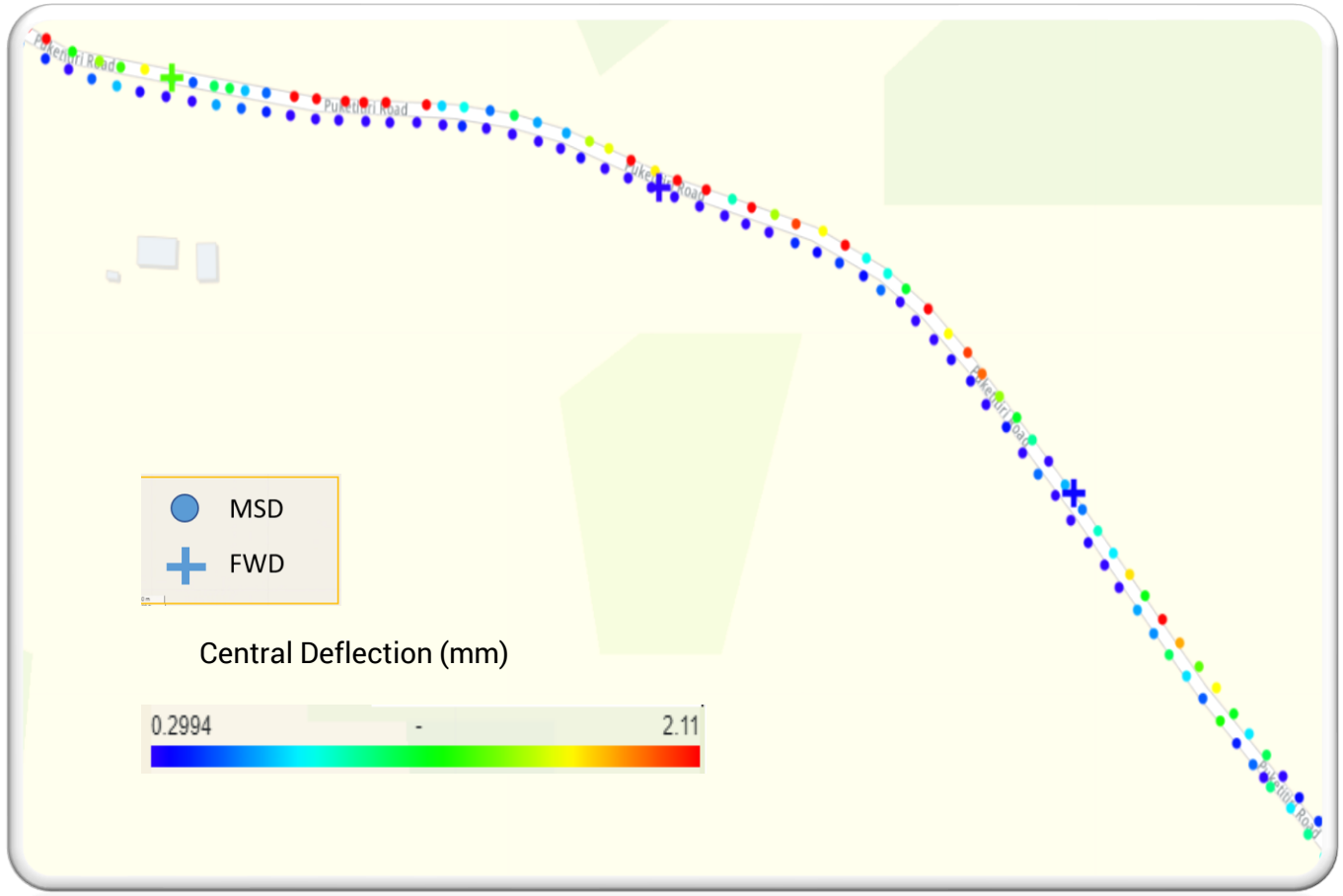
Hastings – Puketitiri Rd

- FWD Central Deflection (d0) Results from Network Level Survey in October 2014
- 200m spacings staggered across L1 and R1 Lanes



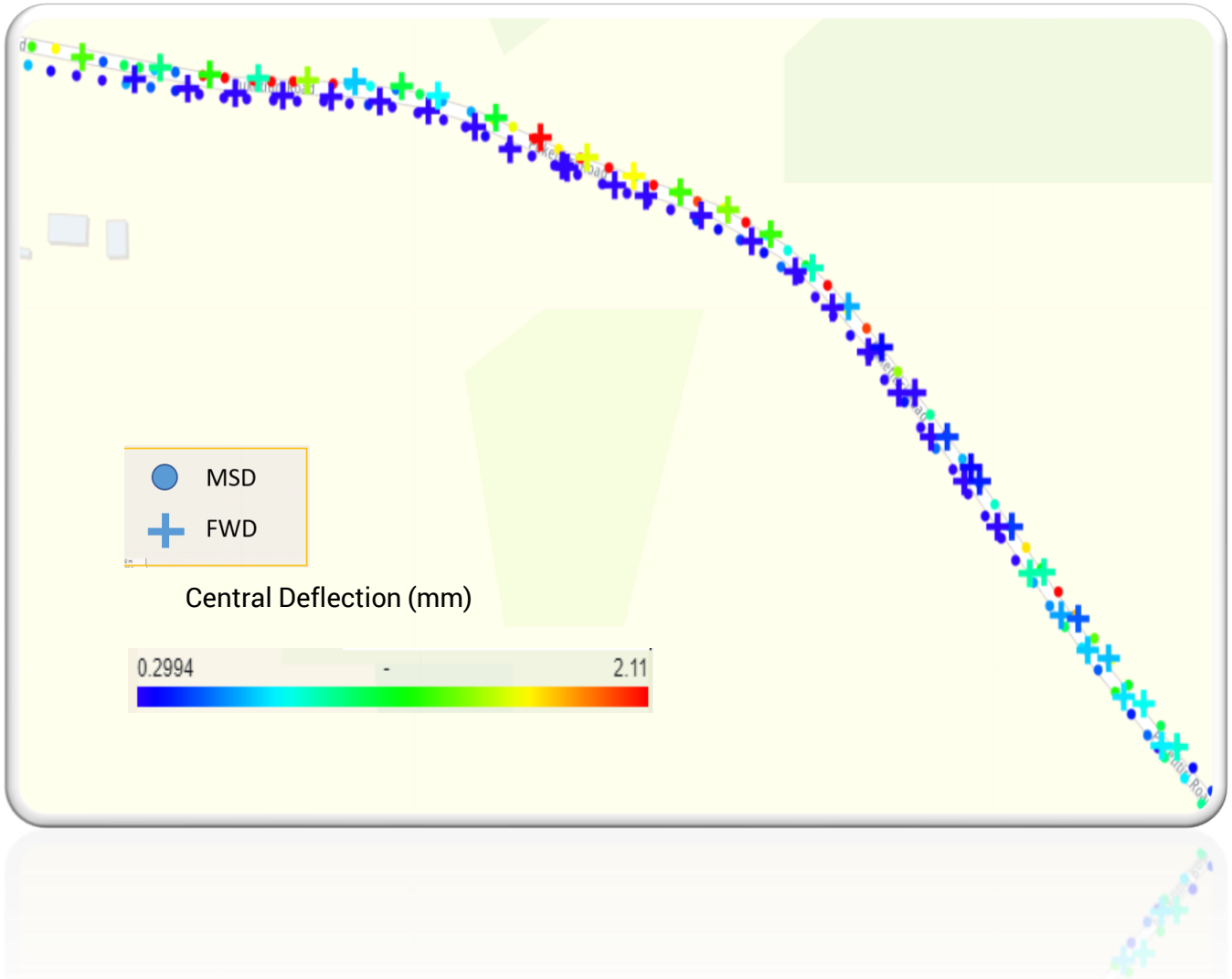
Hastings – Puketitiri Rd

- MSD d0 Results from Network Level Survey in August 2021
- PLUS FWD Central Deflection (d0) Results from Network Level Survey in October 2014



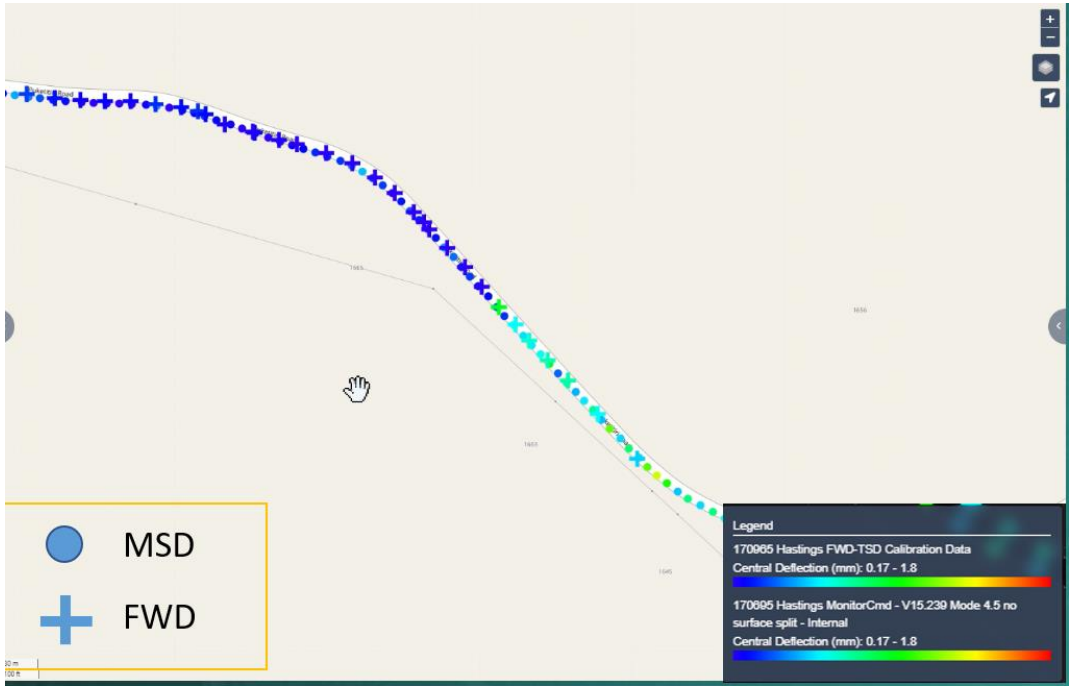
Hastings – Puketitiri Rd

- FWD Central Deflection Results from Project Level Testing in December 2021 (20m spacings staggered across L1 and R1 Lanes)
- PLUS MSD d0 Results from Network Level Survey in August 2021

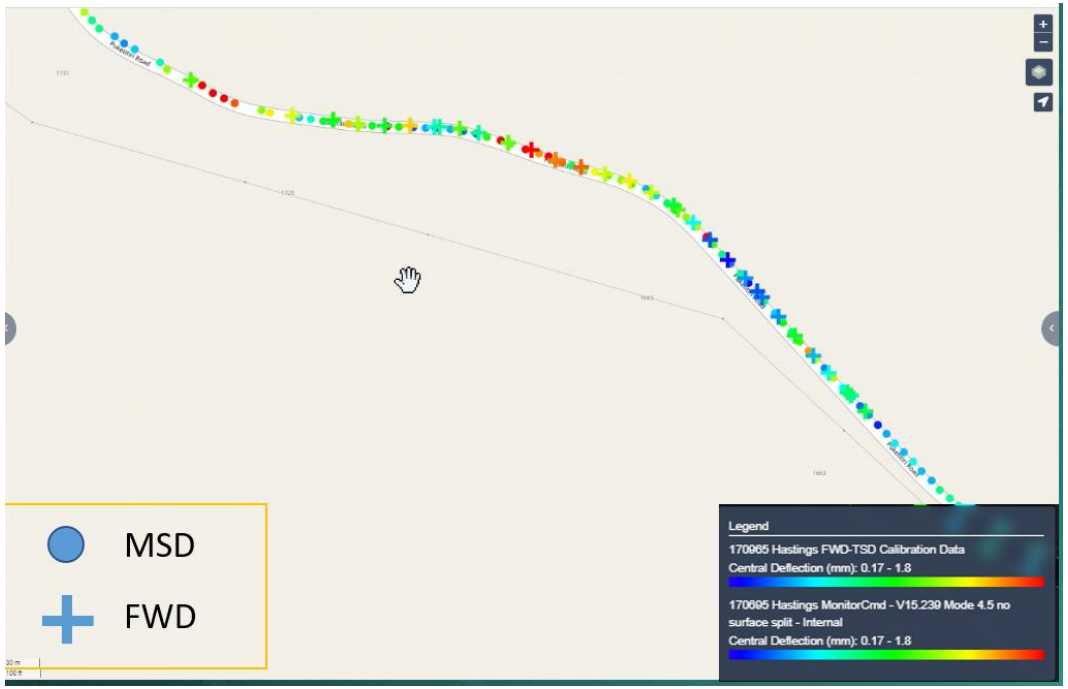


Hastings – Puketitiri Rd

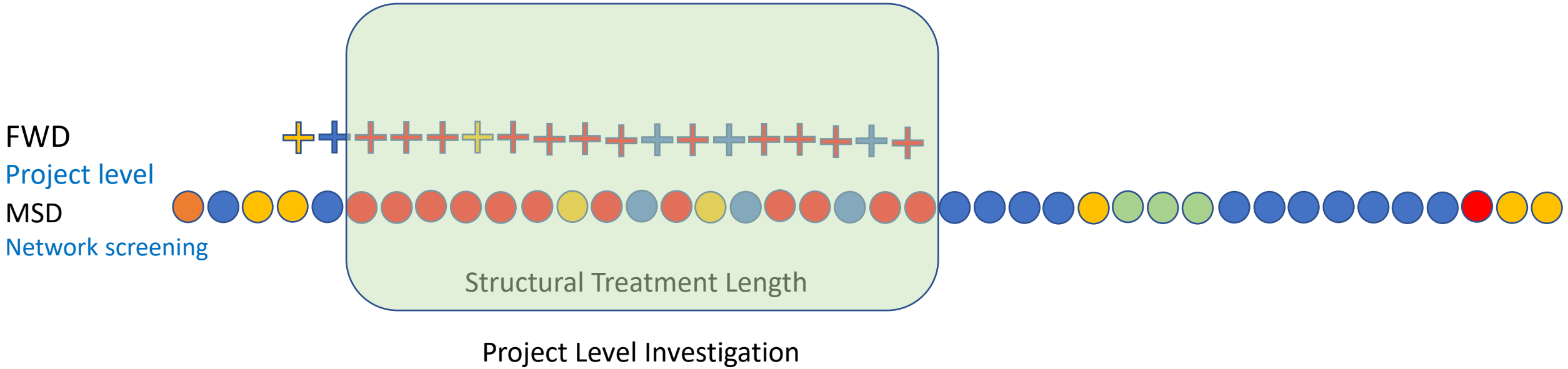
- West Bound



- East Bound



MSD & FWD improving knowledge of the pavement



What's Needed to Manage Pavements?

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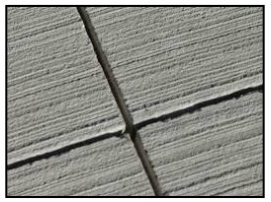
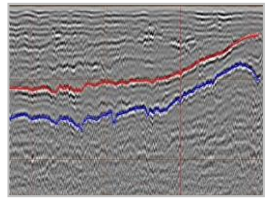
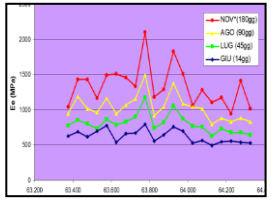
Models

Simpler said than done!

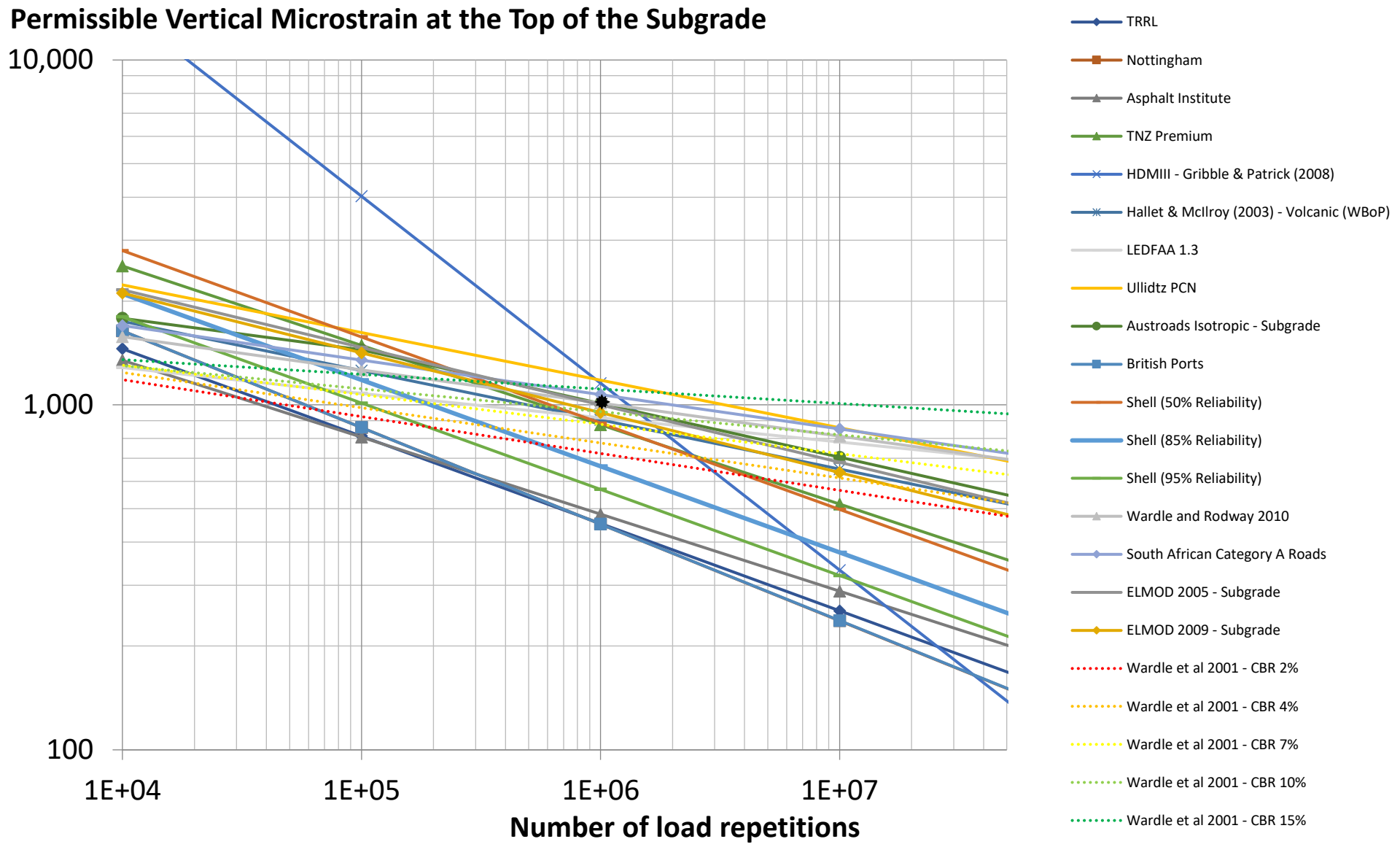
RIMS
Roading Infrastructure Management Support

Materials				
Construction Processes				
Maintenance Practices				
Loading				
Environment				

- We believe in the perfect pavement
- We simplify pavement
- Models are too generic

Our Carbon Equation

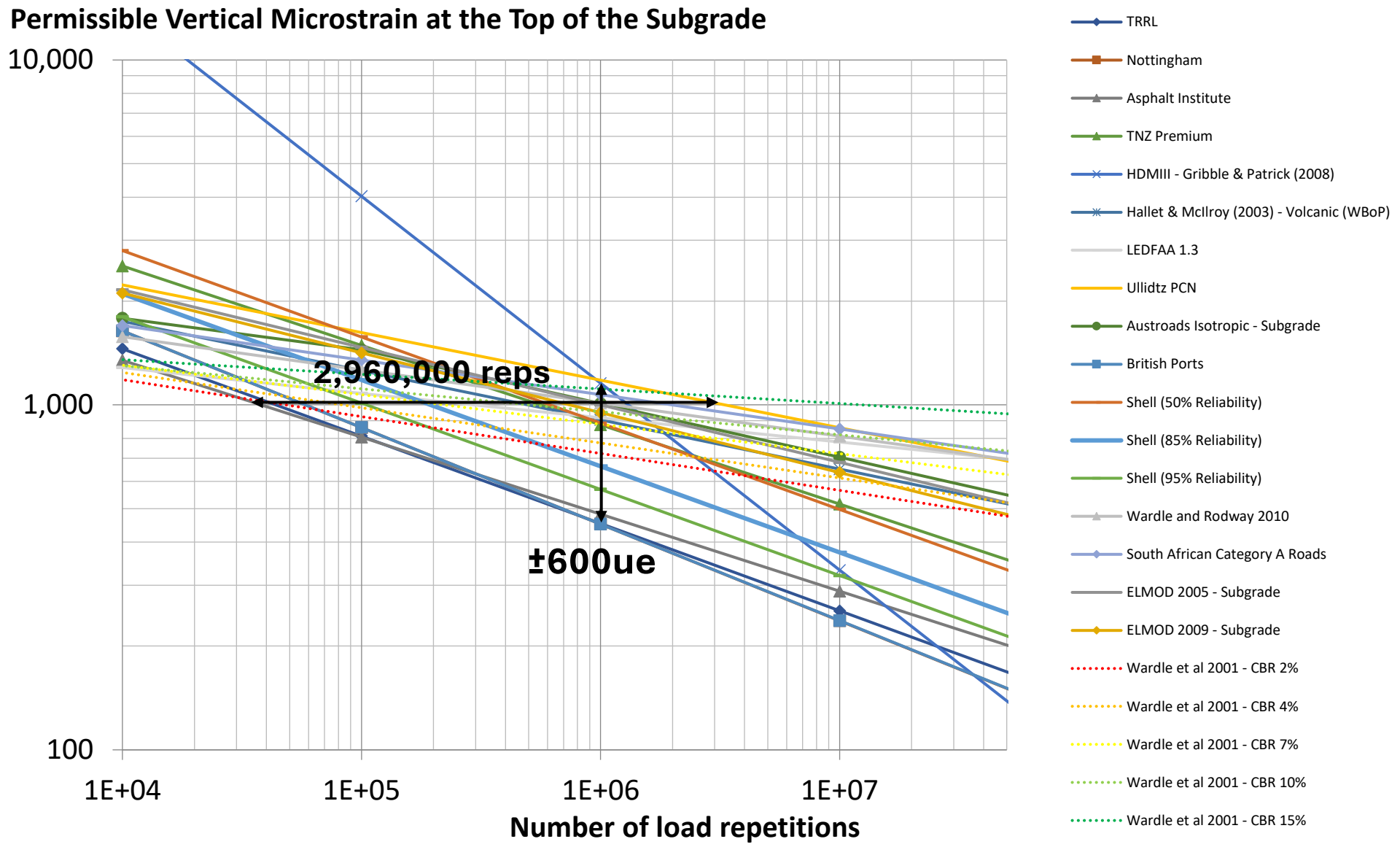
Traditional Pavement Models



RIMS
Roading Infrastructure Management Support

Our Carbon Equation

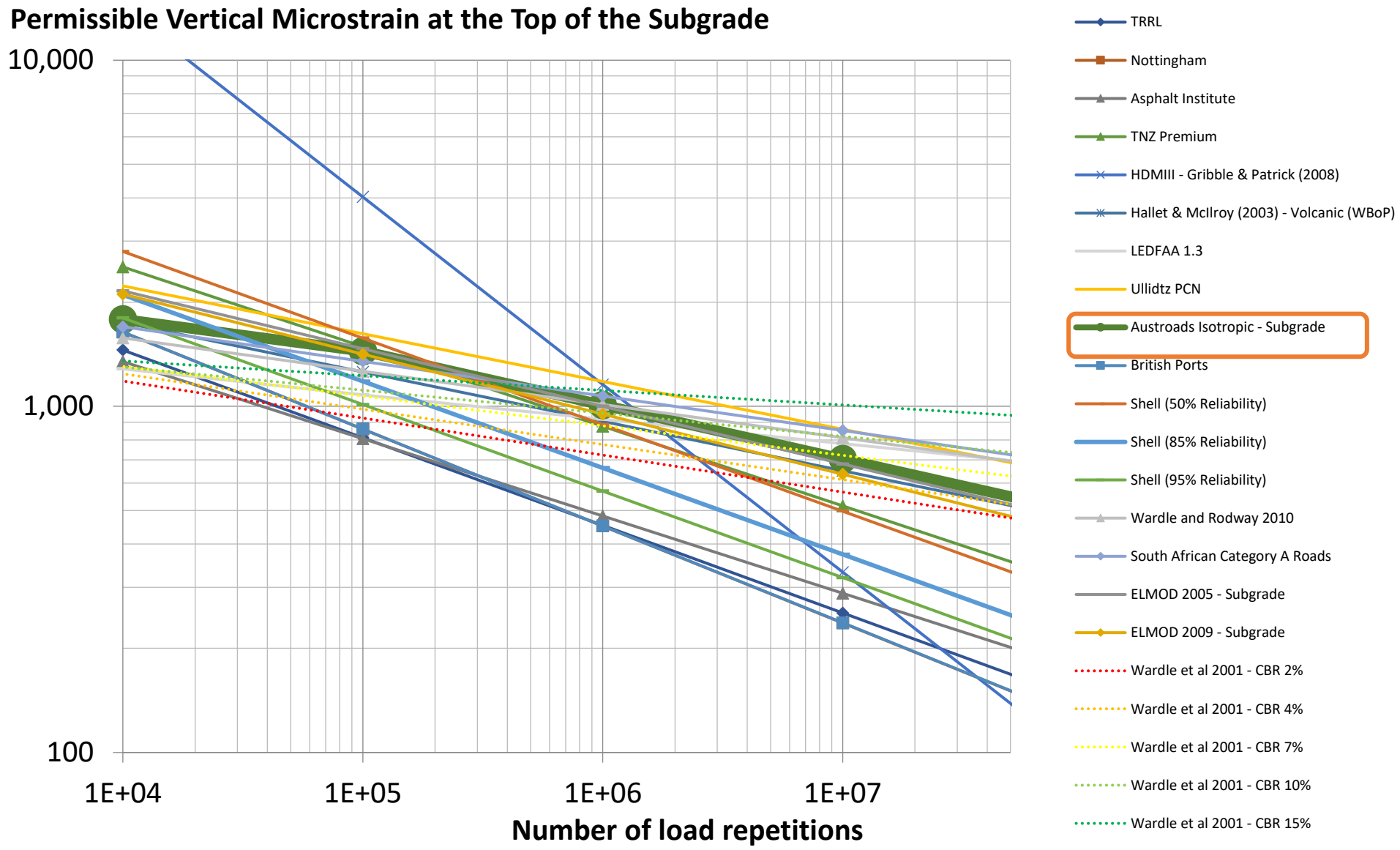
Traditional Pavement Models



RIMS
Roading Infrastructure Management Support

Our Carbon Equation

Traditional Pavement Models



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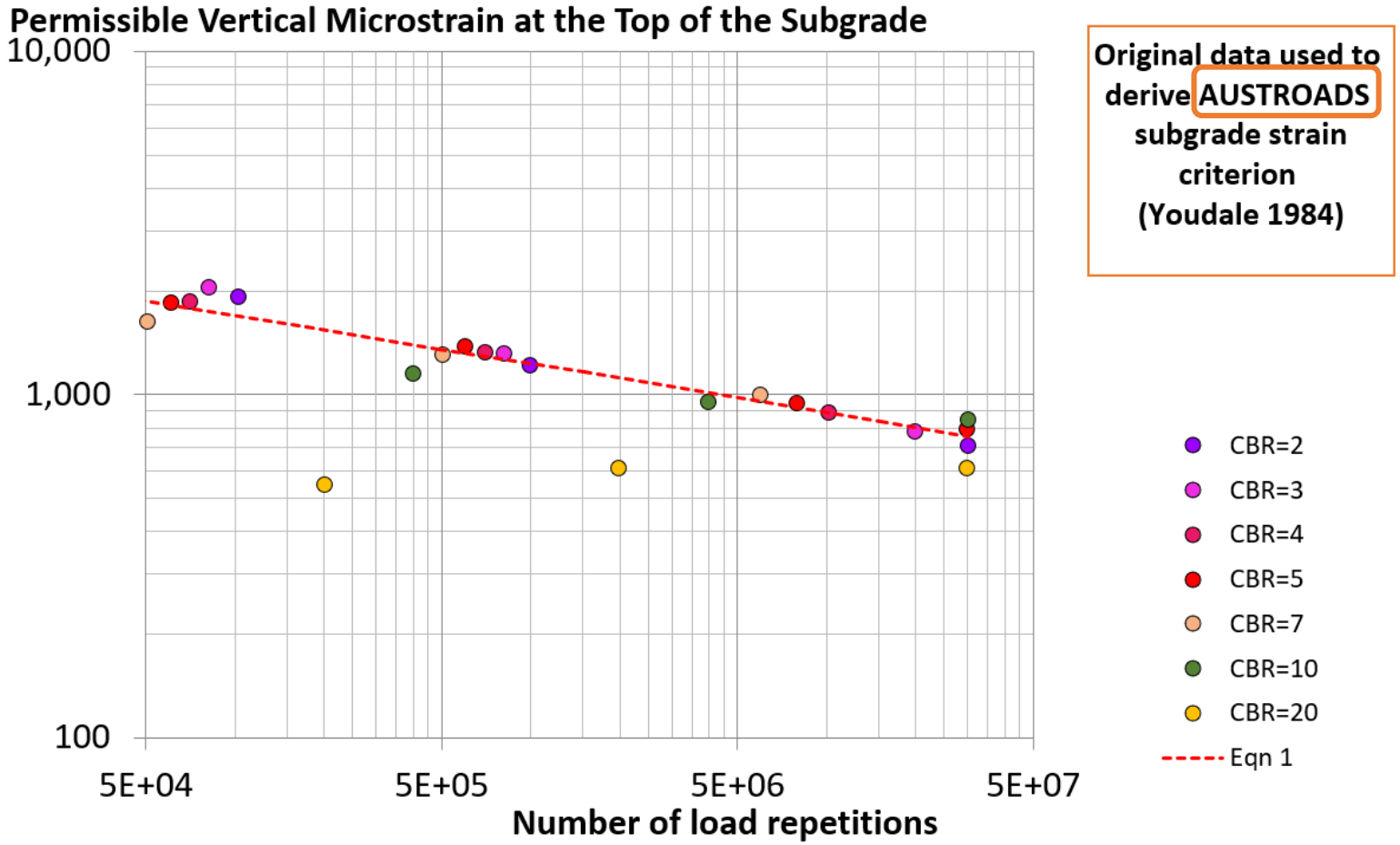
Our Carbon Equation

Many models based on limited data

22 data points



Original data used to derive AUSTROADS subgrade strain criterion (Youdale 1984)

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Standards based on data from 30-80 years ago.

- Axle loads
- Traffic volume
- Material properties
- Created locally applied globally
- Inevitably fail to produce designs optimizing life cycle cost.

Expected life varies geographically and is sensitive to:

- Environmental factors
- Quality of construction:
- Layer thickness & compaction
- Maintenance Practices
- Quality of natural and imported materials
- Quality assurance is based on a few samples only

EXISTING PAVEMENTS MODELS

The current integrated research approach

Laboratory Testing

Field Trials

Guidelines and Specifications

Accelerated Pavement Testing

Modelling:
Pavement Simulations
Life Cycle Analysis

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An Integrated Research Approach - huge data sets

Laboratory Testing

Field Trials

Guidelines and Specifications

Accelerated Pavement Testing

Modelling:
Pavement Simulations
Life Cycle Analysis

Regional Precedent Performance

adds another tool to the tool box

3D Multivariate Analysis

1-30 year FWP

Data collected over a number of years, stored and analysed

Our Carbon Equation

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Regional Precedent Performance (RPP)

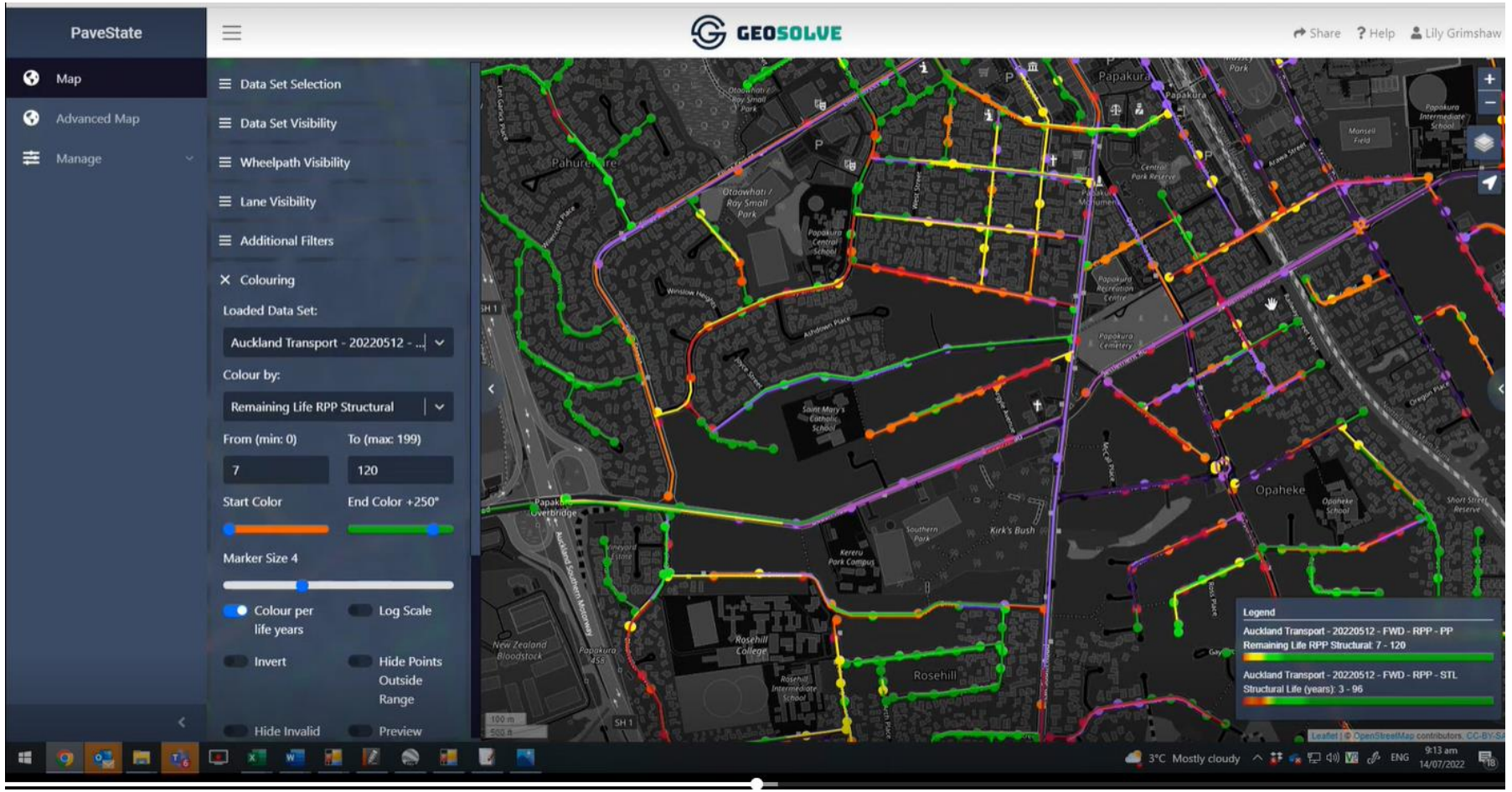
Huge Data Sets

3D Multi-Variate Analysis

- 20+ distress modes including:
  - Susceptibility of each STL to Overloaded axles (Risk of damage)
  - Subsurface Drainage Priorities
- Region specific models
- Structural life for each STL and a suite of generic design solutions & costs
- Long Term & Short Term Mechanistic Forward Work Programmes

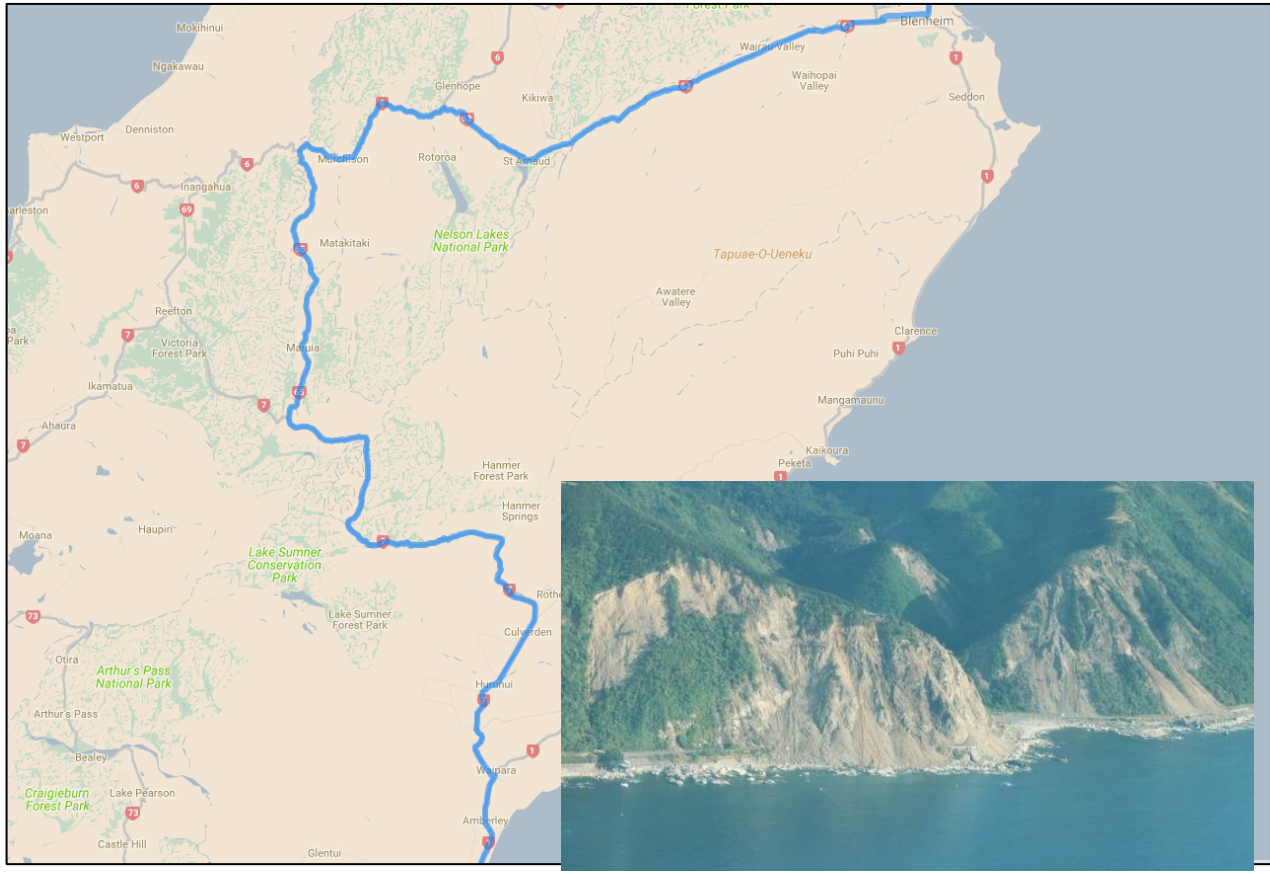
Structural Treatment Length

- Failure mode
- Remaining MESA
- Optimum rehabilitation & time of maintenance /rehab



Kaikoura Bypass Case History

- Kaikoura earthquake 11/11/2016
- Needed bypass route
- Original 25-Year Traffic will be experienced by mid next year on northern section (SH 63)
- The ultimate “Reality Check” of life prediction models: Real traffic on real roads with a range of real environments.



Our Carbon Equation

SO, To Maintain or Rehabilitate?

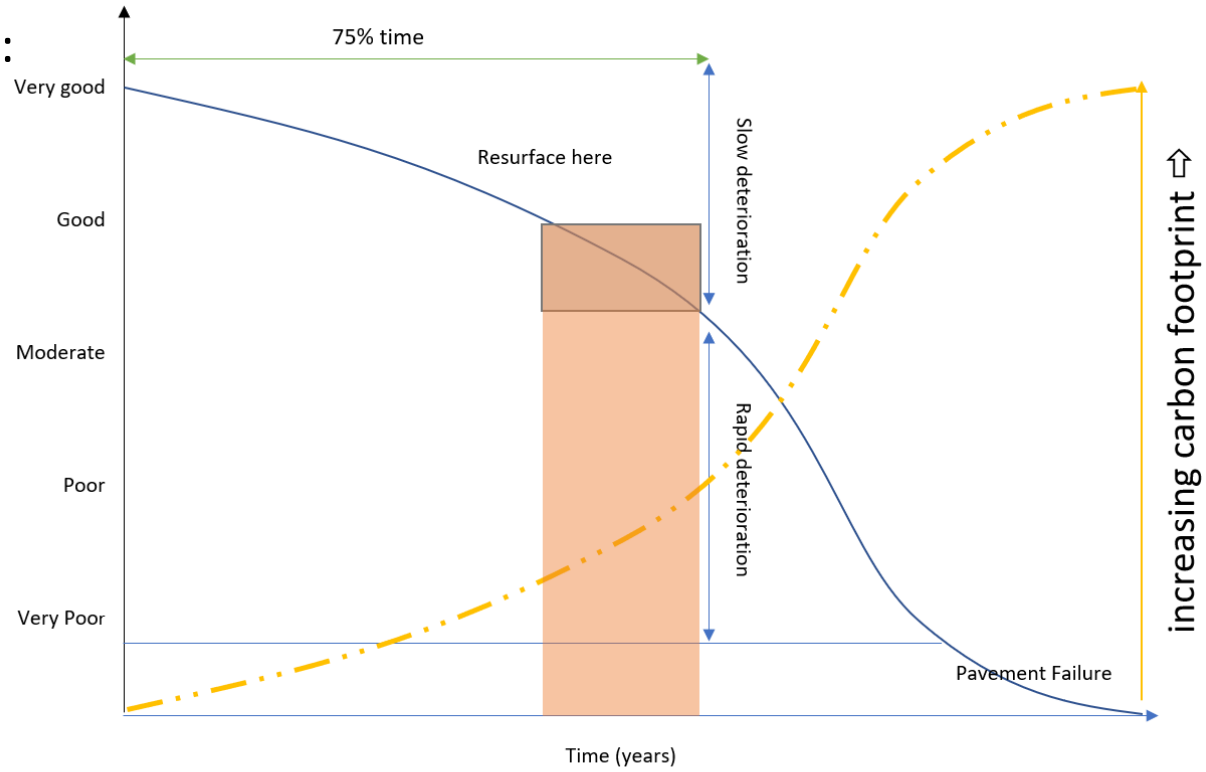
Both are necessary

High speed structural data provides critical information for:

- Improvement of models
- Structural information

- Visual and functional data
  - Short term FWP
  - Help refine time for intervention
  - Identify localised pavement failure, pot holes etc
- Together:
  - Improve models
  - Define STL
  - Provide short term and long term maintenance & management of pavements

Save money and reduce the carbon and environmental footprint



Road Pavement Deterioration Vs Time

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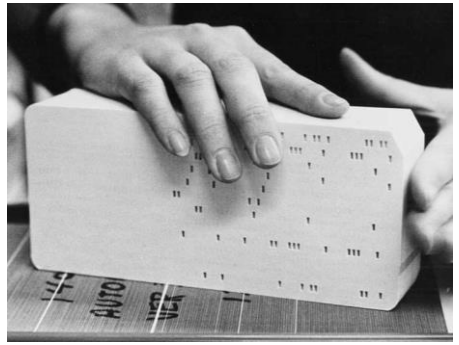
Then vs Now



empirical → mechanistic-empirical → machine learning and Big Data

univariate → bivariate → multi-variate

maintenance → & → management

Our Carbon Equation

Quantum Leap!!!! - RPP modelling

Room temperature Quantum computers are now a reality

- Now is the time to collect and store these data
- Data Deluge
- Consistent Condition Data Collection.

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THANK YOU

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