



# Near-Continuous Structural Evaluation for Urban Networks

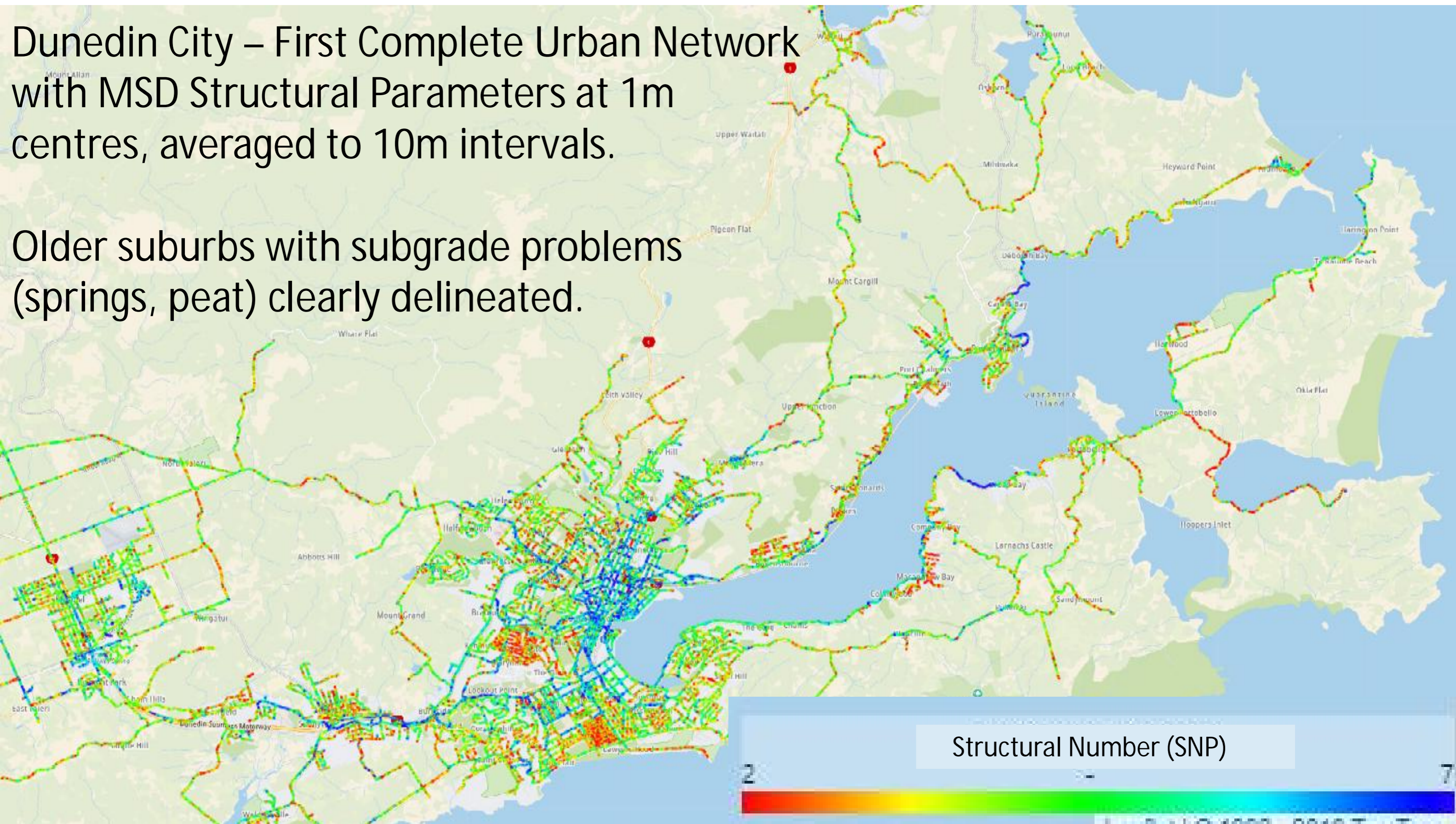
Testing and Calibration: FWD- TSD- MSD

Application of Calibrated Mechanistic Approach (RPP)



Dunedin City – First Complete Urban Network  
with MSD Structural Parameters at 1m  
centres, averaged to 10m intervals.

Older suburbs with subgrade problems  
(springs, peat) clearly delineated.



Structural Number (SNP)

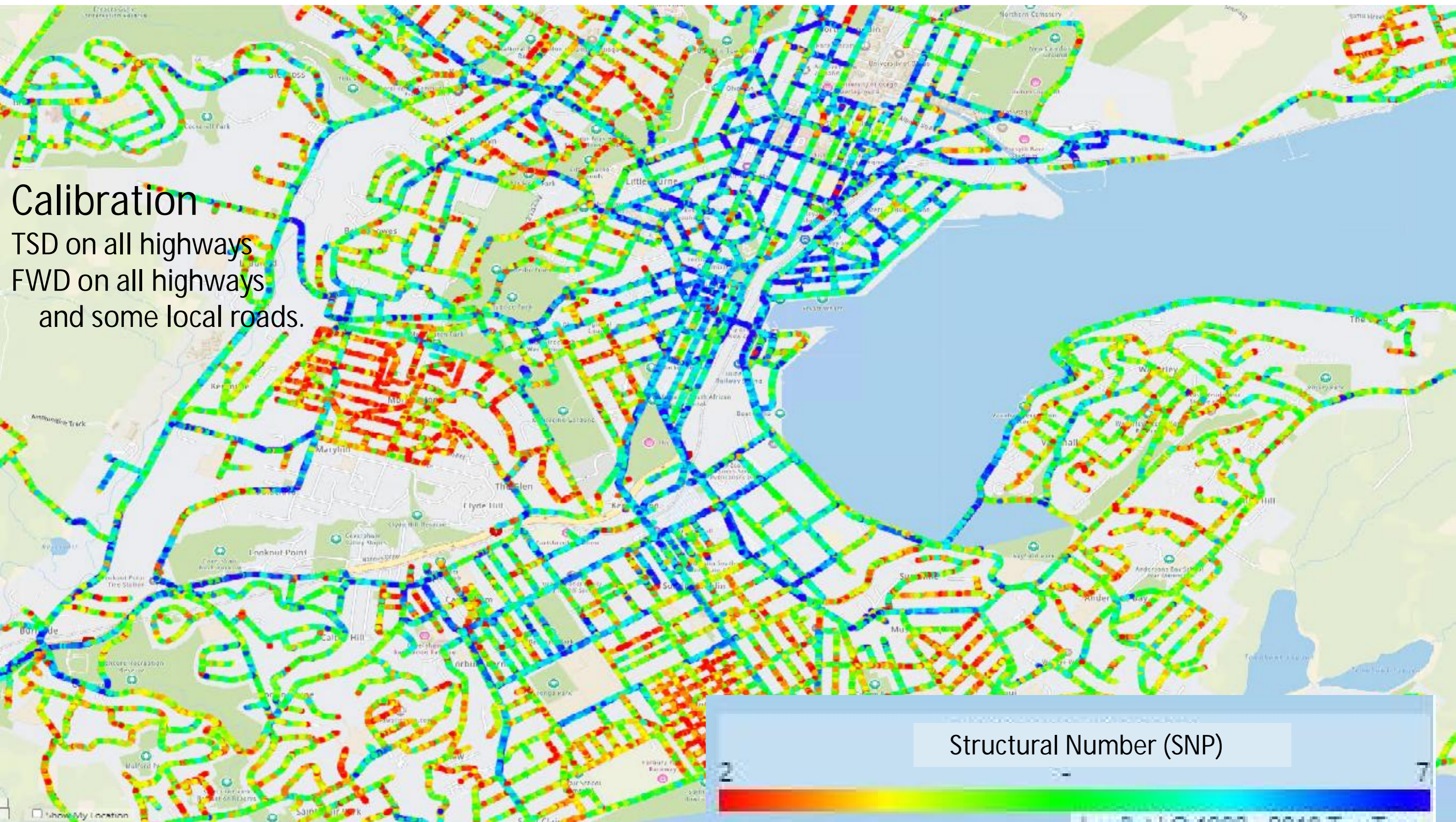
2

7

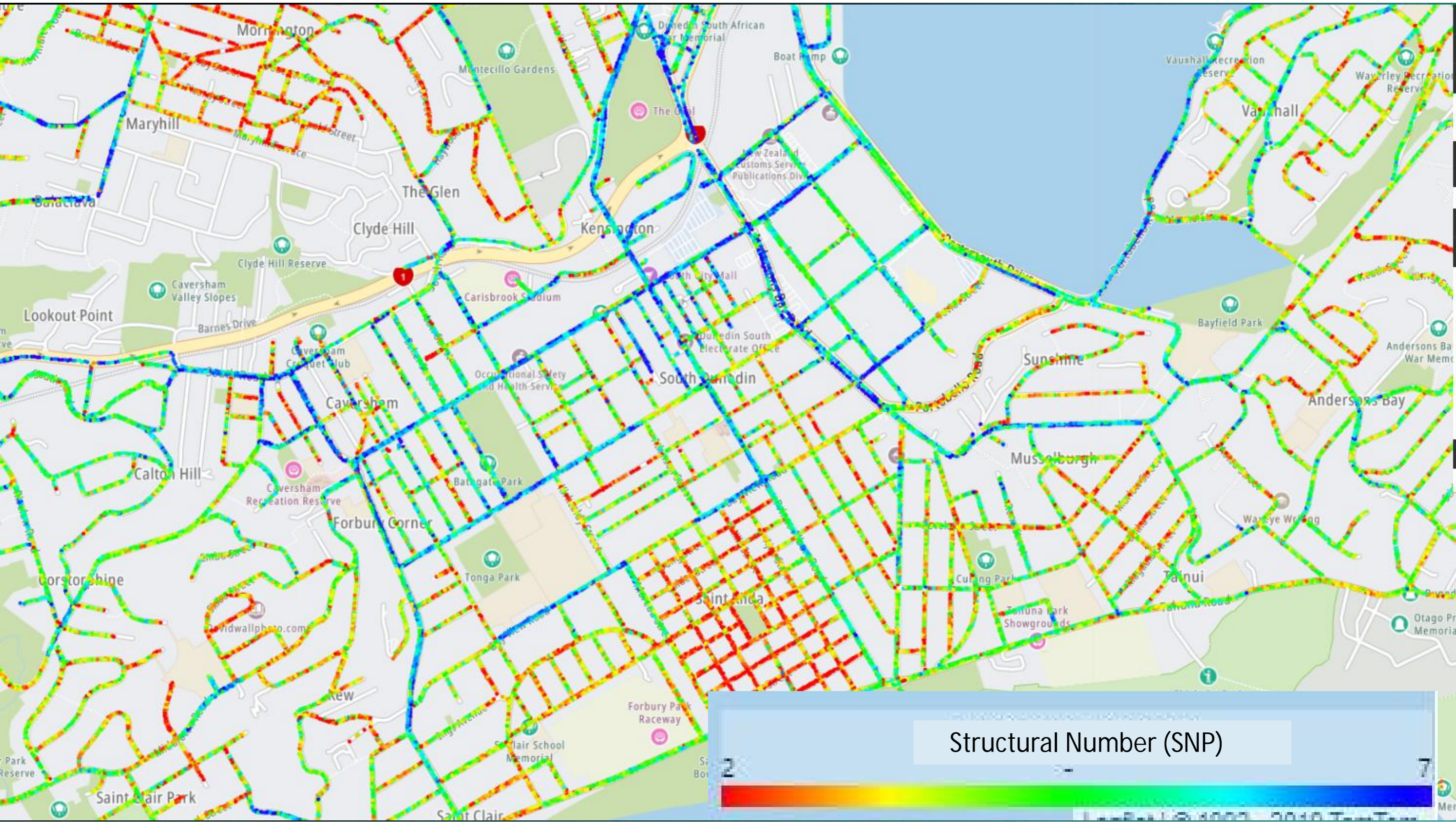


# Calibration

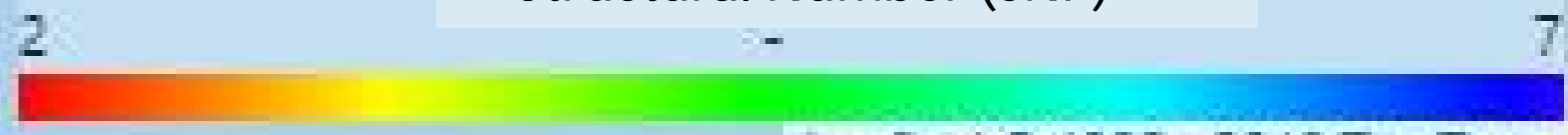
TSD on all highways  
FWD on all highways  
and some local roads.







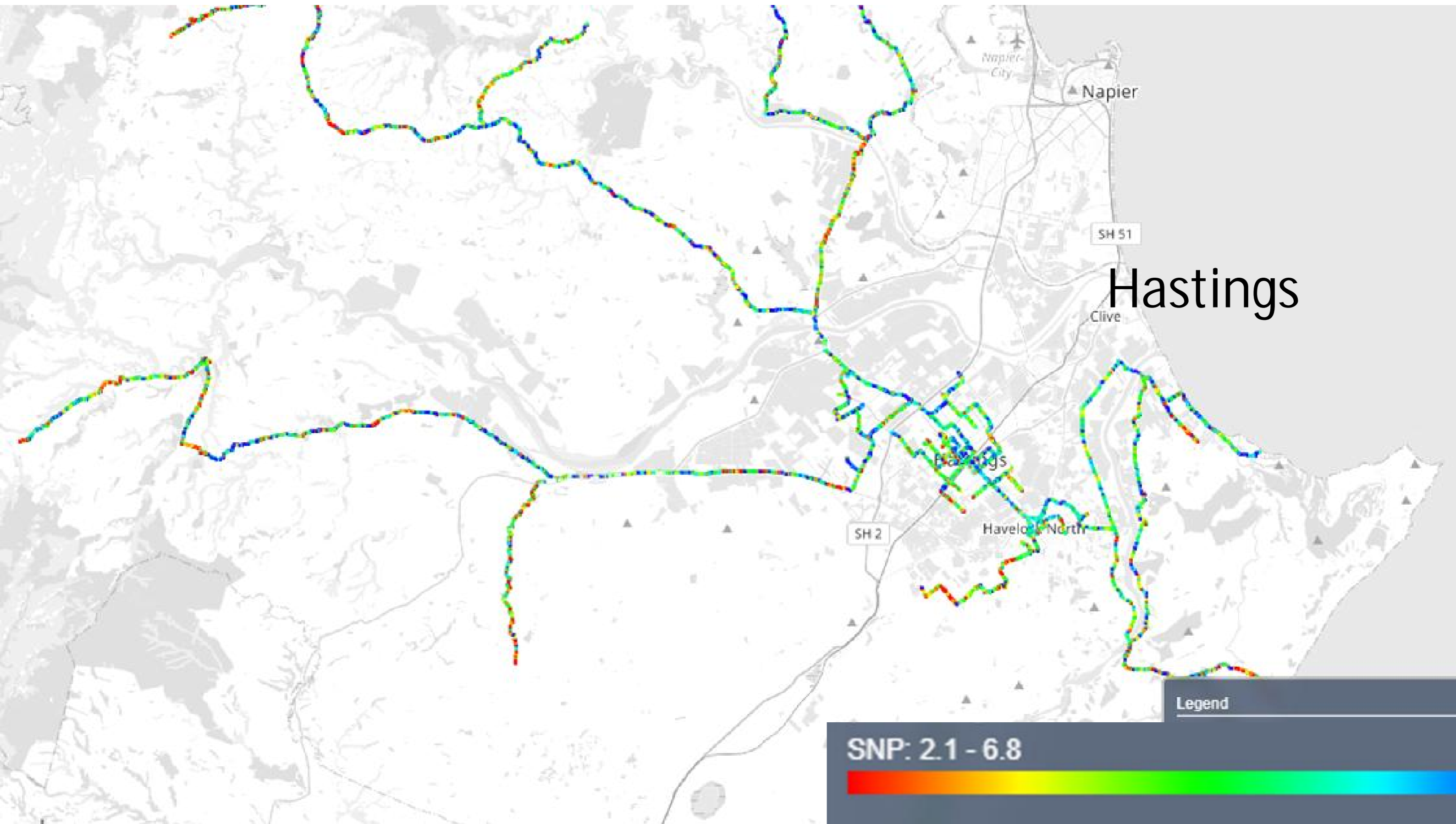
Structural Number (SNP)







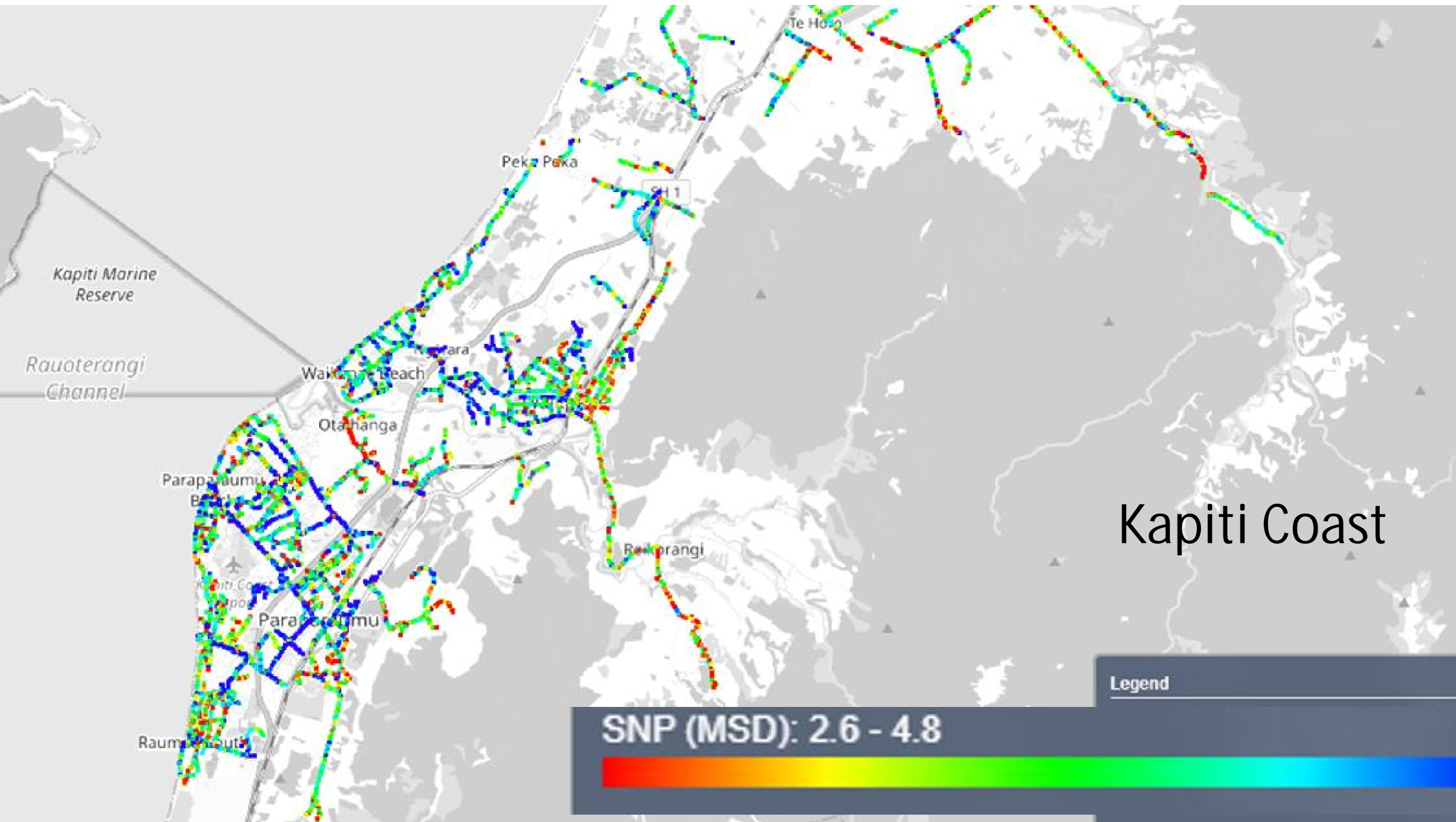




# Hastings

SNP: 2.1 - 6.8

Legend



**Photo**

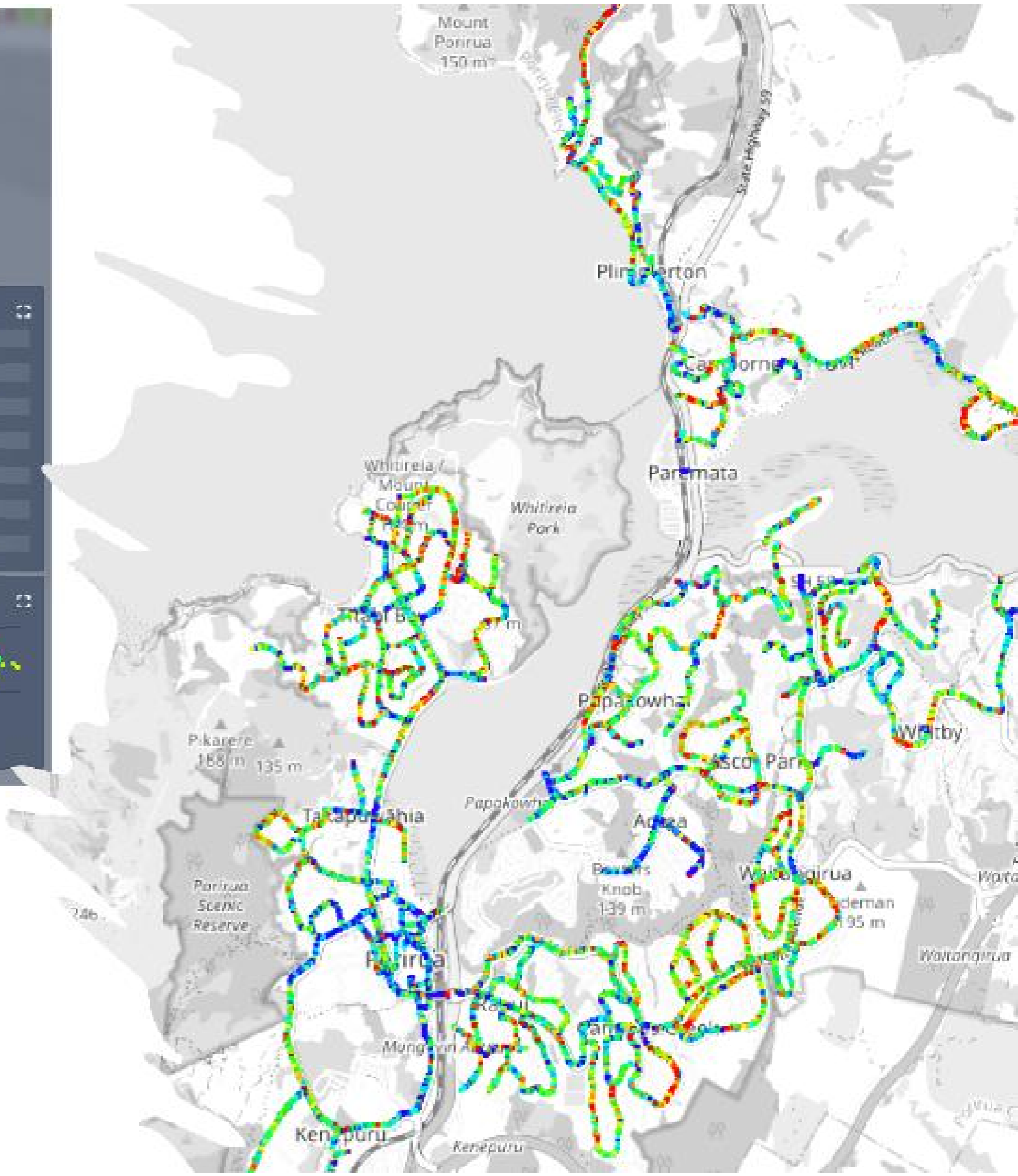
**Test Point**

Road ID	152
Road Name	18/204 N. 10/2013
Lane	L1
RP	1,525 km
Wheel Track	L
σ <sub>h</sub> (MSD)	7.04
Curvature Function (MSD)	0.585
BU (MSD)	2.76
LU (MSD)	2.41
SNP (MSD)	7.73
Item MESA Aust Roads GMP Method	0.022
Rem Life Aust Roads GMP Method	0.3
Year of Failure Aust Roads GMP Method	2030

**Test Point Road Graph**

**Legend**

2 10/214 Porirua WestCoast - V15 18/10/2013 - Cleod Rev A  
 SNP (MSD): 3.2 - 5.6

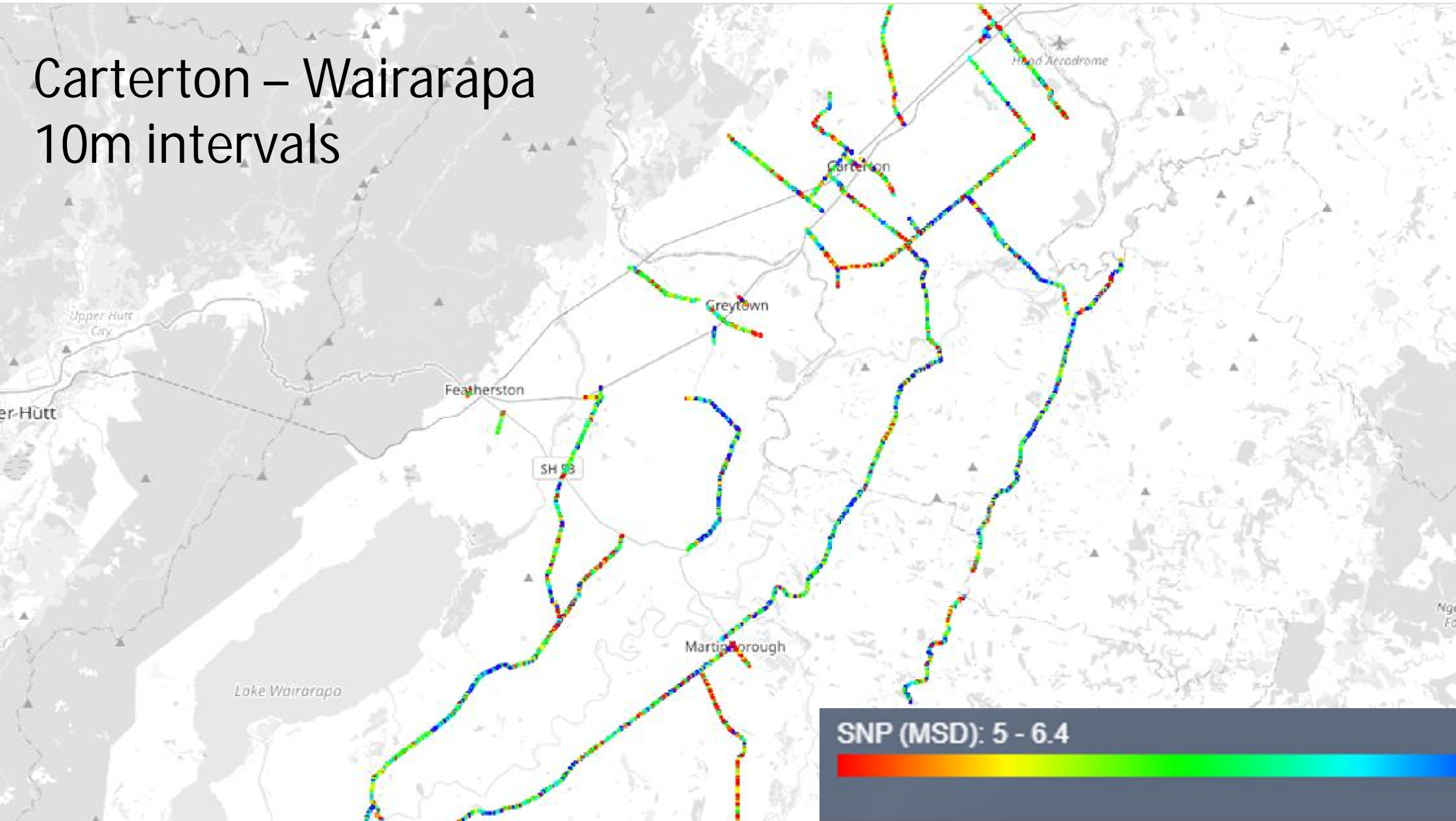


# Porirua





# Carterton – Wairarapa 10m intervals





Data Set Selection

Data Set Visibility

Wheel Track Visibility

Lane Visibility

Additional Filters

Colouring

Loaded Data Set:

210674.01 Milford Airport SH 94... | v

Colour by:

SNP | v

From (min: 0.5) To (max: 7.79)

3.8 5.5

Start Color End Color +270°

Marker Size 10

Colour per life years

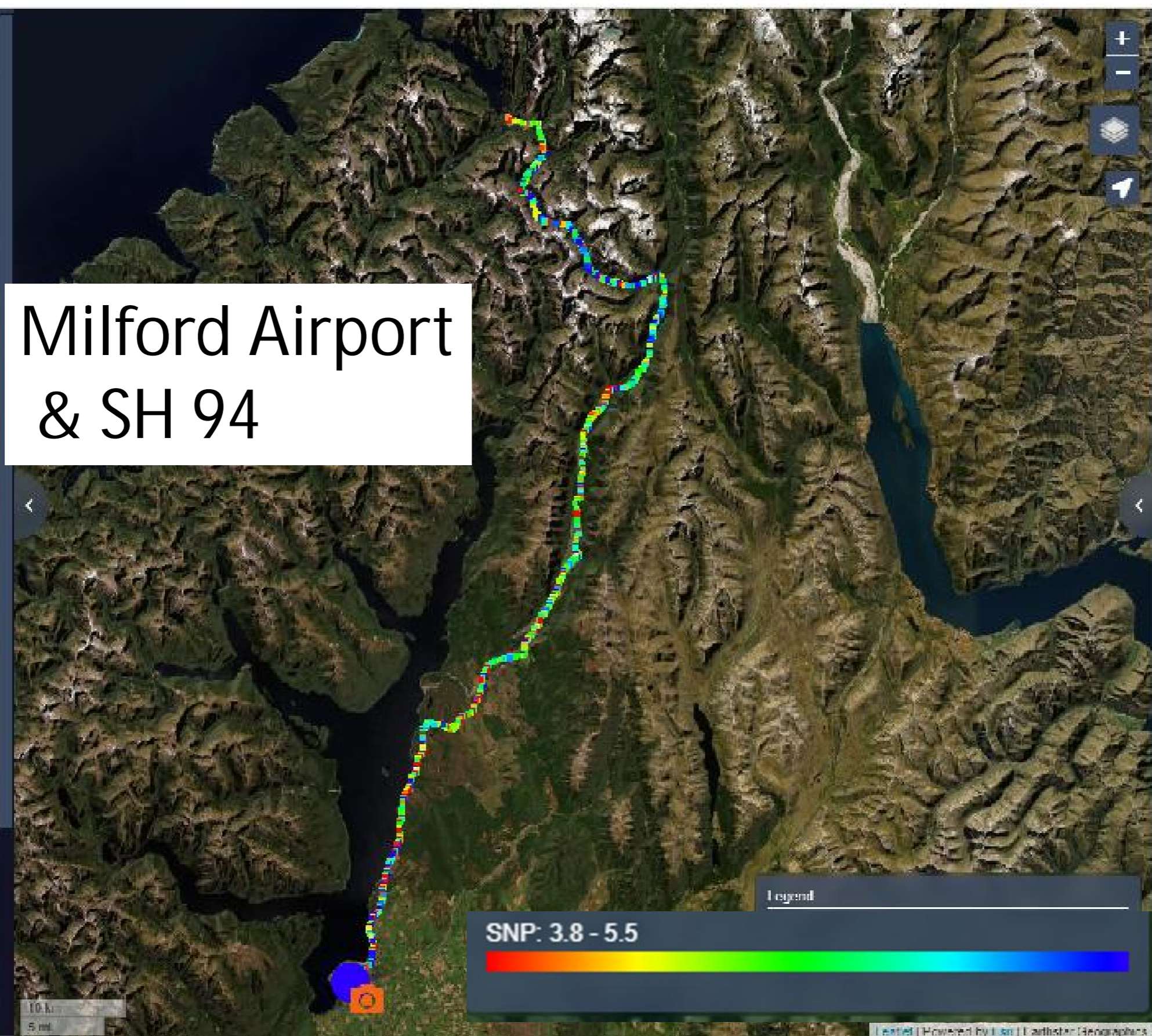
Log Scale

Invert

Hide Points Outside Range

Hide Invalid Values

Preview Marker Size



Photo

45°14'42" 157°43'45" 222.0m 300  
2001-11-10 21:40:4

Test Point

Road ID	35
Road Name	SH 94
Lane	L
RP	0
Wheel Track	L

Test Point Road Graph



- Data Set Selection
- Data Set Visibility
- Wheel Track Visibility
- Lane Visibility
- Additional Filters
- Colouring

Loaded Data Set:

210674.01 Milford Airport SH 94

Colour by:

SNP

From (min: 0.5) To (max: 7.79)

3.8 5.5

Start Color End Color +250°

Marker Size 4

Colour per life years

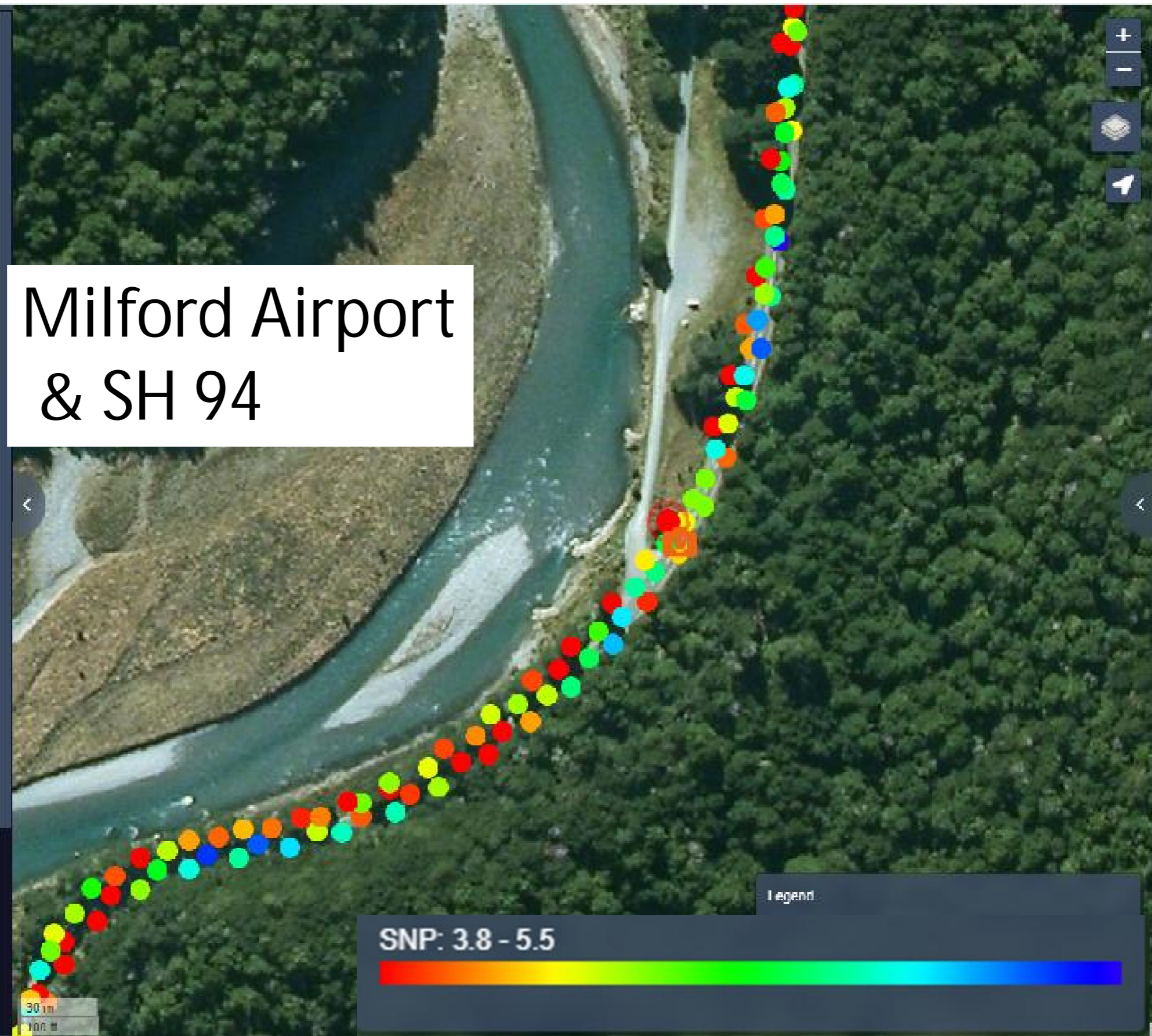
Invert

Hide Invalid Values

Log Scale

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Preview Marker Size



Photo

Test Point

Road ID

Road Name

Lane

RP

Wheel Track

Test Point Road Graph

SNP

14 200 14 300 14 400

rhainag



# MSD and FWD tests involve fundamentally different conditions

Thick Structural AC or Cement Bound  
Thin Surfacing and Unbound

- minor differences
- radical differences but very relevant

## MSD

- Pneumatic tyre (deformable) with 30mm rubber and steel mesh/ply
- Rolling load creating a mini “bow wave” at traffic speed
- Rotation of principal stresses
- Measurement of 3D longitudinal, transverse and vertical deformations characterising the asymmetric deflection bowl
- Transverse accelerations affect wheel load to match those of actual heavy vehicles
- Using a rolling wheel inherently acknowledges that the longitudinal profile (at all wavelengths) induces changes in dynamic vertical loads which have a consequent impact on pavement life prediction.
- Near continuous spatial coverage at about 1m centres optionally presented as median each 10 or 20m
- Both wheeltracks tested simultaneously at minimal additional cost.
- Response is always from loading within each wheeltrack as no additional edge clearance is required.
- Seasonal effect considerations required for FWD correlations

## FWD

- Steel/fibre circular plate (stiff) covered with 3mm of ribbed rubber
- Stationary position and weights dropped to mimic vertical load at traffic speeds
- Fixed orientation of principal stresses
- Measurement of vertical deformations only, characterising a symmetric deflection bowl
- No consideration of any transverse (radial) accelerations on corners or due to camber or superelevation
- Static location provides a reading which relates only to loading from a smooth road (IRI=0) . *This leads to both under and over prediction of remaining structural life, and substantially so for mature roads.*
- Spatially separated individual test points every 20 or 50m centres staggered across lanes –no indication of variation on the vast majority of the pavement
- Normally only one wheel track is tested, otherwise costs are double.
- Because the load plate is centrally located, the wheelpath cannot always be tested if there is inadequate clearance (eg from parked vehicles)
- Seasonal effects normally considered relative to wetter months for design



# TSD and FWD tests involve fundamentally different conditions

Thick Structural AC or Cement Bound – minor differences  
Thin Surfacing and Unbound – radical differences

The Gold Standard?

## TSD

- Pneumatic tyre (deformable) with 30mm rubber and steel mesh/ply
- Rolling load creating a mini “bow wave” at traffic speed
- Rotation of principal stresses
- Measurement of surface slopes characterising an asymmetric deflection bowl
- On corners, transverse accelerations affect wheel load to match those of actual heavy vehicles
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## FWD

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# MSD - Site construction QA

On compacted earthfill or aggregates,

Test more slowly, say 20 km/hr (yet that still provides 350-700 tests per minute)

Predicting final deflection at pavement finished level

Refining as each additional layer placed and compacted provides ultimate QA -

go

