GEOSOLVE
ENGINEERING CONSULTANTS

Pavement Analytics Group

Traffic Speed Deflectometer (DaRTS 2018): Reality checks for State Highways:

Pavement Remaining Life Determinations

10m vs 2m averaging

Regional Precedent Performance (RPP Model)

Nov. 2018 Acknowledgements: ARRB, Greenwood Engineering, NZTA (D Robertson)

Pavement life prediction - background

	NZ Life Prediction OM
1960's - 1987 Shell/ TRRL/ AASHTO	
1990's Irwin et al.	
2000's Austroads, TNZ RR	?
2002 Mechanistic Template 23 distress modes – Dawson	?
2005 Structural Number (SNC, SNP) – Hit rate. X	3
2010's Dawson, 5 modes > Regional Precedent Performance	2
2015 3 decades FWD + TSD Calibrated Mechanistic (RPP) FWDUG	1
2017 80/20…. TSD with rigorous sub-sectioning	<1
2018 4 years of TSD all national highways now at 10 m intervals RPP	……..
2018+ enable reliable planing and obtain substantial cost savings on maintenance from TSD prediction of remaining life at 2m intervals	

Reality Checks

- When is a Treatment Length in Terminal Condition?
- Discussed between Contractor and Roading Authority for FWP Approval
- Cost Responsibilities: Heavy Maintenance vs Area Wide Rehabilitation

- Importance of an informed decision on when each TL is in terminal condition
- Previously based on joint visual survey. Now TSD at 10 m (or less?) intervals enables an additional perspective:
  a common nationwide quantitative measure of future ongoing maintenance cost vs one-off rehab cost.
- Ie the decision based on NPV could now be objective rather than subjective
- Case Histories .....

TSD Desktop Regional Calibration

2015-2018: Mechanistic analyses and interpretation at 10 m intervals for all state highways - 80/20 approach all highways


Remaining Life
> 25 years
15 - 25 years
10 - 15 years
5 - 10 years
2½ - 5 years
1 - 2½ years
0 - 1 years
Wellington SH 1
TSD January 2017
Mostly > 25 years life
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2018 CNES / Airbus
Google Earth


Remaining Life
> 25 years
15 - 25 years
10 - 15 years
5 - 10 years
2½ - 5 years
1 - 2½ years
0 - 1 years
Homogeneous sub-sectioning into structural treatment lengths
(cusum technique)
Image © 2018 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google Earth

Current Practice: Remaining life of 10m average intervals from TSD

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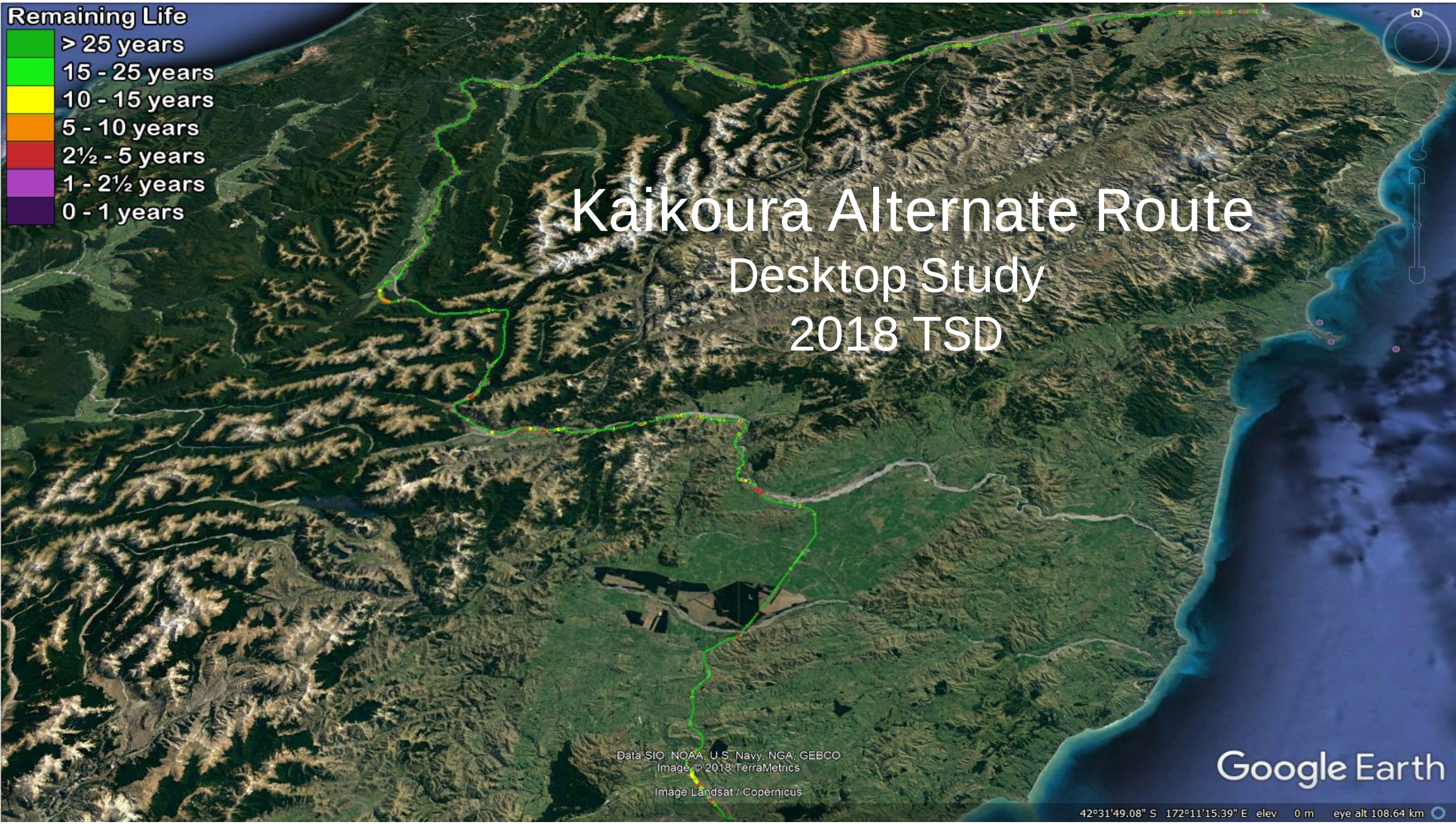
Remaining Life
> 25 years
15 - 25 years
10 - 15 years
5 - 10 years
2½ - 5 years
1 - 2½ years
0 - 1 years
Zoom in on 10m average intervals from TSD
Google Earth
2005
Imagery Date: 6/4/2016 40°52'29.94" S 175°01'42.23" E elev 0 m eye alt 277 m


Remaining Life
> 25 years
15 - 25 years
10 - 15 years
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2½ - 5 years
1 - 2½ years
0 - 1 years
Kaikoura Alternate Route
Desktop Study
2018 TSD
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2018 TerraMetrics
Image Landsat / Copernicus
Google Earth
42°31'49.08" S 172°11'15.39" E elev 0 m eye alt 108.64 km

Kaikoura Earthquake - Alternate Route 2018/2019 Proposed FWP - Desktop study

SH63 RS109 CH7.729-7.820
2018 – Windy Point

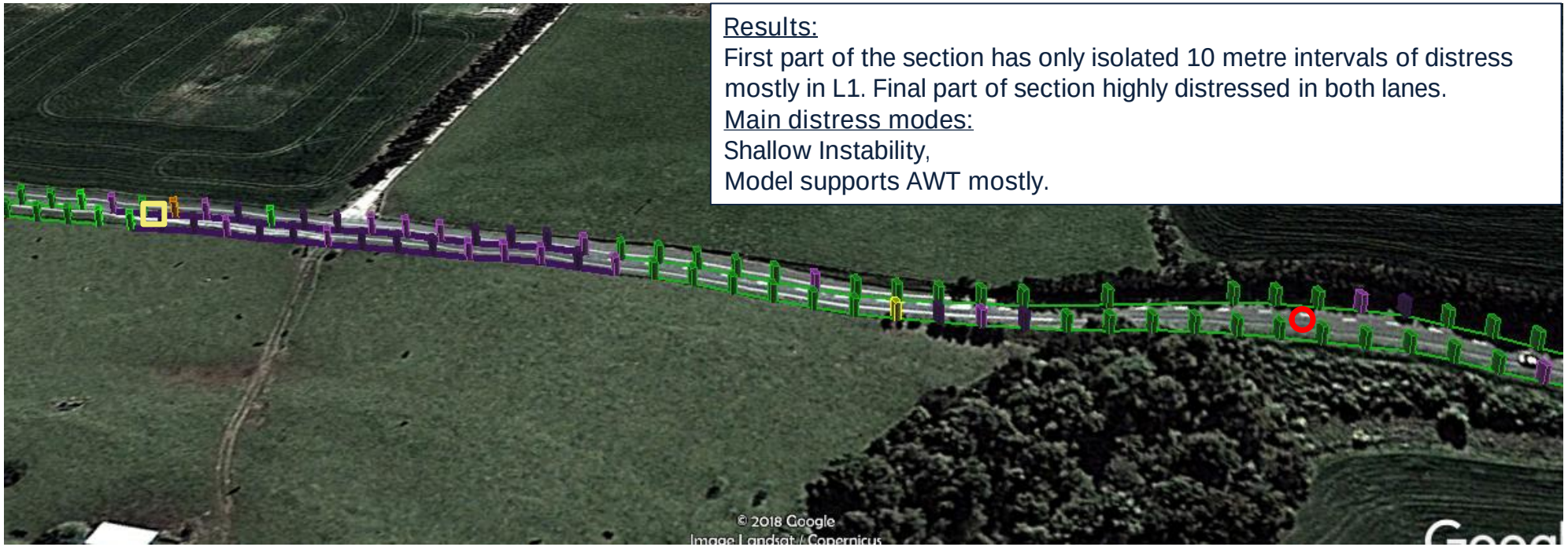
Start
End

TSD Data not supplied:
Similar data density for other years of TSD data due to TSD vehicle speed dropping below 40km/h.

Effective methods have been developed for dealing with TSD data that is noisy, “too slow” (or fast).

SH6 RS209 CH11.250-11.500 2018 - Glenview

Start
End



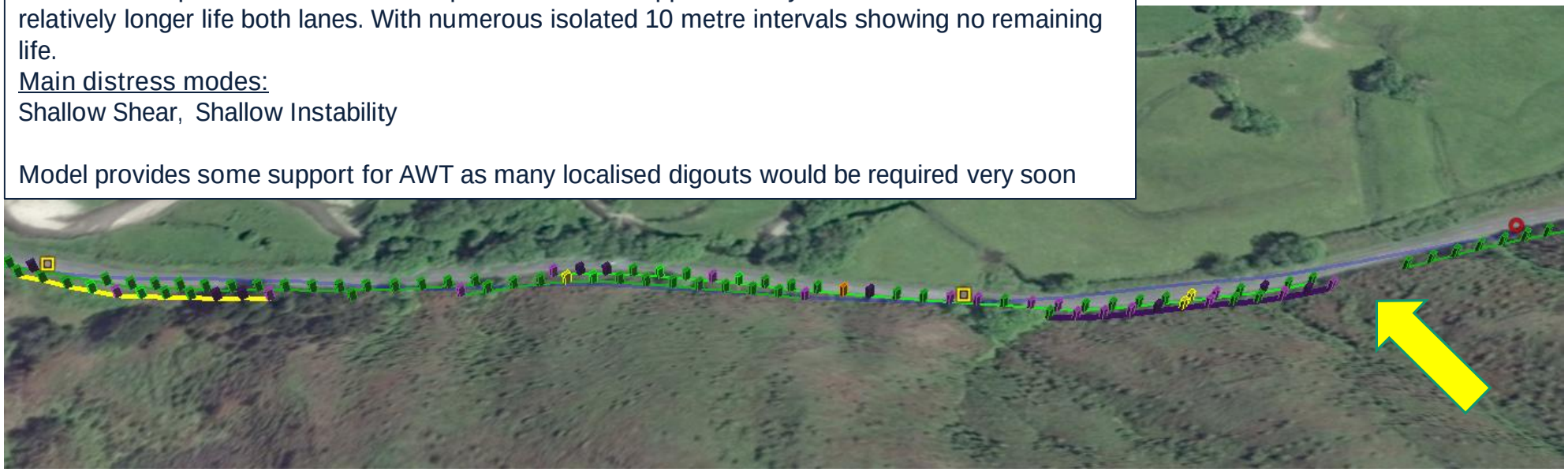
Results:
First part of the section has only isolated 10 metre intervals of distress mostly in L1. Final part of section highly distressed in both lanes.
Main distress modes:
Shallow Instability,
Model supports AWT mostly.

SH65 RS36 CH0.380-0.950
2018 – Warwick Stream

Start
End

Results:
First and final part of the section in L1 present less life. Approximately 300m middle section relatively longer life both lanes. With numerous isolated 10 metre intervals showing no remaining life.
Main distress modes:
Shallow Shear, Shallow Instability

Model provides some support for AWT as many localised digouts would be required very soon



SH63 RS17 CH8.330-8.800
2018 – Fire Station - Wairau

Results:
First and final part of the section mostly affected. Approximately 150m middle section is better but still isolated digouts would be needed.
According to RAMM, section was resurfaced in 2018.
Main distress mode:
Subbase Spreading

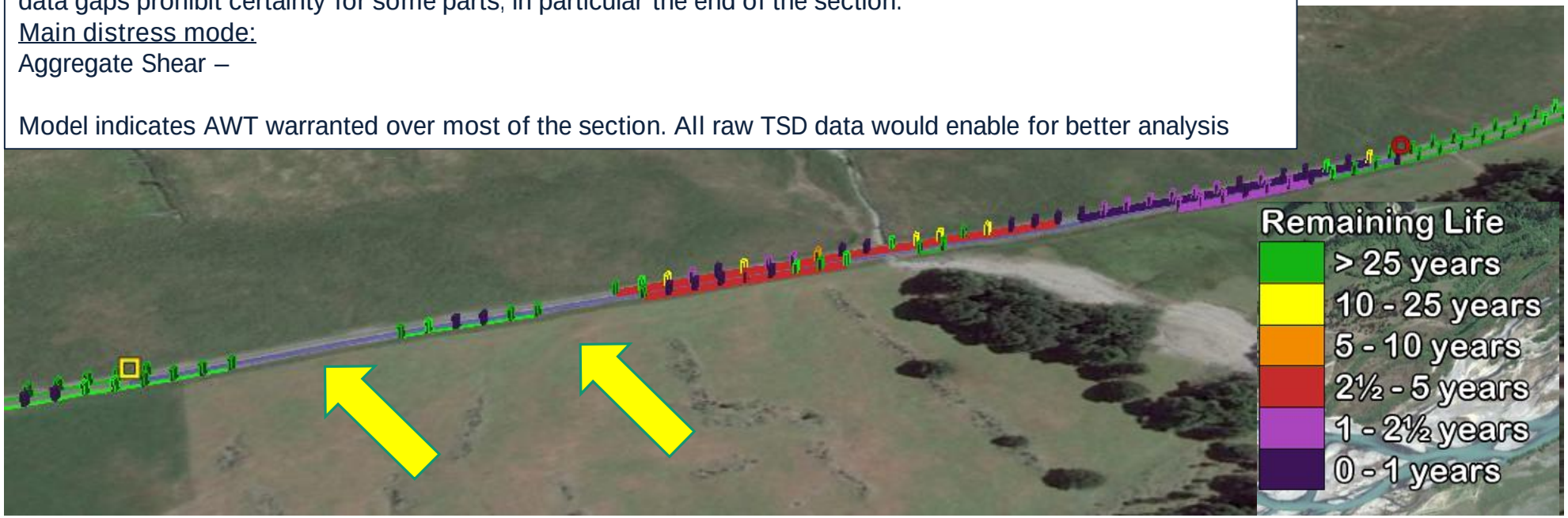
Model clearly supports early AWT full length, and should be extended slightly further at the west end, and possibly to the east.

SH63 RS84 CH5.670-6.130
2018 – Borlase West

Start
End

Results:
Start of section indicates no life with the end of section showing some isolated 10 m intervals of no life. Raw data gaps prohibit certainty for some parts, in particular the end of the section.
Main distress mode:
Aggregate Shear –

Model indicates AWT warranted over most of the section. All raw TSD data would enable for better analysis



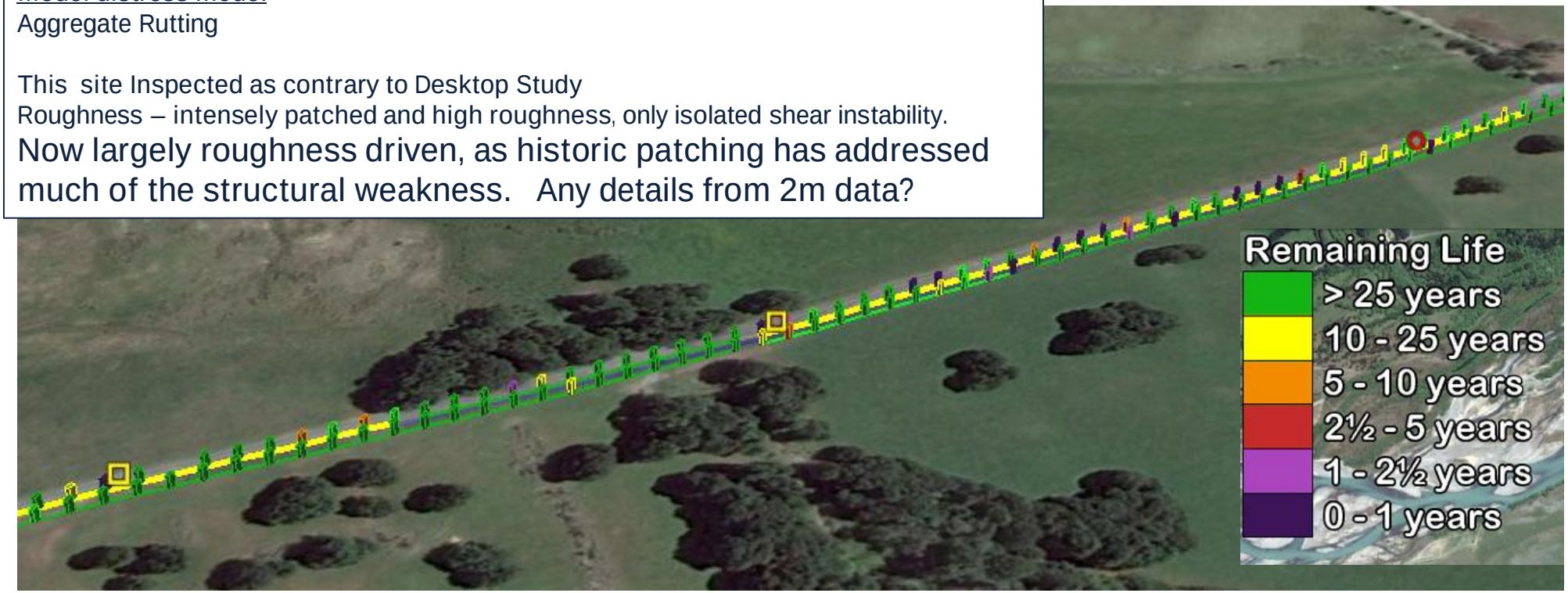
SH63 RS84 CH4.800-5.300 2018 – Borlase East

Remaining life is shown for each 10 m interval, (points) and also as the 30 percentile for each STL (structural treatment length as continuous line)

Start
End

Model distress mode:
Aggregate Rutting

This site Inspected as contrary to Desktop Study
Roughness – intensely patched and high roughness, only isolated shear instability.
Now largely roughness driven, as historic patching has addressed much of the structural weakness. Any details from 2m data?



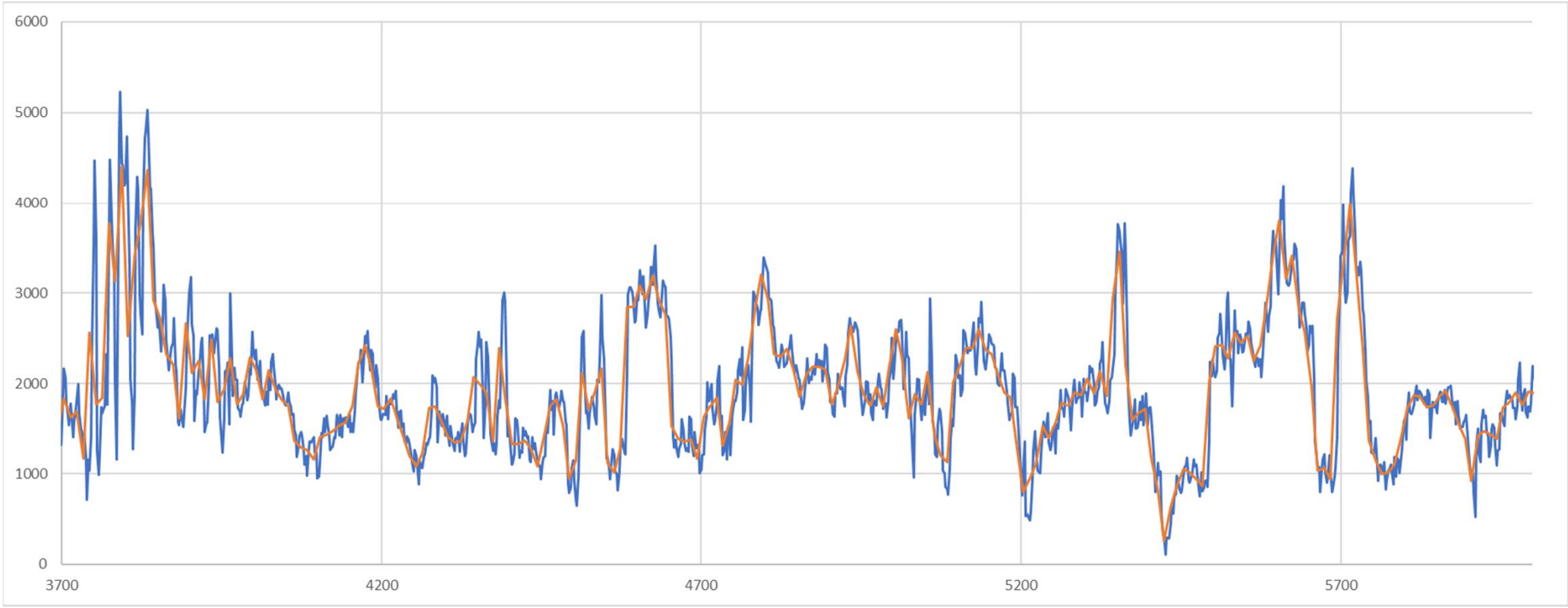
TSD – Enabling a new approach to maintenance?

Typical localised shallow shear deformation occupying about 1 m length in LWP. When averaged over 10 m, the characteristic is lost in the diluted signal. In NZ pavements with typically 0.7 - 2 mm deflection, it would be practical to specify TSD output intervals of about 2 metres rather then 10 m, greatly enhancing the 3-5+ year forward planning for maintenance by predicting the total length of digouts and their locations several years before they are visually detectable.

TSD at 2m vs 10m averaging intervals

Delivering better decisions on structural treatment? localised vs area wide

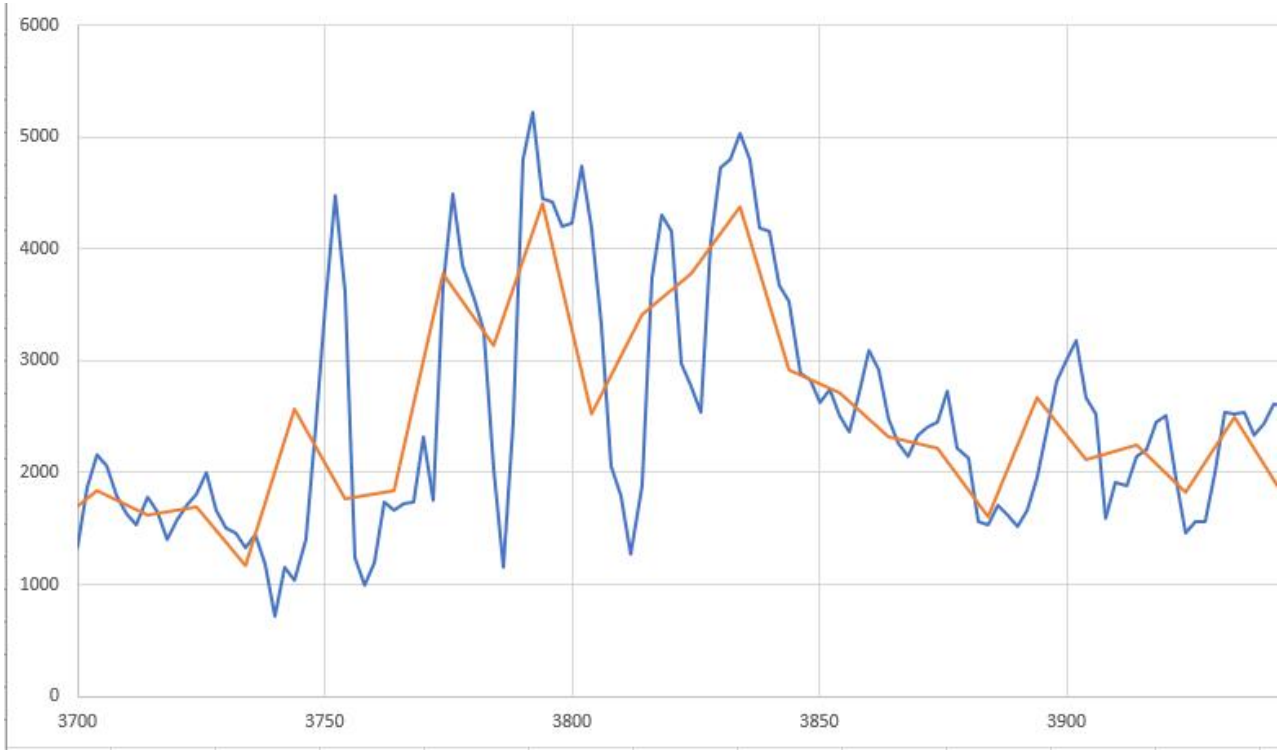
Pavement Slope/Deflection



TSD at 2m vs 10m averaging intervals

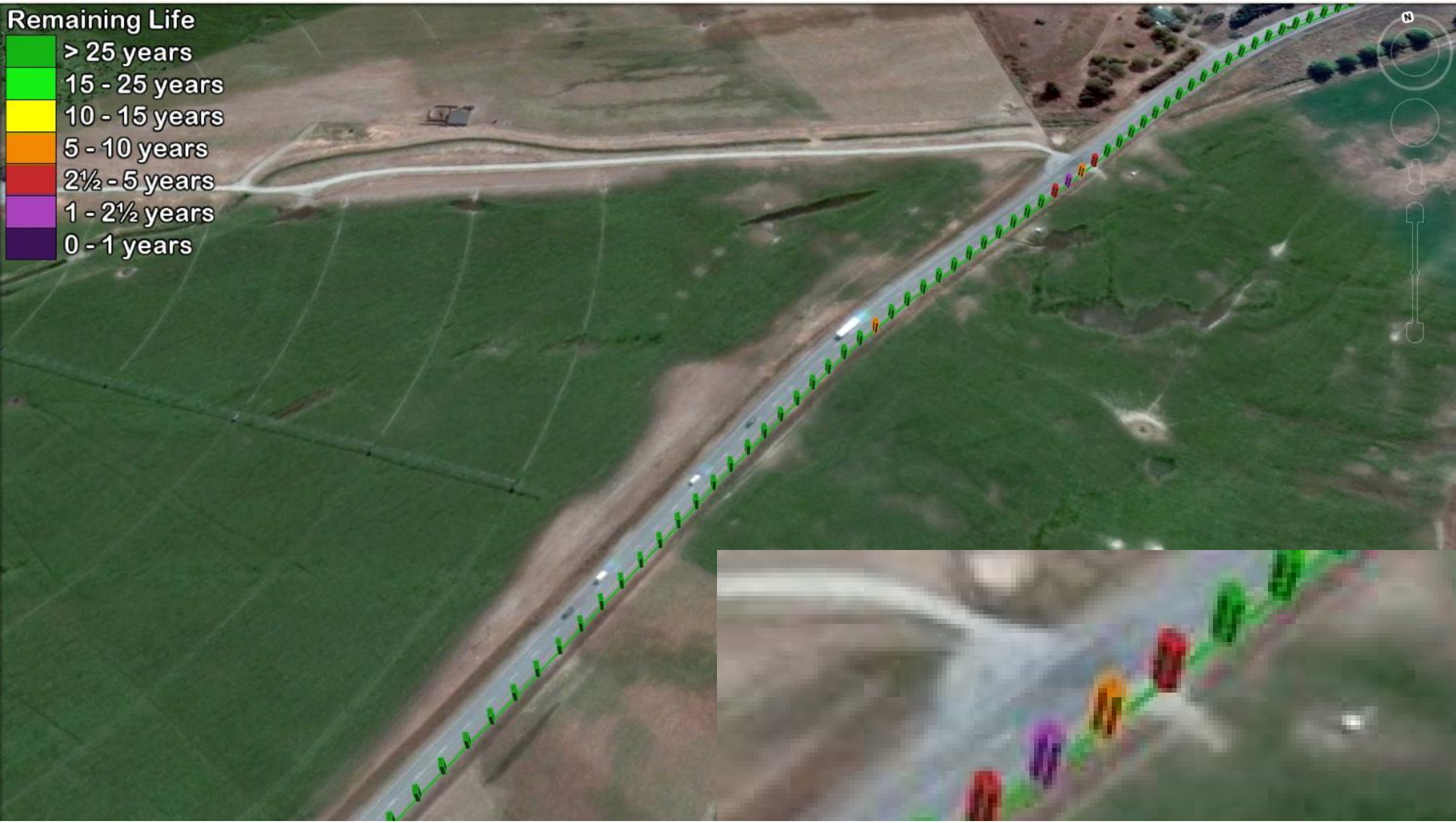
Delivering better decisions on structural treatment? localised vs area wide

Pavement Structural Parameter (eg Bowl Slope/Deflection etc)



Location (m)


Remaining Life
> 25 years
15 - 25 years
10 - 15 years
5 - 10 years
2½ - 5 years
1 - 2½ years
0 - 1 years
N
Current Practice: Remaining life of 10m average intervals from TSD


Remaining Life
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10 - 15 years
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2½ - 5 years
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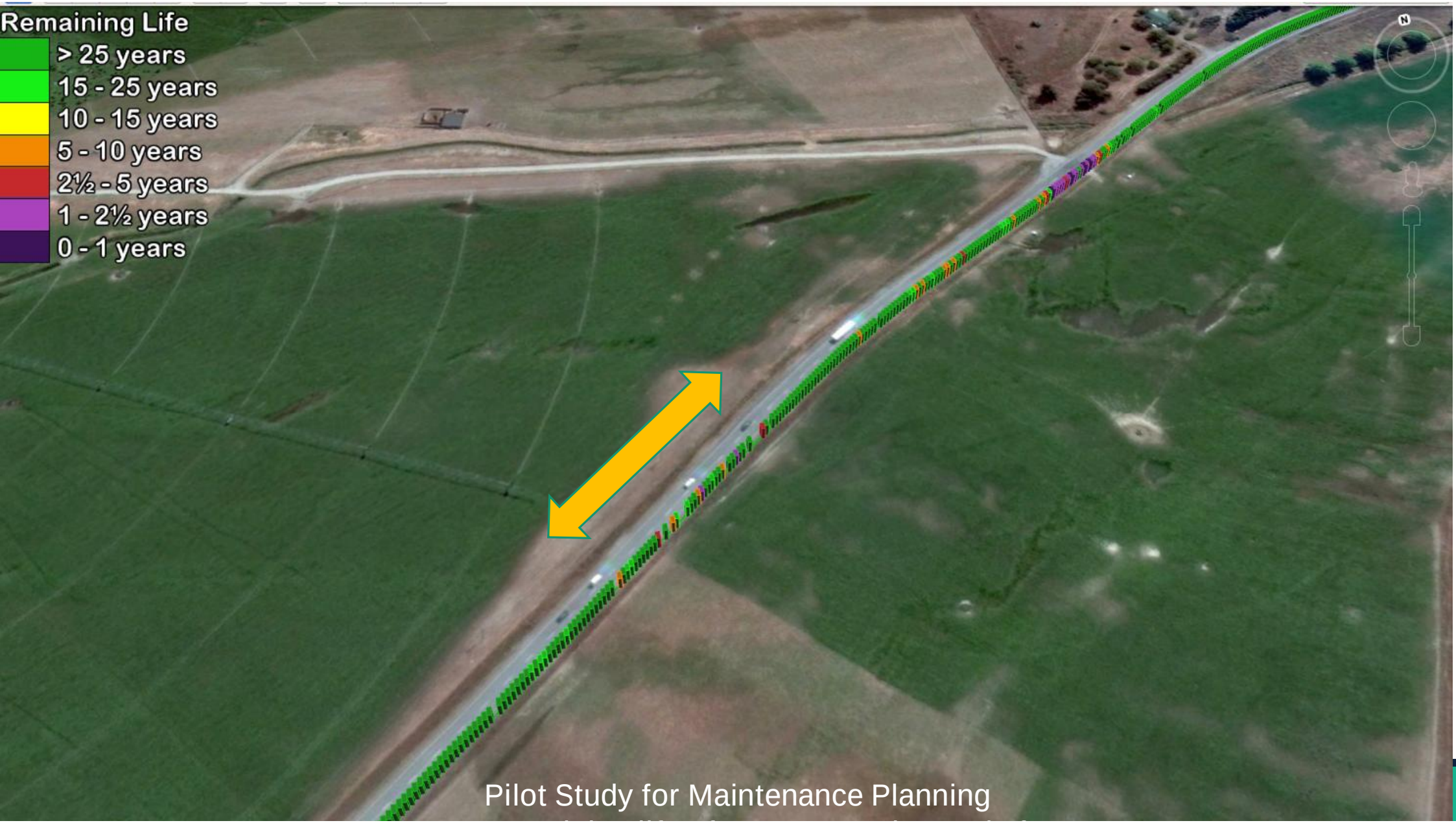
0 - 1 years
N


Remaining Life
> 25 years
15 - 25 years
10 - 15 years
5 - 10 years
2½ - 5 years
1 - 2½ years
0 - 1 years
10m indicates 25 year life
N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10 - 15 years
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N
Pilot Study for Maintenance Planning


Remaining Life
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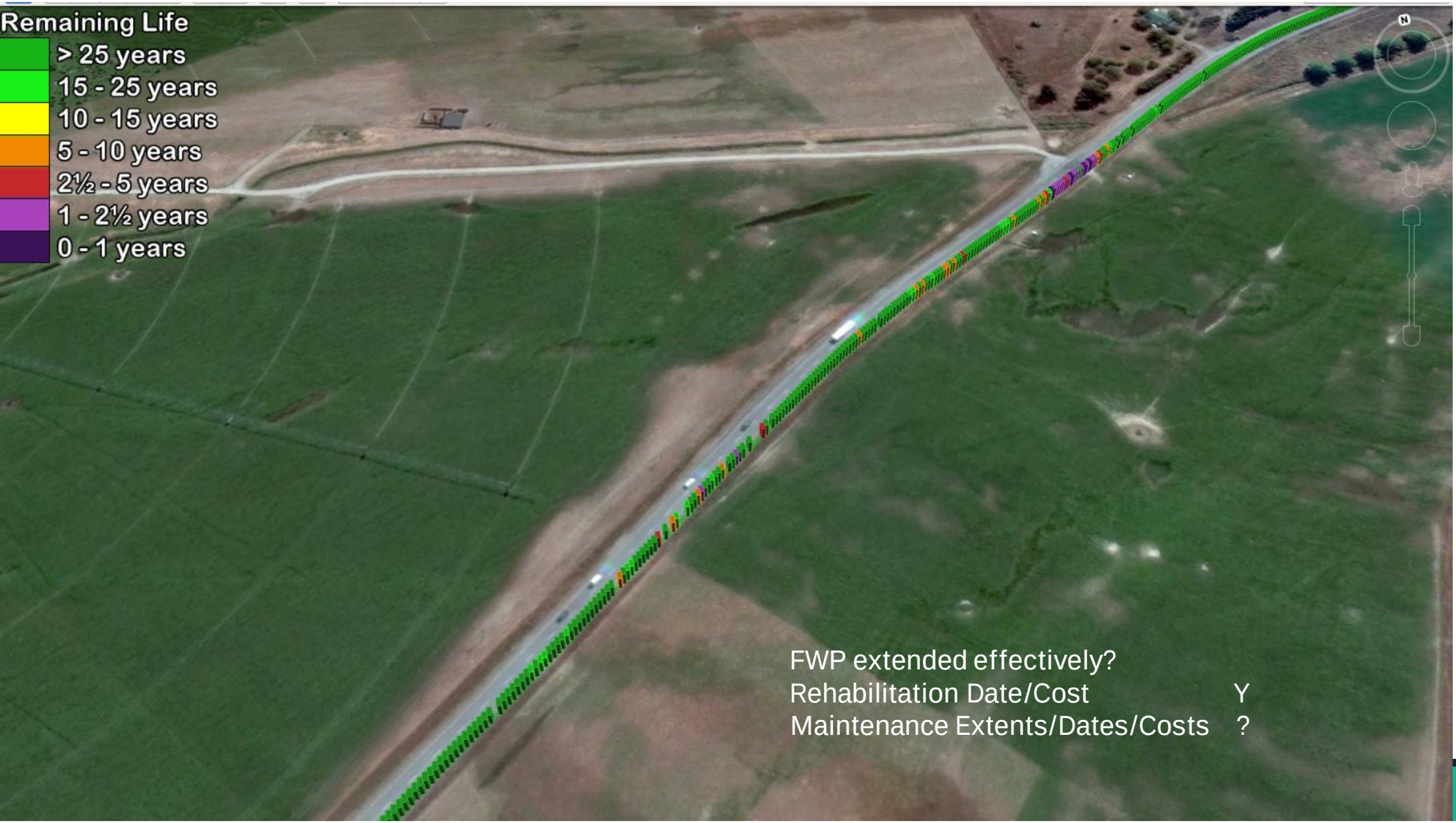
Pilot Study for Maintenance Planning
Zoom in on 2m average intervals from TSD


Remaining Life
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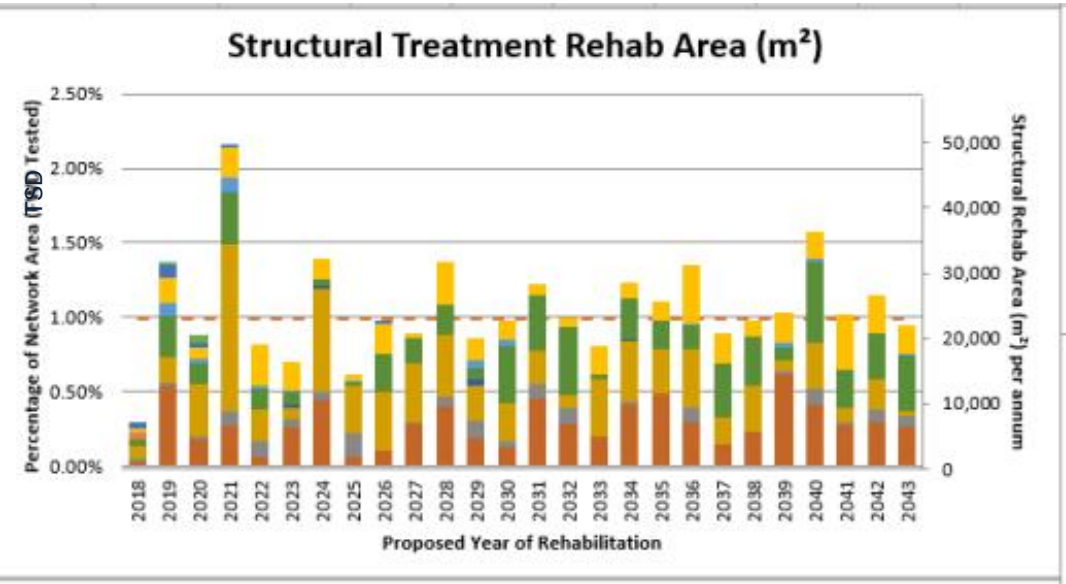
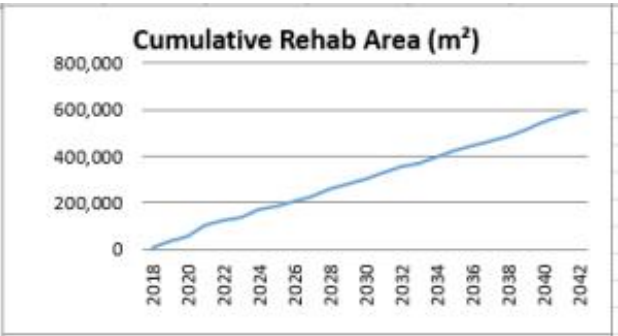
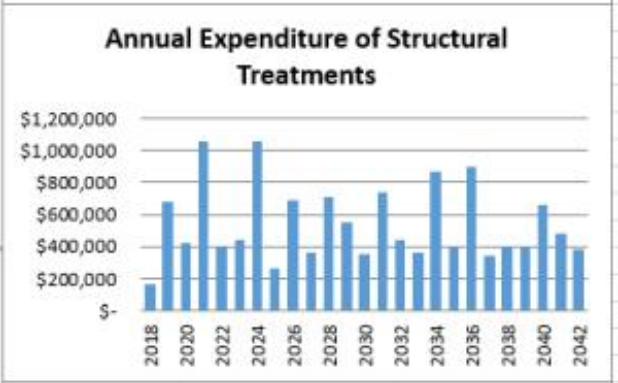
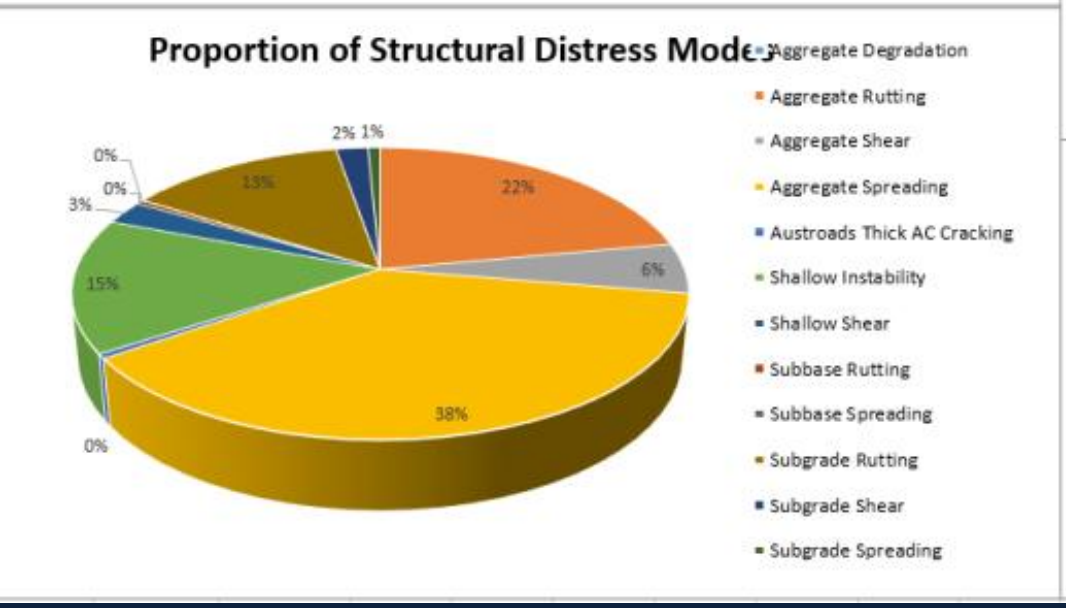
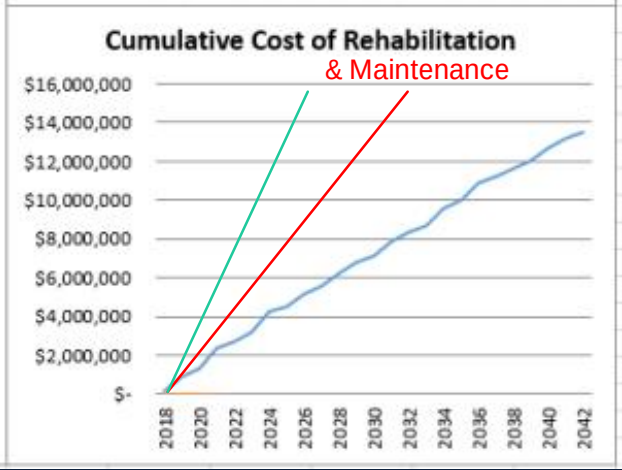
FWP extended effectively?
Rehabilitation Date/Cost Y
Maintenance Extents/Dates/Costs ?











[Kaikoura Alternate Route]

[FWP (Structural) based on TSD]

[Structural Rehabilitation (quantitative & objective)]

[Structural Maintenance (prioritised)]

[Structural Total (minimised) $5.7B/a]

TSD Structural FWP

Desktop Regional Calibration (N Major- Precedent Performance Method)

Targets (i) Pilot study – 2m Alternate Route –Ideal reality check
(ii) SH for all regions 2m – Objective NPV AWT, FWP (& Maintenance)