Trial of a process to estimate depth of cover on buried pipelines

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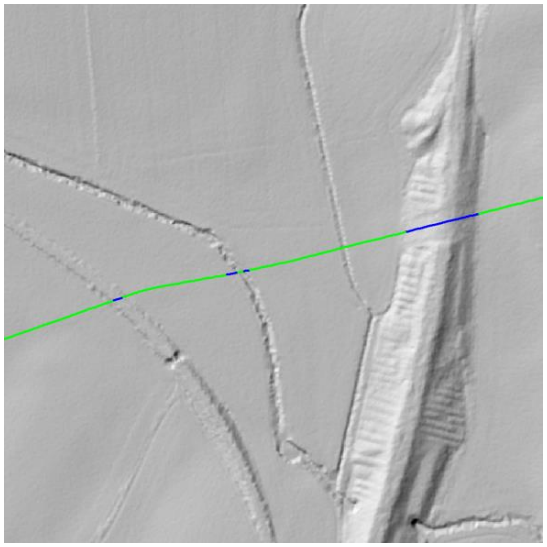

Daniel Finley (CEng MIMechE)
Principal Engineer
ROSEN Group

Third Party Interference

Protection against 3rd party interference can be an effective means of reducing the likelihood of third party damage:

- Depth of cover
- Protection slabs
- Marker tape
- Heavy wall pipe
- Concrete surround

UKOPA provide guidance on managing pipelines with reduced depth of cover[i]

[i] *UKOPA Industry Good Practice Guide, Managing Pipelines with Reduced Depth of Cover*

Standards

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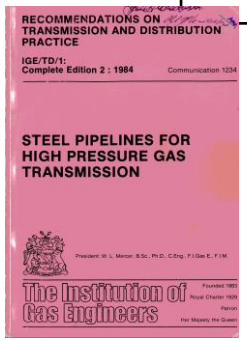
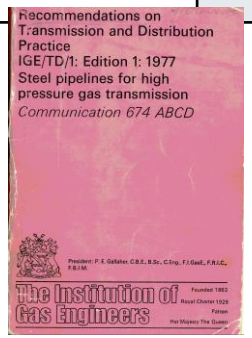
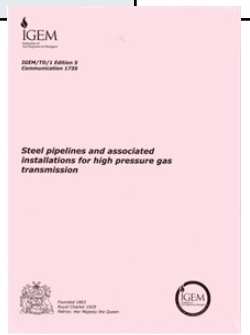
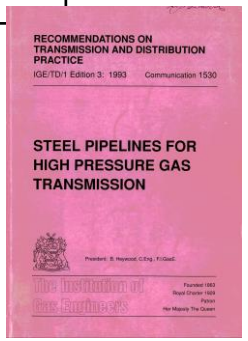
Location / Spec.	IGE/TD/1 Edition 1	IGE/TD/1 (Ed. 2, 3 & 4)	IGEM/TD/1 Edition 5	PD 8010-1:2015	ASME B31.8	AS 2885.1
All	0.9 (3 ft)	1.1				
Rural			1.1	0.9	0.61 (Class 1) 0.76 (Class 2)	0.75
Suburban			1.1	1.2	0.76 (Class 3 & 4)	0.9
Roads			1.2	1.2	0.91	-
Watercourses, canals, rivers			1.2	1.2		1.2
Railways			1.4	1.4 - 1.8	0.91	-
Rocky Ground				0.5		0.9 (W) 0.6 (T1, T2) 0.45 (R1, R2)









New Methodology

Digital Terrain Model

+

Hi-Resolution Inertial Measurement Unit (In-Line Inspection)

=

Depth of Cover Estimate

- Digital Terrain Model (DTM) is an elevation model (ground surface) derived from a data source such as photogrammetry, LiDAR, land surveying
- In-line route mapping using inertial measurement unit to provide three dimensional coordinates of the entire pipeline
- Combine datasets to provide depth for the entire pipeline

In-Line Inspection

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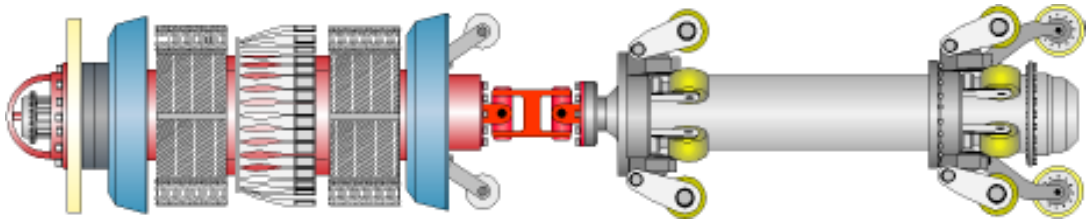
- Feeder 4 – Tixover to Blaby 36” Pipeline 43.85 km

- Above Ground Markers deployed at spacing of approximately 500 m (89 Total)

- Internal inspection was completed on 24th August 2016 using the ROSEN RoCombo inspection tool equipped with axial magnetic flux leakage and extended geometry



Digital Terrain Model Coverage

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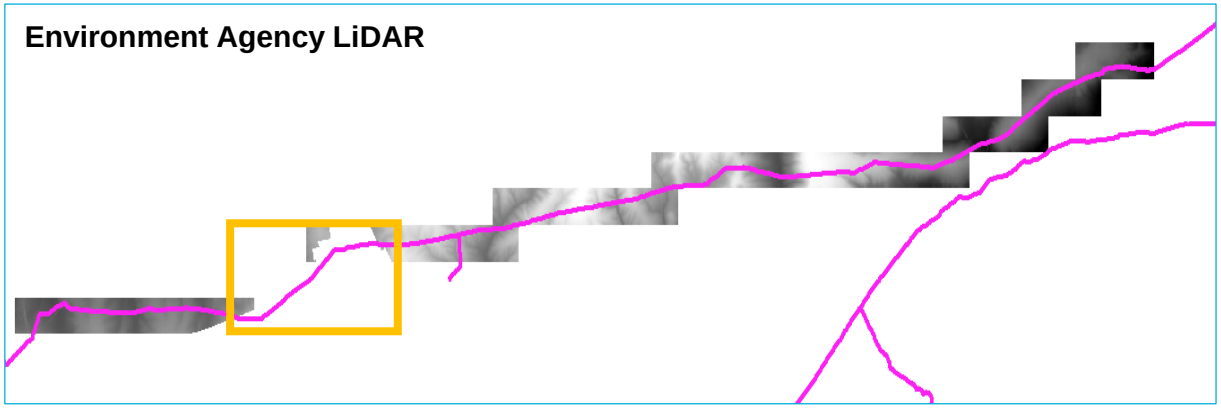
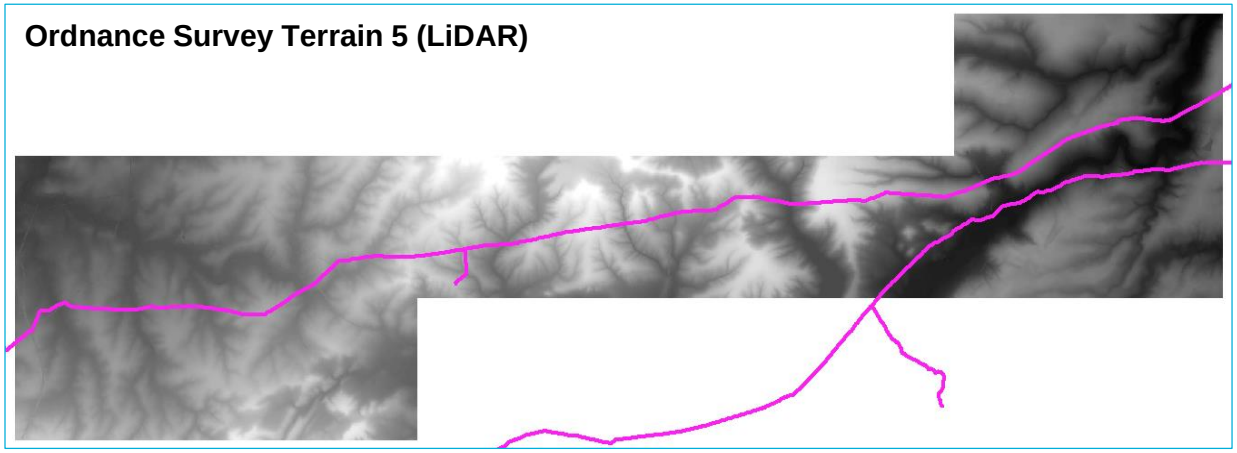


Data Specs.:

- Spatial resolution: 25cm to 2 metres
- Accuracy of ± 5 cm to 15 cm
- Coverage: 72% of England



- Spatial resolution: 5 m
- Accuracy level greater than 2 m RMSE
- Update frequency: Quarterly

Example Depth of Cover Report

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How Accurate?

The following points contribute to the overall accuracy of the results:

- Above ground markers
  - DGPS
  - Depth of Cover
- Digital terrain model (LiDAR)
- Mapping tool data processing and reporting
  - Horizontal
  - Vertical

In field verification completed over 10 sections of pipe, with over 2000 position and pipe depth of cover measurements recorded

Accuracy - Ground Elevation

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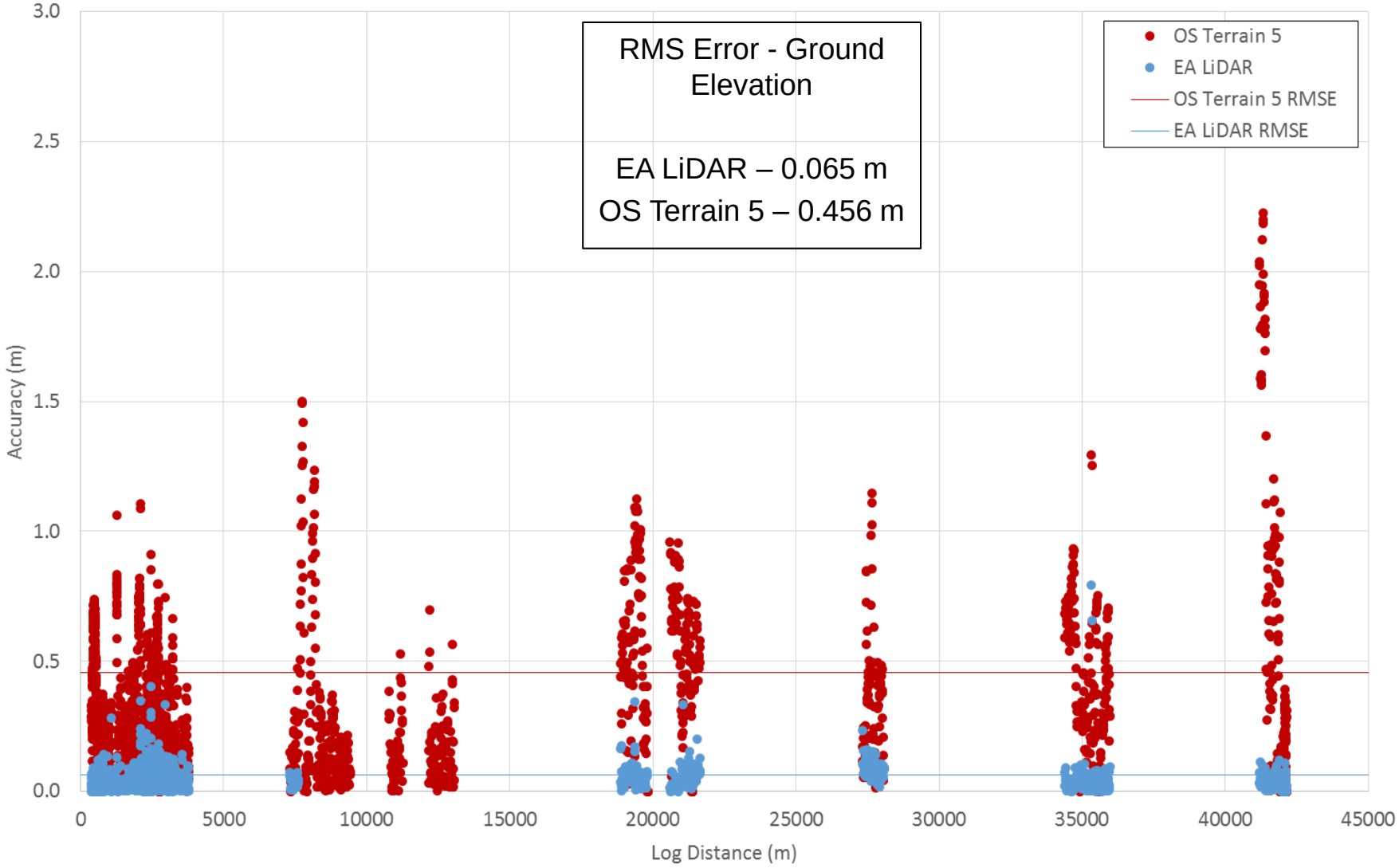
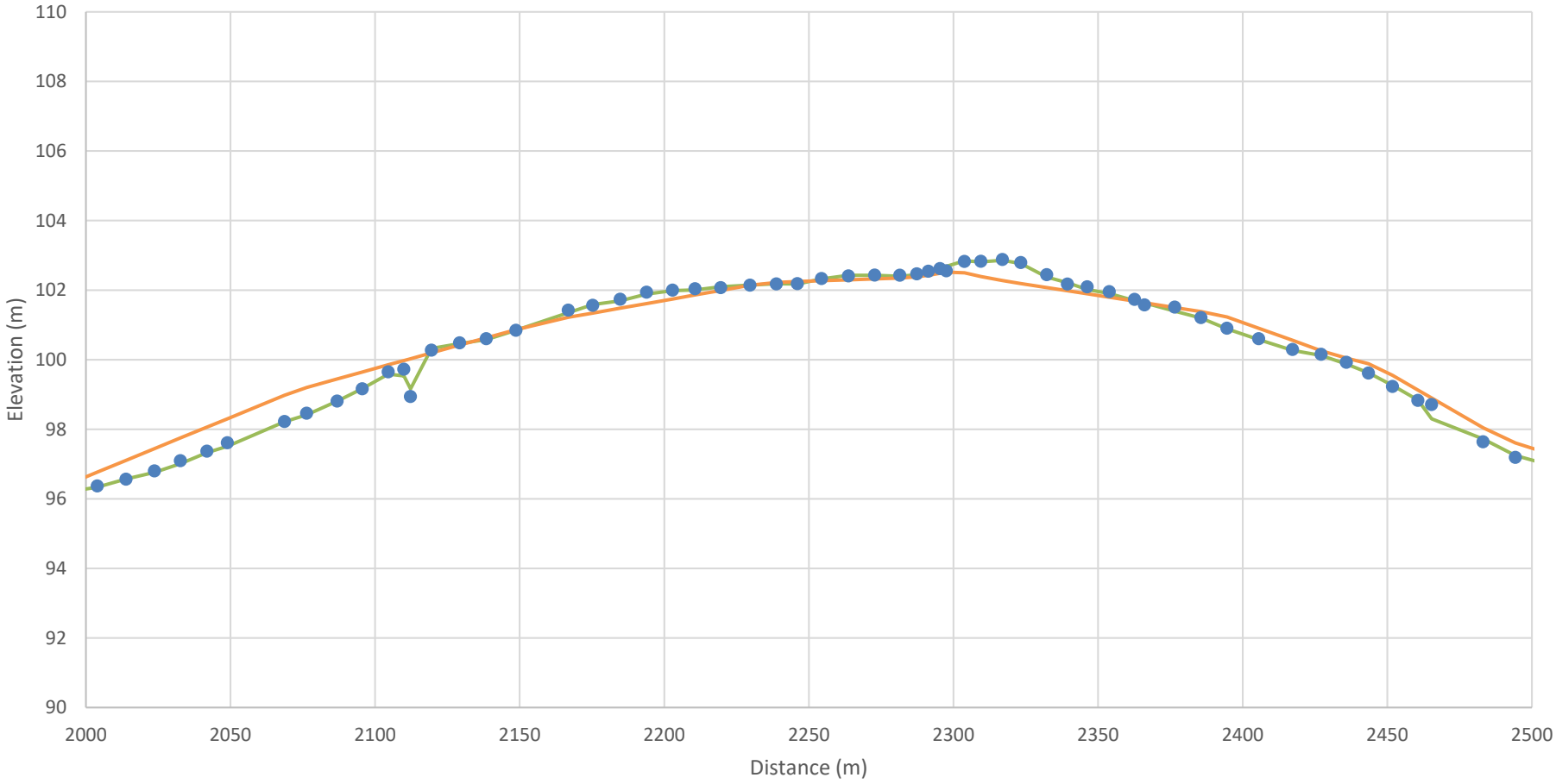


LiDAR Vertical Accuracy



LiDAR Vertical Accuracy

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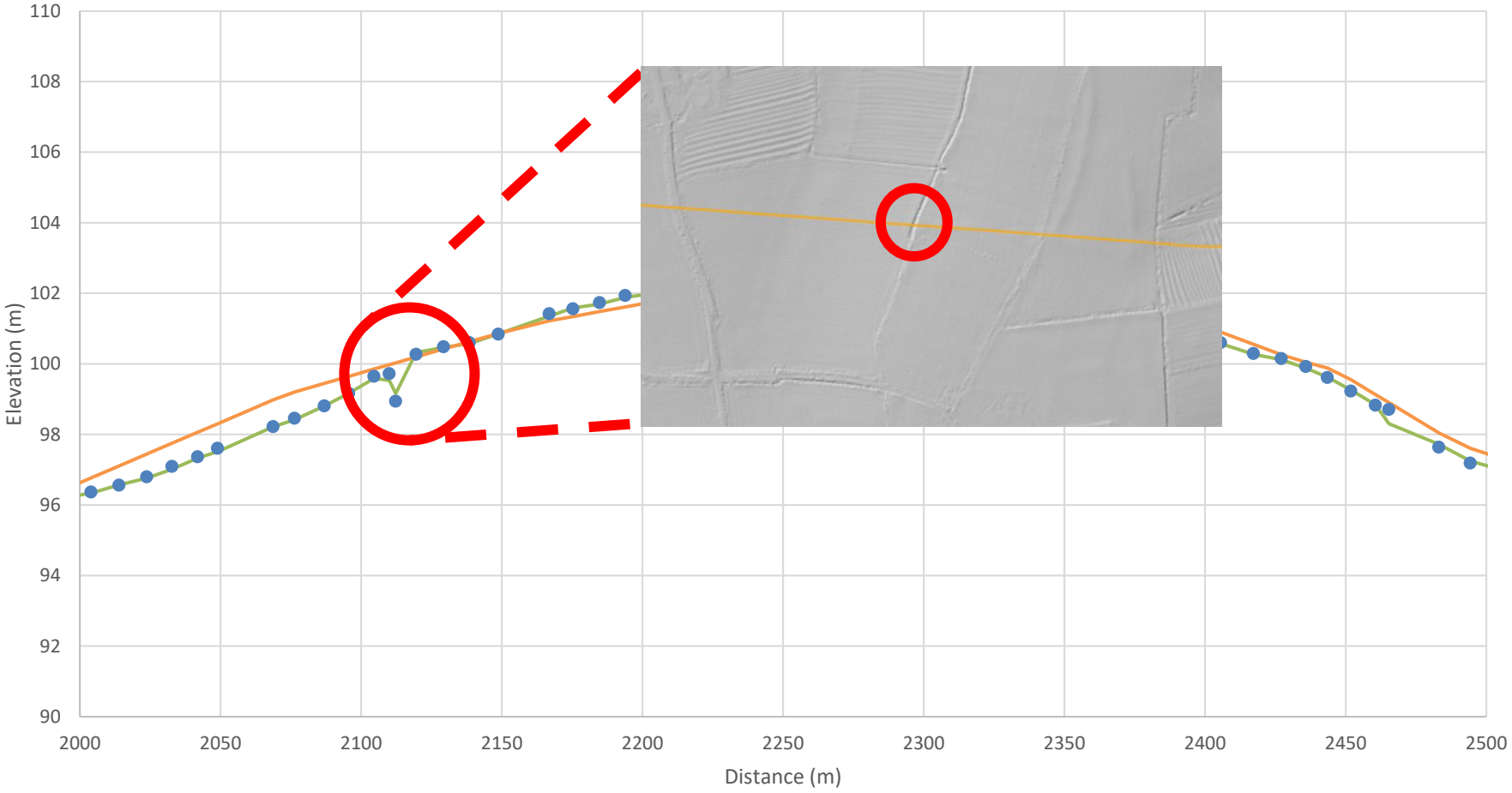
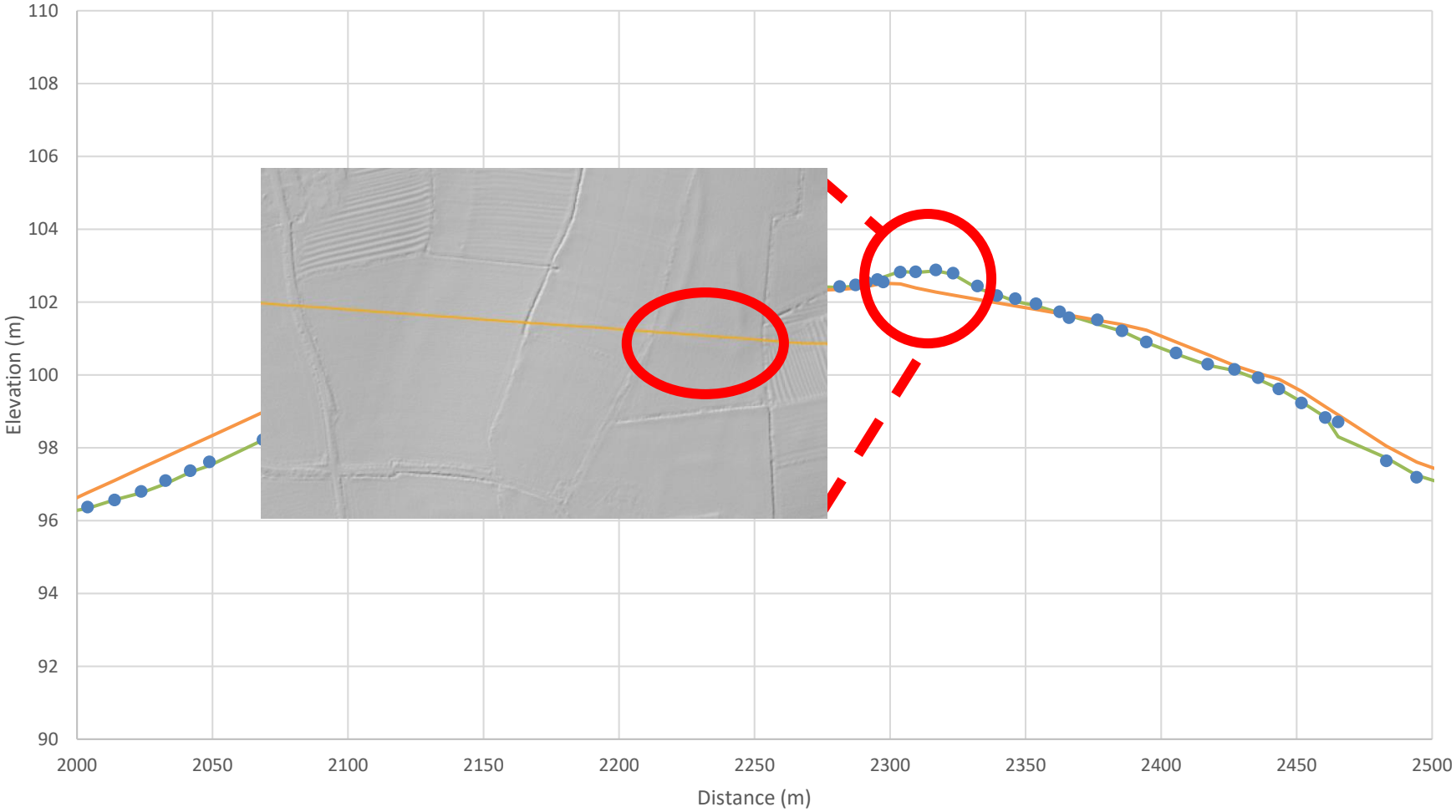


LiDAR Vertical Accuracy



Accuracy – Depth of Cover

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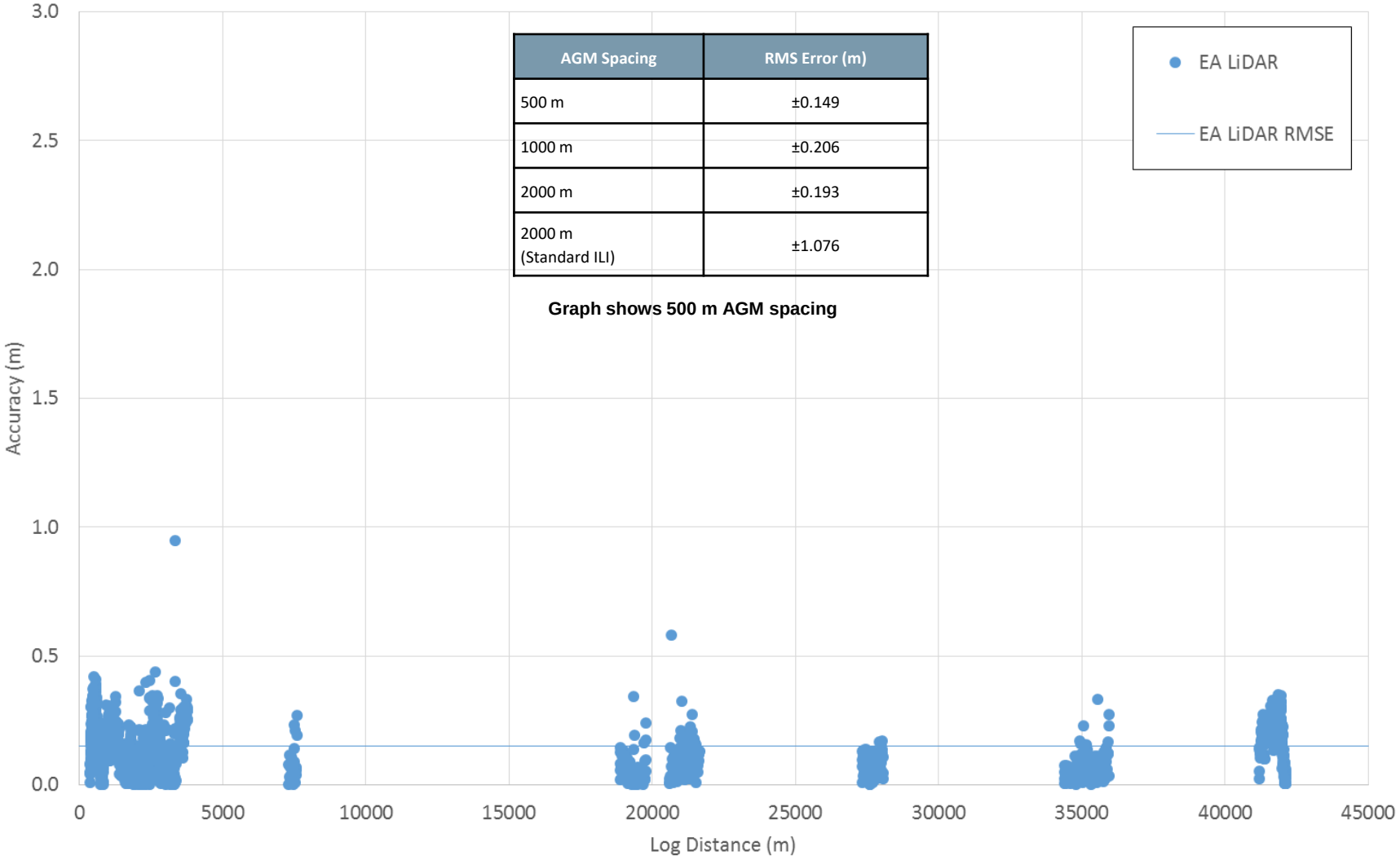
AGM Spacing	RMS Error (m)
500 m	±0.149
1000 m	±0.206
2000 m	±0.193
2000 m (Standard ILI)	±1.076

Graph shows 500 m AGM spacing



Example – Rail & Watercourse

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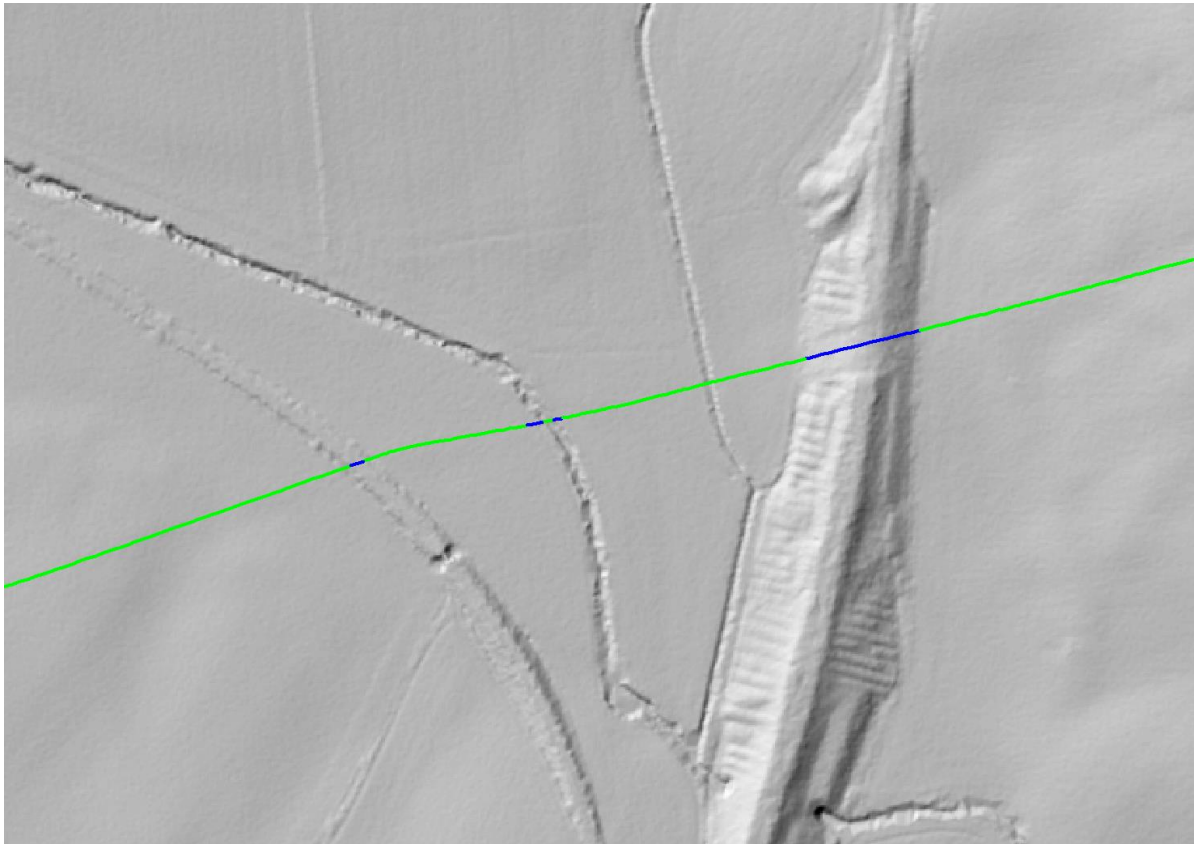

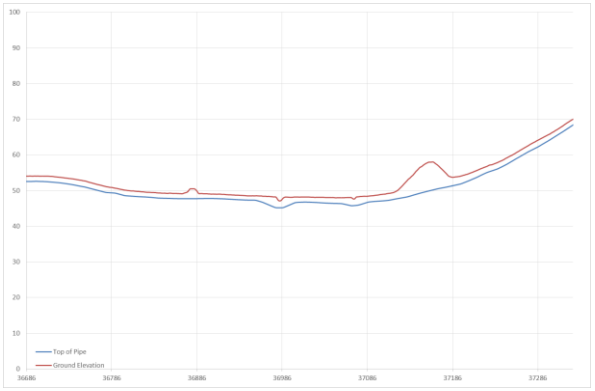

Conclusions

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- The trial has successfully demonstrated a new methodology to estimate the depth of cover over pipelines
- Results have been validated using infield depth of cover measurements obtained with high accuracy survey equipment
- This determined a depth of cover accuracy of ±0.149 m
- Output from the trial includes a specification for carrying out depth of cover inspections

Next Steps

The trial has successfully demonstrated the methodology to estimate the depth of cover over pipelines.

NGGT should consider making this methodology a ‘business as usual’ task to support identification of pipelines with reduced depth of cover.

This will require some NGGT management procedures to be updated to include the specification for completing depth of cover surveys as part of ‘ILI’ runs.

The revised procedures will include a strategic ‘decision tree’ to identify pipeline lengths at risk of reduced cover and enable resources to be focussed where most appropriate.

Further trials are scheduled for 2018.